JENSEN HUGHES



Fire engineering report

Chatswood Chase redevelopment (stage 1)

Client: Multiplex

Job number: SY180281

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Quality management

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Executive summary

This report documents the findings of a fire safety engineering assessment undertaken to determine whether the proposed redevelopment at Chatwood Chase Shopping Centre complies with the relevant performance requirements of the National Construction Code Volume One – Building Code of Australia (NCC) 2022. Jensen Hughes undertook the assessment in accordance with the Australian Fire Engineering Guidelines (AFEG) at the request of Multiplex.

The project is the refurbishment of the existing Chatswood Chase Shopping Centre. The shopping centre is currently a nine level retail building (class 6) anchored by three major tenancies – David Jones, Coles, and Kmart. The existing shopping centre also includes more than 200 specialty and mini-major tenancies.

The new works include:

- reconfiguration of internal retail and void spaces from ground level to level 2
- construction of a new gym tenancy spanning a portion of levels 2 and 3 west.
- construction of new retail tenancies and new centre management office (CMO) on level 3.
- carpark upgrade works including modification of ramps, new concrete footings and foundations, new structural steel works
- upgrade of vertical transport provisions

The area of new works includes areas that do not comply with the deemed-to-satisfy (DTS) provisions of the NCC. Table 1 describes the NCC requirements associated with the performance solutions.

Table 1 NCC requirements associated with the performance solutions

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
1	Internal steel columns supporting the roof on level 3 are not proposed to achieve a fire rating unless they support essential plant equipment.	Specification 5	C1P1	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
2	Slab edge fire stopping is designed on a performance basis.	Specification 5	C1P9	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
3	Green walls incorporating climbing plants are proposed to be provided to the Havilah Street OSD tank/EOT.	Clause C2D10 and C2D14	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
4	The fire wall separating the carpark from the retail use will include glazed elements that will not achieve an FRL of 180/180/180. Instead, the wall will comprise toughened glass protected with wall-wetting sprinklers as part of a tested system.	Clauses C3D8	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
5	The backup generator on level 2A sustaining emergency equipment serving the atrium will not be fire separated from the carpark.	Specification 31 and C3D13	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
6	Steel members supporting the Centre Court and Victoria Avenue skylights are not proposed to achieve a fire rating. The atrium roof structure and membrane will not be protected by sprinklers.	Clause G3D6 and specification 31	C1P2, C1P2 and E1P4	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
	The separation of the existing and new retail fire compartments at the level 3 atrium void consists of heat strengthened glazing instead of fire rated construction.	Clause C3D9			
	Sidewall sprinklers providing coverage to the linear void connecting levels 1 and 2 are installed more than 150 mm below the skylight.	Clause E1D4			
7	The maximum travel distances in the retail areas within the building are in accordance with the following: • up to 65 m instead of 40 m to an exit • up to 100 m instead of 60 m between exits	Clauses D2D5 and D2D6 Part G3 and specifications 21 and 31	C1P2, D1P4, and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
	The smoke hazard management system serving the retail portion of the building will be designed on a performance basis with regards to: • smoke exhaust quantities • smoke reservoir sizes • make-up air provisions outside of trading hours				

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
	The retail portion of the building contains an atrium which is not proposed to comply with part G3 and specification G3.8 of the NCC. This includes: • Atrium bounding construction • Rationalised stair pressurisation provisions • Standby power provisions				
8	The path of egress from the basement retail loading dock involves travel through a secure corridor within the David Jones tenancy loading area. The distance of travel to open space via the non-fire-isolated exit ramp is 100 m instead of 80 m.	Clauses D2D3 and D2D14	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
9	The maximum travel distance to a point of choice in localised retail and BOH storage areas within the building is up to 30 m instead of 20 m.	Clause D2D5	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
10	The maximum travel distance in the level 2 mini-majors are as follows: • 65 m instead of 40 m to an exit • 120 m instead of 60 m between exits	Clauses D2D5 and D2D6	D1P4 and E2P2	Complies with performance requirements A2G2(1)(b)	Verification method A2G2(2)(d)
11	The maximum travel distances from the level 3 centre management office are as follows: • 23 m instead of 20 m to a point of choice • 63 m instead of 40 m to an exit • 105 m instead of 60 m between exits	Clauses D2D5 and D2D6	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
12	The maximum travel distances from the level 3 plant areas within the building are in accordance with the following: • 65 m instead of 40 m to an exit • 100 m instead of 60 m between exits	Clauses D2D5 and D2D6	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
13	The design includes fire-isolated exits which open directly into retail sole occupancy units.	Clause D2D12	D1P5	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
14	Stairs 5 and 15, and stairs 10 and 13, are existing fire-isolated stairs that merge into common fire-isolated passages prior to their discharge to open space.	Clause D2D12	D1P5	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
15	The discharge of fire-isolated stairs to the covered area along the northern boundary incorporates the following departures: • More than 6 m of travel to the road. • Exposure to openings within 6 m • The open perimeter of the covered discharge area is less than 33% of the total perimeter.	Clause D2D12	D1P5	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
16	The discharge of fire-isolated stair 4 within the southern loading dock requires occupants to travel more than 6 m to reach the road.	Clause D2D12	D1P5	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
17	A number of areas within the retail compartment are provided with a single exit instead of two.	Clause G3D7	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
18	The fire hydrant booster assembly is not located within sight of the main entry as the building has multiple street frontages.	Clause E1D2	E1P3	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
19	The hydrant pump room is existing, however new pumps are proposed to be added to the existing room as part of the upgrade works. The pump room will be accessed via a fire-isolated passage which discharges to the covered carpark entry ramp leading to Victoria Avenue. The new sprinkler valve room is not provided with direct access to a road or open space.	Clause E1D2 and specification 17	E1P3 and E1P4	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
20	The fire hydrant system incorporates additional intermediate fire hydrants throughout the building to achieve full coverage which are not within or adjacent to exits.	Clause E1D2	E1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
21	Sprinklers are proposed to be omitted to soffits / canopies over the following locations: • Victoria Avenue entry • Archer Street entry and external terrace	Specification 17	E1P4	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
22	Extra low voltage (ELV) fire cabling is not provided with 'ELV Fire' cable marking as required in AS 1670.1-2018.	Clause E2D2	E4P3	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
23	Fire stopping protection of drainage penetrations through the floor slab within the level 2 wet area is omitted.	Clause C4D13	C1P8	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
24	The design includes a reduction in unobstructed width to 750 mm instead of 1 m at a localised pinch-point within Stair 19 on level 2A due to new hydrant valve inlets within the stairs. The Stair 8 fire-isolated passageway also incorporates the following localised reductions in widths: • Level 00 – 1200 mm instead of 1500 mm • Level 02 – 1170 mm instead of 1500 mm	Clauses D2D8 and D2D10	D1P4	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
	Stair 13 also incorporates a localised reduction in width to 1200 mm from 1500 mm within each scissor stair landing, at the start of the transfer corridor at LGA which connects to Stair 10.				
25	The protection provided to hydrant and sprinkler pipe penetrations through fire rated elements is not proposed to achieve an insulation rating, where the pipe penetrates through: • The concrete slabs within a fire-isolated stair shaft. • The fire stair shaft wall	Clause C4D15 and specification 13	C1P8	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
26	Hydrant ring main isolation valves within basement level 1 are located within the carpark area instead of within fire-isolated stairs in a number of instances.	Clause E1D2	E1P3	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
27	The maximum fire rating of class 6 retail building elements on level 3 is reduced from 180 minutes to 120 minutes.	Specification 5	C1P1 and C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
28	The level 1 speedramp opening is within 3 m of the northern allotment boundary and will not be protected.	Clause C4D3	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
29	The external carpark rooftop areas on levels 2A and 3 are deemed as occupiable outdoor areas. The carpark areas are not fire separated from adjacent internal retail and gym areas on the same storey.	Clauses G6D3 and C3D9	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
30	Fire separation of the level 3 mechanical essential services board (MSSB) is rationalised.	Clause C3D14	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
31	Hydrant coverage to tenancy G-001 requires two hose lengths from an internal hydrant.	Clauses E1D2 and E1D3	E1P1 and E1P3	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
	Tenancy G-001 is not provided with fire hose reel coverage.				

The building has been the subject of previous fire safety engineering assessments by CSIRO and NDY. The impacts of the assessments documented in this report to performance solutions within these previous reports is described in Table 8 of this document.

The fire safety engineering assessment found that the design of the area of new works complies with the relevant performance requirements of the NCC, subject to the following recommendations:

- The fire safety measures in section 5 must be incorporated into the design of the building and maintained and certified in accordance with the Environmental Planning and Assessment (Development Certification and Fire Safety) Regulation 2021 and relevant Australian standards. These fire safety measures and this report must be listed on the fire safety schedule for the building.
- If there are building alterations or additions, a change in use or changes to the fire safety system in the future, a reassessment will be needed to verify consistency with the assessment contained in this report.

Contents

Executive summary 3

1. Introduction 16

2. Performance-based design brief 16

2.1 Stakeholders 16
2.2 PBDB process 16
2.3 Design changes and additional performance solutions 17

3. Description of the building and performance solutions 18

3.1 Building description 18
3.2 Preventive and protective measures 22
3.3 Occupant characteristics 24
3.4 Performance solutions 25

4. Scope and assumptions 36

4.1 Scope 36
4.2 Assumptions 36

5. Fire safety measures 37

5.1 General 37
5.2 Fire resistance 37
5.3 Evacuation 48
5.4 Firefighting equipment 57
5.5 Smoke hazard management 63
5.6 Emergency lighting, exit signs and warning systems 73
5.7 Green walls 75
5.8 Management requirements 76

6. Safety in design 77

7. Performance solution 1 – Fire ratings to internal steel columns on level 3 78

7.1 Introduction 78
7.2 Intent of the NCC 78
7.3 Methodology 79
7.4 Acceptance criteria 79
7.5 Fire hazards 79
7.6 Fire scenarios 81
7.7 Assessment 81
7.8 Conclusion 82

8. Performance solution 2 – Slab edge separation 83

8.1 Introduction 83
8.2 Intent of the NCC 84
8.3 Methodology 85
8.4 Acceptance criteria 85
8.5 Fire hazards 85
8.6 Assessment 85
8.7 Conclusion 86

9. Performance solution 3 – External trellis system 87

9.1 Introduction 87
9.2 Intent of the NCC 88
9.3 Methodology 88
9.4 Acceptance criteria 88
9.5 Fire hazards 89
9.6 Fire scenarios 90
9.7 Assessment 90
9.8 Conclusion 91

10. Performance solution 4 – Fire separation of carpark from the retail mall 92

10.1 Introduction 92
10.2 Intent of the NCC 95
10.3 Methodology 95
10.4 Acceptance criteria 95

10.5 Fire hazards 96
10.6 Fire scenarios 97
10.7 Assessment 97
10.8 Conclusion 99

11. Performance solution 5 – Fire separation of generator room 100

11.1 Introduction 100
11.2 Intent of the NCC 101
11.3 Methodology 101
11.4 Acceptance criteria 101
11.5 Fire hazards 101
11.6 Fire scenarios 102
11.7 Assessment 102
11.8 Conclusion 103

12. Performance solution 6 – Atrium roof and building construction 104

12.1 Introduction 104
12.2 Intent of the NCC 107
12.3 Methodology 108
12.4 Acceptance criteria 108
12.5 Fire hazards 108
12.6 Fire scenarios 112
12.7 Assessment 112
12.8 Conclusion 117

13. Performance solution 7 – Travel distance, smoke hazard management and atrium provisions 118

13.1 Introduction 118
13.2 Intent of the NCC 121
13.3 Methodology 122
13.4 Acceptance criteria 122
13.5 Fire hazards 124
13.6 Fire scenarios 126
13.7 Assessment 133
13.8 Conclusion 144

14. Performance solution 8 – Basement 2 loading dock egress 145

14.1 Introduction 145
14.2 Intent of the NCC 149
14.3 Methodology 149
14.4 Acceptance criteria 149
14.5 Fire hazards 149
14.6 Assessment 150
14.7 Conclusion 151

15. Performance solution 9 – Travel to a point of choice in specialty tenancies and BOH storage areas 152

15.1 Introduction 152
15.2 Intent of the NCC 153
15.3 Methodology 153
15.4 Acceptance criteria 153
15.5 Fire hazards 154
15.6 Fire scenarios 154
15.7 Assessment 154
15.8 Conclusion 156

16. Performance solution 10 – Extended travel distance within the level 2 mini-majors 157

16.1 Introduction 157
16.2 Intent of the NCC 157
16.3 Methodology 158
16.4 Acceptance criteria 158
16.5 Fire hazards 158
16.6 Assessment 158
16.7 Conclusion 160

17. Performance solution 11 – Extended travel distance within level 3 centre management office 161

17.1 Introduction 161
17.2 Intent of the NCC 161
17.3 Methodology 161
17.4 Acceptance criteria 162

17.5 Fire hazards 162
17.6 Design characteristics 164
17.7 Fire scenarios 165
17.8 Assessment 166
17.9 Conclusion 167

18. Performance solution 12 – Extended travel distance in roof plant areas 168

18.1 Introduction 168
18.2 Intent of the NCC 168
18.3 Methodology 168
18.4 Acceptance criteria 169
18.5 Fire hazards 169
18.6 Assessment 169
18.7 Conclusion 170

19. Performance solution 13 – Retail tenancies opening directly into fire-isolated exit 171

19.1 Introduction 171
19.2 Intent of the NCC 171
19.3 Methodology 171
19.4 Acceptance criteria 172
19.5 Fire hazards 172
19.6 Assessment 172
19.7 Conclusion 173

20. Performance solution 14 – Merging of fire-isolated stairs 5/15 and 10/13 174

20.1 Introduction 174
20.2 Intent of the NCC 177
20.3 Methodology 177
20.4 Acceptance criteria 177
20.5 Fire hazards 177
20.6 Fire scenarios 177
20.7 Assessment 178
20.8 Conclusion 182

21. Performance solution 15 – Discharge of fire-isolated stairs along the northern boundary 183

21.1 Introduction 183
21.2 Intent of the NCC 184
21.3 Methodology 184
21.4 Acceptance criteria 185
21.5 Fire hazards 185
21.6 Assessment 185
21.7 Conclusion 190

22. Performance solution 16 – Discharge of fire-isolated stair 4 191

22.1 Introduction 191
22.2 Intent of the NCC 195
22.3 Methodology 195
22.4 Acceptance criteria 196
22.5 Fire hazards 196
22.6 Assessment 196
22.7 Conclusion 197

23. Performance solution 17 – Areas provided with single exit 198

23.1 Introduction 198
23.2 Intent of the NCC 198
23.3 Methodology 198
23.4 Acceptance criteria 198
23.5 Fire hazards 198
23.6 Assessment 199
23.7 Conclusion 201

24. Performance solution 18 – Hydrant booster and pump room location 202

24.1 Introduction 202
24.2 Intent of the NCC 203
24.3 Methodology 203
24.4 Acceptance criteria 203
24.5 Fire hazards 203
24.6 Fire scenarios 204
24.7 Assessment 204

24.8 Conclusion 204
25. Performance solution 19 – Location of hydrant pump room 205
25.1 Introduction 205
25.2 Intent of the NCC 205
25.3 Methodology 206
25.4 Acceptance criteria 207
25.5 Fire hazards 207
25.6 Assessment 208
25.7 Conclusion 208
26. Performance solution 20 – Additional internal hydrants 209
26.1 Introduction 209
26.2 Intent of the NCC 209
26.3 Methodology 209
26.4 Acceptance criteria 210
26.5 Fire hazards 210
26.6 Assessment 210
26.7 Conclusion 211
27. Performance solution 21 – Omission of sprinkler coverage to canopies 212
27.1 Introduction 212
27.2 Intent of the NCC 213
27.3 Methodology 213
27.4 Acceptance criteria 213
27.5 Fire hazards 214
27.6 Fire scenario 215
27.7 Assessment 215
27.8 Conclusion 215
28. Performance solution 22 – Fire rated cabling 216
28.1 Introduction 216
28.2 Intent of the NCC 216
28.3 Methodology 216
28.4 Acceptance criteria 216
28.5 Fire hazards 216
28.6 Assessment 216
28.7 Conclusion 217
29. Performance solution 23 – Protection of floor slab penetrations 218
29.1 Introduction 218
29.2 Intent of the NCC 218
29.3 Methodology 219
29.4 Acceptance criteria 219
29.5 Fire hazards 219
29.6 Assessment 219
29.7 Conclusion 220
30. Performance solution 24 – Reduction of widths 221
30.1 Introduction 221
30.2 Intent of the NCC 222
30.3 Methodology 223
30.4 Acceptance criteria 223
30.5 Fire hazards 223
30.6 Assessment 223
30.7 Conclusion 224
31. Performance solution 25 – Hydrant and sprinkler pipe penetrations to fire stairs 225
31.1 Introduction 225
31.2 Intent of the NCC 226
31.3 Methodology 226
31.4 Acceptance criteria 226
31.5 Fire hazards 226
31.6 Assessment 226
31.7 Conclusion 227
32. Performance solution 26 – Location of hydrant ring main isolating valves 228
32.1 Introduction 228

32.2 Intent of the NCC 228
32.3 Methodology 228
32.4 Acceptance criteria 228
32.5 Fire hazards 229
32.6 Assessment 229
32.7 Conclusion 229

33. Performance solution 27 – Reduction of retail FRLs on level 3 230

33.1 Introduction 230
33.2 Intent of the NCC 231
33.3 Methodology 231
33.4 Acceptance criteria 231
33.5 Fire hazards 231
33.6 Fire scenarios 232
33.7 Assessment 233
33.8 Conclusion 234

34. Performance solution 28 – Unprotected opening on vehicular ramp 236

34.1 Introduction 236
34.2 Intent of the NCC 237
34.3 Methodology 237
34.4 Acceptance criteria 237
34.5 Fire hazards 237
34.6 Fire scenarios 238
34.7 Assessment 238
34.8 Conclusion 239

35. Performance solution 29 – Separation of external rooftop carpark 240

35.1 Introduction 240
35.2 Intent of the NCC 242
35.3 Methodology 242
35.4 Acceptance criteria 242
35.5 Fire hazards 243
35.6 Assessment 243
35.7 Conclusion 244

36. Performance solution 30 – Separation of essential services board on level 3 245

36.1 Introduction 245
36.2 Intent of the NCC 246
36.3 Methodology 246
36.4 Acceptance criteria 247
36.5 Fire hazards 247
36.6 Fire scenario 247
36.7 Assessment 247
36.8 Conclusion 248

37. Performance solution 31 – Fire hydrant and hose reel coverage to tenancy G-001 249

37.1 Introduction 249
37.2 Intent of the NCC 249
37.3 Methodology 250
37.4 Acceptance criteria 250
37.5 Fire hazards 250
37.6 Assessment 250
37.7 Conclusion 252

Appendix A Drawings and information 253

Appendix B FRNSW comments on PBDB 254

Appendix C Fire safety statement 256

Appendix D Retail smoke zones and exit plans 261

Appendix E Sprinkler activation times – Calculation of retail fire sizes 262

Appendix F Evacuation assessment – level 3 centre management office (CMO) 263

F.1 Evacuation assessment framework 263
F.2 Populations nominated 263
F.3 Cue period 263
F.4 Pre-movement phase 264

F.5 Movement period 265
F.6 RSET summary 268

Appendix G Sprinkler and smoke detector activation – level 3 CMO office 269

G.1 Smoke detector activation – proposed design 269
G.2 Sprinkler activation – base case 270

Appendix H FDS smoke modelling assessment 271

H.1 Introduction 271
H.2 FDS input parameters 271
H.3 Model geometry 275
H.4 Scenario 1 results – Fire in Tenancy B-031 (LGF) 280
H.5 Scenario 2 results – Kiosk fire (LGF) 296
H.6 Scenario 3 results – Fire in Tenancy B-031 (LGF) - sensitivity analysis 307
H.7 Scenario 4 results – Fire in Tenancy G-034 (L00) 323
H.8 Scenario 5 results – Fire in Tenancy G-031 (L00) 336
H.9 Scenario 6 results – Fire in Tenancy G-034 (L00) – Sensitivity 345
H.10 Scenario 7 results – Fire in Tenancy G-027 (L00) 356
H.11 Scenario 8 results – Fire in Tenancy G-027 (L00) – Sensitivity 367
H.12 Scenario 9 results – Fire in Tenancy 1-009 (Zone 12) 377
H.13 Scenario 10 results – Fire in Tenancy 1-009 (L01) – Sensitivity 383
H.14 Scenario 11 results – Fire in specialty tenancy 2-024 (Zone 7) 391
H.15 Scenario 12 results – Fire in Tenancy 2-024 (L02) – Sensitivity analysis 400
H.16 Scenario 13 results – Fire in Tenancy 2-010 (L02) – Sensitivity 410

Appendix I Evacuation modelling (retail) 415

I.1 Evacuation assessment framework 415
I.2 Cue period 419
I.3 Pre-movement phase 421
I.4 Movement period 422
I.5 Scenarios 1– Fire in specialty tenancy B-031 (Zone 7) 429
I.6 Scenario 2 – Fire in kiosk Site 11 (Zone 7) 434
I.7 Scenarios 3 – Fire in specialty tenancy B-031 (Zone 7) – sensitivity 439
I.8 Scenarios 4 and 6 – Fire in specialty tenancy G-034 (Zone 7) 444
I.9 Scenario 5 – Fire in specialty tenancy G-031 (Zone 7) 447
I.10 Scenarios 7 and 8 – Fire in specialty tenancy G-027A (Zone 13) 450
I.11 Scenarios 9 and 10 – Fire in specialty tenancy 1-009 (Zone 12) 453
I.12 Scenarios 11 and 12 – Fire in specialty tenancy 2-024 (Zone 7) 455
I.13 Scenarios 13 – Fire in specialty tenancy 2-010 (Zone 1) 458
I.14 Scenario 14 – Fire in level 3 retail tenancy 3-002 460
I.15 RSET summary 461

Appendix J Internal columns supporting level 3 roof 463

J.1 Structural engineer advice 463
J.2 Fire rating of structural elements 465

Appendix K Location of hydrant ring main isolation valves 466

Appendix L Stair pressurisation airflow paths 467

Appendix M Certifier endorsement on sidewall sprinkler issue (performance solution 6) 468

Appendix N Structural statement – Level 3 FRLs 470

Appendix O Radiant heat assessment 471

O.1 Opening perpendicular to the boundary 472

1. Introduction

This report documents the findings of a fire safety engineering assessment undertaken to determine whether the proposed redevelopment at Chatswood Chase Shopping Centre complies with the relevant performance requirements of the National Construction Code Volume One – Building Code of Australia (NCC) 2022[1]. Jensen Hughes undertook the assessment in accordance with the Australian Fire Engineering Guidelines (AFEG)[2] at the request of Multiplex.

2. Performance-based design brief

Clause A2G2(4) of the NCC requires a performance-based design brief (PBDB) be undertaken for all projects. The purpose of the PBDB is to consult with the relevant stakeholders to define the scope of the project and to agree on the objectives, fire safety measures, methods of analysis and acceptance criteria for the performance solutions. Guidance on the development of a PBDB is presented in the AFEG.

2.1 Stakeholders

The relevant stakeholders for this project are listed in Table 2.

Table 2 Stakeholders

Name	Role	Organisation
David Patterson	Client	Multiplex
Des Randall Paul Brodala	Architect	Webber Australia – Executive Architect
Vanessa Hinge	BCA consultant	McKenzie Group
Luke Denny	Certifying authority – BDC 0869	Steve Watson and Partners
Peter Anderson	Mechanical and dry fire services designer	NDY
Will Barlow	Hydraulics and wet fire services designer	CJ Arms
Adam Deller	Wet fire contractor	Innovative fire
Dean Carr	Mechanical contractor	ECJV
-	Referral authority	Fire and Rescue NSW
Grace Huang Malhar Bhadbhade	Fire safety consultant	Jensen Hughes (formerly Warringtonfire)
Chris Jamieson	Certifier – fire safety – BDC2497	Jensen Hughes (formerly Warringtonfire)

2.2 PBDB process

A fire engineering brief questionnaire (FEBQ) was prepared and progressively updated to incorporate design changes and address comments from the stakeholders as summarised in Table 3. The FEBQ document included fitout works to the David Jones tenancy in addition to the proposed wider refurbishment works to the shopping centre. Comments from the design team have been incorporated into this fire engineering report.

For all three FEBQs submissions, FRNSW responded to the applications by indicating they would not provide comments. It is understood that this does not indicate support or objection to the proposed performance solutions.

[1] National Construction Code Volume One – Building Code of Australia 2022, Australian Building Codes Board, Australia
[2] Australian Fire Engineering Guidelines, 2021, version 1.0, Australian Building Codes Board, Australia.

Table 3 PBDB amendment schedule

Version	Author	Organisation	Content	Date
01	Grace Huang Chris Jamieson	Warringtonfire (now Jensen Hughes)	Initial submission	31/11/2023
02	-	FRNSW	No comment provided	13/12/2023
03	Grace Huang Chris Jamieson	Jensen Hughes	4 additional performance solution and update to reflect Stage 1 works only.	6/12/2025
04	-	FRNSW	No comment provided	10/01/2025
05	Grace Huang Chris Jamieson	Jensen Hughes	5 additional performance solutions, updates to reflect change of use on levels 2 and 3 and amendments to Issue 4, 5, 8, 19 and 24.	25/07/2025
06	-	FRNSW	No comment provided	06/08/2025

2.3 Design changes and additional performance solutions

The performance solutions documented in this report are substantially consistent with the information presented to the stakeholders during the PBDB process, except for the specific areas noted in Table 4 in relation to R2.2.

The fire engineering report was progressively updated to incorporate design changes and include additional performance solutions – see Table 4.

Table 4 Summary of FER revisions

Revision	Reason for update
R 2.0	Initial issue
R 2.1	Report updated to reflect Stage 1 of the works only, changes to existing performance solutions and four additional performance solutions as documented in FEBQV03.
R2.2	Report updated to reflect the change of use on levels 2 and 3, changes to existing performance solutions and 5 additional performance solutions as documented in FEBQV05. Performance solution 6 relating fire safety requirements for the skylight voids was also updated to address sidewall sprinklers providing coverage to the linear void installed more than 150 mm below the ceiling. The PBDB was not explicitly updated to include this void as on the basis that the change does not significantly impact the existing fire engineering strategy, method of assessment or acceptance criteria of the previously documented performance solution – refer to Appendix M. This was reviewed and agreed with the certifying authority.
R2.3	Report updated to address minor stakeholder comments. The changes do not impact the outcome of the overall fire engineering strategy.
R2.4	Report updated to address minor stakeholder comments. The changes do not impact the outcome of the overall fire engineering strategy.
R2.5	Report updated to address minor stakeholder comments and reflect as-built conditions. The changes do not impact the outcome of the overall fire engineering strategy.
R2.6	Report updated to reflect a minor amendment to line of smoke separation between smoke zones 8 and 8A on lower ground floor. The change does not impact the outcome of the overall fire engineering strategy.

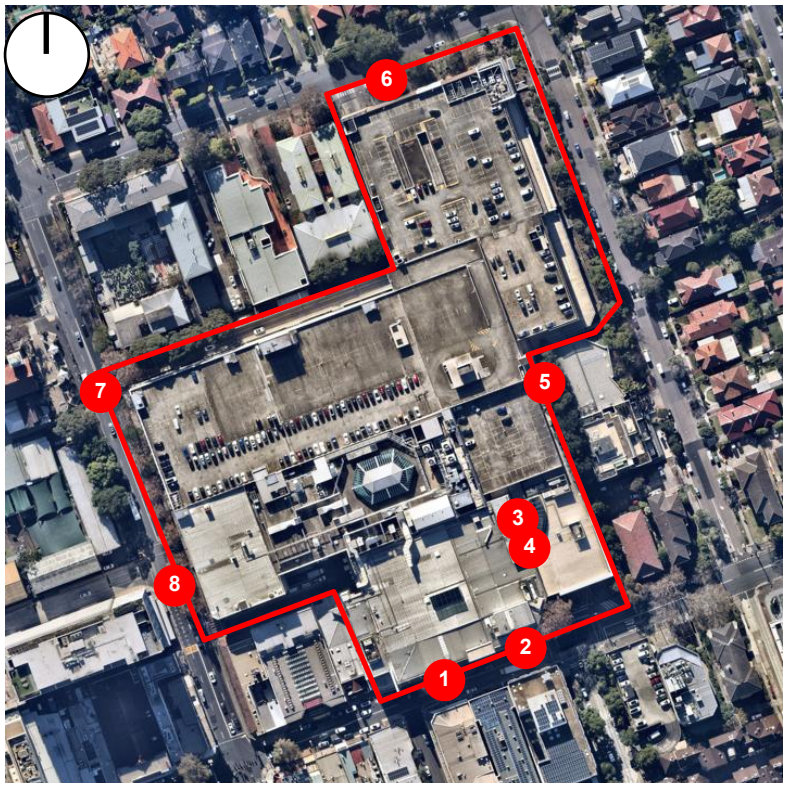
3. Description of the building and performance solutions

3.1 Building description

The project is the refurbishment of the existing Chatswood Chase Shopping Centre. The shopping centre is currently a nine level retail building (class 6) anchored by three major tenancies – David Jones, Coles, and Kmart. The existing shopping centre also includes more than 200 specialty and mini-major tenancies.

The new works include:

- reconfiguration of internal retail and void spaces from ground level to level 2
- construction of a new gym tenancy spanning portions of levels 2 and 3 west
- construction of new retail tenancies and centre management office on level 3
- carpark upgrade works including modification of ramps, new concrete footings and foundations, new structural steel works
- upgrade of vertical transport provisions.



1 – Victoria Avenue pedestrian entry
2 – Hydrant Booster
3 & 4 – Hydrant and Sprinkler pump room and FIP accessed from loading dock, off Victoria Avenue.
5 – Havilah Street pedestrian entry
6 – Malvern Avenue carpark entry
7 – Archer Street carpark entry
8 – Archer Street pedestrian entry

Figure 1 Site plan

Area of new works

The building has previously been subject to numerous fire engineering assessments. Areas of new works to which this report relates are illustrated in Figure 2 and Figure 3. Any previous fire engineering assessments associated with these areas are superseded by this report.

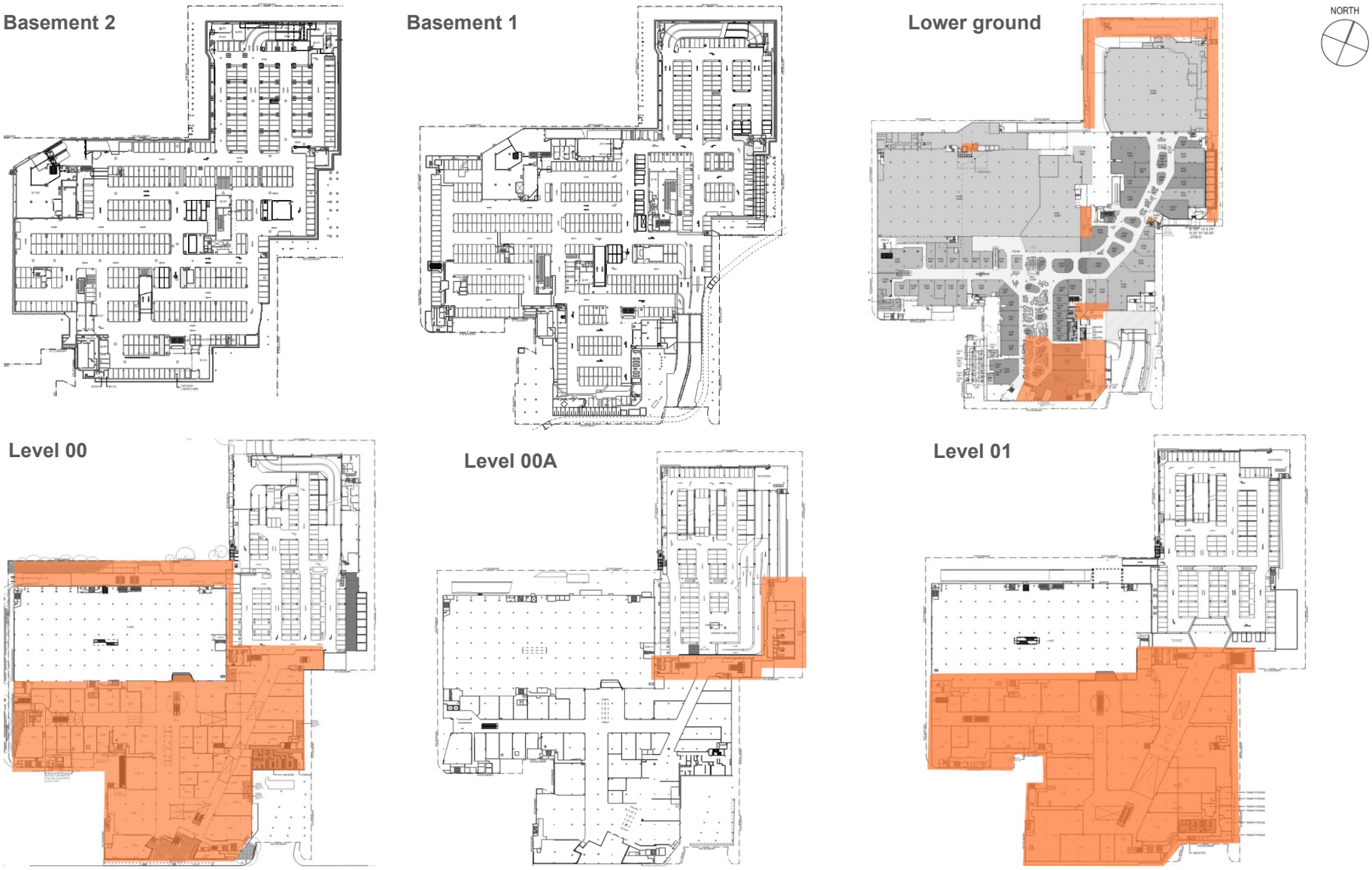


Figure 2 Area of new works – Levels Basement 2 to 01

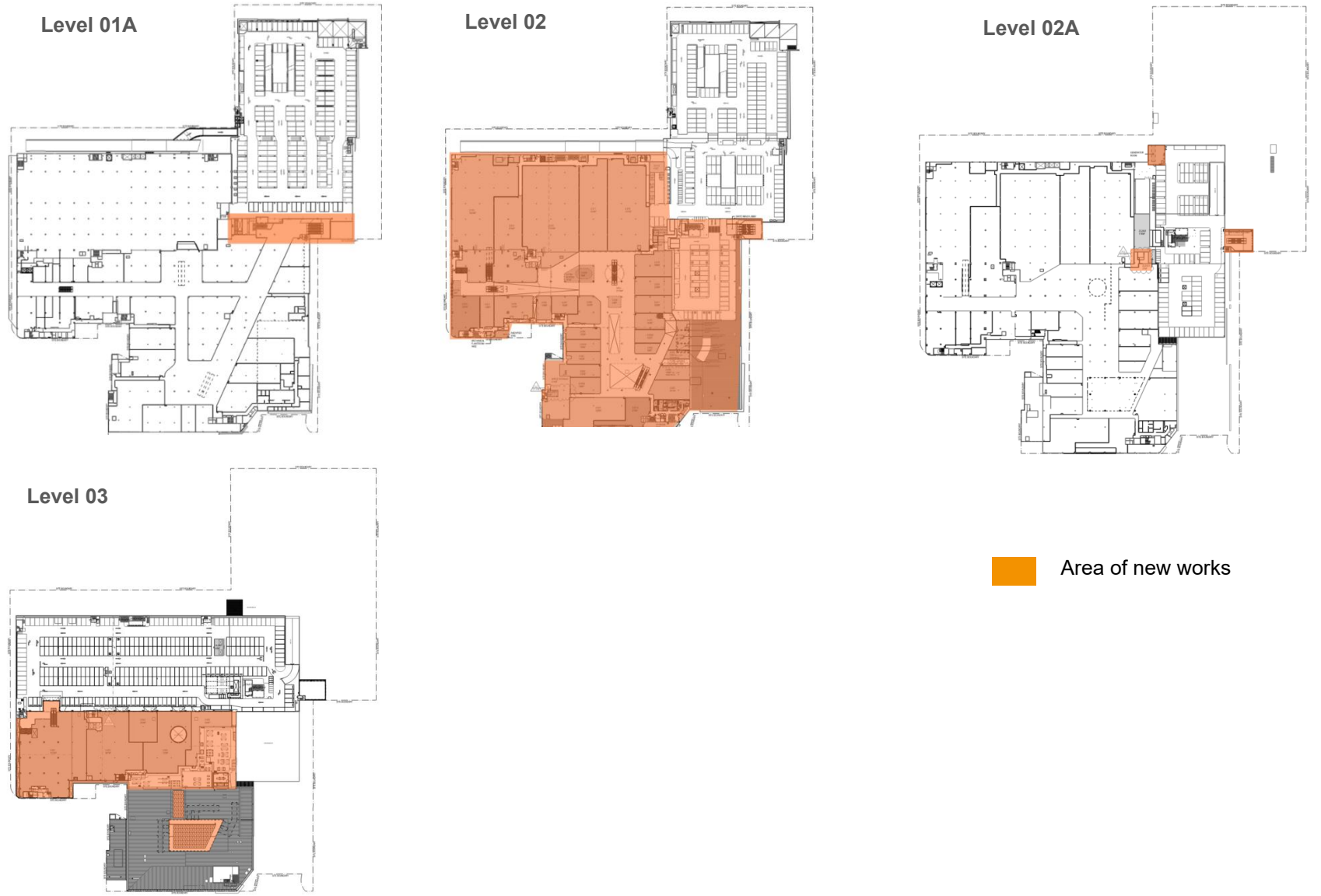


Figure 3 Area of new works – Levels 01A to 03

Table 5[3] shows the main characteristics of the building for determining compliance with the NCC. Table 6 shows the use and classification of the building or part in accordance with part A6 of the NCC.

Table 5 Main building characteristics

Characteristic	NCC provision	Description
Effective height	Schedule 1	Less than 25 m 22.03 m
Type of construction required	C2D2	Type A
Rise in storeys	C2D3	8
Levels contained	-	10

Table 6 Use and classification

Part of building	Use	Classification (A6)
Basements 1 and 2	Carpark	7a
Lower ground	Retail	6
Levels 00 and 01	Retail Carpark	6 7a
Levels, 00A, 01A, 02A and 3A	Carpark	7a
Level 02	Retail Gym	6 9b
Level 03	Office Retail Carpark Gym	5 6 7a 9b

3.2 Preventive and protective measures

The fire safety measures provided in the building are listed in the fire safety statement in Appendix C. Additional fire safety measures required as part of the performance solution are listed in section 5. The high-level fire safety strategy for the proposed works is summarised as follows:

Fire resistance

- The existing loadbearing structure throughout the building comprises concrete columns, floors, and steel elements which generally achieve a 2-hour fire rating in accordance with the existing fire engineering strategy. New loadbearing elements will be fire-rated consistent with the existing strategy unless specifically identified.
- The retail part of the building will form a single fire compartment with interconnected voids.
- Carpark and retail areas will form separate fire compartments.
- Glazed interfaces between the carpark and retail areas are protected with wall-wetting sprinklers.
- The new level 3 retail tenancies and centre management office will form a new fire compartment will be fire separated from the retail area below. The fire separation around the central void to the retail area below will incorporate glazed construction.

[3] McKenzie Group, 23 November 2023, BCA assessment report, 220496-rev7.

Evacuation

- The evacuation strategy for the building comprises a combination of exits discharging directly outside at the lower levels in combination with fire-isolated stairs and passages distributed throughout the building. These exits are generally existing and are not being significantly modified as part of the proposed works.
- Occupants can also progressively evacuate between smoke zones throughout the retail part of the building.
- Emergency exit signage and emergency lighting will be provided for wayfinding.

Firefighting provisions

- The building will be provided with sprinkler protection throughout. The sprinkler system serving the new areas will be upgraded to achieve compliance with the current requirements of AS 2118.1-2017 (unless specifically identified) including the provision of new pumps. The existing sprinkler system will be maintained in areas which are not subject to new works.
- The hydrant system serving the building will be fully upgraded to comply with AS 2419.1-2021 unless specifically identified. The existing hydrant booster location along Victoria Avenue will be maintained. Internal hydrants will be provided within exits and additional internal hydrants required to achieve coverage will be located on a performance basis to facilitate progressive firefighting within the building.
- A fire control room is located at lower ground floor near the booster assembly and fire pump and sprinkler valve rooms providing a consolidated turnout location for fire brigade operations.
- Fire hose reels and extinguishers will be provided throughout the building for first aid firefighting.

Smoke hazard management

- The building will be provided with a smoke detection system throughout for activation of smoke control systems. The smoke detection infrastructure will be upgraded to comply with the current requirements of AS 1670.1-2018 (amendment 1) unless specifically identified.
- The retail part of the building will be divided into smoke zones bounded by full height smoke proof construction. Where smoke zones span circulation areas such as malls and entries to major tenancies, smoke baffles will be provided.
- The smoke hazard management strategy is intended to maintain tenable conditions for evacuation within the smoke zone of origin and to limit smoke spread into adjacent zones.
- Back of house and loading areas are to be separated by construction which prevents the free passage of smoke and will not be provided with smoke exhaust.
- Mall areas connected by the central atrium void and Victoria Avenue void will form a multi-level smoke zone served by exhaust at the top of the skylight structures above the voids.
- Single level mall areas will form separate smoke zones and are provided with dedicated smoke exhaust.
- Tenancies exceeding 1000 m^2 will form separate smoke zones and will be provided with dedicated smoke exhaust.
- Makeup air for the smoke exhaust system will be provided via a combination of passive openings at the mall entries and mechanical supply from adjacent smoke zones.
- Fire-isolated stairs serving the atrium smoke zones will be provided with stair pressurization designed on a performance basis.

3.3 Occupant characteristics

The characteristics of the occupants expected to be in the building are listed in Table 7.

Table 7 Occupant characteristics

Characteristic	Description
Familiarity	Office – Occupants are expected to be staff who are familiar with the layout of the building. Visitors may also be present, but they are expected to be accompanied by staff. Retail/gym – Occupants are expected to be primarily shoppers or customers who may not be familiar with the layout of the building and location of fire exits. A limited number of staff are also expected to be present who are familiar with the layout of the tenancy. Carpark – Occupants are mainly expected to be associated with the gym and retail uses and be within the carpark for short periods.
Awareness	Occupants are expected to be awake and alert to a potential emergency event such as a fire in the building.
Mobility	Occupants are assumed to have the same level of mobility as the general population. This may include a limited proportion of mobility impaired occupants. These occupants may need crutches, a wheelchair or similar to evacuate on their own or need assistance from other occupants.
Age	Occupants of all ages may be present within the building.
Language	Although occupants may have English as their second language, they are expected to understand signs and verbal instructions in English enough to not adversely affect evacuation.
Occupant load	Population densities used in this assessment are based on Fire Code Reform Centre Project 6 – ie 6 m^2/person (tenancies) and 10 m^2/person (mall areas). A more recent SFPE[4] survey of occupant load density in retail buildings provides the following recommended design population densities based on 99% quantile values: • Non-food stores – 10 m^2/persons • Supermarkets – 6.67 m^2/persons This survey provides good agreement with Project 6 densities adopted in the assessment. This approach has been endorsed by the building owner, BCA consultant and project certifying authority.

[4] SFPE Educational & Scientific Foundation, Survey of Occupant Load Densities in Retail Buildings, Report 2019-1, December 2019

3.4 Performance solutions

The area of new works includes areas that do not comply with the DTS provisions of the NCC. We intend to use performance solutions to meet relevant performance requirements of the NCC. Table 8 shows the NCC requirements associated with the performance solutions.

Table 8 NCC requirements associated with the performance solutions

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
1	Internal steel columns supporting the roof on level 3 are not proposed to achieve a fire rating unless they support essential plant equipment.	Specification 5	C1P1	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
2	Slab edge fire stopping is designed on a performance basis.	Specification 5	C1P9	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
3	Green walls incorporating climbing plants are proposed to be provided to the Havilah Street OSD tank/EOT.	Clause C2D10 and C2D14	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
4	The fire wall separating the carpark from the retail use will include glazed elements that will not achieve an FRL of 180/180/180. Instead, the wall will comprise toughened glass protected with wall-wetting sprinklers as part of a tested system.	Clauses C3D8	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
5	The backup generator on level 2A sustaining emergency equipment serving the atrium will not be fire separated from the carpark.	Specification 31 and C3D13	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
6	Steel members supporting the Centre Court and Victoria Avenue skylights are not proposed to achieve a fire rating. The atrium roof structure and membrane will not be protected by sprinklers.	Clause G3D6 and specification 31	C1P2, C1P2 and E1P4	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
	The separation of the existing and new retail fire compartments at the level 3 atrium void consists of heat strengthened glazing instead of fire rated construction.	Clause C3D9			

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
	Sidewall sprinklers providing coverage to the linear void connecting levels 1 and 2 are installed more than 150 mm below the skylight.	Clause E1D4			
7	The maximum travel distances in the retail areas within the building are in accordance with the following: • up to 65 m instead of 40 m to an exit • up to 100 m instead of 60 m between exits	Clauses D2D5 and D2D6 Part G3 and specifications 21 and 31	C1P2, D1P4, and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
	The smoke hazard management system serving the retail portion of the building will be designed on a performance basis with regards to: • smoke exhaust quantities • smoke reservoir sizes • make-up air provisions outside of trading hours				
	The retail portion of the building contains an atrium which is not proposed to comply with part G3 and specification G3.8 of the NCC. This includes: • Atrium bounding construction • Rationalised stair pressurisation provisions • Standby power provisions				
8	The path of egress from the basement retail loading dock involves travel through a secure corridor within the David Jones tenancy loading area.	Clauses D2D3 and D2D14	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
	The distance of travel to open space via the non-fire-isolated exit ramp is 100 m instead of 80 m.				

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
9	The maximum travel distance to a point of choice in localised retail and BOH storage areas within the building is up to 30 m instead of 20 m.	Clause D2D5	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
10	The maximum travel distance in the level 2 mini-majors are as follows: • 65 m instead of 40 m to an exit • 120 m instead of 60 m between exits	Clauses D2D5 and D2D6	D1P4 and E2P2	Complies with performance requirements A2G2(1)(b)	Verification method A2G2(2)(d)
11	The maximum travel distances from the level 3 centre management office are as follows: • 23 m instead of 20 m to a point of choice • 63 m instead of 40 m to an exit • 105 m instead of 60 m between exits	Clauses D2D5 and D2D6	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
12	The maximum travel distances from the level 3 plant areas within the building are in accordance with the following: • 65 m instead of 40 m to an exit • 100 m instead of 60 m between exits	Clauses D2D5 and D2D6	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
13	The design includes fire-isolated exits which open directly into retail sole occupancy units.	Clause D2D12	D1P5	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
14	Stairs 5 and 15, and stairs 10 and 13, are existing fire-isolated stairs that merge into common fire-isolated passages prior to their discharge to open space.	Clause D2D12	D1P5	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
15	The discharge of fire-isolated stairs to the covered area along the northern boundary incorporates the following departures: • More than 6 m of travel to the road. • Exposure to openings within 6 m • The open perimeter of the covered discharge area is less than 33% of the total perimeter.	Clause D2D12	D1P5	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
16	The discharge of fire-isolated stair 4 within the southern loading dock requires occupants to travel more than 6 m to reach the road.	Clause D2D12	D1P5	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
17	A number of areas within the retail compartment are provided with a single exit instead of two.	Clause G3D7	D1P4 and E2P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
18	The fire hydrant booster assembly is not located within sight of the main entry as the building has multiple street frontages.	Clause E1D2	E1P3	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
19	The hydrant pump room is existing, however new pumps are proposed to be added to the existing room as part of the upgrade works. The pump room will be accessed via a fire-isolated passage which discharges to the covered carpark entry ramp leading to Victoria Avenue. The new sprinkler valve room is not provided with direct access to a road or open space.	Clause E1D2 and specification 17	E1P3 and E1P4	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
20	The fire hydrant system incorporates additional intermediate fire hydrants throughout the building to achieve full coverage which are not within or adjacent to exits.	Clause E1D2	E1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
21	Sprinklers are proposed to be omitted to soffits / canopies over the following locations: • Victoria Avenue entry • Archer Street entry and external terrace	Specification 17	E1P4	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
22	Extra low voltage (ELV) fire cabling is not provided with 'ELV Fire' cable marking as required in AS 1670.1-2018.	Clause E2D2	E4P3	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
23	Fire stopping protection of drainage penetrations through the floor slab within the level 2 wet area is omitted.	Clause C4D13	C1P8	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
24	The design includes a reduction in unobstructed width to 750 mm instead of 1 m at a localised pinch-point within Stair 19 on level 2A due to new hydrant valve inlets within the stairs. The Stair 8 fire-isolated passageway also incorporates the following localised reductions in widths: • Level 00 – 1200 mm instead of 1500 mm • Level 02 – 1170 mm instead of 1500 mm Stair 13 also incorporates a localised reduction in width to 1200 mm from 1500 mm within each scissor stair landing, at the start of the transfer corridor at LGA which connects to Stair 10.	Clauses D2D8 and D2D10	D1P4	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
25	The protection provided to hydrant and sprinkler pipe penetrations through fire rated elements is not proposed to achieve an insulation rating, where the pipe penetrates through: • The concrete slabs within a fire-isolated stair shaft. • The fire stair shaft wall	Clause C4D15 and specification 13	C1P8	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
26	Hydrant ring main isolation valves within basement level 1 are located within the carpark area instead of within fire-isolated stairs in a number of instances.	Clause E1D2	E1P3	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
27	The maximum fire rating of class 6 retail building elements on level 3 is reduced from 180 minutes to 120 minutes.	Specification 5	C1P1 and C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
28	The level 1 speedramp opening is within 3 m of the northern allotment boundary and will not be protected.	Clause C4D3	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
29	The external carpark rooftop areas on levels 2A and 3 are deemed as occupiable outdoor areas. The carpark areas are not fire separated from adjacent internal retail and gym areas on the same storey.	Clauses G6D3 and C3D9	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
30	Fire separation of the level 3 mechanical essential services board (MSSB) is rationalised.	Clause C3D14	C1P2	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)
31	Hydrant coverage to tenancy G-001 requires two hose lengths from an internal hydrant. Tenancy G-001 is not provided with fire hose reel coverage.	Clauses E1D2 and E1D3	E1P1 and E1P3	Complies with performance requirements A2G2(1)(a)	Verification method A2G2(2)(b)(ii)

Jensen Hughes asked for information about any previous performance solutions developed for the overall building. The impacts of the assessments documented in this report to performance solutions within these previous reports is described in Table 8 below. The area of new works – where this report supersedes previous fire engineering assessments is further shown in Figure 2 and Figure 3.

Table 9 Previously addressed performance solutions[5]

No	Description of performance solutions	DTS provision	Performance requirements	Status
Chatswood Chase shopping centre CSIRO report no. FPC0430 dated July 1996				
1	This report addresses fire safety in the proposed redevelopment of Chatswood Chase shopping centre in particular the smoke management system where variation from the BCA prescription is sought.	-	EP2.2	Report remains applicable to Kmart and Coles only.
Chatswood Chase extension NDY report no. rp02309s revision M dated 29 September 2009 (BCA 2007)				
1	Reduction in fire rating of building elements within the building generally to 120 minutes.	Clause C1.1 and specification C1.1	CP1 and CP2	Remains applicable – see section 3.4.1
	Steel structures for mezzanine plant rooms not proposed to be fire rated.			
	The building will exceed the compartmentation size requirements for type A construction.	Clause C2.2		
	Separation of the carpark and retail portions will not comprise 3-hour fire rated construction.	Clause C2.8		
2	The proposed new entry opening to the east of the centre from Havilah Street is within 3m of the side boundary.	Clause C3.2	CP2	Superseded by new works
	Part of the Victoria Avenue façade is within 3m of the side boundary – levels lower ground to level 2.			
3	It is proposed to allow distances of travel to a single exit or point of choice of 40 m, with a maximum travel distance of 80 m to the nearest exit and 110 m between alternative exits.	Clause D1.4 and D1.5	DP4, DP6 and EP2.2	Superseded in areas of new works
	Extended travel distances within the plant rooms of up to 40 m.	Clause D1.4		
	Reduction in width in certain areas of the centre – approximately 1 m on level 1 and 1.5 m on level 2	Clause D1.6		
	Smoke reservoirs exceed the DTS area of 2000 m^2 and travel within the smoke reservoir is greater than 60 m – up to 110 m.	Clause E2.2 and specification E2.2b		
4	New stair N103 opens directly into a plant room.	Clause D1.7	DP4 and DP5	Remains applicable
	It is proposed to discharge stair E14 into the mall area in front of the main exit doors.			No longer applicable
	Stair E13 is proposed to discharge through the loading dock, which is a covered area.			No longer applicable
	Discharge from egress passage C.B.05 on the ground level zone B is within 6 m of the external wall of the building.			Remains applicable

[5] DTS provisions and performance requirements referenced in Table 9 are as per the version of the NCC applicable to the base building – ie NCC 2016 Amendment 1. Note that NCC clause and performance requirement referencing has been updated in NCC 2022.

No	Description of performance solutions	DTS provision	Performance requirements	Status
	Stairs from the mezzanine plant room do not specifically discharge at the level of egress to a road or open space and incorporate a travel distance of more than 20 m to open space.	Clause D1.9		Remains applicable
	The stairs between the carpark and centre are not proposed to be fire-isolated.	Clause D1.12		Superseded in areas of new works
5	The existing fire hose reels, hydrants and sprinklers are installed and maintained to Ordinance 70 requirements and do not comply with current codes and standards.	Clauses E1.3, E1.4 and E1.5	EP1.1, EP1.3 and EP1.4	Superseded in areas of new works
	It is proposed to retain the existing fire control centre, which is not directly accessed from the road and contains sprinkler valves etc. It is not proposed to have pumps within the control centre as agreed by NSWFB at FEB.	Clause E1.8	EP1.6	Remains applicable Location of fire control centre to remain the same. New sprinkler valves provided.
6	The atrium voids within the building connecting smoke zones 9, 10, 21 and 33 do not comply with the requirements of part G3 and specification G3.8 of the BCA including: 6m diameter requirement, separating construction, smoke control, evacuation area signs, stair pressurisation to stairs serving the atrium, smoke detection.	Clause G3.2-G3.6, specification G3.8	CP2 and EP2.2	Superseded in areas of new works
7	Unprotected structural steel is proposed for the steel columns supporting the roof and plant on level 1 zone D.	Clause C1.1 and specification C1.1	CP1	Remains applicable
	Unprotected structural steel columns are to be incorporated in the external wall to Victoria Avenue frontage.			Superseded in areas of new works
8	It is not proposed to provide sprinklers to stair N107.	Clauses C3.5 and E1.5	CP2 and EP1.4	Superseded in areas of new works
9	It is not proposed to provide fire rated doors or smoke seals to stair N107.	Clause D1.12	CP2 and DP4	Superseded in areas of new works
10	It is proposed to provide an aggregate unobstructed clear exit width of 750 mm in lieu of 1000 mm from the plant room stair.	Clause D1.6	DP4	Remains applicable
11	Smoke hazard management for the Country Road tenancy extending from ground floor to level 1.	Clause E2.2, table E2.2b and specification E2.2b	EP2.2	Superseded in areas of new works

No	Description of performance solutions	DTS provision	Performance requirements	Status
Chatswood Chase rationalised mall smoke exhaust, egress and structural fire rating system report no. rp140506s0008 revision 3 dated 22 October 2014 (BCA 2014)				
1	Travel distances in the centre court atrium, Archer Street mall, Victoria Avenue mall and the David Jones ground level tenancy include the following extended travel distances: • Up to 40 m to a single exit or point of choice instead of 20 m. • Up to 80 m to the nearest exit instead of 40 m. • Up to 110 m between alternative exits instead of 60 m.	Clauses D1.4 and D1.5	DP4	Superseded in areas of new works
	There is a minor reduction in available required egress width in certain areas of the centre.	Clause D1.6	DP6	
	The smoke reservoirs exceed the DTS area of 2000 m^2 and travel within the smoke reservoir is greater than 60 m (up to 110 m).	Clause E2.2, table E2.2b and specification E2.2b	EP2.2	
2	Structural steel beams are not proposed to be protected instead of achieving an FRL of 180/-/-. These beams are located underneath the Archer Street express carpark ramp.	Specification C1.1	CP1	Remains applicable
Chatswood Chase Lower ground, Archer Street report no. rp03418s revision D dated 9 April 2015 (BCA 2009)				
1	Smoke hazard management for the Archer Street mall is to be reassessed. The smoke reservoir exceeds the DTS area of 2000 m^2 and the extract rates are non-compliant. The smoke reservoir created by the smoke zone was assessed and the reservoir exceeds 60 m in length.	Clause E2.2, table E2.2b and specification E2.2b	EP2.2	Remains applicable
Chatswood Chase David Jones fire engineering report SY180281 R1.2 dated 19 December 2024				
1	The maximum travel distances within the tenancy are: • 43 m instead of 40 m to the nearest exit. • 84 m instead of 60 m between alternative exits.	Clauses E2D3, D2D5 and D2D6 Part G3 and specifications 21 and 31	D1P4 and E2P2	Remains applicable
	The smoke hazard management system serving the tenancy is to be rationalised on a performance basis with regards to: • Smoke exhaust quantities • Smoke reservoir sizes			
	The tenancy is located within a building containing an atrium. Stair pressurisation provisions to fire stairs serving David Jones are rationalised instead of achieving compliance with part G3 and specification G3.8 of the NCC.			

No	Description of performance solutions	DTS provision	Performance requirements	Status
2	Stairs 5 and 15, and stairs 10 and 13, are existing fire-isolated stairs and passageways that merge prior to their discharge to open space.	Clause D2D12	D1P5	Remains applicable
3	Numerous doorways within the David Jones tenancy discharge directly into fire-isolated stairs.	Clause D2D12	D1P4 and D1P5	Remains applicable
4	The path of egress from basement retail loading dock involves travel through a secure corridor within the David Jones tenancy loading area.	Clauses D2D3 and D2D14	D1P4 and E2P2	Remains applicable
	The distance of travel to open space via the non-fire-isolated exit ramp is 100 m instead of 80 m.			

3.4.1 Oversized retail compartment

The oversized retail fire compartment spanning retail portions of lower ground to level two was addressed in NDY fire engineering report (no. rp02309s) dated 29/09/2009. In the new works, the gym tenancy, including the level 3 portion and adjacent lift lobby area, will be incorporated into this existing retail fire compartment. This adds approximately 1,800 m^2 in floor area to the fire compartment. This additional floor area is not considered to impact the existing NDY oversized retail fire compartment performance solution on the basis that:

- The gym tenancy is smoke separated from the remainder of the retail by smokeproof construction in accordance with clause E2D15(1)(a)(ii)(C). Whilst an escalator void connects the level 2 mall to the level 3 lift lobby, the mall smoke hazard management system is expected to limit smoke spread to the level above via the void, in the event of a fire on the lower level of the retail compartments.
- The building is sprinkler protected throughout which is expected to limit the size and intensity of a fire as well as the risk of fire spread.
- Smoke hazard management will be provided to the mall retail areas below to maintain safe conditions for occupant evacuation.
- A fire within the additional floor area of the fire compartment on level 3 is not expected to meaningfully increase the fire risk to the lower levels of the oversized compartment.
- The increase compartment floor area is therefore not considered to significantly increase the potential fire size and intensity or the risk to safe evacuation of occupants from the building.

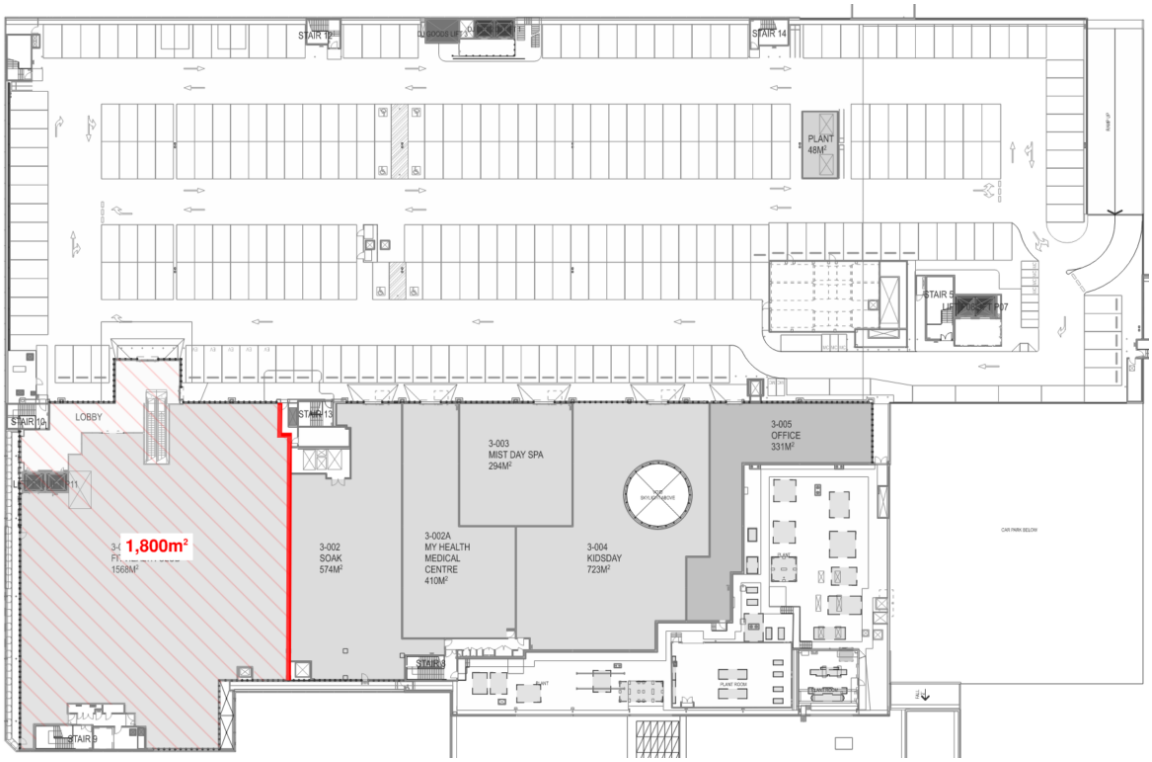


Figure 4 Level 3 – Additional floor area added to existing retail compartment

4. Scope and assumptions

4.1 Scope

- The scope of this report is limited to the performance solutions described in section 3.4. We have not confirmed that every aspect of the building complies with the building code and/or relevant Australian standards. It is the responsibility of other parties to ensure full compliance with the code and standards is achieved.
- The scope of our work does not include assessing the level of performance and/or compliance of external walls and associated materials, unless specifically agreed in writing with Jensen Hughes.
- Matters such as property protection (other than the protection of adjoining property), business interruption, public perception, environmental impacts and broader community issues – such as loss of a major employer and impact on tourism – have not been considered as they are outside the scope of the NCC.
- This report considers fires involving a single ignition point. Our assessment does not cover arson or destructive acts involving:
    - large amounts of accelerants which significantly change the expected burning behaviour of materials
    - multiple ignition sources
    - terrorism.
- The scope of our work is limited to considering evacuation and fire safety issues for people with disabilities to the same degree as the DTS provisions of the NCC. The evacuation of people with disabilities under the provisions of the Disability Discrimination Act 1992 is specifically excluded.
- If there are building alterations or additions, a change in use or changes to the fire safety systems in the future, a reassessment will be needed to verify consistency with the assessment in this report.
- The information in this report specifically relates to the building and must not be used for any other purpose.
- The documentation that forms the basis for this report is listed in 0.
- The figures included in this report are provided for illustrative purposes only and may not reflect the latest design drawings. They should be read together with the latest drawings and other documentation prepared by the project team.
- This report has been prepared based on information provided by others. Jensen Hughes has not verified the accuracy and/or completeness of this information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.

4.2 Assumptions

- The existing building complied with the applicable building standard at the time of construction – ie BCA 2007 and BCA 2014. All new works comply with the DTS provisions of NCC 2022 relating to fire safety, except for the specific performance solutions described in section 3.4.
- All the fire safety systems are to be designed, installed, operated and maintained in accordance with the appropriate Australian standards, other design codes, legislation and regulations relevant to the project unless specifically stated otherwise.

5. Fire safety measures

The fire safety measures required as part of the performance solution are listed in the following sections:

5.1 General

1. The existing building is understood to have complied with the applicable building standards at the time of construction – ie BCA 2007 and BCA 2014. All new works must comply with the DTS provisions of NCC 2022 relating to fire safety unless specifically mentioned. This section does not provide a comprehensive list of fire safety measures. The fire safety measures listed here only relate to the performance solutions. They must be read together with the applicable building standards at the time of construction and/or the DTS provisions of the NCC.

2. The fire safety measures in this section must be incorporated into the design of the building and maintained and certified in accordance with the Environmental Planning and Assessment (Development Certification and Fire Safety) Regulation 2021 and relevant Australian standards. These fire safety measures and this report must be listed on the fire safety schedule for the building.

3. The design must comply with the requirements of the following fire engineering reports except where superseded by the proposed design as noted in Table 9:
   a. Chatswood Chase shopping centre CSIRO report no. FPC0430 dated July 1996
   b. Chatswood Chase extension NDY report no. rp02309s revision M dated 29 September 2009
   c. Chatswood Chase rationalised mall smoke exhaust, egress and structural fire rating system report no. rp140506s0008 revision 3 dated 22 October 2014
   d. Chatswood Chase Lower ground, Archer Street report no. rp03418s revision D dated 9 April 2015

4. We recommend that all fire safety measures should be periodically inspected, tested and maintained in accordance with AS 1851:2012.

5.2 Fire resistance

5.2.1 Fire resistance and stability

5. The fire-resistance levels (FRLs) of new building elements must be designed in accordance with the requirements of specification 5 of the NCC for a building of type A construction unless otherwise specified in this report.

6. The maximum FRL criteria for existing structural building elements within the retail portion of the building is 120 minutes as permitted in the NDY fire engineering report rp02309s revision M dated 29 September 2009. This maximum FRL criteria also applies to any modifications to existing structural elements in the retail portion – e.g. floor slab infills.

7. Internal columns supporting the non-fire-rated level 3 roof are not required to achieve a fire rating, except for columns that support essential fire safety equipment and systems – refer to Appendix J . The following requirements apply:

a. Internal columns supporting essential fire safety equipment and systems must achieve an FRL of not less than 60/-/-.

b. The roof structure must be designed such that failure of the non-fire-rated internal columns on level 3 supporting the roof will only cause localised failure of the roof structure.

c. Failure of the non-fire-rated level 3 internal columns supporting the non-fire-rated roof must not result in the outwards collapse of the level 3 external walls.

d. External columns on level 3 supporting the roof structure must achieve an FRL of 120/-/- in accordance with specification 5 of the NCC for buildings of type A construction.

8. Any wall linings or materials within the Central Atrium or Victoria Avenue skylight voids above the ceiling of mall level 02 must be non-combustible or achieve a material group number of 1.

5.2.2 Fire and smoke separation

9. Where the fire-rated floor slab adjoins a new non-fire-rated curtain wall system with the typical detail shown in Figure 5, the following requirements apply:

a. The gap between the slab edge and curtain wall must be filled with a fire rated material tested in accordance with AS 1530.4:2014 to achieve an FRL of -/120/120 and capable of withstanding thermal and structural movements without loss of seal against fire and smoke.

Note: The appropriate fire rated material must be chosen based on the size of the gap and be installed in accordance with the manufacturer's instructions with input from the façade engineer.

b. The gap between the slab edge and curtain wall must be smoke sealed at the top of the slab by a galvanised steel smoke flashing with a minimum thickness of 1 mm.

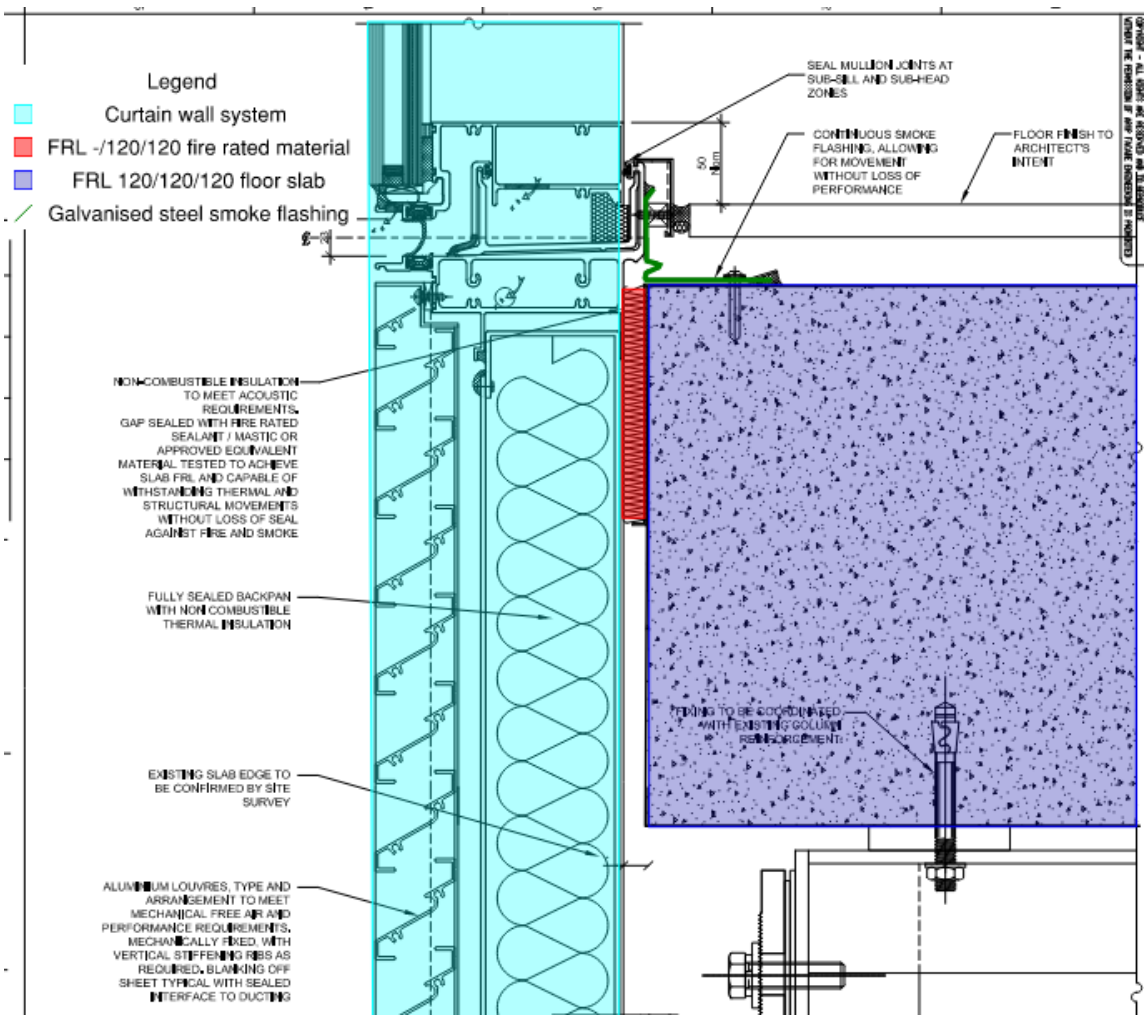


Figure 5 Typical slab edge detail

10. The separation between the retail mall and carpark areas must comprise fire rated construction achieving an FRL of at least 120/120/120 and may include glazed construction provided the following criteria are achieved – refer to Figure 6 to Figure 11:

a. Any bulkheads or parts of the separation above a false ceiling or below a raised floor between the retail and carpark uses must be FRL 120/120/120 fire rated construction.

b. Any glazing within the fire separation between the existing retail mall and carpark shown in Figure 6 – Figure 11 must be protected by wall-wetting sprinklers on both sides in accordance with item 12.

c. The glazing within the fire separation must be toughened and laminated - ie two layers of toughened glass – with a minimum thickness of 2 x 6 mm with a plastic polyvinylbutral (pvb) interlayer not less than 0.38 mm thick.

d. The glass must have polished edges to mitigate the risk of failure of the glass at low temperatures due to imperfections at the glass edge.

e. Frames must be non-combustible with no horizontal transoms or mullions. Butt-joints sealed with an appropriate sealant capable of withstanding at least 150 °C may be used between the individual frameless panes.

f. Bollards and/or wheel stops must be provided around the glazed walls preventing the closest point of vehicles from being parked within 3 m of these walls.

g. Any sliding doors within the glazed separation must automatically close in the event of the activation of the sprinkler system or smoke detection system. In addition:

   i. Smoke detectors must be located within 1.5 m horizontal distance on each side of the sliding doors.

   ii. Any automatic opening device fitted to the sliding doors must be deactivated so that the doors fail safe in the closed position.

h. Where sliding doors also form part of a horizontal exit on levels 00A, 01A and 02, 02A they must be provided with a push to exit button to open the sliding doors in accordance with the following:

   i. The button must be installed in a visible location adjacent to the sliding doors between 900-1100 mm from the finished floor level.

   ii. Signage must be provided to identify the button that states - 'PUSH TO EXIT' - in capital lettering not less than 20 mm high (see Figure 14).

   iii. The doors must return to the closed position after 20 seconds.

11. The level 3 circular void must be separated from the remainder of the level 3 floor area by a bulkhead and glazing assembly in accordance with the following:

a. The occupied floor side bulkhead must be lined with 2 layers of 13 mm fire rated plasterboard, up to the underside of the smoke exhaust plenum.

b. Where the bulkhead is penetrated by structural steel elements, the plasterboard must be neatly cut around the steel elements with the annular gap around the penetration appropriately fire sealed (with a fire resistant mastic or similar).

c. The glazing must be heat-strengthened and provided in accordance with items 10d and 10e.

d. The glazing is to be protected with wall-wetting sprinklers on the level 3 side in accordance with items 12 and 13.

e. The glazing assembly may include a concrete hob at the base.

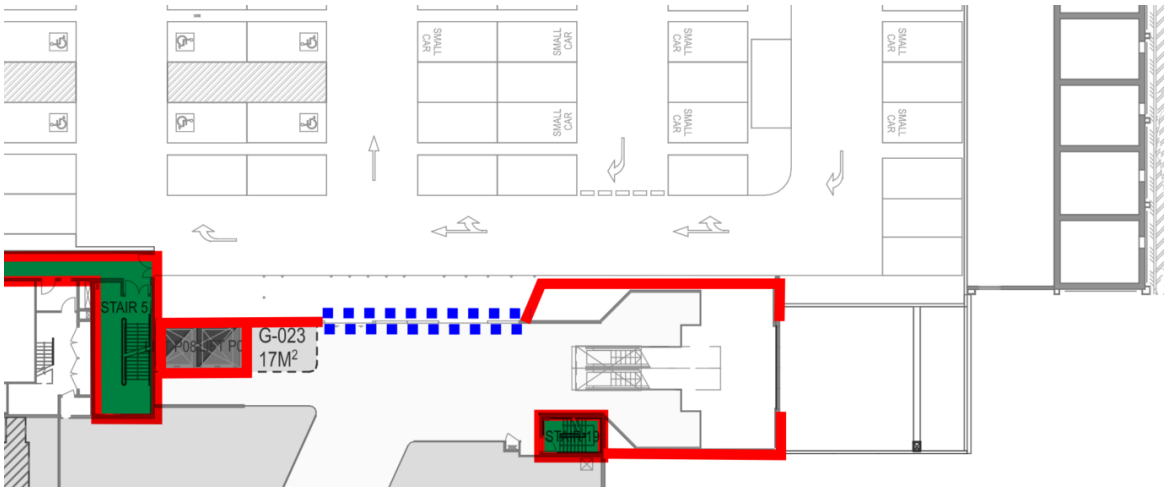
Refer to Figure 12 and Figure 13.

12. The glazing protected by a wall-wetting sprinkler system must be designed in accordance with AS 2118.2:2021 for exposure of hazards and comply with the following requirements:

a. The sprinklers must be quick response with a temperature rating of 68 °C or less.

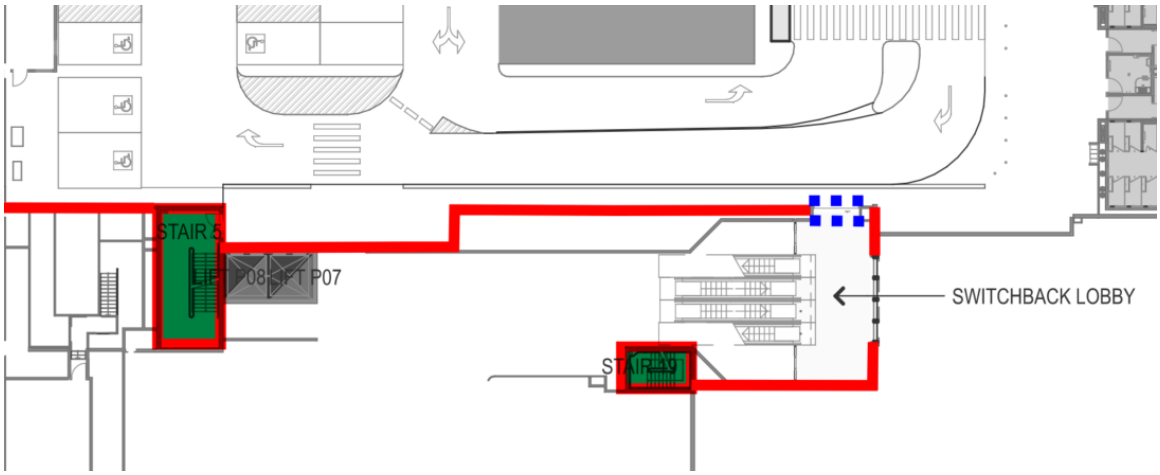
b. The sprinklers must be maintained at a flow rate of not less than 75 L/min per head.

13. The wall-wetting sprinklers in item 12 must be provided with independent stop valves on each level from the sprinkler system. A dedicated sprinkler valve set for wall-wetting sprinklers is to be provided must be provided in the new sprinkler valve room.



Fire separation
Toughened glazing with wall-wetting sprinklers
Fire-isolated exit

Figure 6 Ground level (L00) – Performance based fire separation



Fire separation
Toughened glazing with wall-wetting sprinklers
Fire-isolated exit

Figure 7 Level 00A – Performance based fire separation

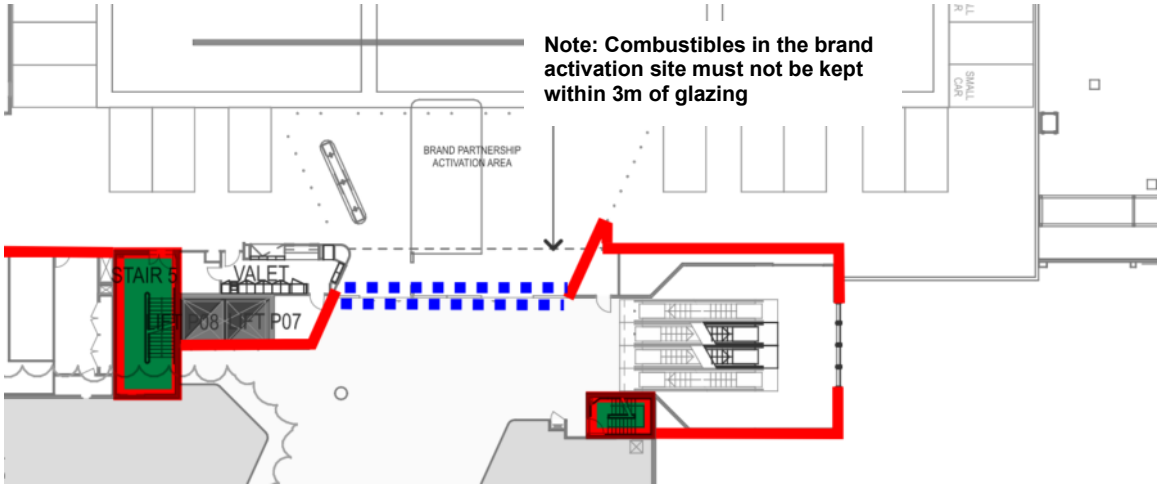


Figure 8 Level 01 – Performance based fire separation

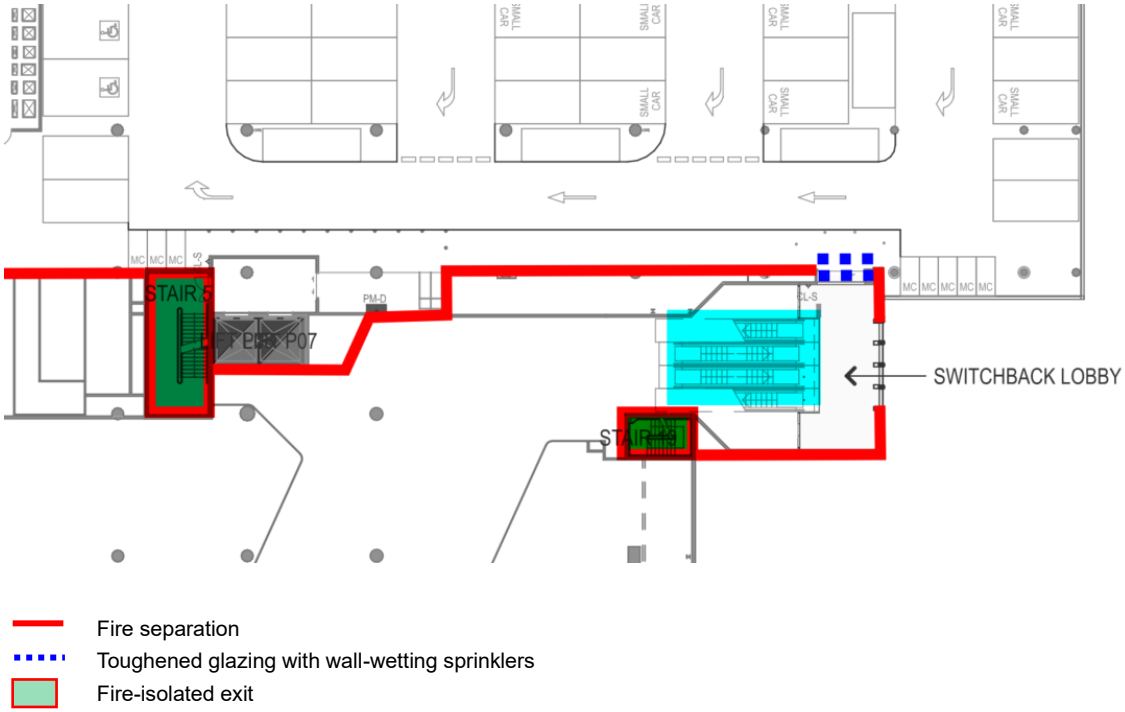
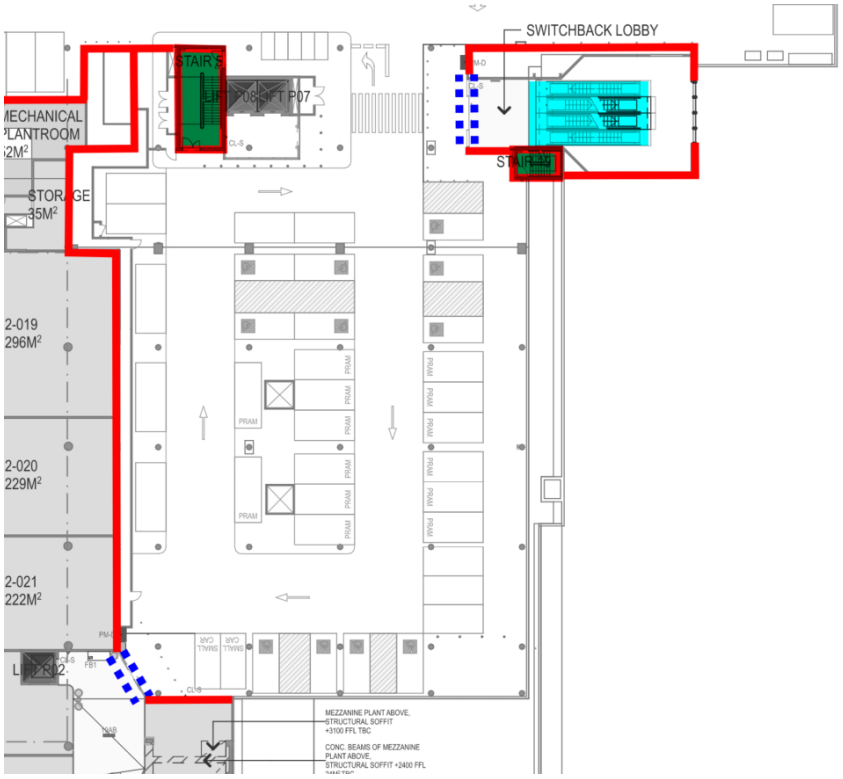
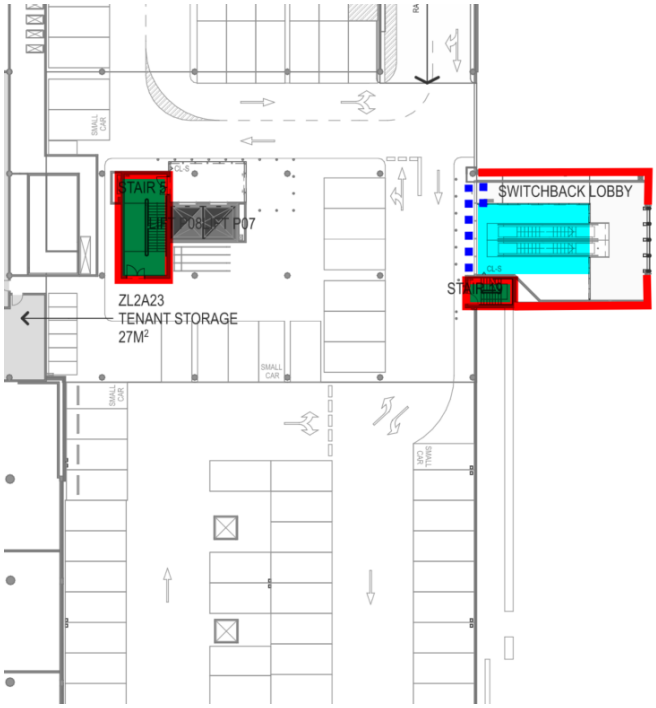


Figure 9 Level 01A – Performance based fire separation



Fire separation
Smoke separation
Toughened glazing with wall-wetting sprinklers
Fire-isolated exit

Figure 10 Level 02 – Performance based fire separation



Fire separation
Toughened glazing with wall-wetting sprinklers
Fire-isolated exit

Figure 11 Level 02A – Performance based fire separation

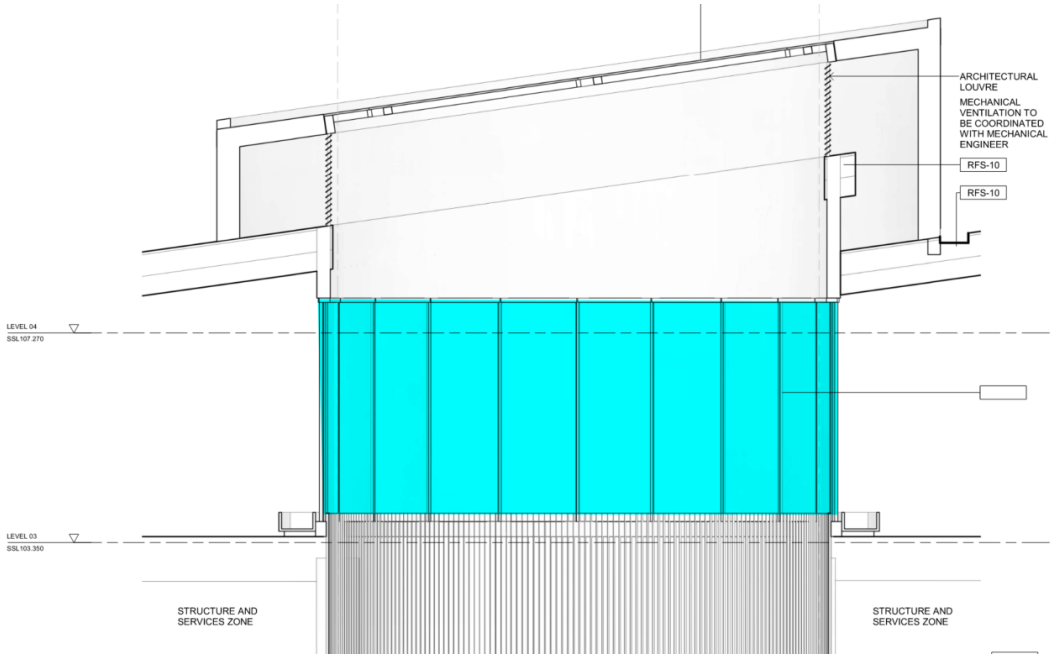


Figure 12 Level 3 – Glazed circular void – heat strengthened glass protected with wall-wetting sprinklers

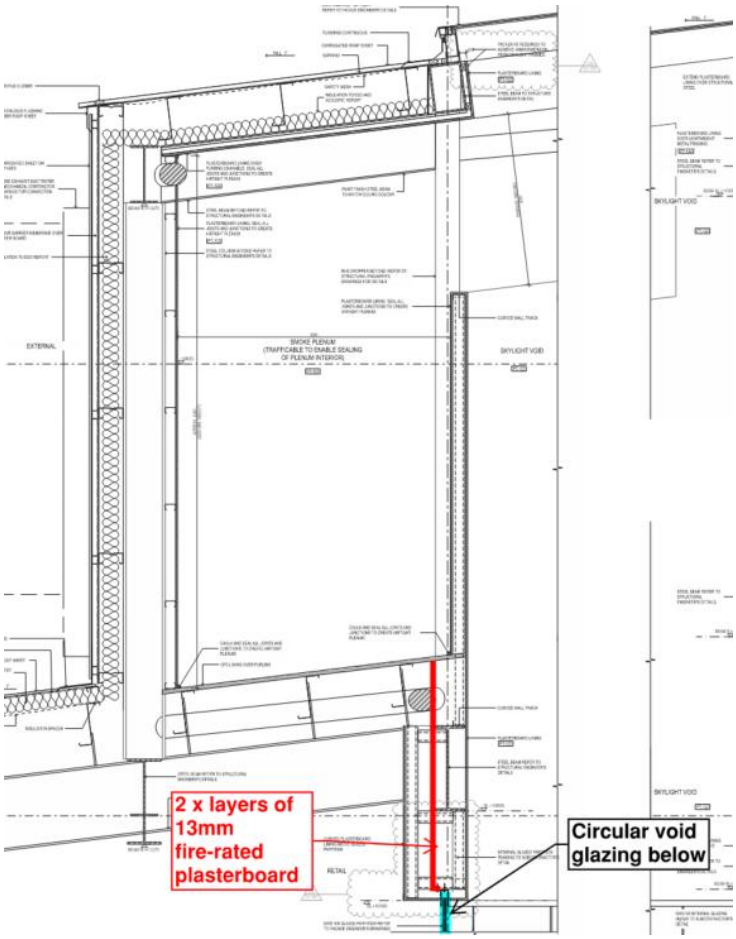


Figure 13 Level 3 – Bulkhead above circular void glazing

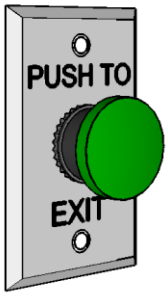


Figure 14 Green push button signage

14. Fire separation is not required between the retail and gym uses and the external carpark (deemed as an occupiable outdoor area) on levels 2A and 3. Building elements within the external carpark requiring an FRL must be located more than 6 m from the external facades of the retail and gym areas on these levels.

15. The level 3 enclosure containing the mechanical switchboard (MSSB) MSR-3 must be fire separated as follows:

    a. The enclosure must be separated from the adjacent gym tenancy by a fire wall achieving FRL 120/120/120.

    b. The enclosure must be separated from the adjacent retail tenancy east by fire-resistant construction. The fire-resistant construction must achieve FRL -/120/120, except that steel roof elements may penetrate the wall. The annular gaps around the steel roof element penetrations must be neatly formed and infilled with an appropriate fire resisting sealant.

    c. For mechanical risers located within the enclosure:

        i. The carpark exhaust risers must be fire-rated to achieve FRL -/120/120.

        ii. The smoke exhaust riser must be fire-rated to achieve FRL -/120/120 to the underside of the roof covering. Any steel roof members that penetrate the fire rating of the riser must be protected with cementitious spray achieving an FRL of 120/-/- for a distance of 500 mm from the connection with the riser.

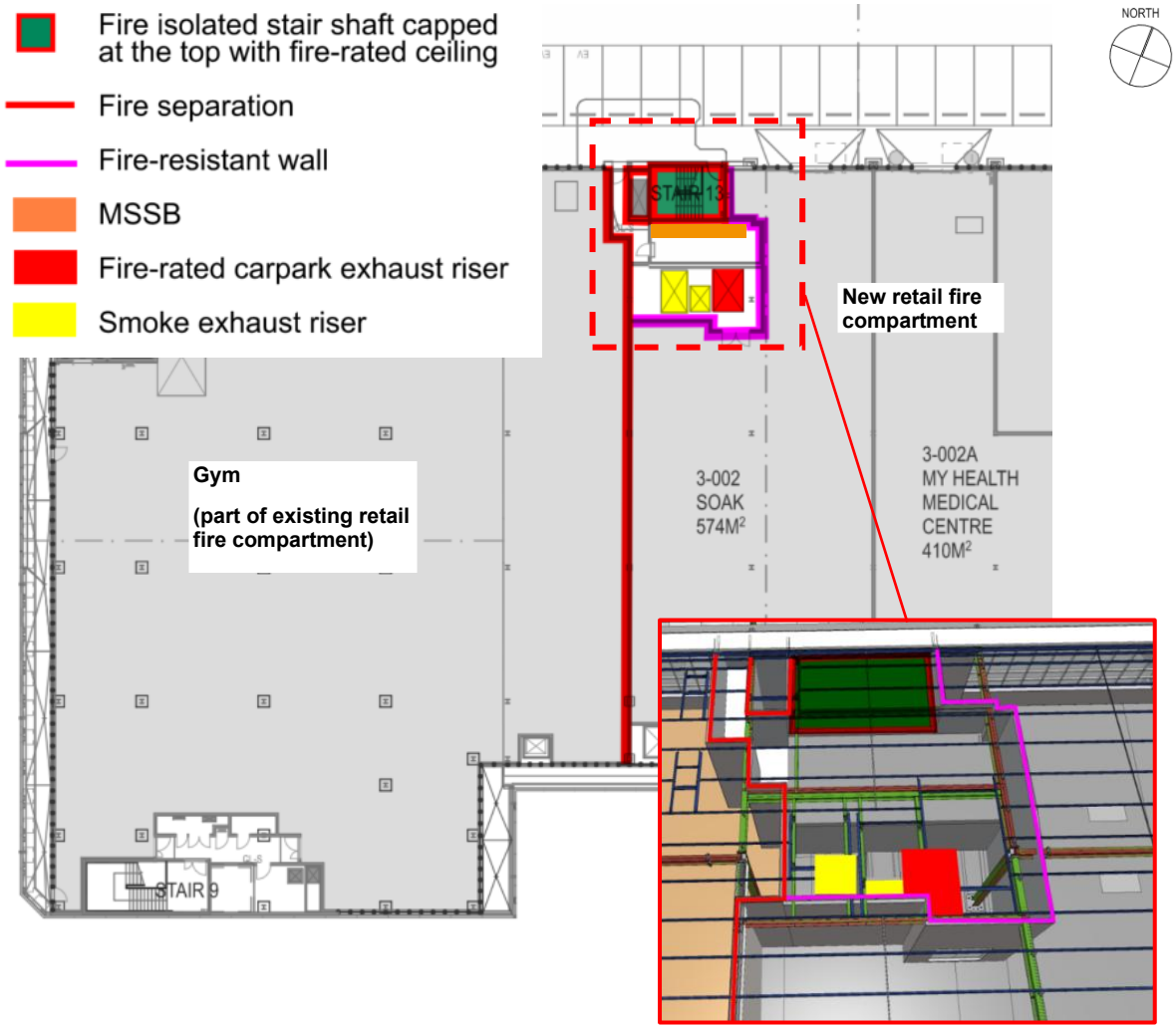


Figure 15 Level 3 – Location of MSSB MSR-3

5.2.3 Protection of openings

16. Penetrations within the level 2 tenancy 2-001 wet area and to the water fountain adjacent (see Figure 16) are not required to be fire protected. The annular gap around the service penetrations and the floor slab must be smoke sealed.

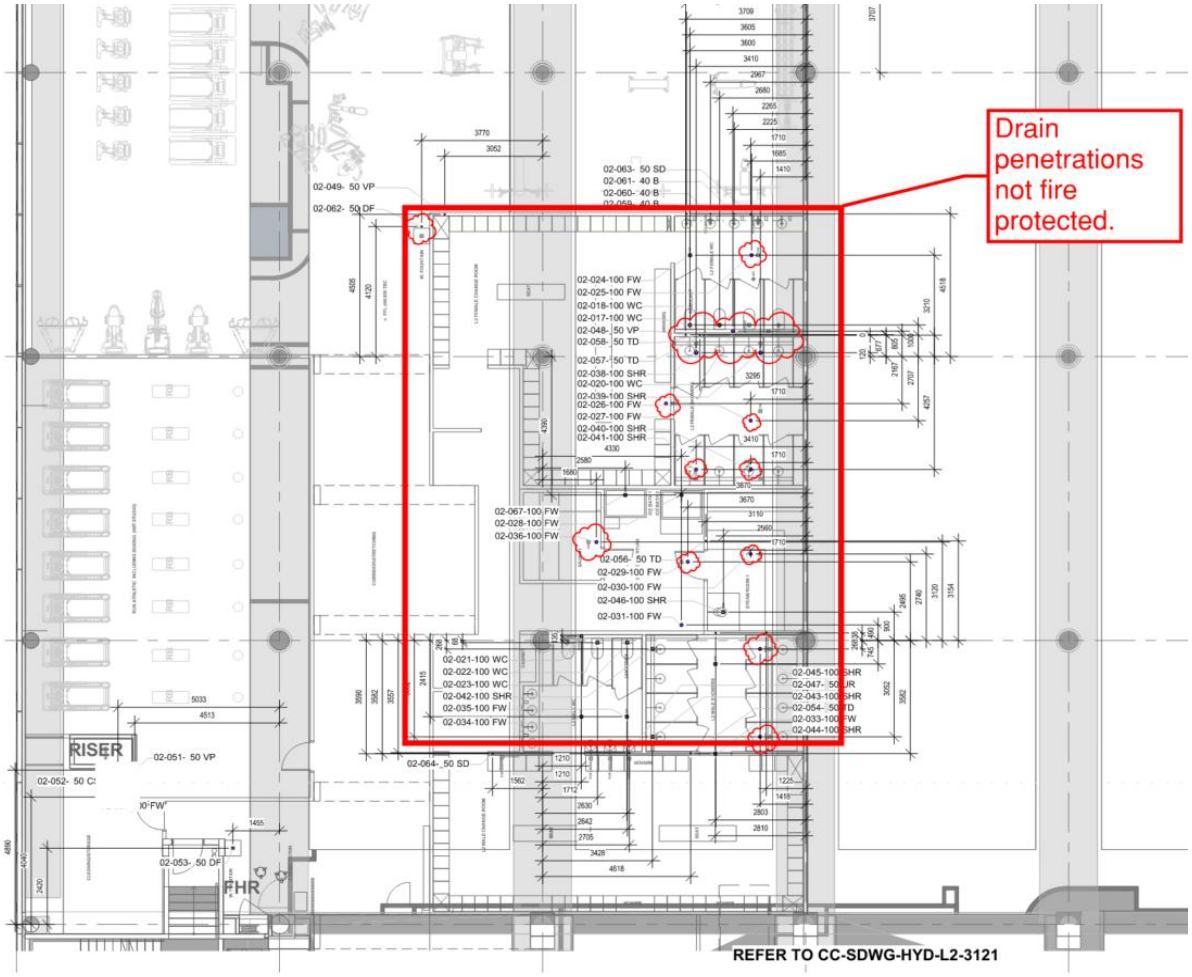


Figure 16 Drainage penetrations within wet areas not protected

17. Sprinkler and hydrant pipes penetrating fire rated floors and walls must be protected in accordance with Clause C4D15 of the NCC, except for the following locations:

    a. Metal sprinkler / hydrant pipes penetrating concrete or masonry fire stair shaft:

        i. Protection to comply with clause S13C3(2) and (4) of specification 13.

        ii. In addition to the fire stopping options identified under Specification S13C7, the annular gap around the metal pipe may be protected with a tested fire-rated sealant capable of achieving an integrity rating of not less than the fire rated wall.

    b. Metal sprinkler / hydrant pipes penetrations through concrete floor slabs within a single fire-isolated stair shaft do not require protection.

18. The level 1 speedramp off-shoot opening located within 3 m of the northern allotment boundary is not required to be protected in accordance with clauses C4D3 and C4D4 of the NCC.

a. The closest carparking bay on this level must be no less than 6 m from the allotment boundary.

b. The northern speedramp parapet wall spanning the full height of the opening must achieve a minimum FRL of -/60/60.

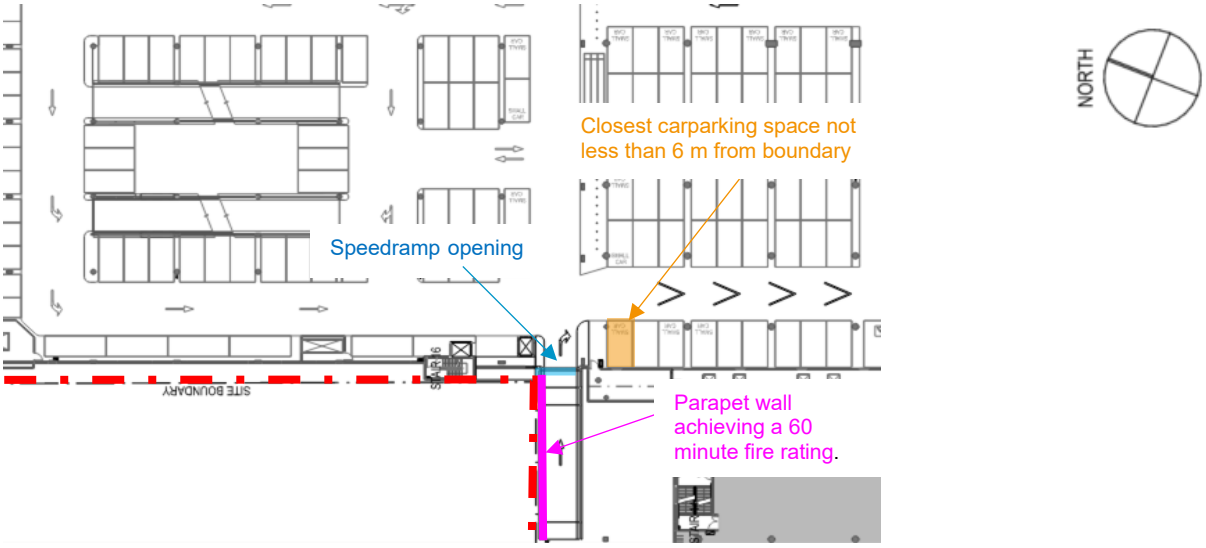


Figure 17 Unprotected speedramp opening

5.3 Evacuation

5.3.1 Provisions of escape

19. Exits within the building must be provided in accordance with Appendix D.

20. The unobstructed widths within fire stairs may be reduced in the following locations:

a. Stair 19 – 750 mm instead of 1 m on level 2A at a localised pinch-point due to hydrant valve installation.

b. Stair 8

i. Level 00 – Reduction to 1200 mm instead of 1500 mm at door from passageway into the stair

ii. Level 02 – Reduction to 1170 mm instead of 1500 mm within the Stair 8 fire-isolated passageway.

c. Reduced width of 1200 mm instead of 1500 mm at a localised area within each Stair 13 scissor stair at the LGA landing (see Figure 18).

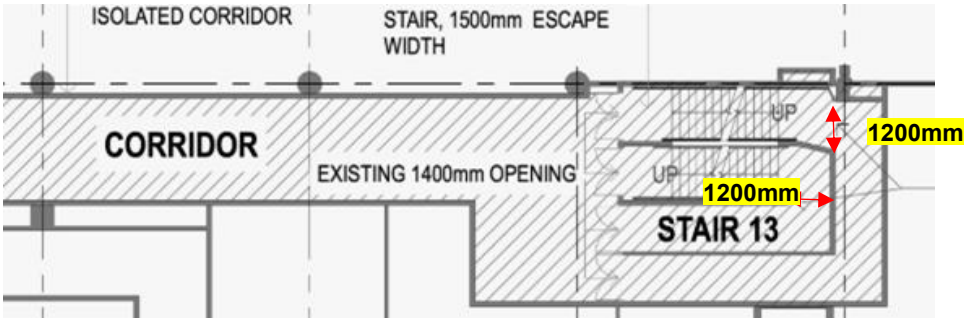


Figure 18 Localised reduction in existing Stair 13

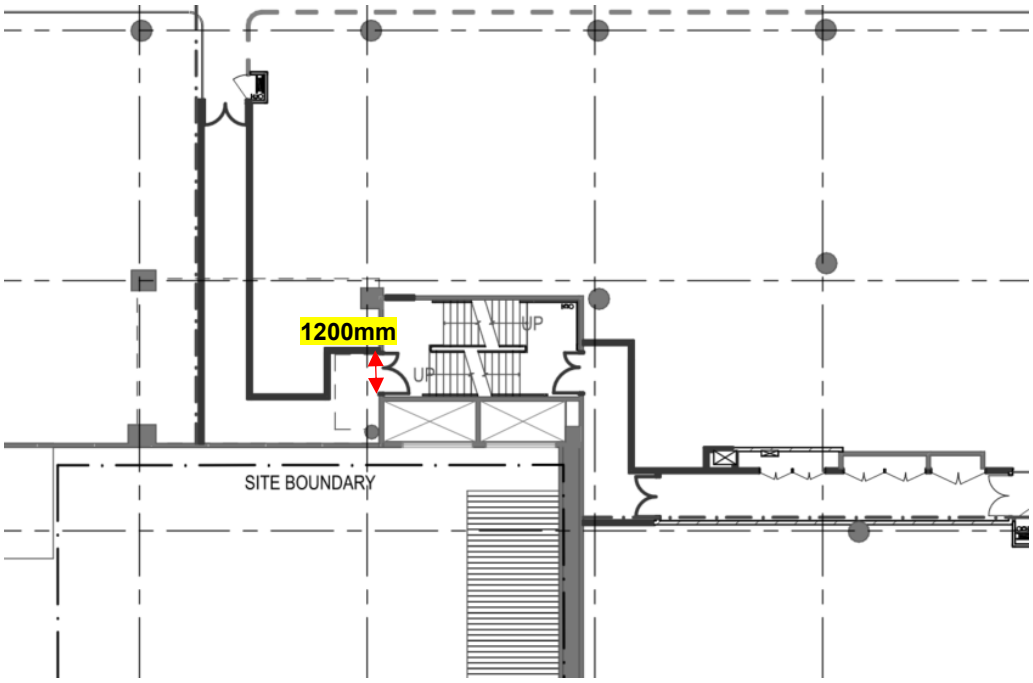


Figure 19 Level 00 – Reduced width to doorway into Stair 8

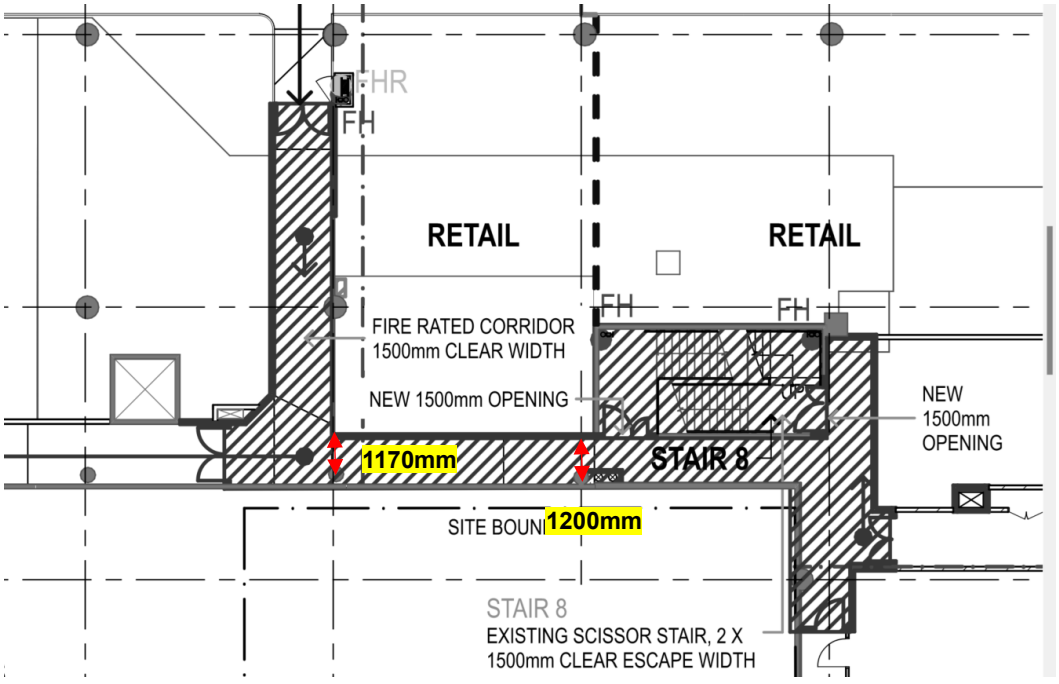


Figure 20 Level 02 – Localised reduction through fire-isolated passageway to Stair 8

21. Access to fire-isolated exit stair 11 must be provided through the David Jones tenancy for occupants in the commercial / common loading dock areas on basement level 2. The following requirements apply:

    a. A secure egress corridor must be provided from the commercial loading dock to stair 11 via the David Jones tenancy as shown in Figure 21.

    b. Signage stating ‘KEEP CORRIDOR CLEAR AT ALL TIMES’ or similar must be provided within the secure corridor to prevent storage in this area. The lettering must be not less than 50 mm high in a colour contrasting with that of the background.

c. The door leading to the secure corridor from the commercial loading dock is permitted to be locked provided that it unlocks automatically upon fire alarm in the building.

d. This path of travel to stair 11 via the secure corridor within the David Jones tenancy must be listed as an essential fire safety measure on the building's fire safety schedule to ensure it is inspected as part of the annual fire safety statement renewal process.

e. The requirements relating to this path of travel to stair 11 must be included in the David Jones tenancy agreement / operational manuals.

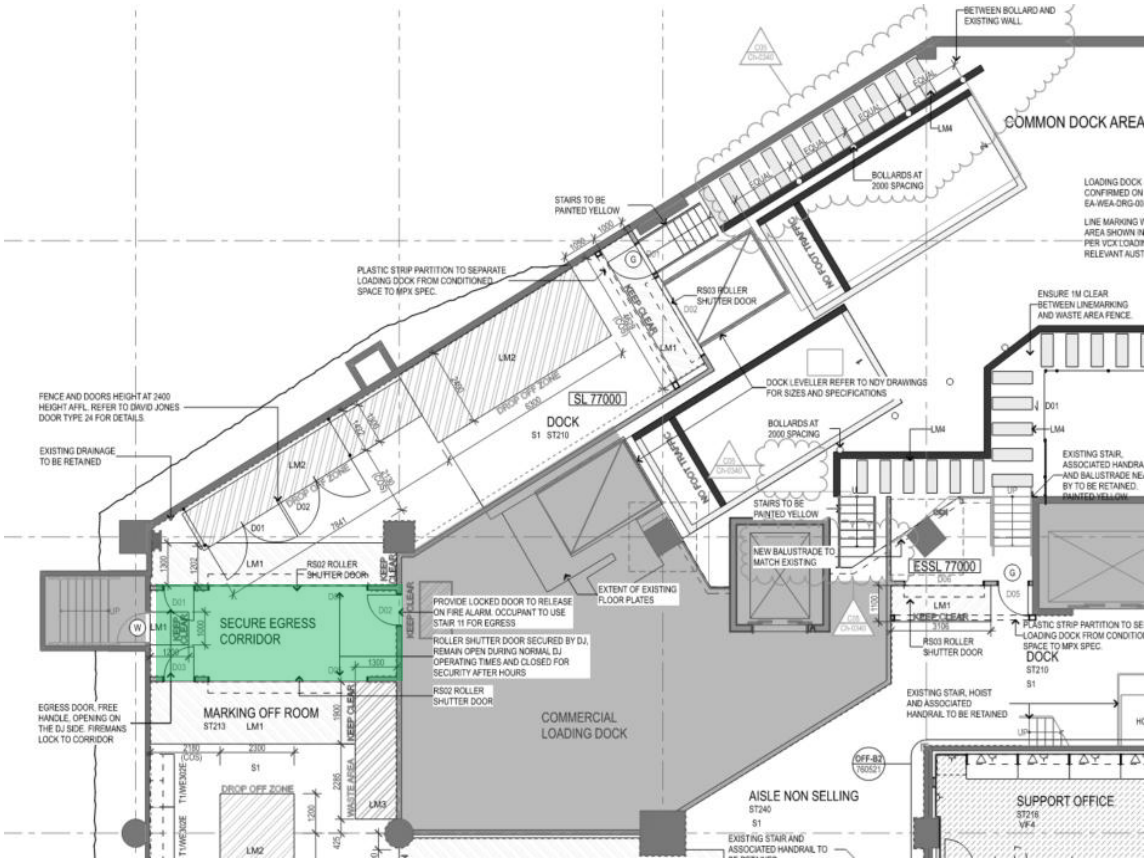


Figure 21 Secure egress corridor from commercial loading dock to stair 11

22. The following requirements apply to the existing non-fire-isolated exit ramp in the northern portion of the basement 2 loading dock:

a. The gradient of the ramp must be confirmed to be no steeper than 1:8.

b. Floor markings must be provided throughout the path of travel from the base of the ramp at basement level 2 to fire-isolated exit stair 16 at lower ground level. Floor markings with the following characteristics are recommended:

i. The width of the path of travel marked on the floor must be not less than 1 m.

ii. Yellow non-slip paint markings comprising diagonal lines within a border as shown in Figure 22 must be provided.

c. An exit sign must be provided at the base of the ramp on basement level 2, identifying the ramp as an exit from this level.

d. A standard swinging door complying with clause D3D25 and the operation of latch requirements of clause D3D26 of the NCC must be provided for afterhours access to

the exit ramp when the roller shutter at the base of the ramp is in the closed position. An exit sign must be provided above this door.

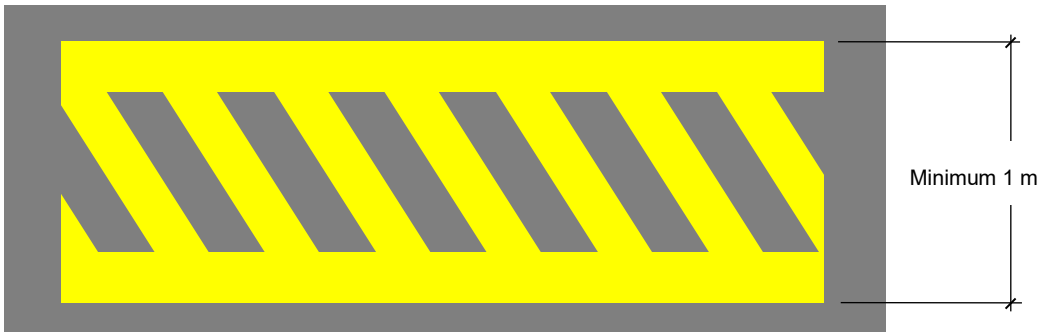


Figure 22 Floor line marking for path of travel

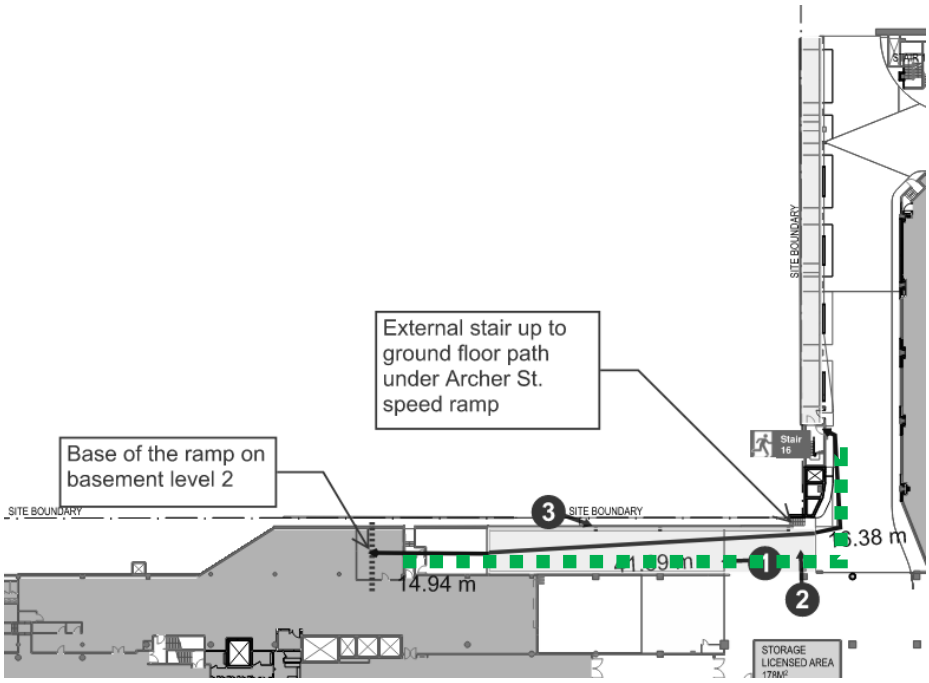


Figure 23 Indicative marked path of travel from base of ramp to Stair 16

5.3.2 Construction of exits

23. Doorways opening directly into fire-isolated exit stairs or fire-isolated exit passageways from retail tenancies must be protected with self-closing or automatically closing FRL -/60/30 fire doors fitted with smoke seals. The smoke seals must:

    a. be tested in accordance with AS 1530.7:2007 to meet the smoke leakage rates specified in AS 6905:2007

    b. be medium temperature rated – ie capable of resisting exposure to 200°C for 30 minutes

    c. be fitted to all sides of the door leaf including under the bottom edge.

5.3.3 Discharge of exits

Fire-isolated stairs 5, 10, 13 and 15

24. The following fire-isolated stairs are permitted to discharge via a common fire-isolated passage:
    a. Stairs 5 and 15 merge into a common 1.6 m wide passage at level 00 and discharge to the northern boundary.
    b. Stairs 10 and 13 are connected by a common fire-isolated passage at level LGA before discharging to Archer Street.

25. Appropriate wayfinding signage should be provided to Stairs 10 and 13 at lower ground level to direct occupants to the discharge to Archer Street at ground level.

Fire-isolated stair 4

26. The existing yellow line marking and ‘KEEP CLEAR’ signage on the floor in the lower ground level loading dock into which fire-isolated stair 4 discharges must be maintained – refer to Figure 25 and Figure 26. This requirement must be identified as an essential fire safety measure on the building’s fire safety schedule and inspected as part of the annual fire safety statement renewal process.

27. Bollards must be provided as appropriate where stair 4 discharges in the loading dock to prevent parked vehicles from obstructing occupant evacuation. A 1.5 m wide path of travel (to match the stair width) must be maintained from the discharge location of stair 4 to open space on the eastern side of the building leading to the alternative path of travel northwards.

28. An alternative path of travel must be provided from the discharge location of stair 4 in the northward direction along the eastern perimeter of the building leading to Havilah Street to the east as shown in Figure 24. The path of travel must be a flat, trafficable surface not less than 1 m wide.

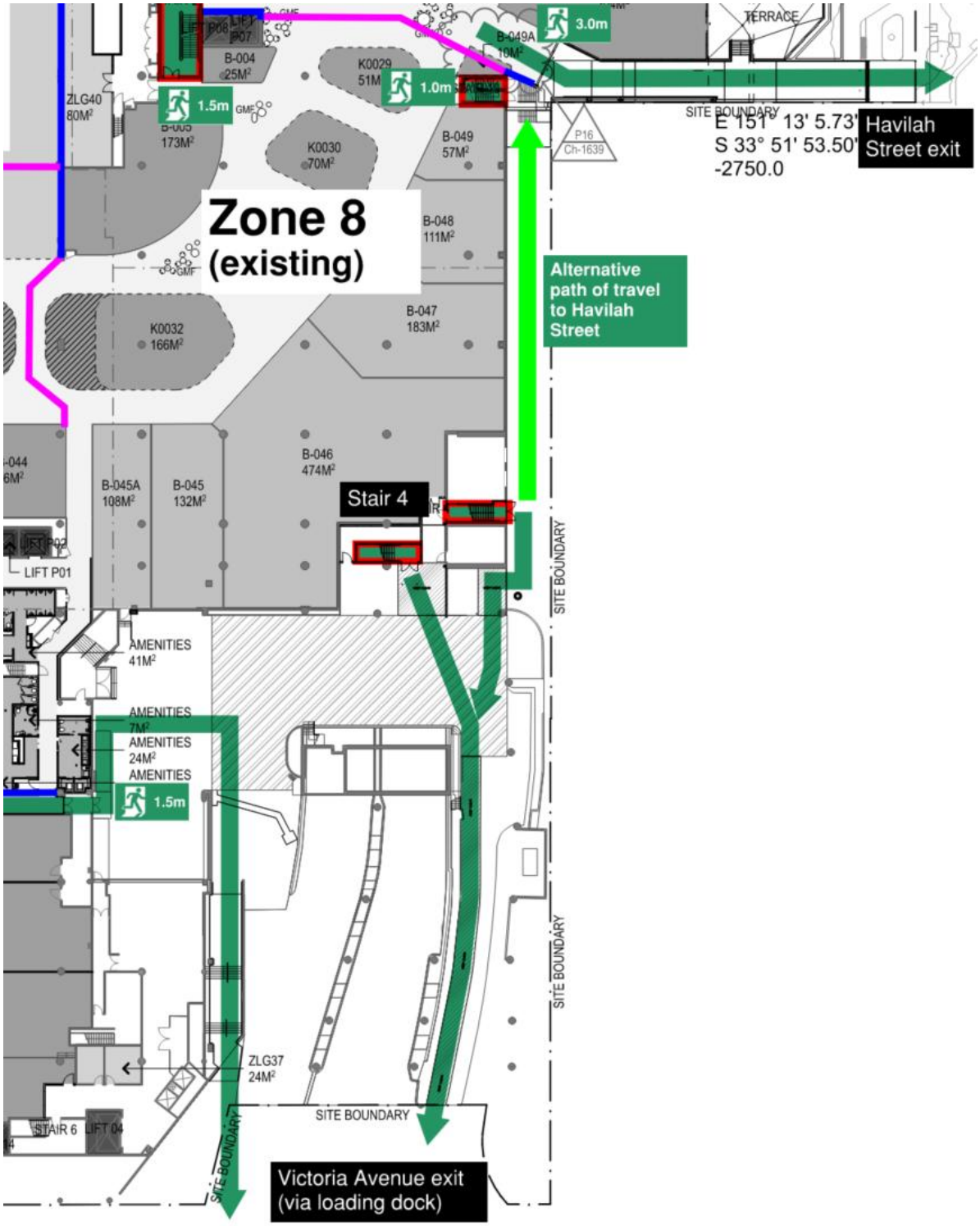


Figure 24 Discharge of fire-isolated stair 4 at lower ground level

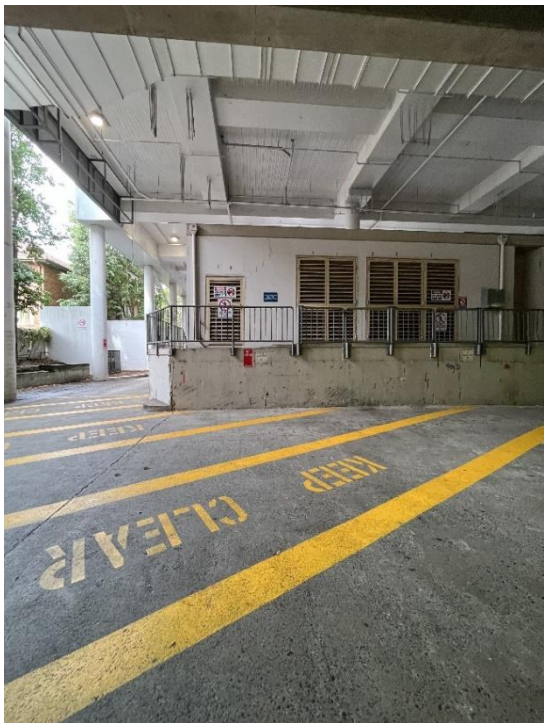


Photo 1



Photo 2

Figure 25 Photos of loading dock at the discharge of fire-isolated stair 4

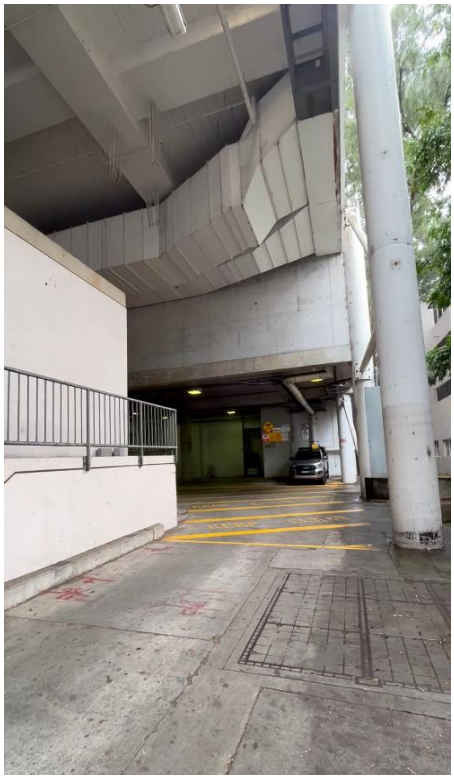


Photo 3

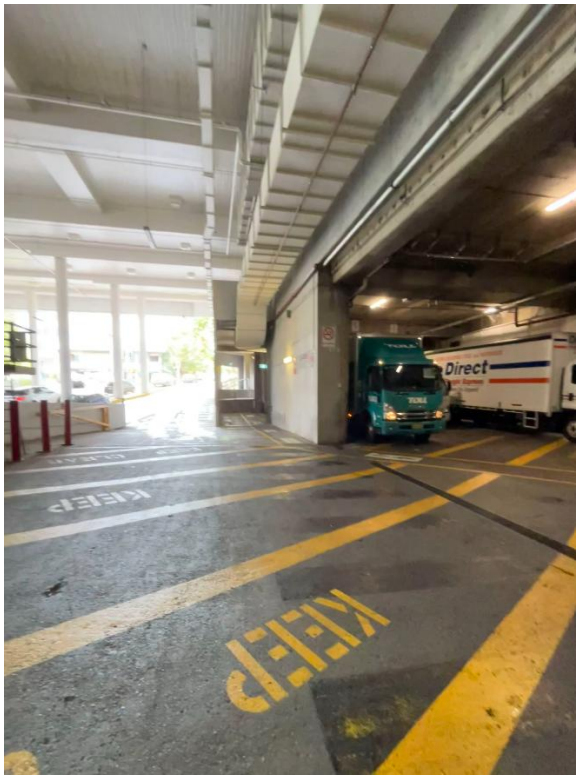


Photo 4

Figure 26 Photos of loading dock at the discharge of fire-isolated stair 4

Northern boundary under Archer Street speed ramp

29. The existing linear heat detection system must be maintained beneath the Archer Street speed ramp to provide full coverage to the northern discharge area, as per the existing NDY fire engineering report (2014). Activation of the existing linear heat detection system shall:
    a. Provide a notification to the Fire Indicator Panel (FIP)
    b. Provide a notification to the fire brigade
    c. Provide a notification to building security in the security control rooms

30. The linear heat detection system shall not initiate the Emergency Warning and Intercommunication System (EWIS) in the centre. Trained security staff or the fire brigade shall determine if it is necessary to evacuate the centre in the event of a fire beneath the ramp following investigation. The procedures for investigating a fire below the ramp are to be documented in the building's emergency management plan.

31. The path of travel along the northern boundary egress to Archer Street must achieve a minimum width of 2.8 m width throughout. This path must be delineated with line markings in accordance with Figure 22.

32. Floor markings are to be provided along the path of travel in the northern discharge area under the Archer Street speed ramp to guide occupants to Archer Street. The floor markings must be in accordance with item 22(b) and Figure 22.

33. Any openings within the northern external wall that is less than 3m above the path of egress to the road must be protected to maintain the integrity and insulation rating of the wall.

34. Additional wayfinding must be provided at the discharge of the ground floor fire-isolated passageway into which stairs 5 and 15 connect, to indicate to evacuating occupants the availability of alternative exits within the carpark if the path of travel to the road through the northern boundary is obstructed. Refer to Figure 27. The following requirements apply:
    a. Signage must be provided at the discharge as shown in Figure 27. The words 'USE EXITS WITHIN CARPARK IF EXTERNAL PATH IS OBSTRUCTED' must be in capital letters not less than 50 mm high in a colour contrasting with the background.
    b. Exit and direction signage must be provided such that the location of the two nearby exits within the carpark are made obvious to occupants discharging from the fire exits.

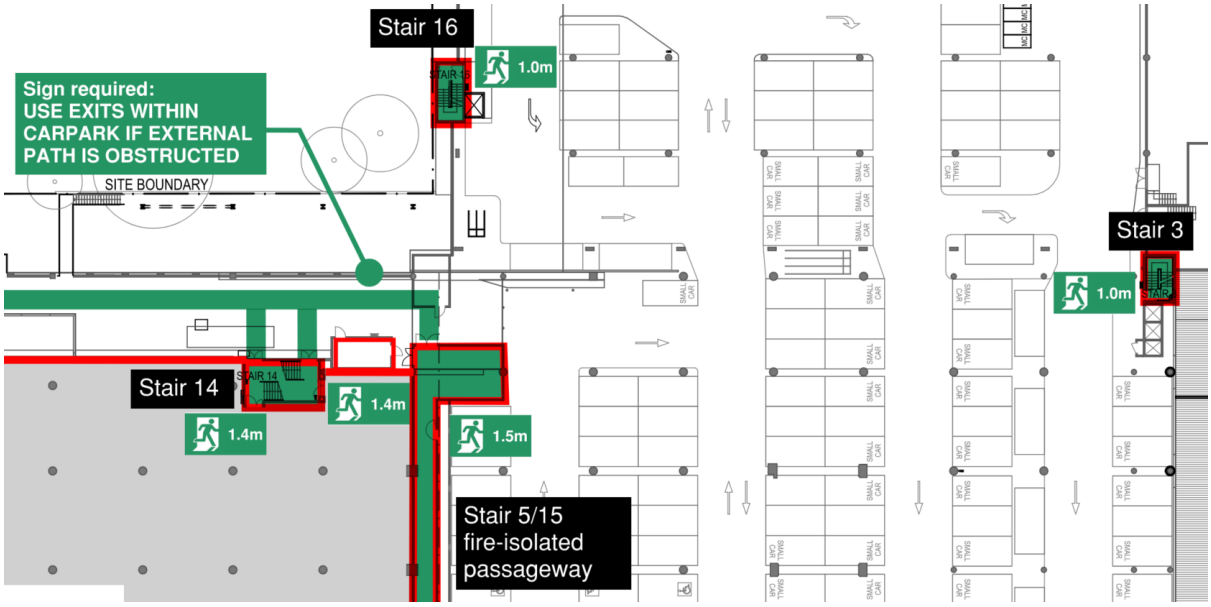


Figure 27 Discharge at ground floor for Stairs 5/15 - alternative egress into the carpark

5.4 Firefighting equipment

5.4.1 Fire hydrant and fire hose reel system

35. A fire hydrant system must be installed throughout the building in accordance with clause E1D2 of the NCC and AS 2419.1:2021, unless specifically stated.

36. Where hydrant coverage cannot be achieved using internal hydrants located within fire-isolated stairs and adjacent to exits, additional internal hydrants are to be located as follows:

    a. No point on the floor required to be protected shall be more than 40 m from an internal hydrant.

    b. Additional hydrants must be within mall areas or paths of travel to exits.

    c. Additional hydrants must be not more than 25 m from an internal fire hydrant within a fire-isolated stair, or within 4 m of a required exit.

    d. If full coverage cannot be achieve using a single additional hydrant, any subsequent hydrants must be located within 25 m of an internal hydrant complying with item (c) above.

    e. Additional hydrants must not be located within tenancies unless that tenancy is directly served by a fire-isolated exit or an exit discharging directly to a road or open space.

    f. Location plans are to be provided adjacent to each internal hydrant in accordance with clause 11.6 of AS 2419.1-2021.

    Note: With the exception of the attack hydrant located at the fire hydrant booster assembly, external hydrants are generally not provided to the building. The fire services designer has confirmed that this design does not rely of external hydrants being provided to achieve system coverage and compliance with AS 2419.1-2021.

37. Hydrant coverage to tenancy G-001 may be achieved using two hose lengths via the internal hydrant located within the Victoria Avenue entrance lobby – refer to Figure 28. Signage must be provided at this internal hydrant to clearly identify that two lengths of hose are required to achieve full coverage to tenancy G-001.

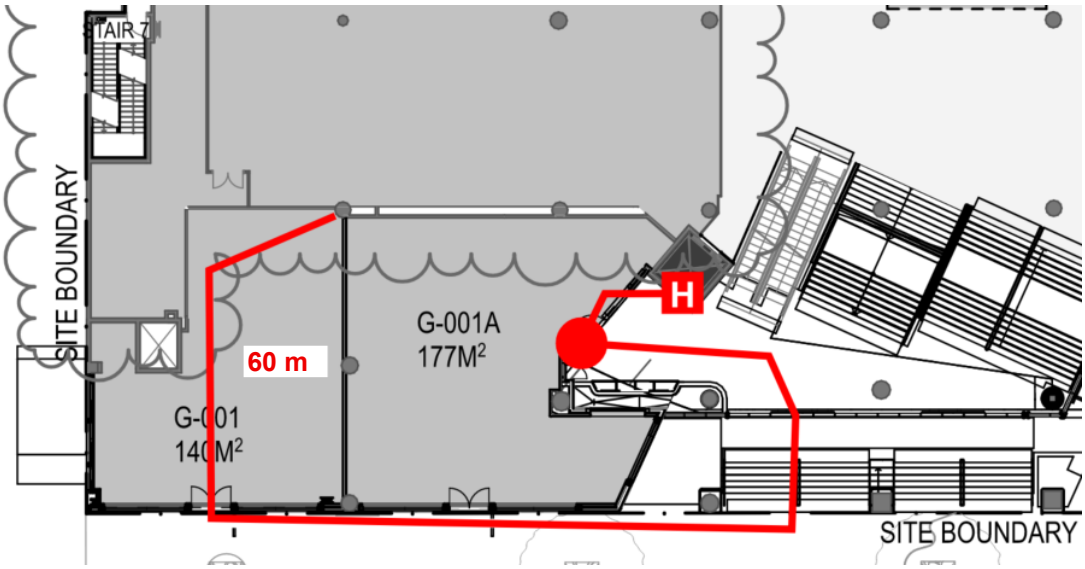


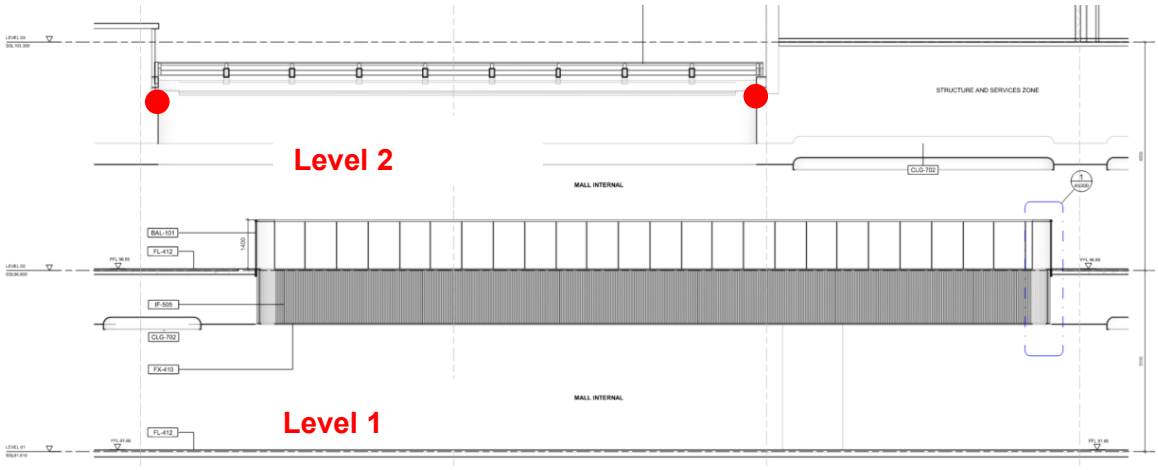
Figure 28 Tenancy G-001 – Two hose lengths for hydrant coverage and no fire hose reel coverage

38. Ring main isolation valves may be located outside of fire-isolated stairs within the basement 1 carpark, subject to the following requirements:
    a. Isolation valves within the basement level 1 carpark area must be located at least 2 m above floor level.
    b. The location of isolation valves must be clearly identified on the hydrant block plans for the building.
39. The booster must be identified by a red strobe light which is activated by an alarm signal from the FDCIE.
40. Block plans must be provided at the booster assembly, at the FDCIE and within the Victoria Avenue mall entrance indicating the location of the key firefighting equipment on the site - ie the booster assembly, FDCIE and hydrant locations. These plans must be minimum A3 size, oriented according to the location and provided with 'YOU ARE HERE' indication.
41. A fire hose reel system must be installed throughout the building in accordance with clause E1D3 of the NCC and AS 2441:2005, with the exception of tenancy G-001 where coverage is not proposed – refer to Figure 28.
42. Portable fire extinguishers must be provided as listed in clause E1D14 of the NCC and must be selected, located and distributed in accordance with sections 1, 2, 3 and 4 of AS 2444:2001. Tenancy G-001 must be provided with 4.5 kg ABE type fire extinguishers in both the front and back of house areas.

5.4.2 Sprinkler system

43. A sprinkler system in accordance with the requirements of specification 17 of the NCC and AS 2118.1:2017 must be provided throughout the new areas of the building. The existing sprinkler system in accordance with AS 2118.1-1999 is to be maintained in areas that are not impacted by the new works.
44. The new sprinkler system must have the following additional characteristics:
    a. All sprinkler heads must be quick response.
    b. Activation temperature of 68 °C except where otherwise required by AS 2118.1:2017.
    c. Concealed, recessed or flush-mounted sprinkler heads must not be used. Semi-recessed sprinkler heads are permitted where they achieve a quick response rating.
    d. The sprinkler system must be permanently connected with a direct data link or other approved monitoring system to a fire station or fire station dispatch centre in accordance with AS 2118.1:2017.
    e. Sprinkler valves must be provided to permit each level, and major / mini-major tenancy exceeding 1000 m^2, to be isolated separately. The intent of this requirement is to prevent large areas of a single floor being unprotected at any one time.
    f. Fire alarm monitoring system connected to a fire station dispatch centre in accordance with S20C8 and AS 1670.3 is to be provided. The protected premises address for alarm response must be identified as Victoria Avenue to ensure brigade personnel turn out to the correct side of the building.
45. Sprinklers are not required to be provided in the following locations:
    a. The Victoria Avenue and Archer Street external covered entry areas – see Figure 31 and Figure 32.
    b. The skylight roof over the central atrium void.
    c. The skylight roof over the Victoria Avenue atrium void.

46. Sidewall sprinklers provided the linear void connecting levels 1 and 2 may be installed a maximum of 340 mm below the skylight ceiling instead of 150 mm – refer to Figure 29.



● Indicative sidewall sprinkler location – maximum 340 mm below ceiling

Figure 29 Linear void

47. The new sprinkler valve room and extended hydrant pump room are accessed from the lower ground floor loading bay entry off Victoria Avenue. The following requirements apply:

    a. The new sprinkler valve room and extended hydrant pump room must be identified on the hydrant block plans at the booster assembly. Hydrant block plans must also be provided in the fire control centre, hydrant pump room, sprinkler pump rooms, and sprinkler valve enclosures.

    b. The path of travel to the subject services rooms must be indicated with the appropriate wayfinding signage and directional plaque signs so that fire fighters are able to reach the rooms in an efficient manner.

48. The fire hydrant pump room and new sprinkler valve room must be accessed from a fire-isolated corridor. Services rooms making a direct connection to the fire-isolated corridor must be provided with smoke seals. Refer to Figure 30.

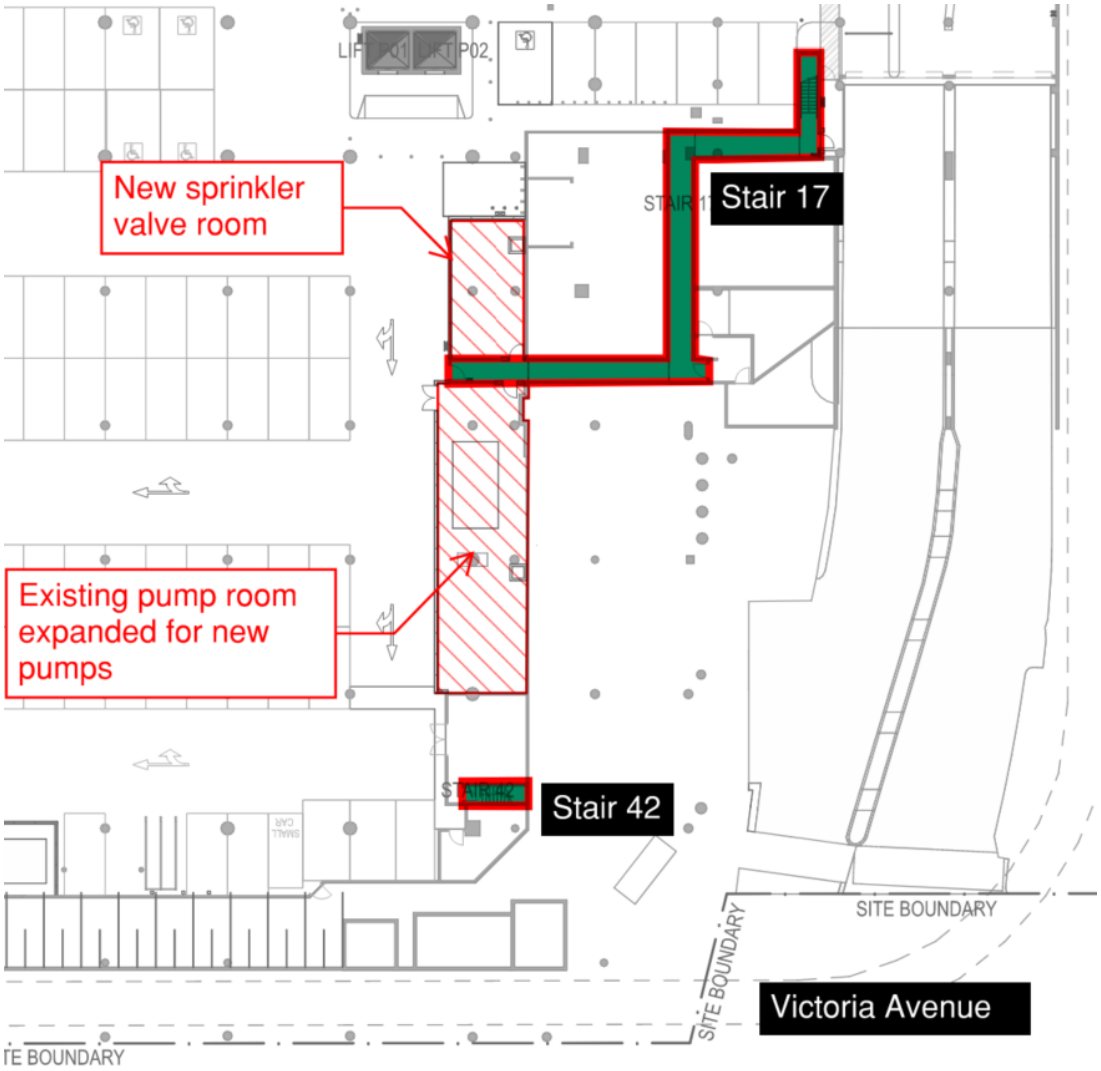


Figure 30 Basement level 1 services rooms

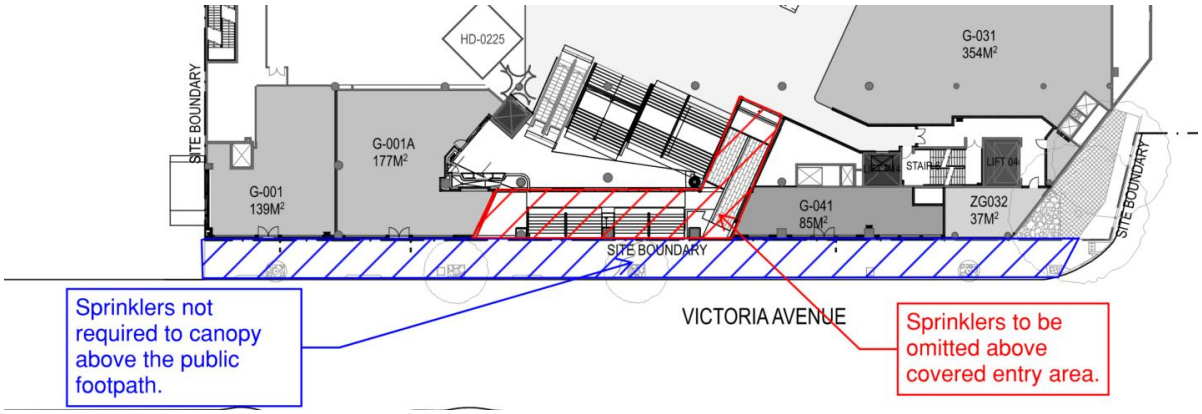


Figure 31 Victoria Avenue entry area where sprinklers are to be omitted

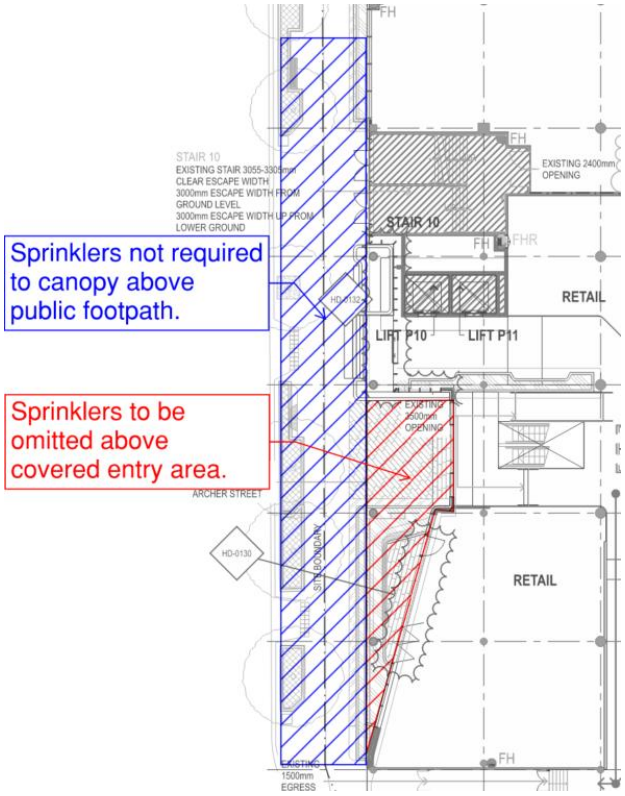


Figure 32 Archer Street entry area where sprinklers are to be omitted

5.4.3 Standby power supply

49. An alternative power supply is to be provided to operate required safety system serving the atrium (retail) fire compartment in accordance with clause S31C20 in specification 31 of the NCC, except for mechanical air handling units providing makeup air to the atrium smoke compartment.

50. Mall entries and casement windows providing makeup air to the building must automatically open on activation of smoke exhaust. The automatically opening function must be provided with battery backup in accordance with clause S31C20 in specification 31 of the NCC.

51. Alternative power to the new sprinkler and hydrant pumps, smoke exhaust fans and stair pressurisation systems serving the atrium / retail fire compartment is supplied via a generator located on level 2A. The generator must—

    a. be located in the northern corner of carpark level 2A as shown in Figure 33, and

    b. be capable of providing backup power for a duration of not less than 4 hours, and

    c. be connected automatically if the normal power supply fails; and

    d. be connected to the safety systems by means of cabling complying with C3D14(3) of the NCC.

    Note: The generator room is not required to be fire separated from the carpark.

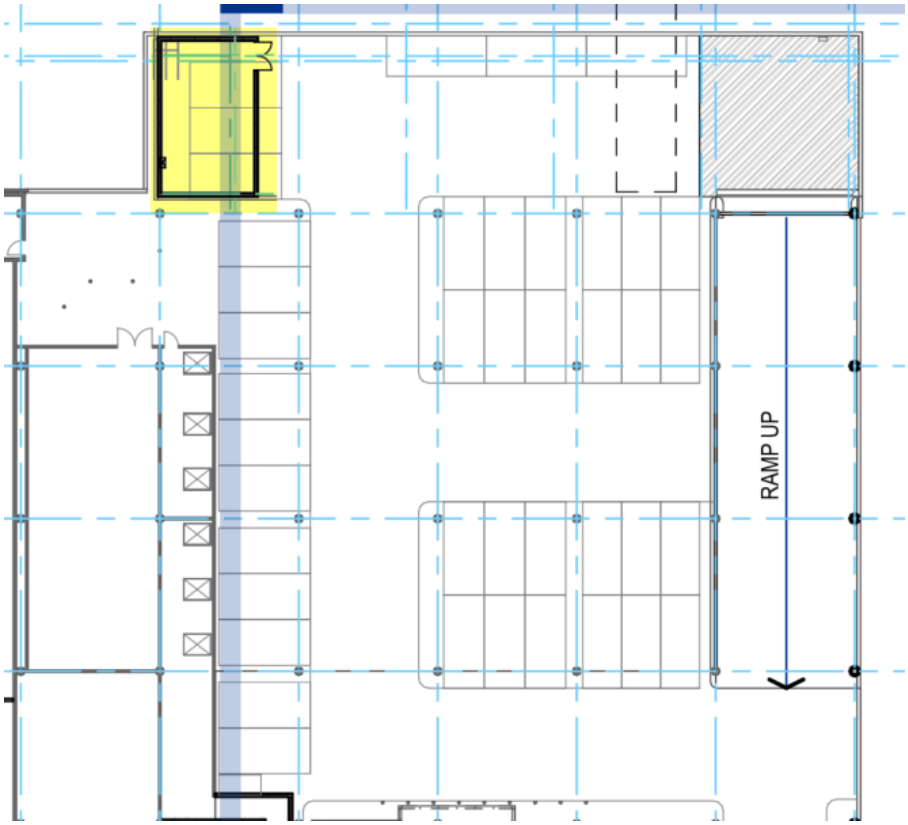


Figure 33 Location of generator room on level 2A north

5.5 Smoke hazard management

5.5.1 Smoke detection

52. A smoke detection system must be installed throughout the new and refurbished retail areas – including the mall, major and specialty tenancies – to activate the smoke exhaust systems in accordance with specification 20 and S20C6 of NCC 2022. The smoke detectors must:

    a. Be spaced not more than 20 m apart and not more than 10 m from any wall, bulkhead or smoke curtain

    b. For specialty tenancies at least one detector must be provided in each tenancy.

    c. In enclosed malls and walkways, be spaced not more than 15 m apart and not more than 7.5 m from any wall, bulkhead or curtain.

    d. Have a sensitivity not exceeding 0.5% smoke obscuration perimeter with compensation for external airborne contamination as necessary in a multi-storey walkway and mall.

    e. Form part of a building fire or smoke detection system complying with AS 1670.1:2018 or be a separate dedicated system incorporating control and indicating equipment complying with AS 1670.1:2018.

    f. Activate an emergency warning and intercom system (EWIS) installed in accordance with AS 1670.4:2018.

    g. Be connected to a fire alarm monitoring system connected to a fire station or fire station dispatch centre in accordance with AS 1760.3:2018.

    Note: Smoke detectors are not required within ceiling voids or other concealed spaces separated from the occupied areas.

53. Retail tenancies and BOH storage areas on levels 01 and 02 that incorporate extended travel distances to a point of choice or exit of up to 30 m must be provided with additional smoke detectors spaced in accordance with section 5 of AS 1670.1:2018. This requires the smoke detectors to be located as follows:

    a. For level surfaces, detectors shall be arranged so that the distance from any point on the level surface of the protected area to the nearest detector does not exceed 7 m.

    b. The distance from any detector and the nearest detector to it shall not exceed 10 m.

    c. The distance from the nearest row of detectors to any wall or partition shall not exceed 5 m or be less than 300 mm.

    d. The smoke detectors must:

        i. be compatible with and fully integrated within the building's smoke detection system and connected to the building's FDCIE.

        ii. Operate the smoke hazard management systems and activate the EWIS.

54. Smoke detectors must be provided throughout the centre management office (CMO) portion of level 3 in accordance with the following requirements:

a. At least one detector shall be provided in every room throughout the class 5 part of the building, except smoke detectors are not required in kitchens and other areas where the use of the area is likely to result in smoke detectors causing spurious signals.

b. Smoke detectors below the ceiling must be arranged as follows – consistent with the requirements of section 5 of AS 1670.1:2018:

   i. The distance from any point on the level surface of the protected area to the nearest detector does not exceed 7 m.

   ii. The distance from any detector and the nearest detector to it shall not exceed 10 m.

c. The distance from the nearest row of detectors to any wall or partition shall not exceed 5 m or be less than 300 mm.

55. The internal roof plant areas on level 3 must be provided with at least one smoke detector in each room.

56. The smoke detection and EWIS infrastructure serving the area of new works is to comply with AS 1670.1:2018 and AS 1670.4:2018, except that existing cabling that will be retained does not have 'ELV Fire' labelling where not installed within a cable conduit. The cabling must be provided with the red outer sheath as per clause 3.24.3 of AS 1670.1-2018.

5.5.2 Smoke exhaust

57. The retail portion of the building is provided with a performance-based smoke exhaust system. The mall must be divided into smoke zones per level as described in Table 10 and illustrated in Figure 34, Figure 35 and Figure 36.

a. Any new tenancies with a floor area of more than 1000 m^2 and less than 2000 m^2 opening into an enclosed portion of the mall must form their own smoke compartment and be provided with their own independent smoke exhaust system in accordance with E2D3 and specification 21 of the NCC.

b. Minor storage, amenities areas etc. are excluded from smoke exhaust requirements.

c. Back of house areas separated from the retail trading floor by full height construction which prevents the free passage of smoke are not required to be provided with smoke exhaust.

Table 10 Smoke zoning and exhaust provisions

Smoke zone	Location	Exhaust	Makeup air from adjacent zones	Comment
11	Level 00 Archer Street Mall	30 m^3/s	All mall entry doors open	On-floor exhaust via ceiling coffer details, with exhaust points distributed within ceiling plenum space above the mall. Refer to Figure 34.
12	Level 01 and 02 Archer Street Mall	Level 01 – 20 m^3/s Level 02 – 30 m^3/s	All mall entry doors open	On-floor exhaust via ceiling coffer details, with exhaust points distributed within ceiling plenum space above the mall. Refer to Figure 34.

7	Level LG-02 Centre court atrium zone	240 m^3/s	All mall entry doors open *Lower ground:* Zone 5&6 – 12.5 m^3/s Zone 8&8A – 26.7 m^3/s Kmart – 25.6 m^3/s B-056 – 10.2 m^3/s Coles – 14.85 m^3/s *Ground:* Zone 11 – 10.7 m^3/s Zone 13. – 8.8m^3/s *Level 1:* Zone 12 – 9.8 m^3/s Zone 13 – 11.5 m^3/s *Level 2* Zone 12 – 3.1 m^3/s Mini-majors – 27.9m^3/s	Three exhaust fans with a total of 120 m^3/s provided at the top of the central atrium void above level 3. Three exhaust fans with a total of 120 m^3/s provided at the top of the Victoria Avenue void above level 2 (refer to Figure 35).
13	Level 00 and 01 Havilah Street Mall	80 m^3/s	All mall entry doors open	Two exhaust points with a total of 80 m^3/s along the skylight at the top of the void above level 1. Refer to Figure 36.
9&10 (existing)	Level LG Food court	25 m^3/s	All mall entry doors open	On-floor exhaust via single exhaust point within B-040 bulkhead. DTS compliant smoke exhaust.
Mini-majors 2-015 and 2-018 (>1,000m^2)		DTS compliant smoke exhaust		
David Jones tenancy		Refer to David Jones fire engineering report		
Kmart (existing)		Refer to CSIRO fire safety study report		
Smoke zones 8, 8A and Coles/8B (existing)		Refer to NDY fire engineering report rp02309s dated 2009		
Smoke zones 5 and 6 (existing)		Refer to NDY fire engineering report s25298-001-fe dated 2015		

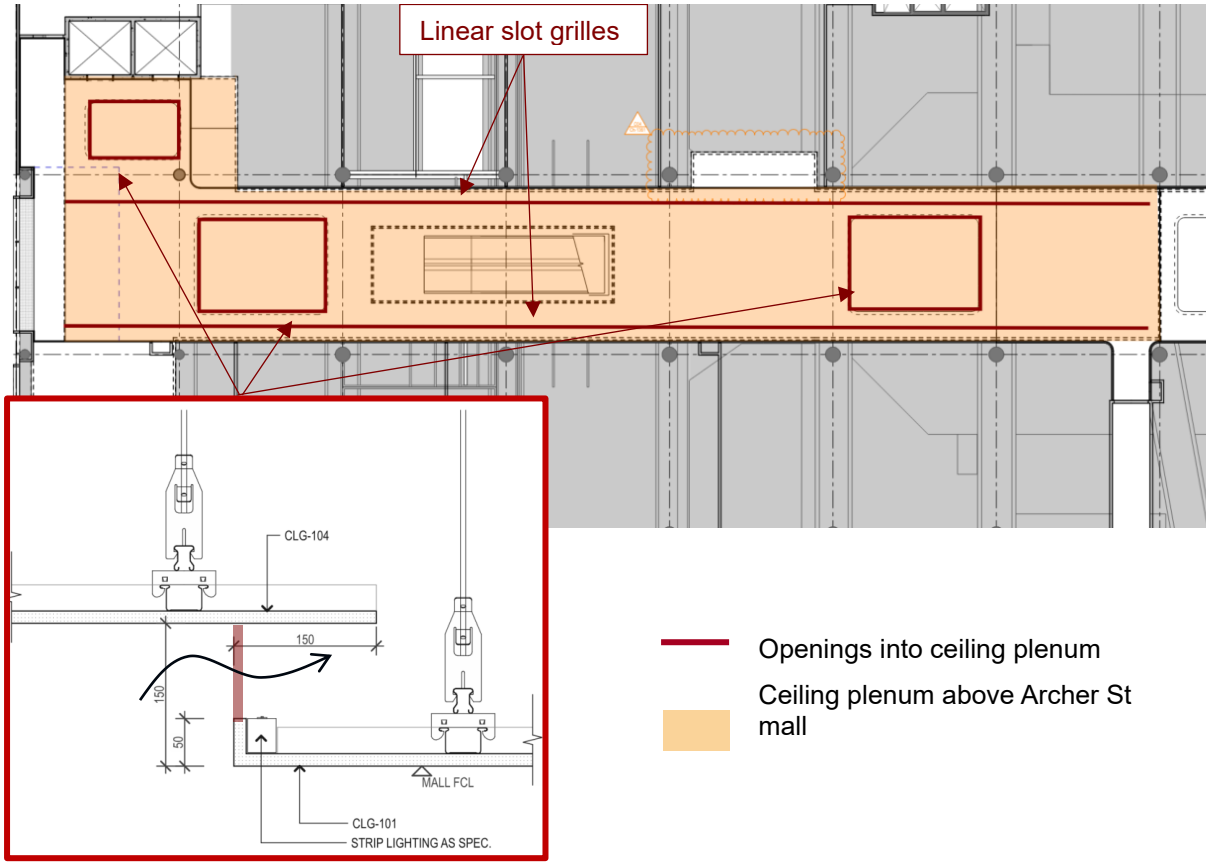


Figure 34 Zones 11 and 12 typical – Archer Street mall ceiling detail

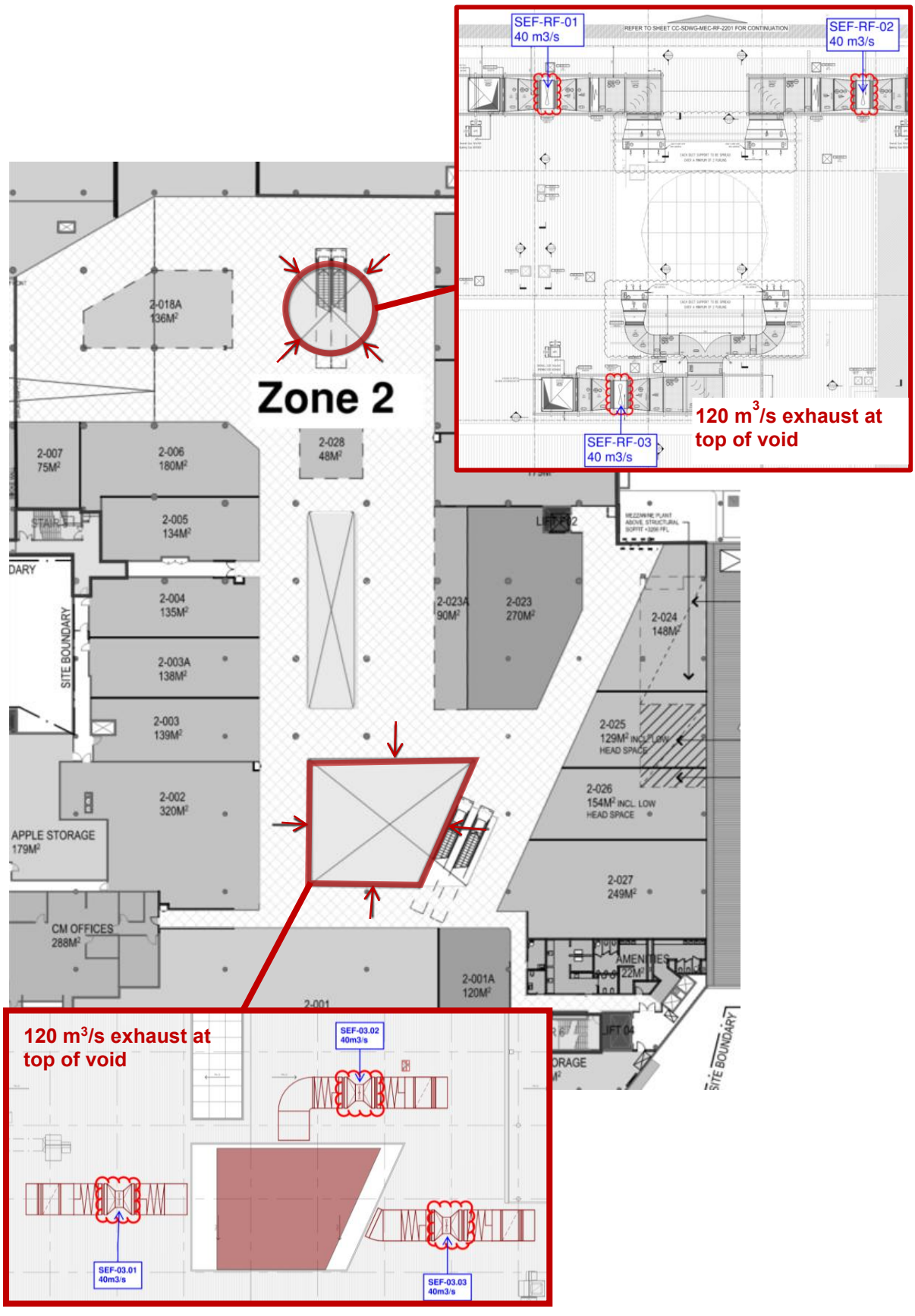


Figure 35 Zone 7 smoke exhaust

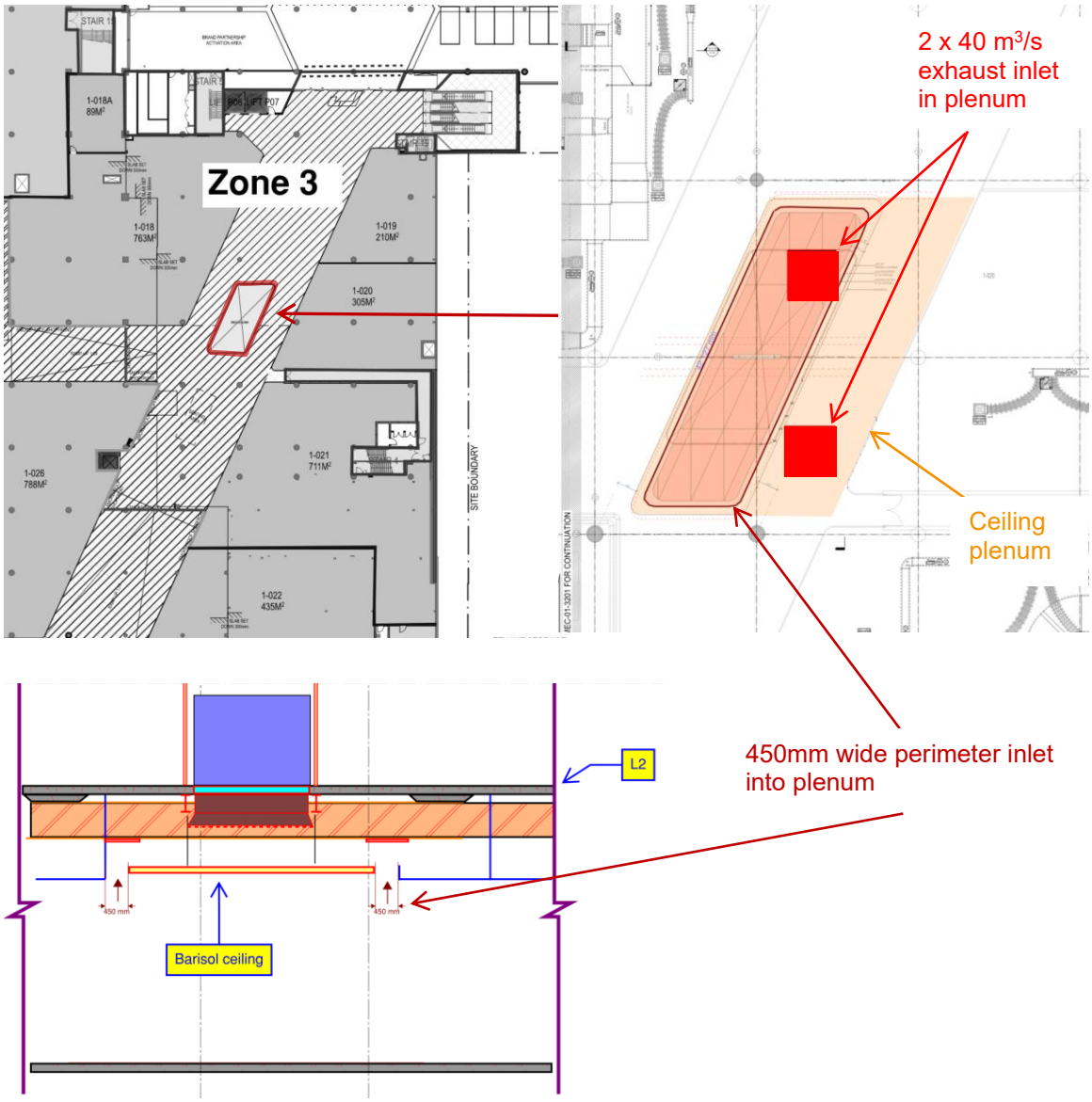


Figure 36 Zone 13 smoke exhaust

58. The smoke exhaust system must operate upon the activation of the smoke detection system within the building. Smoke detectors must only activate the smoke exhaust fans located in the same smoke zone.

59. The smoke exhaust serving the lower ground floor Victoria Avenue smoke zone (9 and 10) must be capable of operating simultaneously as the central atrium exhaust, in the event of smoke spread to the zone. In all other cases the smoke exhaust systems are not required to operate simultaneously if smoke migrates to an adjacent zone.

60. Make-up air for the smoke exhaust system is to be provided through a combination of mechanical supply and mall entries on levels LG and 00 as described in Table 10.

61. Mall entries providing makeup air must automatically open upon activation of smoke exhaust and comprise the following approximate free areas:

- Lower ground:
  - Havilah Street entry – minimum 5.5 m^2
- Lower ground A
  - Victoria Avenue entry – minimum 15 m^2
  - Façade casement windows – minimum 18 m^2
- Level 00
  - Archer Street entry – minimum 10.4 m^2

5.5.3 Smoke reservoirs

62. Building elements bounding adjacent smoke zones must comprise smoke proof construction extending to the underside of the floor slab above. Smoke-proof construction:

a. Is construction, including openings around penetrations and the junction of the smoke walls with other building elements that prevent the free passage of smoke.

b. May incorporate glazing provided it is safety glass complying with AS 1288-2006.

c. Must incorporate smoke dampers where air handling ducts penetrate walls, unless:

i. The duct forms part of a smoke hazard management system required to operate in fire mode, or

ii. The duct is of steel construction, only includes openings into a single smoke compartment, and is fully sealed where it passes through other smoke compartments.

Note: It is understood that specialty tenancies comprise set ceilings with walls continuing to the underside of the ceiling, or for tenancies with no ceilings, walls are full height to the underside of the slab.

63. Smoke doors incorporated into smoke proof walls must comply with the following:

a. The leaves must be solid-core and at least 35 mm thick, or are capable of withstanding smoke at 200 °C for 30 minutes.

b. The leaves must be fitted with medium temperature smoke seals.

c. The leaves must be self-closing or automatically closing. Any automatic closing operation must be initiated by smoke detectors installed in accordance with the relevant provisions of AS 1670.1-2018, located on each side of the doorway at a horizontal distance of not more than 1.5 m from the doorway.

d. Any glazing incorporated into the doors must comply with AS 1288.

64. Where retail tenancies have portions of their shopfront coinciding with smoke zone boundaries – as indicated in Appendix D in which they wish to provide doorways, the following will apply:

a. The doors must be self-closing or automatically closing upon fire trip

b. The doors must be of solid smokeproof construction.

c. The height of the door must be kept below the smoke baffle height.

d. Smoke detection is to be provided within the tenancy.

65. Any smoke wall construction above the ceiling must be stamped ‘SMOKE WALL – ALL OPENINGS AND PENETRATIONS MUST BE SEALED’ at not less than 5 m centres on both sides of the wall. The lettering must be not less than 50 mm high in a colour contrasting with the background.

66. The level 2 northern common back of house area must be separated from the adjacent mini-major tenancies by smokeproof construction.

67. The gym tenancy spanning level 2 and 3 west must be smoke separated from the level 2 retail mall by smokeproof construction in accordance with item 62.

68. A 3.6 m high sliding door may be provided to the gym tenancy smoke proof shopfront, provided that:

    a. The door automatically closes upon fire trip.

    b. Smoke detectors are to be located within 1.5 m of the door on either side.

    c. A secondary swing door not more than 3 m high is to be provided along the shopfront to facilitate occupant egress.

Smoke baffles

69. Smoke baffles are to be provided in the following locations – see smoke zone plans in Appendix D:

    a. At the shopfront line above openings between the mall and major tenancies (>1000 m^2)

    b. Between mall smoke zones on the same level

    c. Around the perimeter of the Archer Street escalator void connecting Level 00 to Level 2, on each level.

    Note:

    - Smoke baffles or solid construction below the general ceiling height must not be provided around the perimeter of the central atrium void or Victoria Avenue void.
    - Smoke baffles are not required between specialty tenancies (<1000 m^2) and the mall unless specifically identified.

70. The depth of smoke baffles must be no more than 3 m above the finished floor level, and not less than 600 mm below the adjoining ceiling level unless otherwise stated.

71. The smoke baffles at the following locations may be more than 3 m above the finished floor level, but not less than 600 m below the adjoining ceiling level:

    a. The smoke baffles around the Archer Street escalators on level 00 (smoke zone 11) and level 02 (smoke zone 12).

    b. The mall smoke baffles between smoke zones 7 and 12 on level 02.

    Refer to Figure 37 and Figure 38 .

72. Smoke baffles must be constructed as follows:

    a. Extend downwards from the underside of an imperforate ceiling, floor slab or roof.

    b. Comprise any of the following:

        i. Non-shatterable non-combustible construction.

        ii. Toughened or heat strengthened laminated safety glass with a thickness of not less than 6 mm

    c. The baffle may be used as a signage zone for the tenancy.

73. Kiosks must not be located below or within 3 m of smoke baffles separating mall smoke zones.

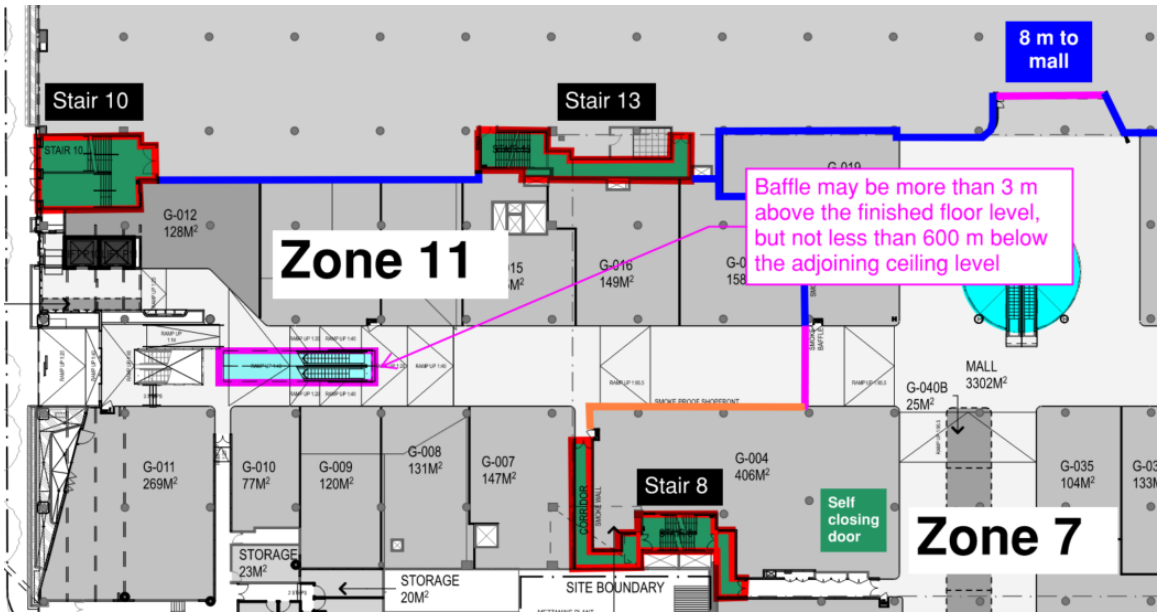


Figure 37 Smoke baffles permitted to be higher than 3 m above finished floor level – Level 00

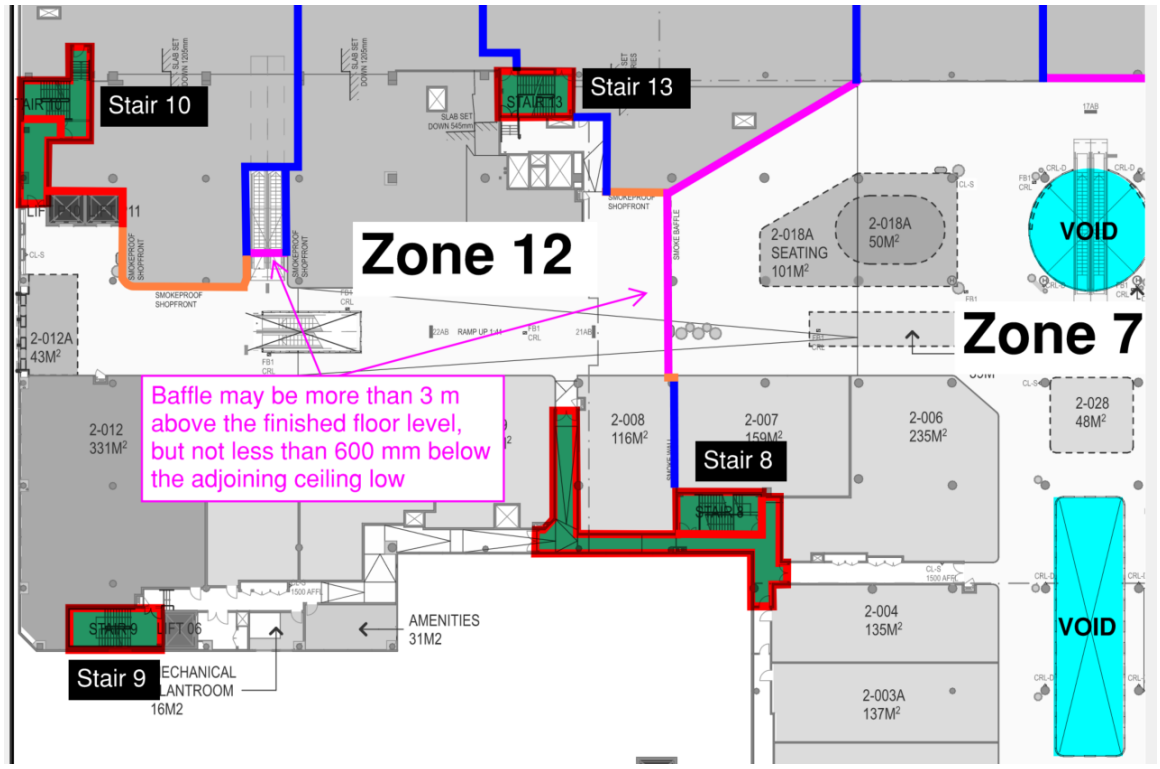


Figure 38 Smoke baffles permitted to be higher than 3 m above finished floor level – Level 02

Ceilings

74. The ceiling plenum above common mall area within smoke zones 11 and 12 must be utilised for smoke exhaust:

    a. The ceiling plenum must be smoke separated from the adjacent specialty tenancies and smoke zone.

    b. The smoke zones must incorporate the ceiling detail illustrated in Figure 34 to provide openings to the ceiling plenum.

5.5.4 Stair pressurisation

75. The existing stair pressurisation system to fire-isolated stairs 6, 7 and 8 which serve smoke zone 7 (the centre court atrium smoke zone) must be retained. The performance criteria for the stair pressurisation system will be based on achieving a velocity of 1 m/s through the door(s) leading to the mall on the level of fire origin, with the final discharge door open. The testing strategy developed by the project mechanical contractor has been appended to this report – see Appendix L.

76. Access to fire-isolated stairs 7 and 8 must incorporate:

    a. Self-closing doors to the service corridor leading to the fire-isolated passageway accessing Stair 8 on all levels

    b. Fire-isolated corridors with self-closing or automatic closing fire doors accessing Stair 7 on level 01.

77. The door into fire-isolated 7 on level 2 from the Apple storage area is not required to be tested to achieve the required 1 m/s velocity. The Apple storage is to be separated from the remainder of the mall area by construction that prevents the free passage of smoke, in accordance with item 62.

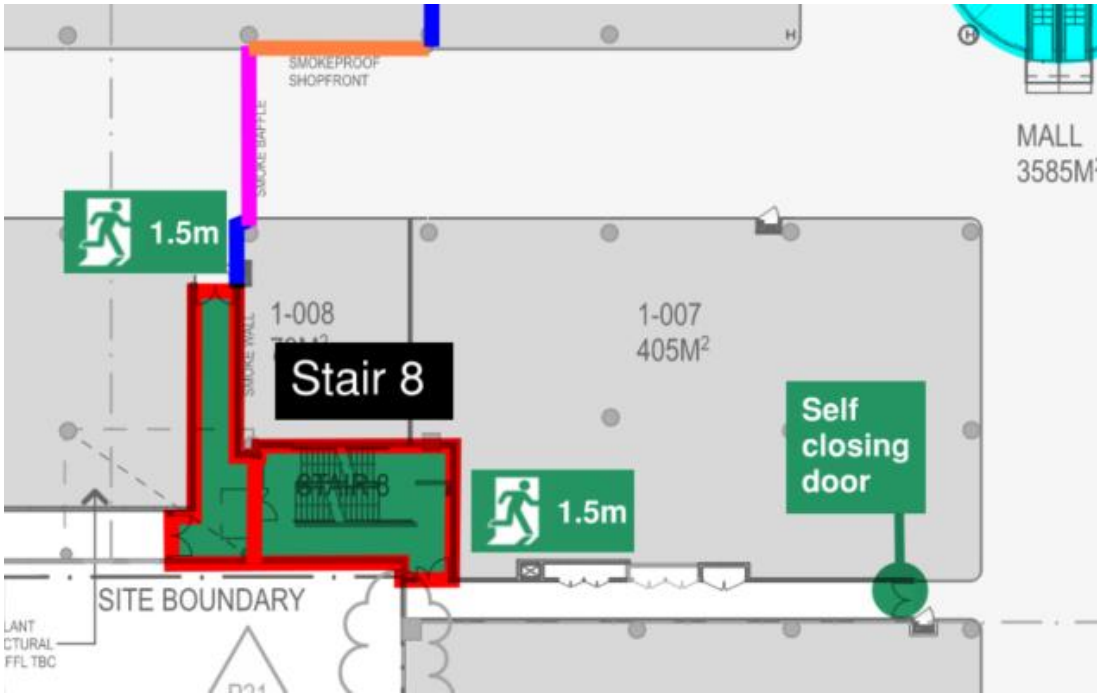


Figure 39 Self-closing door to service corridor leading to Stair 8 on all retail levels (typical)

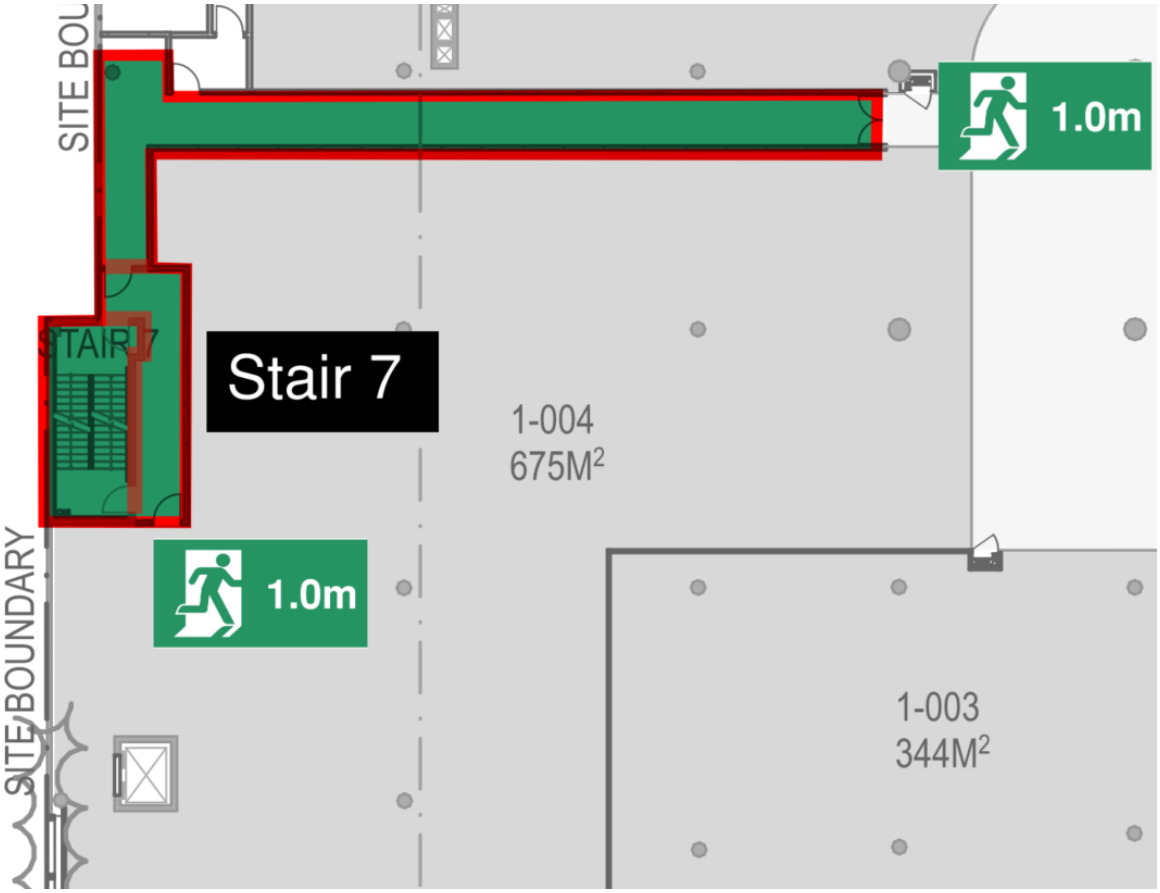


Figure 40 Fire-isolated stair 7 access through fire-isolated passageway from smoke zone 7

5.6 Emergency lighting, exit signs and warning systems

78. An emergency lighting system must be installed in accordance with clauses E4D2 and E4D4 of the NCC and AS/NZS 2293.1:2018 throughout the new / refurbished areas of the building. The existing emergency lighting system is to be maintained in areas of the building that are not impacted by the new works.

79. The path of travel along the northern boundary under the speed ramp to Archer Street must be provided with emergency lighting and directional exit signage compliant with AS/NZS 2293.1-2018.

80. An emergency warning and intercom system (EWIS) must be provided in accordance with specification 31 of the NCC and AS 1670.4:2018 to all new and substantially modified areas of the building. The existing EWIS is to be maintained in areas of the building that are not impacted by the new works. The following requirements apply:

a. The EWIS must operate immediately upon the activation of the sprinkler system within the building.

b. A 3-minute investigation period is permitted where only a single smoke detector in the building activates. The EWIS must operate after this investigation period is complete.

c. Strobes are to be provided to the external plant areas where required by AS 1670.4:2018.

d. The EWIS must operate immediately upon the activation of a second smoke detector within the building – ie a 'double knock' system.

e. The activation of the existing linear heat detection system under the Archer Street speed ramp must not operate the EWIS serving the building.

81. The cause and effect requirements for the smoke detection, sprinkler, warning and smoke hazard management systems throughout the new areas of the building are identified in Table 11 below.

Table 11 Smoke detection and sprinkler cause and effect

Fire detection	Emergency warning			Alarm signalling equipment	Smoke hazard management		
	Alarm verification	EWIS in smoke zone of origin	EWIS in adjacent smoke zones		Non-essential air handling systems in zone of origin	Smoke exhaust in zone of fire origin	Makeup air
First point type smoke detector	Alert building management to allow investigation. A 3 minute investigation period will be programmed during which time management can either reset or verify the alarm. If no action is taken and smoke has not cleared after 3 minutes the alarm will be verified.			Alert remote monitoring facility	Shutdown	Run	Open / supply
First point type detector alarm verified or no action after 3 minutes	-	EVAC tones operate	ALERT tones cascading to EVAC after 3 minutes	Alert remote monitoring facility	Shutdown	Run	Open / supply
Second point type smoke detector	-	EVAC tones operate	ALERT tones cascading to EVAC after 3 minutes	Alert remote monitoring facility	Shutdown	Run	Open / supply
Sprinkler activation	-	EVAC tones operate	ALERT tones cascading to EVAC after 3 minutes	Alert remote monitoring facility	Shutdown	Run	Open / supply

82. Additional visual and tactile signals must be provided to augment the audible emergency evacuation signal if the averaged A-weighted sound pressure level of the background noise is higher than 85 dB in areas throughout the building in accordance with AS 1670.1:2018 – eg plant rooms.

5.7 Green walls

83. The green wall trellis system on the OSD tank / EOT façade as shown in Figure 41 must not incorporate any combustible elements except for the climbing plants, and the growing medium located at the base of the wall. The trellis system must comprise steel wire ropes in front of the external wall system complying with Clause C2D10 of the NCC.

84. The green wall trellis system is required to be maintained such that the vegetation and planting medium remains hydrated, with all reasonable measures undertaken to reduce the occurrence of dead or dry vegetation. The following requirements apply:

    a. The green wall trellis system must be identified on the fire safety schedule of the building.

    b. Visual inspections are to occur on a fortnightly basis.

    c. The vegetation is to be regularly pruned, and dead and dry vegetation removed.

    d. Records of scheduled maintenance undertaken are to be continually kept up-to-date and be available for inspection for renewal of the building's annual fire safety statement.

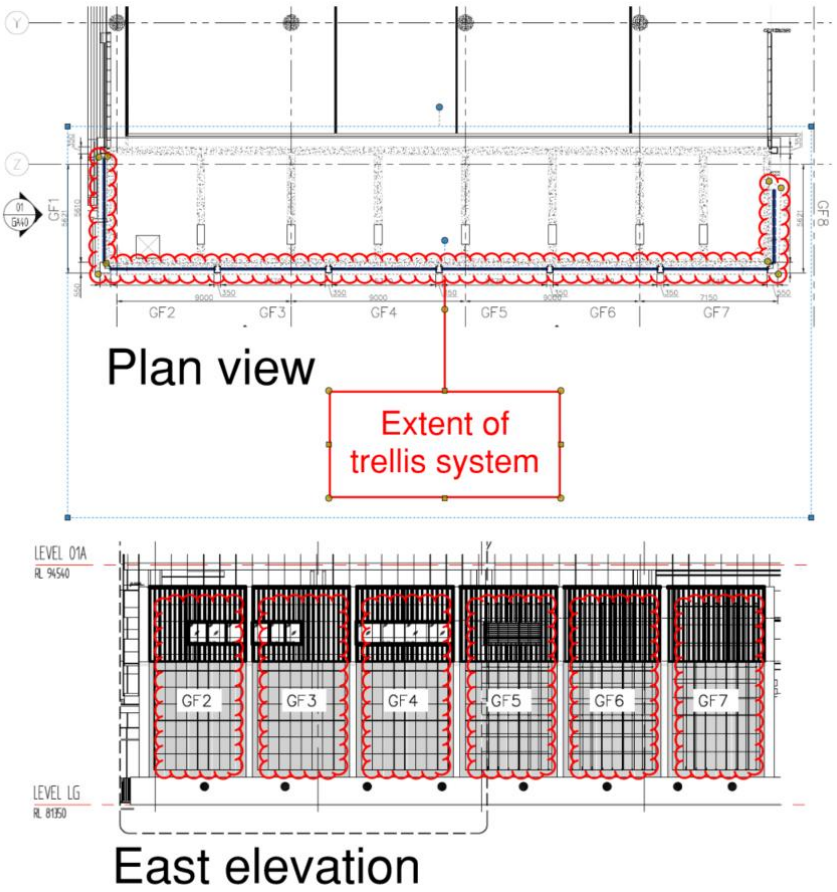


Figure 41 Extent of trellis system on OSD tank / EOTF facade

5.8 Management requirements

85. The following restrictions apply to the central atrium, Victoria Avenue and linear skylight voids:

    a. No combustible displays, advertising banners, screens, or seasonal decorations are permitted above the height of the level 02 ceiling within the central atrium and Victoria Avenue void areas.

    b. Combustible displays, large seasonal decorations including Christmas trees, temporary stages, or other combustible installations at the base of the central atrium or Victoria Avenue Void must not extend over more than one storey or 5 m above the base of the atrium.

    c. Hanging material banners, lightweight seasonal decorations, and lighting fixtures are permitted within the central atrium and Victoria Avenue voids.

    d. No rubbish bins, vehicles, permanent retail kiosks, or combustible seasonal decorations exceeding 2m in height are permitted at the base of the linear void connecting levels 1 and 2. The base of the linear void may contain mall furniture, signage elements, planters and temporary display stands and carts.

    Note: Where larger or more extensive combustible items or displays are proposed within the voids area, a separate risk assessment is to be undertaken by an appropriately qualified fire safety engineer.

86. The Victoria Avenue and Archer Street covered entry areas must not be used for:

    a. For the storage of combustibles

    b. As a retail trade-out or staged seating/dining area

6. Safety in design

Our scope of work is to assess the level of fire safety and demonstrate that the design complies with the relevant performance requirements of the NCC. A preliminary safety in design review considered whether the recommended fire safety measures in section 5 could reasonably be expected to introduce unique or unusual hazards that would not otherwise be present in the construction, installation and/or maintenance of the building. The fire safety measures in section 5 are performance specifications for other consultants to incorporate into their designs. The detailed designers retain discretion over where and how systems and structures are installed and are therefore responsible for the safety in design for the detailed design. It is important to note that the outcomes of our review are limited to issues that could reasonably be foreseen by a fire safety engineer within our limited scope and involvement in the project. It is likely that other parties involved in detailed design, installation and/or maintenance will identify additional issues.

Our preliminary safety in design review has not identified any unique or unusual hazards for the performance solution that would not otherwise be present in the construction, installation and/or maintenance of the building.

Residual risks are to be considered and addressed by appropriate people within the design, construction and maintenance teams who have duties under health and safety legislation.

7. Performance solution 1 – Fire ratings to internal steel columns on level 3

7.1 Introduction

Clause C2D2 of the NCC requires that the building must comply with the requirements of specification 5 for type A construction. Table S5C11g of the NCC requires that internal columns achieve a 120-minute fire rating for a class 5 use.

Clause S5C17 in specification 5 of the NCC states that '*for a building with an effective height of not more than 25 m and having a roof without an FRL in accordance with S5C15, in the storey immediately below that roof, internal columns other than those referred to in S5C11(1)(d) and internal walls other than fire walls and shaft walls may have –*

(a) In a class 2 or 3 building: FRL 60/60/60; or

(b) In a class 5, 6, 7, 8 or 9 building –

(i) With rise in storeys exceeding 3: FRL 60/60/60; or

(ii) With rise in storeys not exceeding 3: no FRL'

The new roof over the class 5, 6 and 9b expansion is a light weight, non-combustible structure that does not require an FRL. Internal columns within level 3 supporting this roof are required to achieve an FRL of 60/-/- in accordance with the requirements of clause S5C17(b)(i) outlined above.

The performance solution is to permit the subject internal columns supporting the new non fire rated roof to have no fire rating, except where they support essential fire safety systems on the roof.

External columns on level 3 supporting the roof structure must achieve an FRL of 120/-/- in accordance with specification 5 of the NCC for buildings of type A construction. External columns are not included in this performance solution.

This assessment was prepared to show that the design complies with performance requirement C1P1 of the NCC.

7.2 Intent of the NCC

The guide to the NCC states that the intent of clause C2D2 is '*to establish the minimum fire-resisting construction required for class 2–9 buildings*.' It also states that *'the required type of construction of a building depends on risk levels as indicated by the class of building and the building's height as indicated by the rise in storeys.*

The class of building is a measure of the building's likely:

- use;
- fire load;
- population; and
- mobility of the occupants, such as whether they are sleeping or alert.

The height (rise in storeys) of the building is relevant as a measure of likely evacuation times and evacuation difficulty.'

The guide also notes that other factors may need to be considered such as the maximum fire compartment size.

The guide to the NCC states that the intent of clause S5C11 in specification 5 is '*to specify the fire-resistance level (FRL) and other requirements for building elements in Type A construction.*'

7.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 12.

Table 12 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression Sub-system F – Fire services intervention

7.4 Acceptance criteria

The acceptance criteria for this assessment are as follows:

- The steel columns supporting the lightweight roof structure must be able to withstand the effects of a worst credible sprinkler controlled fire without failure.
- Where sprinklers fail to operate successfully the structure must mitigate the risk of unexpected catastrophic or disproportionate collapse.
- Structural support to essential fire safety equipment on the roof is provided equivalent to a design complying with the DTS provisions of the NCC.

7.5 Fire hazards

7.5.1 Hazard identification

Table 13 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 13 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The potential for unexpected catastrophic collapse of the roof or portions of the building due to the failure of the non-fire-rated internal columns on level 3.	• Sprinklers provided throughout level 3, mitigating the risk of the steel columns reaching critical temperature for failure • Internal columns fire rated where they support the essential fire safety equipment on the roof • Structure designed to prevent catastrophic failure of large parts of the roof or the building structure if internal columns on level 3 fail

7.5.2 Performance of steel structure

The design of steel reinforced structural elements under fire conditions is based on the critical steel temperature concept. This is a comparison of the yield strength and loading at normal conditions and the yield strength and loading conditions in fire conditions.

The change in yield strength at elevated temperature has been experimentally investigated. An approximation of this test data has been included in many national standards such as AS 4100:2020[6] as shown in Figure 42.

[6] AS 4100:2020, Steel structures, Standards Australia, clause 12.4.1.

The relationship shows that the yield strength of structural steel when exposed to fire conditions does not reduce until the steel temperature reaches 215 °C.

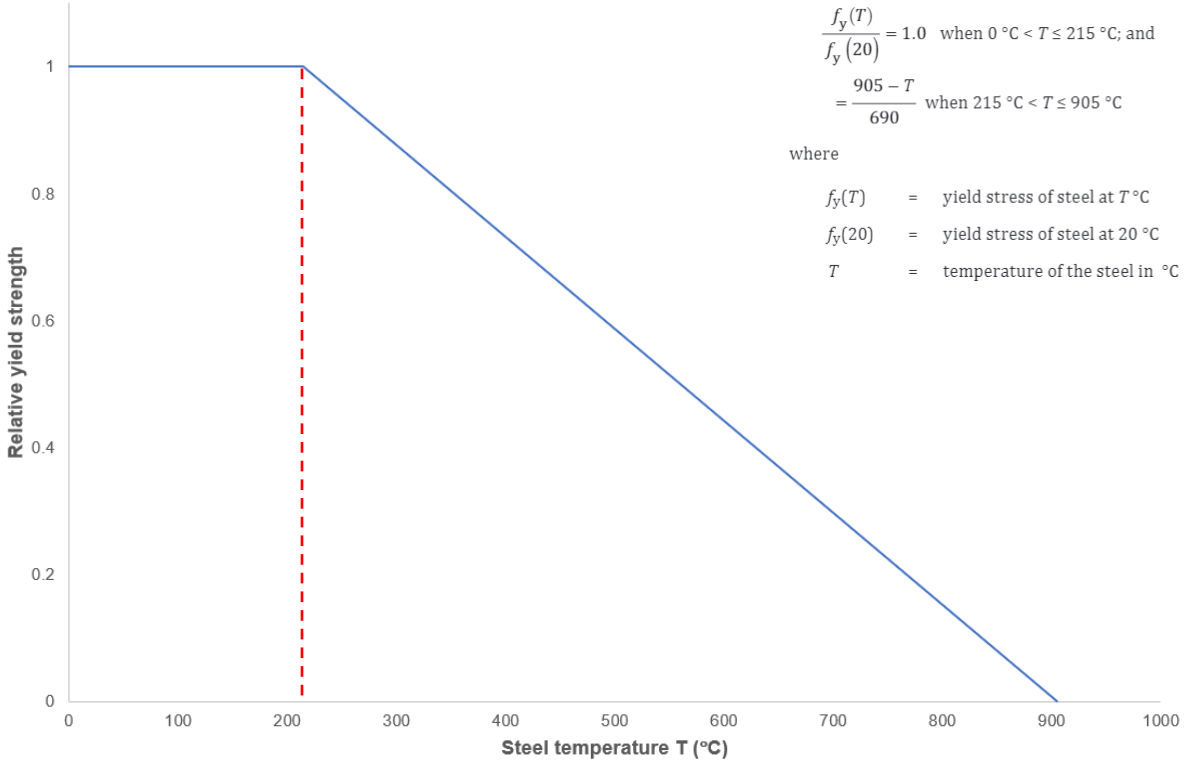


Figure 42 Reduction in yield strength of steel with temperature

7.5.3 Sprinklers

The new areas of the building are to be provided with a sprinkler system in accordance with specification 17 of the NCC and AS 2118.1:2017. The successful activation of the sprinklers is expected to provide the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe egress time.
- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.
- A reduction in the chances of a fire spreading beyond the area of origin or flashover occurring.

The successful operation of the sprinkler system is expected to have the following impact on compartment temperatures during a fire[7]:

- The average temperatures outside the immediate area of operation of the sprinkler system will be below 100 °C.
- The temperature in the localised area above the fire will be somewhat higher than the mean compartment temperature but is still unlikely to exceed 200 °C.

[7] England JP, Young SA, Hui MC and Kurban N, 2000, Guide for the design of fire resistant barriers and structures, Warrington Fire Research Australia and Building Control Commission, Melbourne VIC.

Full scale tests have shown that standard sprinklers can be expected to maintain tenable conditions in relation to temperature and toxicity outside the room where the fire started. Fast response sprinklers have been shown in most instances to maintain a survivable atmosphere in the room of fire origin[8,9].

Data collected in the US demonstrates that in properties with sprinklers compared with those with no automatic suppression system, fatalities were reduced by 87%, civilian injuries were reduced by 27% and firefighter fireground injuries were reduced by 67%[10]. When fatalities do occur in sprinkler protected buildings, the victims tend to be in close proximity to the fire, involved in its ignition or incapable of self-preservation[11].

The CIBSE Guide E[12] notes the following potential concessions for buildings protected by sprinklers:

- Building compartment areas / volumes may be increased over that for a similar building without sprinklers.
- A structural element is liable to maintain its load-bearing capacity and a separating element will maintain both its integrity and its ability to resist the transfer of heat. The fire resistance levels may therefore be reduced if sprinklers are fitted.
- The distance required to travel to an exit can potentially be increased without reducing the level of safety to people.

Statistics on US experience show that sprinklers operated in 92% of the fires in which sprinklers were present and the fire was considered large enough to activate them. They were effective at controlling the fire in 96% of fires in which they operated[13]. Data provided by Marryatt concludes that 92% of fires are controlled by 1-5 heads[14].

Sprinkler systems have been demonstrated to achieve high operational reliability through numerous statistical studies. Budnick estimated that the mean reliability of sprinkler systems was 93-96%, based on the analysis of 16 separate studies[15]. Reliability is likely to be even higher where sprinkler systems are correctly designed, commissioned and maintained.

7.6 Fire scenarios

The assessment considers the following fire scenarios on a qualitative basis:

- A worst credible sprinkler-controlled fire within the level 3 that could impact upon the non-fire-rated internal columns supporting the roof.
- A worst credible fire within the level 3 that is not controlled by the sprinkler system.

7.7 Assessment

7.7.1 Sprinkler activation

The building is provided with a sprinkler system throughout, including level 3. The beneficial impacts of sprinklers are detailed in section 7.5.3 of this report. The successful operation of the sprinkler system is expected to have the following impact on compartment temperatures during a fire[16]:

- The average temperatures outside the immediate area of operation of the sprinkler system will be below 100 °C.

[8] Madrzykowski D, 1991, NISTIR 4631 – The reduction in fire hazard in corridors and areas adjoining corridors provided by sprinklers, Building and Fire Research Laboratory NIST, Gaithersburg MD.
[9] Fire protection handbook, 2008, 20th edition, NFPA, Quincy MA, pp 20-151.
[10] Ahrens M, 2017, U.S. Experience with sprinklers, National Fire Protection Association.
[11] Fire protection handbook, 2008, 20th edition, NFPA, Quincy MA.
[12] Fire safety engineering – CIBSE guide E, 2019, 4th edition, CIBSE Publications Department.
[13] Ahrens M, 2017, U.S. Experience with sprinklers, National Fire Protection Association.
[14] Marryatt HW, 1988, Fire: A century of automatic sprinkler protection in Australia and New Zealand 1886-1986, Australian Fire Protection Association, Melbourne VIC.
[15] Budnick EK, 2001, Automatic sprinkler system reliability, Fire Protection Engineering, Winter 2001, issue 9, pp 7-12.
[16] England JP, Young SA, Hui MC and Kurban N, 2000, Guide for the design of fire resistant barriers and structures, Warrington Fire Research Australia and Building Control Commission, Melbourne VIC.

- The temperature in the localised area above the fire will be somewhat higher than the mean compartment temperature but is still unlikely to exceed 200 °C.

As detailed in section 7.5.2, the yield strength of structural steel when exposed to fire conditions does not reduce until the steel temperature reaches 215 °C. In the event of a fire on level 3 that is controlled by the sprinkler system, the non-fire-rated internal columns are therefore not expected to reach the critical temperature for failure.

It is noted that sprinkler systems have been demonstrated to achieve high operational reliability through numerous statistical studies. Budnick estimated that the mean reliability of sprinkler systems was 93-96%, based on the analysis of 16 separate studies[17]. Reliability is likely to be even higher where sprinkler systems are correctly designed, commissioned, and maintained. However, the assessment considers a scenario where sprinklers fail to operate on a fire on level 3.

7.7.2 Sprinkler failure – redundancy analysis

The loadbearing external columns supporting the roof structure, and the internal columns supporting essential fire safety systems on the roof, will be fire rated as required by specification 5 of the NCC. In the event of a fire on level 3 that is not controlled by the sprinkler system, these columns are protected to the extent required by the NCC and are not expected to cause failure of the essential fire safety systems they support.

It is acknowledged that if sprinklers fail to operate or control a fire on level 3, the non-fire-rated internal columns supporting the roof could fail. It is noted that the columns only support the non-fire-rated roof. The roof is to be designed such that the failure of an internal column would only cause localised failure of the lightweight roof structure and would not cause outward collapse of the external walls of the building as per the structural engineers' advice – refer to Appendix J. On this basis, unexpected catastrophic collapse of the roof structure, or collapse of parts of the building is not expected to occur.

By the time the fire grows to a size that is large enough to cause localised failure of the roof structure, occupants in the vicinity of the fire are expected to have evacuated via the fire-isolated exits serving level 3 or moved to the outdoor areas on level 3, which represent a place of relative safety from the fire.

Firefighters are expected to approach via the fire-isolated exits, and use the internal hydrants provided within the exits and adjoining external roof areas to fight a fire on level 3 if they cannot undertake external firefighting. As unexpected catastrophic collapse of the roof structure is not expected to occur, firefighters are not considered to be exposed to greater risk from localised failure of the roof structure relative to a DTS compliant building with a non-fire-rated roof. It is noted that a fully developed fire on level 3 could cause localised failure of the non-fire-rated roof covering even if the internal columns are fire rated as required by the NCC.

7.8 Conclusion

The assessment shows that:

- The steel columns supporting the lightweight roof structure must be able to withstand the effects of a worst credible sprinkler protected fire without failure.
- Where sprinklers fail to operate successfully the structure must mitigate the risk of unexpected catastrophic or disproportionate collapse.
- Structural support to essential fire safety equipment on the roof is provided equivalent to a design complying with the DTS provisions of the NCC.

The proposed design of the building is therefore considered to comply with performance requirement C1P1 of the NCC, subject to complying with the fire safety measures in section 5.

[17] Budnick EK, 2001, Automatic sprinkler system reliability, Fire Protection Engineering, Winter 2001, issue 9, pp 7-12.

8. Performance solution 2 – Slab edge separation

8.1 Introduction

Clause C2D2 of the NCC requires that the building must comply with the requirements of specification 5 for type A construction. Table S5C11g within specification 5 requires the floor slab of class 6 building portions to achieve an FRL of 180/180/180. This has been reduced to FRL 120/120/120 as part of an existing fire engineering performance solution for the building.

Floors must extend to the external walls where they are provided to separate fire compartments sharing a common external wall. The NCC defines an external wall as *'an outer wall of a building which is not a common wall.'* The DTS provisions of the NCC do not specify how fire rated floors are to be terminated against a non-fire-rated external wall such as a curtain wall in a sprinkler protected building.

Clause C4D16 of the NCC requires construction joints, spaces and the like in and between building elements required to be fire-resisting with respect to integrity and insulation to be protected in a manner identical with a prototype tested in accordance with AS 1530.4 to achieve the required FRL.

Where new curtain wall facades are to be provided in the subject building on the Archer Street and Victoria Avenue elevations, a 15-20 mm gap will exist between the edge of the fire rated floor slab and the non-combustible backpan forming the innermost element of the curtain wall system. A typical detail is shown in Figure 43 below.

The gap will be sealed with a fire rated material achieving the same FRL as that of the floor slab, with smoke flashing provided above the slab. The fire rated material will be tested in accordance with AS 1530.4 between two fire-rated elements. The specific non-compliance to be addressed is that in its application within the subject curtain wall systems, the fire rated material will be located between a fire-rated element (the floor slab) and a non-fire-rated element (curtain wall backpan) – ie it will not be installed as per a system tested in accordance with AS 1530.4.

This assessment was prepared to show that the design complies with performance requirement C1P2 of the NCC.

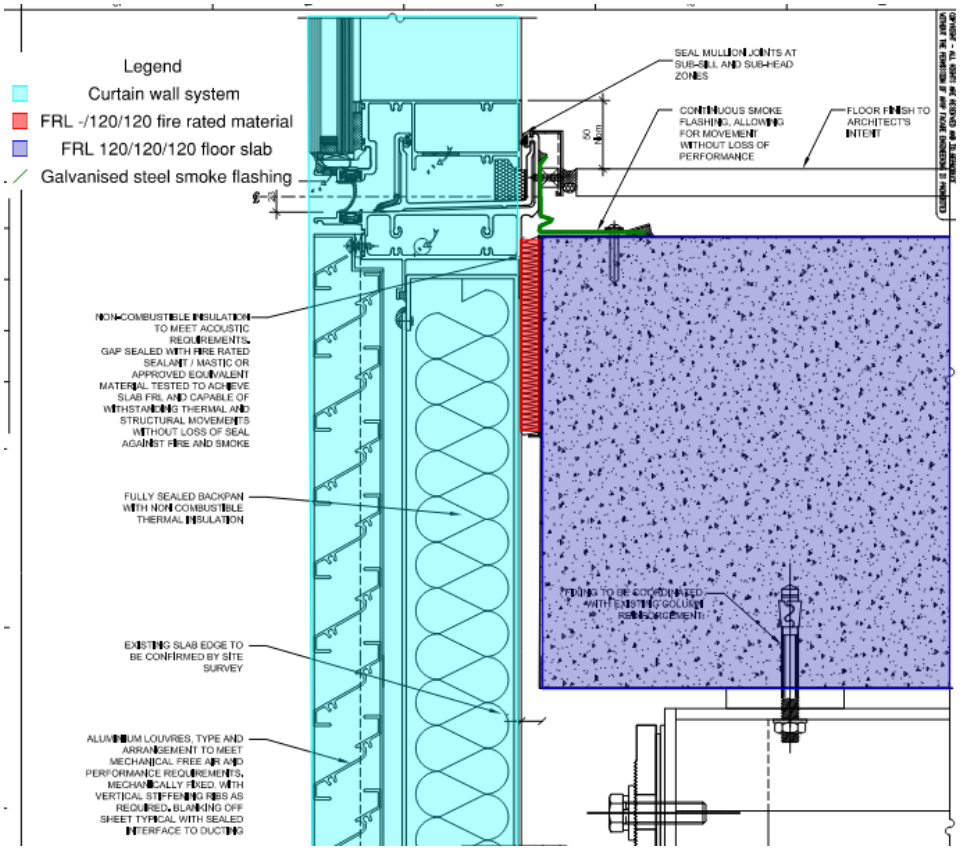


Figure 43 Typical slab edge detail

8.2 Intent of the NCC

8.2.1 Clause C2D2 and specification 5 – Type of construction required

The guide to the NCC states that the intent of clause C2D2 is '*to establish the minimum fire-resisting construction required for class 2–9 buildings*.' It also states that '*the required type of construction of a building depends on risk levels as indicated by the class of building and the building's height as indicated by the rise in storeys.*

The class of building is a measure of the building's likely:

- use;
- fire load;
- population; and
- mobility of the occupants, such as whether they are sleeping or alert.

The height (rise in storeys) of the building is relevant as a measure of likely evacuation times and evacuation difficulty.'

The guide also notes that other factors may need to be considered such as the maximum fire compartment size.

The guide to the NCC states that the intent of clause S5C11 in specification 5 is 'to specify the fire-resistance level (FRL) and other requirements for building elements in Type A construction.'

8.2.2 Clause C4D16 – Construction joints

The guide to the NCC states that the intent of clause C4D16 is '*to limit the spread of fire between building elements required to be fire-resisting.' It also states that 'to avoid the spread of fire between*

fire compartments or to another building, construction joints between building elements are normally packed with fire retardant material.'

8.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 14.

Table 14 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression

8.4 Acceptance criteria

The acceptance criteria for this assessment is that the risk of fire or smoke spread between storeys via the external wall construction joints is adequately mitigated considering the active and passive fire safety measures proposed.

8.5 Fire hazards

Table 15 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 15 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The potential for fire or smoke spread between storeys through gaps in the external wall system at the construction joints	• Sprinkler protection to internal portions of the building to mitigate the risk of fire spread • Fire rated material or mastic provide in the gap between the slab edge and curtain wall, with galvanised steel flashing providing a smoke seal at the top of the slab

8.6 Assessment

8.6.1 Sprinklers successfully operate

In the event of a fire in the subject building, sprinklers can be expected to suppress the fire or control fire growth and limit the extent of fire and smoke spread. In this scenario, the physical separation between storeys at the external wall and slab junction, including the fire rated material, the smoke flashing above, and the metal framing elements of the curtain wall can be expected to remain in place and maintain the integrity of the separation.

The benefit of sprinklers is previously discussed in section 7.5.3. The benefits are clearly acknowledged in the DTS provisions of the NCC, which provide a range of concessions for sprinkler-protected buildings. In particular, clause C3D7 of the NCC, which specifies passive fire rating requirements for vertical separation between external wall openings in different storeys behind a curtain wall, does not apply where a building is sprinkler protected.

8.6.2 Sprinkler failure – redundancy

If sprinklers fail to successfully operate, a fully developed fire could occur in the building. Such a fire may compromise the integrity of the non-fire-rated curtain wall, leading to external flaming and exposure of combustibles on the storey above after an extended period. Fire spread between storeys could also occur via heat transfer through the curtain wall elements. The redundancy analysis will consider the potential impact of the proposed fire stopping between the slab edge and curtain wall on the risk of fire spread between storeys.

It is important to note that the DTS provisions of the NCC relating to vertical fire separation between openings in external walls do not apply where sprinklers are provided. This means that even in a DTS compliant design, openings in external walls on different storeys need only be separated by the thickness of the intermediate floor slab. There is no requirement for any physical separation or fire separation of combustibles on the storey above. In the event of sprinkler failure and a fully developed fire occurring, external flaming could occur and a credible risk of fire spread between storeys exists.

Clause C3D7 of the NCC provides vertical separation requirements for curtain walls and panel walls in non-sprinkler protected buildings. In a non-sprinkler protected building, clause C3D7(1)(c) requires a vertical fire-rated spandrel to be provided behind the curtain wall or panel wall. Any gaps are required to be *'packed with a non-combustible material that will withstand thermal expansion and structural movement of the walling without the loss of seal against fire and smoke'.* The requirements of clause C3D7 for fire stopping of gaps in curtain wall systems would not apply in a sprinkler protected building.

In the proposed design, the 15-20 mm gap between the slab edge and curtain wall is to be filled by a fire rated material. A non-combustible smoke flashing is provided at the top of the gap as a smoke seal. The combination of these measures can be expected to maintain the fire separation between storeys and limit fire and smoke spread via the gap between the slab edge and curtain wall up to the point where the curtain wall structure fails. This is consistent with the fire stopping requirements of clause C3D7 of the NCC.

The internal wall linings and multiple framing elements of the curtain wall would need to fail to some degree for direct fire spread to occur via the curtain wall system. It is likely at this point that the curtain wall structure would also have failed, resulting in external flaming. The gap between the slab edge and curtain wall is not considered to significantly increase the risk of fire spread between storeys in this scenario when compared to a credible DTS compliant design where the levels are only separated by the thickness of the intermediate fire rated floor slab.

It is noted that all materials contained within the external wall are of non-combustible construction and will not significantly contribute to fire spread via the external wall junction.

8.7 Conclusion

The assessment shows that the risk of fire or smoke spread between storeys via the external wall construction joints is adequately mitigated considering the active and passive fire safety measures proposed. The proposed design of the building is therefore considered to comply with performance requirement C1P2 of the NCC, subject to complying with the fire safety measures in section 5.

9. Performance solution 3 – External trellis system

9.1 Introduction

Clause C2D10 of the NCC states that in a building required to be of type A or B construction, external walls and common walls – including all components incorporated in them including the façade covering, framing and insulation – must be non-combustible. Clause C2D10 also provides concessions for minor combustible building elements permitted to be included in the external wall system.

Clause C2D14 of the NCC states that an ancillary element must not be fixed, installed, attached to, or supported by the concealed internal parts or external face of an external wall that is required to be non-combustible, unless the ancillary element is non-combustible. This clause also includes concessions for certain ancillary attachments to external walls that may include combustible elements.

Climbing plants on trellis systems are not specifically mentioned in clause C2D10 and C2D14 of the latest version of the NCC – ie NCC 2022. The NCC currently does not include any DTS provisions regarding climbing plants or biophilic external wall elements.

A green wall comprising climbing plants supported on a stainless steel wire mesh is proposed on the concrete Havilah Street façade of the OSD tank / end-of-trip (EOT) facilities. This façade section is a two-storey portion that steps out from the rest of the elevation as shown in Figure 44.

The plants and growing medium are considered to be combustible components of the green wall trellis. No other combustible components are proposed.

This assessment was prepared to show that the design complies with performance requirement C2P2 of the NCC.

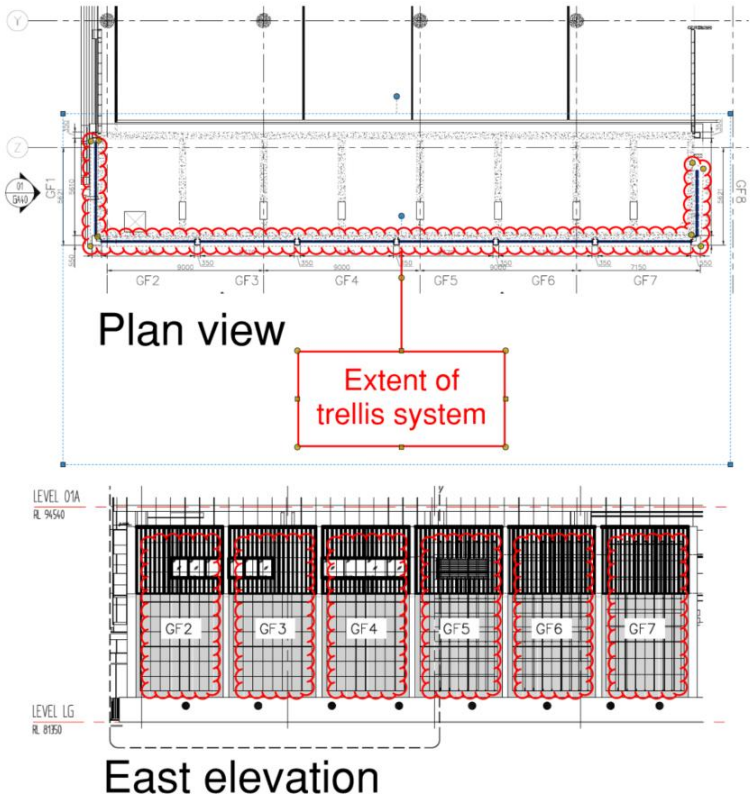


Figure 44 Extent of trellis system on OSD tank / EOTF façade along Havilah Street

9.2 Intent of the NCC

9.2.1 Clause C2D10 – Non-combustible building elements

The guide to the NCC states that the intent of clause C2D10 is '*to specify the non-combustibility for building elements and to permit the use of certain materials that are known to provide acceptable levels of fire safety where an element is required to be non-combustible.*'

It also states that '*C2D10(4) allows a concession from the requirement for non-combustibility for minor ancillary items forming part of an external wall. These minor ancillary items include gaskets, caulking, sealants and damp-proof courses. They may be used wherever a material is required to be non-combustible. In some instances the material may contain combustible components.*'

9.2.2 Clause C2D14 – Ancillary elements

The guide to the NCC states that the intent of clause C2D14 is '*to permit certain building components that may contain a limited amount of combustible material to be attached to an external wall required to be non-combustible.' It also states that 'C2D14 prescribes certain allowable ancillary elements that may form part of or be attached to an external wall required to be non-combustible, subject to certain limitations or conditions. These conditions include the ancillary element being constructed of materials meeting certain fire properties, and limitations on its potential extent of coverage of the wall.*'

9.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 16.

Table 16 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute Deterministic
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control Sub-system F – Fire services intervention

9.4 Acceptance criteria

The acceptance criteria for the assessment is that the climbing plants on the must not represent an undue risk of fire spread via the external walls of the building. This means that:

The risk of the climbing plants on the trellis being ignited is suitably mitigated.

In the event of ignition, the vegetation does not facilitate rapid fire spread beyond the area of origin, fire spread between fire compartments, or cause secondary fires as a result of flaming debris or radiant heat.

The climbing plants on the trellis must not increase the risk of obstruction to evacuating occupants and firefighting operations.

9.5 Fire hazards

9.5.1 Hazard identification

Table 17 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 17 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Fire spread up the building via the external wall due to the combustible elements within the proposed green wall systems.	• Sprinkler system provided throughout the building, mitigating the risk of ignition of the vegetation. • Maintenance measures to ensure the vegetation and planting medium are well hydrated – fortnightly visual inspections to confirm this. • Non-combustible components of the except for the vegetation and growing media. • Proposed trellis remote from the discharge location of fire-isolated exits.

9.5.2 Fire load and ignition sources

The proposed trellis system described in section 9.1 and shown in Figure 44 includes vegetation supported on a steel trellis, which in turn is fixed to a two-storey portion of a concrete external wall facing Havilah Street.

The components of the trellis system comprise non-combustible materials, except for the vegetation and growing media, which represent the primary fire load of these systems. No combustible modules or associated pipes or irrigation lines are proposed to be located on the external wall itself.

There are no ignition sources within the trellis system. The only credible risk of ignition of the vegetation is from a fire inside the building. This is further discussed in the assessment in section 9.6 of this report.

9.5.3 Sprinklers

The beneficial impacts of sprinklers have previously been detailed in section 7.5.3 of this report. The successful activation of the sprinklers is expected to provide the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe egress time.
- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.
- A reduction in the chances of a fire spreading beyond the area of origin or flashover occurring.

The successful operation of the sprinkler system is expected to have the following impact on compartment temperatures during a fire[18]:

- The average temperatures outside the immediate area of operation of the sprinkler system will be below 100 °C.
- The temperature in the localised area above the fire will be somewhat higher than the mean compartment temperature but is still unlikely to exceed 200 °C.

[18] England JP, Young SA, Hui MC and Kurban N, 2000, Guide for the design of fire resistant barriers and structures, Warrington Fire Research Australia and Building Control Commission, Melbourne VIC.

9.6 Fire scenarios

The assessment considers a credible, worst-case scenario of a fire inside the building that is not controlled by the sprinkler system and becomes fully developed.

9.7 Assessment

9.7.1 Likelihood of ignition

The OSD tanks and the EOT facility, which includes showers, toilets and change rooms, are areas that contain very limited fire load and ignition sources. The risk of a fire starting in these areas is inherently low. These areas are separated from the external green wall trellis by the concrete external wall, which may include a limited number of openings from the EOT facility on level 00A as shown in Figure 44.

The building is provided with a sprinkler system throughout, including within the carpark portions. If sprinklers successfully operate on a fire inside the building, the likelihood of the climbing plants on the trellis or in the planter boxes being ignited is very low. The beneficial impacts of sprinklers are detailed in section 9.5.3 above.

The external walls on which the vegetation is located face the public road. There is also no external fire load in proximity to the trellis. Therefore, the risk of a fire outside the building igniting the vegetation is also very low. The likelihood of ignition of the vegetation is further mitigated by regular maintenance of the plants to ensure that they remain hydrated such that there is no dry vegetation on the façade.

Research undertaken within the Fire Ecology[19] report set the objective of quantifying the ignition risk of typical green wall plant species, resulting heat release rate and smoke toxicity, amongst other key data. The results of the research showed a clear correlation between general combustibility of the plant species and the moisture content achieved:

'Fresh plant specimens of all three species did not ignite even at high radiative heat flux levels. On the other hand, at a low MC (moisture content), ignition was observed for all species even at low radiative heat flux levels'.

The likelihood of ignition of the vegetation is further mitigated by regular maintenance of the plants to ensure that they remain hydrated such that there is no dry vegetation on the façade

It is acknowledged that if a fire inside the building is not controlled by the sprinkler system and becomes fully developed, the vegetation on the trellis system could ignite. The following sections consider the consequences of the plants igniting in terms of fire spread, occupant evacuation and fire brigade intervention.

9.7.2 Risk of fire spread

Research was undertaken by Bielawski et. al.[20] on vertical greenery systems (VGS) consisting of vegetation biomass and organic materials as well as plastic or metal elements in supporting systems to determine the impact of moisture content and wind on the fire behaviour of modular living walls. The research found that moisture content is a crucial factor in plants' reaction to fire. Highly moist plants were observed to cause a slower spread of fire compared to dry vegetation.

In the unlikely event that well maintained and hydrated vegetation on the trellis system ignites, it is not expected to burn rapidly or represent a significant risk of rapid fire spread in the absence of other combustible elements in proximity to the vegetation.

The plants on the concrete external walls of the OSD tank / EOT facility extend over a maximum of only two storeys such that rapid vertical fire spread over multiple storeys via the façade is not expected to occur.

[19] Moisture Content, Ignitability, and Fire Risk of Vegetation in Vertical Greenery Systems, Kalani C. Dahanayake & Cheuk Lun Chow, 2018
[20] An explanatory investigation into moisture content and wind impact on the fire behaviour of modular living walls, Bielawski J. et. Al., 2024

The stainless steel wire mesh or cable on which the climbing plants are intended to grow is directly fixed to the concrete external wall. The proposed green wall systems therefore do not form any cavities within the external wall system which could represent a pathway for fire spread.

The openings in the concrete Havilah Street façade of the OSD tanks / EOT facilities are limited to a single storey – ie the EOT area on level 00A. Thus, there is no risk of fire breaking out of external wall openings, spreading to the level(s) above and re-entering the building via other openings.

Further, the vegetation is not in proximity to adjacent buildings or external fire load to which fire could spread and result in secondary fires remote from the area of fire origin.

9.7.3 Occupant evacuation and fire brigade intervention

The vegetation is not located directly above or adjacent to any fire-isolated exits from the building. In the unlikely event that the plants are ignited, occupants are not expected to be obstructed as they exit the building onto the road via fire-isolated exits and passageways remote from the Havilah Street façade.

The vegetation is not close to any of the major fire brigade services for the building, all of which have access from Victoria Avenue to the south.

Given the negligible risk of rapid fire spread and the low-rise nature of the Havilah Street elevation which has direct access for fire brigade vehicles from the public road, fire brigade intervention is not considered to be impacted in the event of a fire involving the vegetation.

9.8 Conclusion

The assessment shows that the climbing plants on the trellis do not represent an undue risk of fire spread via the external walls of the building. The proposed design of the building is therefore considered to comply with performance requirement C1P2 of the NCC, subject to complying with the fire safety measures in section 5.

10. Performance solution 4 – Fire separation of carpark from the retail mall

10.1 Introduction

Clause C3D9 of the NCC states that if a building has parts of different classifications located alongside one another in the same storey, each building element of that storey must have the higher FRL for both the classifications concerned, or the parts must be separated by a fire wall in accordance with specification 5 of the NCC.

The building is subject to an existing performance solution which provides a general allowance for building elements to achieve a fire rating of 120 minutes instead of 180 minutes.

The separation between the carpark and the retail mall on levels 00 to 02A is proposed to be a combination of fire rated wall and glazing protected with wall-wetting sprinklers.

This assessment was prepared to show that the design complies with performance requirements C1P2 of the NCC.

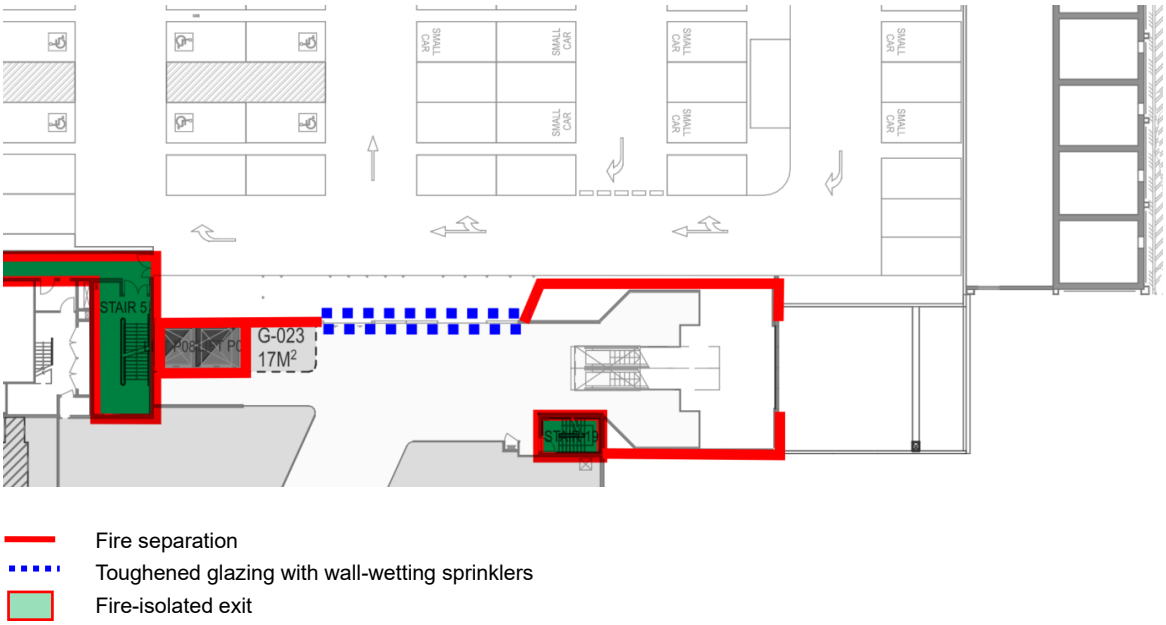
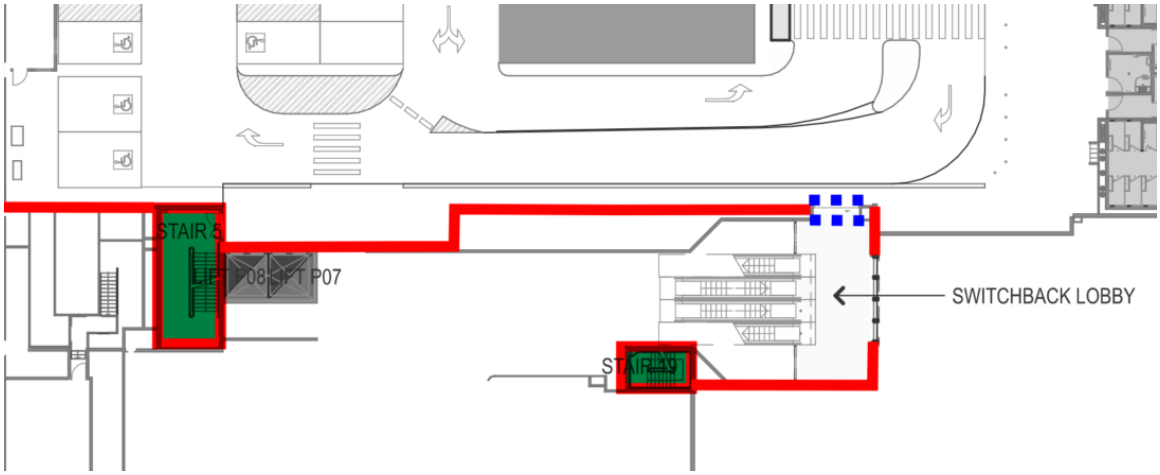
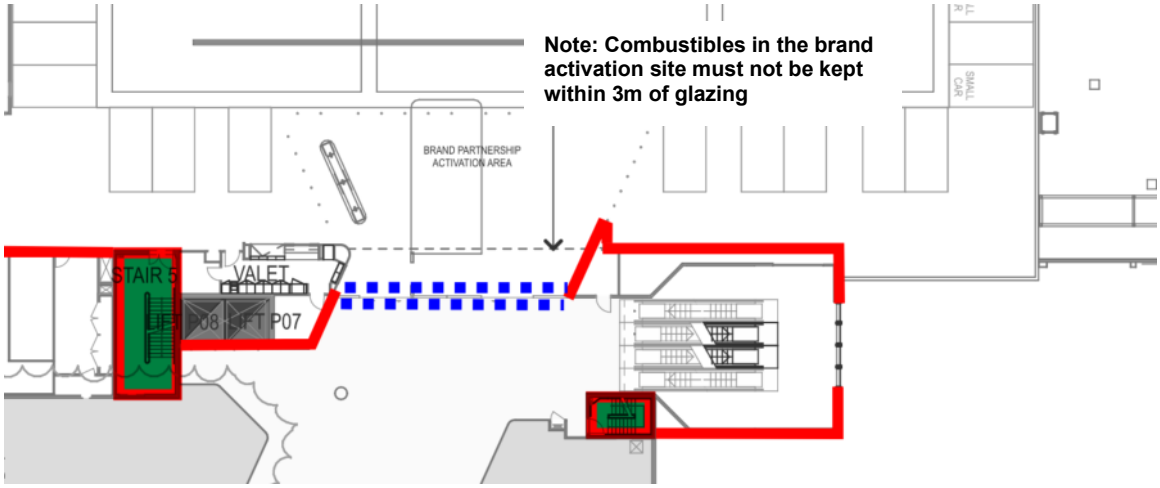


Figure 45 Ground level (L00) – Performance based fire separation



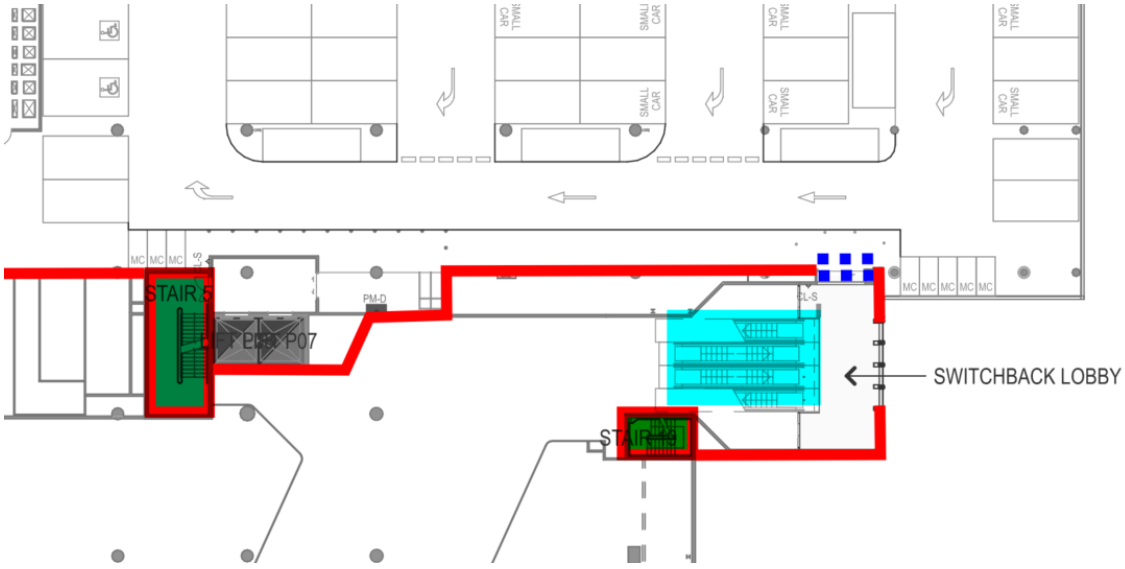
Fire separation
Toughened glazing with wall-wetting sprinklers
Fire-isolated exit

Figure 46 Level 00A – Performance based fire separation



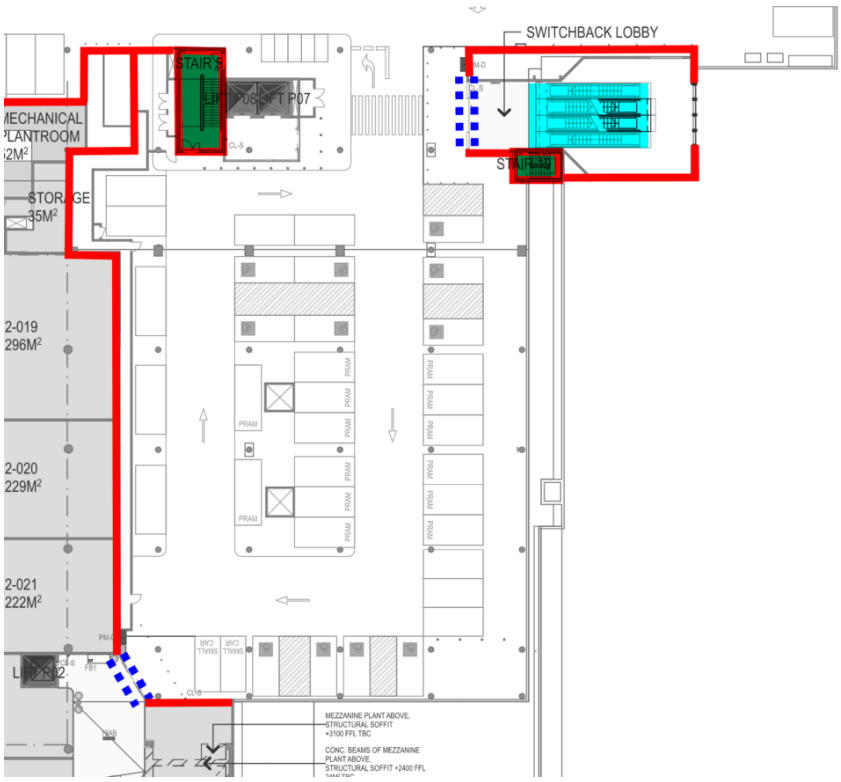
Fire separation
Toughened glazing with wall-wetting sprinklers
Fire-isolated exit

Figure 47 Level 01 – Performance based fire separation



Fire separation
Toughened glazing with wall-wetting sprinklers
Fire-isolated exit

Figure 48 Level 01A – Performance based fire separation



Fire separation
Smoke separation
Toughened glazing with wall-wetting sprinklers
Fire-isolated exit

Figure 49 Level 02 – Performance based fire separation



Figure 50 Level 02A – Performance based fire separation

10.2 Intent of the NCC

10.2.1 Clause C3D8 – Separation by fire walls

The guide to the NCC states that the intent of clause C3D8 is '*to explain that buildings separated by a fire wall may be considered as fire compartments or be regarded as separate buildings.*'

10.2.2 Clause C4D6 – Doorways in fire walls

The guide to the NCC states that the intent of clause C4D6 is *'to maintain the integrity of fire walls by limiting the spread of fire through doorways.*'

10.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 18.

Table 18 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control Sub-system E – Occupant evacuation and control

10.4 Acceptance criteria

The acceptance criteria is that the assessment must demonstrate that the fire walls between the retail and carpark fire compartments which incorporate glazing protected with wall-wetting sprinklers, mitigates the risk of fire spread between compartments.

The assessment must also demonstrate that the proposed glazing and AS 2118.2-2021 wall wetting sprinkler system is appropriate to the fire hazard of the adjoining areas.

10.5 Fire hazards

10.5.1 Hazard identification

Table 19 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 19 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Potential fire spread between retail and carpark compartments as a result of not providing traditional fire rated construction.	Performance based fire separation consisting of toughened glazing protected by wall-wetting sprinklers.

10.5.2 Separation of uses

The provision of fire walls separating areas of different building classification on the same storey is necessary where areas have differing fire rating requirements and fire safety measures. The primary reason for separating the carpark and retail parts of the subject building is to provide delineation for the smoke hazard management provisions serving the retail and atrium compartment from the other uses. On certain levels the fire walls between the carpark and retail areas also serve as horizontal exits to limit travel distances to a place of safety and facilitate phased evacuation.

As the fire-rating requirements for the retail parts of the building have generally been rationalised to a maximum of 2 hours under the existing performance solution, the carpark and retail, areas require equivalent structural fire resistance levels. The separations are therefore not considered criteria for the purposes of maintaining structural adequacy in the event of a fire in either compartment.

10.5.3 Fuel load

The area adjoining the glazed parts of the fire wall on the carpark side is typically pedestrian of vehicular circulation space. The risk of a fire occurring near the glazing on the carpark side is low. In areas where parking is permitted near the glazing, the spaces must be set back and protected with bollards so that no cars can be parked within 3 m of the glazing. Similarly, the glazed parts of the fire wall adjoin mall and circulation areas on the retail side. There are no glazed elements opening directly into retail tenancies and the risk of significant combustible fire load directly against the glazing is therefore low on both sides.

10.6 Fire scenarios

The assessment considers the following fire scenarios:

- A worst credible sprinkler-controlled fire within the carpark or retail compartments
- A sprinkler failure scenario within the carpark fire compartment involving the closest vehicle space to the glazing in the fire wall.

Note: A fire within the carpark fire compartment is the primary risk with respect to the evacuation provisions and smoke hazard management strategy for the building and is therefore identified for the redundancy study. This is because the retail compartment contains a significantly higher occupant load and more onerous smoke hazard management provisions.

10.7 Assessment

10.7.1 Glazing requirements

The walls between the carpark and retail areas will be of fire rated construction achieving an FRL of not less than 120/120/120, except for the localised glazed areas considered under this performance solution. The glazing incorporated into the fire walls will be laminated toughened safety glass complying with AS 1288:2021. Toughened glass can withstand higher radiant heat exposure and surface temperature than plain float glass. Testing carried out by the National Research Council of Canada found that '*without water protection, tempered and heat-strengthened glazing can sustain a glazing temperature on the exposed side of more than 350°C. However, when water was sprayed onto the hot glazing, the glazing failed at much lower temperatures. The critical temperatures established for heat-strengthened and tempered glazing are 150–165°C and 200°C, respectively*'[21,22]. The Australian Glass and Window association identifies that tempered / toughened glass can withstand a temperature difference of about 250°C without failure[23] .

This type of glazing is permitted within smoke walls as described under clause C2.5 of the NCC and is permitted to be incorporated into smoke walls in both hospital and aged care building to facilitate staged evacuation.

10.7.2 Wall-wetting sprinklers

To further mitigate the risk of fire spread via the glazed elements in the fire wall, the glazing is to be protected with wall-wetting sprinklers on both sides. The wall wetting sprinklers are to be designed in accordance with AS 2118.2-2021. The wall wetting sprinklers are provided with independent stop valves from the general sprinkler system. This provides an additional layer of redundancy in the event of failure of the on-floor sprinkler system.

The NCC recognises the benefit of wall-wetting sprinklers in mitigating external fire spread between buildings, fire compartments, and to protect exposed discharge areas from fire-isolated stairs. Although these provisions primarily relate external fire spread situations, the wall-wetting sprinklers may be installed internally to protect glazing exposed to an internal fire scenario.

Similarly, the provisions for separation of atriums by bounding construction incorporating glazed walls or doors permit the use of wall wetting sprinklers to maintain separation between the atrium and the remainder of the building. The guide to the NCC explains the following in relation to these wall-wetting sprinkler provisions:

'*The location of the sprinkler heads must allow full wetting of the glazing without wetting an adjacent head. Consequently, water should run down the window, cooling the glass and therefore creating a resistance to the spread of fire and/or smoke through the glazed wall by reducing its potential to failure during a fire. It is also important that the adjacent sprinkler head not be wetted, because the cooling effect of the water may delay its activation*.'

[21] Kim, A.K. and Lougheed, G.D. The Protection of Glazing Systems with Dedicated Sprinklers, Journal of Fire Protection Engineering, Vol. 2, 1990, pp. 49-59.
[22] Babrauskas, Glass breakage in fires, Fire Science and Technology Inc, 1996
[23] Australian Glass and Window Association, Technical fact sheet: Thermal stress glass breakage, Version 1, June 2019.

AS 2118.2:2021 provides detailed requirements for the design of wall-wetting sprinkler systems protecting glass infills including internal protection. This system is intended for applications where the maximum radiant heat exposure is limited to 40kW/m^2. The standard outlining spacing, location and water flow requirements intended to complete and uniform coverage of the glazing by direct impingement and rundown. The standard permits the inclusion of doors provided that they are self or automatically closing.

The rate of water discharge to protect glazing under clause S31C5 of the NCC is required to be either 0.25 L/s.m^2 or 0.16 L/s.m^2 based on the potential setback of combustibles from the glazing. The higher flow rate is required where there is a potential high fire load adjoining the separation. The 0.25 L/s.m^2 equates to 75L/min for wall-wetting sprinklers spaced 2.5 m apart covering a glazing height of 2 m which is generally consistent with the design flow requirements of AS 2118.2:2021. The proposed system will achieve a flow rate of not less than 75 L/min per head.

10.7.3 Sprinkler-controlled fire within carpark or retail compartments

The carpark and retail parts of the building adjoining the subject fire walls will be sprinkler protected throughout. In the event of a sprinkler-controlled fire, compartment temperatures at the glazed separations can be expected to be less than 100°C, well below the failure temperature of toughened glazing. The wall wetting sprinkler protection provides an additional layer of protection in the event of a sprinkler-controlled fire to mitigate the risk of glazing failure

10.7.4 Sprinkler failure fire scenario on carpark side

To estimate the radiant heat exposure from a fire on the carpark side of the glazing, which is considered the primary hazard, a calculation has been performed using Equation 1 from NFPA 92[24]:

$$R = \left(\frac{Q_r}{4\pi q_r}\right)^{1/2}$$

Equation 1 Separation distance – NFPA 92 section 5.2.5

Where:

R = separation distance from target to centre of fuel package (m)

Q_r = radiative portion of the heat release rate of the fire (kW)

q_r = incident radiant heat flux

A fire scenario involving a non-sprinkler-controlled fire in the vehicle space closest to the glazing with a set-back distance of 3 m is assumed. It is noted that Equation 1 measures the distance R to the centra of the fuel package. Noting that vehicles may include multiple compartments and fuel packages, the fuel package is conservatively assumed to be at the edge of the car space rather than the centre – ie the separation distance is assumed to be 3 m.

A worst credible fire size of 10MW is adopted based on full scale test data from 10 studies (38 tests) for a range of internal combustible engine vehicles (ICEV) and Battery Electric Vehicles (BEV) summarised by Hodges et al[25]. These studies show a range fire of sizes with only one passenger vehicle out of the 38 included in the summary exceeding 10MW. The paper highlights that these tests were based on vehicles with smaller energy capacity than currently available and provides a conservative method to estimate HRR for larger capacity vehicles. A fire size of 15 MW is considered as a sensitivity study which is representative of an 8-person passenger van estimated using the conservative calculation method presented in the reference paper.

The radiant heat calculated at the glazing for the two scenarios described above is as follows:

- 10MW at 4 m distance = 26.5 kW/m^2
- 15MW at 4 m distance = 39.8 kW/m^2

[24] NFPA 92 – 2024 Edition, section 5.2.5
[25] Hodges et al, Design fire scenarios for hazard assessment of modern battery electric and internal combustion engine passenger vehicles, Fire Safety Journal 146, 2024

Based on the calculations undertaken, the proposed wall-wetting sprinkler system designed to AS 2118.2-2021 – which is limited to radiant heat exposure up to 40 kW/m^2 – is considered to adequately mitigate the risk of glazing failure in the event of a fire in the carpark.

10.7.5 Occupant evacuation

It is proposed that wall-wetting sprinklers are located to provide coverage to the glass sliding door panel when in the closed position. To facilitate this, the sliding door within the glazed separation is to automatically close in the event of a fire. Smoke detectors are to be located within 1.5 m of the sliding door on both sides. The automatic closing device on the sliding door must operate following activation of these detectors. Clearly marked push to exit buttons will be provided to the retail side of the sliding doors, which serve as horizontal exits on levels 00A, 01A, 02, 02A and 3, to facilitate occupant evacuation. The doors are to automatically close again within a 20 second limit to reduce any smoke spread between the two compartments.

The glazing also provides occupants with good visual access into the carpark areas. In the event of such a fire occurring, occupants are expected to locate the hazard prior to using the sliding doors and proceed to seek alternative means of escape. In this scenario the sliding door would therefore stay in the closed position.

The wall-wetting sprinkler heads must be installed below any door frame or door header which may obstruct coverage. In an unlikely event of a fire within proximity of the sliding doors activating the wall-wetting sprinklers an uninterrupted film of water is expected to be provided to the entire surface of the sliding doors and infill any potential gaps between the sliding door and fixed glazing. The sprinkler heads in the path of a doorway must also be installed at least 1980 mm above floor level in accordance with clause D2D7 of the NCC so that they do not impede evacuation. Combustibles are also not expected within close proximity of the glass doors as they are in a thoroughfare area. The doors are not within the vicinity of carparking spaces This reduces the risk of a severe fire occurring in close proximity to the glass sliding door panels.

10.8 Conclusion

The assessment shows that the combination of sprinkler protection within the building, glazed separation protected with wall-wetting sprinklers and setback of potential fire sources from combustible fuel loads mitigates the risk of fire spread between the retail and carpark uses. The proposed design of the building is therefore considered to comply with performance requirements C2P2 of the NCC, subject to complying with the fire safety measures in section 5.

11. Performance solution 5 – Fire separation of generator room

11.1 Introduction

Clause S31C20 in specification 31 of the NCC requires that:

'*(1) If a required path of travel to an exit is within an atrium, a suitable alternative power supply be provided to operate required safety systems, including sprinkler systems and fire hydrant pumps, air handling systems, alarms, warning and communication systems and emergency lighting circuits.*

(2) The alternative power supply must—

(a) be connected automatically if the normal power supply fails; and

(b) if located within the building, be separated from the remainder of the building by an enclosure with an FRL of at least 120/120/120; and

(c) be connected to the safety systems by means of cabling complying with C3D14(3).'

Additionally, clause C3D13 of the NCC requires that emergency generators used to sustain emergency equipment operating in emergency mode be separated from the remainder of the building by construction achieving a FRL 120/120/120 minimum.

The building will be provided with a diesel generator as the alternative power supply serving the retail atrium. The generator is located on level 2A within the carpark fire compartment. The generator room is required to be provided with louvres to provide cross ventilation when operating. On this basis it is not practical to fire separate the generator room from the carpark fire compartment. This performance solution permits the omission of the fire rating from the generator room on the basis that it is in a separate fire compartment remote from the atrium which it serves.

This assessment was prepared to show that the design complies with performance requirements C1P2 of the NCC.

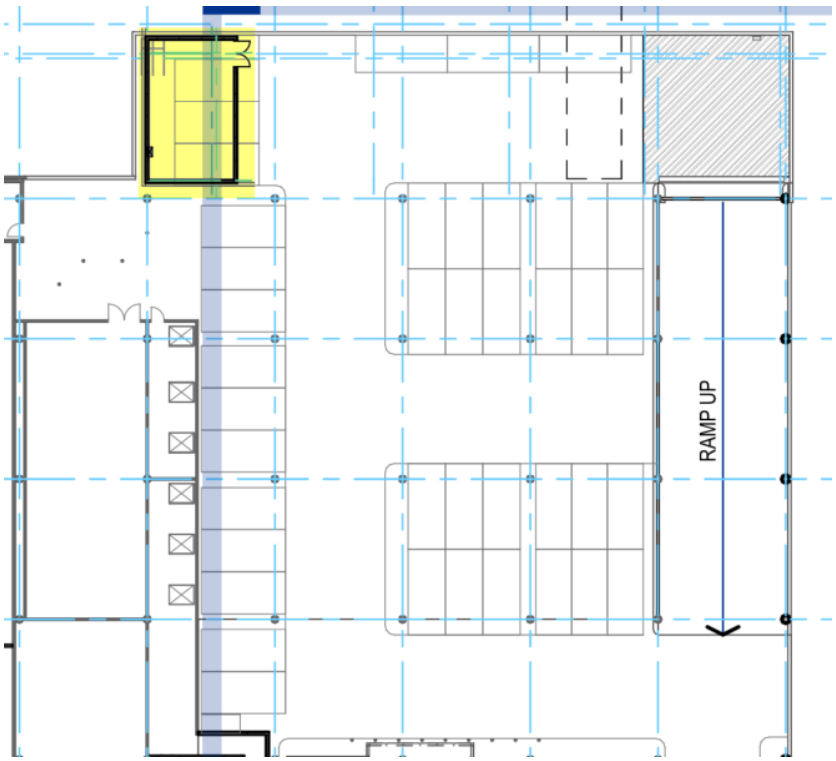


Figure 51 Location of generator room on level 2A north

11.2 Intent of the NCC

The guide to the NCC states that the intent of clause S31C20 is *'to require the installation of a suitable standby power system in a building containing an atrium.*'

It also states that S31C20 '*only applies where a required path of travel to an exit passes through an atrium (see S31C20(1)).*

Under S31C20(1), because of the need to continue the operation of emergency services, a standby power supply is required. This is particularly important because of the increased fire hazard associated with atriums, and the dangers for occupants if they have to evacuate through atriums.

To make sure it operates when needed during a fire, the standby power supply must:

- *automatically come into operation when the normal power supply fails;*
- *if located within the building, be protected by fire-resisting construction;*
- *be connected to the safety systems by means of cabling suitable to resist fire; and*
- *come from two supply sources.*

S31C20 is consistent with the protection required for electricity supply systems in C3D14.

S31C20(3) sets out means of achieving compliance with S31C20(1). To make sure that the necessary power to operate the emergency equipment is available during a fire, it requires the standby power to be from one of the listed alternatives.'

11.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 20.

Table 20 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression

11.4 Acceptance criteria

The acceptance criteria for this assessment is that the atrium part of the building is provided with a suitable standby power supply which is adequately separated from a fire affecting the atrium.

11.5 Fire hazards

Table 21 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 21 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The standby power supply fails to operate due to fire exposure in the event of a fire scenario involving the atrium.	• The generator will be in the level 2A carpark, which is a separate fire compartment, remote from the part of the building including the atrium. • The building is provided with sprinkler protection throughout.

11.6 Fire scenarios

The assessment will consider the following scenarios:

- A worst credible fire scenario affecting the retail atrium compartment at the same time as a general mains power failure leading to operation of the standby generator.
- A worst credible sprinkler-controlled fire scenario involving a fire in the carpark located near the standby power generator.

11.7 Assessment

11.7.1 Retail / atrium fire scenario

As reflected by clause S31C20 and the associated guidance in the NCC, the standby power supply is required specifically to provide additional redundancy to the fire safety systems serving the atrium part of the building. This is clear as the standby power supply is only required where a required path of travel to an exit is within an atrium.

In the event of a fire within the retail part of the building adjoining the central atrium void coinciding with a mains power outage, the generator located on level 2A carpark will provide standby power for the essential fire safety systems serving the atrium. This includes sprinkler systems and fire hydrant pumps, air handling systems, alarms, warning and communication systems and emergency lighting circuits for a duration of not less than 4 hours.

The retail part of the building is fire separated from the level 2A carpark where the generator is located. This fire separation includes glazed elements protected by wall wetting sprinklers at the mall entry points addressed as a performance solution. The generator is on the northern side of the level 2A carpark remote from the closest mall entry.

The retail part of the building is provided with sprinkler protection throughout. In the event of a worst credible sprinkler-controlled fire in the retail / atrium compartment, fire spread can be expected to be limited to the area of fire origin, further mitigating the risk of fire spread between the retail and carpark fire compartments.

In summary, the location of the generator and fire separation of the carpark and retail areas adequately mitigates the risk of the generator being exposed to a fire in the retail / atrium part of the building.

11.7.2 Level 2A carpark fire scenario

A fire occurring on the level 2A carpark involving the vehicles in the spaces adjacent to the generator room represents a potential threat to the generator equipment. The risk of fire spread or damage to the generator from a worst credible sprinkler-controlled fire is low. In the unlikely event of sprinkler failure coinciding with a fire directly adjacent to the generator room, the risk of fire or smoke spread to the retail / atrium part of the building is low.

The generator is in a remote corner of the carpark away from the mall entries. The carpark is also fire separated from the retail part of the building. Level 2A is located above the general retail mall levels, further mitigating the risk of smoke spread downwards to the retail / atrium part of the building.

In the extremely unlikely event of a fire occurring directly adjacent to the generator, coinciding with sprinkler failure and a general power failure, such a scenario would not present a significant hazard to occupants within the atrium part of the building.

11.8 Conclusion

The assessment shows that the atrium part of the building is provided with a suitable standby power supply which is adequately separated from a fire affecting the atrium. The proposed design of the building is therefore considered to comply with performance requirements C1P2 of the NCC, subject to complying with the fire safety measures in section 5.

12. Performance solution 6 – Atrium roof and building construction

12.1 Introduction

12.1.1 Fire rating of roofs

Clause S5C11 and table S5C11g require the roof of a class 6 building of type A fire rated construction to achieve an FRL of 180/60/30. Clause S5C15 of the NCC provides a concession whereby the roof need not achieve an FRL if the covering is non-combustible, and the building has a sprinkler system installed throughout.

12.1.2 Separation of classifications

Clause C3D9 of the NCC requires:

'*If a building has parts of different classifications located alongside one another in the same storey—*

(a) each building element in that storey must have the higher FRL prescribed in Specification 5 for that element for the classifications concerned; or

(b) the parts must be separated in that storey by a fire wall.'

12.1.3 Atrium roofs

Clause G3D6 of the NCC requires:

'*In an atrium—*

(a) the roof must have the FRL prescribed in Table S5C11g; or

(b) the roof structure and membrane must be protected by a sprinkler system (other than a FPAA101D or FPAA101H system) complying with Specification 17.'

Clause S31C3 of specification 31 of the NCC states that:

'(1) A roof of an atrium which does not have the FRL prescribed in Specification 5 or the Deemed-to-Satisfy Provisions of Part C3 must be protected by automatic sprinklers arranged to wet both the covering membrane and supporting structure of the roof…

…

(b) less than 20 m above the floor of the atrium or the floor of the highest storey where the bounding construction is set back more than 3.5 m from the atrium well if a Class 6, 7 or 8 part of a building is open to the atrium.'

12.1.4 Central court atrium

As central court atrium void connects five storeys, the additional atrium provisions under Part G3 of the NCC are applicable – see Figure 52. The following performance solutions are identified for the central atrium void:

- The skylight void which forms part of the existing retail fire compartment will be separated from the new level 3 retail fire compartment by toughened glazing instead of fire-rated construction in accordance with clause C3D9 of the NCC.
- The glass atrium roof will not achieve an FRL and will not be protected by sprinklers arranged to wet the covering membrane and supporting structure.

12.1.5 Victoria Avenue void

The Victoria Avenue void connects three storeys in a sprinkler protected building with one of those storeys having direct egress to a road or open space – see Figure 53. This void is therefore not

required to comply with the additional atrium provisions under Part G3. The glass roof above the void will not achieve a fire rating. Although the building is generally sprinkler protected throughout, sprinklers will not be provided to the glazed roof directly above the void. Subsequently, the roof structure does not qualify for the concession under clause S5C15 of the NCC and is addressed by a performance solution.

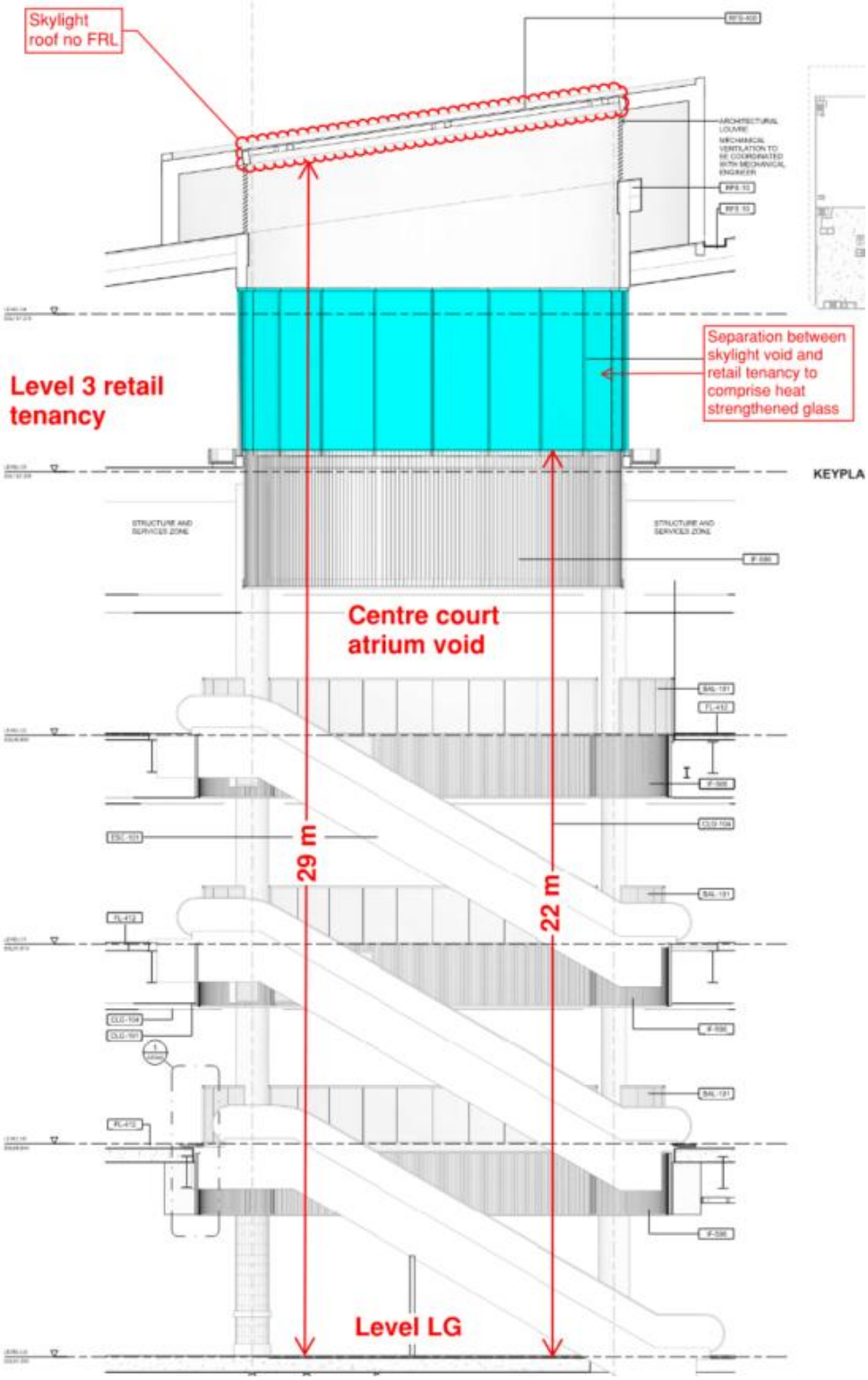


Figure 52 Centre court atrium void

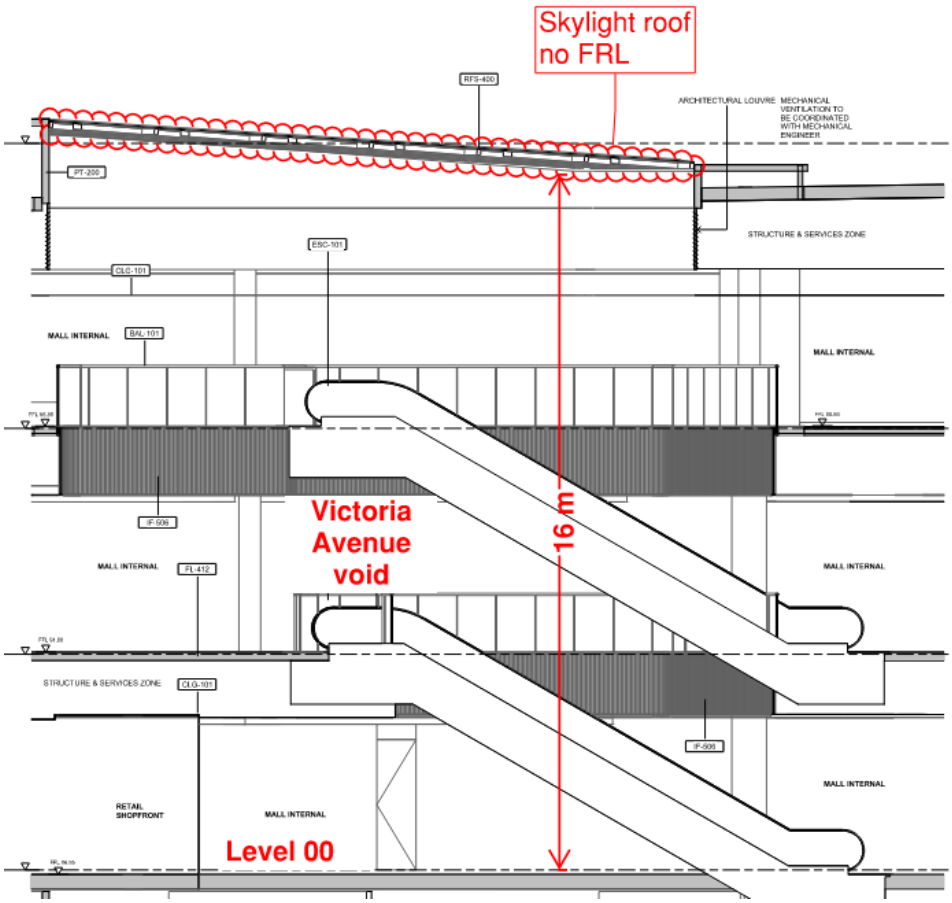


Figure 53 Victoria Avenue void

12.1.6 Linear void

The linear void connects levels 1 and 2 within smoke zone 7 – see Figure 54. As it only connects two storeys, it is not required to comply with the additional atrium provisions under Part G3. The void is however still subject to the requirements of specification 17 and AS 2118.1:2017 for sprinkler protection. The void will be protected with sidewall sprinklers.

Clause 5.6.1(b) of AS 2118.1:2017 stipulates the following in relation to the spacing and location of sidewall sprinklers:

(a) '*The sprinklers shall be mounted with their deflectors not more than 150 mm and not less than 100 mm from the ceiling.*

(b) *In the case of horizontal sidewall sprinklers, the deflector shall be not more than 150 mm from the wall face.*

(c) *In the case of vertical sidewall sprinklers, the centre-line of the sprinklers shall not be less than 50 mm and not more than 150 mm from the wall face.*

(d) *The shall be no obstruction at the ceiling within an area extending a lot the wall 1 m on each side of a sprinkler and 1.2 m at right angles to the wall. Beams on any boundary of this area shall not exceed a depth of 100 mm.'*

Due to the sloped pitch of the roof and spatial constraints, it is not practicable to install the sidewall sprinklers within 150 mm of the ceiling. The sprinklers are instead installed as high as practical – a maximum of 340 mm below the skylight ceiling.

This assessment was prepared to show that the design complies with performance requirements C1P2, C2P2 and E1P4 of the NCC.

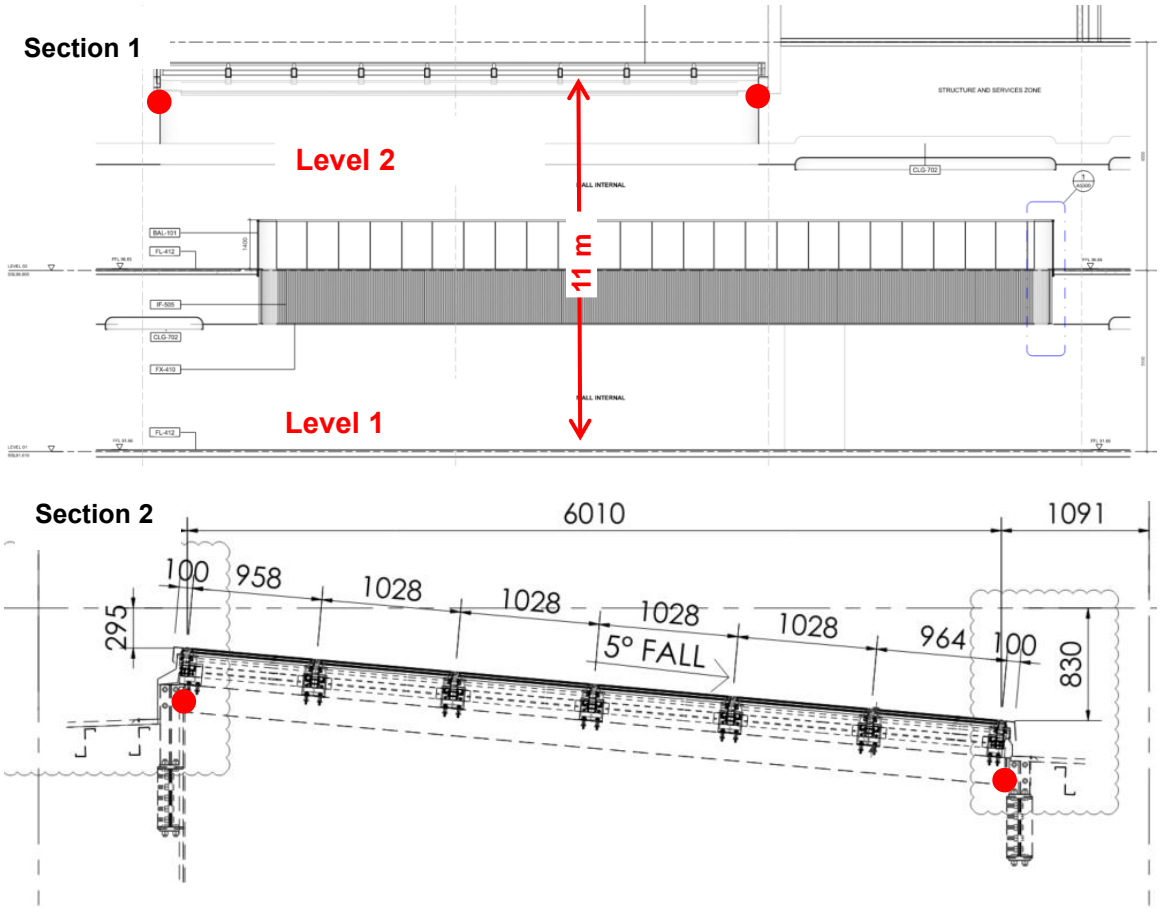


Figure 54 Linear void

12.2 Intent of the NCC

The guide to the NCC states that the intent of clause S5C15 is '*to allow the roofs of certain buildings not to have a fire-resistance level (FRL).*'

The guide states that the intent of clause C3D9 is *'to minimise the risk of a fire in one classification on a storey causing the failure of building elements in another classification on the same storey.*'

The guide states that the intent of clause G3D6 is '*to minimise the risk that the roof of an atrium will not remain in place during a fire.*'

The guide states that the intent of clause S31C3 is '*to set out the roof protection requirements for a building containing an atrium.*'

The guide to the NCC provides the following commentary regarding to atrium floor protection:

'*Because of the height of the roof in an atrium, the sprinklers protecting it are unlikely to be effective at the lowest level of the atrium. Additional sprinklers are therefore normally required to protect that level, as this area is normally a large open space, and is potentially the primary source of a major fire. Adequate protection of the floor often requires the use of sidewall sprinkler heads, as required by S31C4(a). S31C4(a) requires a "performance-type" decision as to the types of sprinklers (sidewall and overhead) and their combination.'*

12.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 22.

Table 22 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative and quantitative absolute
Fire safety sub-systems addressed	Sub-system A – Fire initiation, development and control Sub-system B – Smoke development, spread and control Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression

12.4 Acceptance criteria

The acceptance criteria for this assessment are that:

- The glazed separation between the new and existing retail fire compartments at the top of the centre court atrium void must withstand a worst credible sprinkler-controlled fire scenario within the retail compartment. Heat strengthened glass can be expected to withstand temperatures of more than 250°C[26, 27] which will be adopted as the quantitative failure criteria.
- The risk of fire and smoke spread from a fire on the level 3 retail side of the separation to existing the retail compartment below via the atrium void is mitigated by the sprinkler system and smoke hazard management provisions.
- The risk that the skylight roof structures will fail during a fire is adequately mitigated by the on-floor sprinklers and the height of the roofs.
- Sprinkler provisions to the linear void adequately mitigate the fire risks present.

12.5 Fire hazards

12.5.1 Hazard identification

Table 23 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 23 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Fire and smoke spread between the new and existing retail fire compartments via the glazed void.	• The building is sprinkler protected throughout.

[26] Australian Glass and Window Association, Technical fact sheet: Thermal stress glass breakage, Version 1, June 2019.
[27] Babrauskas, Glass breakage in fires, Fire Science and Technology Inc, 1996

Hazards	Preventive and protective measures
Failure / collapse of the skylight roof structure due to fire exposure.	• The retail void is provided with smoke exhaust which will aid in the removal of smoke and hot gases from below the skylights. • The glazing to the void between the new and existing retail fire compartments on level 3 is to be heat strengthened which can be expected to withstand temperatures of 200°C. • The glazing is located at high level making the risk of direct flame exposure from the retail side low. • Restrictions on fire load directly below the skylights will apply.
A fire impacting the linear void may develop to a size which overrides the building system, due to delayed activation of the sidewall sprinklers.	• Coverage to the base of the void is in part provided to the level 01 on-floor sprinklers. • Restrictions on fire load at the base of the void will apply.

12.5.2 Layout and fire load

Central court atrium

The central court atrium void is circular with a diameter of approximately 11 m. Escalators span the void centrally between levels from lower ground floor to level 02. It is therefore not practical for large combustible items to be located centrally within the void or to span multiple storeys. Isolated hanging banners, displays, and seasonal decorations may be hung within the void.

A retail kiosk will be located at the base of the atrium void – see Figure 55. The area around the void on levels 00, 01, and 02 is designated as circulation space. Kiosks and shopfronts on these levels are set back greater than 5m from the perimeter of the atrium void.

Any wall lining materials within the void located above the level 02 mall ceiling are to be non-combustible or achieve a group number of 1 to minimise the risk of fire spread.



Figure 55 Area around central court atrium – leasing plan

Victoria Avenue void

The Victoria Avenue void connects level 00 to level 02. A retail kiosk is located at the base of the void and it is credible that other displays and seasonal decorations may be present within the void. Other hanging decorations, electronic displays and advertising banners are also expected within the void.

The areas around the void on levels 01 and 02 are designated circulation spaces which can be expected to contain a low fire load. The shopfronts of the closest tenancies to the edge of the atrium void are generally setback 4m or more.

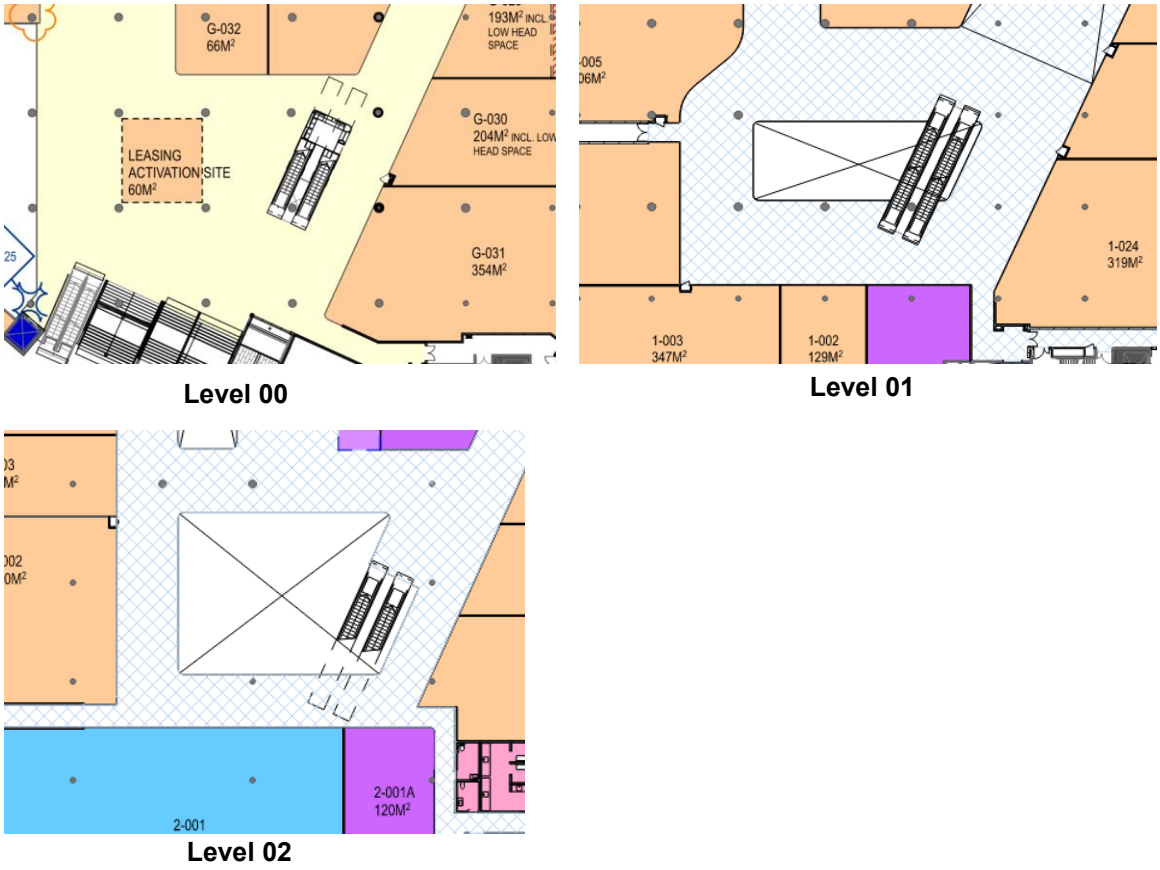


Figure 56 Area around Victoria Avenue void – leasing plan

Linear void

The linear void connects level 01 and level 02. The use of the area below the void is primarily restricted to mall furniture, planters, and signage. The area may also contain temporary display stands and carts. Permanent retail tenancies and kiosks are not permitted below the void.

The area around the void on level 02 is designated circulation spaces which can be expected to contain a low fire load. The shopfronts of the closest tenancies to the edge of the atrium void are generally setback 4 m or more.

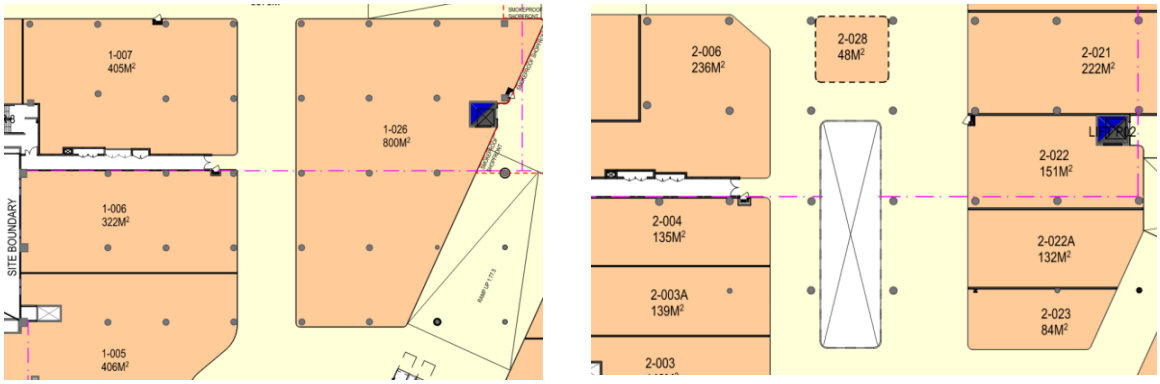


Figure 57 Area around Victoria Avenue void – leasing plan

12.5.3 Sprinklers

Except for the glazed roof structures above the voids, all other parts of the mall are to be provided with compliant sprinkler protection throughout. As discussed in section 7.5.3 the successful activation of the sprinkler system can be expected to limit fire temperatures away from the area of fire origin to less than 100°C.

Sprinklers are proposed to be omitted from below the skylight roofs for the following reasons:

- Hazards associated with maintaining sprinkler heads above the void which would require access from an elevated work platform.
- Reduced efficacy of sprinklers considering the height above the credible fire load.
- The provision of large quantities of smoke exhaust from below the skylight further impacting on the operation of sprinklers.

12.6 Fire scenarios

The assessment will consider the following fire scenarios:

1. Worst credible sprinkler-controlled fire within the retail mall area.
2. Worst credible sprinkler-controlled fire within the level 3 retail area.
3. Robustness scenario involving retail kiosk on lower ground directly below the centre court atrium void where sprinklers fail to control the fire.
4. Robustness scenario involving a kiosk on level 00 directly below the Victoria Avenue void where sprinklers fail to control the fire
5. Robustness scenario involving a fire on level 01 directly below the rectangular void.
6. Robustness scenario involving non-sprinkler-controlled fire scenario within the level 3 retail area.

12.7 Assessment

12.7.1 Performance of heat strengthened glass

The glass between the new level 3 and existing and retail fire compartments and the glazing to both skylights will comprise heat strengthened laminated glass. Heat strengthened glass can withstand higher radiant heat exposure and surface temperature than plain float glass. Testing carried out by the National Research Council of Canada found that '*without water protection, tempered and heat-strengthened glazing can sustain a glazing temperature on the exposed side of more than 350°C. However, when water was sprayed onto the hot glazing, the glazing failed at much lower temperatures. The critical temperatures established for heat-strengthened and tempered glazing are 150–165°C and 200°C, respectively*'.[28, 29] The Australian Glass and Window association identifies that tempered / toughened glass can withstand a temperature difference of about 250°C without failure[30].

12.7.2 Performance of sprinklers in high ceiling areas

Except for the small areas directly below the multi-storey skylight voids, all parts of the mall adjoining the centre atrium and Victoria Avenue voids are provided with full sprinkler coverage. The sprinklers around the perimeter of the voids and below the escalators within the voids can also be expected to provide a degree of coverage to kiosks and isolated combustibles at the base of the voids.

The atrium provisions of the NCC acknowledge the reduced benefit of sprinklers below high-level atrium roofs. Sprinklers are not required below atrium roofs located more than 20 m above the base of the atrium in a class 6 building or more than 12 m above the base of the atrium in a class 2, 3, 5 or 9

[28] Kim, A.K. and Lougheed, G.D. The Protection of Glazing Systems with Dedicated Sprinklers, Journal of Fire Protection Engineering, Vol. 2, 1990, pp. 49-59.
[29] Babrauskas, Glass breakage in fires, Fire Science and Technology Inc, 1996
[30] Australian Glass and Window Association, Technical fact sheet: Thermal stress glass breakage, Version 1, June 2019.

building. The guide to the NCC explains that *'the heights of the atrium roof have been selected as those beyond which a smoke plume produced by a typical fire would no longer be hot enough to damage an unprotected roof.'* The potential smoke plume temperatures for non-sprinkler-controlled fire scenarios below the subject roofs are calculated in section 12.7.5. Other research indicates the efficacy of sprinklers is significantly reduced at ceiling heights above 12 m where sprinklers failed to control fires and head skipping was observed[31, 32].

In both the central and Victoria Avenue skylights, significant smoke exhaust will be provided directly below the skylights. The smoke exhaust will be activated by the smoke detectors within the mall or below the skylights. Once activated the air velocity below the skylights is expected to remove heat and smoke further reducing the efficacy of any sprinklers provided directly below the skylights.

Given the roof height and full sprinkler coverage to the general mall and retail areas, the provision of sprinklers to the central atrium and Victoria Avenue void roofs is not considered to provide any clear benefits to fire suppression in the event of a fire within the retail area.

12.7.3 Fire scenario 1 – sprinkler-controlled fire in the retail mall

In the event of a worst credible sprinkler-controlled fire within the retail fire compartment, temperatures at the top of the atrium void can be expected to be less than 100°C, well below the failure temperature of heat strengthened glazing. Smoke exhaust is also provided from the top of the atrium void which will activate to remove smoke and hot gases from below the skylight structures, further mitigating the risk of the glazed separation failing due to thermal stress.

Smoke modelling has been undertaken for a range of worst credible sprinkler-controlled fire scenarios throughout the mall areas, including a kiosk at the base of the central atrium. For all scenarios the smoke temperatures at the top of the atrium void were significantly less than 100°C – refer to smoke modelling results in 25.7.

12.7.4 Scenario 2 – sprinkler-controlled fire on level 03

The retail compartment will be provided with sprinkler protection throughout. As in the retail compartment, the successful activation of the sprinkler system can be expected to limit temperatures to less than 100°C remote from the fire. Even for a fire in the localised area adjacent to the glazing, sprinklers can be expected to limit temperatures to less than 200°C which is below the failure criteria for heat strengthened glass.

12.7.5 Scenarios 3 and 4 – unsprinklered kiosk fire directly below skylight

The mall levels 00, 01, and 02 include circulation spaces around both the central atrium with kiosks and shops generally setback more than 5m from the perimeter of the voids. Similarly, the mall areas on levels 01 and 02 around the Victoria Avenue void are designated as circulation spaces. While isolated combustibles may be present within these circulation areas, the risk of a large fire developing and threatening the skylight structures in the unlikely event of sprinkler failure is low.

A fire involving a kiosk or display at the base of the voids directly below the skylight is considered to represent the greatest potential exposure hazard in the event of sprinkler failure. Fire plume calculations have been undertaken to evaluate the potential temperature exposure to the skylight structures and glazing to the level 3 retail separation in the event of an unsprinklered kiosk fire at the base of the voids.

The gas temperature near the ceiling was calculated according to Alpert's correlation[33] – see Equation 2 – where T_{max} is the maximum gas temperature, Q_c is the heat release rate, and *H* is the ceiling height.

$$T_{max} - T_{\infty} = \frac{16.9 Q_c^{2/3}}{H^{5/3}}$$

[31] Kung H C et al, 2012, 'Sprinkler protection of non-storage occupancies with high ceiling clearance' Fire Safety Journal, Elsevier, v. 54 pp49-56.
[32] Nam S , 2007, Fire Protection At High Ceiling Clearance Facilities, AOFST 7
[33] Drysdale D, 1998, An introduction to fire dynamics, Second Edition, Wiley, UK, pp 140

Equation 2 Alpert's correlation

A fire size of 10MW was adopted to represent a kiosk fire based on an unsprinklered class 6 occupancy under clause S21C2 of the NCC. This equates to approximately 500kW/m^2 for a 20m^2 kiosk which is conservative given kiosks typically comprise a relatively low fire load compared with fully enclosed shops. This is also representative of a single large vehicle parked at the base of the atrium. The fire was assumed to be raised 2m above floor level to be representative of a typical kiosk fuel package – see Figure 58. The gas temperature for a range of ceiling heights relevant to the scenarios under consideration were calculated as summarised in Table 24.

Table 24 Gas temperatures for various ceiling heights based on 10MW fire

Scenario	Ceiling height	T_{max}
Level 00 kiosk fire below Victoria Avenue skylight	14m	117°C
Level 00 kiosk fire below centre court level 3 glazed separation	20m	74°C
Level 00 kiosk fire below centre court skylight glazing	27m	53°C

The temperatures calculated are below the 250°C adopted as the criteria for failure of toughened glass. This demonstrates that even in the unlikely event of sprinkler failure, the risk of the glazed skylight structure or glazed separation to level 03 being exposed to temperatures which could cause failure is low due to the height and physical separation from high fire load areas. These calculations ignore the beneficial effect of the smoke exhaust system provided below the skylight which can be expected to remove smoke and hot gases.

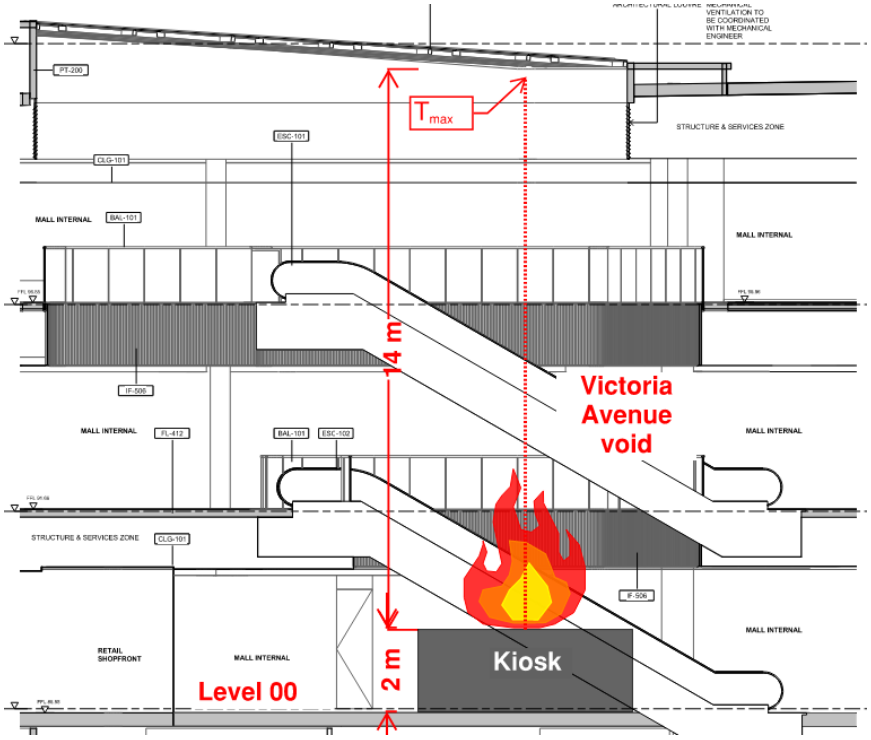


Figure 58 Plume calculation parameters for Victoria Avenue skylight void

12.7.6 Scenario 5 – Fire at the base of the linear void

The level 02 mall area includes circulation spaces around the linear void, with shops generally set back more than 4 m from the perimeter of the linear void. While isolated combustibles may be present within the circulation space, the risk of a large fire developing is low.

On level 01, the use of the base of the void is restricted to mall furniture, signage elements, planters and temporary display stands and carts. Permanent retail shops and kiosks are not permitted below this void.

Coverage to the perimeter of the void is achieved by the general on-floor sprinklers on level 01 – see Figure 59. If a fire develops at the base and begins to spread, it is expected to be controlled by the sprinklers on level 01. Given the limited amount of fire load within the space, it is not expected that a fire at the base of the void in isolation is capable of developing to a size capable of overriding the level 01 sprinkler system.

In the unlikely event that level 01 on-floor sprinklers fail to control the fire at the base of the void, the fire is expected to be of sufficient size and intensity to activate the sidewall sprinklers within the void, despite the minor increase in offset from the skylight ceiling. The sprinkler provisions to the linear void are therefore considered appropriate given the fire hazards present within and at the base of the void.

Furthermore, the guide to the NCC, provides the following commentary in relation to atrium floor protection –

‘*Adequate protection of the floor often requires the use of sidewall sprinkler heads, as required by S31C4(a). S31C4(a) requires a “performance-type” decision as to the types of sprinklers (sidewall and overhead) and their combination.’*

Whilst the linear void is not an atrium as defined by Part G3 of the NCC, the commentary acknowledges that challenges is providing sprinkler coverage to void-type spaces and accepts that performance-type designs may be required.

The sidewall sprinklers will also be quick response heads. This exceeds the requirements of the NCC for the protection of a void not subject to Part G3 atrium provisions and is expected to reduce the delay in sprinkler activation associated with the increased offset from the ceiling.

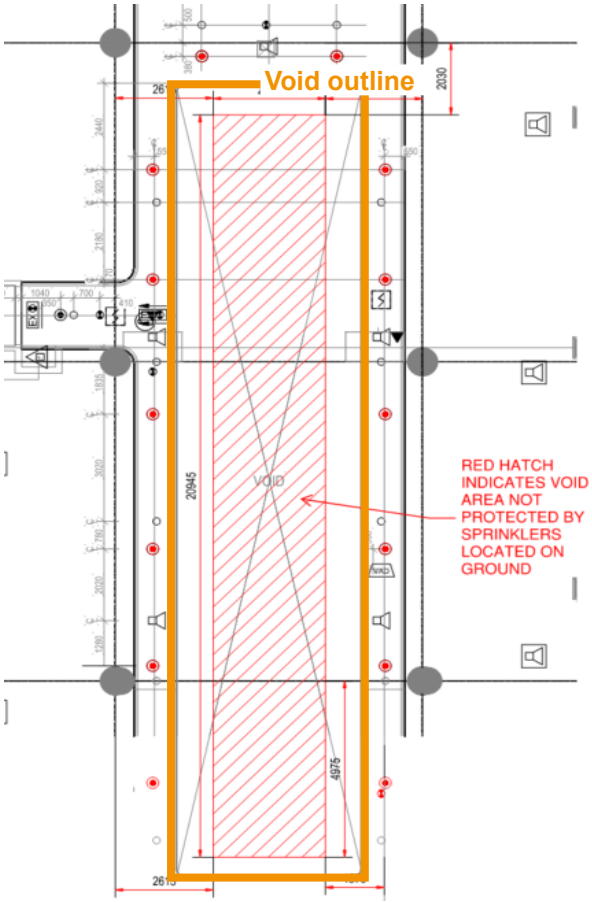


Figure 59 Sprinkler coverage provided to base of linear void by level 01 sprinklers.

12.7.7 Scenario 6 – Sprinkler failure in level 3 retail tenancy

In the unlikely event of sprinkler failure, a fire within a level 3 retail tenancy could become fully developed and result in failure of the heat strengthened glass separation. In this scenario, the roof of the level 3 retail fire compartment, which is not required to be fire rated under the NCC, would also be expected to fail. The risk of significant fire and smoke spread to the mall below via the atrium void is low due to the buoyancy of hot smoke. In the unlikely event of sprinkler failure, the design is sufficiently robust that a disproportionate fire and smoke spread to the retail part of the building is unlikely to occur.

12.7.8 Controls on combustible fuel load

To further mitigate the risk of fire spread within the centre court atrium, Victoria Ave and the linear voids, the following usage and fuel load restrictions are to apply and must be identified as essential fire safety measures:

- Any wall linings or materials within the central atrium void above the soffit of mall level 02 must be either non-combustible or achieve a material group number of 1. This is consistent with the requirements for wall linings in fire-isolated exits and is considered to mitigate the risk of fire spread propagating from the mall areas via wall and ceiling linings and impinging on the glazed skylight and separating elements to the L03 compartment.
- No combustible displays, advertising banners, screens, or seasonal decorations are permitted above the level 02 ceiling within the void areas below the central or Victoria Avenue skylights.

- Combustible displays, large seasonal decorations including Christmas trees, temporary stages, or other combustible installations at the base of the central atrium or Victoria Avenue void must not extend over more than one storey or 5 m above the base of the atrium.
- Isolated or discontinuous hanging banners which do not extend over more than one storey, lighting, and hanging seasonal decorations are permitted within the central atrium and Victoria Avenue voids.
- No rubbish bins, vehicles, permanent retail kiosk, or combustible seasonal decorations exceeding 2 m in height are permitted at the base of the linear void.

Where more extensive combustible items or displays are proposed within the central or Victoria Avenue voids, a separate risk assessment is to be undertaken by an appropriately qualifies fire safety engineer.

12.8 Conclusion

The assessment shows that the glazed separation between the existing and new fire compartments at the top of the centre court atrium void can withstand a worst credible sprinkler-controlled fire scenario within the retail compartment. The risk of fire and smoke spread from a fire on the level 3 retail side of the separation is adequately mitigated by the sprinkler system and smoke hazard management provisions at the top of the atrium. The risk that the skylight roof structures will fail during a fire is adequately mitigated by the on-floor sprinklers and the height of the roofs. The proposed design of the building is therefore considered to comply with performance requirements C1P2, C2P2 and E1P4 of the NCC, subject to complying with the fire safety measures in section 5.

13. Performance solution 7 – Travel distance, smoke hazard management and atrium provisions

13.1 Introduction

Travel distance

Clauses D2D5 and D2D6 of the NCC require that for a class 6 retail building:

- no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m.
- exits that are required as alternative means of egress must be not more than 60 m apart.

The following maximum travel distances are proposed to the retail mall:

- 30 m to a point of choice instead of 20 m – refer to section 15.
- 68 m to the nearest exit instead of 40 m
- 100 m between two alternative exits instead of 60 m.
- This is increased to 119 m between alternative exits Stair 4 and Stair 8 on level 00 – refer to section 13.7.6.

Smoke hazard management

Clause E2D15(2) of the NCC, for a class 6 building containing an enclosed common walkway or mall serving more than one class 6 sole-occupancy unit, states that *'where the floor area of a class 6 part of a fire compartment referred to in (1) is more than 2,000 m^2, the fire compartment, including the enclosed common walkway or mall, must be provided with –*

(a) an automatic smoke exhaust system complying with specification 21; or

(b) if the building is single storey, automatic smoke-and-heat vents complying with specification 22; or

(c) if the floor area of the fire compartment is not more than 3,500 m^2 and the building has a rise in storeys of not more than 2, a sprinkler system (other than a FPAA101D or FPAA101H system) complying with specification 17.'

The existing smoke hazard management system to the areas of new works will be modified as part of this new scope. This performance solution will supersede the existing strategy documented within NDY report no. rp02309s revision M dated 29 September.

The smoke hazard management strategy for the refurbished areas is summarised as follows:

- Separation of the mall into smoke zones as described in Table 25 and smoke zone plans in Appendix D.
- Smoke exhaust will be provided from the smoke zone of fire origin, controlled by dampers following activation of smoke detectors. Smoke exhaust quantities from each zone are summarised in Table 25.
- Make-up air for the smoke exhaust system will be provided through a combination of mall entries and mechanical apply from adjacent zones, and reduced after hours.

The following departures are noted:

- The smoke exhaust rates are proposed to be designed on a performance basis instead of clause S21C2. Smoke exhaust rates proposed are specified in Table 25.
- The size of the smoke reservoirs formed by the retail floor exceeds the 2,000 m^2 limit stipulated by clause S21C4 clause 4 of specification E2.2b.

Table 25 Smoke zoning and exhaust provisions

Smoke zone	Location	Exhaust	Makeup air from adjacent zones	Comment
11	Level 00 Archer Street Mall	30 m^3/s	All mall entry doors open	On-floor exhaust via ceiling coffer details, with exhaust points distributed within ceiling plenum space above the mall. Refer to Figure 34.
12	Level 01 and 02 Archer Street Mall	Level 01 – 20 m^3/s Level 02 – 30 m^3/s	All mall entry doors open	On-floor exhaust via ceiling coffer details, with exhaust points distributed within ceiling plenum space above the mall. Refer to Figure 34.
7	Level LG-02 Centre court atrium zone	240 m^3/s	All mall entry doors open *Lower ground:* Zone 5&6 – 12.5 m^3/s Zone 8&8A – 26.7 m^3/s Kmart – 25.6 m^3/s B-056 – 10.2 m^3/s Coles – 14.85 m^3/s *Ground:* Zone 11 – 10.7 m^3/s Zone 13. – 8.8m^3/s *Level 1:* Zone 12 – 9.8 m^3/s Zone 13 – 11.5 m^3/s *Level 2* Zone 12 – 3.1 m^3/s Mini-majors – 27.9m^3/s	Three exhaust fans with a total of 120 m^3/s provided at the top of the central atrium void above level 3. Three exhaust fans with a total of 120 m^3/s provided at the top of the Victoria Avenue void above level 2 (refer to Figure 35).
13	Level 00 and 01 Havilah Street Mall	80 m^3/s	All mall entry doors open	Two exhaust points with a total of 80 m^3/s along the skylight at the top of the void above level 1. Refer to Figure 36.
9&10 (existing)	Level LG Food court	25 m^3/s	All mall entry doors open	On-floor exhaust via single exhaust point within B-040 bulkhead. DTS compliant smoke exhaust.
Mini-majors 2-015 and 2-018 (>1,000m^2)		DTS compliant smoke exhaust		
David Jones tenancy		Refer to David Jones fire engineering report		

Smoke zone	Location	Exhaust	Makeup air from adjacent zones	Comment
Kmart (existing)		Refer to CSIRO fire safety study report		
Smoke zones 8, 8A and Coles/8B (existing)		Refer to NDY fire engineering report rp02309s dated 2009		
Smoke zones 5 and 6 (existing)		Refer to NDY fire engineering report s25298-001-fe dated 2015		

Atrium provisions

Part G3 of the NCC provides additional requirements for buildings containing an atrium in accordance with the definition provided within Schedule 1 of the NCC. These include atrium well dimensions, bounding construction, fire separation, exits and fire and smoke control systems.

The central court void within the northern retail portion connects lower ground floor to level 2 – four storeys – and is considered an atrium in accordance with clause G3D1 of the NCC. Owing to this connection it has been determined that the Part G3 Atrium Construction requirements of the NCC apply to the whole retail compartment. The provisions to the retail area and atrium are not proposed to comply with part G3 of the NCC in the following aspects:

- Atrium bounding construction – The atrium is proposed to be openly connected to the four retail levels (LG to L2)
- Stair pressurisation – Provision of stair pressurisation to stairs opening into the atrium (retail) compartment will be rationalised:
    - Pressurisation to fire-isolated stairs which do not serve the atrium smoke zone may be omitted.
    - For fire-isolated stairs directly opening into the atrium smoke zone – ie stairs 6, 7, and 8 – the performance criteria for the stair pressurisation system will be based on achieving a velocity of 1 m/s through the door(s) on the level of fire origin, with the final discharge door open.
    - AS 1668.1:2015 would require 1 m/s velocity from the pressurised stair through all doors into the fire affected compartment. Due to the atrium connection, this would mean all doors on all levels of each stair would need to be open when testing the pressurisation system. This is impractical given the size and number of doors in the existing arrangement. The smoke hazard management strategy will utilise atrium smoke exhaust to limit the risk of smoke spread into exits and to limit the risk of smoke spread between zones.
    - The velocity across the Stair 7 door opening into the level 2 Apple storage space is not required to be tested provided that the tenancy is separated from the remainder of the mall by construction, including openings, penetrations and junctions with other building elements, that prevents the free passage of smoke.
- Standby power – alternative power provisions to emergency equipment serving the atrium (retail) are as follows:
    - The following systems are provided with generator backup –
        - New sprinkler and hydrant pumps
        - Smoke exhaust fans
        - Stair pressurisation system
    - The following systems are provided with battery backup –
        - Emergency lighting system

  - Fire alarm system
  - Auto-opening doors and openings for makeup air
- Mechanical air handling units provide makeup air to the atrium smoke zone. Whilst they are supplied by the essential power circuit, they are not provided with alternative power provisions.

Note: The following aspects of the atrium design are addressed in separate performance solutions within this report.

- The atrium is proposed to be separated from the new L3 retail fire compartment by heat strengthened glazing only
- Provision of sprinklers and fire rating to atrium roof structure –
  - Sprinklers under the skylights are not proposed to be provided, where sprinkler coverage to the mall areas can otherwise be achieved by the general on-floor sprinklers.
  - The atrium roof will not achieve the required FRL, despite the structure and membrane not being protected by a sprinkler system.

  Refer to section 12 for assessment.

This assessment was prepared to show that the design complies with performance requirements D1P4, D1P5 and E2P2 of the NCC.

13.2 Intent of the NCC

13.2.1 Clause D2D5 – Exit travel distances

The guide to the NCC states that the intent of clause D2D5 is '*to maximise the safety of occupants by enabling them to be close enough to an exit to safely evacuate.*' It also states that '*the D2D5 travel distances are based on an assumption of what is considered "reasonable" distances to be travelled by occupants in reaching an exit.*'

The guide further explains *'D2D5(3)(a) sets out the maximum travel distance in class 5–9 buildings. The distances specified allow people to evacuate in a reasonable time, assuming that they are not asleep. In case a fire blocks a path of travel, D2D5(3)(a) requires that alternative routes must be available within 20 metres of the starting point, unless it is possible to reach a single exit within 20 m.*'

13.2.2 Clause D2D6 – Distance between alternative exits

The guide to the NCC states that the intent of clause D2D6 is '*to require that if an exit is inaccessible, access to any required alternative exit must be available within a reasonable distance.' It also states that* '*where a building requires multiple exits, the exits maximise the choices of a person evacuating, in case one exit becomes blocked*.'

13.2.3 Clause E2D3 – General requirements

The guide to the NCC states that the intent of clause E2D3 is *'to specify the requirements for minimising the smoke risks.'*

By conservatively estimating the expected peak fire size and subsequent amount of smoke produced based on first principles, the suitability of the design in maintaining tenability in the evacuation routes can be determined taking into account building specific details such as ceiling height and sprinkler system characteristics.

13.2.4 Clause G3D3 – Separation of atrium by bounding walls

The guide to the NCC states that the intent of clause G3D3 is '*to minimise the risk of spread of fire and smoke from or to the atrium or other parts of the building.*'

13.2.5 Clause G3D8 – Fire and smoke control systems

The guide to the NCC states that the intent of clause G3D8 is '*to specify the additional fire and smoke control systems required for an atrium.*'

13.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 26.

Table 26 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Quantitative absolute Deterministic
Fire safety sub-systems addressed	Sub-system A – Fire initiation, development and control Sub-system B – Smoke development, spread and control Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control Sub-system F – Fire services intervention

13.4 Acceptance criteria

13.4.1 ASET/REST timeline

The acceptance criteria for this assessment are:

- Occupants must be able to safely evacuate in the event of the credible worst case fire scenarios.
- The design must facilitate fire brigade intervention.

Occupant safety will be assessed by comparing the available safe egress time (ASET) and the required safe egress time (RSET) which will be quantified based on the credible worst case fire scenarios selected for assessment. The ASET/RSET timeline is illustrated in Figure 60. The design is considered to facilitate safe evacuation if the ASET exceeds the RSET by a suitable safety margin. The ASET will be quantified and evaluated using the occupant tenability criteria identified in section 13.4.3.

Fire brigade intervention will be analysed for the worst credible fire scenarios using the tenability criteria for firefighters identified in section 13.4.4.

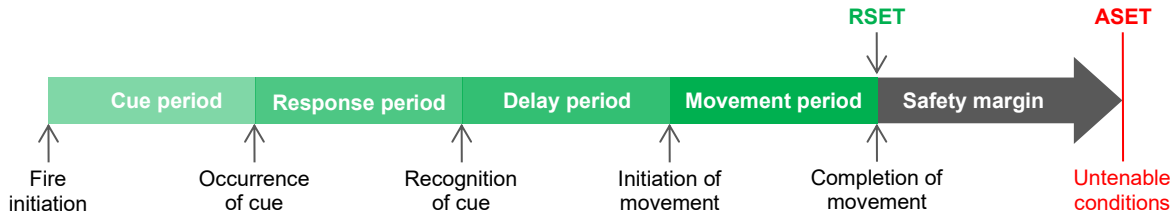


Figure 60 ASET / RSET timeline

13.4.2 Safety factor

All engineering analysis includes a varying degree of uncertainty associated with the assessment methodology and in the estimated input values depending on the amount of relevant statistical data and research available. To account for these potential variations and uncertainties the AFEG recommends that a suitable safety factor be included in the ASET / RSET assessment to achieve an acceptable level of safety.

The required safety factor will depend on the accuracy and level of conservatism of the assessment methodology and the estimated input variables. The greater level of conservatism, the lower safety factor required to achieve the satisfactory level of safety. For worst-credible fire scenarios and conservatively assumed input values no or very limited safety factor is required .

For the purpose of this assessment localised or sprinkler controlled fire scenarios will be used for the ASET / RSET analysis with an additional safety factor of 1.5 – ie a margin of safety equivalent to 50% of each of the components of the RSET will be adopted. Additional safety factors will not be applied when undertaking sensitivity analyses.

13.4.3 Tenability criteria for building occupants

Table 27summarises the criteria used to assess the tenability of evacuation routes which is consistent with the practice note for tenability criteria in building fires prepared by The Society of Fire Safety NSW Chapter[34]. These parameters are evaluated at 2 m above finished floor level based on clause S21C2 of specification 21 specification E2.2b of the NCC which requires smoke control systems to be designed with a minimum smoke layer height of 2 m above the highest floor level. Similarly, the Fire Safety Verification Method (FSVM)[35] requires tenability criteria to be measured at 2 m above floor level.

Table 27 Tenability criteria for evacuating occupants

Tenability criteria	Limiting value	Comment
Visibility to a non-illuminated surface	10 m	Applicable for large enclosures and long travel distances.
	5 m	Applicable for small enclosures of less than 100 m^2 or where the distance to an exit is 5 m or less[34].
Convected heat	60 °C	Applicable for long exposure of more than 10 minutes. The FSVM handbook nominates a fractional effective dose (FED) of thermal effects greater than 0.3 as the criteria[36]. FED for thermal effects does not begin to accumulate unless occupants are exposed to temperatures greater than 60 °C.
	100 °C	Applicable for short term exposure of up to 10 minutes[36].
Radiant heat	2.5 kW/m^2	This equates to a temperature of 200 °C for a black body emitter, and as such the smoke layer must not exceed this temperature above evacuation routes.

13.4.4 Tenability criteria for firefighters

The tenability criteria proposed for firefighters in full turnout gear are identified in Table 13[37] . These parameters are evaluated at 1.5 m above finished floor level for exposure of up to 10 minutes.

Table 28 Tenability criteria for firefighters

Tenability criteria	Limiting value
Radiant heat	3 kW/m^2 above floor level for areas outside the direct vicinity of the fire.

[34] Society of Fire Safety NSW Chapter, Practice note for tenability criteria in building fires, version 2.0, Engineers Australia, 3 April 2014.
[35] Fire Safety Verification Method Standard, 2022, Australian Building Codes Board, Australia, clause 1.5.
[36] Purser DA, 2016, Assessment of hazards to occupants from smoke, toxic gases and heat, The SFPE Handbook of Fire Protection Engineering, 5th edition, SFPE, Springer, chapter 63, figure 63.28.
[37] Australasian Fire and Emergency Service Authorities Council, Fire Brigade Intervention Model Manual, version 3.0, 14 April 2020.

Tenability criteria	Limiting value
Convected heat	120 °C above floor level for areas outside the direct vicinity of the fire.

13.4.5 Stair pressurisation

The following acceptance criteria will be adopted for the assessment of the stair pressurisation system:

- The proposed stair pressurisation provisions adequately mitigate the risk of smoke spread into fire stairs serving the retail compartment.
- Where the performance of the stair pressurisation system serving a fire stair is proposed to be reduced, the presence of the atrium within the retail compartment must not increase the risk of smoke spread into the fire stair which would otherwise not require stair pressurisation.

13.5 Fire hazards

13.5.1 Hazard identification

Table 29 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 29 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Occupants are exposed to untenable smoke conditions before evacuating to a place of relative safety.	• The retail mall will be provided with a performance-based smoke exhaust system. • The retail mall will be provided with multiple alternative exits via a combination of fire-isolated stairs and exits discharging directly outside • A sprinkler system will be installed throughout the building. • The retail mall will be provided with smoke detectors connected to activate the emergency warning system for early warning. • Emergency lighting and exit signage will be provided for wayfinding.

13.5.2 General occupancy characteristics

The general fire hazards and characteristics of retail occupancies are as follows:

- Historically, retail occupancies represent a low life safety risk. US data collected between 2009-2013 for 13,570 retail occupancies recorded 12 civilian fire deaths[38].
- The potential loss of life is high due to the high occupant density in peak periods. However, the risk of a worst case fire occurring and not being noticed or extinguished during a peak period is very low[38]. This is supported by US data which shows that whilst fires are more common during the day, the loss per fire is greater outside of trading hours[38].
- Occupants may have limited familiarly with the layout of the building. Provided they are not obstructed, occupants can be expected to evacuate via the main tenancy and mall entrances.
- 72% of the fires did not extend beyond the room of fire origin[38].

[38] Campbell R, 2015, US Structure fires in stores and other mercantile properties, National Fire Protection Association.

13.5.3 Fire load

The primary fire hazard with respect to the risk of obstruction, size and intensity is a fire involving stock and stored commodities. The building will contain a variety of commodities and fire load configurations including free standing stock, shelving, palletised storage and rack storage.

The building will be provided with sprinkler protection throughout. As discussed in section 7.5.3, the presence of a sprinkler system can be expected to control fire development, if not extinguish the fire.

Fire load data for various retail occupancies[39] is summarised in Figure 61.

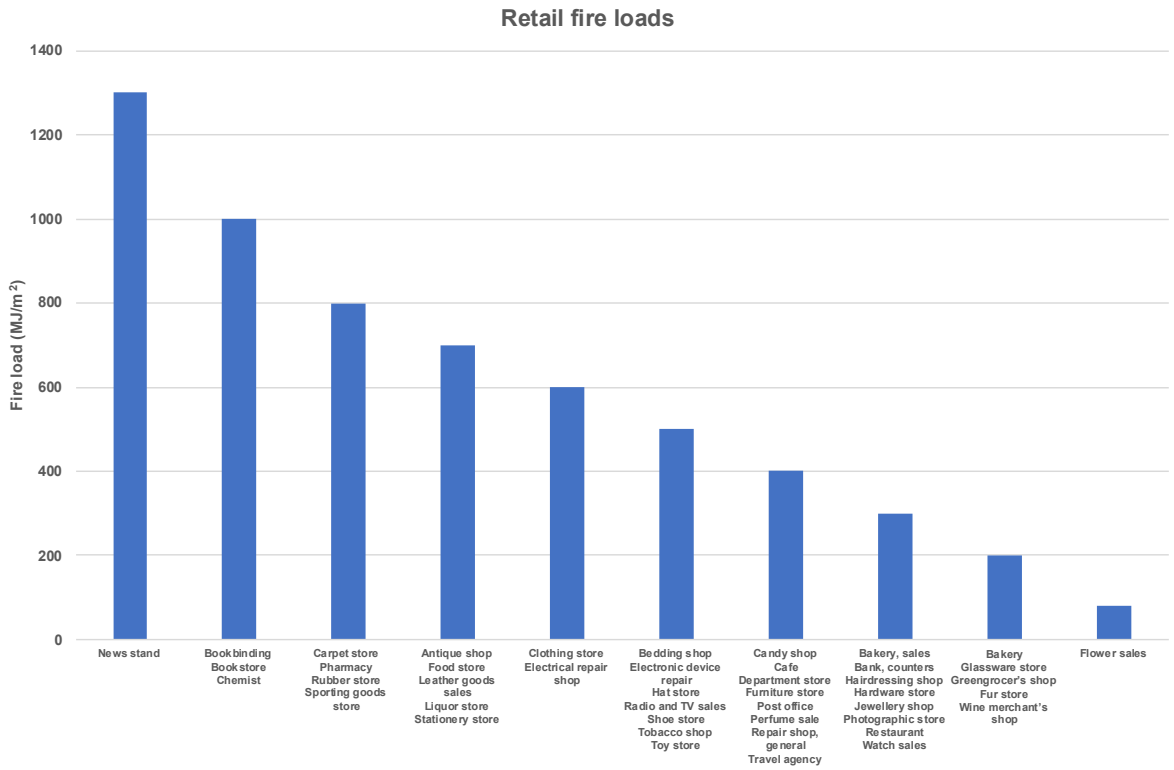


Figure 61 Fire load densities for retail occupancies

13.5.4 Ignition sources

The following leading ignition sources were identified based on US data collected between 2009-20131:

- cooking equipment (21%)
- electrical and lighting equipment (15%)
- arson (11%)
- heating equipment (11%)
- smoking materials (6%).

[39] Thomas PH, 1986, Design guide: Structural fire safety CIB W14 Workshop report, Fire Safety Journal, volume 10, issue 2, table A1.3.13.

13.6 Fire scenarios

The selection of appropriate fire scenarios must take into consideration the:

- likelihood of occurrence
- potential consequences
- impact on the issues being assessed.

Considering the fire hazards identified in section 13.5 and the criteria described above, the following fire scenarios have been selected to be quantitatively analysed:

Table 30 Fire scenarios

No.	Fire location	Fire size and growth rate	Comments
Lower ground floor			
1	Specialty tenancy B-031 (Zone 7)	1.5 MW fast t^2	Worst credible blocked exit scenario for Zone 7 on lower ground: • The fire growth rate is assumed to be controlled upon activation of the first row of sprinklers. • Zone 7 on lower ground floor forms one smoke zone with the centre court zones on levels 00 to 2, connected by the centre court atrium and Victoria Avenue voids. Zone 7 is served by mechanical exhaust at the top of atrium, activated by the smoke detection system. • Lower ground food court (LG.9&10) is provided with on-floor mechanical smoke exhaust, activated by the smoke detection system. • The tenancy and the remainder of the building are assumed to be occupied at the maximum population. • Exits out into the Victoria Avenue and Mills Lane loading docks adjacent to the fire location are assumed to be blocked.
2	Kiosk Site 11 (Zone 7)	1.5 MW fast t^2	Worst credible scenario for Zone 7 on lower ground: • The fire growth rate is assumed to be controlled upon activation of the first row of sprinklers. • Zone 7 on lower ground floor forms one smoke zone with the centre court zones on levels 00 to 2, connected by the centre court atrium and Victoria Avenue voids. Zone 7 is served by mechanical exhaust at the top of atrium, activated by the smoke detection system. • Lower ground food court (zones 9&10) is provided with on-floor mechanical smoke exhaust, activated by the smoke detection system. • The building is assumed to be occupied at the maximum population. • Egress into the mall assumed to be blocked for populations within K-Mart and B-056 on lower ground.
3	Specialty tenancy B-031 (Zone 7)	3.5 MW fast t^2	Sensitivity analysis for scenario 1: • Same as scenario 1 except that the fire is assumed to be controlled by the second row of sprinkler heads, resulting in a larger fire size.

No.	Fire location	Fire size and growth rate	Comments
Ground level (level 00)			
4	Specialty tenancy G-034 (Zone 7)	1.5 MW fast t^2	Worst credible blocked exit scenario for Zone 7 on level 00: • The fire growth rate is assumed to be controlled upon activation of the first row of sprinklers. • Zone 7 forms one smoke zone with centre court zones on levels 00 to 02. • Zone 7 is served by mechanical exhaust at the top of atrium, activated by the smoke detection system. • The tenancy and the remainder of the building are assumed to be occupied at the maximum population. • The exit into fire-isolated stair 8 directly adjacent to the fire location are assumed to be blocked. • This is also considered to be representative of the worst credible scenario for this smoke zone on levels 01 and 02, given the similar layout except that these levels have ceiling heights.
5	Specialty tenancy G-031 (Zone 7)	1.5 MW fast t^2	Worst credible scenario for Zone 7 on level 00 with consideration to proximity to exhaust and adjacent smoke zone: • The fire growth rate is assumed to be controlled upon activation of the first row of sprinklers. • Zone 7 on level 00 forms one smoke zone with the centre court zones on levels 00 to 02, connected by the centre court atrium and Victoria Avenue voids. • Zone 7 is served by mechanical exhaust at the top of atrium, activated by the smoke detection system. The tenancy and the remainder of the building are assumed to be occupied at the maximum population. • All exits are assumed to be available in this scenario.
6	Specialty tenancy G-034 (Zone 7)	2.8 MW fast t^2	Sensitivity analysis for scenario 4: Same as scenario 4 except that the fire is assumed to be controlled by the second row of sprinkler heads, resulting in a larger fire size.
7	Specialty tenancy G-027A (Zone 13)	1.5 MW fast t^2	Worst credible blocked exit scenario for Zone 13 on level 00: • The fire growth rate is assumed to be controlled upon activation of the first row of sprinklers. • Zone 13 on level 00 forms one smoke zone with the Havilah Street mall zone on level 1. • Level 00 mall provided with mechanical smoke exhaust, activated by the smoke detection system. • The tenancy and the remainder of the building are assumed to be occupied at the maximum population. • Fire-isolated stair 6 directly adjacent to the fire location are assumed to be blocked. • This is also considered to be representative of the worst credible scenario for this smoke zone on level 1 given the similar layout of the two levels.
8	Specialty tenancy G-027A (Zone 13)	2.8 MW fast t^2	Sensitivity analysis for scenario 7: • Same as scenario 7 except that the fire is assumed to be controlled by the second row of sprinkler heads, resulting in a larger fire size.

No.	Fire location	Fire size and growth rate	Comments
Level 1			
9	Specialty tenancy 1-009 (Zone 12)	1.5 MW fast t^2	Worst credible blocked exit scenario for Zone 12 on level 1: • The fire growth rate is assumed to be controlled upon activation of the first row of sprinklers. • Zone 12 on level 1 forms a combined smoke zone with the Archer St mall above on level 02. The two areas are connected via an escalator void. • Level 1 and 2 malls are provided with mechanical smoke exhaust within ceiling plenum, activated by the smoke detection system. • The tenancy and the remainder of the building are assumed to be occupied at the maximum population. • The exit into fire-isolated stair 8 directly adjacent to the fire location are assumed to be blocked. • This is also considered to be representative of the worst credible scenario for this smoke zone on levels 00 and 02, given the similar layout of the two levels except that these levels have height ceiling heights.
10	Specialty tenancy 1-009 (Zone 12)	2.8 MW fast t^2	Sensitivity analysis for scenario 9: Same as scenario 9 except that the fire is assumed to be controlled by the second row of sprinkler heads, resulting in a larger fire size.
Level 2			
11	Specialty tenancy 2-024 (Zone 7)	1.5 MW fast t^2	Worst credible blocked exit scenario for Zone 7 on level 02: • The fire growth rate is assumed to be controlled upon activation of the first row of sprinklers. • Zone 7 on lower ground floor forms one smoke zone with the centre court zones on levels 00 to 02, connected by the centre court atrium and Victoria Avenue voids. • Zone 7 is served by mechanical exhaust at the top of atrium, activated by the smoke detection system. • The tenancy and the remainder of the building are assumed to be occupied at the maximum population. • The carpark exit adjacent to the fire location is assumed to be blocked.
12	Specialty tenancy 2-024 (Zone 7)	2.8 MW fast t^2	Sensitivity analysis for scenario 11: • Same as scenario 11 except that the fire is assumed to be controlled by the second row of sprinkler heads, resulting in a larger fire size.

No.	Fire location	Fire size and growth rate	Comments
13	Specialty tenancy 2-010 (Zone 12)	2.8 MW fast t^2	Worst credible blocked exit scenario for Zone 12 on level 2: • The fire growth rate is assumed to be controlled upon activation of the first row of sprinklers. • Zone 12 level 02 forms a combined smoke zone with the Archer St mall below on level 01. The two areas are connected via an escalator void. • Level 2 mall provided with mechanical smoke exhaust within ceiling plenum, activated by the smoke detection system. • The tenancy and the remainder of the building are assumed to be occupied at the maximum population. • The exit into fire-isolated stair 8 directly adjacent to the fire location are assumed to be blocked. • This is also considered to be representative of the worst credible scenario for this smoke zone 11 on level 00, given the similar layout of the two levels except that these levels have height ceiling heights.

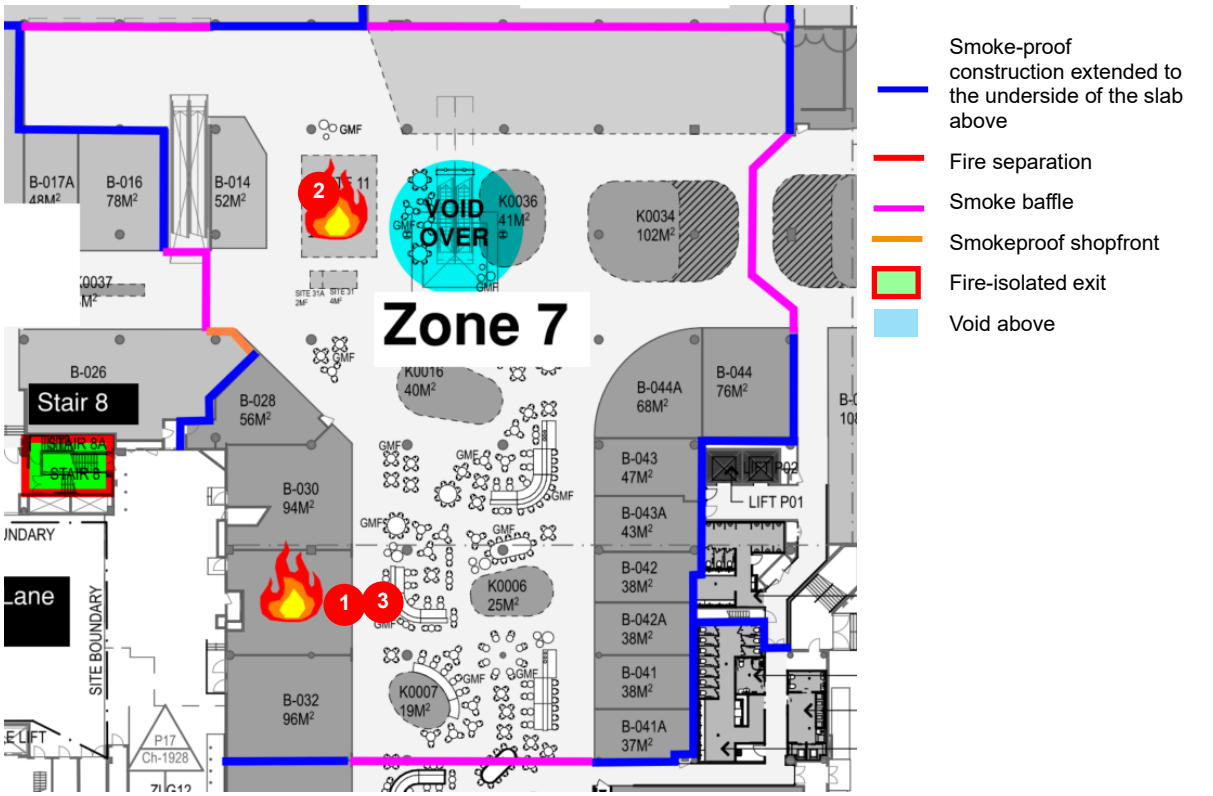


Figure 62 Fire scenario – Lower ground floor

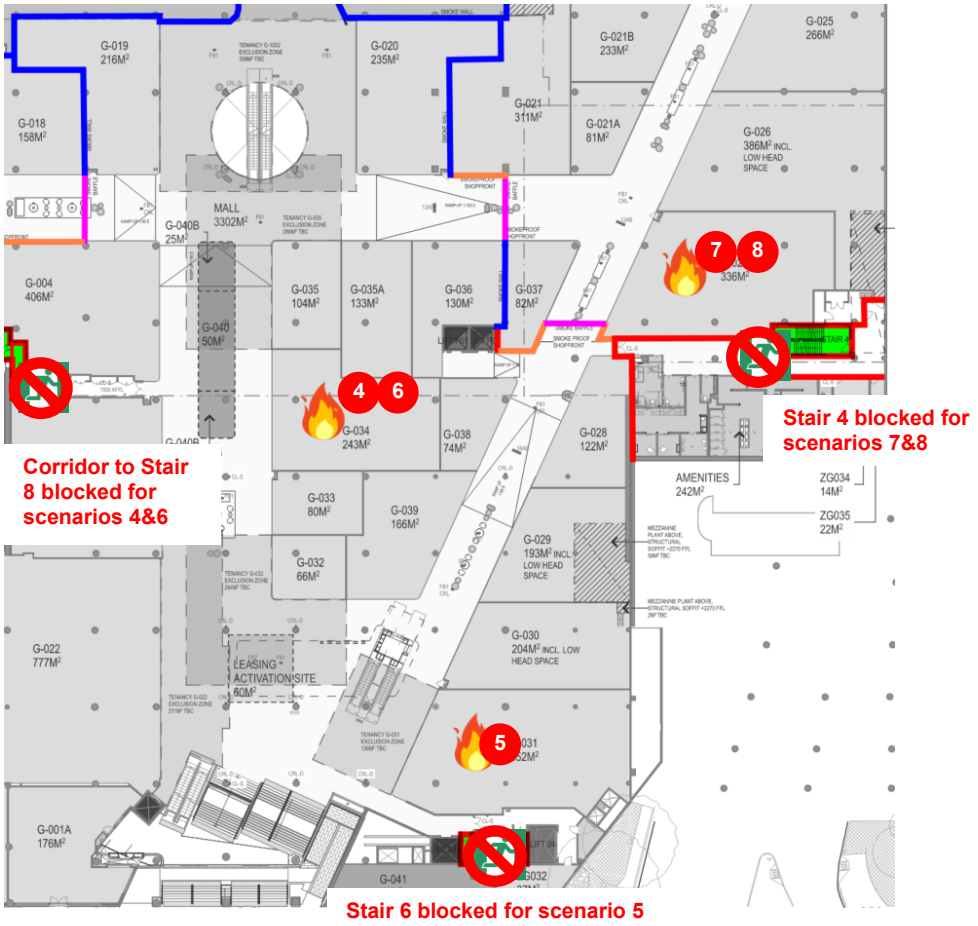


Figure 63 Fire scenario – Level 00

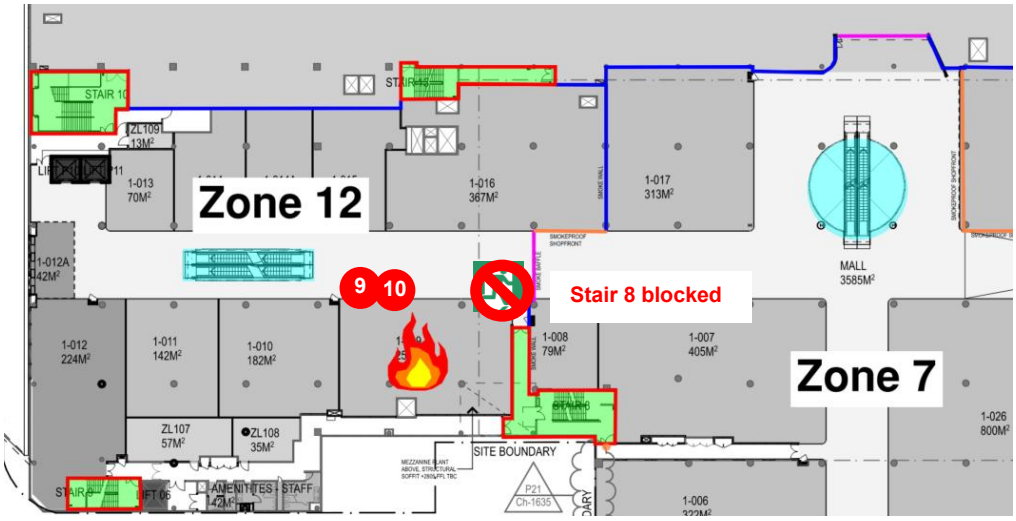


Figure 64 Fire scenario – Level 1

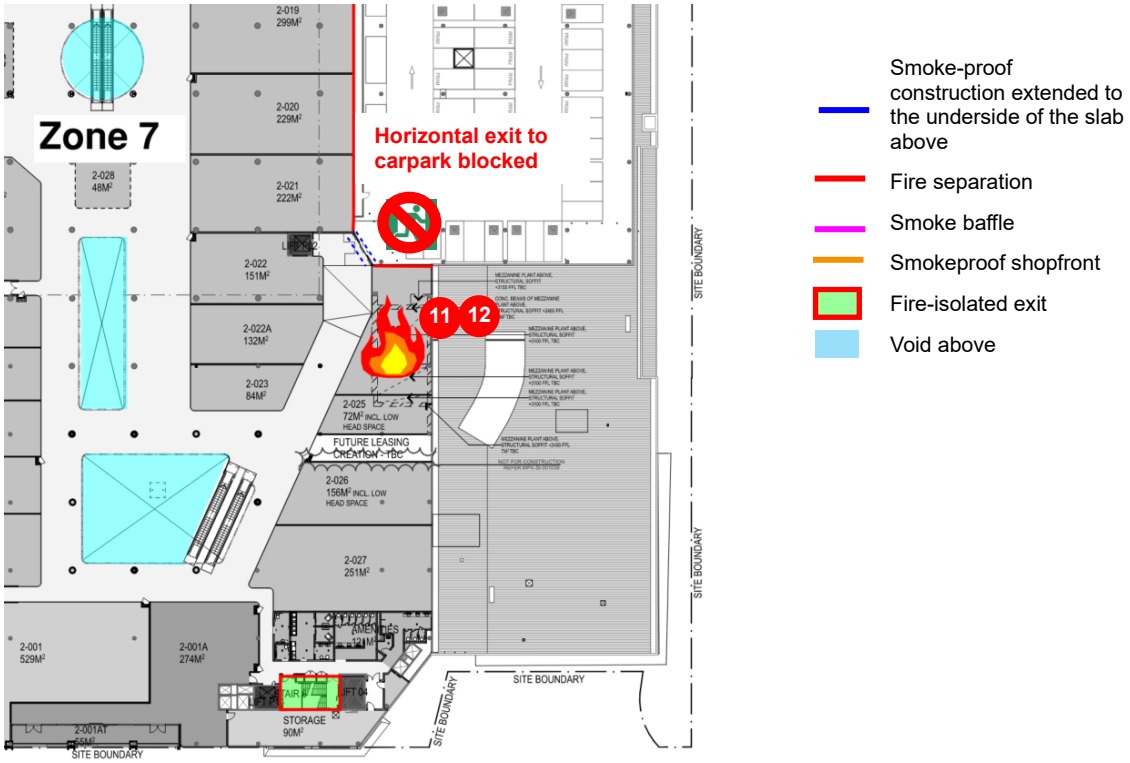


Figure 65 Fire scenario – Level 2 Zone 7

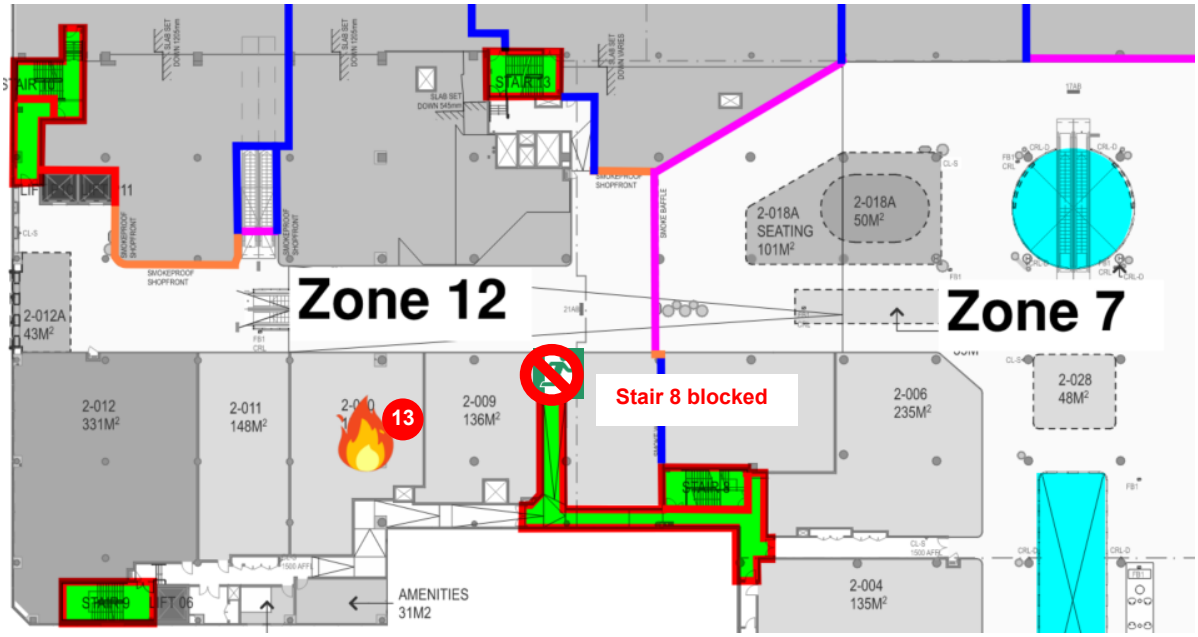


Figure 66 Fire scenario – Level 2 Zone 12

13.6.1 Design fire

To carry out a quantitative fire safety assessment it is necessary to describe the fire scenarios as 'design fires' by specifying parameters such as heat release and time. The design fire provides the basis for calculation fire and smoke characteristics used to evaluate the tenability criteria.

The following assumptions have been incorporated into the characterisation of the design fires used for the assessment of the building:

- The incipient phase of fire development is excluded for conservatism.
- The fire is assumed to develop at a fast t^2 growth rate[40,41,42].
- The time for activation of the sprinkler system within the building has been based upon sprinkler heads with a response time index (RTI) of 50 $(ms)^{1/2}$, activation temperature of 68 °C and spacing of 3.5 m x 3.5 m.
- The fire is in the centre of four heads – ie worst case location in terms of distance to a head.
- The sprinkler system within the building has conservatively been assumed to control the fire rather than suppressing the fire – ie the heat release rate at sprinkler activation is maintained rather than reduced.
- The base of the fire is assumed to be raised 0.5 m above the finished floor level.

The time for activation of the sprinkler system within the warehouse has been determined using Alpert's correlation[43] and research into the heat loss effect of thermal response of automatic sprinklers[44]. The input values used in the modelling of the sprinkler controlled design fire are shown in Table 31 and the output data is attached in Appendix E.

[40] Society of Fire Safety NSW Chapter – Practice Note for Design Fires version 1.0, 22 March 2012 – Table 7.
[41] Guide E – Fire Engineering, 4th Edition, CIBSE, UK, 2019 – Table 6.2
[42] British Standard BS EN 1991-1-2:2002, Annex E, Eurocode 1: Actions on structures – Part 1-2: General actions – Table 4.5
[43] Alpert RL, Calculation of response time of ceiling mounted fire detectors, Fire Technology, 8(3), pages 181 – 195, 1972.
[44] Heskestad G and Bill RG, Conduction heat-loss effect on thermal response of automatic sprinklers, Fire Safety Journal, v.14, pages 113-125, 1988.

Table 31 Calculation of sprinkler activation and maximum heat release

Fire location	Growth rate	Height above fire (m)	Activation time (s)	Fire size calculated / modelled (MW)
Lower ground				
Scenario 1 – Fire in specialty tenancy B-031 (Zone 7)	Fast	4.25	182	1.47 / **1.5**
Scenario 2 – Fire in kiosk Site 11 (Zone 7)	Fast	4.25	172	1.47 / **1.5**
Scenario 3 – Fire in specialty tenancy B-031 (Zone 7, sensitivity)	Fast	4.25	277	3.41 **/ 3.5**
Ground level (level 00)				
Scenario 4 – Fire in specialty tenancy G-034 (Zone 7)	Fast	3.5	164	1.07 / **1.5**
Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)	Fast	3.5	164	1.2 / **1.5**
Scenario 6 – Fire in specialty tenancy G-034 (Zone 7, sensitivity)	Fast	3.5	250	2.78 **/ 2.8**
Scenario 7 – Fire in specialty tenancy G-027A (Zone 13)	Fast	3.5	164	1.2 / **1.5**
Scenario 8 – Fire in specialty tenancy G-027A (Zone 13, sensitivity)	Fast	3.5	164	2.78 **/ 2.8**
Level 1				
Scenario 9 – Fire in specialty tenancy 1-009 (Zone 12)	Fast	3.5	164	1.2 / **1.5**
Scenario 10 – Fire in specialty tenancy 1-009 (Zone 12, sensitivity)	Fast	3.5	250	2.78 **/ 2.8**
Level 2				
Scenario 11 – Fire in specialty tenancy 2-024 (Zone 7)	Fast	3.5	164	1.2 / **1.5**
Scenario 12 – Fire in specialty tenancy 2-024 (Zone 7, sensitivity)	Fast	3.5	250	2.78 **/ 2.8**
Scenario 13 – Fire in specialty tenancy 2-010 (Zone 12)	Fast	3.5	164	1.2 / **1.5**

13.7 Assessment

13.7.1 Smoke modelling

Computational fluid dynamics (CFD) modelling

The ASET was determined by modelling the development of untenable conditions within the retail mall. This involves modelling smoke production and spread with respect to fire size and time. The ASET values are determined based on the output of the modelling conducted to predict smoke generation and movement.

CFD was used to model smoke generation and movement. The CFD program used for this modelling was Fire Dynamics Simulator (FDS) version 6[45,46]. This program has been developed by the National Institute of Science and Technology (NIST) in the United States, for the purposes of modelling smoke and fire in buildings and outdoors. A full description of the CFD modelling conducted is included in Appendix H.

Smoke modelling results

The results of the smoke modelling for the building are summarised in Table 32 with the output data attached in Appendix H.

Table 32 Summary of smoke modelling results

Fire scenario	Area considered	ASET (mm:ss)	Criteria	Comment
Lower ground floor				
Scenario 1 – Fire in specialty tenancy B-031 (Zone 7)	Zone 7 and lower ground food court	>15:00 >15:00 **6:41**	Heat flux 2.5 kW/m^2 Smoke temp 60 °C **Visibility 10 m**	Visibility reduced to less than 10 m throughout a significant portion of the mall smoke zones adjoining the tenancy of origin.
	Rest of lower ground level mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 9 minutes.
	Zone 7 on level 00	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 9 minutes.
	Zone 7 on level 01	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 9 minutes.
	Zone 7 on level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 9 minutes.
Scenario 2 – Fire in kiosk site 11 (Zone 7)	Zone 7 and lower ground food court	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes Steady state reached at 10 minutes.
	Rest of lower ground level mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes Steady state reached at 10 minutes.
	Zone 7 on level 00	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 10 minutes.
	Zone 7 on level 01	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 10 minutes.

[45] National Institute of Standards and Technology (NIST), FDS and Smokeview (SMV), https://pages.nist.gov/fds-smv/downloads.html/, accessed 3 April 2020, United States Department of Commerce, USA.
[46] McGrattan K et al, 2020, NIST Special Publication 1019: 6th edition, Fire Dynamics Simulator user's guide, United States Department of Commerce, USA.

Fire scenario	Area considered	ASET (mm:ss)	Criteria	Comment
	Zone 7 on level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 10 minutes.
Scenario 3 – Fire in specialty tenancy B-031 (Zone 7, sensitivity)	Zone 7 and lower ground food court	>15:00 >15:00 **5:15**	Heat flux 2.5 kW/m^2 Smoke temp 60 °C **Visibility 10 m**	Visibility reduced to less than 10 m throughout a significant portion of the mall smoke zones adjoining the tenancy of origin.
	Rest of lower ground level mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes
	Zone 7 on level 00	>15:00 >15:00 **8:35**	Heat flux 2.5 kW/m^2 Smoke temp 60 °C **Visibility 10 m**	Visibility reduced to less than 10 m throughout a significant portion of the mall smoke zone on level 00.
	Zone 7 on level 01	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes
	Zone 7 on level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes
Ground level (level 00)				
Scenario 4 – Fire in specialty tenancy G-034 (Zone 7)	Zone 7 on level 00	>15:00 >15:00 **12:30**	Heat flux 2.5 kW/m^2 Smoke temp 60 °C **Visibility 10 m**	Visibility reduced to less than 10 m throughout a significant portion of the mall smoke zone adjoining the tenancy of origin.
	Rest of level 00 mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 14 minutes.
	Zone 7 on level 01	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 14 minutes.
	Zone 7 on level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 14 minutes.
Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)	Zone 7 on level 00	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 5 minutes.
	Rest of level 00 mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 5 minutes.
	Zone 7 on level 01	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 5 minutes.
	Zone 7 on level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 5 minutes.

Fire scenario	Area considered	ASET (mm:ss)	Criteria	Comment
Scenario 6 – Fire in specialty tenancy G-034 (Zone 7, sensitivity)	Zone 7 on level 00	>15:00 >15:00 **10:00**	Heat flux 2.5 kW/m^2 Smoke temp 60 °C **Visibility 10 m**	Visibility reduced to less than 10 m throughout a significant portion of the mall smoke zone adjoining the tenancy of origin.
	Rest of level 00 mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
	Zone 7 on level 01	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
	Zone 7 on level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
Scenario 7 – Fire in specialty tenancy G-027A (Zone 13)	Zone 13 on level 00	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
	Rest of level 00 mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
	Zone 13 on level 01	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
Scenario 8 – Fire in specialty tenancy G-027A (Zone 13, sensitivity)	Zone 13 on level 00	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
	Rest of level 00 mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
	Zone 13 on level 01	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
Level 01				
Scenario 9 – Fire in specialty tenancy 1-009 (Zone 12)	Zone 12 on level 1	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 4.5 minutes.
	Rest of level 01 mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 4.5 minutes.
	Zone 12 on level 2	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10	No loss of tenability after 15 minutes. Steady state reached at 4.5 minutes.
Scenario 10 – Fire in specialty tenancy	Zone 12 on level 1	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.

Fire scenario	Area considered	ASET (mm:ss)	Criteria	Comment
1-009 (Zone 12, sensitivity)	Rest of level 01 mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
	Zone 12 on level 2	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10	No loss of tenability after 15 minutes.
Level 02				
Scenario 11 – Fire in specialty tenancy 2-024 (Zone 7)	Zone 7 Level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 12.5 minutes.
	Remainder of the mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 12.5 minutes.
Scenario 12 – Fire in specialty tenancy 2-024 (Zone 7, sensitivity)	Zone 7 Level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
	Remainder of the mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes.
Scenario – Fire in specialty tenancy 1-009 (Zone 12)	Zone 12 on Level 02	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 7 minutes.
	Remainder of the mall	>15:00 >15:00 >15:00	Heat flux 2.5 kW/m^2 Smoke temp 60 °C Visibility 10 m	No loss of tenability after 15 minutes. Steady state reached at 7 minutes.

13.7.2 Evacuation modelling

The results of the evacuation assessment for the retail mall are summarised in Table 33. A full description of the evacuation assessment and calculations is attached in Appendix I.

Table 33 Evacuation times

Fire scenario	Area considered	Cue period (mm:ss)	Pre-movement + movement period (mm:ss)	RSET (mm:ss)
Lower ground level				
Scenario 1 – Fire in specialty tenancy B-031 (Zone 7)	Zone 7 and lower ground food court	1:00	2:24	**3:24**
	Rest of lower ground level mall	1:24	5:17	**6:41**
	Level 00	1:24	6:24	**7:48**
	Level 01	1:24	10:48	**11:12**
	Level 02	1:24	8:58	**10:22**

Fire scenario	Area considered	Cue period (mm:ss)	Pre-movement + movement period (mm:ss)	RSET (mm:ss)
Scenario 2 – Fire in kiosk site 11 (Zone 7)	Zone 7 and lower ground food court	0:48	2:24	**3:12**
	Rest of lower ground level mall	0:48	5:17	**6:05**
	Level 00	0:48	6:23	**7:12**
	Level 01	0:48	9:48	**10:36**
	Level 02	0:48	10:34	**11:23**
Scenario 3 – Fire in specialty tenancy B-031 (Zone 7, sensitivity)	Zone 7 and lower ground food court	1:00	2:27	**3:27**
	Rest of lower ground level mall	1:24	5:17	**6:41**
	Level 00	1:24	7:22	**8:46**
	Level 01	1:24	9:06	**11:30**
	Level 02	1:24	11:06	**12:30**
Ground level (level 00)				
Scenario 4 – Fire in specialty tenancy G-034 (Zone 7) **Scenario 6** – Fire in specialty tenancy G-034 (Zone 7, sensitivity)	Zone 7 on level 00	1:10	3:06	**4:16**
	Rest of level 00 mall	1:32	6:36	**8:09**
	Level 01	1:32	8:04	**9:36**
	Level 02	1:32	9:26	**10:58**
Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)	Zone 7 on level 00	1:15	5:05	**6:20**
	Rest of level 00 mall	2:23	6:48	**9:11**
	Level 01	2:23	9:53	**12:16**
	Level 02	2:23	10:08	**12:31**
Scenario 7 – Fire in specialty tenancy G-027A (Zone 13) **Scenario 8** – Fire in specialty tenancy G-027A (Zone 13, sensitivity)	Zone 13 on level 00	1:00	3:08	**4:08**
	Rest of level 00 mall	1:37	6:59	**8:36**
	Zone 13 on level 01	1:37	7:29	**9:06**
Level 01				
Scenario 9 – Fire in specialty tenancy 1-009 (Zone 12) **Scenario 10** – Fire in specialty tenancy 1-009 (Zone 12, sensitivity)	Zone 12 on level 01	1:10	2:05	**3:15**
	Rest of level 01 mall	1:43	10:09	**11:52**
	Zone 12 on level 2	1:43	8:25	**10:08**
Level 02				
Scenario 11 – Fire in specialty tenancy 2-024 (Zone 7)	Zone 7 on level 02 – only localised area near tenancy of fire origin	0:55	10:38	**11:33**

Fire scenario	Area considered	Cue period (mm:ss)	Pre-movement + movement period (mm:ss)	RSET (mm:ss)
Scenario 12 – Fire in specialty tenancy 2-024 (Zone 7, sensitivity)	Rest of level 02 mall	0:55	10:38	**11:33**
Scenario 13 – Fire in specialty tenancy 2-010 (Zone 1)	Zone 1 on level 02 – only localised area near tenancy of fire origin	1:00	1:57	**2:57**
	Rest of level 02 mall	1:00	11:25	**12:25**

13.7.3 Comparison of ASET / RSET

A comparison of the ASET / RSET margin for the scenarios assessed are summarised in Table 34.

Table 34 Comparison of ASET / RSET

Fire scenario	Area considered	ASET (mm:ss)	RSET (mm:ss)	ASET / RSET	Safety factor
Lower ground floor					
Scenario 1 – Fire in specialty tenancy B-031 (Zone 7)	Zone 7 and lower ground food court	6:41	3:24	1.9	> 1.5
	Rest of lower ground level mall	>15:00	6:41	>2.2	> 1.5
	Level 00	>15:00	7:48	>1.9	> 1.5
	Level 01	>15:00*	11:12	>1.5	> 1.5
	Level 02	>15:00*	10:22	>1.5	> 1.5
Scenario 2 – Fire in kiosk site 11 (Zone 7)	Zone 7 and lower ground food court	>15:00	3:12	>4.6	> 1.5
	Rest of lower ground level mall	>15:00	6:05	>2.4	> 1.5
	Level 00	>15:00	7:12	>2.0	> 1.5
	Level 01	>15:00*	10:36	>1.5	> 1.5
	Level 02	>15:00*	11:23	>1.5	> 1.5

Fire scenario	Area considered	ASET (mm:ss)	RSET (mm:ss)	ASET / RSET	Safety factor
Scenario 3 – Fire in specialty tenancy B-031 (Zone 7, sensitivity)	Zone 7 and lower ground food court	5:15	3:27	1.5	> 1.0
	Rest of lower ground level mall	>15:00	6:41	>2.2	> 1.0
	Level 00	>15:00	8:46	>1.7	> 1.0
	Level 01	>15:00	11:30	>1.3	> 1.0
	Level 02	>15:00	12:30	>1.2	> 1.0
Ground level (level 00)					
Scenario 4 – Fire in specialty tenancy G-034 (Zone 7)	Zone 7 on level 00	12:30	4:16	2.9	< 1.5
	Rest of level 00 mall	>15:00	8:09	>1.8	> 1.5
	Level 01	>15:00	9:36	>1.6	> 1.5
	Level 02	>15:00*	10:58	>1.5	> 1.5
Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)	Zone 7 on level 00	>15:00	6:20	>2.4	> 1.5
	Rest of level 00 mall	>15:00	9:11	>1.6	> 1.5
	Level 01	>15:00*	12:16	>1.5	>1.5
	Level 02	>15:00*	12:31	>1.5	> 1.5
Scenario 6 – Fire in specialty tenancy G-034 (Zone 7, sensitivity)	Zone 7 on level 00	10:00	4:16	2.3	> 1.0
	Rest of level 00 mall	>15:00	8:09	>1.8	> 1.0
	Level 01	>15:00	9:36	>1.6	> 1.0
	Level 02	>15:00*	10:58	>1.5	> 1.0
Scenario 7 – Fire in specialty tenancy G-027A (Zone 13)	Zone 13 on level 00	>15:00	4:08	>3.6	> 1.5
	Rest of level 00 mall	>15:00	8:36	>1.7	> 1.5
	Zone 13 on level 01	>15:00	9:06	>1.7	> 1.5
Scenario 8 – Fire in specialty tenancy G-027A (Zone 13, sensitivity)	Zone 13 on level 00	>15:00	4:08	>3.6	> 1.0
	Rest of level 00 mall	>15:00	8:36	>1.7	>1.0
	Zone 13 on level 01	>15:00	9:06	>1.7	> 1.0
Level 01					
Scenario 9 – Fire in specialty tenancy 1-009 (Zone 12)	Zone 12 on level 1	>15:00	3:15	>4.6	> 1.5
	Rest of level 01 mall	>15:00*	11:52	>1.5	> 1.5
	Zone 12 on level 2	>15:00*	10:08	>1.5	> 1.5
Scenario 10 – Fire in specialty tenancy 1-009	Zone 12 on level 1	>15:00	3:15	>4.6	> 1.0
	Rest of level 01 mall	>15:00*	11:52	>1.0	> 1.0

Fire scenario	Area considered	ASET (mm:ss)	RSET (mm:ss)	ASET / RSET	Safety factor
(Zone 12, sensitivity)	Zone 12 on level 2	>15:00*	10:08	>1.5	>1.0
Level 02					
Scenario 11 – Fire in specialty tenancy 2-024 (Zone 7)	Zone 7 Level 02 – only localised area near tenancy of fire origin	>15:00*	11:33	> 1.5	> 1.5
	Remainder of the mall	>15:00*	11:33	> 1.5	> 1.5
Scenario 12 – Fire in specialty tenancy 2-024 (Zone 7, sensitivity)	Zone 7 Level 02 – only localised area near tenancy of fire origin	15:00	11:33	1.2	> 1.0
	Rest of level 2 mall	15:00	11:33	1.2	> 1.0
Scenario 13 – Fire in specialty tenancy 2-010 (Zone 1)	Zone 12 on Level 02	>15:00	2:57	> 5.2	> 1.5
	Rest of level 2 mall	>15:00*	12:25	> 1.5	> 1.5
Note: Smoke modelling results show that steady state smoke conditions have been reached on this level / smoke zone remote from the smoke zone of origin. On this basis the ASET for this level / smoke zone is assumed to be indefinite.					

The ASET / RSET margin for the assessed areas satisfies the acceptance criteria specified in section 13.4.

13.7.4 Fire brigade intervention

The smoke modelling performed demonstrated that temperatures within the sprinkler protected building remain below 60 °C for the duration of the simulation except for the region immediately surrounding the fire. These temperatures are consistent with expected compartment temperatures in the event of sprinkler-controlled fires. As stated in section 7.5.3, it can generally be assumed that successful operation of the sprinkler system will have the following impact on compartment temperatures during a fire:

- The average temperatures outside the immediate area of operation of the sprinkler system are below 100 °C.
- The temperature in the localised area above the fire is unlikely to exceed 200 °C.

These temperatures are below the tenability limits for attending firefighters except for the localised area around the fire. It is therefore considered the design facilitates fire brigade intervention to the degree necessary to achieve compliance with the performance requirements of the NCC.

13.7.5 Makeup air provisions

Makeup air serving the atrium smoke compartment (smoke zone 7) is provided via a combination of mechanical supply delivered to the mall via tenancies and mall entries and casement windows on level LG and 00. In an after hours fire scenario where tenancy shopfronts may be closed from the mall, or a redundancy power failure scenario where the mechanical supply (which is not provided with backup power) fails to operate, reduced mechanical makeup air will be provided for the smoke exhaust system, leading to increased velocities through passive openings.

The smoke exhaust system serving the atrium smoke compartment has been design such that the maximum velocity expected across passive openings does not exceed 5.4 m/s when relying solely on natural make up air provided by mall entries and casement windows. An air velocity of 5.4 m/s is equivalent to a gentle to moderate breeze in accordance with the Beaufort Wind Scale and is not expected to create unsafe conditions for occupant evacuation. The makeup air coming through openings is further located on the lower retail levels (LG and L00) and is not expected to cause significant disruption to the smoke layer exhausted above level 2 and level 3 voids in the event of a fire within the atrium smoke compartment.

13.7.6 Level 00 amenities

The level 00 corridor to the amenities area forms part of the path of travel to Stair 4 on the level. The corridor, amenities and tenant back of house area as a whole is fire separated from the mall. The amenities area can be considered a place of relative safety in the event of a fire in the mall area. Whilst the alternative distance between the exits Stair 8 and Stair 4 measures 119 m, occupants are able to reach an exit or place of relative safety within 100 m. If in the event of a fire within this area blocking access to Stair 4, the fire separation provided is expected to limit the risk of fire and smoke spread as occupants seek an alternative exit within the mall.

13.7.7 Stair pressurisation

Requirements for stair pressurisation

The requirement for stair pressurisation is driven solely by the presence of an atrium in the building. There is otherwise no requirement for stair pressurisation to be provided to the above ground levels of the building, given that the building is below 25 m in effective height.

The scope of AS 1668.1 includes an explanatory note (C1.2) which states that '*Due consideration should be given to fire engineering solutions utilizing some or all of the following tools: passive fire compartmentation, smoke channelling method and building design, fire and smoke detection and alarm systems, and automatic fire suppression systems'*.

Stairs 6, 7, and 8 are the only fire isolated stairs accessed directly off the centre court atrium smoke zone 7. The smoke hazard management system is designed to maintain tenable conditions for evacuation in the smoke zone of origin and to limit smoke spread to adjacent zones. Whilst on level 00 stair 4 also technically serves smoke zone 7, it is not directly accessed from the smoke zone 7 mall. It is instead accessed from the fire-separated amenities area, which will limit the risk of smoke spread from the smoke zone 7 mall into the stair. The presence of the atrium is not considered to increase the risk of smoke spread to stairs 3, 4, 5, 9, 10, 11, 12, 13, 14, 15 and 19 which are remote from the atrium.

It is also noted that for class 5-9b buildings less than 25 m in effective height the NCC does not require stair pressurisation where an alternative means of smoke hazard management is provided – ie zone pressurisation. Whilst this allowance is not explicitly noted for shopping centres – ie class 6 buildings more than 2000 m^2 in floor area – the same intent is considered to be applicable. The smoke exhaust system provided to the retail mall is considered to provide an adequate means of smoke hazard management and it has been demonstrated in smoke modelling that the proposed system design mitigates the risk of smoke spread to exits remote from the fire-affected tenancy and facilitate occupant evacuation – refer to section 13.7.1.

Provisions for smoke zone 7 – centre court atrium zone

The proposed smoke hazard management strategy utilises a combination of smoke detection for early warning, atrium smoke exhaust to maintain tenability in circulation routes, and sprinklers to control fire size. The availability of multiple alternative exits and paths of travel to adjacent smoke zones provides redundancy if a single stair is obstructed.

The provision of pressurisation to the stairs within smoke zone 7 with a reduced level of performance can still be expected to limit smoke spread into the stair enclosures on the level of fire origin for a worst credible scenario. The stair pressurisation provides additional protection to the stairs on the level of fire origin in the event of a fire near the stair where occupants evacuate through smoke. The

stair pressurisation also provides protection for fire brigade staging operations in the fire isolated exits opening onto the atrium zone.

Stairs 6, 7 and 8

Stairs 6, 7 and 8 are located within the atrium smoke zone (smoke zone 7). Stairs 7 and 8 are accessed off a service corridor on all levels. The separation provided by multiple doors prior to reaching the fire-isolated door reduces the risk of smoke spread into the stairs in the event of a fire within the atrium zone.

On level 2, stair 7 is only accessed from the Apple storage area. The door opening from stair 7 on the level will not be tested to achieve the required 1 m/s velocity. This area is separated from the remainder of the mall by construction, including openings, penetrations and junctions with other building elements, that prevent the free passage of smoke. Given the stair is accessed only from an area which is separated from the atrium smoke zone, the presence of the atrium is not considered to increase the risk of smoke spread to stair 7 from this level.

On levels ground to 02, Stair 6 opens into a mall corridor which is accessed directly from the general mall area. The proposed rationalisation of stair pressurisation for Stair 6 allows for the testing of the door velocity based on only doors within the fire-affected floor leading to the mall and the final discharge door being open. The evacuation and CFD modelling undertaken demonstrates that a significant dense smoke layer does not develop around the stair during the evacuation period in the event of a fire within the smoke zone that is remote from the stair. In the event of a fire adjacent to one of the exits, occupants are expected to utilise alternative exits from the smoke zone.

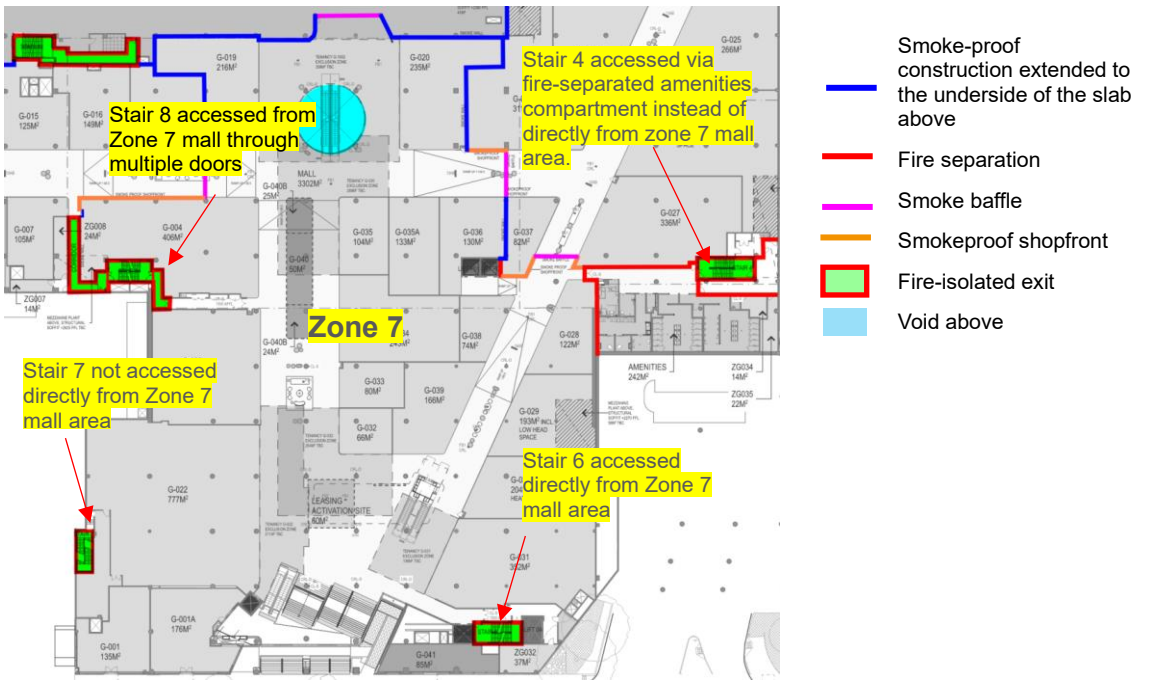


Figure 67 Level 00 – Fire-isolated exits accessed from Zone 7

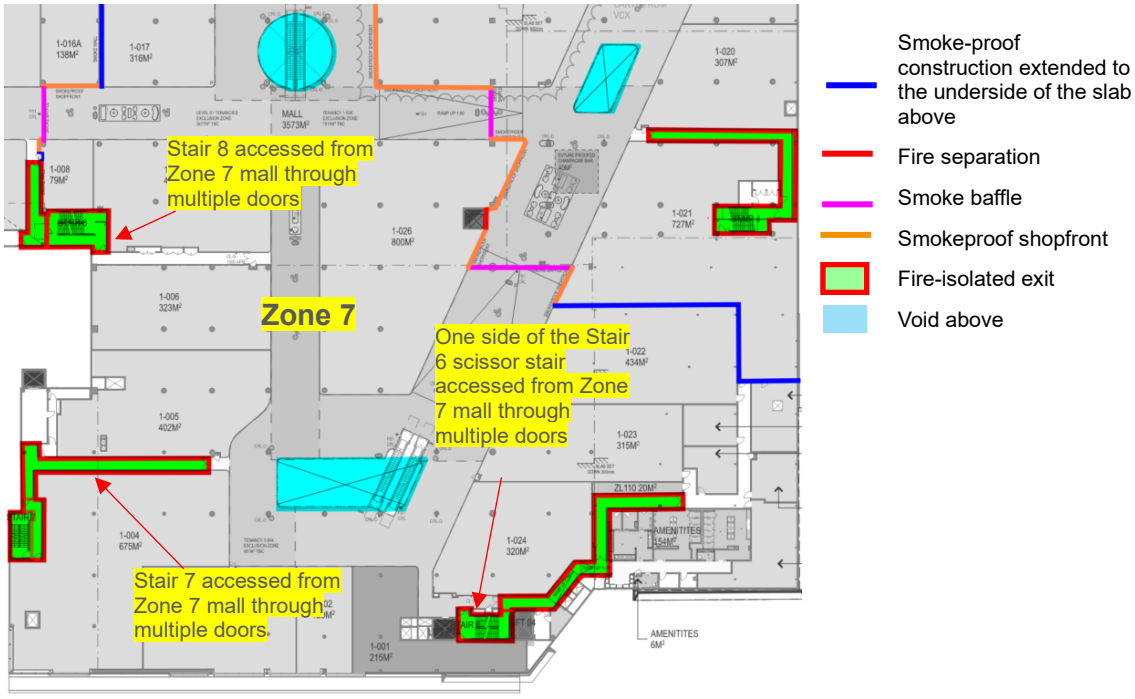


Figure 68 Level 01 – Fire-isolated exits accessed from Zone 7

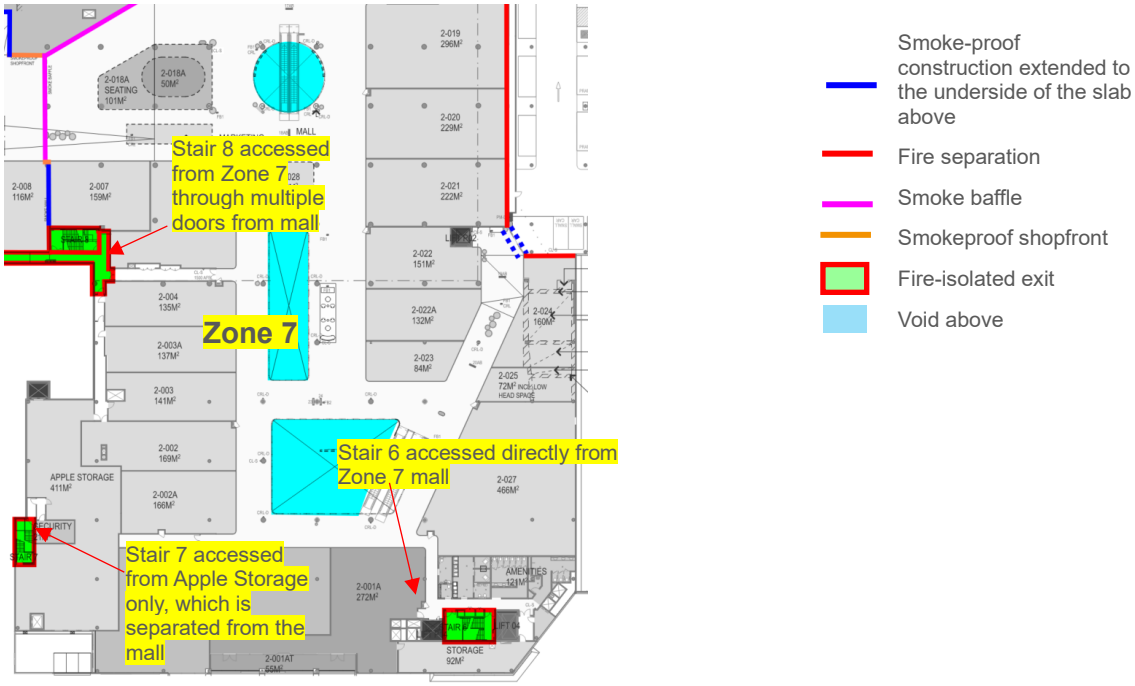


Figure 69 Level 2 – Fire-isolated exits accessed from Zone 7

13.8 Conclusion

The assessment shows that the tenancy facilitates safe occupant egress and fire brigade intervention in the event of a fire. The proposed design of the building is therefore considered to comply with performance requirements D1P4, D1P5 and E2P2 of the NCC, subject to complying with the fire safety measures in section 5.

14. Performance solution 8 – Basement 2 loading dock egress

14.1 Introduction

Clause D2D3(7) states that every occupant of a storey or part of a storey must have access to the required number of exits without passing through another sole-occupancy unit.

Clause D2D14(3) of the NCC states that '*in a class 5, 6, 7, 8 or 9 building, the distance from any point on a floor to a point of egress to a road or open space by way of a required non-fire-isolated stairway or non-fire-isolated ramp must not exceed 80 m*.'

The building has an existing loading dock on basement level 2 that includes common / commercial loading dock areas as well as areas that form part of the David Jones tenancy. Refer to Figure 70.

Occupants within the common areas of the loading dock are required to pass through a secure corridor within the David Jones tenancy to access fire-isolated exit stair 11. Refer to Figure 71.

An alternative exit is provided via the main vehicular ramp to the north leading up to lower ground level. The ramp is provided with a security roller shutter at the base which will be open during trading hours. When it is closed after hours, a swing door is provided adjacent to the shutter for egress via the ramp.

The distance of travel to open space via the non-fire-isolated exit ramp from the basement 2 loading dock is more than 80 m – approximately 100 m – measured to fire-isolated stair 16 at lower ground level, which leads to open space on Malvern Avenue to the north. This path of travel includes up to 41 m of travel to reach an area on the ramp that is open to the sky, 42 m of travel along the open area, and then approximately 17 m of travel underneath the building to reach stair 16. Refer to Figure 72 and Figure 73.

Upon discharging to lower ground level via the ramp, occupants also have the option of travelling up to ground level via an external stair and subsequently exiting the building onto Archer Street via the pathway under the Archer Street speed ramp. The distance to this external stair up to ground level is approximately 83 m. Refer to Figure 73.

This assessment was prepared to show that the design complies with performance requirements D1P4 and E2P2 of the NCC.

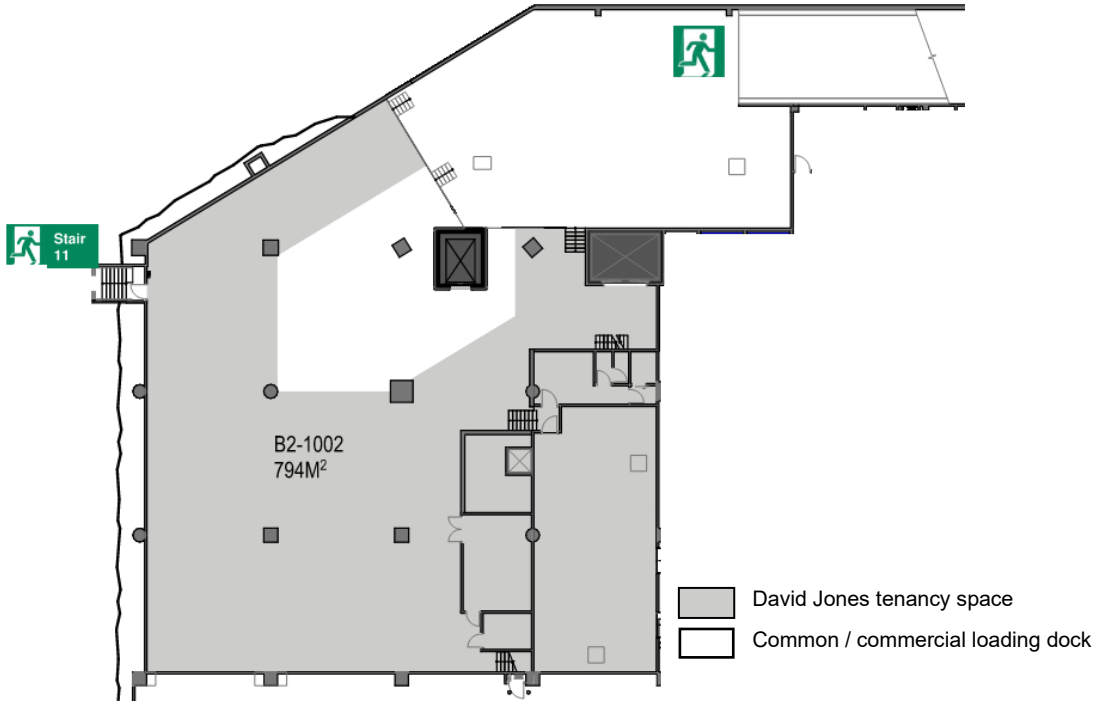


Figure 70 Basement 2 loading dock – general layout

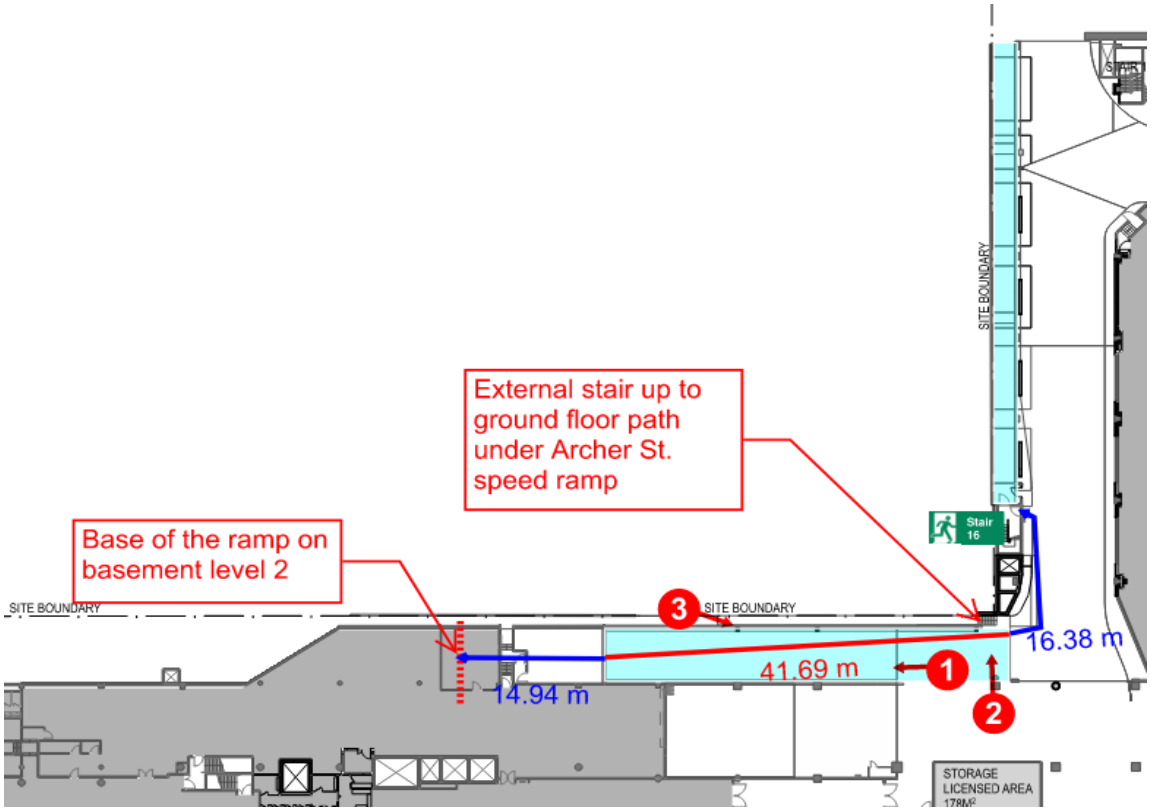
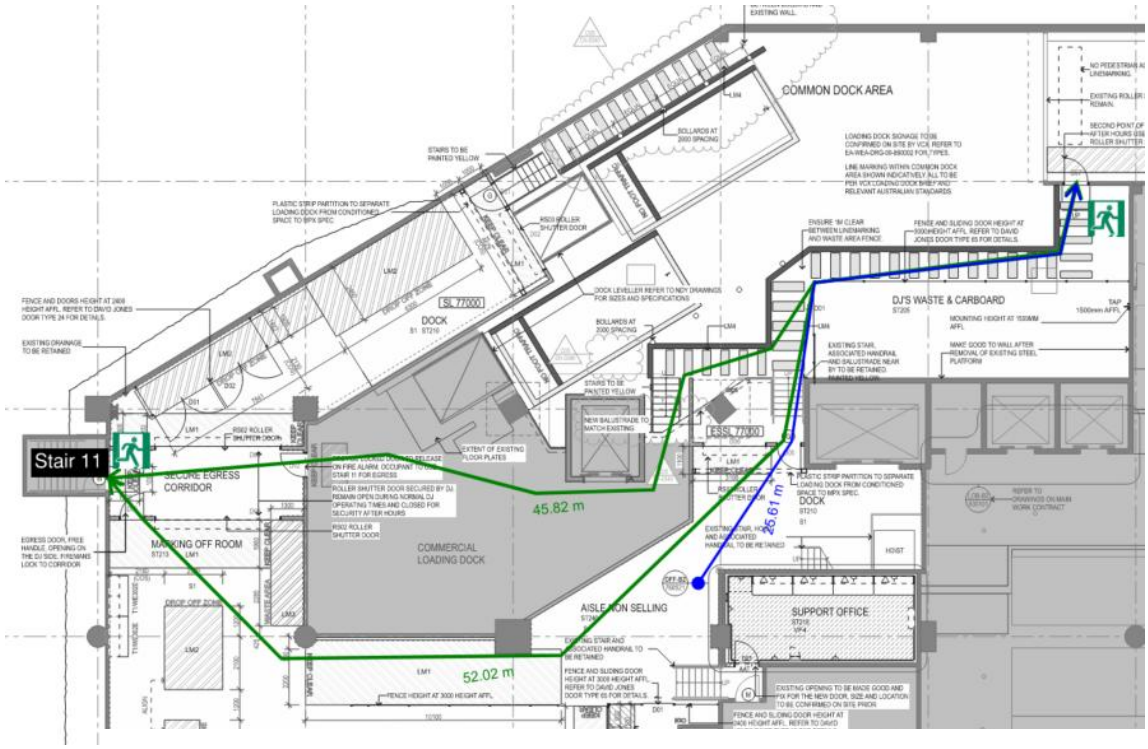


Figure 71 Secure egress corridor from commercial loading dock to stair 11



Distance between alternative exits

Travel distance along basement level 2 to the base of the ramp when ramp is the nearest exit

Figure 72 Egress through basement 2 loading dock

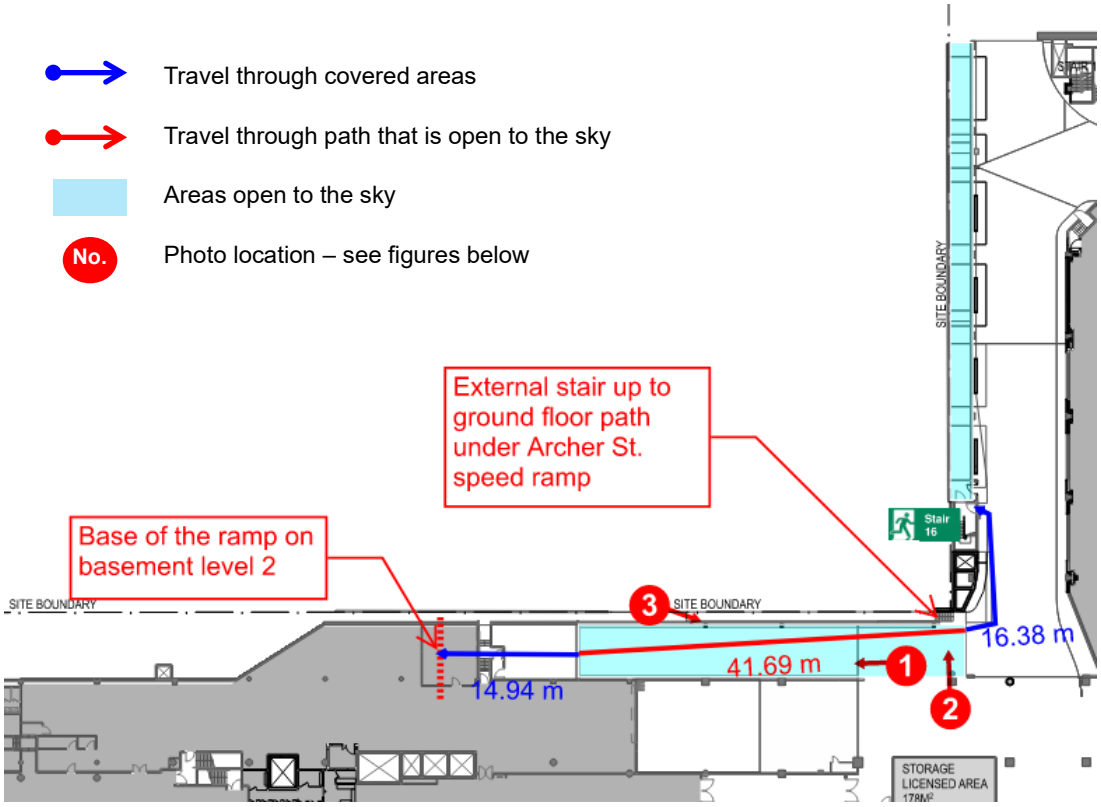


Figure 73 Path of travel to open space via northern exit ramp from basement 2 – lower ground level plan shown



Photo 1



Photo 2

Figure 74 Photos at lower ground level at the top of the exit ramp from basement level 2



Photo 3

Figure 75 Photo from the path up to ground level from external stair

14.2 Intent of the NCC

14.2.1 Clause D2D3 – Number of exits required

The guide to the NCC states that the intent of clause D2D3 is '*to require the provision of sufficient exits to enable safe egress in case of an emergency.' It also states that 'the purpose of regulatory control over the number of exits in a building is to maximise the opportunities for people to have egress from the building in an emergency*'

Although not stated in the guide to the NCC, it is understood that clause D2D3(7) requires exits to be accessible without passing through a sole-occupancy unit in recognition of the fact that occupants in other units or in the common areas may not have access to the unit through which the exit is provided.

14.2.2 Clause D2D14 – Travel by non-fire-isolated stairways or ramps

The guide to the NCC states that the intent of clause D2D14 is '*to require that a person using a non-fire-isolated stairway or ramp be provided with a safe evacuation path.*'

Although not stated in the guide to the NCC, it is understood that by limiting the total travel distance to open space to 80 m, clause D2D14(3) intends to mitigate the risk of an internal path of travel being obstructed by fire or smoke before occupants reach open space.

14.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 35.

Table 35 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control

14.4 Acceptance criteria

The acceptance criteria for this assessment is that the design of the loading dock on basement level 2 facilitates safe occupant evacuation in the event of a fire within the loading dock.

14.5 Fire hazards

Table 36 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 36 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The potential for occupants in the commercial loading dock being obstructed from reaching exit stair 11 due to having to travel through the David Jonest tenancy	• Secure egress corridor provided through the David Jones tenancy to stair 11 for occupants in the commercial / common loading dock areas • Secure corridor provided with signage stating 'KEEP CORRIDOR CLEAR AT ALL TIMES' • Door leading to secure corridor from commercial loading dock designed to unlock automatically upon fire alarm • Egress corridor to be listed as an essential fire safety measure on the building's fire safety schedule, and included in the David Jones tenancy agreement / operational manuals
The potential for occupants in the basement 2 loading dock to be obstructed by untenable smoke conditions prior to reaching open space when evacuating via the northern ramp	• Sprinklers provided throughout the building to mitigate risk of untenable smoke conditions developing • Travel to final exit point from the ramp includes long stretches that are open to the sky • Floor markings provided throughout path of travel from the base of the ramp to fire-isolated exit stair 16 at lower ground level to mitigate wayfinding delays • Exit and directional signs provided along path of travel • Standing swinging door provided for afterhours access to the exit ramp

14.6 Assessment

14.6.1 Exit through the David Jones loading area

The primary hazard to be addressed in the assessment is the potential for occupants in the common loading dock areas on basement level 2 to be unable to access fire-isolated exit stair 11 due to the pathway to the stair being through the David Jones tenancy.

To ensure access to stair 11 is maintained for occupants in the common areas, a secure corridor is to be provided through the David Jones tenancy connecting the commercial loading dock area to stair 11 as shown in Figure 71. This corridor is accessed from the commercial loading dock via a door that unlocks upon fire alarm in the building. The corridor is to be provided with signage stating 'KEEP CLEAR AT ALL TIMES' to ensure that there is no storage in the corridor that could obstruct the path of travel to stair 11.

This arrangement has been discussed with the architect, David Jones and the shopping centre management – ie Vicinity – to ensure that the secure corridor is kept clear of obstructions and access to the corridor is maintained for occupants in the common areas in the event of a fire alarm in the building[47].

The secure corridor must be identified on the building's fire safety schedule to ensure that it is annually inspected as part of the annual fire safety statement renewal process. The requirements must also be included in the David Jones tenancy agreement or operating procedures to ensure that staff are aware of the egress arrangement within the basement 2 loading dock.

14.6.2 Travel via non-fire-isolated ramp

The loading dock on basement level 2 is provided with sprinklers throughout. In the event of a fire in the loading dock, sprinklers can be expected to control fire size and intensity and reduce the amount of smoke produced by the fire. The sprinkler system can generally be expected to maintain tenable conditions away from the area of fire origin. The benefits of a sprinkler system are detailed in section 7.5.3 of this report.

[47] Aconex correspondence from Webber to Warringtonfire (now Jensen Hughes), 13 October 2023, Re: Confirming David Jones fire engineering scope, mail no. WEBBER-GCOR-001210

Occupants in the loading dock are expected to be retail or commercial staff who will be familiar with the layout of the loading dock and exits from the space, including the ramp. They are expected to be alert and capable of responding promptly to an emergency. The ramp will be provided with an exit sign at basement level 2, and additional directional exit signs and floor line markings to direct occupants towards the final exits from the building out onto the road. In the event of a fire within the basement level 2 loading dock, the familiarity of occupants with the building layout and the additional wayfinding measures are expected to reduce potential delays in evacuation.

In limiting the total distance to a road or open space via a non-fire-isolated stair or ramp to 80 m, the NCC intends to mitigate the risk of an internal path of travel being obstructed by fire or smoke before occupants reach open space. The NCC does not cater for building designs where occupants reach an external area that is open to the sky within 80 m but are then required to travel under a portion of the building before the final exit to open space.

Occupants evacuating via the ramp are considered to be in a place of relative safety once they reach the area that is open to the sky – ie a distance of approx. 41 m, including 26 m within basement level 2 to the base of the ramp and approximately 15 m on the ramp itself. Refer to Figure 72 and Figure 73.

Smoke or hot gases from a fire in the loading dock spreading up the ramp are expected to dissipate into the atmosphere and are not credibly expected to obstruct the subsequent path of travel to the road, noting that it incorporates an approx. 42 m stretch that is fully open to the sky before occupants have to travel through a covered area again – see Figure 73 and Figure 74.

Once occupants travel up the ramp to lower ground level, they are provided with alternative paths to reach the road – ie via stair 16 at lower ground level to Malvern Avenue to the south, or the external stair up to ground level leading to the path under the Archer Street speed ramp and subsequently to Archer Street to the west. Refer to Figure 73 to Figure 75. In the unlikely event that one of these paths is obstructed by smoke from a fire, occupants can exit the building via the other.

14.7 Conclusion

The assessment shows that the design of the loading dock on basement level 2 facilitates safe occupant evacuation in the event of a fire within the loading dock. The proposed design of the building is therefore considered to comply with performance requirements D1P4 and E2P2 of the NCC, subject to complying with the fire safety measures in section 5.

15. Performance solution 9 – Travel to a point of choice in specialty tenancies and BOH storage areas

15.1 Introduction

Clause D2D5 of the NCC requires that for a class 6 retail building no point on a floor must be more than 20 m from an exit or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m.

The maximum travel distance from specialty tenancies with a floor area less than 1,000 m^2 to a point of choice in the mall may be increased up to 30 m when measured from the furthest point. This is intended to provide flexibility for tenancy fitouts.

Travel distance to a point of choice relates to the possibility for a fire to directly block the path of travel to an exit. Therefore, the departure relating to travel to a point of choice from the smaller tenancies has been addressed separately from the general assessment for the retail portion – see section 13.

Additionally, the maximum travel distance from back of house (BOH) storage areas on levels 01 and 02 is up to 30 m to a point of choice or single exit (with flexibility to allow for fitout of the spaces) – see Figure 77 and Figure 76.

Note: The provision of a single exit to the BOH storage areas on level 1 is further addressed in Performance Solution 17.

This assessment was prepared to show that the design complies with performance requirement D1P4 of the NCC.

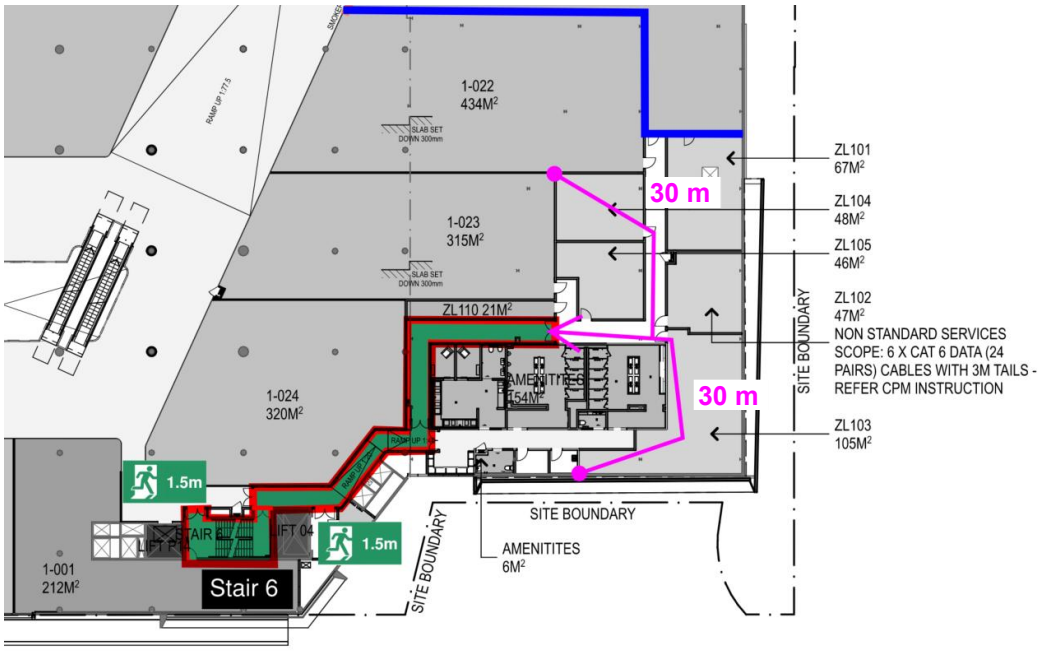


Figure 76 Extended travel to an exit within BOH storage area on level 01

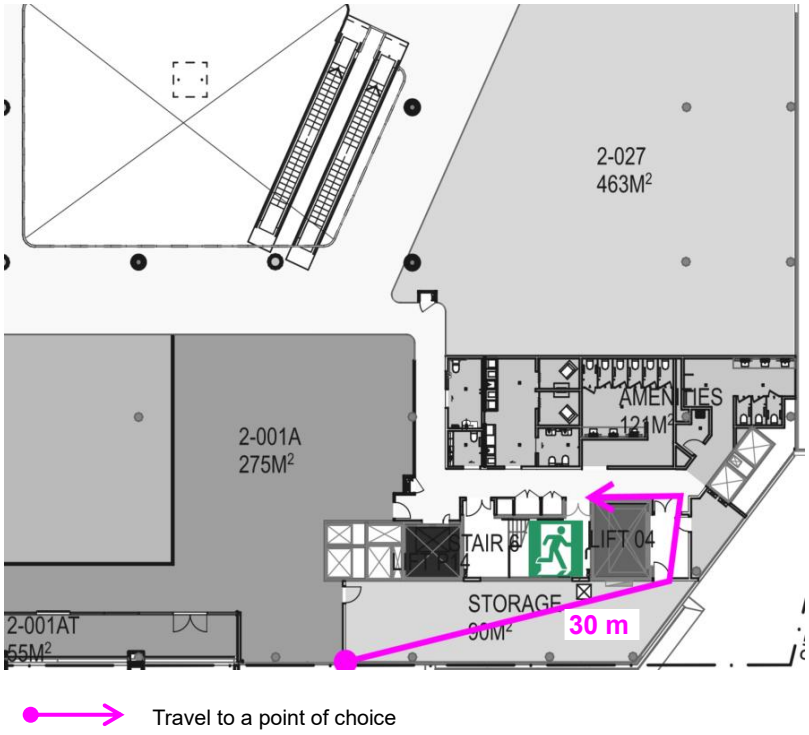


Figure 77 Extended travel to a point of choice within BOH storage area on level 02

15.2 Intent of the NCC

The guide to the NCC states that the intent of clause D2D5 is '*to maximise the safety of occupants by enabling them to be close enough to an exit to safely evacuate.' It also states that 'the D2D5 travel distances are based on an assumption of what is considered "reasonable" distances to be travelled by occupants in reaching an exit*.'

15.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 37.

Table 37 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control

15.4 Acceptance criteria

The acceptance criteria for this assessment is that the maximum travel distance to a point of is reasonable considering the fire hazards and fire safety measures provided.

15.5 Fire hazards

Table 38 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 38 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Occupants within the area of fire origin are obstructed by fire or smoke before reaching a point of choice between exits.	• Sprinkler system installed throughout the building mitigating fire and smoke spread. • Smoke exhaust system maintaining the mall as a place of safety. • Early warning provided by additional smoke detectors installed within the affected BOH areas and retail tenancies.

15.6 Fire scenarios

The assessment considers a credible, worst-case scenario of a fire inside a BOH area or tenancy that has up to 30 m of travel to a point of choice or single exit.

15.7 Assessment

15.7.1 Introduction

The hazard associated with the extended travel distances from the BOH areas and small retail tenancies (< 1,000 m^2) must be assessed in terms of the ability of the occupants to safely undertake an evacuation should a fire occur. The reason that clause D2D5 of the NCC stipulates travel distance requirements is to ensure that all occupants of the building are within a reasonable distance of an exit so that they can safely evacuate in the event of a fire.

The travel distances specified under clause D2D5 are generic figures. The requirements are considered to be conservative for the proposed building as they relate to all possible design scenarios irrespective of the fire safety measures provided within the building. They also have no regard to the layout and partitioning of an enclosure.

Active fire safety systems such as automatic sprinklers and smoke exhaust are considered to greatly enhance the level of safety in a building allowing increased exit travel distances compared to that of a DTS building design without any active fire safety measures.

15.7.2 Impact of sprinkler system

A sprinkler system in accordance with specification 17 of the NCC and AS 2118.1:2017 is provided to the areas of new works. The existing sprinkler system in accordance with AS 2118.1-1999 will also be maintained in existing areas not impacted by the new works.

The sprinkler system can be expected to supress or control the fire to the area or item of origin, significantly reducing the risk that occupants are obstructed by fire or exposed to untenable fire and smoke conditions. The reliability of a sprinkler system, together with the impact that a sprinkler system will have on fire spread and fire intensity have previously been discussed in section 7.5.3.

15.7.3 Impact of smoke exhaust system

Although there is no smoke exhaust provided within individual specialty tenancies smaller than 1,000 m^2, smoke from a fire in a tenancy is expected to spill into the mall through the shopfront. The mechanical smoke exhaust system in the mall areas is expected to maintain tenability in the mall areas. This allows the mall to be considered as a place of relative safety for a fire within a specialty tenancy. The available safe egress time is increased within specialty tenancies by removing heat and smoke produced by a fire.

This aspect of the smoke exhaust system is particularly beneficial for a fire near the shop entrance which has the greatest potential to block the path of travel to the point of choice in the mall.

15.7.4 Impact of smoke detection system

In the BOH storage areas and tenancies where the travel distance to a point of choice in the mall is up to 30 m, smoke detection complying with AS 1670.1:2018 and clause S20C4 of the NCC will be provided below the ceiling. The provision of smoke detection within these tenancies and BOH areas reduces the cue time in case of fire as smoke detectors activate at an earlier stage than sprinklers.

In a DTS compliant design, smoke detection need only be provided to the retail area with 20 m spacing and not more than 10 m from any wall, bulkhead or smoke curtain.

Compared to the DTS compliant design the proposed design requires a 10 m smoke detector spacing is required below the ceiling. The space has been effectively halved in the proposed design which can be expected to reduce detection time for a fire located in the most remote location from a detector. This provides a clear benefit in terms of early warning for occupants in the BOH area or tenancy of fire origin.

15.7.5 Occupant evacuation

BOH storage areas

The BOH storage areas impacted by extended travel distances are not accessible to the public. Occupants within these areas are staff who are familiar with the BOH layout and location of the exit.

Specialty tenancies

The open layout of the public sales area of a specialty tenancy – ie no or very limited solid partitions and obstructions – means that the shop entrance is visible from the majority of the tenancy. This significantly reduces the risk of occupants becoming trapped by a fire before reaching the mall.

In addition, given that the mall is the only point of entry to the retail tenancies, occupants are expected to be familiar with its location. This will limit the wayfinding process and reduce the evacuation time from the fire affected area compared to a building with enclosed rooms and corridors where a fire may be undetected for some time. It is noted that the DTS provisions place no restrictions on the partitioning of an area when considering travel distances.

Furthermore, the time required for occupants to evacuate the fire affected area and travel an additional 10 m to reach a point of choice in the mall is a small part of the overall evacuation time from a shopping centre.

Movement time

The maximum 30 m to a point of choice from the BOH storage area or retail tenancies is 10 m further than a design complying with the clause D2D5 of the NCC.

The evacuation time from the impacted areas can be estimated on the following basis:

- Queuing time within the BOH storage areas or a small retail tenancy is expected to be limited and is conservatively ignored.
- On flat surfaces where the occupant density is less than 0.5 person/m^2, the SFPE Handbook[48] and CIBSE Guide E[49] specify walking speeds of approximately 1.2 m/s. A walking speed of 1.0 m/s is conservatively adopted for this assessment to account for variations in occupant characteristics.

[48] Gwynne SMV and Rosenbaum ER, 2016, Employing the hydraulic model in assessing emergency movement, The SFPE Handbook of Fire Protection Engineering, 5th edition, SFPE, Springer, chapter 59.
[49] Fire engineering – CIBSE Guide E, 4th edition, 2019, CIBSE Publications Department, pp 7-12.

The additional 10 m travel distance equates to approximately 10 seconds increase in the time for occupants to reach a point of choice compared to a DTS complying design. The additional 10 seconds is considered to be insignificant and is readily offset by the beneficial effects of the sprinklers, smoke exhaust, smoke detection and the relatively simplistic layout of a BOH areas and small specialty tenancy.

15.8 Conclusion

The assessment shows that proposed design facilitates safe occupant evacuation. The proposed design of the building is therefore considered to comply with performance requirements D1P4 of the NCC, subject to complying with the fire safety measures in section 5.

16. Performance solution 10 – Extended travel distance within the level 2 mini-majors

16.1 Introduction

Clauses D2D5 and D2D6 of the NCC require that for a class 6 retail building:

- no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m.
- exits that are required as alternative means of egress must be not more than 60 m apart.

The following maximum travel distances are proposed within Level 2 mini-majors 2-017 and 2-108

- 65 m to the nearest exit instead of 40 m
- 120m between two alternative exits instead of 60 m.

This assessment was prepared to show that the design complies with performance requirements D1P4 and E2P2 of the NCC.

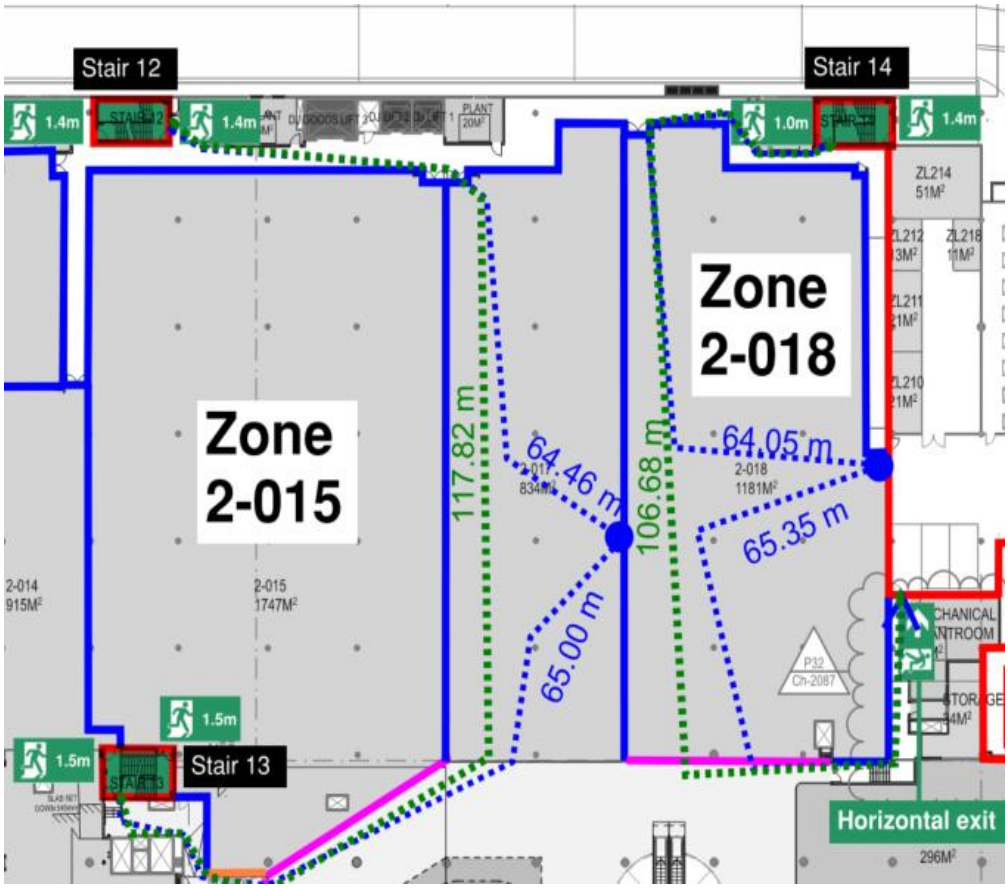


Figure 78 Extended travel distance within L2 mini-majors

16.2 Intent of the NCC

The intent of clauses D2D5 and D2D6 have previously been discussed in section 13.2.

16.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 39.

Table 39 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(b): Demonstrating equivalence to the DTS provisions
NCC assessment methodology	Clause A2G2(2)(d): Comparison to the DTS provisions
Type of assessment	Qualitative comparative
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system E – Occupant evacuation and control

16.4 Acceptance criteria

The acceptance criteria for this assessment is that the proposed design enables occupants to evacuate to a place of safety equivalent to a design that complies with the DTS provisions of the NCC.

16.5 Fire hazards

Table 40 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 40 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Extended travel distances resulting in longer evacuation times and increased work that evacuating occupants are exposed to untenable smoke conditions.	• The tenancies will be provided with smoke detection for activation of smoke control. • Sprinkler system installed throughout the building mitigating fire and smoke spread. • Smoke exhaust system maintaining the mall as a place of safety. • Smoke exhaust system to mini-major tenancies >1000 m^2 in floor area. • Smoke separation of the common BOH areas maintaining the area as a place of safety.

16.6 Assessment

The primary hazard associated with the extended travel distances is that occupants may not be able to evacuate the building or reach a place of safety before they are exposed to untenable conditions in the event of a fire within the tenancy. The mini-majors are provided with exits within the common back of house area and also open into the mall area of the shopping centre. The extended travel distances from these tenancies include travel through the mall before reaching a fire-isolated exit – refer to Figure 78.

16.6.1 Impact of smoke exhaust system

The mini-major exceeding 1,000m^2 in floor area (tenancy 2-018) will be provided with a smoke exhaust system in accordance with specification 21 of the NCC. Tenancy 2-017 being less than 1000 m^2 forms part of the mall smoke zone which is also provided with smoke exhaust. The provision of smoke exhaust within major tenancies and the mall is intended to maintain the height of the smoke layer above at least 2 m to enable safe evacuation of the zone of fire origin and mitigate the risk of smoke spread to the mall smoke zone. The mall area can therefore be considered a place of relative

safety for occupants evacuating from mini-majors exceeding 1,000m^2 in floor area. Once they have exited the tenancy, occupants are provided with the option of two exits from the mall in opposite directions – stair 13 and the horizontal exit to the carpark.

The mini-major tenancy under 1,000m^2 in floor area (tenancy 2-017) will be served by the mall smoke exhaust system. The provision of smoke exhaust within the mall is intended to maintain the height of the smoke layer above at least 2 m within mall area and above any openings to adjacent smoke zones. Once they have exited the tenancy, occupants are able to proceed to stair 8 in an adjacent smoke zone under the protection of the smoke exhaust system. The mall can therefore also be considered a place of relative safety for the mini-majors under 1,000m^2 in floor area.

16.6.2 Smoke separation

The common back of house area is separated from the front of house mini-major areas by smokeproof construction. In the event of a fire within the trading areas of the mini-major, smoke spread into this common back of house area will be limited by the combination of smoke exhaust and the physical separation provided by the smokeproof construction. The back of house area can therefore also be considered a place of relative safety for occupants evacuating from the mini-majors.

16.6.3 Travel to a place of relative safety

The maximum distance occupants are required to travel to evacuate the tenancy or to a place of relative safety does not exceed 40 m. The maximum distance between doorways / entries to places of safety within the tenancy is within 60 m (approximately 56 m). With the back of house and mall area, occupants within the subject mini-majors are not at risk of being exposed to untenable conditions greater than the extent of that within a DTS compliant design. The proposed tenancy is therefore considered to facilitate safe occupant evacuation to a degree equivalent to that of a DTS complying design with a maximum travel distance of 40 m to the nearest exit and 60 m between exits.

In the event of a fire within the common back of house area or mall area occupants are expected to receive intrinsic cues of the fire at the entry to the area from the mini-major tenancy. From there they can proceed toward the alternative exit under the protection of either smokeproof separation or the mall smoke exhaust, which will limit smoke spread from the fire-affected area.

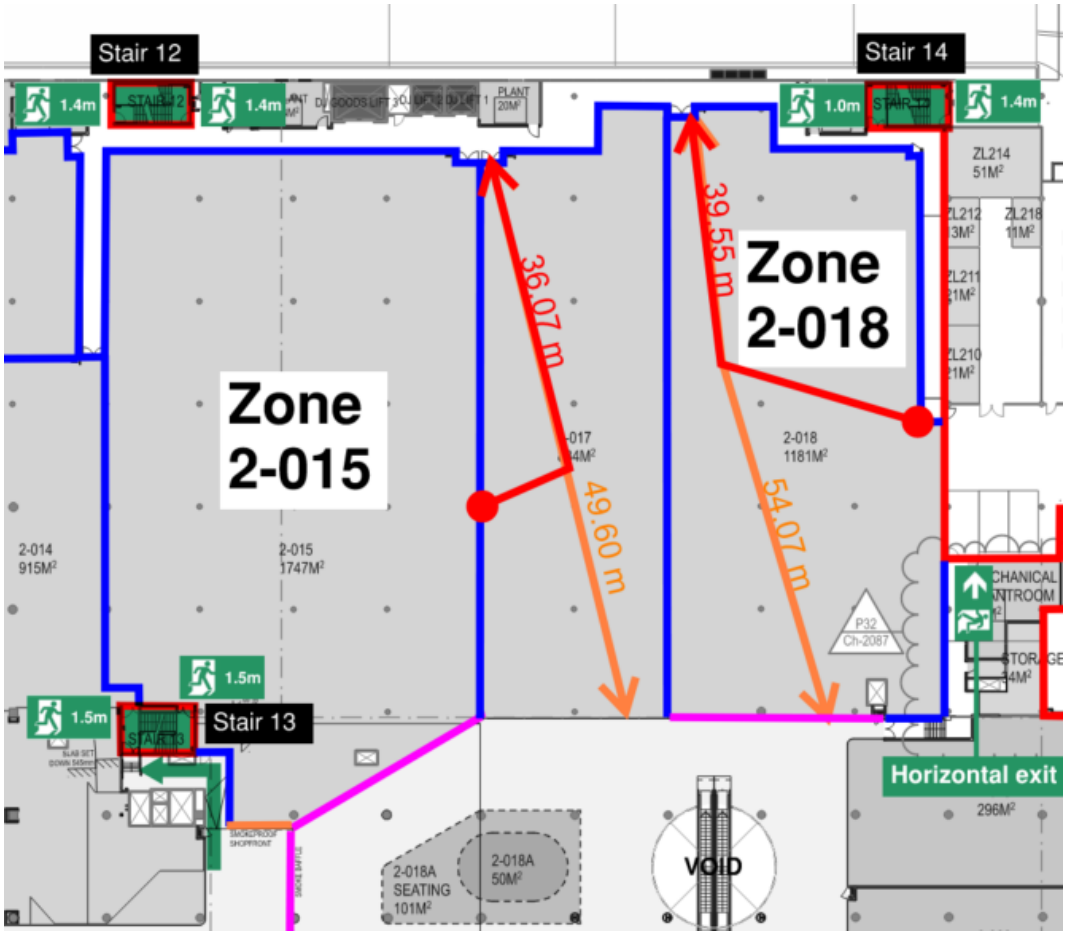


Figure 79 Travel to place of relative safety

16.7 Conclusion

The assessment shows that the proposed design enables occupants to evacuate to a place of safety equivalent to that of a design that complies with the DTS compliant travel distances. The proposed design of the building is therefore considered to comply with performance requirements D1P4 and E2P2 of the NCC, subject to complying with the fire safety measures in section 5.

17. Performance solution 11 – Extended travel distance within level 3 centre management office

17.1 Introduction

Clause D2D5(3)(a) of the NCC states that for class 5 buildings or parts, '*no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m*.'

Clause D2D6(c)(iii) of the NCC states that '*exits that are required as alternative means of egress must be not more than 60 m apart*.'

The centre management office (CMO) on level 03 includes the following maximum travel distances:

- 23 m instead of 20 m to a point of choice
- 63 m instead of 40 m to the nearest exit – conservatively measured to account for future fitout
- 105 m instead of 60 m between alternative exits.

This assessment was prepared to show that the design complies with performance requirements D1P4 and E2P2 of the NCC.

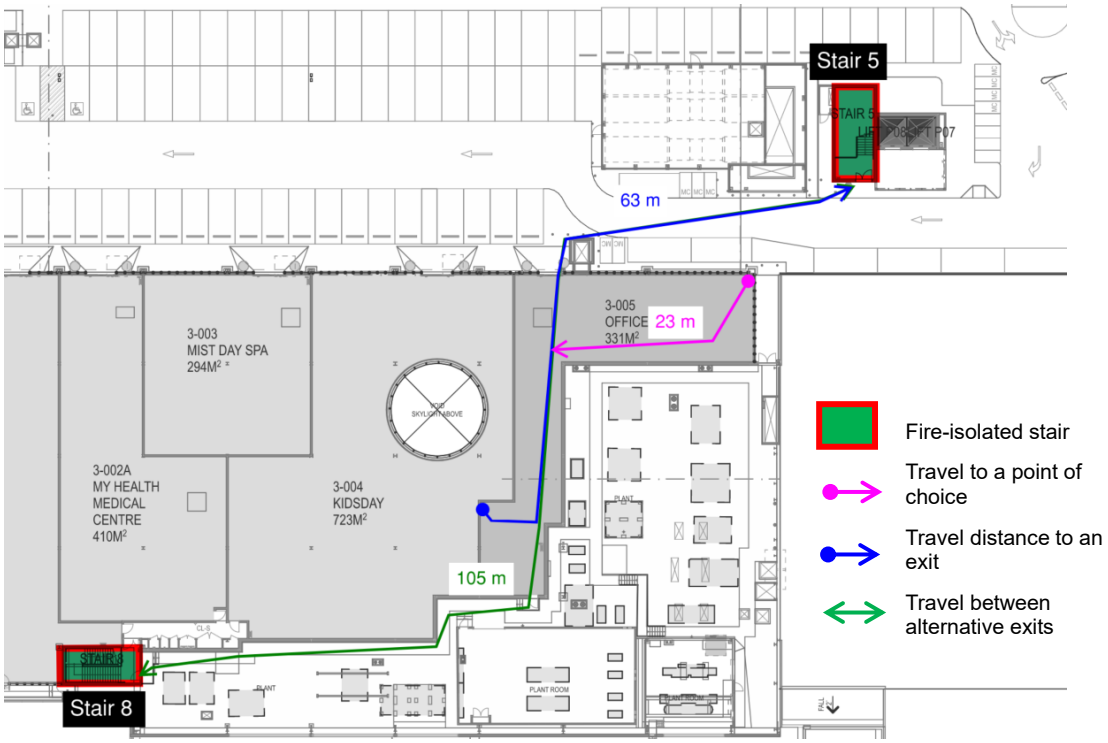


Figure 80 Extended travel distances – level 3

17.2 Intent of the NCC

The intent of clauses D2D5 and D2D6 have previously been discussed in section 13.2.

17.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 41.

Table 41 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(b): Demonstrating equivalence to the DTS provisions
NCC assessment methodology	Clause A2G2(2)(d): Comparison to the DTS provisions
Type of assessment	Qualitative and quantitative comparative Deterministic
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control

17.4 Acceptance criteria

The acceptance criteria for this assessment is that the available safe egress time (ASET) / required safe egress time (RSET) margin arising from the proposed design is at least equivalent to the corresponding margin arising from the base case. The base case is considered to provide a representative level of life safety required by the DTS provisions of the NCC.

The ASET / RSET timeline is illustrated in Figure 81.

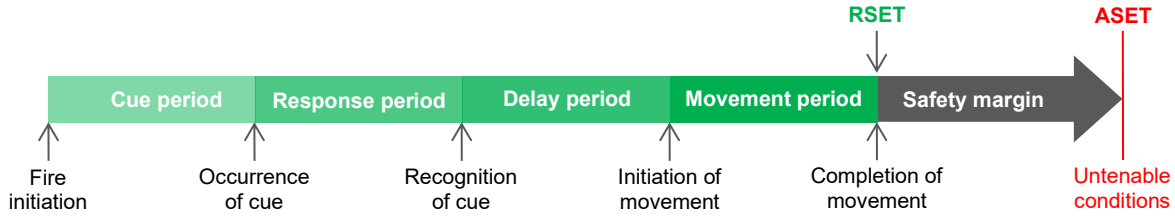


Figure 81 ASET / RSET timeline

17.5 Fire hazards

17.5.1 Hazard identification

Table 42 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 42 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The potential for occupants in the offices to be obstructed by untenable smoke conditions before reaching an available exit due to longer evacuation times.	• Sprinklers provided throughout CMO, mitigating the risk of untenable conditions developing in the event of a fire. • Smoke detection provided within the office areas for early warning. • Access provided from the office areas to the external areas of level 3, which are open to the sky and represent a place of relative safety from a fire inside the building.

17.5.2 General occupancy characteristics

The general fire hazards and characteristics of office occupancies are as follows:

- Historically, few deaths occur in office occupancies. US data collected between 2007-2011 estimates 3,340 fires in office properties per year with an average of four civilian deaths[50].
- Office occupancies include well established and consistent fire loads.
- Occupants are generally expected to be awake, alert and familiar with the layout and location of exits.
- 80% of office fires were confined to the room of fire origin[50].

17.5.3 Fire load

Internal office areas

Furnishings and contents make up the majority of fire load in office occupancies. Furnishings may include items such as chairs, desks, tables, sofas and files. These combustibles comprise a combination of wood, paper, metal, thermoplastics, fabric and foam materials. Computers and associated electrical equipment also contribute significantly to modern office fire loads.

Data from historical surveys[51] nominates a mean fire load density for office occupancies of 420 MJ/m^2 with a 95% fractile value of 950 MJ/m^2.

The building will be provided with sprinkler protection throughout. As discussed in section 7.5.3, the presence of a sprinkler system can be expected to control fire development, if not extinguish the fire. Data from the US[50] indicates that property damage in offices was reduced by 46% and deaths were reduced by 62% when wet pipe sprinklers were present, compared to fires with no sprinklers. Sprinklers operated 90% of the time in fires large enough to activate the equipment and they were effective in 88% of these fires.

17.5.4 Ignition sources

Internal office areas

The following leading ignition sources were identified based on US data collected between 2007-2011[50]:

- cooking equipment (29%)
- electrical and lighting equipment (12%)
- heating equipment (11%)
- arson (10%)
- smoking materials (9%).

17.5.5 Layout

The CMO is located in the south-eastern portion of the level 3 floor plate, adjacent to the existing rooftop carpark on the north, retail tenancies to the west, and roof plant to the east and south. The rooftop carpark is open to the sky.

The CMO is served by Stair 5 and 8. Fire-isolated exits are also distributed throughout the rooftop carpark. Refer to Figure 82.

[50] Campbell R, 2013, US Structure fires in office properties, National Fire Protection Association.
[51] Thomas PH, 1986, Design guide: Structural fire safety CIB W14 Workshop report, Fire Safety Journal, volume 10, issue 2, table A1.3.4.



Figure 82 Level 3 - Fire-isolated exits

17.5.6 Sprinklers

The beneficial impacts of sprinklers have previously been detailed in section 7.5.3 of this report. The successful activation of the sprinklers is expected to provide the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe egress time.
- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.
- A reduction in the chances of a fire spreading beyond the area of origin or flashover occurring.

17.5.7 Smoke detection

The CMO will be provided with smoke detection below the ceiling spaced in accordance with section 5 of AS 1670.1:2018 – ie 10 m grid. Activation of a smoke detector will operate the building's EWIS. The design requires at least one detector provided in each partitioned room.

The smoke detectors proposed as part of the performance solution can be expected to provide earlier detection of smoke for a wide range of fire scenarios. The proposed smoke detection system provides a clear benefit in terms of early warning, particularly for occupants remote from the room of origin, and where occupants are required to pass by the room of origin during an evacuation.

17.6 Design characteristics

The proposed design complies with the DTS provisions of the NCC except for the performance solutions described within section 3.4 of this report. The proposed design will be compared to a base case complying with the DTS provisions of the NCC.

The base case is similar in layout to the proposed design with the main differences between the designs being the travel distances and the smoke detection system provided in the proposed design.

Clause E2D9 of the NCC provides the following smoke hazard management options for a class 5 building or part:

- *'in each required fire-isolated stairway, including any associated fire-isolated passageway or fire-isolated ramp, an automatic air pressurisation system for fire-isolated exits in accordance with AS 1668.1; or*
- *a zone pressurisation system between vertically separated fire compartments in accordance with AS 1668.1, if the building has more than one fire compartment; or*
- *an automatic smoke detection and alarm system complying with specification 20; or*
- *a sprinkler system (other than a FPAA101D or FPAA101H system) complying with specification 17.'*

A comparison between the key building characteristics of the proposed design and the base case is provided in Table 43. The designs are assumed to have openings, room sizes and fire loads that are identical.

Table 43 Comparison of proposed design and base case

Characteristic	Proposed design (performance solution)	Base case (prescriptive)
Travel to a point of choice	23 m	20 m
Travel distance to the closest exit	63 m	40 m
Distance between alternative exits	105 m	60 m
Effective height	< 25 m	< 25 m
Sprinkler system	Yes	Yes
Smoke detection system	Full smoke detection Spaced in accordance with section 5 of AS 1670.1:2018 – ie 10 m grid	No
Building occupant warning system	EWIS	EWIS

17.7 Fire scenarios

17.7.1 Fire scenario selection

The selection of appropriate fire scenarios must take into consideration the:

- likelihood of occurrence
- potential consequences
- impact on the issues being assessed.

A workstation fire within the office area on level 3 was identified as a suitable design fire scenario for assessment to address the non-compliance related to extended travel distances and the ability of occupants to safely evacuate the floor of fire origin.

17.7.2 Design fire

In order to carry out a quantitative fire safety assessment it is necessary to describe the fire scenarios as 'design fires' by specifying parameters such as heat release and time. The design fire provides the basis for calculation of fire and smoke characteristics used to evaluate the tenability criteria.

A survey conducted by the Building and Fire Research Laboratory[52] determined that there were four main fuel packages associated with commercial office buildings – reception area furnishings, office furnishings, workstations, and maintenance carts. The testing indicated that workstations result in the

[52] Madrzykowski D, 1996, Office work station heat release rate study: Full scale vs bench scale, Conference Proceedings of the Seventh International Fire Science and Engineering Conference, Interflam '96, Interscience Communications Limited, London, England, pp 47-55.

worst case scenario out of these fuel packages. A number of workstation configurations were tested, including single panel, two-panel and three-panel. The testing showed that the growth rate was between a medium and fast t^2 fire, excluding the incipient growth phase.

This is supported by the following references:

- CIBSE Guide E[53] recommends a medium t^2 growth rate for office occupancies.
- NFPA 92[54] provides t^2 growth rates for typical office fuel packages including workstations, shelf storage and office modules which range from slow to fast.
- Enclosure Fire Dynamics[55] recommends a fast t^2 fire growth rate for offices.

A fast t^2 fire growth rate is adopted for the office portion of the building.

17.8 Assessment

17.8.1 Qualitative assessment

The CMO is located adjacent to an external carpark to the north and an external plant corridor to the south, both of which are open to the sky. Refer to Figure 82. The carpark is also served by multiple fire-isolated exits around its perimeter.

If a fire starts within the CMO, the sprinkler system in this area can be expected to contain fire spread and maintain tenability for occupants in the rooftop carpark outside. In the unlikely event that fire inside the offices were to spread to isolated combustibles located externally, smoke and hot gases from the fire can be expected to vent naturally into the atmosphere and not obstruct occupant evacuation through the carpark except in the immediate vicinity of the fire.

Given the low likelihood of fire spread to the rooftop carpark and the open nature of this area, occupants are considered to be in a place of relative safety from a fire within the internal CMO once they are outdoors.

If travel distances are measured to the door discharging to the rooftop carpark, rather than the fire stair access from the rooftop, the distance would comply with the DTS provisions. In the event of a fire in the CMO, occupants can evacuate to a place of safety equivalent to a design complying with the DTS provisions of the NCC.

17.8.2 Quantitative assessment

Available safe egress time

The base case for the assessment has the same use, floor area, volume and ventilation as the proposed design. Factors that vary between the designs are the travel distances and the smoke detector system provided in the proposed design. These differences in the designs will not impact upon the time for untenable conditions to develop within the floor of fire origin.

For this reason, the ASET has not been calculated within the assessment. The comparison of ASET / RSET margins can be based on a comparison of the RSETs.

Required safe egress time

The results of the comparative evacuation assessment attached in Appendix F are summarised in Table 44. They indicate that the RSET for the proposed design is less than the RSET calculated for the base case. This is due to the earlier warning provided by the smoke detection system within the proposed design. The assessment demonstrates that the expected evacuation time on the floor of fire origin within the proposed design is at least equivalent to a design complying with the DTS provisions of the NCC. The proposed design achieves the acceptance criteria nominated in section 17.4 of this report.

[53] Fire safety engineering – CIBSE guide E, 2019, 4th edition, CIBSE Publications Department.
[54] NFPA 92. Standard for smoke control systems: National Fire Protection Association 2018, Table B.5.3(h).
[55] Karlsson B, Quintiere JG. 2000, Enclosure fire dynamics: CRC Press LLC.

Table 44 Comparison of RSETs

Building	Measure	Cue period (s)	Pre-movement phase	Movement period (s)	RSET excl. pre-movement phase (s)
Proposed design	Point of choice	53	Equivalent	25	78
	Nearest exit	53	Equivalent	63	116
	Alternative exit	53	Equivalent	168	221
Base case	Point of choice	137	Equivalent	25	162 (>78)
	Nearest exit	137	Equivalent	60	197 (>113)
	Alternative exit	137	Equivalent	100	237 (>221)

17.9 Conclusion

The assessment shows that for the level 3 CMO, occupants are expected to evacuate faster than a design that complies with the DTS provisions of the NCC. This is due to the smoke detection system within the proposed design.

The proposed design of the building is therefore considered to comply with performance requirements D1P4 and E2P2 of the NCC, subject to complying with the fire safety measures in section 5.

18. Performance solution 12 – Extended travel distance in roof plant areas

18.1 Introduction

Clauses D2D5 and D2D6 of the NCC require that for a class 6 retail building:

- no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m.
- exits that are required as alternative means of egress must be not more than 60 m apart.

The following maximum travel distances are proposed to the roof plant area:

- 65 m to the nearest exit instead of 40 m
- 100 m between two alternative exits instead of 60 m

This assessment was prepared to show that the design complies with performance requirements D1P4 and E2P2 of the NCC.

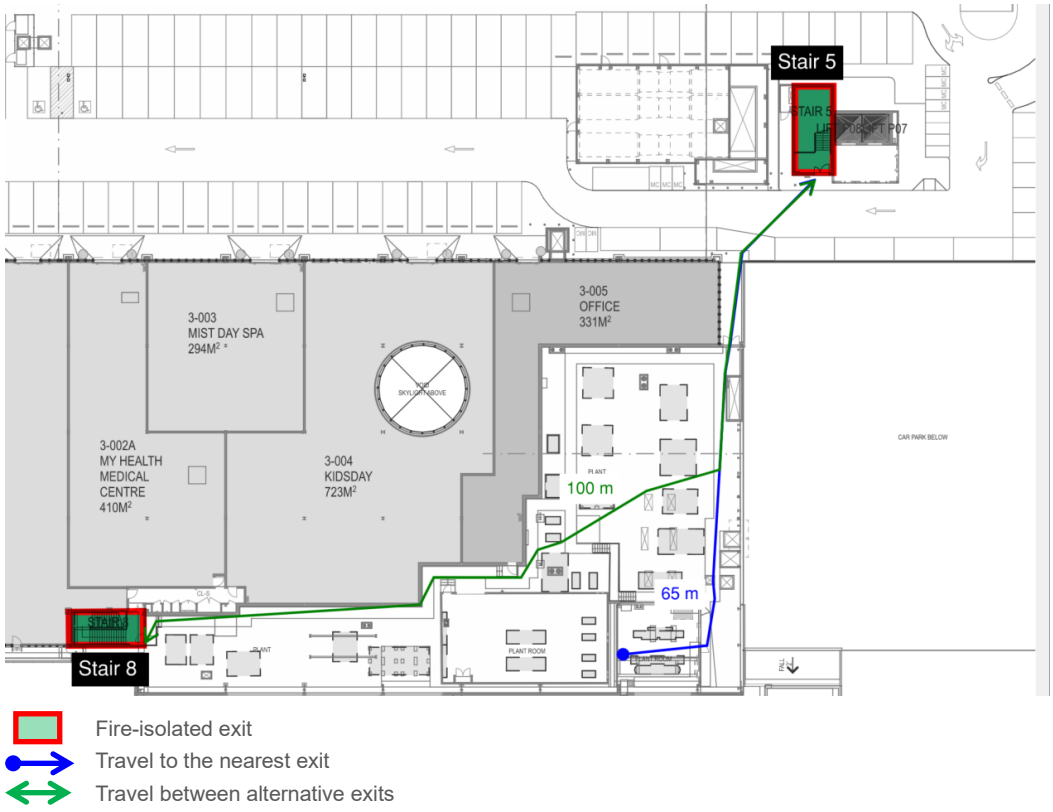


Figure 83 Extended travel distance within roof plant

18.2 Intent of the NCC

The intent of clauses D2D5 and D2D6 of the NCC have previously been discussed in section 13.2.

18.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 45.

Table 45 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control

18.4 Acceptance criteria

The acceptance criteria for this assessment is that the location of exits serving the plant areas on level 3 enables safe evacuation considering the occupant characteristics, fire hazard, and fire safety measures.

18.5 Fire hazards

Table 46 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 46 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Extended travel distances resulting in longer evacuation times.	• Sprinkler system installed throughout the building mitigating fire and smoke spread. • Early warning provided by smoke detectors installed. • Low occupant loads thereby reducing the impact of queuing.

18.6 Assessment

The plant areas are not accessible to the general population of the building and are expected to be occupied only infrequently by a few maintenance personnel. The low population means that occupants can evacuate the compartment without queuing at the exit.

Maintenance personnel are expected to be reasonably familiar with the layout of the areas and be able to locate the exits promptly if there is a fire. In addition, maintenance personnel are expected to be able-bodied and are assumed to have the same level of mobility as the general population excluding those with disabilities.

Given that the subject plant areas are small spaces, occupants within the areas at the time of a fire will be within close proximity to its location. The occupants would be expected to receive intrinsic cues about the development of a fire in the early stages of a fire and evacuate prior to the exits becoming blocked or the area becoming untenable.

To warn occupants of the plant area who are remote from the area of fire origin, it is a recommendation of the fire safety strategy for the building that smoke detectors spaced in accordance with the requirements of AS 1670.1:2018 are provided within the plant areas. The provision of a smoke detection system will facilitate the receipt of a cue by the occupants in the early stages of a fire within the plant areas, even if they do not respond to intrinsic cues.

The plant areas will be protected by a sprinkler system complying with the requirements of specification 17 of the NCC and AS 2118.1:2017 to new areas. The reliability of a sprinkler system, together with the impact that a sprinkler system will have on fire spread and fire intensity have been previously discussed in section 7.5.3. The presence of the sprinkler system can therefore be expected to further enhance tenable conditions thereby facilitating safe occupant evacuation.

Occupants of the plant areas are provided with exits in opposite directions mitigating the risk of obstruction. The path of travel north to Stair 5 after exiting the eastern plant rooms is open to the sky. Once occupants discharge from the enclosed plant area to the open roof area they are in a place of relative safety. From this point occupants can proceed to stair 5 without the risk of being exposed to untenable smoke conditions. The proposed design is therefore considered to mitigate the risk of obstruction and limit the travel distance which occupants are required to travel through smoke in accordance with the intent of the NCC.

Based on the above, the design is considered adequate for facilitating safe occupant evacuation from the plant areas despite the extended travel distances.

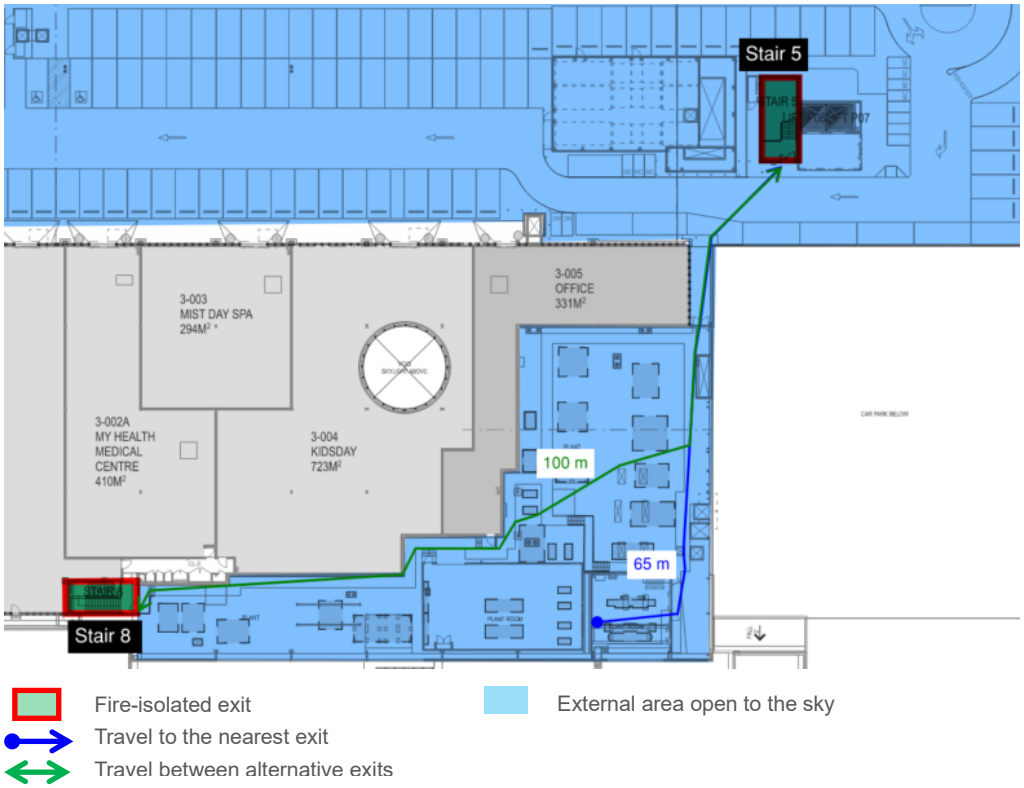


Figure 84 Roof plant – Area open to the sky

18.7 Conclusion

The assessment shows that the location of exits serving the plant areas on level 3 enables safe evacuation considering the occupant characteristics, fire hazard, and fire safety measures. The proposed design of the building is therefore considered to comply with performance requirements D1P4 and E2P2 of the NCC, subject to complying with the fire safety measures in section 5.

19. Performance solution 13 – Retail tenancies opening directly into fire-isolated exit

19.1 Introduction

Clause D2D12(1) of the NCC states that 'a doorway from a room must not open directly into a stairway, passageway or ramp that is required to be fire-isolated unless it is from –

(a) a public corridor, public lobby or the like; or

(b) a sole-occupancy unit occupying all of a storey; or

(c) a sanitary compartment, airlock or the like.'

The retail portion of the building includes numerous doors from retail tenancies that open directly into fire-isolated exits. The tenancies do not occupy the entire storey. The following specific areas have been identified:

- David Jones tenancy on the ground floor and level 1 – stairs 10, 11, 12, 13, 14 and 15
- Tenancy 1-001 on level 1 – stair 6
- Tenancy 1-004 on level 1 – stair 7
- Tenancy 1-021 on level 1 – stair 4
- Tenancy 1-012 on level 1 – stair 9
- Tenancy 2-013 on level 2 – stairs 10 and 11
- Tenancy 2-014 on level 2 – stair 13
- Tenancy 2-015 on level 2 – stair 13

This assessment was prepared to show that the design complies with performance requirements D1P5 of the NCC.

19.2 Intent of the NCC

The guide to the NCC states that the intent of clause D2D12 is '*to enable occupants to safely enter a fire-isolated exit which discharges to a safe location.'*

It also states that '*D2D12(1) requires that a doorway must not open into a fire-isolated exit unless it opens from a public area, a sole-occupancy unit which occupies a whole floor, or a toilet. This is to limit the number of entry points into a fire-isolated exit to retain its fire-resisting performance.*'

19.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 47.

Table 47 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system C – Fire spread, impact and control Sub-system E – Occupant evacuation and control

19.4 Acceptance criteria

The acceptance criteria for this assessment is that the fire-isolated stairs accessed directly from retail tenancies facilitate safe occupant evacuation from the building.

19.5 Fire hazards

Table 48 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 48 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The potential for fire or smoke to spread to an exit via a doorway opening directly into the exit	• Doorways protected with self-closing fire doors fitted with medium-temperature smoke seals.
The potential for occupants to be unable to access a fire-isolated exit which serves a tenancy that does not occupy the entire storey	• Multiple alternative exits provided from the public mall areas on each storey for occupants to evacuate

19.6 Assessment

The hazard associated with the doors from retail tenancies which open directly into fire-isolated exits in the building must be assessed in terms of the intent of the NCC, which is to retain the fire resisting performance of the exits and ensure that occupants are not required to travel through a tenancy to which they may not have access in order to reach an exit.

Part of the reason that clause D2D12 of the NCC does not allow doorways from retail tenancies on the same storey to open directly into a fire-isolated exit is to avoid situations where doors from multiple tenancies open into a single exit as shown in Figure 85. This could result in a fire in a single tenancy spreading into the exit and rendering it untenable for the other tenancies. Clause D2D12 of the NCC reduces the likelihood of this occurring by requiring smoke lobbies between the individual tenancies and the exit, or by pressurising the exit.

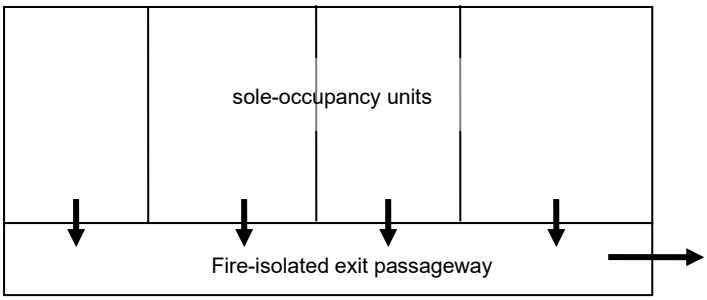


Figure 85 Non-compliant fire-isolated exit

Clause D2D12 of the NCC does not account for large retail tenancies provided with their own dedicated fire-isolated exits to reduce travel distances within the tenancies.

The fire-isolated stairs serving the tenancies identified above are dedicated exits provided for occupants within that tenancy. Occupants from the mall areas or other tenancies on the same storey do not require these exits for evacuation. This does not deviate from the intent of clause D2D12, which is to limit the number of entry points into a fire-isolated exit.

It is acknowledged that there is a relatively higher risk of smoke spread into the fire-isolated stair in this scenario compared to a fire-isolated stair accessed from circulation areas or smoke lobbies. However, the risk to occupants evacuating from the levels above is considered equivalent to evacuation via a fire-isolated stair serving a tenancy that occupies an entire storey, where the entry door could open directly into the stair.

To mitigate the risk of significant smoke spread into the fire-isolated stair, medium temperature smoke seals will be fitted to the fire doors protecting doorways that open directly into a fire-isolated stair from

the subject tenancies. It is noted that the NCC does not require smoke seals to doors opening into a fire-isolated stair from retail tenancies that occupy the entire storey.

19.7 Conclusion

The assessment shows that the fire-isolated stairs accessed directly from retail tenancies facilitate safe occupant evacuation from the building. The proposed design of the building is therefore considered to comply with performance requirements D1P5 of the NCC, subject to complying with the fire safety measures in section 5.

20. Performance solution 14 – Merging of fire-isolated stairs 5/15 and 10/13

20.1 Introduction

Clause D2D12(1) of the NCC requires that *'each fire-isolated stairway or fire-isolated ramp must provide independent egress from each storey served and discharge directly, or by way of its own fire-isolated passageway –*

(a) to road or open space; or

…

(c) into a covered area that –

(i) Adjoins a road or open space; and

(ii) (is open for at least ⅓ of its perimeter; and

(iii) (has an unobstructed clear height throughout, including the perimeter openings, of not less than 3 m; and

(iv) *provides an unimpeded path of travel from the point of discharge to the road or open space of not more than 6 m.'*

Stair 5 is an existing communication stair which extends from basement 2 to level 03. The stair is upgraded to be fire-isolated exit serving the carpark areas on all levels except for the lower ground floor where it serves the retail mall, as well as the level 3 retail and office areas. Stair 15 is an existing fire-isolated stair which extends from lower ground floor to level 01A. It serves the David Jones tenancy on levels 00 and 01. As part of the proposed works, stair 5 will be merged at level 00 into the existing fire-isolated passageway serving stair 15 which discharges to the path adjacent to the northern boundary leading to the Archer Street.

Stairs 10 and 13 are fire-isolated scissor stairs serving lower ground, level 00, level 01, and level 02. The stair systems are connected by a fire-isolated passage on level LGA and merge before discharging to Archer Street at level 00 – see Figure 87. This is an existing condition which is not being modified as part of the David Jones fitout.

The following departures from the DTS provisions relating to the fire-isolated stairs serving retail mall will be addressed as performance solutions:

- Fire stairs 5/15 and 10/13 discharge via a common passage instead of being provided with their own independent fire-isolated passageways.
- Stair 15 serves as a 2 m exit from David Jones and stair 5 serves as a 1.5 m wide exit from carpark on levels 00 to 2A. The available width in the common passageway serving stairs 5/15 is generally 2 m but reduces to 1.6 m past columns resulting in a localised reduction in the required exit width.

This assessment was prepared to show that the design complies with performance requirements D1P5 of the NCC.

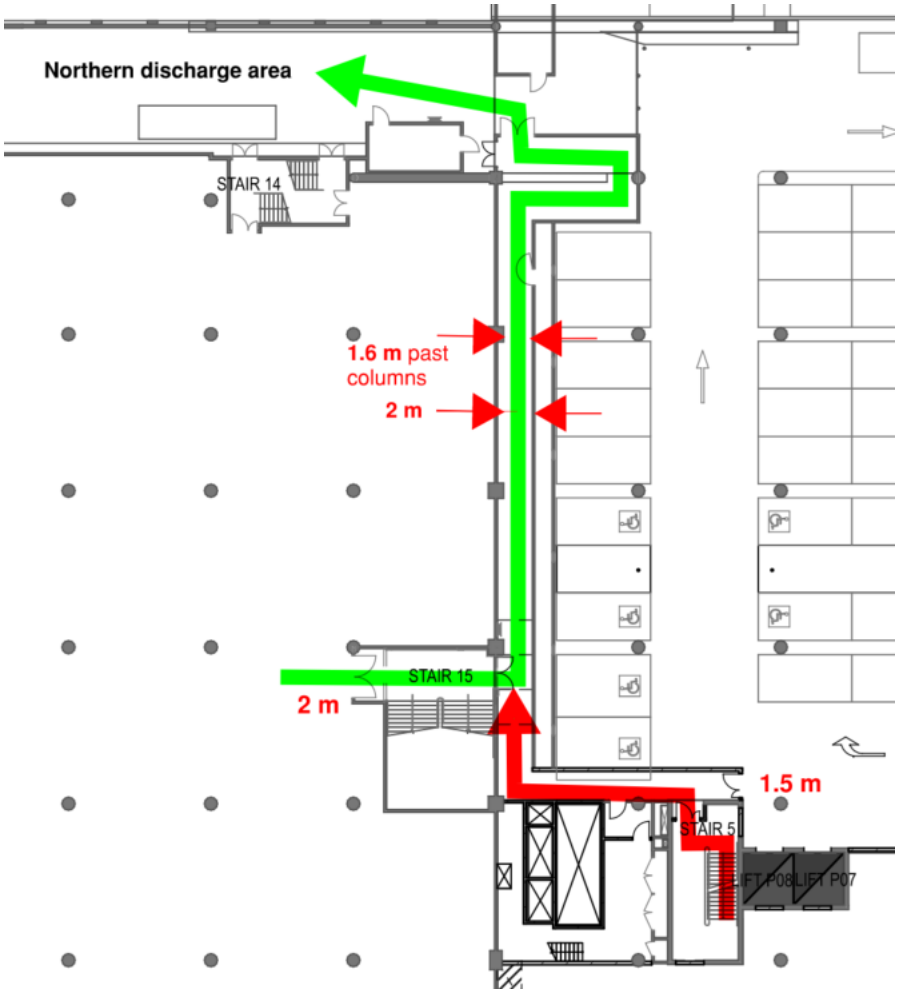
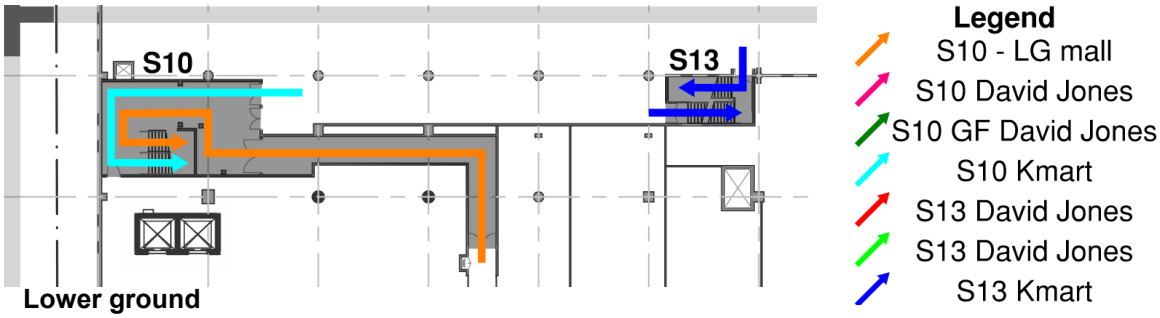
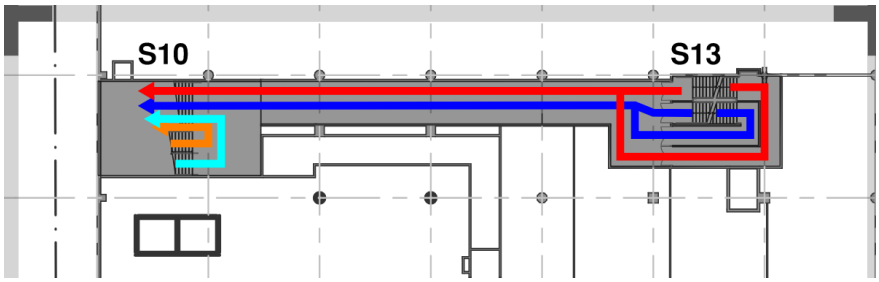


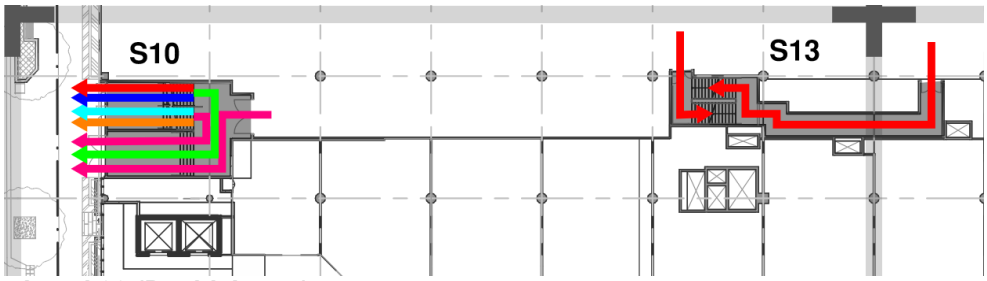
Figure 86 Stair 5 and 15 discharge passage



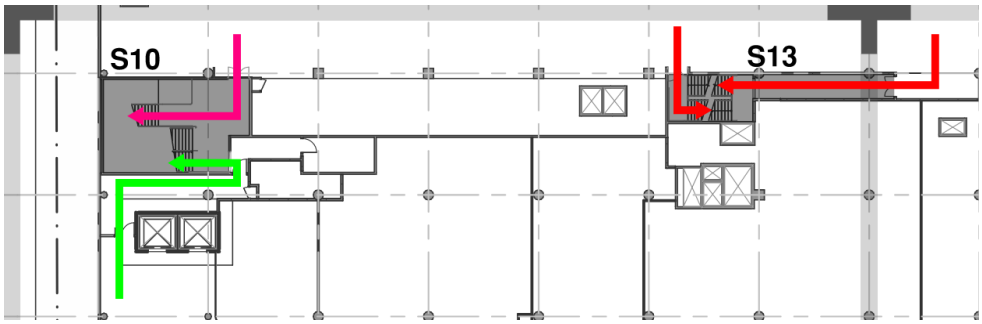
Lower ground



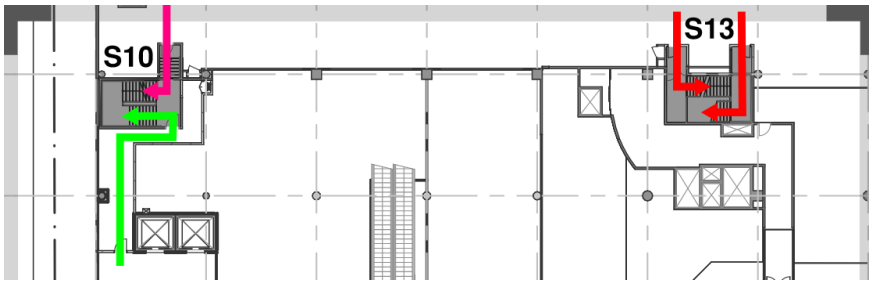
Lower ground A



Level 00 (David Jones)



Level 01 (David Jones)



Level 02

Figure 87 Stair 10 and 13 exit system

20.2 Intent of the NCC

The guide to the NCC states that the intent of clause D2D12 is '*to enable occupants to safely enter a fire-isolated exit which discharges to a safe location.'*

20.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 49.

Table 49 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative / Quantitative absolute
Fire safety sub-systems addressed	Sub-system E – Occupant evacuation and control

20.4 Acceptance criteria

The acceptance criteria for the assessment are as follows:

- The design must mitigate the risk of fire and smoke spread into the common fire-isolated passages serving multiple exits.
- The single discharge passage serving multiple exits must be wide enough to maintain a continuous flow of occupants into the fire-isolated stairs from the fire affected compartment. In other words, the merging of the exits must not lead to undue queuing within the exit system which could delay evacuation from the compartment of fire origin.

20.5 Fire hazards

Table 50 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 50 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The merging of multiple exits may lead to excessive queuing within the exit system, subsequently delaying occupant evacuation from the fire affected area.	• The retail part of the building will be provided with a smoke detection and warning system. • The emergency warning system will incorporate a phased evacuation signal prioritising the smoke zone of fire origin. • The building will be provided with sprinkler protection throughout. • Multiple alternative exits are provided from David Jones and the adjoining retail and carpark areas.
Fire or smoke spread into the common passage may affect two alternative exits reducing the redundancy of the exit system	

20.6 Fire scenarios

The assessment considers worst credible fire scenarios affecting the building as described in section 13.5.2.

Additionally, a blocked exit scenario where the main entry / exit leading to the mall is unavailable will be considered. This leads to a challenging evacuation scenario in terms of queuing within the fire-isolated exits directly serving the tenancy.

20.7 Assessment

20.7.1 Risk of obstruction of obstruction

The hazard associated with merging multiple fire-isolated exits into a single passage and point of discharge is that smoke spread into this passage, or direct obstruction of the discharge location, could compromise multiple alternative exits.

The building is provided with sprinkler protection throughout. Successful operation of the sprinkler system can be expected to supress or control the fire and maintain tenable smoke conditions outside the immediate area of fire origin – refer to section 7.5.3. The risk of smoke or fire affecting the fire-isolated exit system in the event of a worst credible sprinkler-controlled fire is very low. Furthermore, the David Jones tenancy and adjoining mall areas are provided with a smoke hazard management system designed on a performance basis which further mitigates the risk of smoke spread into the fire-isolated exits.

From the point where stairs 5 and 15 merge into level 00 corridor until the discharge point, there are no other entry points or connections into the fire-isolated passage. This minimises the potential for smoke spread into the common fire-isolated passage downstream of the point where the stairs merge. The passage discharges to a semi-external path of travel below the carpark speed ramp which comprises a low fire load and fire hazard.

Likewise, there are no additional door openings into the passage connecting stairs 10 and 13 or into stair 10 at the level of discharge. The descending flights from stair 10 are separated from the stair 13 discharge passage due to the scissor stair arrangement. Only the ascending flights from stair 10 serving the lower ground floor join into the stair 13 passage before discharging to Archer Street. On this basis, the number of doors opening into the stair system and subsequent risk of smoke spread into the exit is not considered to be increased in comparison to a complying fire stair discharging via its own independent fire-isolated passage to a road or open space.

David Jones is provided with multiple alternative exits around the perimeter of both levels as well as being provided with access to the mall smoke zone during trading hours when the maximum population is feasible. Even in the unlikely event that either stair 5 or stairs 10/13 were unavailable due to obstruction of the common passage, more than half of the required exit width serving the tenancy would still be available via the alternative exits. This provides significant redundancy for a blocked exit scenario.

20.7.2 Population and exit width

The worst credible population calculated for the David Jones tenancy is 1117 for level 00 and 1084 for level 01 based on an occupant density of 6 m^2/person across the entire floor area of the tenancy. This equates to a required aggregate exit width of 10 m for level 00 and 9.5 m for level 01, calculated in accordance with clause D2D8 of the NCC based on 2 m plus 500 mm for every 60 persons (or part) exceeding 200. The tenancy is provided with an aggregate exit width of 15m on level 00 and 14 m on level 01 which exceeds the minimum requirements of the NCC.

Furthermore, this conservatively excludes the exit width provided via the mall entry. A significant percentage of the occupants – likely more than 50% – would be expected to evacuate via the mall entry as they are familiar with this path of travel. Once within the mall occupants are in a separate smoke zone and are in a place of relative safety in the event of a fire within David Jones. This further reduces the potential population within the fire-isolated exits compared with a design meeting the minimum requirements of the NCC.

The significant exit width redundancy incorporated into the exit system for both levels of David Jones means that the potential number of occupants evacuating per 1 m of exit width is less than that of a design complying with the minimum requirements of clause D2D8 of the NCC. This further mitigates the potential queuing within the exit system compared with a design complying with the minimum requirements of the NCC.

20.7.3 Evacuation modelling

Pathfinder evacuation modelling was undertaken as part of the ASET/RSET assessment documented in Section 13. The evacuation modelling undertaken as part of this assessment included the merging paths of travel in stairs 5/15 and 10/13. The smoke and evacuation modelling demonstrates that occupants can safely evacuate from the David Jones tenancy prior to the onset of untenable smoke conditions with a significant safety margin.

In addition, a further evacuation model using the software package Pathfinder was developed to review the queuing within the exit system serving David Jones. The purpose of the evacuation model was to ensure that queuing and congestion within the discharge passages will not result in overcrowding of the exit stairs and subsequent delays in evacuation into the stairs from within the tenancy. The model was based on the following key assumptions:

- For the purposes of evaluating a challenging evacuation scenario within David Jones, all occupants are assumed to only use the required exits from the tenancy. No occupants evacuate via the main entry to the mall.
- Occupants within the David Jones tenancy on the level of fire origin will receive intrinsic fire cues such as seeing and smelling smoke in addition to the warning system cues following smoke detection. On this basis, occupants are assumed to commence movement towards exits based on a normal distribution of pre-movement times between 0 to 1 minute in the tenancy of fire origin, and 0 to 3 minutes in the non-fire affected zones.
- All parts of the building including both levels of David Jones and the adjoining mall and carpark levels are assumed to have a worst credible population – see Table 51. The population considered within basement loading dock is limited to those sharing an exit stair with the retail use, based on even distribution of the population between available exits within the area.
- The width of the merged passage serving stairs 5 and 15 has been modelled as 1.6 m wide throughout to evaluate the impact of the reduced exit width past the encroaching columns.

Table 51 Populations assumed for Pathfinder model

Level	Area considered	Population
Basement 1	Carpark	254
Basement 2	Carpark	377
Level LG	Retail	3199
Level 00	David Jones	1117
	Other retail and carpark	1678
Level 01	David Jones	1084
	Other retail and carpark	1945
Level 0A	Carpark	93
Level 01A	Carpark	149
Level 02	Carpark	2381
Level 2A	Carpark	199
Level 3	Retail / carpark / office / gym	906

Figure 88 Population assumed for evacuation modelling

The occupant density within the exits was evaluated visually using Pathfinder to identify areas where queuing within the exit system occurs. As shown in Figure 89[56], occupant movement speed can be expected to reduce as density within the exit system increases. Occupants within a corridor can be

[56] Gwynne SMV and Rosenbaum ER, 2016, Chapter 59: Employing the hydraulic model in assessing emergency movement, The SFPE Handbook of Fire Protection Engineering, 5th edition, Springer, New York.

expected to maintain a movement speed of 0.75 m/s or more where the density does not exceed 2 persons/m^2.

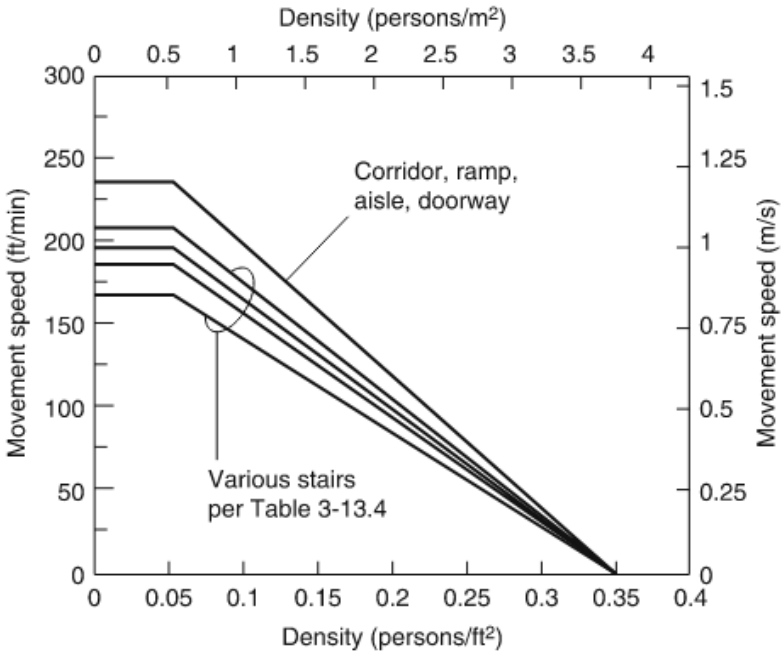


Figure 89 Occupant movement speed in relation to density

Figure 90 shows the progressive Pathfinder evacuation model results within the fire-isolated passage connecting stairs 10 and 13. Snapshots are shown for approximately 60 seconds, 120 seconds, and 180 seconds after the commencement of the evacuation. All occupants from the David Jones trading floor have entered the fire-isolated exits after approximately 180 seconds. It can be seen from these images that the occupant density within the passage does not generally exceed 1 persons/m^2 to 1.5 persons/m^2 indicating a continuous flow of occupants. Although a localised queue forms around the final discharge location where the passage from stair 13 meet stair 10, this does not impact on the flow of occupants into the exits from the retail areas served by these exits.

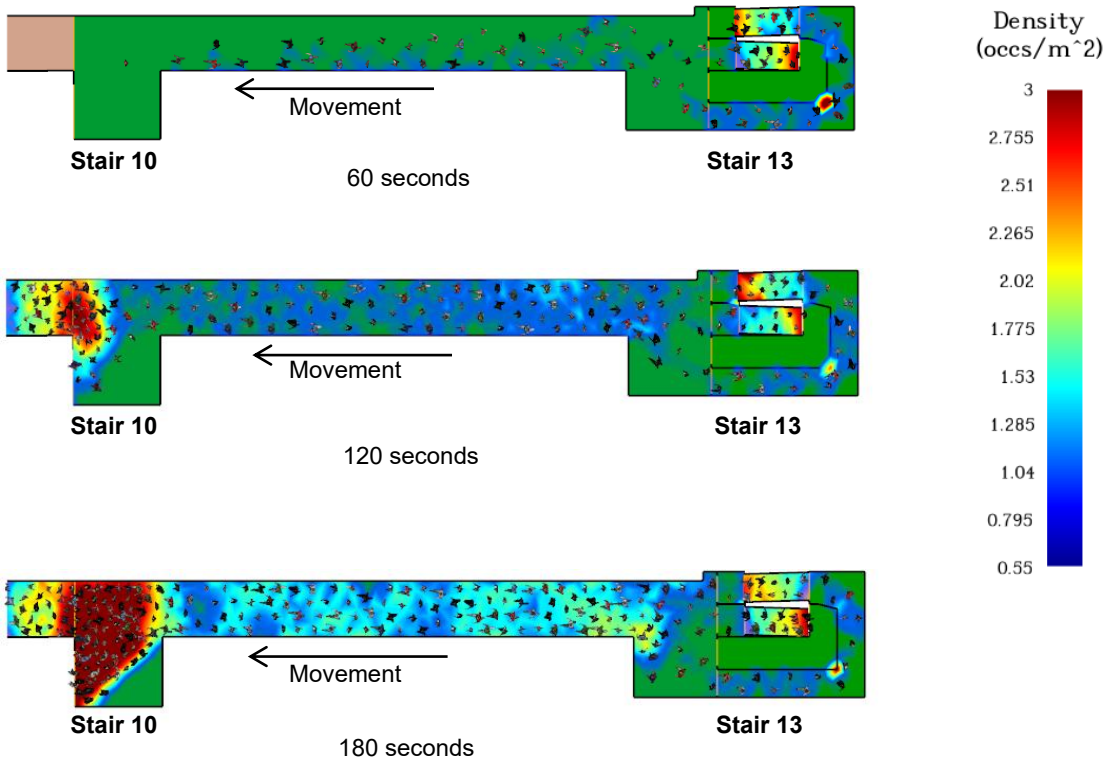


Figure 90 Pathfinder occupant density results for passage serving stairs 10 and 13

Similarly, the Pathfinder evacuation results for stairs 5 and 15 show queuing within the stair at the doorway into the common passage at level 00. However, the queue is wholly contained within the exit and does not impact on the ability of occupants to safely enter the exit from David Jones or the adjoining carpark areas. The density within the common fire-isolated discharge passage does not generally exceed 1.0 to 1.5 persons/m^2 indicating a continuous flow of occupants.

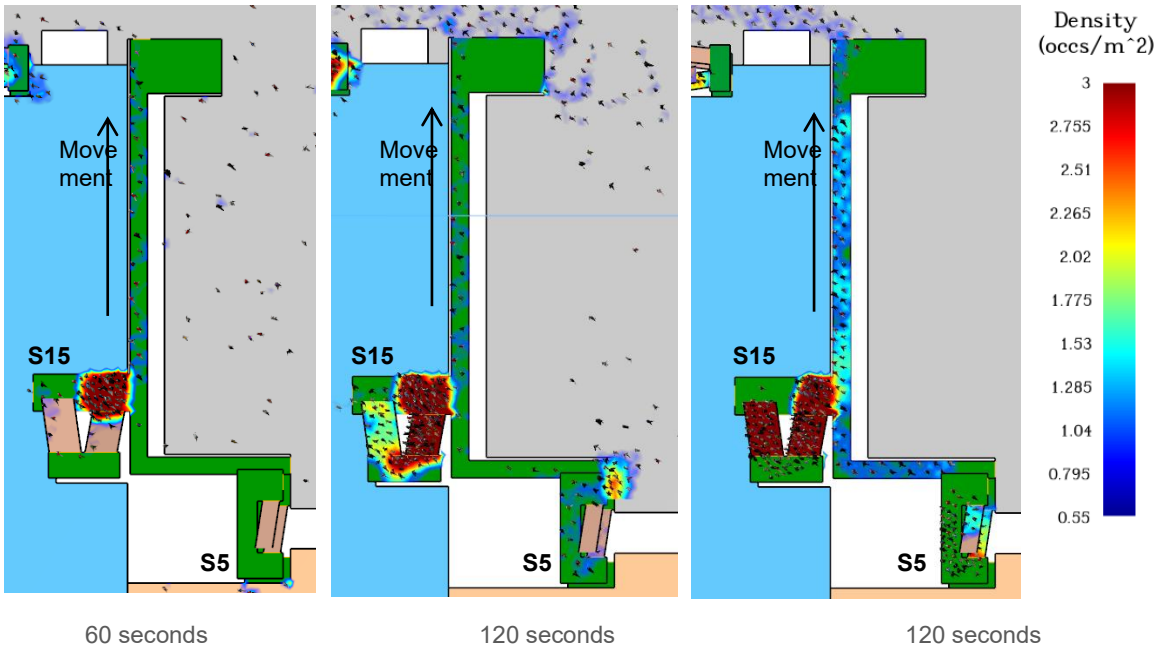


Figure 91 Pathfinder occupant density results for passage serving stairs 5 and 15

The results of the Pathfinder modelling demonstrate that the merging of the subject exits into a common fire-isolated passage does not lead to undue queuing within the exit system which could delay evacuation from the zone of fire origin.

20.8 Conclusion

The assessment shows that the design mitigates the risk of fire and smoke spread into the common fire-isolated passages serving multiple exits. The single discharge passage serving multiple exits is wide enough to maintain a continuous flow of occupants into the fire-isolated stairs from the fire affected compartment. The proposed design of the building is therefore considered to comply with performance requirements D1P5 of the NCC, subject to complying with the fire safety measures in section 5.

21. Performance solution 15 – Discharge of fire-isolated stairs along the northern boundary

21.1 Introduction

Clause D2D12(1) of the NCC requires that '*each fire-isolated stairway or fire-isolated ramp must provide independent egress from each storey served and discharge directly, or by way of its own fire-isolated passageway –*

(c) to road or open space; or

…

(d) into a covered area that –

(v) Adjoins a road or open space; and

(vi) is open for at least ⅓ of its perimeter; and

(vii) has an unobstructed clear height throughout, including the perimeter openings, of not less than 3 m; and

(viii) *provides an unimpeded path of travel from the point of discharge to the road or open space of not more than 6 m.*'

Clause D2D12(3) further requires that '*where a path of travel from the point of discharge of a fire-isolated exit necessitates passing within 6 m of any part of an external wall of the same building, measured horizontally at right angles to the path of travel, the following applies:*

(a) That part of the wall must have—

(i) (an FRL of not less than 60/60/60; and

(ii) any openings protected internally in accordance with C4D5'

Stairs 5, 12, 14 and 15 discharge to the northern boundary of the site under an existing speed ramp, where occupants travel west along a nominated path of travel to reach Archer Street. The discharge of the stairs and path of travel to the road is an existing configuration for the building, with the exception that Stairs 5, 11, 12, 13 and 14 have been extended to serve the new level (L3) gym and retail tenancies as well as the new centre management office.. No new works have been proposed to this existing discharge area.

This performance solution is therefore limited to assessing the following departures identified by the project BCA consultant and certifier –

- The covered path of travel below the speed ramp to Archer Street is more than 6 m
- The covered area is open for 25% of the total perimeter instead of 33%.
- Occupants are required to pass within 6 m of unprotected openings to the existing substation.

See Figure 92.

Note: Stairs 5/15 discharge from a common fire-isolated stairway to the northern elevation under the covered area adjacent to the ground level L00 carpark. The merging of these two stairs is assessed in section 20.

This assessment was prepared to show that the design complies with performance requirements D1P5 of the NCC.

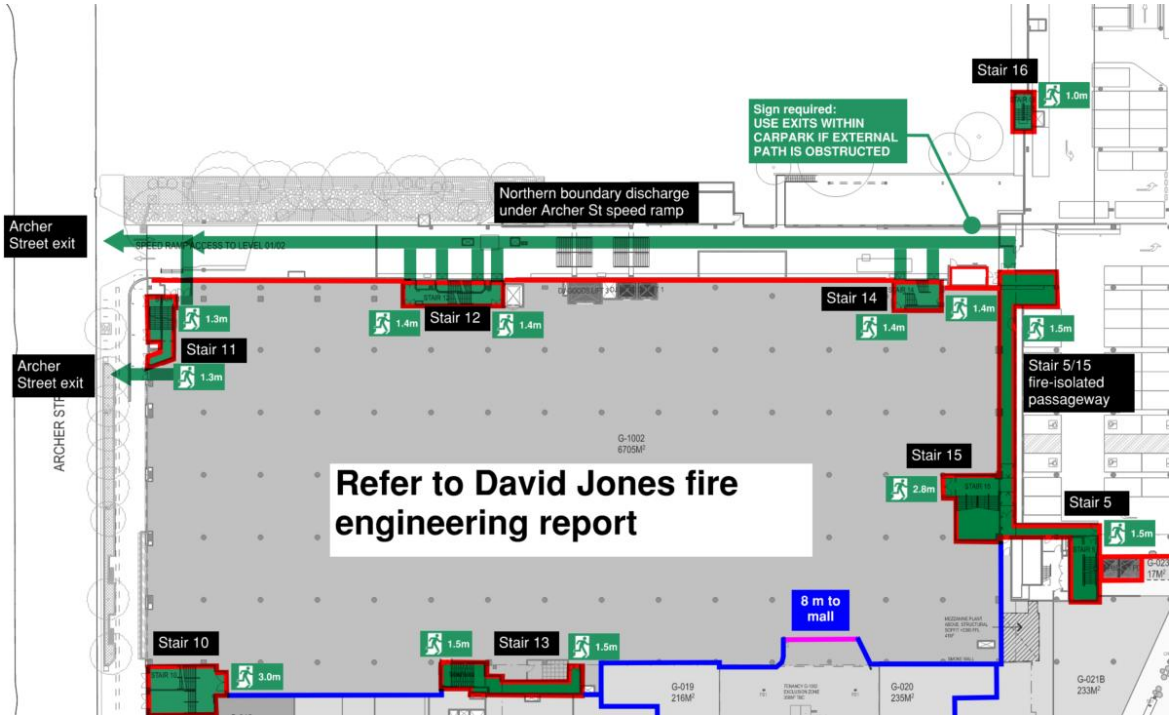


Figure 92 Discharge of fire-isolated stairs along the northern boundary

21.2 Intent of the NCC

The guide to the NCC states that the intent of clause D2D12 is '*to enable occupants to safely enter a fire-isolated exit which discharges to a safe location.*'

It also states that '*D2D12(2)(a) requires fire-isolated exits to discharge to roads or open spaces. However, there are some exemptions:*

D2D12(2)(b) sets out the requirements for a fire-isolated exit to discharge into an area within a building (including the requirement that it be open for at least two thirds of its perimeter, to aid smoke ventilation); and

D2D12(2)(c) sets out the requirements for a fire-isolated exit to discharge into a covered area outside the building (including the requirement that it be open for at least one third of its perimeter, to aid smoke ventilation)'

21.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 52.

Table 52 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system E – Occupant evacuation and control

21.4 Acceptance criteria

The acceptance criteria for this assessment is that stairs 5, 12, 14 and 15 discharge to a place of relative safety where occupants can proceed via a protected path of travel to a road or open space. If the primary path of travel to the road via the speed ramp is obstructed alternative paths of travels must be available as a redundancy, along with appropriate detection and management procedures.

21.5 Fire hazards

Table 53 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 53 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Occupants discharging from fire-isolated exits along the northern boundary are obstructed by fire or exposed to untenable smoke conditions prior to reaching a place of safety.	• The discharge area is separated from the remainder of the building by construction achieving an FRL of not less than 120/120/120. • A linear heat detection system is provided beneath the carpark ramp located over the discharge area. • The discharge area below the ramp is provided with a significant amount of natural ventilation at high level. • Exit and wayfinding signage is to be provided throughout the area. • Emergency lighting is to be provided throughout the discharge area.

21.6 Assessment

21.6.1 Layout of discharge area

The discharge of exits to the northern boundary area under the speed ramp is an existing condition. The area is primarily of non-combustible concrete and masonry construction and fire separated from the retail areas of the centre. The area consists of heights ranging from 5 m to 10 m for the majority of the path of travel to the street, with the lowest being 3.2 m. The soffit height within the area is expected to adequately facilitate the ventilation of smoke in the event of a fire within the area to the atmosphere. The extent of the open perimeter is illustrated in Figure 93. Whilst the open perimeter for the overall space is 25% instead of 33%, northern elevation itself is open for more than half its total area (53%). Furthermore most of the obstructions are below 3 m so that they would not prevent smoke from venting above the path of travel. The area is considered a safe discharge location similar to open space, considering the fire separation, construction and generous soffit heights provided.

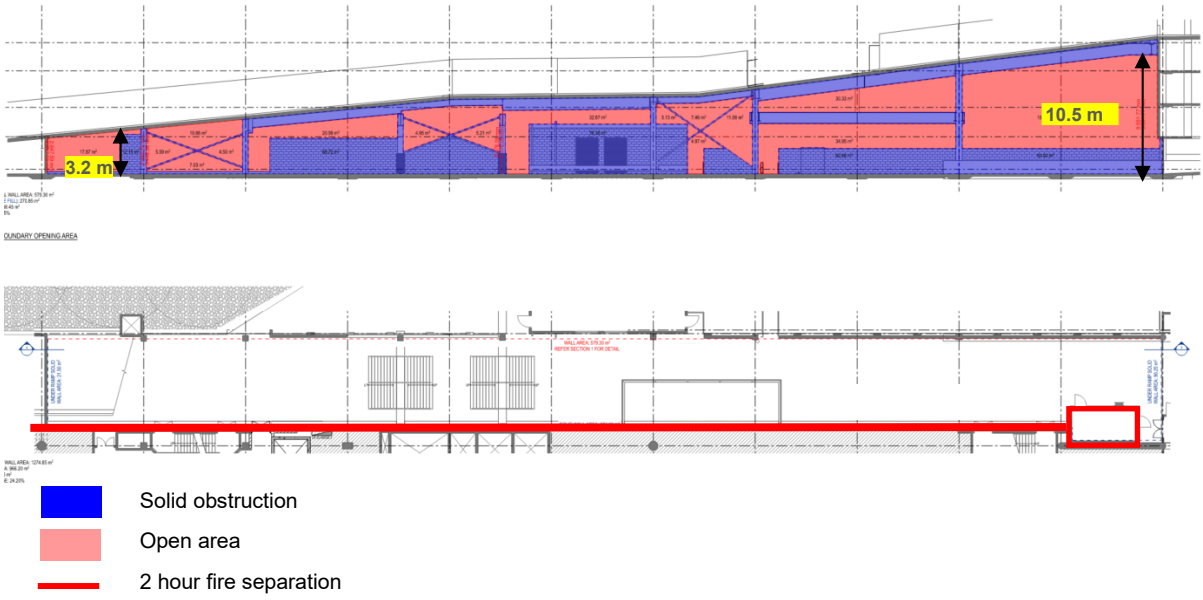


Figure 93 Open perimeter at northern boundary discharge

Table 54 provides a comparison between the proposed design and a design complying with the DTS provisions of the NCC. The complying design has an equivalent floor area, ceiling height of 3 m and complying open perimeter. This comparison demonstrates that the proposed design has more high level ventilation and a significantly larger smoke reservoir than a design complying with the DTS provisions of the NCC.

Table 54 Comparison of smoke venting parameters

Parameter	Proposed design	DTS complying design
Floor area	678 m^2	678 m^2
Perimeter of northern discharge boundary	200 m	200 m
Open perimeter	48 (24.2% of perimeter)	66 (33.3% of perimeter)
Soffit height	3.2 – 10 m	3 m
Open area above 2 m	272 m^2	66 m^2
Volume above 2 m	2,047 m^3	495 m^3

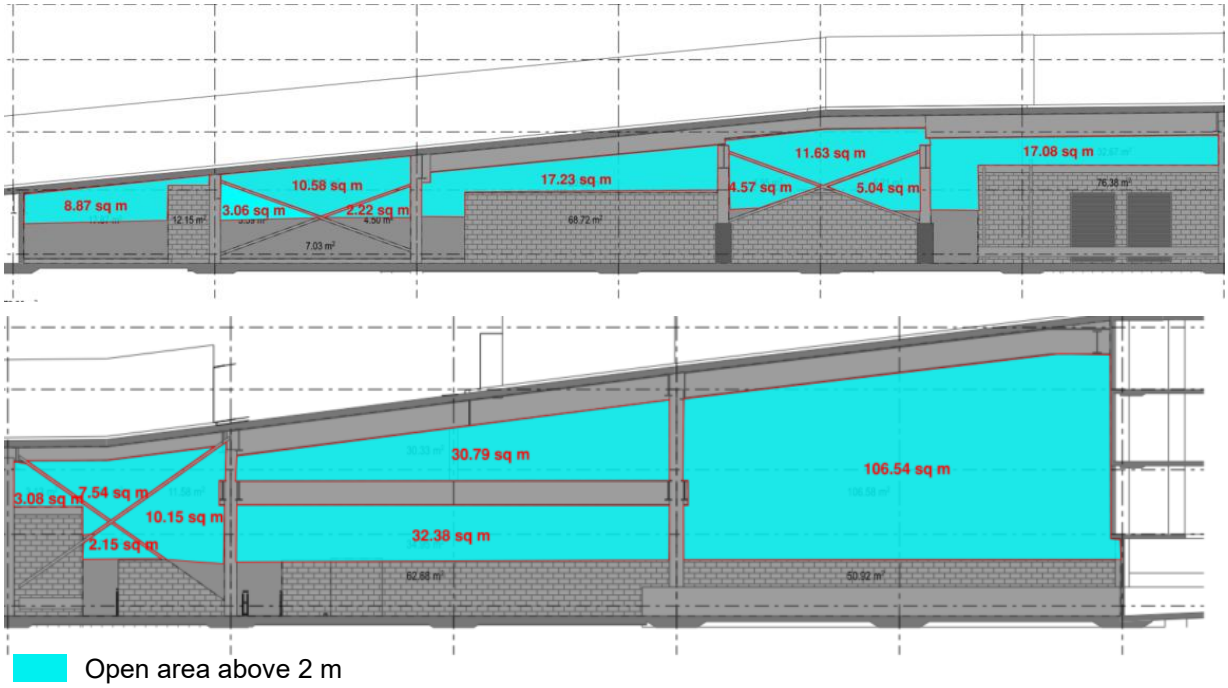


Figure 94 Northern boundary discharge – area of openings above 2 m

21.6.2 Path of travel

The path of travel from the discharge of fire-isolated stairs is illustrated in Figure 95. For occupants discharging from Stairs 5, 14 and 15, the path of travel to the road requires occupants to pass within 6 m of existing plant equipment and a substation. The existing plant equipment comprises an air handling unit (AHU) and a chilled water plant. The existing AHU will be demolished as part of the new works. The chilled water plant will remain.

Stair 12 egresses further west of the building where, occupants continue a maximum of 20 m under the carpark ramp before reaching open space where they continue west to Archer Street.

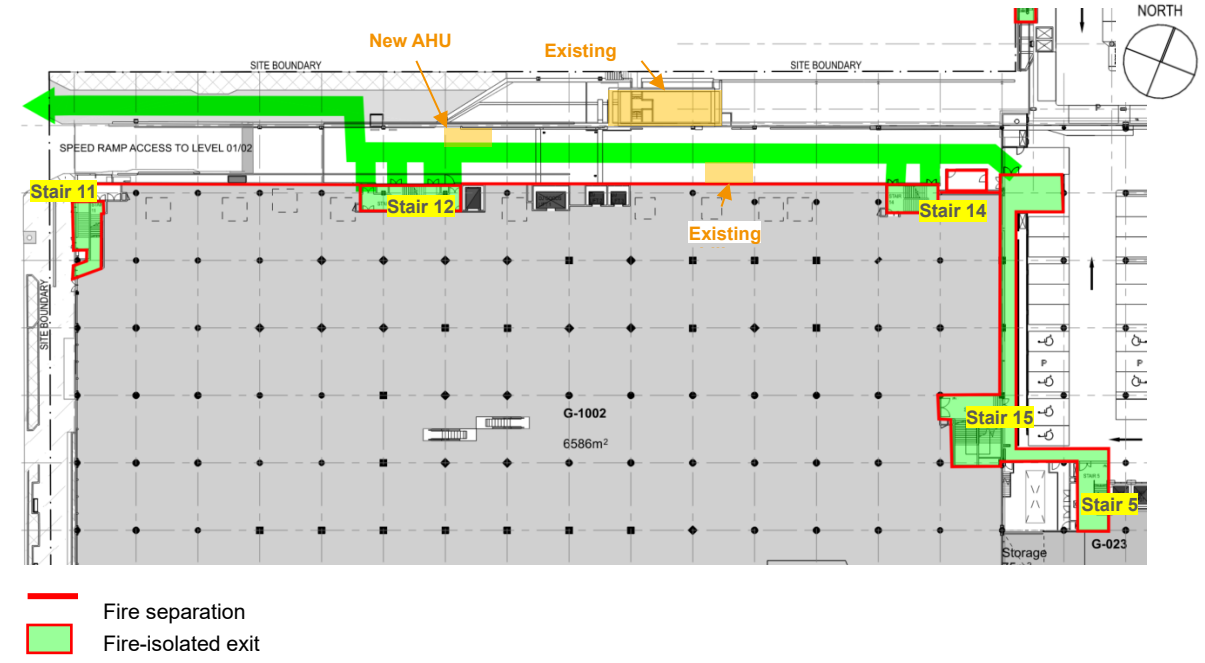


Figure 95 Discharge of fire-isolated stairs along the northern boundary



Photo 1



Photo 2

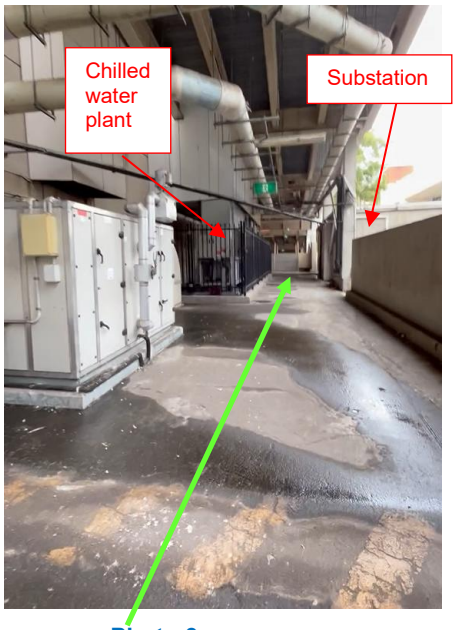


Photo 3

Figure 96 Photos showing discharge area stairs 5,14 and 15

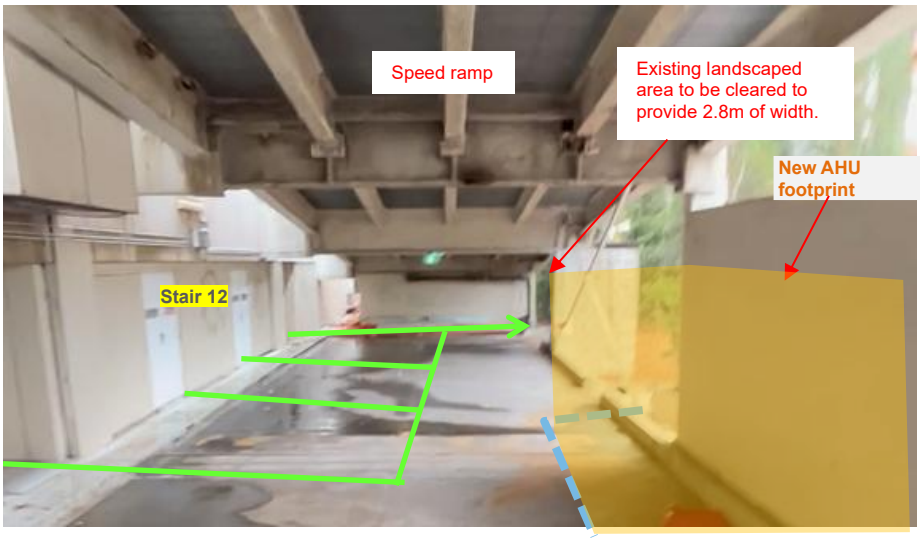


Figure 97 Photos showing discharge area stair 12

Linear heat detection is provided to the discharge area under the ramp as per the requirements of the existing FER. As per the existing detection and alarm strategy, a fire within the northern discharge area triggering the linear heat detection system – such as a plant equipment or substation fire – will not activate EWIS in the centre and initiate building evacuation. Notification will however be provided to the FIP and fire brigade via alarm signalling equipment (ASE), as well as trained staff within the security control room. The trained staff and fire brigade will then determine if it is necessary to evacuate the centre and direct occupants away from exits impacted by the fire. The evacuation procedures for a fire scenario below the speed ramp are to be documented as part of the building's emergency management plan.

A fire within the building is also not expected to impact occupant travel from the discharge area to the road given that the area is separated from retail areas by 2 hour fire rated construction. Any openings less than 3 m above the path of travel must be protected to maintain the integrity and insulation rating of the wall. As mentioned above, ductwork penetrating slab to levels below are also provided with fire dampers.

The path of travel will also be delineated with floor markings provided with exit and emergency lighting in accordance with AS 2293.1-2018 to ensure occupant wayfinding within this area is adequately facilitated.

In the unlikely event that the external path of Archer Street is obstructed occupants are able to proceed into the carpark to seek alternative egress. Signage will be provided at the discharge of Stair 14 and the common passageway serving Stairs 5 and 15 to direct occupants to the nearest exits within the carpark in the event the external path is blocked. Exit and direction signage will also be provided such that the location of the two nearby exits within the carpark are made obvious to occupants discharging from the fire exits.

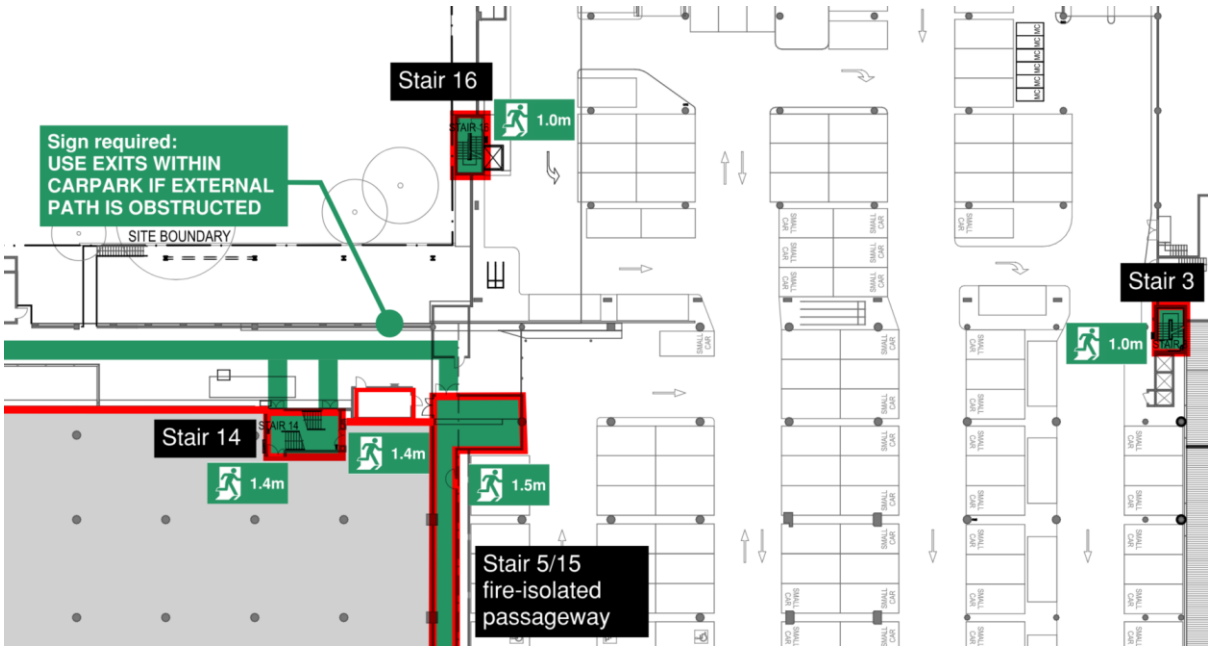


Figure 98 Discharge at level 00 for Stairs 5/15 – Alternative egress into the carpark

21.7 Conclusion

The assessment shows that stairs 5, 12, 14 and 15 discharge to a place of relative safety where occupants can proceed via a protected path of travel to a road or open space. If the primary path of travel to the road via the speed ramp is obstructed alternative paths of travels must be available as a redundancy, along with appropriate detection and management procedures. The proposed design of the building is therefore considered to comply with performance requirements D1P5 of the NCC, subject to complying with the fire safety measures in section 5.

22. Performance solution 16 – Discharge of fire-isolated stair 4

22.1 Introduction

Clause D2D12(2) of the NCC requires that 'each fire-isolated stairway or fire-isolated ramp must provide independent egress from each storey served and discharge directly, or by way of its own fire-isolated passageway –

to road or open space; or

…

into a covered area that –

(i) Adjoins a road or open space; and

(ii) is open for at least ⅓ of its perimeter; and

(iii) has an unobstructed clear height throughout, including the perimeter openings, of not less than 3 m; and

(iv) provides an unimpeded path of travel from the point of discharge to the road or open space of not more than 6 m.'

Stair 4 is an existing fire-isolated scissor stair serving retail levels 00 and 01. One of the scissor stair exits currently discharges into the existing loading dock in the south-eastern portion of the lower ground level. The other scissor stair exit leads to an external uncovered area to the east, but subsequently requires occupants to walk underneath the covered loading dock to reach open space on Victoria Avenue. The total distance to reach open space through the covered area is more than 6 m – approximately 60 m. Refer to Figure 99. This is an existing condition which is not being significantly modified under the proposed works. However, the exit stairs serve retail levels which are being refurbished under the new works.

The loading dock is sprinkler protected, has a clear height ranging between 4-8 m, and is open along its eastern and southern perimeter.

An alternative path of travel is also provided in the northward direction along the eastern perimeter of the building, eventually leading to Havilah Street to the east as shown in Figure 99.

This assessment was prepared to show that the design complies with performance requirement D1P5 of the NCC.

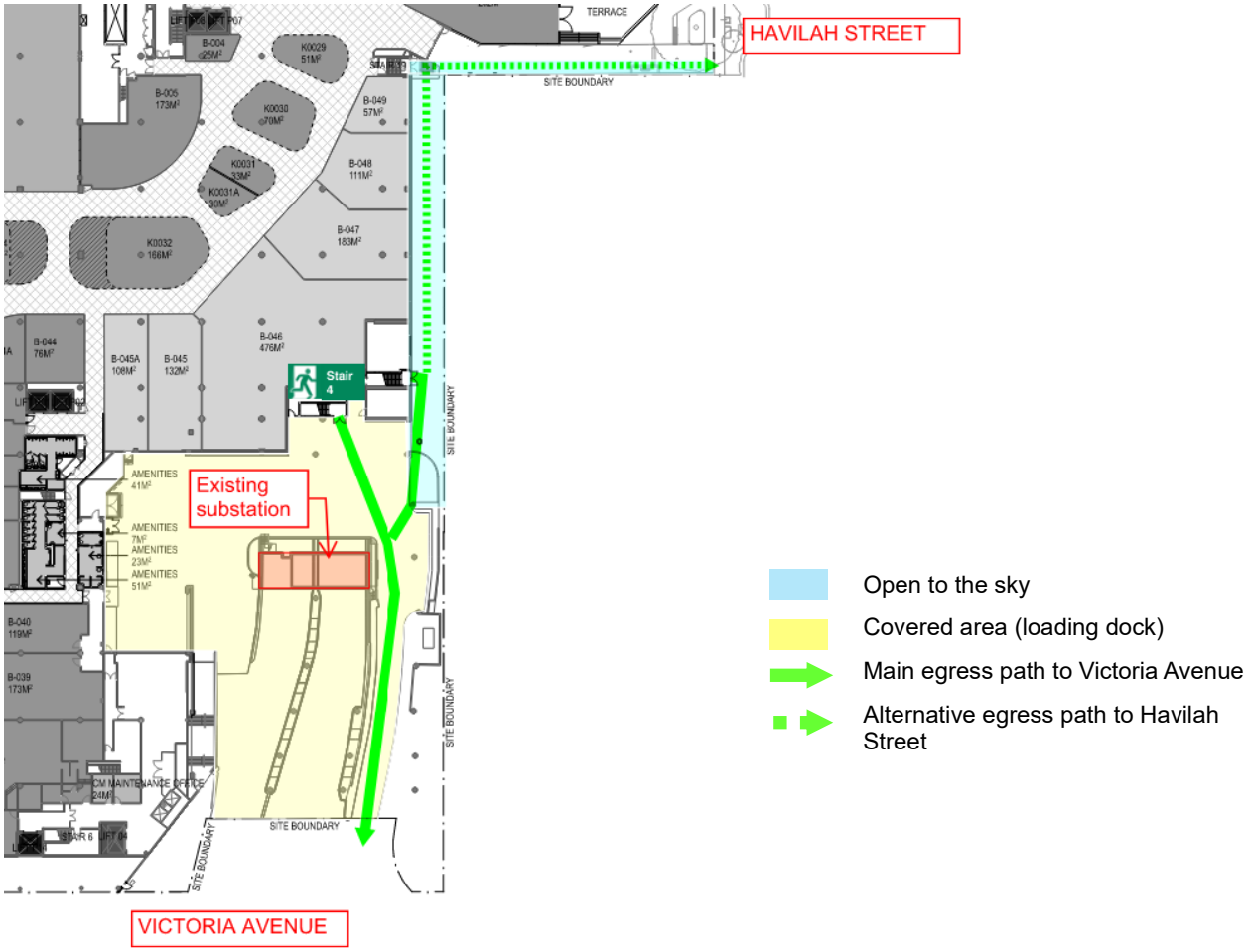


Figure 99 Discharge of fire-isolated stair 4 at lower ground level

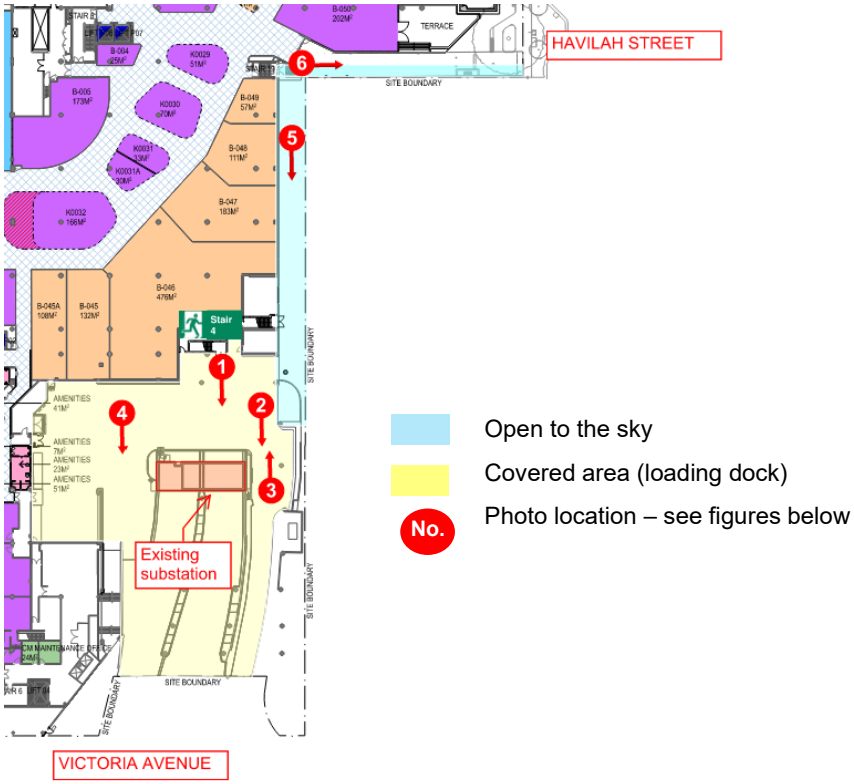


Figure 100 Location of photos shown in figures below

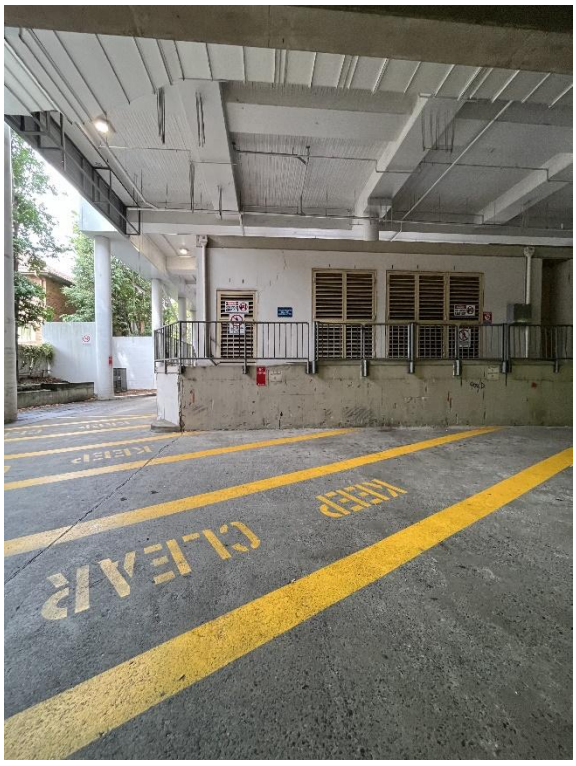


Photo 1



Photo 2

Figure 101 Photos of loading dock at the discharge of fire-isolated stair 4

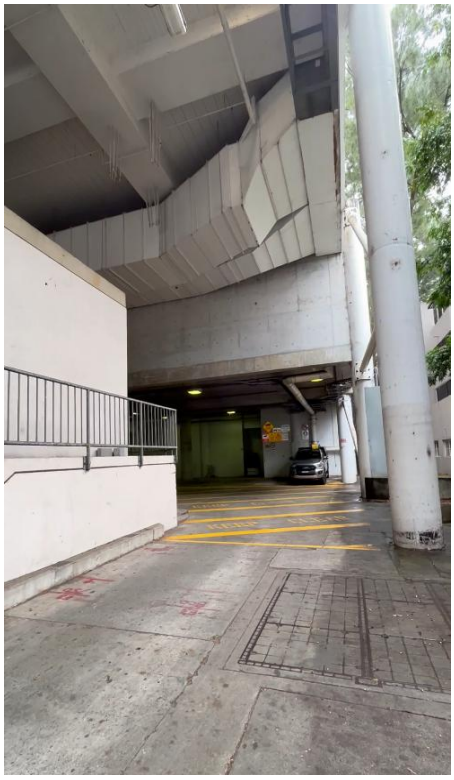


Photo 3

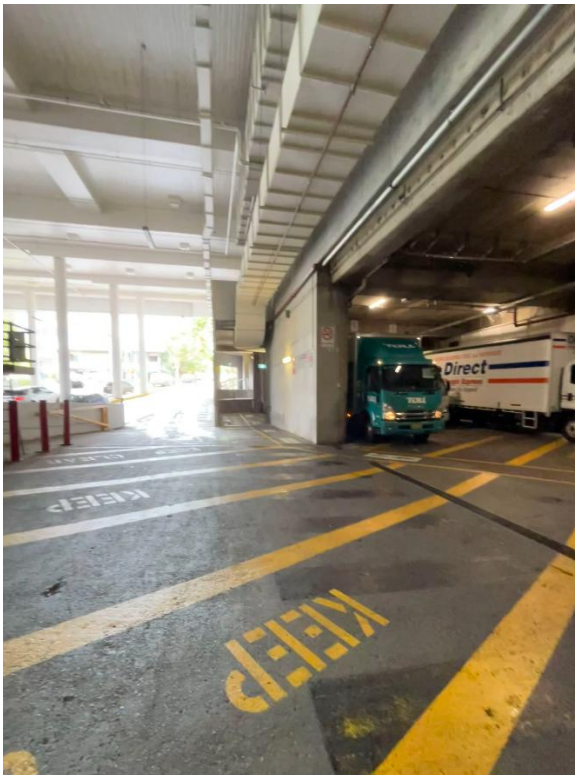


Photo 4

Figure 102 Photos of loading dock at the discharge of fire-isolated stair 4



Photo 5



Photo 6

Figure 103 Photos of existing alternative egress path to Havilah Street

22.2 Intent of the NCC

The guide to the NCC states that the intent of clause D2D12 is *'to enable occupants to safely enter a fire-isolated exit which discharges to a safe location.'*

It also states that '*D2D12(2)(a) requires fire-isolated exits to discharge to roads or open spaces. However, there are some exemptions:*

D2D12(2)(b) sets out the requirements for a fire-isolated exit to discharge into an area within a building (including the requirement that it be open for at least two thirds of its perimeter, to aid smoke ventilation); and

D2D12(2)(c) sets out the requirements for a fire-isolated exit to discharge into a covered area outside the building (including the requirement that it be open for at least one third of its perimeter, to aid smoke ventilation)'

22.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 55.

Table 55 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute

Assessment approach	
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control

22.4 Acceptance criteria

The acceptance criteria for this assessment is that the design of the discharge location of fire-isolated scissor stair 4 facilitates the safe evacuation of occupants to a road or open space.

22.5 Fire hazards

Table 56 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 56 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The potential for occupants to be obstructed by fire or untenable smoke before reaching a road or open space from the discharge location of stair 4.	• Sprinkler system provided throughout the loading dock into which stair 4 discharges. • Yellow line marking stating ‘KEEP CLEAR’ to prevent combustible items being stored near discharge location of stair 4 • Bollards provided near the discharge location of stair 4 to prevent vehicles obstructing the path of travel to open space. • Alternative path of travel northwards and subsequently east to Havilah Street as shown in Figure 99. • Exit and directional signs along the path of travel to open space from the discharge of stair 4.

22.6 Assessment

The discharge location of the two existing exits forming scissor stair 4 is described in detail in section 22.1 and shown in Figure 99. The existing loading dock into which stair 4 discharges is provided with sprinkler protection, has a clear height ranging between 4-8 m, and is open along its eastern and southern perimeter. However, the path of travel to open space from the discharge location exceeds 6 m – approximately 60 m.

The loading dock contains negligible permanent fuel load in proximity to the discharge location of stair 4. Existing floor line marking with wording stating ‘KEEP CLEAR’ further mitigates the risk of storage of combustible items near the stair discharge location – see Figure 101 and Figure 102. The loading dock also has no major ignition sources in proximity to the stair discharge location. The risk of a severe fire in the loading dock that could immediately obstruct occupants as they exit the stair into the loading dock is therefore very low.

The loading dock includes an existing substation that is located approximately 16 m away from the discharge point of stair 4. Occupants are required to walk past the eastern wall of this substation to reach open space on Victoria Avenue to the south as shown in Figure 100 – Figure 102. The substation generally comprises concrete / masonry construction and includes vent openings in the north-facing wall. A fire in the substation represents the worst-credible fire scenario that could obstruct occupants evacuating via stair 4.

The loading dock is provided with sprinkler protection throughout. In the event of a substation fire, sprinklers can be expected to control fire growth and limit fire spread towards the discharge location of stair 4, particularly in the absence of combustible items between the substation and the point of

discharge. Sprinklers can also be expected to limit compartment temperatures and improve tenability for occupants evacuating via stair 4. The beneficial impacts of a sprinkler system are detailed in section 7.5.3 of this report.

Further, the substantially open nature of the loading dock is expected to facilitate the ventilation of smoke and hot gases in the event of a fire involving the substation. Based on the sprinkler protection provided, the fire rated construction bounding the substation, the height of the loading dock, and the available ventilation, it is considered unlikely for untenable conditions to develop along the path of travel to Victoria Avenue to the south while occupants are evacuating if there is a fire involving the substation.

Occupants have a clear line of sight towards the substation and adjacent areas from the discharge location of stair 4. In the unlikely event that occupants find their path to Victoria Avenue obstructed by fire or smoke from the substation, they can use the alternative path northwards that eventually leads to Havilah Street to the east of the site. This path of travel is open to the sky throughout, but is not utilised as the primary path of travel as it provides a less direct connection to a road or open space. Refer to Figure 99 and Figure 103.

22.7 Conclusion

The assessment shows that the design of the discharge location of fire-isolated scissor stair 4 facilitates the safe evacuation of occupants to a road or open space. The proposed design of the building is therefore considered to comply with performance requirement D1P5 of the NCC, subject to complying with the fire safety measures in section 5.

23. Performance solution 17 – Areas provided with single exit

23.1 Introduction

Clause G3D7 of the NCC states that '*all areas within an atrium must have access to at least 2 exits.*'

The NCC consultant for the project has deemed that this requirement applies to all areas that are in the same fire compartment as the central atrium void extending from lower ground level to level 02.

The amenities block in the south-eastern portion of level 01 and the tenant storage areas adjacent to the amenities are only provided with access to the fire-isolated passageway associated with exit stair 6. These areas are otherwise separated from the general mall area on level 01 by solid construction.

The mid-landings of the Havilah Street escalator on levels 00A and 01A are provided with a single exit, being the horizontal exit into the carpark fire compartment. They are then provided with access to multiple fire-isolated exits from within the carpark.

This assessment was prepared to show that the design complies with performance requirements D1P4 and E2P2 of the NCC.

23.2 Intent of the NCC

The guide to the NCC states that the intent of clause G3D7 is *'to require that safe egress is available from an atrium.'*

23.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 57.

Table 57 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system B – Smoke development, spread and control Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control

23.4 Acceptance criteria

The acceptance criteria for this assessment is that the design of the amenities block and Havilah Street escalator mid-landings located within the atrium fire compartment facilitates safe occupant evacuation in the event of a fire in the building.

23.5 Fire hazards

Table 58 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 58 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The potential for occupant evacuation from the amenities block or escalator mid-landings to be obstructed due to untenable smoke conditions prior to reaching the single exit	• Sprinkler protection provided throughout the building to reduce the likelihood of untenable conditions developing beyond the area of fire origin • Retail mall, including atrium fire compartment, provided with performance-based smoke exhaust • Retail compartment fire separated from the carpark

23.6 Assessment

23.6.1 Havilah Street escalator mid-landings

The Havilah Street switchback escalators are in the same fire compartment as the central atrium void and include mid-landings on levels 00A and 01A that only have a single exit – ie the horizontal exit into the carpark fire compartment – refer to Figure 104. Occupants are subsequently provided with multiple fire-isolated exits from the carpark.

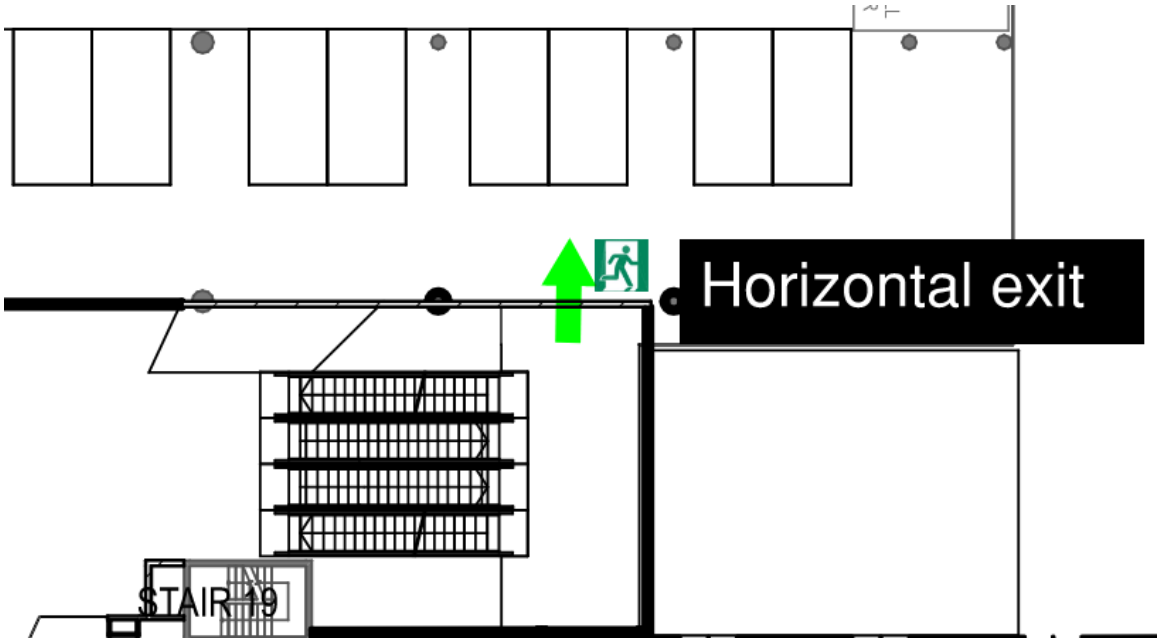


Figure 104 Single exit from Havilah Street escalator mid-landings – typical

The mid-landings are small 50 m^2 areas that incorporate a maximum travel distance of less than 15 m to the horizontal exit into the carpark. They are expected to be occupied infrequently by a limited number of people – ie around 5 based on Project 6 population densities – making their way up or down to a retail level, which has access to multiple exits.

Although they are in the same fire compartment as the central atrium void, they are in an adjacent smoke zone. The building is provided with a performance-based smoke exhaust system. The smoke hazard management assessment undertaken in section 13 of this report and the smoke modelling results included in Appendix H demonstrate that a fire in the central smoke zone containing the atrium void does not result in significant smoke spread into the adjacent zones.

The mid-landings of the Havilah Street escalators are therefore not meaningfully impacted by any potential fire or smoke spread via the central atrium void connecting lower ground level to level 2. The

mid-landings do not represent the same risk in terms of occupant evacuation as the retail mall areas directly adjacent to the atrium void in the central smoke zone.

In the event of a fire in the central smoke zone containing the atrium void, occupants on the mid-landings can promptly make their way into the carpark fire compartment without being impacted by smoke from the fire. Once within the carpark, they are considered to be in a place of relative safety from a fire in the retail compartment. They can then exit the building via one of the multiple fire-isolated exits provided throughout the carpark.

23.6.2 Level 01 amenities block and tenant storage areas

The level 01 amenities block and tenant storage areas are located behind specialty tenancies in the south-eastern portion of level 01 – refer to Figure 105. Access to the amenities and tenant storage areas from the level 01 mall is via a fire-isolated passageway that forms part of the fire-isolated exit system involving stair 6. As such, the only exit from the amenities block is via this passageway. The amenities block is not directly open to the retail mall and is completely physically separated from the central atrium void.

The retail mall in the central smoke zone containing the atrium void is provided with sprinkler protection throughout and a performance-based smoke exhaust system. A fire in this area can be expected to be suppressed or controlled by the sprinkler system, and smoke from the fire is exhausted at the top of the atrium void on level 3.

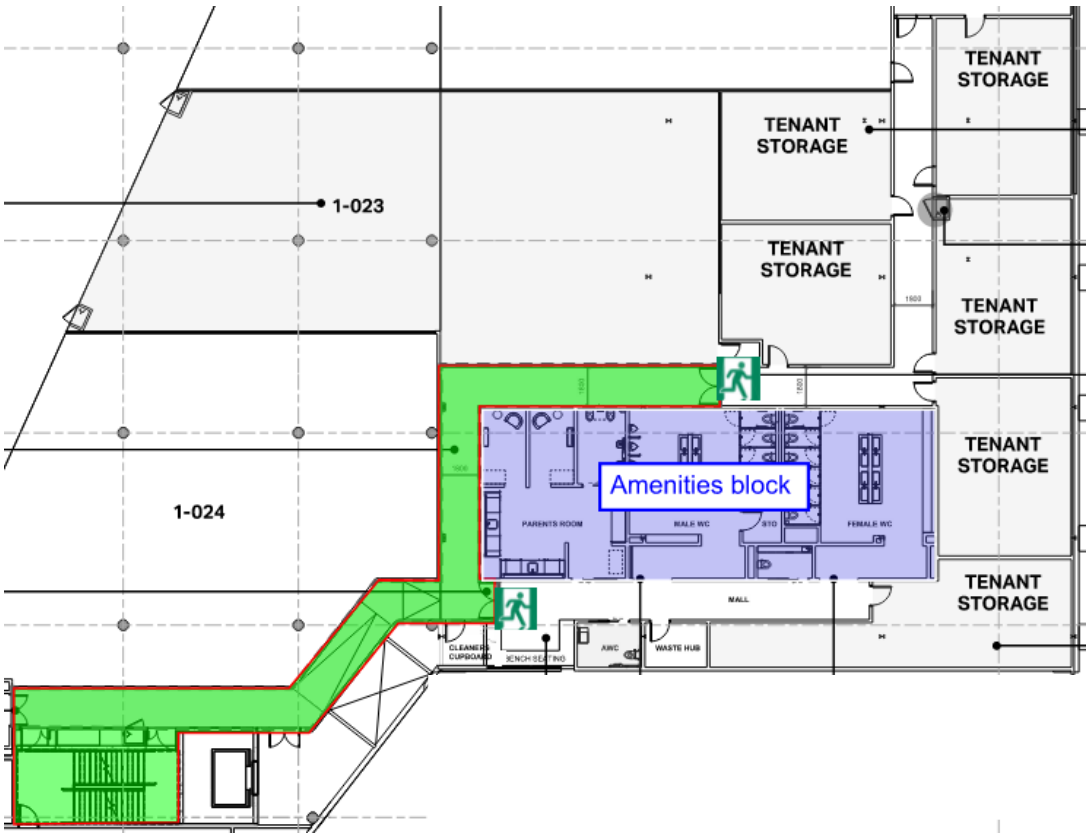


Figure 105 Level 01 amenities block and tenant storage areas provided with one exit

Given the fire safety systems and separating construction provided, no significant fire or smoke spread into the amenities block and tenant storage areas on level 01 is expected to occur. This area does not represent the same risk in terms of occupant evacuation as the retail mall areas directly adjacent to the atrium void that are not physically separated from the void.

Occupants are in a place of relative safety once within the fire-isolated passageway, and they can subsequently exit the building via stair 6 accessed off this passageway without being impacted by smoke in the retail mall outside.

23.7 Conclusion

The assessment shows that the design of the amenities block and Havilah Street escalator mid-landings located within the atrium fire compartment facilitates safe occupant evacuation in the event of a fire in the building. The proposed design of the building is therefore considered to comply with performance requirements D1P4 and E2P2 of the NCC, subject to complying with the fire safety measures in section 5.

24. Performance solution 18 – Hydrant booster and pump room location

24.1 Introduction

Clause E1D2 of the NCC states that in a building required to be served with a fire hydrant system *'the fire hydrant system must be installed in accordance with AS 2419.1.*'

Clause 7.3.1 of AS 2419.1-2021 requires that a hydrant booster assembly be located 'within or affixed to the facade of the building containing the principal pedestrian entrance and not more than 20 m from the principal pedestrian entrance'.

The existing fire hydrant and sprinkler booster assembly located off Victoria Avenue and serves the entire development – see Figure 106. As part of the works the hydrant system will be upgraded to comply with AS 2419.1-2021 with new hydrant booster assembly provided. The area around the booster location will be reconfigured as part of the proposed works, however the booster location will remain unchanged – see Figure 107. As the building consists of multiple entrances, it has been deemed that its location is required to be assessed as a performance solution.

This assessment was prepared to show that the design complies with performance requirements E1P3 of the NCC.

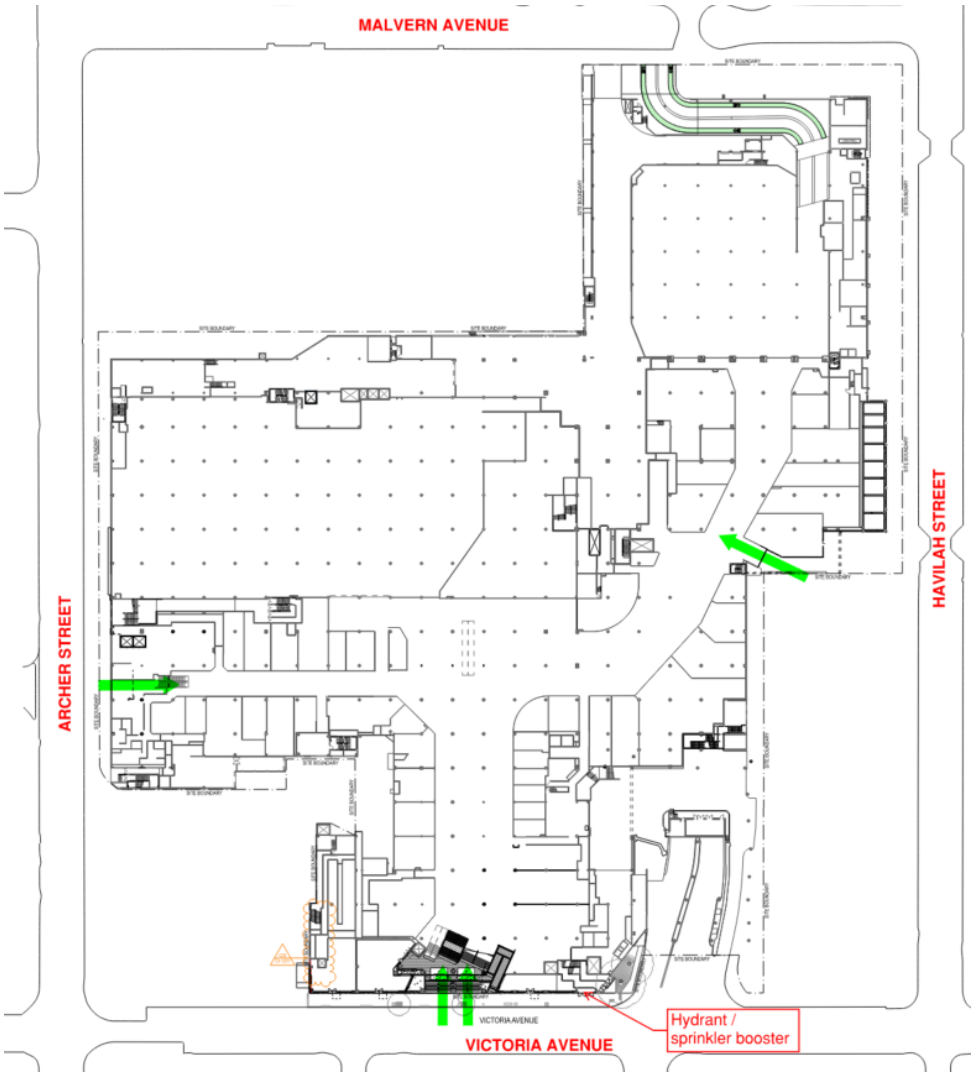


Figure 106 Site plan showing booster location

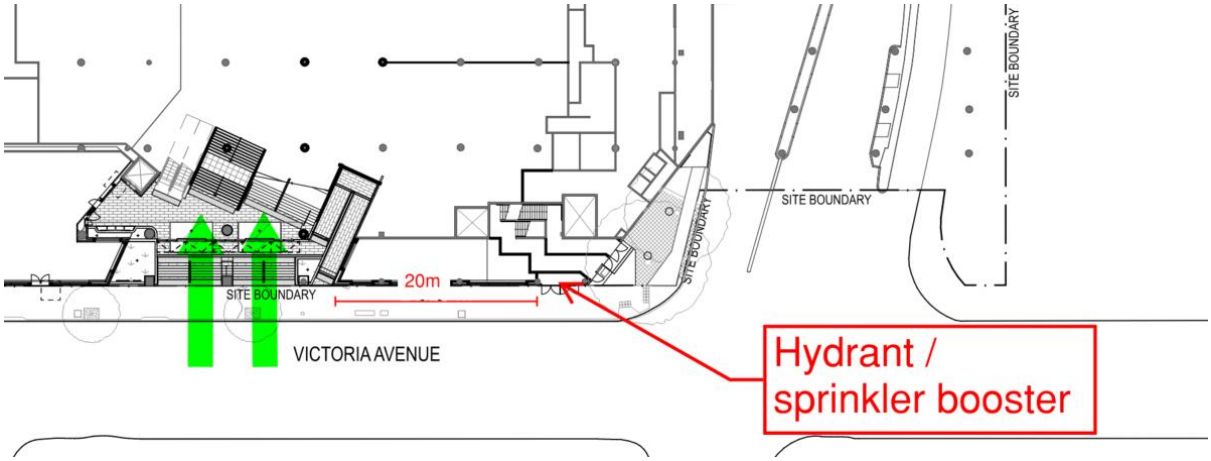


Figure 107 Booster location and Victoria Avenue entry

24.2 Intent of the NCC

The guide to the NCC states that the intent of clause E1D2 is '*to require the installation of suitable fire hydrant systems to facilitate the fire brigade's firefighting operations*.'

24.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 59.

Table 59 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system F – Fire services intervention

24.4 Acceptance criteria

The acceptance criteria for this assessment is that the fire hydrant booster assembly on Victoria Avenue can be easily located and accessed by firefighters.

24.5 Fire hazards

24.5.1 Hazard identification

Table 60 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 60 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Firefighting operations are delayed due to the location of the booster assembly.	• The booster location is approximately 20 m from the main Victoria Avenue pedestrian entry. • The building will be provided with an alarm monitoring service. The turnout address will be identified as Victoria Avenue. • The booster location will be identified with a red strobe.

24.6 Fire scenarios

The assessment will consider a general fire scenario in the building requiring attendance by Fire and Rescue NSW.

24.7 Assessment

A new booster will be provided in accordance with AS 2419.1-2021 in the same location as the existing booster. The booster is located approximately 20 m to the east of the Victoria Avenue mall entry. Although the building includes multiple pedestrian entries, this is the largest and most prominent. This is considered to meet the intent AS 2419.1-2021 which requires the booster to be located within 20 m of the principal pedestrian entry.

The booster is located adjacent to the access stair to the sprinkler valve, fire pump, and fire control rooms located at basement level 1. This provides a centralised location for coordination of fire brigade activities.

The building will be served by a fire alarm monitoring system connected to a fire station dispatch centre in accordance with S20C8 and AS 1670.3. The protected premises address for alarm response must be identified as Victoria Avenue to ensure brigade personnel turn out to the correct side of the building.

To ensure that the booster assembly can be readily located, a red strobe is to be provided near the booster assembly which is visible from Victoria Avenue. The strobe is to operate upon activation of the fire alarm in the building. This is in addition to the red strobe required at the principal pedestrian entrance under AS 1670.1:2015. There will also be block plans located at the FDCIE that will indicate the location of the booster assembly to assist attending fire crews.

24.8 Conclusion

The assessment shows that the fire hydrant booster assembly on Victoria Avenue can be easily located and accessed by firefighters. The proposed design of the building is therefore considered to comply with performance requirements E1P3 of the NCC, subject to complying with the fire safety measures in section 5.

25. Performance solution 19 – Location of hydrant pump room

25.1 Introduction

The existing hydrant system will be decommissioned, and a new system provided complying with AS 2419.1-2021 as required by clause E2D3 of the NCC. The existing fire hydrant pump room located on basement 1 will be expanded to accommodate new pumps as part of the upgrade.

The existing sprinkler system complying with AS 2118.1-1999 is proposed to be retained with an additional sprinkler valve room provided at basement level B1 to cater for the redevelopment.

Clause 6.11.2(c) of AS 2419.1-2021 requires that a hydrant pump room shall '*have a door leading directly to:*

(iii) Road or open space;

(iv) An airlock or smoke lobby that leads to –

(A) A fire-isolated passageway or stair, leading to road or open space; and

(B) A fire-isolated passageway or stair, pressurised in accordance with AS/NZS 1668.1, leading to road or open space.'

Clause S17C6 in specification 17 of the NCC requires that:

1. '*Sprinkler alarm valves must be located in a secure room or enclosure which has direct egress to a road or open space.*
2. *All sprinkler valve rooms and enclosures must be secured with a system suitable for use by the fire brigade*.'

The expanded hydrant pump room and new sprinkler valve room will be located adjacent to the existing firefighting infrastructure at basement level 1. The rooms will open directly into an existing fire-isolated corridor which leads to a path of travel to Victoria Avenue via the carpark entry ramp – see Figure 108. The fire-isolated corridor is not pressurised.

This assessment was prepared to show that the design complies with performance requirements E1P3 and E1P4 of the NCC.

25.2 Intent of the NCC

25.2.1 Clause E1D2 – Fire hydrants

The guide to the NCC states that the intent of clause E1D2 is 'to require the installation of suitable fire hydrant systems to facilitate the fire brigade's firefighting operations.'

Achieving compliance with clause E1D2 is one means of achieving compliance with performance requirement E1P3 which sets out the level of performance which a building solution must meet. The guide to the NCC provides the following commentary of performance requirement E1P3:

'As set out in E1P3, a fire hydrant system must be installed when necessary, and be appropriate to a number of factors, including:

- the need to meet the requirements of the local fire brigade (because of the pressures and flows), fire hydrants should only be used by the fire brigade;
- the floor area of the building which is a measure of the size of any potential fire; and
- the fire hazard which means the danger in terms of potential harm and degree of exposure arising from the start and spread of fire, and the smoke and gases generated by a fire.'

25.2.2 Clause S17C6 – Sprinkler valve enclosures

The guide to the NCC states that the intent of clause S17C6 is '*to require the location of sprinkler valves in a secure, easily accessible area.*' It also states that '*sprinkler control valves must be located in a secure area to prevent unauthorised tampering or vandalism. S17C6(1) requires that sprinkler alarm valves be in a room having "direct egress to a road or open space". The intent is to help fire brigade personnel gain quick access to valves, and, if the need arises, to exit quickly*.'

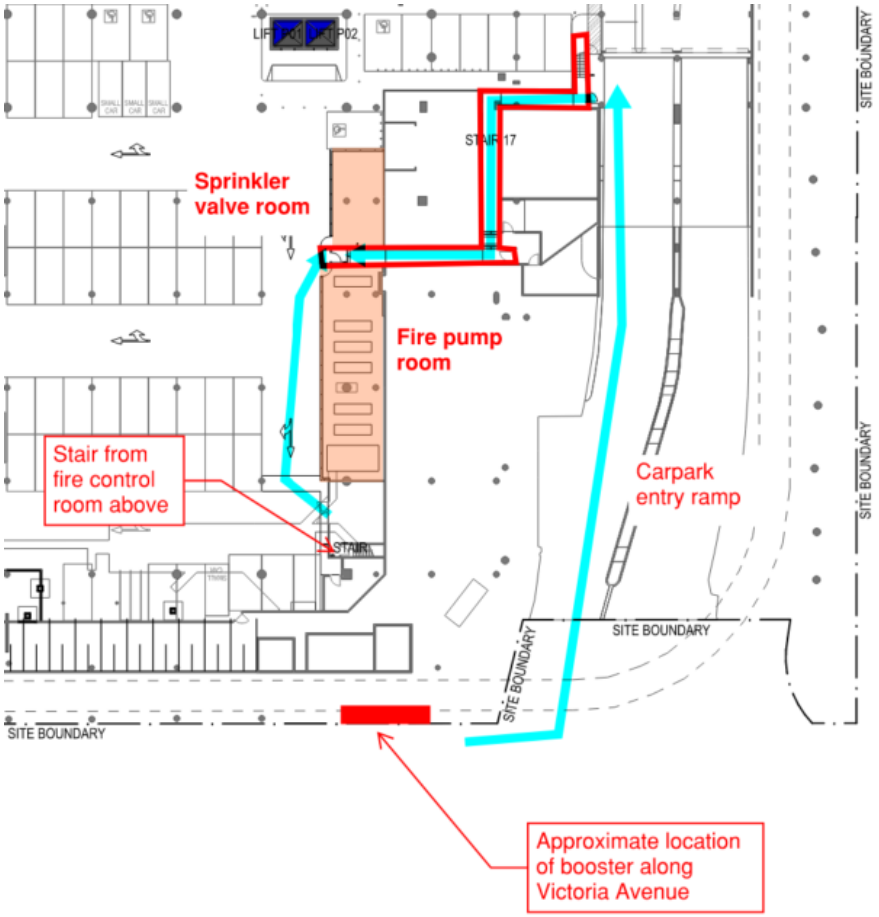


Figure 108 Basement 1 plan – location and access to sprinkler valve and pump rooms

25.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 61.

Table 61 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system F – Fire services intervention

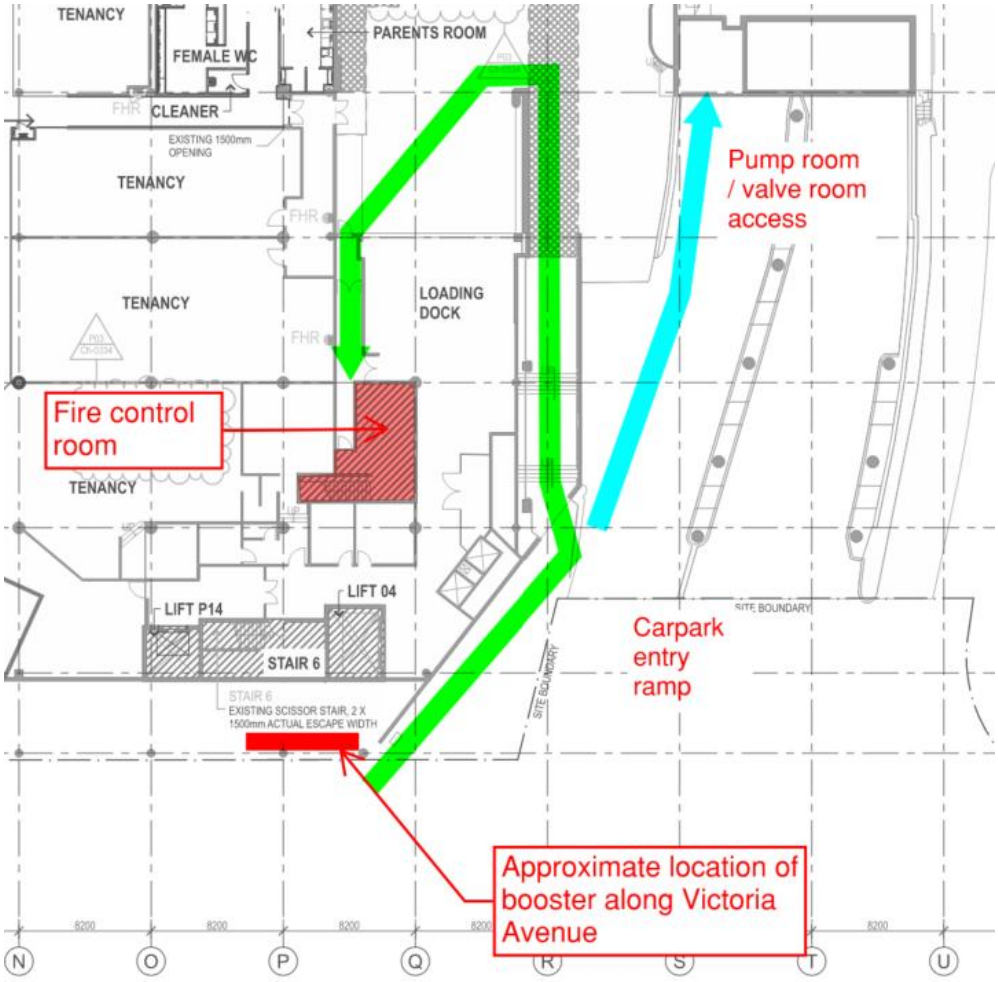


Figure 109 Lower ground floor plan – location and access to fire control room

25.4 Acceptance criteria

The acceptance criteria for this assessment is that the location of the hydrant pump room and the new sprinkler valve rooms are in a separately secured area which facilitates the safe access and egress of fire brigade personnel from the room.

25.5 Fire hazards

Table 62 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 62 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The sprinkler valve and pump rooms are not provided with direct egress to a road or open space. This may impede access and egress to these areas for fire brigade personnel.	• Tactical fire plans indicating the locations of the hydrant pump and sprinkler valve rooms are to be provided at the booster assembly along Victoria Avenue. • Signage directing attending firefighters to the pump and valve rooms is to be provided on the doors leading to these rooms.

25.6 Assessment

The location of the new sprinkler valve room and the expanded hydrant pump room are adjacent to existing firefighting infrastructure including the tank room and existing valves which are accessed down the carpark entry ramp adjacent to the booster assembly and fire control room – see Figure 108 and Figure 109. This provides a centralised hub to coordinate fire fighter intervention and operations on site.

Upon being notified of a fire incident within the building, the fire brigade personnel are expected to respond to the booster assembly or fire control room along Victoria Avenue. Brigade personnel can enter the rooms from the basement level 1 carpark via the fire control centre room or through the existing fire-isolated corridor at the base of the carpark ramp from the loading bay.

If brigades need to evacuate, they can do so via the fire-isolated passageway which discharges at the base of the carpark ramp. From there brigade personnel can continue up the ramp to Victoria Avenue bound by fire rated concrete construction and sprinkler protection. The ramp is provided with sprinkler coverage and separated from the remainder of the building by concrete and masonry construction.

Vehicle access via the carpark ramp can be expected to be managed by brigade personnel at the booster assembly, directly adjacent to the carpark entry, in the event of a fire incident. Alternatively access to the basement 1 carpark is also available where access to multiple fire-isolated stairs is provided.

Hydrant and sprinkler block plans will be provided to indicate the location of the new valve room and expanded pump room. These plans will be located at the fire control centre and hydrant booster assembly with the path of travel to the sprinkler pump and valves rooms clearly identified.

Signage is to be provided to identify the doorways leading from the base of the carpark ramp and basement 1 carpark into the passage serving the sprinkler / pump and valve rooms. The signage must state the following in capital letters not less than 50 mm high:

ACCESS TO FIRE PUMP AND

SPRINKLER VALVE ROOM

The block plans and signage are considered to enable fire brigade personnel to quickly locate and access the pump and valve rooms from the booster and fire control room.

25.7 Conclusion

The assessment shows that the location of the hydrant pump room and the new sprinkler valves are in a separately secured area which facilitates the safe access and egress of fire brigade personnel from the room. The proposed design of the building is therefore considered to comply with performance requirements E1P3 and E1P4 of the NCC, subject to complying with the fire safety measures in section 5.

26. Performance solution 20 – Additional internal hydrants

26.1 Introduction

The building is provided with a fire hydrant system in accordance with clause E1D2 and AS 2419.1-2021.

Clause 3.6.2 of AS 2419.1:2021 states that 'except where permitted by Clause 3.6.3, internal hydrants shall be located in accordance with the following:

(b) Where fire-isolated exits are provided or external stairs and/or ramps are used in lieu of fire-isolated stairs in compliance with the Deemed-to-Satisfy provisions of the NCC, internal fire hydrants shall be located –

(i) In every required fire-isolated exit, external stair, or ramp at every storey, except where installed in accordance with Item (c)

(ii) In every required fire-isolated exit, external stair or ramp at each storey other than where coverage is provided in accordance with Clause 3.5.1, regardless of the number of fire hydrants needed to provide coverage or

(iii) In every required fire-isolated exit, external stair or ramp at each storey, other than where coverage is provided in accordance with Clause 3.5.1, regardless of the number of fire hydrants needed to provide coverage

(c) Where required non-fire-isolated exits are provided, internal fire hydrants shall be located not more than 4 m from a required exit, except that internal fire hydrants need not be located adjacent to each required non-fire-isolated exit, provided fire hydrant coverage to all parts of the floor is achieved.'

The design of the fire hydrant system incorporates intermediate fire hydrants throughout the building remote from exits to achieve full coverage.

This assessment was prepared to show that the design complies with performance requirements E1P3 of the NCC.

26.2 Intent of the NCC

The guide to the NCC states that the intent of clause E1D2 is *'to require the installation of suitable fire hydrant systems to facilitate the fire brigade's firefighting operations.'*

Achieving compliance with clause E1D2 is one means of achieving compliance with performance requirement E1P3 which sets out the level of performance which a building solution must meet. The guide to the NCC provides the following commentary of performance requirement E1P3:

'As set out in E1P3, a fire hydrant system must be installed when necessary, and be appropriate to a number of factors, including:

the need to meet the requirements of the local fire brigade (because of the pressures and flows), fire hydrants should only be used by the fire brigade;

the floor area of the building which is a measure of the size of any potential fire; and

the fire hazard which means the danger in terms of potential harm and degree of exposure arising from the start and spread of fire, and the smoke and gases generated by a fire.'

26.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 63.

Table 63 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system F – Fire services intervention

26.4 Acceptance criteria

The acceptance criteria for this assessment is that the hydrant system, incorporating intermediate hydrants to achieve coverage, is suitable to facilitate the fire brigade's firefighting operations.

26.5 Fire hazards

Table 64 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 64 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The use of intermediate hydrants to achieve fire hydrant coverage may result in delays in setting up and difficulties in attacking the fire.	• Additional internal hydrants are located not more than 25m apart to facilitate progressive access for firefighters. • Location plans are to be provided at every hydrant illustrating the location of the next available additional hydrant. • The building is provided with sprinkler protection throughout.

26.6 Assessment

Clause 3.6.1 of AS 2419.1-2021 requires:

'(e) All parts of the floor shall be not more than 40 m from an internal fire hydrant installed in accordance with clause 3.6.2 except where otherwise specified by Item (f).

(f) Where travel distances throughout the building are in compliance with the deemed-to-satisfy provisions of the NCC, all parts of the floor shall be not more than 45 m from an internal fire hydrant installed in accordance with clause 3.6.2.'

Due to the layout of the building, which includes travel distances exceeding 40 m to an exit throughout the mall and major tenancies, it is not possible to achieve full hydrant coverage from the internal fire hydrants located in accordance with clause 3.6.2 – ie within fire-isolated exits and within 4m of required non-fire-isolated exits.

Full hydrant coverage of the retail mall areas will be achieved by providing additional internal fire hydrants away from the required exits. The additional internal hydrants will be located within mall areas and paths of travel to exits from the mall so that they can be readily access without needing to enter an individual tenancy which could delay firefighting operations. The only exception to this is where additional internal hydrants are required within a tenancy which is provided with direct access to one fire-isolated exit from within the tenancy.

The additional hydrants have been located to allow progressive movement of firefighters towards the central parts of the building away from exits. This enables firefighters to stage operations within the floor under the protection of a hose stream. To facilitate this, the additional fire hydrants must be located as follows:

(a) Additional hydrants must be not more than 25 m from internal fire hydrant within a fire-isolated stair, or within 4 m of a required exit.

(b) If full coverage cannot be achieve using a single additional hydrant, any subsequent hydrants must be located within 25 m of an internal hydrant complying with (a).

(c) No point on the floor required to be protected shall be more than 40m from an internal hydrant.

(d) Location plans are to be provided adjacent to each internal hydrant in accordance with clause 11.6 of AS 2419.1-2021.

Figure 110 shows an example layout illustrating the internal hydrant location requirements. Although hydrant coverage can also be achieved by connecting additional hose lengths from the internal hydrants located within the fire-isolated exits, the provision of additional hydrants provides operational flexibility should firefighters choose to utilise them.

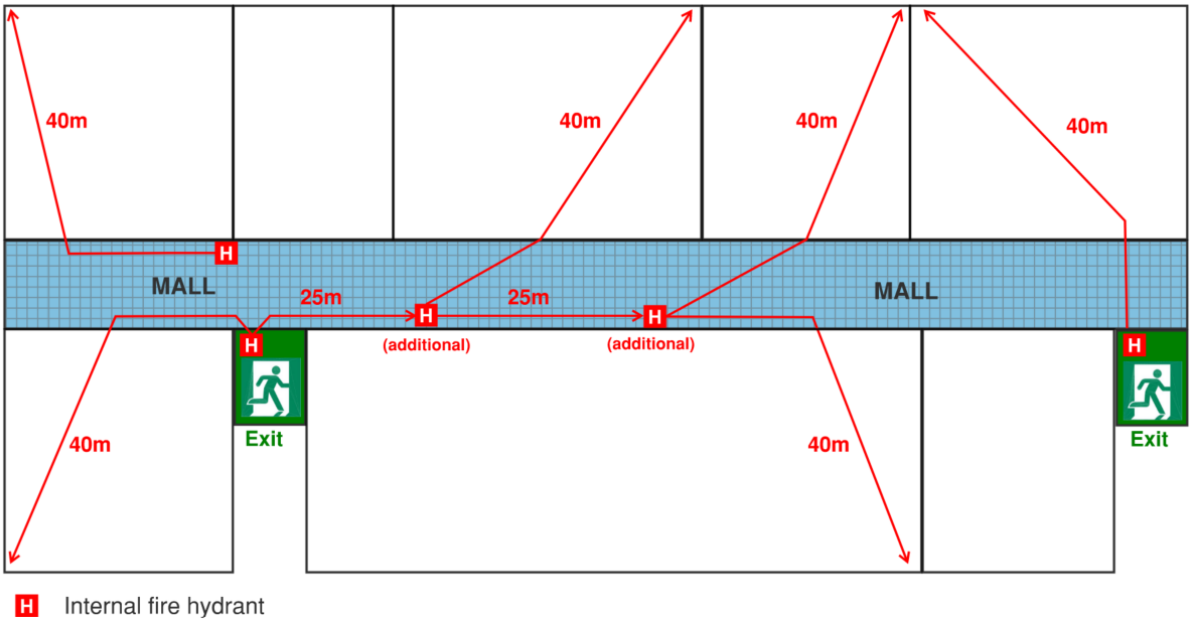


Figure 110 Example layout showing internal hydrant location requirements

The location plans provided at every additional hydrant are to detail the location of the additional fire hydrants serving the floor to assist firefighters planning operations. The plans are required to be oriented in a manner that reflects the aspect of the fire hydrant installation as it is presented to the reader and identify key features of the building such as exits, compartmentation, and unique hazards.

26.7 Conclusion

The assessment shows that the hydrant system, incorporating intermediate hydrants to achieve coverage, is suitable to facilitate the fire brigade's firefighting operations. The proposed design of the building is therefore considered to comply with performance requirement E1P3 of the NCC, subject to complying with the fire safety measures in section 5.

27. Performance solution 21 – Omission of sprinkler coverage to canopies

27.1 Introduction

The building is required to be provided with a sprinkler system complying with specification 17 E1.5 of the NCC and AS 2118.1:2017. Clauses 5.9.7 and 5.9.8 of AS 2118.1:2017 provide the following guidance on when sprinklers need to be installed under canopies and roof overhangs:

'*Canopies*

Sprinklers shall be installed under all canopies where goods are stored or handled or where the dividing wall between the canopy and the building is of combustible construction.

Note: For canopies of non-combustible construction less than 2.5 m in width over pedestrian walkways, or any width over public footpaths, sprinklers may be omitted.

Roof overhang

A roof overhang exceeding 1.5 m in width shall be treated as a canopy.

Note: Protection is not required for roof overhangs that extend from sprinkler-protected areas and project over the roof of adjoining sprinkler-protected areas and are not opposed to an exposure hazard (see clause 3.1.2).'

The new external covered entry areas outside the Victoria Avenue and Archer Street frontages of the building are greater than 2.5 m in width and are not proposed to provide with sprinklers - . Although these circulation areas adjoin the public footpath, they are within the allotment boundary and are therefore not exempt from coverage under the standard.

This assessment was prepared to show that the design complies with performance requirements E1P4 of the NCC.

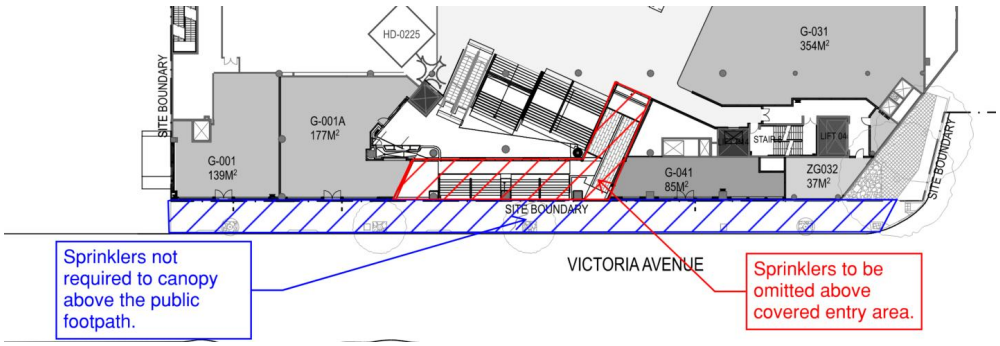


Figure 111 Victoria Avenue entry area where sprinklers are to be omitted

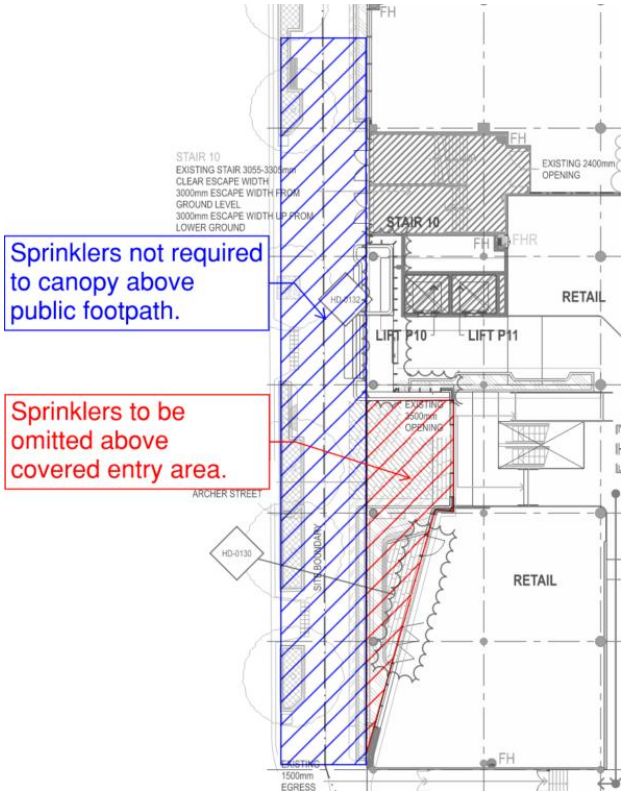


Figure 112 Archer Street entry area where sprinklers are to be omitted

27.2 Intent of the NCC

The guide to the NCC states that the intent of clause E1D4 is '*to require the installation of suitable fire sprinkler systems where necessary to address specific hazards.*'

27.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 65.

Table 65 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression

27.4 Acceptance criteria

The acceptance criteria for this assessment is that the low fire load, non-combustible construction and open nature of the covered entry areas mitigates the risk of spread of fire, without the need for sprinkler protection.

27.5 Fire hazards

27.5.1 Hazard identification

Table 66 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 66 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
A fire occurring below the unsprinklered building overhang / canopy could spread into the building and overcome the sprinkler system.	• The area where sprinklers are to be omitted is a circulation which contains negligible fire load. • The external wall linings bounding the subject area will be non-combustible. • The remainder of the building will be provided with sprinkler protection except where specifically noted.

27.5.2 Fire load

The covered entry areas from Victora Avenue and Archer Street will comprise non- combustible wall, floor and ceiling linings – see Figure 113 and Figure 114. These areas are circulation spaces which cannot practically contain any retail uses or permanent storage. Isolated low level planting is provided around the Victora Avenue entry.



Figure 113 Victoria Avenue entry façade material summary

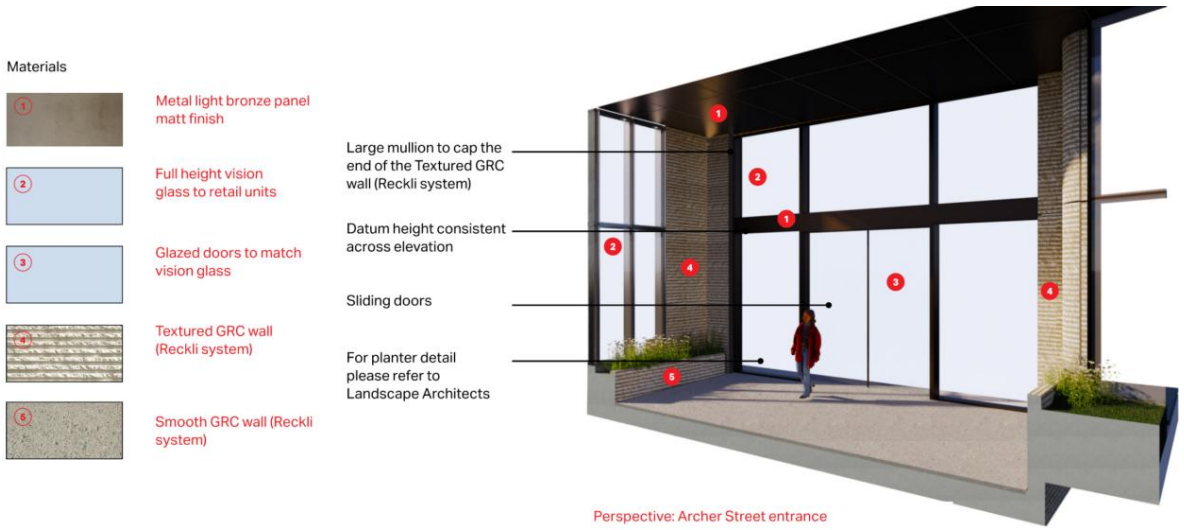


Figure 114 Archer Street entry façade material summary

27.6 Fire scenario

The assessment will consider a credible fire involving a small, isolated item such as a rubbish bin or planting below the covered entry areas.

27.7 Assessment

AS 2118.1:2017 acknowledges the low fire hazard associated with certain canopies including those located above public footpaths. Although the subject covered entry areas are not technically public space – being within the allotment boundary of the building – they are not secured from the public domain and cannot practically be used for storage of goods. These areas are only intended to be used for public access to the building.

The covered entry areas where sprinklers are proposed to be omitted are outside the external walls of the building. Floor, wall, and ceiling linings bounding these areas are required to be non-combustible materials. Limited low-level planting may be provided which is not considered to present a significant risk of ignition or fire spread.

Both entry areas are double height spaces with a clear height throughout of more than 5 m. The entry areas are fully open to the underside of the awning over the public footpath. In the unlikely event of a fire involving a small, isolated item placed within the entry area such as a rubbish bin, smoke and hot gases can be expected to vent to atmosphere. The risk of subsequent fire spread or propagation to the internal retail areas is remote. The likelihood and consequences of a fire involving an isolated combustible item is consistent with a covered public footpath which could include isolated items such as bins, planting, and seating.

In consideration of the low fire load associated with the covered entry areas, the non-combustible construction, and the available ventilation, the potential risk that a fire spread could develop and spread back into the building to overrun the internal sprinkler system is extremely low.

Manual fire suppression of a localised fire under the canopy can be undertaken by staff using fire hose reels or extinguishers adjacent to the mall entries, or by fire brigade personnel using hydrants. Fire hose reel and hydrant coverage is to be provided to these areas to facilitate suppression in this unlikely scenario.

27.8 Conclusion

The assessment shows that the low fire load, non-combustible construction, and open nature of the covered entry areas mitigates the risk of spread of fire, without the need for sprinkler protection. The proposed design of the building is therefore considered to comply with performance requirements E1P4 of the NCC, subject to complying with the fire safety measures in section 5.

28. Performance solution 22 – Fire rated cabling

28.1 Introduction

The existing dry fire infrastructure serving the areas of new works will generally be upgraded to comply with AS 1670.1:2018 and AS 1670.4:2018, which are the referenced standards in NCC 2022.

Clause 3.24.3 of AS 1670.1-2018 and clause 3.6.3 of AS 1670.4-2018 both stipulate that '*for ELV transmission paths not installed within cable conduit, the outer sheath of a cable shall be coloured red with contrasting marking "ELV Fire" at intervals not exceeding 2 m.*'

The existing dry fire cabling is to be retained as part of the upgrade. The existing cables are provided with a red outer sheath but do not have the required 'ELV Fire' marking.

This assessment was prepared to show that the design complies with performance requirements E4P3 of the NCC.

28.2 Intent of the NCC

Whilst there is no commentary on the intent clauses 3.24.4 of AS 1670.1-2018 and clause 3.6.3 of AS 1670.4-2018, it is understood that the requirement for cables to be labelled is to allow the differentiation of cables of different voltages for maintenance and to clearly identify cables serving essential fire safety equipment.

28.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 67.

Table 67 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system D – Fire detection, warning and suppression

28.4 Acceptance criteria

The acceptance criteria for this assessment is that there is a suitable means to differentiate existing ELV fire cabling from other cabling of different voltages and/or systems.

28.5 Fire hazards

Table 68 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 68 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Lack of means to differentiate the existing ELV fire cabling from other cabling of different voltages and/or systems Impeding maintenance works.	The existing ELV cabling is provided with a red outer sheath which is exclusive for such cabling.

28.6 Assessment

The requirement for 'ELV Fire' (extra low voltage) labelling for cables is to facilitate maintenance works to the building's smoke detection and EWIS system and the differentiation of cables of different

voltages. The existing cables are currently differentiated from other cabling to the building by red outer sheath as shown in Figure 115.

The coloured outer sheath is considered sufficient to assist in identification of the cabling and differentiation from other voltages and systems for maintenance and does not impact the current maintenance operation of the building.

It is also noted that the centre will be provided with a new fire indicator panel (FIP). Confirmation has been provided from the FIP manufacturer that the existing cables are compatible with the new FIP.



Photo 1

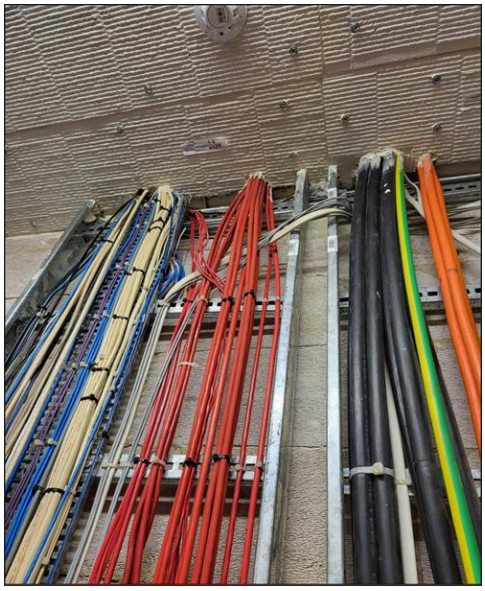


Photo 2

Figure 115 Photos of existing ELV cabling to the centre

28.7 Conclusion

The assessment shows that there is a suitable means to differentiate existing ELV fire cabling from other cabling of different voltages and/or systems. The proposed design of the building is therefore considered to comply with performance requirements E4P3 of the NCC, subject to complying with the fire safety measures in section 5.

29. Performance solution 23 – Protection of floor slab penetrations

29.1 Introduction

The building is subject to Type A fire rated construction in accordance with C2D2 of the NCC, which requires floors to achieve a fire rating in accordance with specification 5.

The fire rating of the structural elements within retail areas have been rationalised to require 2 hours fire rating instead of compliance with specification 5, which requires 3 hours within the fire engineering report rp01857s dated 28 September 2009 prepared by NDY (NDY FER).

Clause C4D13 of the NCC requires where a service passes through a floor that is required to have an FRL with respect to integrity and insulation, the service must be protected to achieve a commensurate fire rating.

The penetrations in the level 2 floor slab within wet areas of tenancy 2-013 above David Jones are not proposed to be protected. All other service penetrations in fire-rated floors throughout the building must be protected in accordance with clause C4D13 of the NCC.

This assessment was prepared to show that the design complies with performance requirements C1P8 of the NCC.

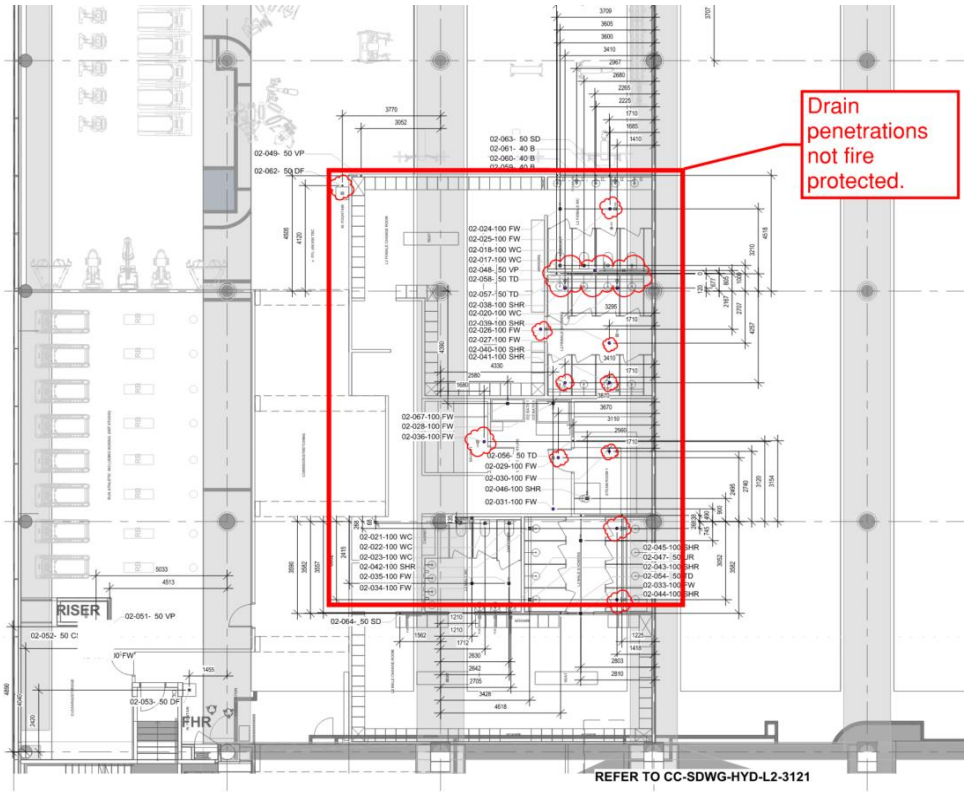


Figure 116 Drain penetrations within wet areas not protected

29.2 Intent of the NCC

The guide to the NCC states that the intent of clause C4D13 is *'to limit the spread of fire through service openings in floors and ceilings required to resist the spread of fire.'* It also states that *'the performance of a fire resisting element may be compromised if service penetrations are not adequately protected. The method of protection should ensure the fire resisting capabilities of the element being penetrated is maintained.'*

29.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 69.

Table 69 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control

29.4 Acceptance criteria

The acceptance criteria for this assessment is that the risk of fire spread via the pipework service penetrations in the level 2 floor slab is adequately mitigated in the proposed design.

29.5 Fire hazards

Table 70 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 70 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Potential fire and smoke spread between levels via the unprotected service penetration openings.	• The building is sprinkler protected throughout. • The level 1 David Jones tenancy is provided with smoke exhaust to limit the spread of smoke to areas remote from the fire-affected area. • The openings are located within wet or circulation areas in the level above, where there is limited combustible load.

29.6 Assessment

The penetrations are located within level 2 tenancy 2-013, above the level 1 David Jones tenancy area. They are limited to drainage pipes within wet areas and a water fountain pipe installation in the adjacent corridor. The penetrations range from 50 to 100 mm in diameter.

Wet areas are likely to comprise hard, tiled surfaces. The areas as well as the adjacent corridor are expected to contain limited fire load and minimal ignition sources. It is unlikely that a fire will originate within the wet areas and spread downwards via the non-protected penetrations into the retail tenancy below due to the hard tiled surfaces and minimal combustible items within the bathroom.

The building is sprinkler protected throughout. The benefits of successful sprinkler operation have been previously discussed in section 7.5.3. The successful activation of the sprinklers is expected to provide the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe egress time.
- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.
- A reduction in the chances of a fire spreading beyond the area of origin or flashover occurring.

In the event of a worst credible sprinkler-controlled fire on level 1 within the David Jones tenancy, the risk of fire or significant smoke spread to the wet area above is low. The services are located within the ceiling void of the tenancy that is provided with concealed space sprinkler protection. The risk of a fire occurring within the ceiling void and developing to a size that could result in failure of the pipe work through the slab and subsequent fire or smoke spread through the opening in the slab is very low.

In the unlikely event of a fully developed fire within David Jones resulting in failure of the pipework, the potential for fire spread to the wet areas above is low. These areas are expected to contain hard tiled surfaces and limited fire load. No combustibles are likely to be against the drainage penetrations. The David Jones tenancy on level 1 is provided with its own dedicated smoke exhaust system, which is further expected to limit significant smoke spread to level 2 in this unlikely scenario.

29.7 Conclusion

The assessment shows that the risk of fire spread via the pipework service penetrations in the level 2 floor slab is adequately mitigated in the proposed design. The proposed design of the building is therefore considered to comply with performance requirements C1P8 of the NCC, subject to complying with the fire safety measures in section 5.

30. Performance solution 24 – Reduction of widths

30.1 Introduction

Clause D2D8 of the NCC stipulates that the unobstructed width of each exit or path of travel to an exit, except for doorways, must not be less than 1 m.

Clause D2D10 further states that '*the unobstructed width of a required exit must not diminish in the direction of travel to a road or open space, except where the width is increased in accordance with D2D8(1)(b) or D2D9(a)(i).*'

Stair 19 incorporates a localised reduced clear width within the level 2A landing due to the new hydrant valve inlet within the stair.

Stair 8 also incorporates the following localised reductions in width:

- Level 00 – 1200 mm instead of 1500 mm at door from passageway into the stair
- Level 02 –1170 mm instead of 1500 mm within the Stair 8 fire-isolated passageway.

Stair 13 incorporates a localised reduction in width to 1200 mm from 1500 mm within each scissor stair landing, at the start of the transfer corridor at LGA which connects to Stair 10 – refer to Figure 66.

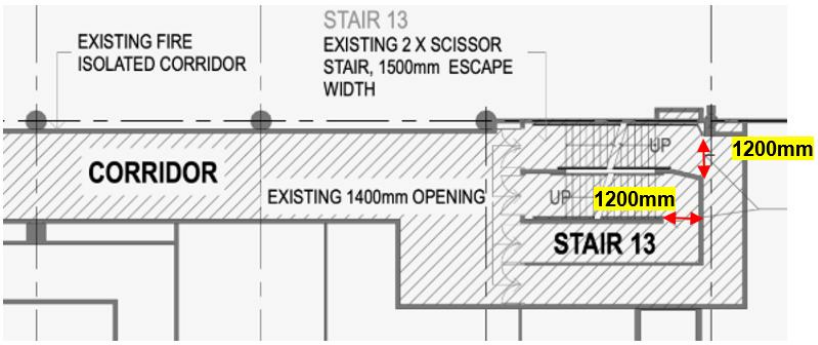


Figure 117 Localised reduction in existing Stair 13

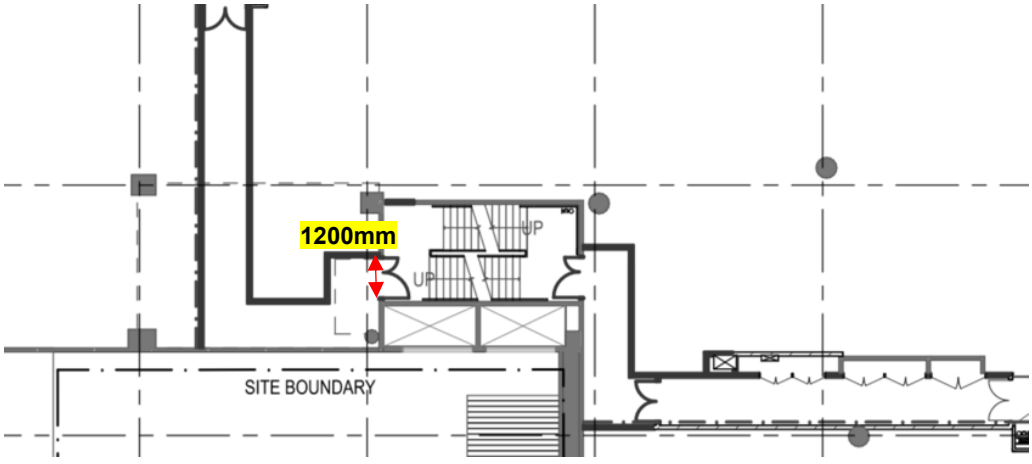


Figure 118 Level 00 – Reduced width to doorway into Stair 8

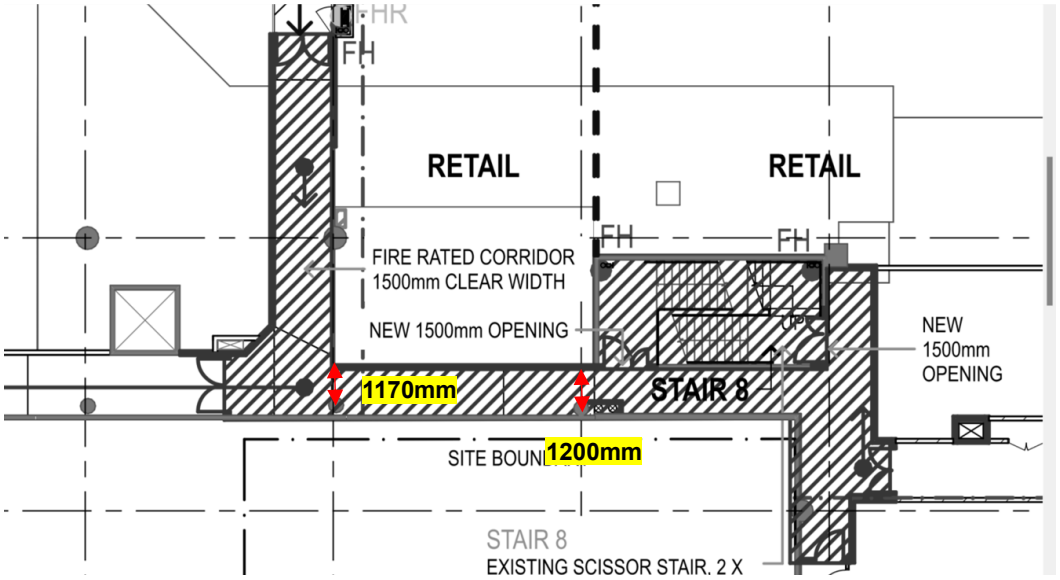


Figure 119 Level 2 – Localised reduction through fire-isolated passageway to Stair 8



Figure 120 Worst case reduced width instance – Stair 19 Level 2A 750 mm measured from indicative valve location to nearest stair tread.

This assessment was prepared to show that the design complies with performance requirements D1P4 of the NCC.

30.2 Intent of the NCC

30.2.1 Clause D2D8 – Width of exits and paths of travel to exits

The guide to the NCC states that the intent of clause D2D8 is *'to require exits and paths of travel to an exit to have dimensions to allow all occupants to evacuate safely within a reasonable time.'*

30.2.2 Clause D2D10 – Exit width not to diminish in direction of travel

The guide to the NCC states that the intent of clause D2D10 is *'to require exits and paths of travel to an exit to have dimensions to allow all occupants to evacuate safely within a reasonable time.'* It also states that *'under D2D10, the required unobstructed width of exit or path of travel must not be reduced in the direction of egress. This provision aims to avoid congestion in an exit or a path of travel to an exit.'*

30.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 71.

Table 71 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system E – Occupant evacuation and control

30.4 Acceptance criteria

The acceptance criteria for this assessment is that the localised reductions in unobstructed width within fire-isolated stairs 6, 11, 13 and 19 do not impede or slow evacuation of occupants from the building.

30.5 Fire hazards

Table 72 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 72 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The reduced unobstructed width can potentially impede occupants negotiating a path of travel in an evacuation	• No specific preventive and protective measures.

30.6 Assessment

30.6.1 Body dimensions

A survey of key body dimensions was undertaken for people across multiple countries[57] and firefighters in the United States[58]. The results of the surveys are summarised in Table 73 and Table 74 respectively. Although conducted overseas, the results are considered applicable to the Australian general population and firefighters. This is based on the assumption that deviations of body dimensions between the countries are minimal. This indicates that the reduced unobstructed width within the impacted stairs– ie down to 750 mm for a 1 m stair or 1200 mm for a 1500 mm stair– can accommodate occupants (95th percentile shoulder width of 550 mm) in single or double file, and firefighters (95th percentile shoulder width of 592 mm). This includes a safety margin to allow for future changes to body dimensions.

[57] International Standards Organisation 2015, Basic human body measurements for technological design – Worldwide and regional design ranges for use in product standards, ISO 7250-3-2015, International Standards Organisation, Switzerland.
[58] Lackore R, 2007, Firefighter Anthropometric Data White Paper, Fire Apparatus Manufacturer's Association.

The NFPA ready reference on human behaviour in fire emergencies[59] states that the major axis – across the shoulders – of a body ellipse used to develop egress systems is 609 mm.

Table 73 Summary of measurements from global survey

	Male percentiles			Female percentiles		
	5th	50th	95th	5th	50th	95th
Hip breadth, standing (mm)	282	334	387	290	357	423
Shoulder width (mm)	387	469	550	362	430	498

Table 74 Summary of measurements from US firefighter survey

	Male percentiles			Female percentiles		
	5th	50th	95th	5th	50th	95th
Width across hips (mm)	363	414	495	343	414	503
Shoulder width (mm)	470	528	592	432	470	554

30.6.2 Group dynamics and movement

In the event of simultaneous evacuation of larger groups of occupants, it is likely that a crowd builds up at localised bottlenecks such as doorways or, in this case, gates. The movement of individuals becomes dependent on the distance between different occupants and surrounding obstructions as occupants try and move forward at the same time as keeping a reasonable private space to other persons and objects.

Research into occupants moving through localised obstructions such as single leaf doors demonstrate that occupants make more efficient use of the full width of the doorway and temporarily accept lesser spatial separation to other occupants. This is consistent with the allowance under clause D2D8 of the NCC where the width of the exit paths at doorways may be locally reduced by 250 mm.

The reduction in width within stair 19 occurs at pinch point (no less than 750 mm) where new hydrant valve is installed. Therefore, it can be concluded that the flow of occupants through the impacted fire stairs is at least equivalent to that of a localised reduction in width permitted in a DTS compliant doorway.

Whilst it is noted that the localised reduction within Stairs 8 and 13 are more than a 250 mm reduction in width, occupants past the pinch point are expected to behave similarly as it is a localised obstruction which only temporarily affects the movement of the individuals within the group. Evacuation modelling has been undertaken for the retail shopping centre, incorporating these localised reduction in widths – see section 13 and Appendix I. The modelling undertaken demonstrates the design facilitates safe occupant evacuation with regard to ASET/RSET margin.

30.7 Conclusion

The assessment shows that the localised reductions in unobstructed width within fire-isolated stairs 8, 13 and 19 do not impede or slow evacuation of occupants from the building. The proposed design of the building is therefore considered to comply with performance requirements D1P4 of the NCC, subject to complying with the fire safety measures in section 5.

[59] Human behaviour in fire emergencies, 2003, NFPA, USA, p 63.

31. Performance solution 25 – Hydrant and sprinkler pipe penetrations to fire stairs

31.1 Introduction

Clause C4D15 of the NCC requires metal pipe service penetrations to be protected in accordance with a tested prototype or in accordance with specification 13.

'*Specification 13 requires that metal pipe systems are protected as follows:*

(a) A pipe system comprised entirely of metal (excluding pipe seals or the like) that is not normally filled with liquid must not be located within 100 mm, for a distance of 2 m from the penetration, of any combustible building element or a position where combustible material may be located, and must be constructed of—

(i) copper alloy or stainless steel with a wall thickness of at least 1 mm; or

(ii) cast iron or steel (other than stainless steel) with a wall thickness of at least 2 mm.

(b) An opening for a pipe system comprised entirely of metal (excluding pipe seals or the like) must—

(i) be neatly formed, cut or drilled; and

(ii) be no closer than 200 mm to any other service penetration; and

(iii) accommodate only one pipe.

(c) A pipe system comprised entirely of metal (excluding pipe seals or the like) must be wrapped but must not be lagged or enclosed in thermal insulation over the length of its penetration of a wall, floor or ceiling unless the lagging or thermal insulation fulfils the requirements of S13C7.

(d) The gap between a metal pipe and the wall, floor or ceiling it penetrates must be fire-stopped in accordance with S13C7.'

This performance solution describes the fire stopping requirements for sprinkler and hydrant pipe penetrations where they pass through concrete and masonry fire-rated elements. Instead of compliance with the fire stopping options outlined in clause S13C7 in specification 13, the metal pipes will be protected with a tested fire-rated sealant capable of achieving an integrity rating of not less than the fire-rated wall.

Table 75 Method of protecting sprinkler / hydrant pipework

Location	Solution	Comment
Metal sprinkler / hydrant pipes penetrating concrete or masonry fire stair shaft	Comply with S13C3(2) and (4) of specification 13. In lieu of the fire stopping options identified under Specification S13C7, the annular gap around the metal pipe is to be protected with a tested fire-rated sealant capable of achieving an integrity rating of not less than the fire rated wall.	S13C3(1) in specification 13 is not applicable as the pipe is normally filled with water. S13C3(3) in specification 13 is not relevant as the pipe is not required to be wrapped, lagged, or insulated.
Metal sprinkler / hydrant pipes penetrating concrete floor slabs within a single fire-isolated stair shaft	No protection required.	Pipe is wholly contained within a single stair shaft.

This assessment was prepared to show that the design complies with performance requirements C1P8 of the NCC.

31.2 Intent of the NCC

The guide to the NCC states that the intent of clause C4D15 is *'to maintain the fire performance of building elements by limiting fire spread by way of service penetrations.'* It also states that *'C4D15 considers the protection of openings in elements that are providing a barrier to the spread of fire and are thus required to have an FRL. The elements of an FRL that provide the barrier to spread of fire are insulation and integrity and that protecting an opening in an element an FRL for structural adequacy is unnecessary. For this reason, C4D15 only applies to an element required to have an FRL with respect to integrity or insulation.'*

31.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 67.

Table 76 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control

31.4 Acceptance criteria

The acceptance criteria for this assessment is that the method of protecting the metal sprinkler / hydrant pipework services through the identified fire rated elements mitigates the risk of fire spread via the service penetrations.

31.5 Fire hazards

Table 68 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 77 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Potential fire and smoke spread to and from fire-isolated stairs due to the unprotected service penetrations openings.	• The building is sprinkler protected throughout. • For metal sprinkler and hydrant pipes penetrating the fire stair shaft, the annular gap around the pipe is to be protected with a fire-rated sealant.

31.6 Assessment

31.6.1 Sprinkler / hydrant pipes passing through concrete and masonry fire-isolated stair shaft walls

The building is sprinkler protected throughout. The benefits of successful sprinkler operation have been previously discussed in section 7.5.3. The successful activation of the sprinklers is expected to provide the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe egress time.
- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.

- A reduction in the chances of a fire spreading beyond the area of origin or flashover occurring.

In the event of a sprinkler-controlled fire, the temperature of the pipework on the non-fire-affected side of the fire wall is not expected to exceed the insulation criteria of AS 1540.4-2014.

Specification 13 provides a DTS solution for protection of metal pipe penetrations. Under S13C3 of specification 13, pipes which are not normally filled with water are required to be separated from combustibles within 2 m of the wall. This is to mitigate the risk of combustibles being ignited due to heating of the pipework on the non-fire-affected side of the wall. By omission, pipes which are normally filled with water, such as sprinkler and hydrant pipes, are not required to meet this provision. This acknowledges the low risk of heat transfer / insulation failure for metal pipes which are normally filled with water. Other than the requirement discussed above, specification 13 does not require metal pipes to achieve any level of insulation performance.

The gap between the pipes and the wall is to be protected in accordance with S13C7 of specification 13 or using a tested sealant capable of achieving an integrity rating equivalent to the wall. Either method is considered to maintain the integrity performance of the penetration consistent with the requirements of the NCC. In the unlikely event of sprinkler failure, the risk of integrity failure – flames or radiant heat exposure through the penetration – is therefore mitigated in accordance with the performance intent of the NCC.

In the event of sprinkler failure, the risk of fire spread as a result of insulation failure is mitigated equivalent to a design complying with specification 13 which does not place any restrictions on exposure to combustibles, or require any insulation rating, for pipes which are normally filled with water.

31.6.2 Sprinkler / hydrant pipework passing through floors in a single stair shaft

The sprinkler / hydrant risers penetrating the fire stair floor landings technically require protection in accordance with clause C4D13 or C4D15 as the floor is a fire rated element. The protection of these penetrations provides no actual benefit where the pipe is wholly contained within a single fire-isolated stair shaft as the area above and below the floor forms part of the same shaft / compartment.

31.7 Conclusion

The assessment shows that the method of protecting the metal sprinkler / hydrant pipework services through the identified fire rated elements mitigates the risk of fire spread via the service penetrations. The proposed design of the building is therefore considered to comply with performance requirements C1P8 of the NCC, subject to complying with the fire safety measures in section 5.

32. Performance solution 26 – Location of hydrant ring main isolating valves

32.1 Introduction

The building's hydrant system will be upgraded to AS 2419.1-2021 as part of the scope of works.

'Clause 8.7.2 of AS 2419.1-2021 requires that hydrant isolating valves installed within a building to be installed:

(i) '*In a fire-isolated stair;*

(ii) *In a plant, tank or pump room;*

(iii) *Where fire-isolated stairs are not provided, not more than 4 m from an exit that leads to a road or open space*.'

The fire hydrant system isolation valves will generally be installed within fire-isolated stairs or the fire pump room, with the exception that multiple ring main isolation valves at basement level 1 will be located within the carpark area. This is due to existing spatial and structural constraints, preventing valves being installed within the fire stair.

The hydrant block plan for basement level 1 indicating the location of ring main isolation valves has been appended to this report – see Appendix K.

This assessment was prepared to show that the design complies with performance requirements E1P3 of the NCC.

32.2 Intent of the NCC

The intent of the clause E1D2 of the NCC has been previously discussed in 26.2.

32.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 78.

Table 78 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system F – Fire services intervention

32.4 Acceptance criteria

The acceptance criteria for this assessment is that the hydrant isolation valves within the basement level 1 carpark does not impede firefighting operations.

32.5 Fire hazards

Table 79 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 79 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Hydrant ring main isolation valves may not be readily accessed in the event of a fire resulting in delays and potential impediment to firefighting within the building.	• The ring main isolation valves are for maintenance purposes only and access is not expected to be required for brigade intervention activities. • The ring main isolation valves are to be located at least 2 m above floor level to limit the likelihood of damage.

32.6 Assessment

The hydrant ring main isolation valves throughout for the building are located within the fire-isolated exit stairs from lower ground floor upwards. The basement level 1 carpark is located only one level below ground and served by multiple exits. The reason isolation valves are located within the occupied internal area on basement level 1 is because of existing structural and spatial constraints within the fire stairs at this level.

The isolation valves are intended to be used for maintenance only and it is considered unlikely that fire brigade personnel will need to access the valves during fire-fighting operations.

The location of the valves will be clearly identified on the block plan for the building, to assist fire brigade personnel in locating the on-floor isolation valves, in the unlikely event that access is required.

The isolation valves located within the carpark area are also to be located at least 2 m above floor level, limiting the likelihood of damage by pedestrians or vehicles.

32.7 Conclusion

The assessment shows that the hydrant isolation valves within the level 1 basement carpark does not impede firefighting operations. The proposed design of the building is therefore considered to comply with performance requirements E1P3 of the NCC, subject to complying with the fire safety measures in section 5.

33. Performance solution 27 – Reduction of retail FRLs on level 3

33.1 Introduction

Clause C2D2 of the NCC requires the building to comply with specification 5. In a building of type A fire-rated construction, each building element is required to comply with tables S5C11a to S5C11g.

The level 3 retail areas are classified as class 6 occupancies and generally require a fire rating of 180 minutes in accordance with tables S5C11a to S5C11g. The fire rating of the following building elements are reduced from 180 to 120 minutes:

- Fire wall separating the gym tenancy and retail tenancy 3-002.
- Loadbearing external columns
- Fire separation between retail tenancy 3-004 and the atrium void to the lower level.

Note:

- The fire rating of internal columns has been addressed in Performance solution 1.
- The fire separation of the lower level atrium void and level 3 by heat-strengthened glazing protected with wall-wetting sprinklers is addressed in Performance solution 6.
- Given the fire rating requirements to the class 6 retail tenancies are reduced to 2 hours, these tenancies are not required to be separated from the adjacent class 5 centre management office.

This assessment was prepared to show that the design complies with performance requirements C1P1 and C1P2 of the NCC.



Figure 121 Class 6 retail uses on level 3

33.2 Intent of the NCC

The intent of clause C2D2 and clause S5C11 in specification 5 to the NCC has been previously discussed in section 7.2.

33.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 80.

Table 80 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control Sub-system F – Fire services intervention

33.4 Acceptance criteria

The acceptance criteria for this assessment is that the 2 hour fire rated structure of the class 6 portion of the building can withstand the effects of a credible sprinkler controlled fire without failure. This will be achieved if the fire temperature is limited below the critical temperature for degradation of the structural elements.

In the event of sprinkler failure, the acceptance criteria is as follows:

- The risk of fire spread to adjacent fire compartments and structures is adequately mitigated.
- The design mitigates the risk of unexpected catastrophic or disproportionate collapse.
- Fire rating of the structure is greater than the time required for occupant evacuation and fire brigade intervention for a retail fire on level 3, with appropriate safety factors.

It is acknowledged that the fire ratings of building elements are based on standard fire curves and as such may not be a true reflection of the performance of all structural elements subject to the heat exposure of a real fire. As a result, a safety factor of 2 is proposed for the assessment of occupant evacuation. This is considered sufficient to address the uncertainties associated with comparing the time for occupants to evacuate to the theoretical time to structural failure based on the fire ratings of building elements.

33.5 Fire hazards

33.5.1 Hazard identification

Table 81 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 81 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Risk of unexpected catastrophic failure of the structure due to fire exposure.	• Sprinkler system installed throughout the building mitigating fire and smoke spread. • Smoke detection and warning provided throughout the tenancy. • Access to adjacent roof area provided for firefighting and evacuation.

33.5.2 Performance of structure

The design of steel reinforced structural elements under fire conditions is based on the critical steel temperature concept. This is a comparison of the yield strength and loading at normal conditions and the yield strength and loading conditions in fire conditions.

The change in yield strength at elevated temperature has been experimentally investigated. An approximation of this test data has been included in many national standards such as AS 4100:2020 as shown in Figure 122.

The relationship shows that the yield strength of structural steel when exposed to fire conditions does not reduce until the steel temperature reaches 215 °C.

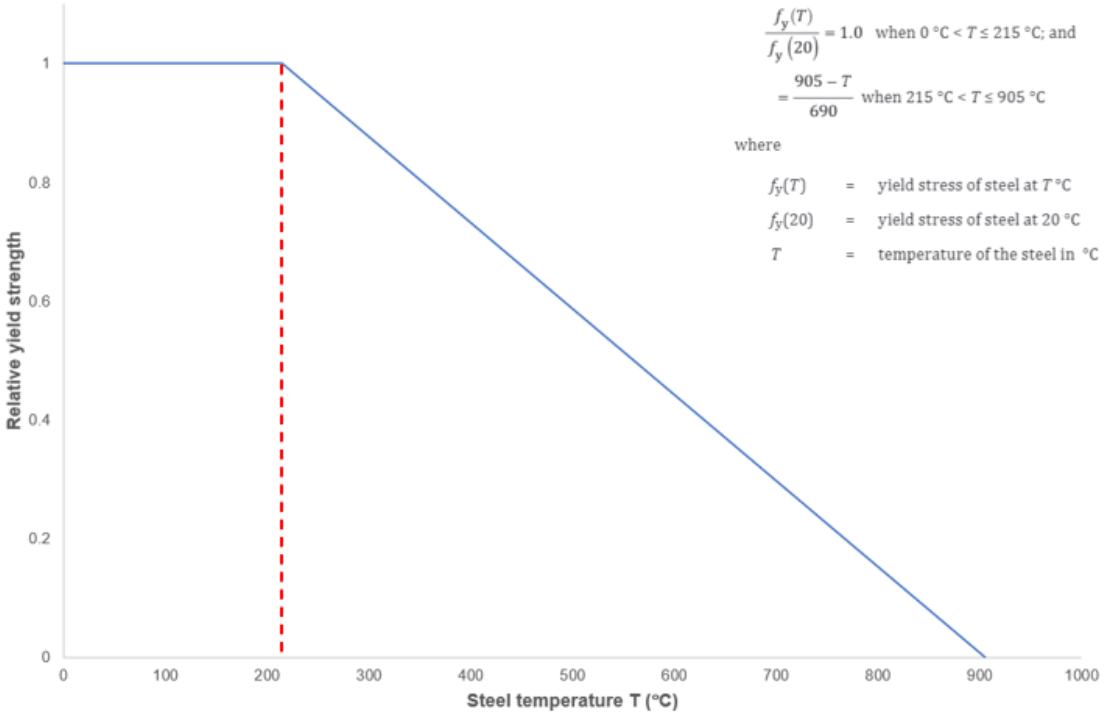


Figure 122 Reduction in yield strength of steel with temperature

33.6 Fire scenarios

The fire scenarios identified for qualitative assessment are summarised in Table 82 based on the fire hazards identified in section 33.5 and the criteria described above.

Table 82 Fire scenario

Scenario	Location	Fire scenario characteristics
Scenario 1 (design scenario)	Level 3 retail use	• Sprinkler controlled fire • The design fire is not quantified.

Scenario	Location	Fire scenario characteristics
Scenario 2 (redundancy scenario)	Level 3 retail used	• Sprinkler failure – the fire grows to a fully developed fire. • The design fire is not quantified.

33.7 Assessment

33.7.1 Scenario 1 – Sprinkler-controlled fire (worst credible design scenario)

The building is provided with a sprinkler system in accordance with specification 17 of the NCC and AS 2118.1:1999, with new and modified parts to AS 2118.1:2017. The reliability of a sprinkler system together with the impact that a sprinkler system will have on fire spread and fire intensity have previously been discussed in section 7.5.3.

As previously stated, the successful operation of the sprinkler system is expected to have the following impact on compartment temperatures during a fire:

- The average temperatures outside the immediate area of operation of the sprinkler system will be below 100 °C.
- The temperature in the localised area above the fire will be somewhat higher than the mean compartment temperature but is still unlikely to exceed 200 °C.

The successful activation of the sprinkler system will limit the average compartment temperatures to below the critical temperatures for the structural elements in the level 3 retail area as identified in section 33.5.2. Consequently, the assessment demonstrates that the structure can resist the effects of a sprinkler controlled fire.

33.7.2 Scenario 2 – Sprinkler failure (redundancy scenario)

The retail tenancies are located at the topmost level of the building, adjacent to an external carpark area. As discussed in Performance solution 6, downward fire spread to the lower retail levels due to the failure of the heat strengthened glass separation is mitigated due to the buoyancy of hot smoke and gases and the atrium smoke exhaust system. Failure of the level 3 retail structure will not have significant impact to the evacuation of the lower levels of the building.

Loadbearing elements within level 3 only support a lightweight roof that does not require a fire rating under specification 5. The roof will be designed such that the failure of an internal column would only cause localised failure of the roof. Unexpected catastrophic collapse of the roof or disproportionate collapse of the level 3 structure is therefore not expected to occur.

The fire rating of internal columns has been omitted (see Performance solution 1) except where they support essential fire safety equipment. Where they support essential fire safety equipment (ie. atrium smoke exhaust fans) they will achieve an FRL of 120/-/- as required by the NCC. External columns will also achieve an FRL of 120/-/-.

To the west, the retail tenancies are 2-hour fire separated from the gym which forms part of the existing fire compartment incorporating the lower retail levels. In the event of sprinkler failure resulting in a fully developed fire in a level 3 retail tenancy, the internal columns within the fire-affected retail tenancy are expected to fail, causing localised collapse of the non-fire-rated roof structure. In this scenario, smoke and hot gases will be vented to the atmosphere and the size and intensity of the fire is expected to be limited and unlikely to compromise the 2 hour fire separation between the fire compartments.

The retail tenancies are provided with smoke detection in accordance with section 5 of AS 1670.1:2018. This exceeds the minimum requirements of the NCC for a sprinkler protected retail building where smoke detection would only be required for activation of smoke hazard management systems. The enhanced smoke detection system can be expected to provide warning for occupants in the early stages of a fire in the retail tenancies, particularly those occupants who are remote form the area of fire origin.

By the time the fire grows to a size that is large enough to cause localised failure of the roof structure, occupants in the vicinity of the fire are expected to have evacuated via the fire-isolated exits serving level 3 or moved to the external carpark area, which represents a place of relative safety from the fire. The carpark is served by multiple alternative fire-isolated exits from which occupants can proceed to evacuate through.

Confirmation has been provided from the structural engineer that the reduced fire rating of the building elements from 3 hours to 2 hours has no adverse impacts on the structural design of the remainder of the building – see Appendix N.

Occupant evacuation

The required safe evacuation time (RSET) for occupants on level 3 in the event of a worst credible sprinkler controlled fire scenario has been calculated to be 15 minutes – see Appendix I. The two hour fire rating of the structure is considered sufficient for occupant evacuation, with a safety factor of 8. It is acknowledged that the duration of fire resistance determined in accordance with AS 1530.4 based on exposure to standard fire conditions will differ to a natural fire scenario. Irrespective, the comparison to the required evacuation time provides a reasonable estimate of the inherent safety factor incorporated into the design.

It is further noted that if stairs 8 and 13 are impacted by an uncontrolled fire in a level 3 retail tenancy, firefighters can approach the fire-affected tenancy through a number of alternative fire stairs within the external carpark, and utilise the internal hydrants within these stairs.

Fire brigade intervention

Data collected by the Australian Government between 2009/10 to 2018/19[60] indicate the median value for fire brigade arrival time in NSW major cities is between 6.3 and 7.2 minutes. In 90% of fires, the fire brigade had arrived in 9.5 to 11.7 minutes – see Figure 123. The average duration at building fire incidents is 77 minutes, based on data collected by FRNSW[61]. With a typical response time of 10 minutes and the peak average duration at incidents being 80 minutes resulting in a combined time of 90 minutes, the proposed fire ratings are considered sufficient for the average response by the fire brigade in the unlikely event of sprinkler failure.

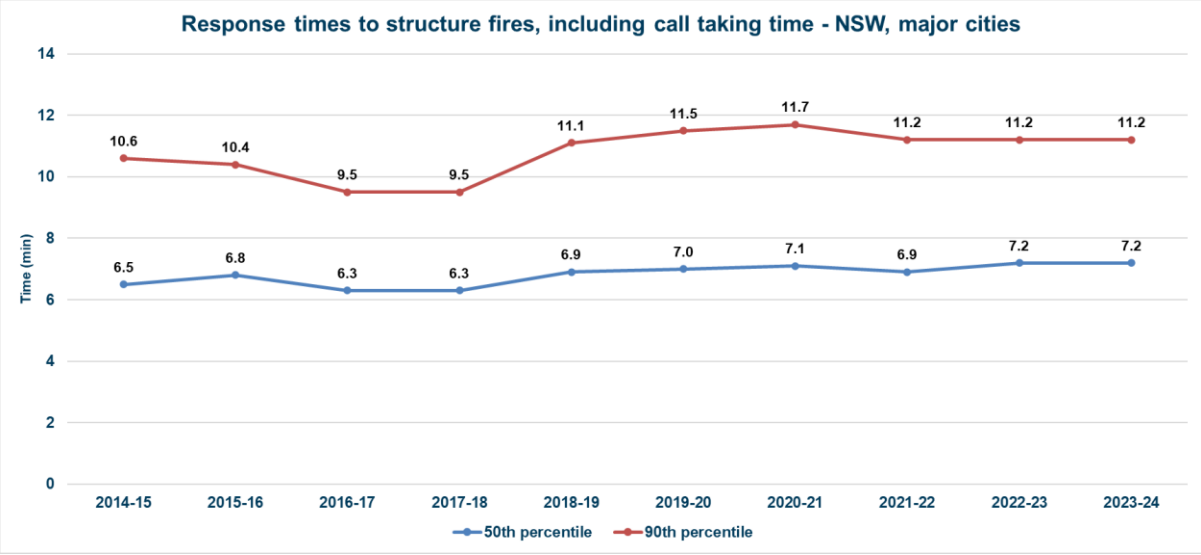


Figure 123 Response time to structure fires – NSW major cities

33.8 Conclusion

The assessment shows that the proposed 2 hour fire rating for the level 3 retail areas provides an adequate level of fire resistance and facilitates safe occupant evacuation and fire brigade intervention.

[60] Australian Government, Report on government services 2025, chapter 9 emergency services for fire and other events.
[61] NSW Fire Brigades annual statistical report 2006/07, NSW Fire Brigades.

The proposed design of the building is therefore considered to comply with performance requirements C1P1 and C1P2 of the NCC, subject to complying with the fire safety measures in section 5.

34. Performance solution 28 – Unprotected opening on vehicular ramp

34.1 Introduction

Clause C4D3 of the NCC states that openings in an external wall that are required to have an FRL must be protected in accordance with clause C4D5 of the NCC if they are located within 3 m of the side or rear allotment boundary.

The opening within the new level 1 speedramp offshoot is less than 3 m from the northern boundary and unprotected.

This assessment was prepared to show that the design complies with performance requirement C1P2 of the NCC.

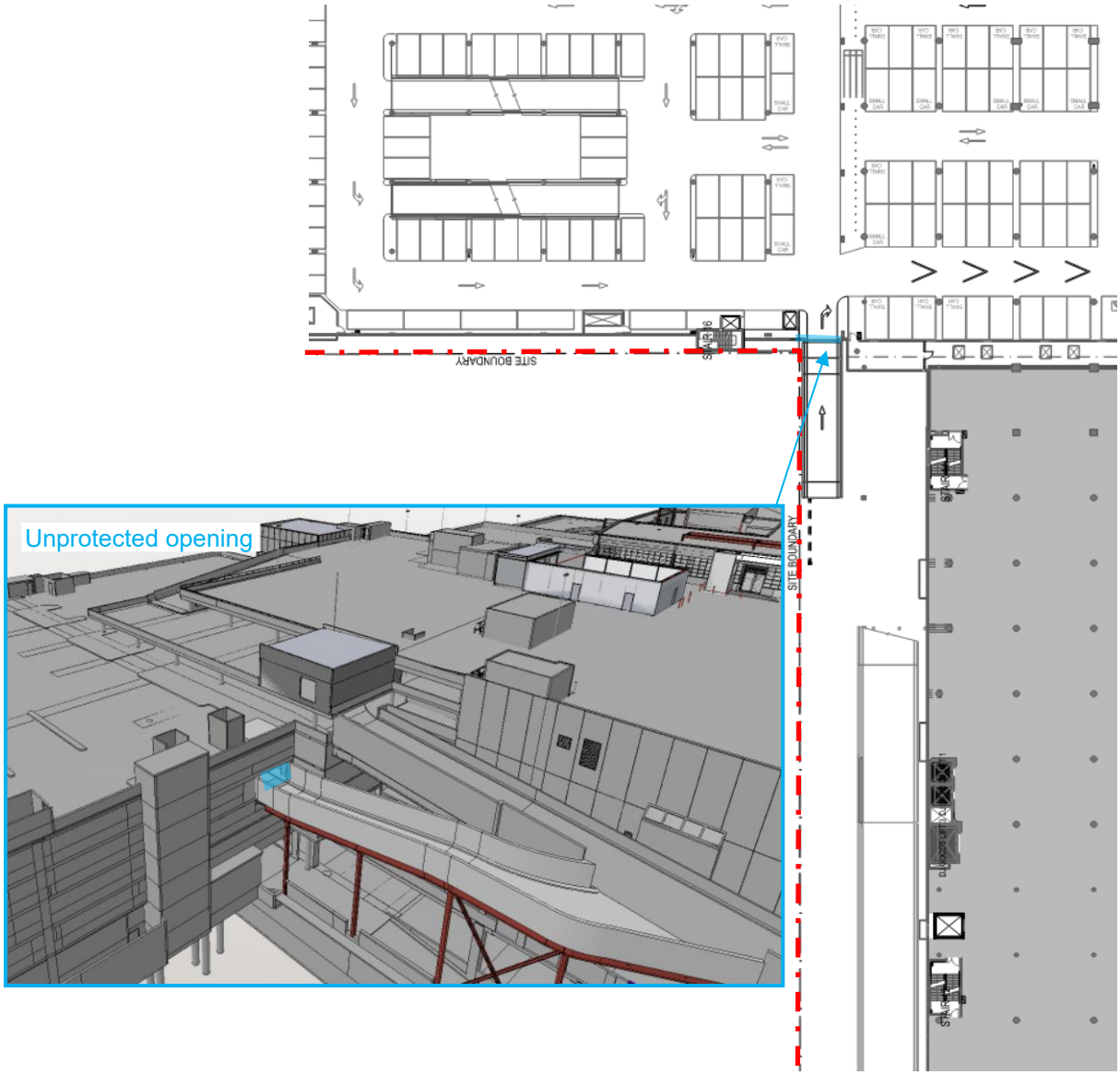


Figure 124 Isometric view of unprotected opening

34.2 Intent of the NCC

The guide to the NCC states that the intent of clause C4D3 is *'to require any opening in external walls to be protected, only where the wall is required to have an FRL, to prevent the spread of fire from the boundary of an adjoining allotment, or one building to another building on the same allotment.'*

34.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 83.

Table 83 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	A2G2(2)(b)(i): Verification method in the NCC
Type of assessment	Quantitative absolute Deterministic
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control

34.4 Acceptance criteria

The acceptance criteria for this assessment is that the risk of fire spread between allotments via the unprotected level 1 speedramp opening is adequately mitigated.

Where quantitative radiant heat calculations are used the acceptance criteria is that allotment boundary and the nearest carpark bay to the unprotected opening is not subject to radiant heat of more than 13 kW/m^2 – piloted ignition of cotton fabric after a long time[62]– in the event of a fire within the building or the adjacent allotment respectively.

34.5 Fire hazards

34.5.1 Hazard identification

Table 84 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 84 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Fire spread to and from the adjacent allotment via the level 1 speedramp opening.	• Sprinkler system provided which is expected to control / suppress a potential fire and mitigate fire spread. • The ramp opening is shielded from the site boundary by the fire-rated walls of the speedramp which span the full height of the opening.

34.5.2 Mechanism of fire spread

Fire spread can occur via three different methods, or by a combination of the three. The three methods are conduction, convection and radiation.

[62] AS 1530.4:2014: Fire resistance of test elements of construction – Table A3

Conduction takes place when two items are in contact and heat is transferred from the ignited object to the other. As there are no surrounding buildings in direct contact with the building, conduction of heat cannot occur.

Convection takes place when the flame of the fire plume carries sufficient heat to cause another object to ignite. This can either be by piloted or non-piloted ignition. Piloted ignition is achieved by the introduction of an ignition source such as a flame from a burning ember or a spark. Non-piloted ignition occurs when an object's temperature is raised sufficiently to cause the onset of combustion, which is spontaneous.

Radiation is the third mechanism of fire spread and occurs when the intensity of a fire is sufficient to radiate heat onto nearby objects and cause ignition. This can again be by either piloted or non-piloted ignition. Radiation is usually the dominant mode of heat transfer when the object is remote from the fire, particularly where fire spread occurs between a building and an allotment boundary.

34.6 Fire scenarios

34.6.1 Radiant heat emitted to adjacent properties

A sprinkler-controlled fire within the level 1 carpark is considered based on the fire hazards identified in section 34.5 and the criteria described above for radiant heat emitted to adjacent properties.

34.6.2 Radiant heat received from adjacent properties

The radiant heat received from the adjacent property is calculated based on a heat flux source equivalent verification method CV1 on the boundary – ie 80 kW/m^2. This equates to an equivalent temperature of 817°C. Based on this temperature, the size of the emitter required to result in 20 kW/m^2 at 3 m from the boundary was calculated to be 3.1 m x 3.1 m. This is a conservative radiant heat source for evaluation of exposure for distances less than 3 m when benchmarked against CV1.

34.7 Assessment

34.7.1 Radiant heat emitted to adjacent properties

As stated in section 2.4.3, the successful operation of the sprinkler system is expected to have the following impact on compartment temperatures during a fire:

- The average temperatures outside the immediate area of operation of the sprinkler system will be below 100 °C.
- The temperature in the localised area above the fire will be somewhat higher than the mean compartment temperature but is still unlikely to exceed 200 °C.

The radiant heat flux received at any point cannot be more than the amount emitted from the source. Assuming the compartment temperature is 200 °C based on the above, the maximum radiant heat flux (q'') that could be emitted from the building in the event of a sprinkler controlled fire can be calculated using the Stefan-Boltzmann law, which is given in Equation 3.

$q'' = \sigma T_s^4$

where:

T_s = absolute temperature of the surface (K)

σ = Stefan-Boltzmann constant = 5.67×10^{-8} W/m^{2}K^4

Equation 3 Stefan-Boltzmann law

The calculated value of 2.84 kW/m^2 is significantly below the values nominated in column 2 of table C1V1, regardless of the location from the boundary. Therefore, fire spread from the building to the adjacent properties via radiant heat emission is prevented when the sprinklers operate.

The probability of sprinkler failure must also be considered in the assessment. One of the acceptable methods of protection under clause C4D5 of the NCC is the use of wall-wetting sprinklers. The

installation of the sprinkler system can be considered at least equivalent to the DTS provisions in terms of prevention of fire spread between adjoining buildings and the probability for system failure.

34.7.2 Radiant heat received from adjacent properties

The worst-case scenario is an opening located at the northern site boundary. The radiant heat received from adjacent properties only considers this scenario on the basis that, if the radiant heat flux is acceptable for this scenario, other openings located further from the site boundary will also receive acceptable levels of heat flux.

The radiant heat received at the nearest carparking bay has been calculated to be below 13 kW/m^2 – calculations and output data attached in Figure 125 and Appendix O. The radiant heat received from the adjacent property is therefore not sufficient to result in fire spread to the building.

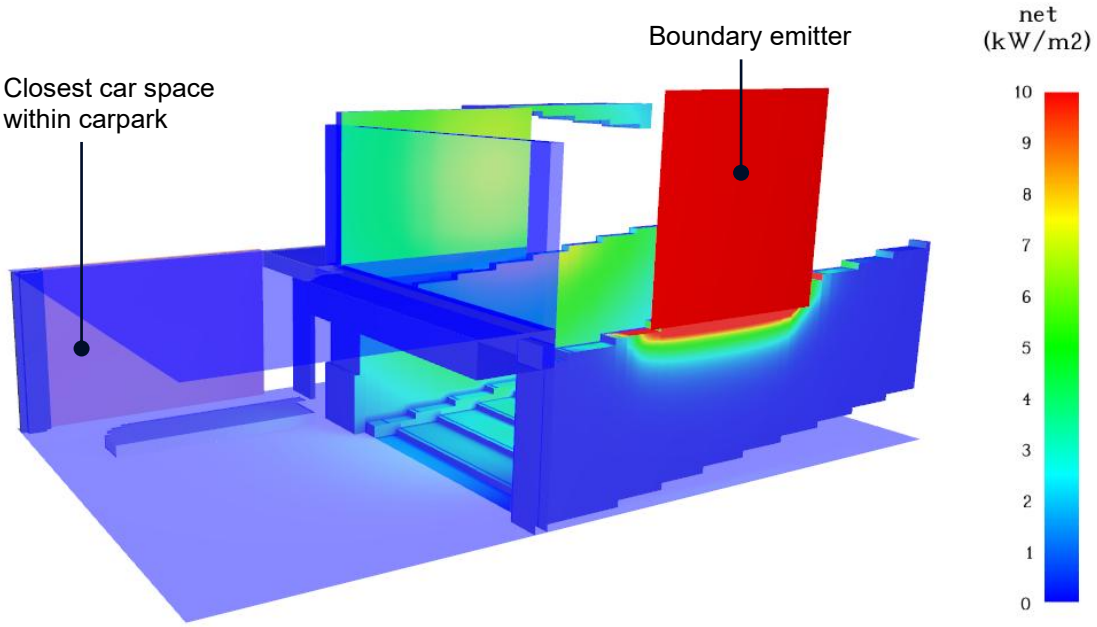


Figure 125 Radiant heat exposure via speedramp opening

34.8 Conclusion

The assessment shows the risk of fire spread to and from the adjacent allotment via the level 1 speedramp opening is adequately mitigated. The proposed design of the building is therefore considered to comply with performance requirement C1P2 of the NCC, subject to complying with the fire safety measures in section 5.

35. Performance solution 29 – Separation of external rooftop carpark

35.1 Introduction

Clause G6D3 requires that occupiable outdoor areas be treated as a storey with respect to clause C3D8, C3D9 and C3D10 of the NCC, which stipulate the requirements of fire separation of classifications in the same and different storeys.

External carpark areas on levels 2A and 3 of the building are deemed occupiable outdoor areas in accordance with the NCC and are therefore subject to the clauses above.

No fire separation is provided between the level 2A and 3 external carpark areas and the adjacent retail fire compartments.

Note: The external wall on level 2A between the retail and carpark use will incorporate blockwork which achieves an inherent fire rating, however the wall will also have lightweight construction which does not achieve a fire rating.

This assessment was prepared to show that the design complies with performance requirement C1P2 of the NCC.

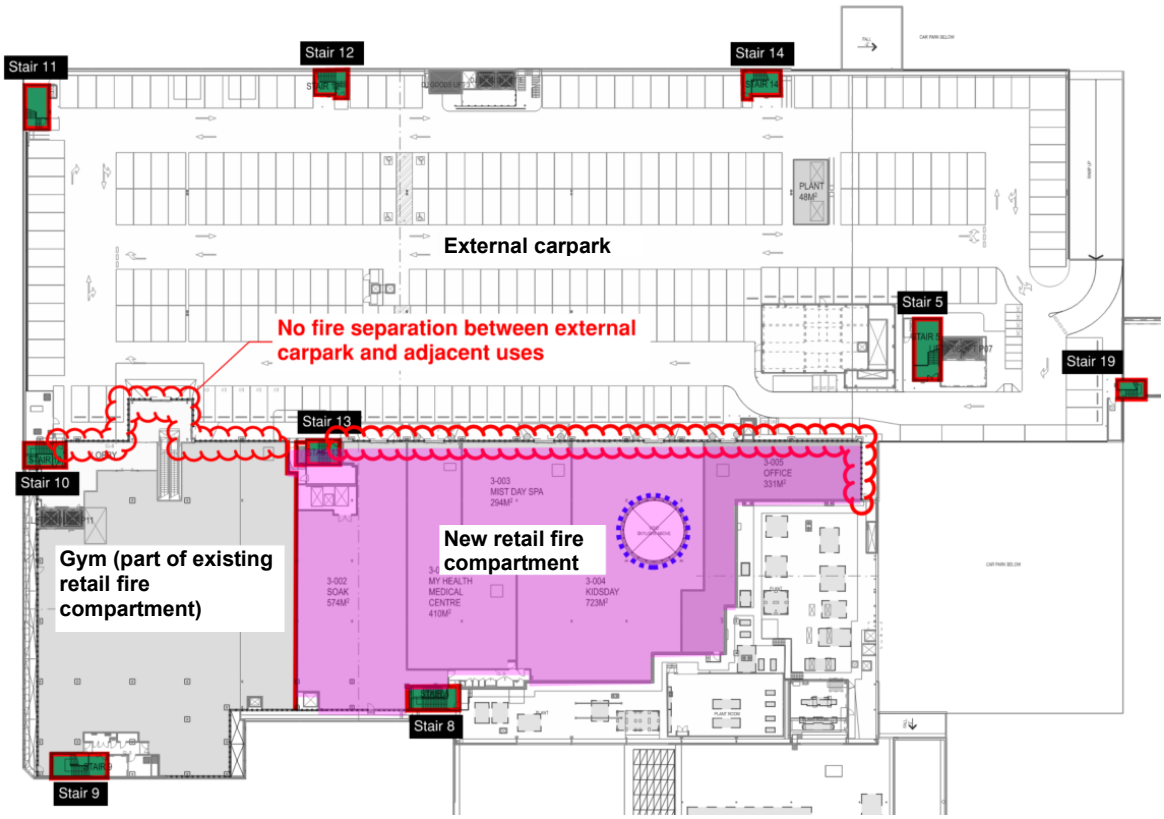


Figure 126 Level 3 - No fire separation provided between external carpark and adjacent retail and gym uses

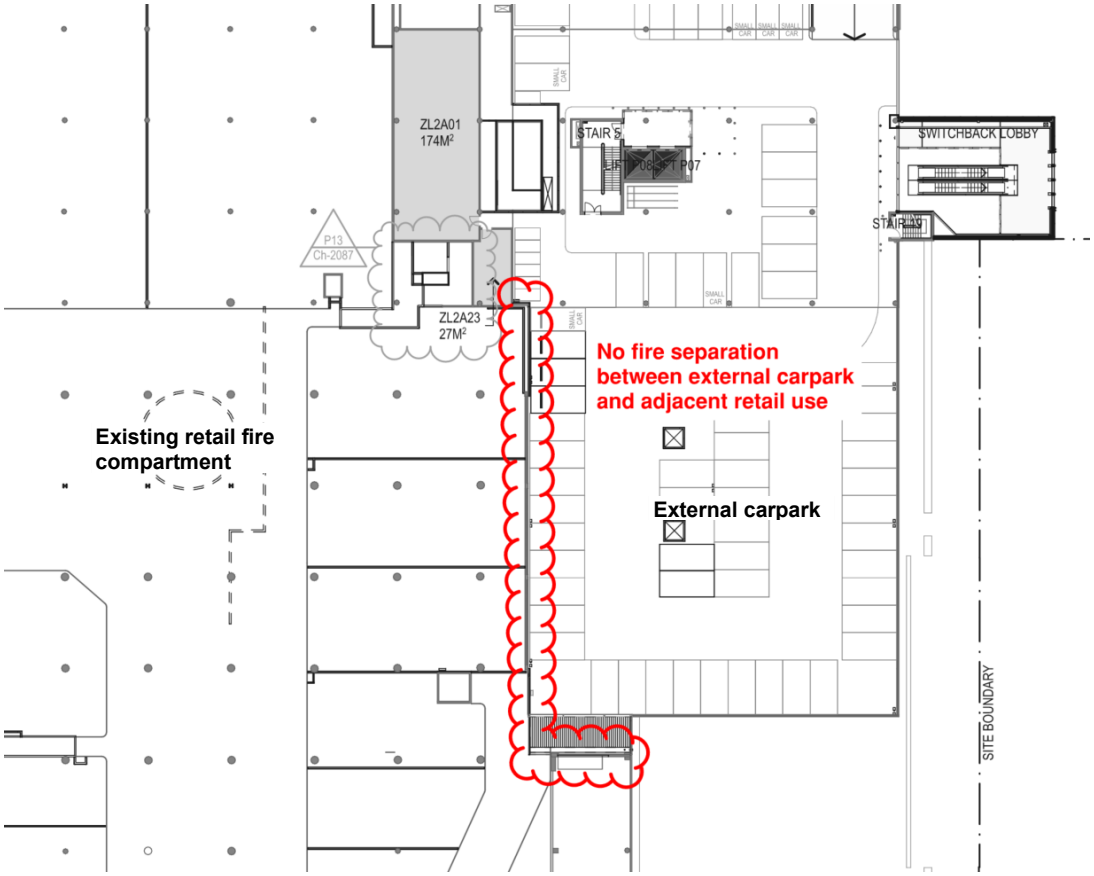


Figure 127 Level 2A – No fire separation provided between external carpark and adjacent retail use

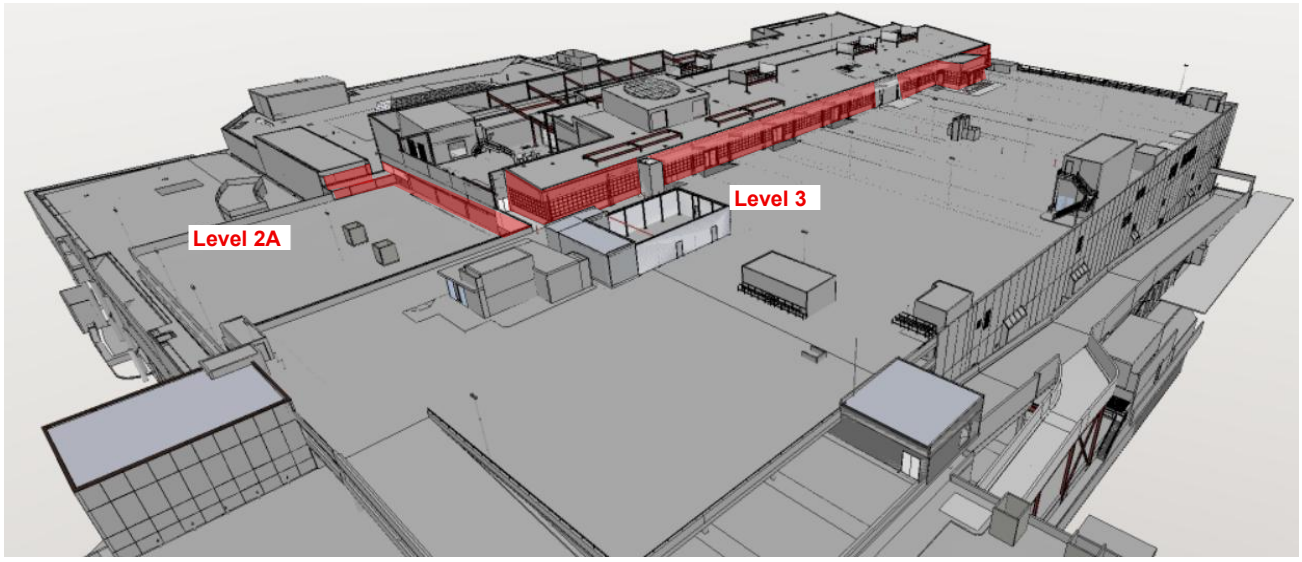


Figure 128 Isometric view

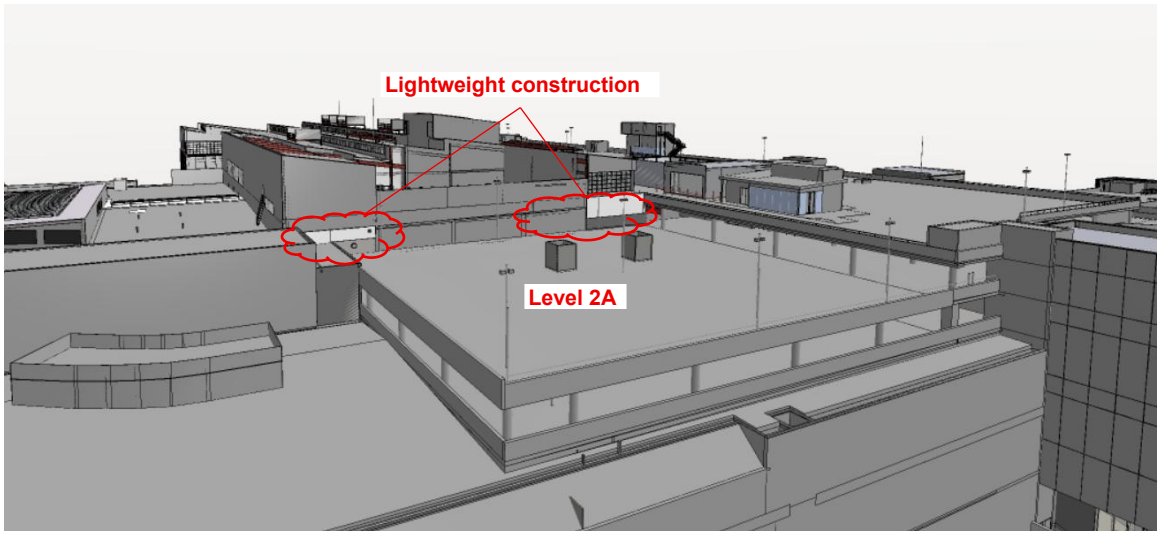


Figure 129 Level 2A – Lightweight construction within external wall

35.2 Intent of the NCC

35.2.1 Clause G6D3 – Fire separation

The guide to the NCC states that the intent of clause G6D3 of the NCC is *'specify fire-resistance and separation requirements for an occupiable outdoor area'*

35.2.2 Clause C3D9 – Separation of classifications in the same storey

The guide to the NCC states that the intent of clause C3D9 of the NCC is '*to minimise the risk of a fire in one classification on a storey causing the failure of building elements in another classification on the same storey.*'

35.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 85.

Table 85 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system C – Fire spread, impact and control

35.4 Acceptance criteria

The acceptance criteria for this assessment is the design adequately mitigates the risk of fire and smoke spread between the internal fire compartments and occupiable outdoor spaces on levels 2A and 3.

35.5 Fire hazards

Table 86 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 86 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
Risk of fire spread between the external carpark area and the internal retail fire compartments on level 3.	• The internal areas are sprinkler-protected throughout.

35.6 Assessment

35.6.1 Requirements of the NCC

Clause C3D9 of the NCC requires building areas of different classification to be fire separated to minimise the risk of a fire in one classification on a storey causing the failure of building elements in another classification on the same storey. This clause allows for the fire separation of different uses to be omitted if each building element is provided to the higher FRL prescribed in Specification 5 for that element for the classifications concerned.

There are no building elements within the external carpark areas which require an FRL, except for fire-isolated stair and mechanical shafts, which are all 2 hours fire rated. This fire rating is consistent with that rationalised for the new level 3 fire compartment (see Performance solution 27) and that of the existing fire compartment which the gym tenancy forms part of (see section 3.4.1). The proposed design could therefore be considered to comply with Clause C3D9(1)(a), where level 3 forms part of a common fire compartment, built to the higher FRL.

35.6.2 Risk of fire and smoke spread

Scenario 1 – External carpark fire (design scenario)

A fire within the external carpark spaces is expected to be limited in size and intensity due to the ability for smoke and hot gases to vent to the atmosphere, such that the building sprinkler system is expected to be capable of addressing any potential external risks of fire and smoke spread into the internal areas of the building.

Scenario 2 – Sprinkler controlled-fire (design scenario)

The building is provided with a sprinkler system in accordance with specification 17 of the NCC and AS 2118.1:1999, with new and modified parts to AS 2118.1:2017. The reliability of a sprinkler system together with the impact that a sprinkler system will have on fire spread and fire intensity have previously been discussed in section 7.5.3.

As previously stated, the successful operation of the sprinkler system is expected to have the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe egress time.
- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.
- A reduction in the chances of a fire spreading beyond the area of origin or flashover occurring.

The successful operation of the sprinklers is expected to mitigate the risk of fire spread from the internal areas of the building to the external carpark in a worst credible sprinkler-controlled fire scenario.

Scenario 3 – Sprinkler failure (redundancy scenario)

All building elements within the external carpark area which require an FRL are located in excess of 6 m from the level 2A and 3 external façade. In the event of sprinkler failure resulting in a fully developed fire within the internal areas of level 2A or 3 and failure of the non-fire-rated facade, fire spread to these building elements in the carpark is not expected to occur. Whilst carparking bays are provided in proximity to the external facades, the risk of fire spread to the external building elements, via vehicles parked nearby is also low, given smoke and hot gases will be vented to the atmosphere.

35.7 Conclusion

The assessment shows that the risk of fire and smoke spread between internal fire compartments and the occupiable outdoor spaces on levels 2A and 3 are adequately mitigated. The proposed design of the building is therefore considered to comply with performance requirements C1P2 of the NCC, subject to complying with the fire safety measures in section 5.

36. Performance solution 30 – Separation of essential services board on level 3

36.1 Introduction

Clause C3D14(2) of the NCC requires that '*a main switchboard located within the building which sustains emergency equipment operating in the emergency mode must* –

(a) be separated from any other part of the building by construction having an FRL of not less than 120/120/120; and

(b) have any doorway in that construction protected with a self-closing fire door having an FRL of not less than -/120/30.'

The mechanical essential services board (MSSB) MSR-3 located on level 3 supplies a number of smoke exhaust fans and mechanical air handling units serving retail levels LG to level 2 forming part of the existing retail fire compartment.

The MSSB is located in a room together with carpark and smoke spill riser/ductwork, and fire separated from the remainder of the building as required by clause C3D14(2). The following is provided instead:

- The enclosure is separated from the adjacent gym tenancy by a fire wall achieving FRL 120/120/120.
- The enclosure is separated from the adjacent retail tenancy east by fire-resistant construction. These walls are not compliant fire-rated walls in accordance with specification 5 as they are penetrated by non-fire-rated roof elements at high level. The annular gaps around the roof elements must be neatly formed and infilled with an appropriate fire resisting sealant.
- The enclosure housing the MSSB also contains three mechanical risers.
  - The carpark exhaust ductwork will be fire-rated to achieve FRL -/120/120
  - The two smoke exhaust fan risers will be fire-rated to achieve FRL -/120/120 to the underside of the roof covering. Any steel roof members that penetrate the fire rating of the riser must be protected with cementitious spray achieving an FRL of 120/-/- for a distance of 500 mm from the connection with the riser.

This assessment was prepared to show that the design complies with performance requirements C1P2 and E2P2 of the NCC.

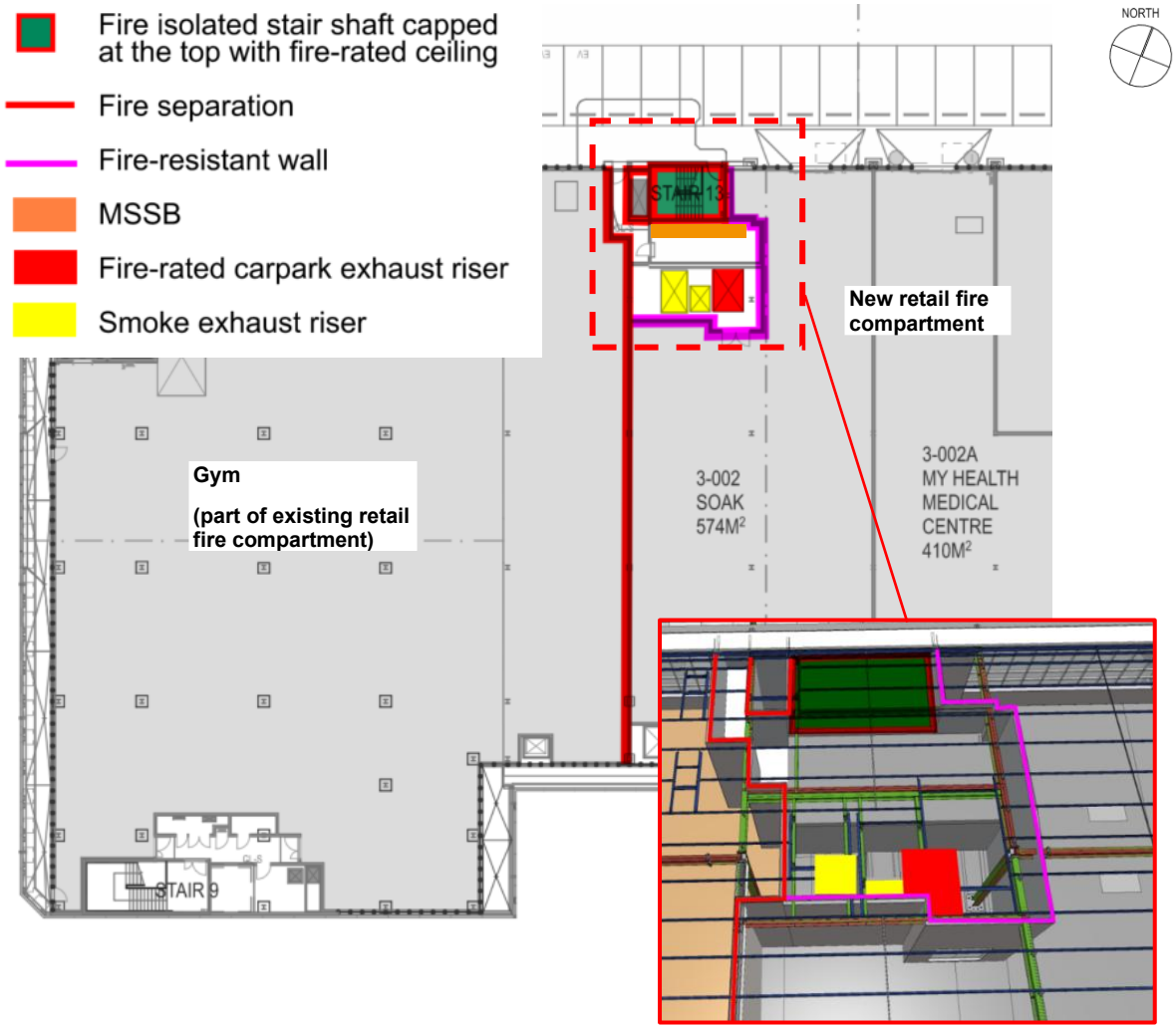


Figure 130 Level 3 – Location of MSSB MSR-3

36.2 Intent of the NCC

The guide to the NCC states that the intent of clause C3D14 is *'to limit the spread of fire from electrical equipment and to enable the uninterrupted operation of emergency equipment during a fire.'*

36.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 87.

Table 87 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system F – Fire services intervention

36.4 Acceptance criteria

The acceptance criteria for this assessment is that the protection provided to the level 3 mechanical essential services board MS3-R, which supplies the smoke exhaust system serving existing retail compartment, adequately facilitates the operation of the smoke exhaust system.

In the event that the board is compromised by fire spread and the operation of the smoke exhaust system is impacted, safe evacuation conditions within the existing retail compartment must be maintained.

36.5 Fire hazards

Table 88 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 88 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The potential for MSSB to be impacted by a fire, impacting the operation of the smoke exhaust system it supplies.	• The MSSB is separated from external areas with a combination of fire-rated and fire-resistance construction.

36.6 Fire scenario

The fire scenarios identified for qualitative assessment are summarised below, based on the fire hazards identified in section 36.5 and the criteria described above.

1. Sprinkler-controlled fire within the building.
2. Sprinkler failure (redundancy) – Fire within the existing fire compartment
3. Sprinkler failure (redundancy) – Fire within the new retail fire compartment

36.7 Assessment

36.7.1 Scenario 1 – Sprinkler controlled fire within the building

The building is provided with a sprinkler system in accordance with specification 17 of the NCC and AS 2118.1:1999, with new and modified parts to AS 2118.1:2017. The reliability of a sprinkler system together with the impact that a sprinkler system will have on fire spread and fire intensity have previously been discussed in section 7.5.3.

As previously stated, the successful operation of the sprinkler system is expected to have the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe egress time.
- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.
- A reduction in the chances of a fire spreading beyond the area of origin or flashover occurring.

The successful operation of sprinklers is expected to mitigate the risk of fire spread between the MSSB enclosure and the remainder of the building.

36.7.2 Scenario 2 – Sprinkler failure (redundancy) – Fire within the existing retail compartment

The MSSB enclosure is located within the new level 3 fire compartment, remote from the areas served by smoke exhaust fans supplied by MSR-3. The fire compartments are separated by fire-rated

construction in accordance with clause C3D8 and specification 5 except that the fire rating has been reduced from 3 hours to 2 hours (as addressed in Performance solution 27).

The carpark exhaust riser within the MSSB room will be fire-sprayed to achieve a 2 hour fire-rating up until it exits the external envelope of the building. Smoke exhaust risers within the MSSB enclosure will be fire-sprayed to achieve a 2 hour fire-rating to the underside of the roof covering. Where steel roof elements penetrate the riser, they will be protected with cementitious spray achieving an FRL of 120/-/- for a distance of 500 m from the interface with the riser, to mitigate the risk of heat transfer between the elements. The protection distance from is nominated based on the Technical Guidance Document (TGD) 8[63] prepared by the Association for Specialist Fire Protection (ASFP). The TGD states that a 500 mm coatback to the secondary elements to limit unwanted heat transfer is considered as a good practice. This protection distance is also endorsed in ASFP Advisory Note 2119, which considers the 500 mm protection as a conservation solution. The fire treatment of the mechanical risers will therefore mitigate the risk of fire spread via hot combustion products to the switch boards as intended by the NCC.

Given the location of the MSSB in a separate fire compartment and passive fire-rated protection provided, a fire within the existing retail compartment is not expected to impact the board or the mechanical provisions it supplies.

36.7.3 Sprinkler failure (redundancy) – Fire within the new level 3 fire compartment

The enclosure is located on the top level of the building and separated from the adjacent retail tenancy to the east by full-height fire-resistant construction. Whilst the construction consists of a 2 hour fire-rated Speedpanel wall, the wall is not considered to be fire-rated in accordance with specification 5 of the NCC. This is because the walls incorporate non-fire-rated roof steel penetrations. The fire resistant walls can be expected to mitigate fire spread to the switch board room during the early stages of fire development up to the point where the non-fire-rated roof structure fails.

As discussed in Performance Solution 1 and Performance Solution 27, loadbearing elements within level 3 only support a lightweight roof that does not require a fire rating under specification 5. The roof will be designed such that the failure of an internal column would only cause localised failure of the roof.

In a redundancy scenario where sprinkler failure results in a fully developed fire within a retail tenancy within the new level 3 fire compartment, the roof structure is expected to fail locally within the fire-affected tenancy which may impact the integrity and structural adequacy of the walls bounding the MSSB enclosure. As the MSSB enclosure only sustains smoke exhaust equipment serving the storeys below, the impact of a fire in the level 3 retail does not present a credible risk of smoke spread to the part of the building serviced by the subject equipment.

36.8 Conclusion

The assessment shows that protection provided to the level 3 mechanical essential services board MS3-R adequately facilitates the operation of the smoke exhaust system. The proposed design of the building is therefore considered to comply with performance requirements C1P2 and E2P2 of the NCC, subject to complying with the fire safety measures in section 5.

[63] Association for Specialist Fire Protection (ASFP), 2010, ASFP Technical Guidance Document 8 – Code of practice for junctions between different fire protection systems when applied to load bearing structural steel elements.

37. Performance solution 31 – Fire hydrant and hose reel coverage to tenancy G-001

37.1 Introduction

Fire hydrant coverage

The building is provided with a fire hydrant system in accordance with clause E1D2 of the NCC and AS 2419.1-2021. AS 2419.1:2021 requires that all parts of the floor shall not be more than 40 m from an internal fire hydrant.

Tenancy G-001 which opens directly outside is located more than 40 m from an internal fire hydrant. Coverage to tenancy G-001 is provided through the use of two hose lengths from an internal hydrant located within the mall entry area

Fire hose reel coverage

The building is required to be provided with a fire hose reel system complying with clause E1D3 of the. The proposed design does not comply with the requirements of this clause as fire hose reel coverage is not provided to Tenancy G-001.

This assessment was prepared to show that the design complies with performance requirements E1P1 and E1P3 of the NCC.

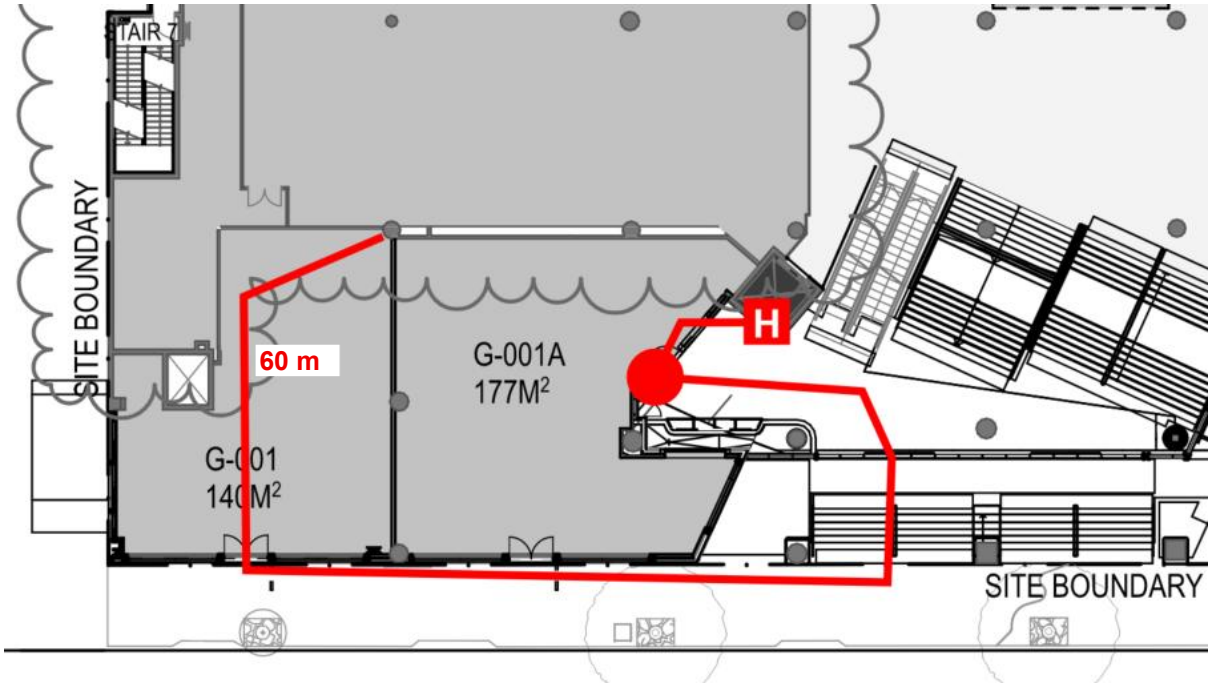


Figure 131 Tenancy G-001 – Two hose lengths for hydrant coverage and no fire hose reel coverage

37.2 Intent of the NCC

37.2.1 Clause E1D2 of the NCC

The intent of the clause E1D2 of the NCC has been previously discussed in 26.2.

37.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the NCC are summarised in Table 89.

Table 89 Performance solution approach and method of assessment

Assessment approach	
Method of meeting performance requirements of the NCC	Clause A2G2(1)(a): Complying with the performance requirements
NCC assessment methodology	Clause A2G2(2)(b)(ii): Other verification methods
Type of assessment	Qualitative absolute
Fire safety sub-systems addressed	Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control Sub-system F – Fire services intervention

37.4 Acceptance criteria

The acceptance criteria for this assessment is that:

- Fire hydrant coverage – the use of two hose lengths does not adversely impact firefighting capabilities of fire brigade.
- Fire hose reel coverage – the provision of portable fire extinguishers allows occupants to undertaken an initial attack on a fire.

37.5 Fire hazards

Table 90 identifies potential fire hazards associated with the departures from the DTS provisions of the NCC.

Table 90 Hazards and preventive / protective measures related to the assessment

Hazards	Preventive and protective measures
The use of two hose lengths to achieve fire hydrant coverage may result in delays in setting up and difficulties in attacking the fire.	• Signage is provided at the internal hydrant within the lobby providing coverage, to clearly identify that two lengths of hose are required to achieve full hydrant coverage to the tenancy.
Non-compliant fire hose reel coverage to the tenancy limiting occupant ability to undertaken initial attack.	• Sprinkler system is provided which is expected to suppress / control a potential fire and mitigate fire spread. • Smoke detection and alarm system is provided which enable early occupant intervention. • Portable fire extinguishers are provided within the front and back of house areas to also enable initial occupant attack on a fire.

37.6 Assessment

37.6.1 Fire hydrant coverage

Clause E1D2 of the NCC requires compliance with AS 2419.1:2021 which sets out requirements for the design, installation and commission of fire hydrant systems for property protection. Sections 3.4, 3.5 and 3.6 of AS 2419.1:2021 outline requirements for the location of on-site fire hydrants.

For external hydrants, clause 3.5.3.4(d)(i) of AS 2419.1:2021 states that '*all parts of a building or open yard that are protected by an external attack / feed fire hydrant shall be not more than 70 m from the external attack / feed fire hydrant.*'

For internal hydrants, clause 3.6.1(e) of AS 2419.1:2021 states that '*all parts of the floor shall be not more than 40 m from an internal fire hydrant installed in accordance with clause 3.6.2 except where otherwise specified in item (f).*' In a building provided with fire-isolated exits, clause 3.6.2(a) of AS 2419.1:2021 generally requires internal hydrants to be provided within each required fire-isolated exit at each storey.

The allowance in AS 2419.1:2021 for additional 30 m of coverage from an external fire hydrant compared to an internal fire hydrant – ie which corresponds to an additional firefighting hose length – is considered to acknowledge typically less physical restrictions outside the building.

Fire hydrant coverage to the tenancy will be achieved by an internal hydrant within the Victoria Avenue entry lobby. The lobby space is a circulation area expected to be relatively free of obstructions. From the hydrant, the hose will be brought out externally to Victoria Avenue, where brigade will approach the tenancy from. The space and path to tenancy G-001 is less physically restrictive compared to a fire-isolated stair within the building. Brigade personnel will also be approaching the tenancy externally from Victoria Avenue, which is considered to be a place of relative safety. Signage is further provided at the internal hydrant within the lobby providing coverage, to clearly identify that two lengths of hose are required to achieve full hydrant coverage to the tenancy.

The use of an additional length of hose is not expected to result in impediment on occupant evacuation as the majority (if not all) occupants are expected to have completed evacuation via the Victoria Avenue mall exit. Once the hoses are laid out, the additional hose length will not increase impediment to occupant evacuation, considering that the constriction in egress width is no worse than that of a single length of hose within a fire stair.

Smoke detection also is provided in accordance with section 5 of AS 1670.1:2018 below ceiling within the tenancy. This will provide an earlier detection time in the event of a fire and therefore an earlier fire brigade arrival time.

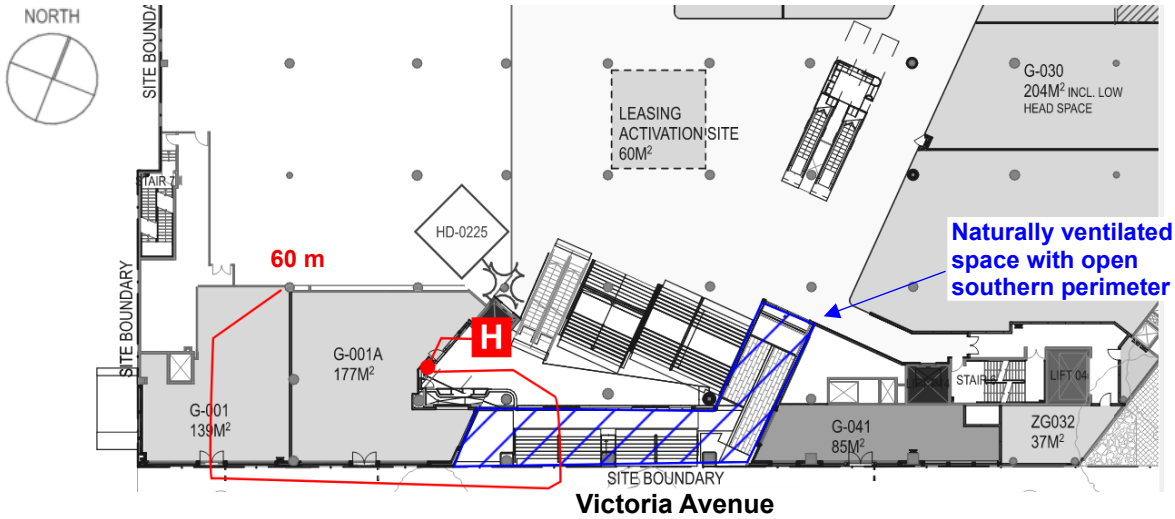


Figure 132 Lobby and setup space

37.6.2 Fire hose reel coverage

The building is provided with a sprinkler system in accordance with specification 17 of the NCC and AS 2118.1-1999, with new and modified components to AS 2118.1:2017. The presence of a sprinkler system means that the probability of a fire spreading beyond the area of origin and not being suppressed or at least controlled by the sprinklers is low. Consequently, the sprinkler system reduces the importance for occupants to undertake an initial attack on the fire.

The tenancy will be provided with a minimum of two portable fire extinguishers – one each for front and back of house – which will allow occupants to undertake an initial attack on a fire. The extinguishers comply with the requirements of clause E1D14 of the NCC. Portable fire extinguishers are expected to adequately provide a means of initial fire attack within this relatively small tenancy

which is less than 200 m^2. In the event that a fire exceeds a size which can be suppressed by portable fire extinguishers occupants are able to evacuate the tenancy directly to open space.

Occupants who may undertake initial attack on a fire are expected to be staff who can be assumed to be awake and capable of responding to the activation of a fire alarm. Staff members are likely to be familiar with the layout and the location of the portable fire extinguishers. This familiarity will enable occupants to evaluate the location of a fire and determine whether it is small enough to attempt initial firefighting. Should occupants choose to attack the fire, they can be expected to be familiar with the location of exits and firefighting equipment. This familiarity with the building will significantly reduce the likelihood of occupants placing themselves in a life threatening situation. In addition, the combination of the smoke detection and alarm system provided within the tenancy and intrinsic cues received by the occupants will enable early intervention.

37.7 Conclusion

The assessment shows that

- the use of two hose lengths does not adversely impact firefighting capabilities of fire brigade.
- the provision of portable fire extinguishers allows occupants to undertaken an initial attack on a fire.

The proposed design of the building is therefore considered to comply with performance requirements E1P3 and E1P3 of the NCC, subject to complying with the fire safety measures in section 5.

Appendix A Drawings and information

Drawing title	Dwg no	Date	Drawn
Common mall plan – Basement 2	EA-WEA-DRG-590171– Rev P01	09/12/2025	Webber Australia – Executive Architect
Common mall plan – Basement 1	EA-WEA-DRG- -590271 – Rev P01	09/12/2025	
Common mall plan – Level LG	EA-WEA-DRG- -590371 – Rev P01	09/12/2025	
Common mall plan – Level 00	EA-WEA-DRG- -590571 – Rev P01	09/12/2025	
Common mall plan – Level 00A	EA-WEA-DRG- -590671 – Rev P01	09/12/2025	
Common mall plan – Level 01	EA-WEA-DRG- -590771 – Rev P01	09/12/2025	
Common mall plan – Level 01A	EA-WEA-DRG--590871 – Rev P01	09/12/2025	
Common mall plan – Level 02	EA-WEA-DRG- -590971 – Rev P01	09/12/2025	
Common mall plan – Level 02A	EA-WEA-DRG--591071 – Rev P01	09/12/2025	
Common mall plan – Level 03	EA-WEA-DRG--591171 – Rev P01	09/12/2025	
Leasing plan – Level 03A	EA-WEA-DRG—5901201 – Rev P07	02/04/2025	
Leasing plan – Level 04	EA-WA-DRG--591301 – Rev P07	02/04/2025	
Fire hydrant coverage package	CC-SDWG-FIR	23/02/2024	Innovative fire

Other information	Ref no	Date	Prepared by
BCA report	220496-07BCA – revision 7	23 November 2023	McKenzie Group

Appendix B FRNSW comments on PBDB

From: Fire Safety <FireSafety@fire.nsw.gov.au>
Sent: Wednesday, 13 December 2023 8:59 AM
To: troy.fowler@vicinity.com.au
Cc: David Patterson; ldenny@swpartners.com.au; Vanessa Hinge; Tse Min CHANG; Chris Jamieson; Malhar Bhadbhade; Paul Mcdonald; Assistant.CapitalAccountants@vicinity.com.au; Grace Huang
Subject: PBDB Not Provided - PBDB V2 - 345 Victoria Avenue Chatswood - Chatswood Chase Shopping Centre - Vicinity Centres PM Pty Ltd - Warringtonfire - SRID 8000032412

CAUTION:This email originated from outside of Element Materials Technology. **DO NOT** click links or open attachments unless you recognize the sender and know the content is safe. Please contact IT Service Desk if you are in any doubt about this email.

Good Morning **Troy,**

Fire & Rescue NSW (FRNSW) acknowledge receipt of your application and supporting documents for a Fire Engineering Brief Questionnaire/Performance Based Design Brief.

In this instance, FRNSW advises that an Fire Engineering Brief Questionnaire/Performance Based Design Brief **will not be provided.**

The decision not to assess the version submitted is not to be interpreted as FRNSW support for the proposal nor an objection to the proposal, only that FRNSW does not have the resources to review and provide stakeholder comment on this proposal.

For any future correspondence regarding this matter, we request that you quote your below reference numbers:

Project Reference:	**FRN20/1745**
Job Number:	**BFS23/7083**
SRID Number:	**8000032412**

Should you have any further queries, please contact the Fire Safety Branch by replying to this email.

Regards,

NSW GOVERNMENT | FIRE + RESCUE

Carissa Gingell
Administrative Support Officer
CSD Admin & Project Services | Fire and Rescue NSW

T: (02) 9742 7434
E: firesafety@fire.nsw.gov.au
A: 1 Amarina Ave, Greenacre, NSW, 2190
Locked Bag 12, Greenacre, NSW, 2190



COMMUNITY SAFETY A
WE WOULD LIKE TO TI

PREPARED FOR ANYTHING.

Huang, Grace

From: Fire Safety <FireSafety@fire.nsw.gov.au>
Sent: Wednesday, 8 January 2025 3:34 PM
To: Huang, Grace
Cc: Luke Denny; Farshid Salehi; David Patterson; Jamieson, Chris; Troy Fowler
Subject: PBDB WILL NOT BE PROVIDED - 345 Victoria Avenue Chatswood - Chatswood Chase Shopping Centre - Vicinity Centres PM Pty Ltd - Jensen Hughes

Categories: Blue Category

Good Afternoon Grace,

Fire & Rescue NSW (FRNSW) acknowledge receipt of your application and supporting documents for a Performance Based Design Brief.

In this instance, FRNSW advises that an Performance Based Design Brief **will not be provided.**

The decision not to assess the version submitted is not to be interpreted as FRNSW support for the proposal nor an objection to the proposal, only that FRNSW does not have the resources to review and provide stakeholder comment on this proposal.

For any future correspondence regarding this matter, we request that you quote your below reference numbers:

Project Reference:	**FRN20/1745**
Job Number:	**BFS24/8139**
SRID Number:	**8000039812**

Should you have any further queries, please contact the Fire Safety Branch by replying to this email.

Regards,

AUBREY BARTOLO
Administrative Support Officer
CSD Admin & Project Services | Fire and Rescue NSW
T: (02) 9742 7434 E: firesafety@fire.nsw.gov.au
1 Amarina Avenue, Greenacre NSW 2190 | Locked Mail Bag 12, Greenacre, NSW 2190

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Fire and Rescue NSW acknowledge the traditional custodians of the lands on which we stand and pay our respects to their Elders from the past and present.

Appendix C Fire safety statement

Fire Safety Statement

Part 12 of the Environmental Planning and Assessment (Development Certification and Fire Safety) Regulation 2021

NSW GOVERNMENT

Fire Safety Measure	Minimum Standard of Performance	Date(s) assessed	APFS*
Main Centre: Access Panels, Doors & Hoppers to Fire-Resisting Shafts	BCA C3.13		CDC 22/1000.02/01
Main Centre: Automatic Fail-Safe Devices	BCA D2.21, C3.6, spec. C3.4, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09 (car park & mall auto entry doors)		CDC 22/1000.02/01
Main Centre: Automatic Fire Detection & Alarm System – Including the ASE	BCA E2.2a AS 4428.6, AS1670.3, AS3013, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01 CDC 23/0415/01
Main Centre: Automatic Fire Suppression Systems (Sprinklers)	BCA C2.3, E1.5, AS 2118.1-1999, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01 CDC 22/1000.02/02
Main Centre: Discharge from Exits (incl. paths of travel from open spaces to public roads)	BCA D1.7, .8, .9, .10, .11, D2.12, Part G4.3, .6, .7, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 23/1575/01
Main Centre: Emergency Lighting	BCA E4, AS 2293.1-1989, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09, AS 2293.1-2005		CDC 23/1575/01 CDC 22/1000.02/01
Main Centre: Emergency Evacuation Plan & Procedure	AS 3745	05 Mar 2024	F033171A
Main Centre: EWIS	BCA E4.9, AS2220.1 &.2, AS1670.4		CDC 22/1000.02/01 CDC 23/0415/01
Main Centre: Exit Signs	BCA E4, AS2293.1-1989, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09, AS2293.1-2005		CDC 23/1575/01 CDC 22/1000.02/01
Main Centre: Fire Blankets	AS 2444		CDC 22/1000.02/01
Main Centre: Fire Control Room	BCA spec. E1.8, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01 CDC 23/0415/01
Main Centre: Fire Dampers	AS1668.1-1991, 1998, CSIRO fire report No. FPC0287 dated February 1995, BCA C3.4, C3.15, AS1682.1, .2- 1990, NDY FSER No. C08004-25 fe rp02309s, revision M		CDC 22/1000.02/01

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Version 4 | Effective from 1 September 2022 | NSW Department of Planning and Environment | 2

Fire Safety Statement

Part 12 of the Environmental Planning and Assessment (Development Certification and Fire Safety) Regulation 2021

NSW GOVERNMENT

Fire Safety Measure	Minimum Standard of Performance	Date(s) assessed	APFS*
	dated 29/9/09		
Main Centre: Fire Doors (incl. self-closing devices)	BCA spec.C3.4, C2.12, .13, C3.8, .10, .11, D2.8, AS 1905-2005	22/05/2024	F049255A CDC 22/1000.02/01
Main Centre: Fire Hose Reels	Ord. 70, Min. spec. 10, BCA E1.4, AS24412005	22/05/2024	F049255A
Main Centre: Fire Hydrant System	BCA E1.3, AS2419.1-2005	08/05/2024	F049255A
Main Centre: Fire Seals Protecting Openings to Fire Resisting Components of the Building	BCA C3.12, .15, spec, C3.15, AS1530.4, AS4072.1		CDC 22/1000.02/01 CDC 22/1000.02/02
Main Centre: Lift Landing Doors	BCA C3.10, AS 1735.11-1982	20 Jun 2024	F055581A
Main Centre: Lightweight Construction	BCA C1.8		CDC 22/1000.02/01
Main Centre: Paths of Travel, Stairways, Passageways or Ramps	BCA D1.6, EP&A 2000 cl. 182-186		CDC 22/1000.02/01
Main Centre: Portable Fire Extinguishers	BCA E1.6, AS 2444-2001	23/05/2024	F049255A
Main Centre: Power Operated Doors	BCA D2.19 (b) (iv)		CDC 22/1000.02/01
Main Centre: Pressurising Systems	AS1668.1, CSIRO fire report No. FPC0287 dated February 1995		CDC 23/0415/01
Main Centre: Smoke Baffles & Walls to Smoke Zone	NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01
Main Centre: Smoke Control System incl. smoke dampers	AS1668.1-1991, AS1682-1990, CSIRO fire report No. FPC0287 dated February 1995, BCA E2, AS1668-1998, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 23/0415/01
Main Centre: Smoke Doors, Smoke Roller Shutters & Perforated Tenancy Roller Shutter (new)	BCA C3.4.3, CSIRO fire report No. FPC0287 dated February 1995, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 23/0415/01
Main Centre: Storage/Display Limitation to mall area adjacent to atrium, located in zone E2 adjacent to Victoria Ave entry on ground floor	NDY FSER No. C08004-25 fe rp02309s,revision M dated 29/9/09		CDC 22/1000.02/01
Main Centre:	BCA E2, spec. E2.2a, AS1670.1-2004		CDC 23/0415/01

Fire Safety Statement

Part 12 of the Environmental Planning and Assessment (Development Certification and Fire Safety) Regulation 2021

NSW GOVERNMENT

Fire Safety Measure	Minimum Standard of Performance	Date(s) assessed	APFS*
Smoke & Heat Detectors			
Main Centre: Smoke Doors	BCA spec. C3.4	22/05/2024	F049255A
Main Centre: Solid Core Doors (incl. self-closing devices)	BCA C3.11 (f)	22/05/2024	F049255A
Main Centre: Wall Wetting Sprinkler & Drencher System	BCA C3.4, E1.5, spec. E1.5, AS2118.2		CDC 22/1000.02/02
Main Centre: Warning and Operational Signage	BCA spec. E1.8, D2.23, E3.3, C3.6, EP & A Regs. 2000 cl.183, AS 2118, AS 2441-2005, AS 2419-1999, AS 1905.1	10/04/2024	F049255A
Main Centre: Alternative Solutions: NDY FSER No. C08004-025 fe rp02309s, revision K dated 7/8/09	BCA CP1, CP2, DP4, DP5, DP6, EP1.1, EP1.3, EP1.5, EP1.6, EP2.2, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01
Coles: Automatic Fire Detection & Alarm System	BCA E2.2a AS 4428.6, AS1670.3, AS3013, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 23/0415/01
Coles: Automatic Fire Suppression Systems (Sprinklers)	BCA C2.3, E1.5, AS 2118.1-1999, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/02
Coles: Emergency Lighting	BCA E4, AS 2293.1-1989, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09, AS 2293.1-2005	10/04/2024	F049255A
Coles: EWIS	BCA E4.9, AS2220.1 &.2, AS1670.4		CDC 23/0415/01
Coles: Exit Signs	BCA E4, AS2293.1-1989, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09, AS2293.1-2005	10/04/2024	F049255A
Coles: Fire Blankets	AS 2444	10/04/2024	F049255A
Coles: Fire Hose Reels	Ord. 70, Min. spec. 10, BCA E1.4, AS24412005	10/04/2024	F049255A
Coles:	BCA E1.3, AS2419.1-2005	08/05/2024	F049255A

Fire Safety Statement

Part 12 of the Environmental Planning and Assessment (Development Certification and Fire Safety) Regulation 2021

NSW GOVERNMENT

Fire Safety Measure	Minimum Standard of Performance	Date(s) assessed	APFS*
Fire Hydrant System			CDC 22/1000.02/02
Coles: Portable Fire Extinguishers	BCA E1.6, AS 2444-2001	10/04/2024	F049255A
Coles: Pressurising Systems	AS1668.1, CSIRO fire report No. FPC0287 dated February 1995		CDC 23/0415/01
Coles: Smoke Control System incl. smoke dampers	AS1668.1-1991, AS1682-1990, CSIRO fire report No. FPC0287 dated February 1995, BCA E2, AS1668-1998, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 23/0415/01
KMART: Automatic Fail-Safe Devices (Roller Door at the Front)	Ord. 70, CSIRO fire report No. FPC0287 dated February 1995		CDC 23/0415/01
KMART: Automatic Fire Detection & Alarm System	Ord. 70, CSIRO fire report No. FPC0287 dated February 1995		CDC 23/0415/01
KMART: Automatic Fire Suppression Systems (Sprinklers)	Ord. 70, CSIRO fire report No. FPC0287 dated February 1995		CDC 22/1000.02/02
KMART: Emergency Lighting	Ord. 70, AS2293.1-1987	09/04/2024	F049255A
KMART: EWIS	BCA E4.9, AS2220.1 &.2, AS1670.4		CDC 23/0415/01
KMART: Exit Signs	Ord. 70, AS2293..1-1987	09/04/2024	F049255A
KMART: Fire Blankets	AS 2444	09/04/2024	F049255A
KMART: Fire Hose Reels	Ord. 70, Min. spec. 10, BCA E1.4, AS24412005	09/04/2024	F049255A
KMART: Fire Hydrant System	BCA E1.3, AS2419.1-2005	08/04/2024	F049255A CDC 22/1000.02/02
KMART: Portable Fire Extinguishers	BCA E1.6, AS 2444-2001	09/04/2024	F049255A
KMART: Pressurising Systems	AS1668.1, CSIRO fire report No. FPC0287 dated February 1995		CDC 23/0415/01
KMART: Smoke Control System incl. smoke dampers	AS1668.1-1991, AS1682-1990, CSIRO fire report No. FPC0287 dated February 1995, BCA E2, AS1668-1998, NDY		CDC 23/0415/01

Fire Safety Statement

Part 12 of the Environmental Planning and Assessment (Development Certification and Fire Safety) Regulation 2021

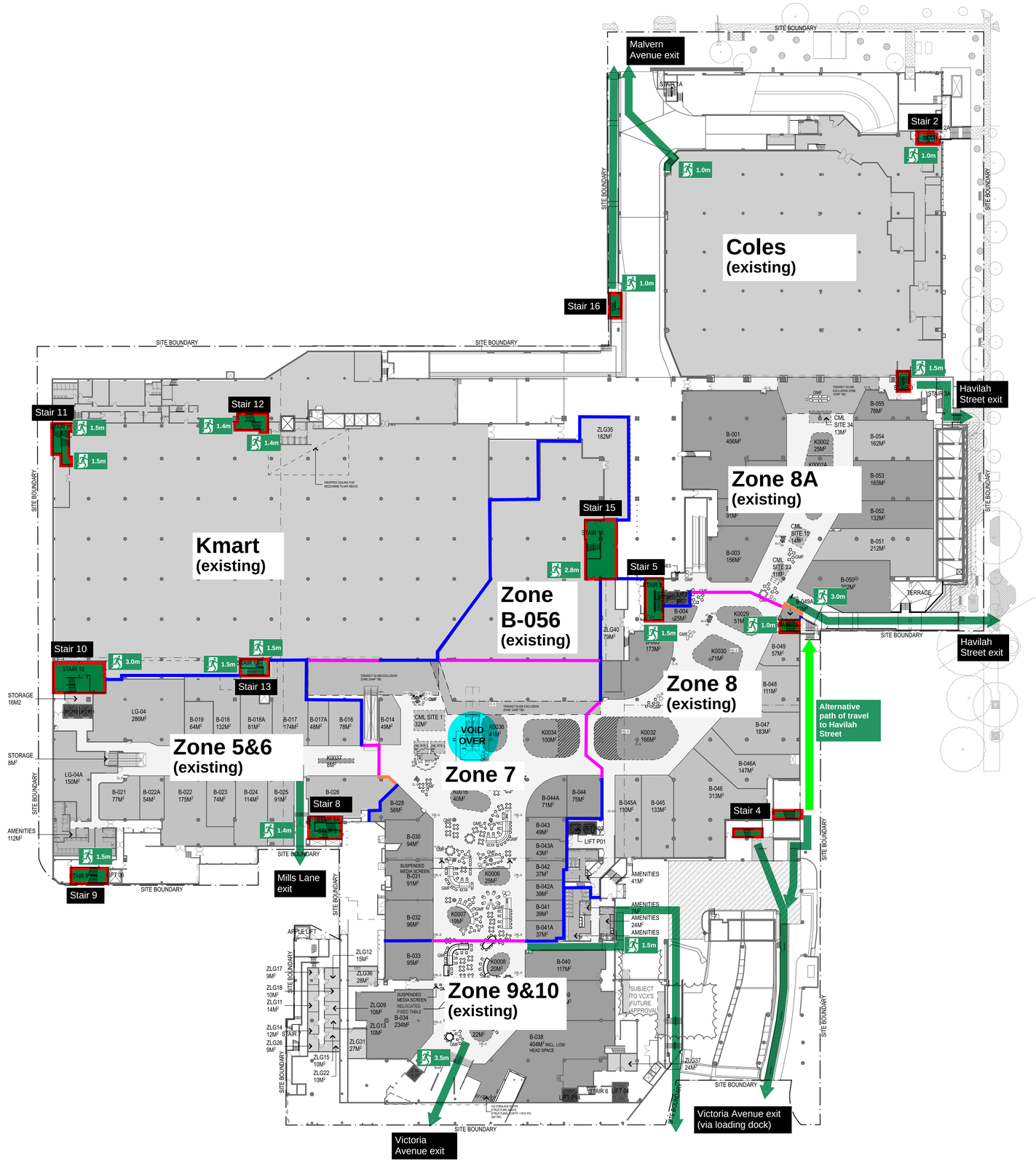
NSW GOVERNMENT

Fire Safety Measure	Minimum Standard of Performance	Date(s) assessed	APFS*
	FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		
David Jones: Automatic Fire Detection & Alarm System	BCA E2.2a AS 4428.6, AS1670.3, AS3013, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01
David Jones: Automatic Fire Suppression Systems (Sprinklers)	BCA C2.3, E1.5, AS 2118.1-1999, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01
David Jones: Emergency Lighting	GRN Ord. 70, AS2293..1-1987 Level 1 & 2 BCA E4, AS 2293.1-1989, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09, AS 2293.1-2005		CDC 22/1000.02/01
David Jones: EWIS	BCA E4.9, AS2220.1 &.2, AS1670.4		CDC 22/1000.02/01
David Jones: Exit Signs	GRN Ord. 70, AS2293.1-1987 Level 1 & 2 BCA E4, AS2293.1-1989, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09, AS2293.1-2005		CDC 22/1000.02/01
David Jones: Fire Blankets	AS 2444	10/04/2024	F049255A
David Jones: Fire Dampers	AS1668.1-1991, 1998, CSIRO fire report No. FPC0287 dated February 1995, BCA C3.4, C3.15, AS1682.1, .2- 1990, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01
David Jones: Fire Hose Reels	Ord. 70, Min. spec. 10, BCA E1.4, AS24412005	10/04/2024	F049255A
David Jones: Fire Hydrant System	BCA E1.3, AS2419.1-2005	08/05/2024	F049255A
David Jones: Portable Fire Extinguishers	BCA E1.6, AS 2444-2001	10/04/2024	F049255A
David Jones: Pressurising Systems	AS1668.1, CSIRO fire report No. FPC0287 dated February 1995		CDC 22/1000.02/01
David Jones: Smoke Control System incl. smoke dampers	AS1668.1-1991, AS1682-1990, CSIRO fire report No. FPC0287 dated February 1995, BCA E2, AS1668-1998, NDY FSER No. C08004-25 fe rp02309s, revision M dated 29/9/09		CDC 22/1000.02/01

Appendix D Retail smoke zones and exit plans

Plans showing the exits from the building and retail smoke zones are included on pages below. The following is noted:

- The width indicated on the plans is the clear unobstructed width of the exit element – e.g. fire-isolated stairway or passageway.
- The clear unobstructed width of the doors opening into exits from the retail mall must comply with clause D2D9 of the NCC, except for the doors opening into stair 15 from the David Jones tenancy on levels 00 and 01. On these levels, the existing double doors into stair 15 can be retained.



LEGEND:

- TENANCY - MAJOR / MINI MAJOR
- TENANCY - SPECIALTY RETAIL
- TENANCY - FOOD & BEVERAGE
- TENANCY - STORAGE
- CENTRE MANAGEMENT
- AMENITY
- CAR WASH
- PLANT ROOM
- PASSENGER LIFT
- GOODS LIFT
- PASSENGER + GOODS LIFT
- MALL COMMON AREA
- TENANCY EXCLUSION ZONE
- DIGITAL RETAIL DIRECTORY - SETOUT DIMENSIONS CENTRAL TO SIGN
- SHOPALITE - DOUBLE SIDED - SETOUT DIMENSIONS CENTRAL TO SIGN
- SHOPALITE - SINGLE SIDED - SETOUT DIMENSIONS CENTRAL TO SIGN
- FREESTANDING SIGNAGE - SETOUT DIMENSIONS CENTRAL TO SIGN
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- ATM MACHINE
- DIGITAL MEDIA SCREEN
- CL-S — SINGLE GPO - CLEANER 110MM AFFL
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- PM-D — DOUBLE GPO - PAY MACHINE 300MM AFFL
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- GMF — GENERAL MALL FURNITURE SHOWN FOR INFORMATION ONLY - REFER TO FURNITURE DRAWINGS FOR FURTHER DETAIL
- EXISTING MOVEMENT JOINT
- CONSTRUCTION JOINT

Legend

- Fire isolated exit
- Path of travel
- Fire separation
- Smoke wall
- Smoke baffle
- Internal wall-wetting sprinklers
- Smoke proof shop front

NOTES

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345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

TITLE
COMMON MALL PLAN - LEVEL LG (NO TENANCY NAME)

ISSUED STATUS
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PROJECT #	SCALE @ A0	AUTHORED	APPROVED	FIRST ISSUE
23300	1:500	WEB	KLB	9/12/2025
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Date Printed: 9/12/2025



Legend

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- Path of travel
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- Smoke proof shop front

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- AMENITY
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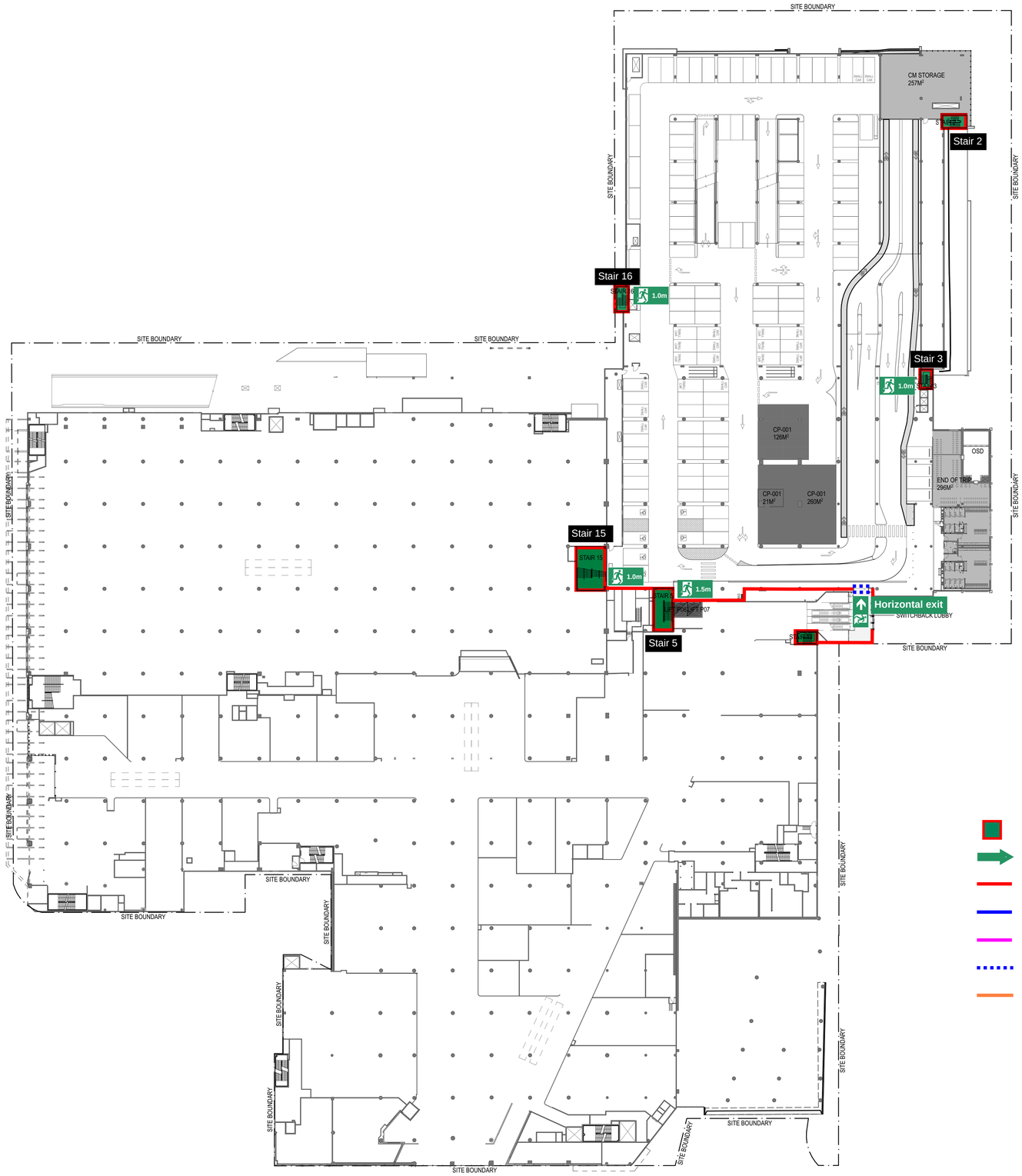
TITLE
COMMON MALL PLAN - LEVEL 00 (NO TENANCY NAME)

ISSUED STATUS
FOR INFORMATION

PROJECT #	SCALE @ A0	AUTHORED	APPROVED	FIRST ISSUE
23300	1:500	WEB	KLB	9/12/2025

ORIGINATOR	ROLE	ZONE	SHEET NO.	REVISION
WEA	EA	00	590571	P01

Date Printed: 9/12/2025



Legend

- Fire isolated exit
- Path of travel
- Fire separation
- Smoke wall
- Smoke baffle
- Internal wall-wetting sprinklers
- Smoke proof shop front

LEGEND:

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345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

TITLE

COMMON MALL PLAN - LEVEL 00A (NO TENANCY NAME)

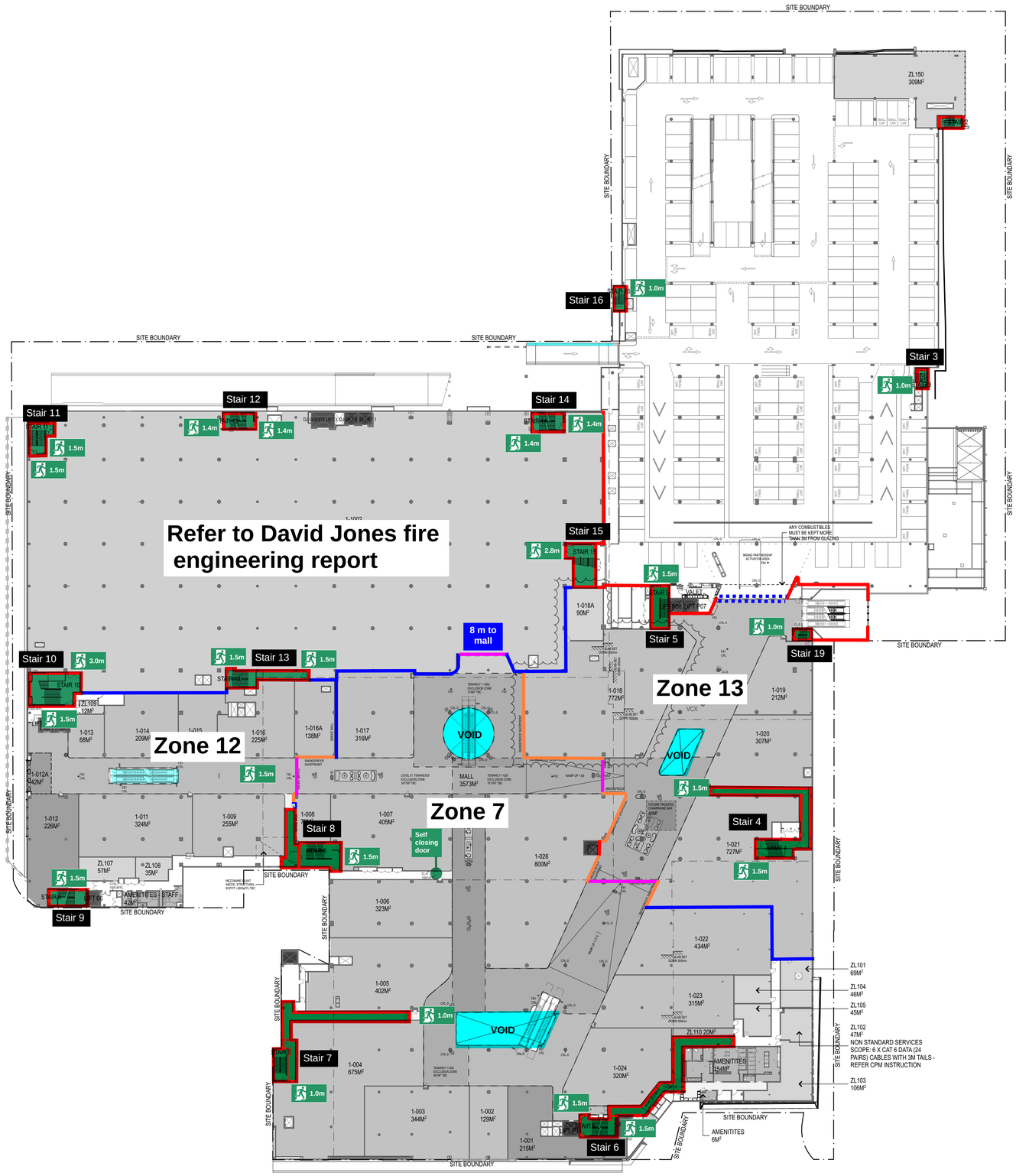
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23300	1:500	WEB	KLB	9/12/2025

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WEA	EA	00	590671	P01

Date Printed: 9/12/2025



Legend

- Fire isolated exit
- Path of travel
- Fire separation
- Smoke wall
- Smoke baffle
- Internal wall-wetting sprinklers
- Smoke proof shop front

LEGEND:

- TENANCY - MAJOR / MINI MAJOR
- TENANCY - SPECIALTY RETAIL
- TENANCY - FOOD & BEVERAGE
- TENANCY - STORAGE
- CENTRE MANAGEMENT
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CHATSWOOD CHASE
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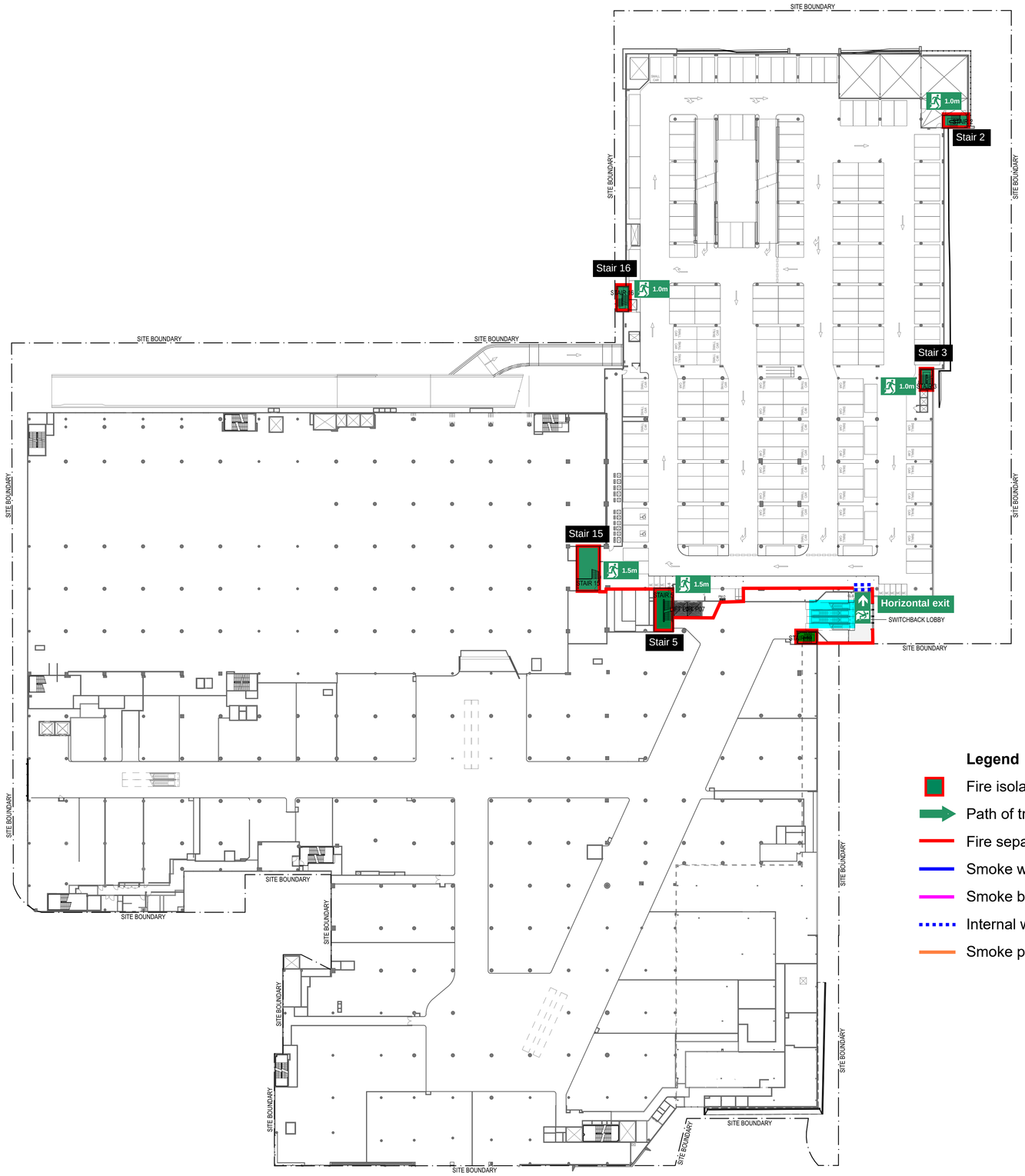
TITLE
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WEA	EA	00	590771	P01

Date Printed: 9/12/2025



Legend

- Fire isolated exit
- Path of travel
- Fire separation
- Smoke wall
- Smoke baffle
- Internal wall-wetting sprinklers
- Smoke proof shop front

LEGEND:

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PROJECT

CHATSWOOD CHASE

345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

TITLE

COMMON MALL PLAN - LEVEL 01A (NO TENANCY NAME)

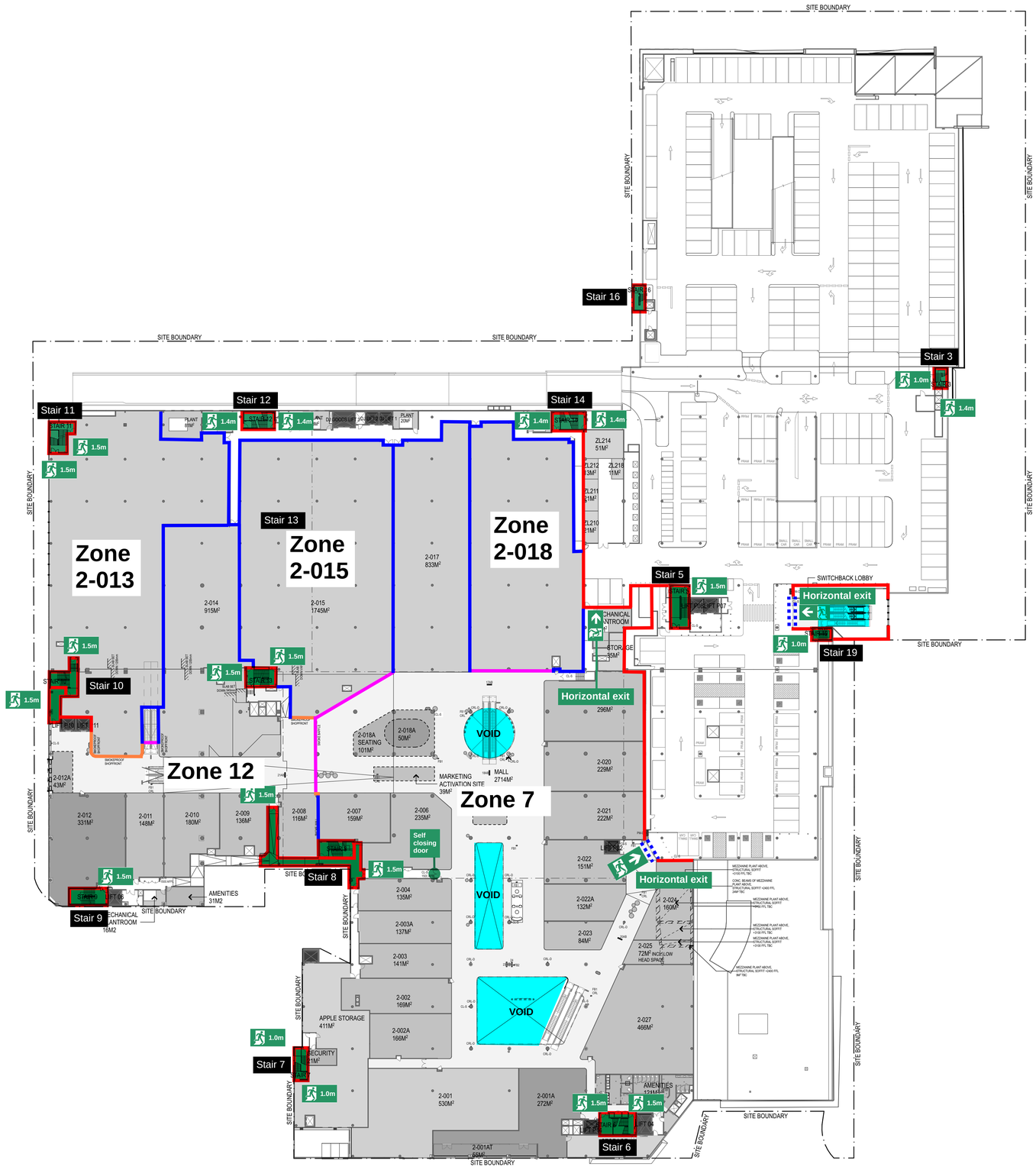
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LEGEND:

- TENANCY - MAJOR / MINI MAJOR
- TENANCY - SPECIALTY RETAIL
- TENANCY - FOOD & BEVERAGE
- TENANCY - STORAGE
- CENTRE MANAGEMENT
- AMENITY
- CAR WASH
- PLANT ROOM
- PASSENGER LIFT
- GOODS LIFT
- PASSENGER + GOODS LIFT
- MALL COMMON AREA
- TENANCY EXCLUSION ZONE
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- SHOPALITE - DOUBLE SIDED - SETOUT DIMENSIONS CENTRAL TO SIGN
- SHOPALITE - SINGLE SIDED - SETOUT DIMENSIONS CENTRAL TO SIGN
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- AUTOMATIC PAY MACHINE
- VENDING MACHINE - BEVERAGE
- ATM MACHINE
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- CL-S — SINGLE GPO - CLEANER 110MM AFFL
- CRL-D — DOUBLE GPO - CHRISTMAS DECORATION 3000MM AFFL
- PM-D — DOUBLE GPO - PAY MACHINE 300MM AFFL
- FB# — FLOOR BOX
- CRL — CHRISTMAS DECORATION EQUIPMENTS
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- EXISTING MOVEMENT JOINT
- CONSTRUCTION JOINT

Legend

- Fire isolated exit
- Path of travel
- Fire separation
- Smoke wall
- Smoke baffle
- Internal wall-wetting sprinklers
- Smoke proof shop front

NOTES

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PROJECT
CHATSWOOD CHASE
345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

TITLE
COMMON MALL PLAN - LEVEL 02 (NO TENANCY NAME)

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Legend

- Fire isolated exit
- Path of travel
- Fire separation
- Smoke wall
- Smoke baffle
- Internal wall-wetting sprinklers
- Smoke proof shop front

LEGEND:

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TITLE

COMMON MALL PLAN - LEVEL 02A (NO TENANCY NAME)

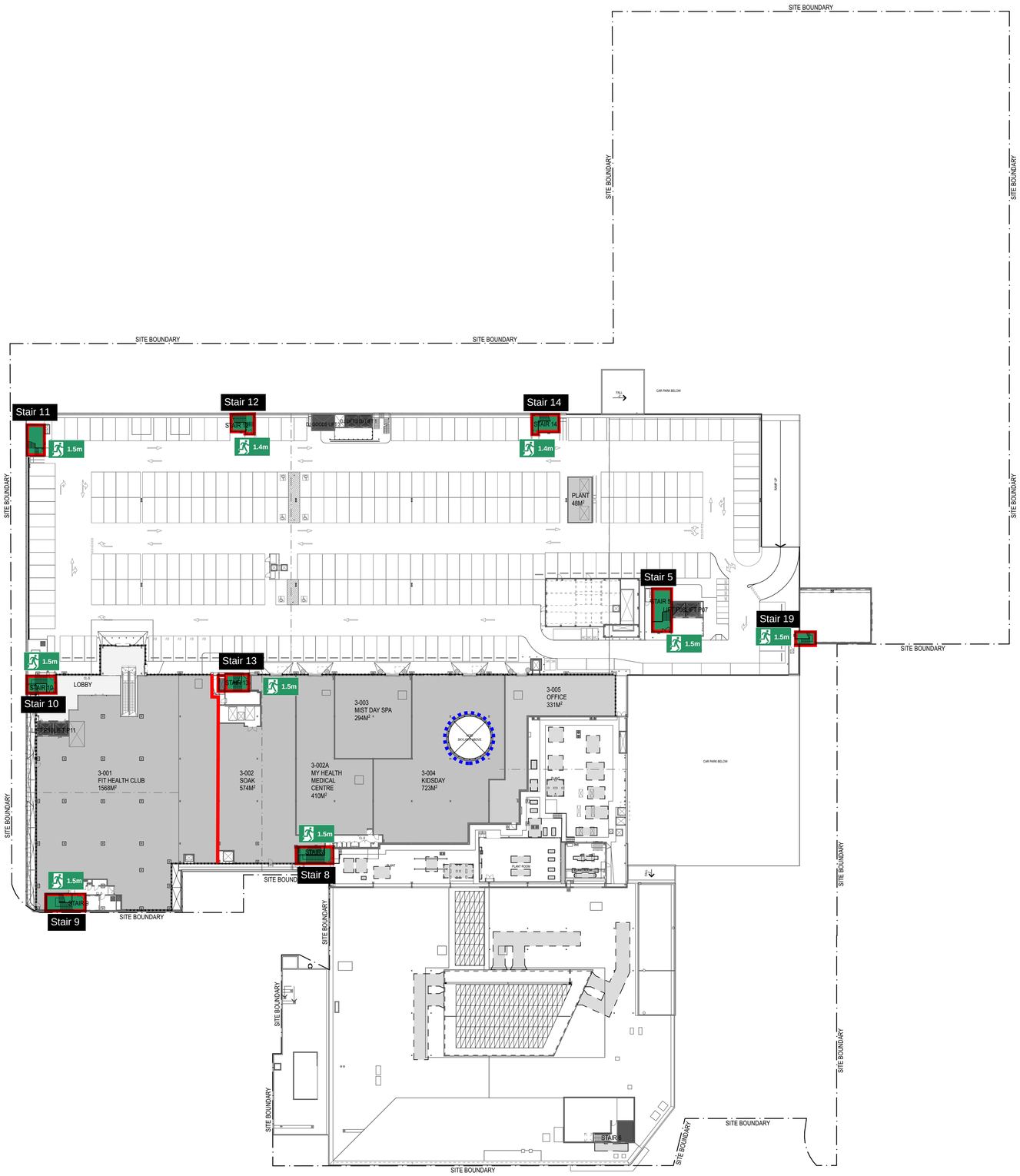
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345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

TITLE

COMMON MALL PLAN - LEVEL 03 (NO TENANCY NAME)

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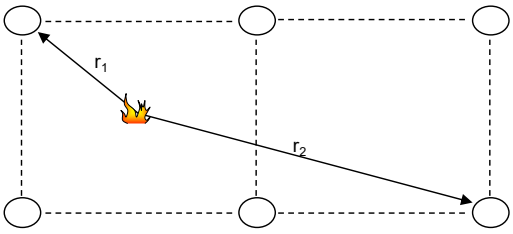
Appendix E Sprinkler activation times – Calculation of retail fire sizes

Sprinkler activation

QA version: 18 July 2023

Nomenclature

H	height of ceiling above the fire (m)
u	gas velocity (m/s)
T_a	ambient temperature (deg C)
T_g	ceiling jet temperature (deg C)
Q	fire heat release rate (kW)
r	radial distance from the plume to the sprinkler location (m)
T_d	detector temperature (deg C)
RTI	response time index ($m^{0.5}s^{0.5}$)
C	C factor ($m^{0.5}s^{-0.5}$)



r = r_1 or r_2 depending on first or second row activation

Formulae (based on Alpert's correlations)

$T_g - T_a = 16.85\ Q^{2/3}\ H^{-5/3}$	r/H <= 0.18
$T_g - T_a = 5.36\ (Q/r)^{2/3}\ /\ H$	r/H > 0.18
$u = 0.945\ (Q/H)^{1/3}$	r/H <= 0.15
$u = 0.197\ Q^{1/3}\ H^{1/2}\ r^{-5/6}$	r/H > 0.15

$dTd = (u^{0.5} / RTI)\ [(T_g - T_{room}) - (1 + C\ u^{-0.5})(T_d - T_{room})]\ dt$

Source: Alpert R L (1972), Calculation of response time of ceiling mounted fire detectors, *Fire Technology* , 8(3), pages 181 - 195

Source: Heskestad G and Bill R G (1988), Conduction heat-loss effect on thermal response of automatic sprinklers, *Fire Safety Journal* , v.14, pages 113-125

Ambient temperature 20 °C

Fire location	Fire growth	H	r	Act. °C	RTI	C	Act. time (s)	Fire size (MW)
Scenarios 4 5,7, 9, 11 and 13	Fast	3.5	2.5	68	50	0.8	**164**	**1.2**
Scenarios 6,8,10 12	Fast	3.5	5.5	68	50	0.8	**250**	**2.78**
Scenario 1 and 2	Fast	4.25	2.5	68	50	0.8	**182**	**1.47**
Scenario 3	Fast	4.25	5.5	68	50	0.8	**277**	**3.41**
Scenario 14	Fast	6.2	2.5	68	50	0.8	**223**	**2.21**

Appendix F Evacuation assessment – level 3 centre management office (CMO)

F.1 Evacuation assessment framework

To assess if the proposed design with extended travel distances is at least equivalent to a DTS compliant design the required safe egress time (RSET) has been estimated for the proposed design and the DTS compliant base case.

The AFEG states that the RSET is the time from when a fire initiates to the time when occupants reach a place of safety. The framework used to calculate the RSET is based upon Equation 4. The RSET is measured from the same point of origin as the fire at the time of initiation. The calculation of the RSET using Equation 4 is the addition of four periods, which are briefly described by the following:

- Cue period – the time of fire initiation to the time a cue indicates the occurrence of a fire.
- Response period – the time a cue indicates the occurrence of a fire to the time occupants recognise the cue as an indication of a fire.
- Delay period – the time occupants recognise the cue as an indication of fire to the time occupants commence evacuation.
- Movement period – the time occupants commence evacuation to the time when occupants reach a place of safety. This period is calculated on the basis of human walking speeds and queuing at exits affected by crowding.

RSET = cue period + response period + delay period + movement period

Equation 4 Calculation of RSET

F.2 Populations nominated

The assessment considers the northern office block on level 3, which incorporates the worst-case travel distances. The population in this office block is calculated using the population density specified for an office by Table D2D18 of the NCC – ie 10 m^2/person. This equates to 33 people based on a floor area of 329 m^2. The populations for the proposed design and base case are assumed to be equivalent as they are assumed to have the same use and floor area.

F.3 Cue period

Alpert's correlation[64] was used to calculate the time of activation of the smoke detection system within the proposed design and the sprinkler system within the base case. A floor-to-ceiling height of 2.7 m was used for both designs.

The calculation of the cue period for the proposed design is based upon experiments that suggest activation of smoke detectors can be conservatively approximated by a 5-13 °C rise in temperature[65,66]. A rise in temperature of 13 °C has been adopted for the assessment because it is conservative for the comparison.

The calculation of the cue period for the base case utilised fast response sprinkler heads at 68 °C with light hazard spacing. Conduction losses (C-factor) were ignored because it is conservative for the comparison.

The calculated cue periods are summarised in Table 91 with the output data attached in Appendix G.

[64] Alpert RL, 1972, Calculation of response time of ceiling mounted fire detectors, Fire Technology, 8(3), pp 181-195
[65] Bukowski RW and Averill JD, Methods for Predicting Smoke Detector Activation, Building Fire and Research Laboratory, National Institute of Standards and Technology, USA, 1998
[66] Heskestad G and Delichatsios MA, Environment of Fire Detectors – Phase 1: Effects of fire size, ceiling height and material, 1977

Table 91 Cue period

Building	Detection method	Cue period (seconds)
Proposed design	Section 5 AS 1670.1:2018 smoke detection	53
Base case	AS 2118.1:2017 fast response sprinklers	137

F.4 Pre-movement phase

The pre-movement phase is the time taken between when the cue was first received and the movement phase to a place of safety. The pre-movement phase comprises two components – the response and the delay periods.

F.4.1 Response period

The occupant response period involves the process of interpreting the automatic or intrinsic fire cue and identifying it as a cause for evacuation. The response period is dependent upon the type of cue. Sprinklers are present within the proposed design and the base case. On this basis, the occupant response periods are assumed to be the equivalent for both designs.

F.4.2 Delay period

Following the time for the occupants to interpret the cue and identify it as a cause for evacuation, occupants undertake actions such as collecting belongings, looking for other occupants and investigating to obtain further information prior to beginning to move towards the exits. Since both the proposed design and the base case house the same occupancy group, the delay periods are assumed to be equivalent.

F.4.3 Total pre-movement phase

As discussed in sections F.4.1 and F.4.2, the pre-movement phase for the base case and proposed design are equivalent.

F.5 Movement period

This section describes the evaluation of the time necessary for occupants to reach exits and pass through the exits to a place of safety. The movement period is a function of the population, the occupant density, the movement speed and flow rate through paths of travel and exits. The methodology for calculating the evacuation time is based on the information provided in the SFPE Handbook.

It is recognised that there has been recent debate about the validity of data and recommendations previously relied upon for egress design[67]. This is due to '*demographic changes, especially reduced fitness levels brought on by increasing sedentary lifestyles, increased body size and increased body weight*' and '*reduced individual and societal motivation plus physiological condition*.' In the absence of updated research data, it is considered that the previously adopted data is still applicable, particularly given the level of conservatism inbuilt into the other aspects of the quantitative assessment.

F.5.1 Travel to exits

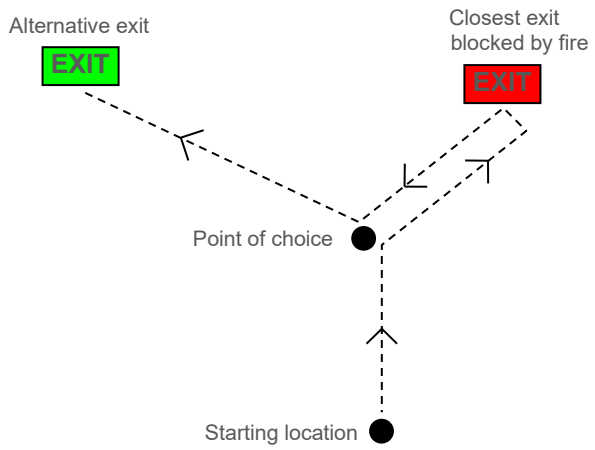
Observations and experiments have shown that evacuation flow speed of a group is a function of the population density. On flat surfaces where the occupant density is less than 0.5 person/m^2, the SFPE Handbook[68] and CIBSE Guide E[69] specify walking speeds of approximately 1.2 m/s. A walking speed of 1.0 m/s is conservatively adopted for this assessment to account for variations in occupant characteristics.

Exit travel distances are based on the following:

Characteristic	Proposed design (performance solution)	Base case (complying)
Travel distance to the closest exit	63 m	40 m
Travel distance between alternative exits	105 m	60 m

Where exits are obstructed by fire, the total distance occupants are required to travel are as follows – see Figure 133:

- Proposed design – 140 m. This is based on 25 m to the point of choice, a further 38 m towards the closest exit which is blocked, and 90 m to the next available exit.
- Base case – 168 m. This is based on 20 m to the point of choice, a further 20 m towards the closest exit which is blocked, and 60 m to the next available exit.



[67] JL Pauls, 2008, Performance of means of egress – Conducting the research needed to establish realistic expectations, in Proceedings, 7th International Conference on Performance-Based Codes and Fire Safety Design Methods.
[68] Gwynne SMV and Rosenbaum ER, 2016, Employing the hydraulic model in assessing emergency movement, The SFPE Handbook of Fire Protection Engineering, 5th edition, SFPE, Springer, chapter 59.
[69] Fire engineering – CIBSE Guide E, 4th edition, 2019, CIBSE Publications Department, pp 7-12.

Figure 133 Maximum distance required to be travelled

F.5.2 Flow through exits

The flow rate through paths of travel and exits is a function of clear width and the exit route element – ie doorway, corridor, stair etc. The useful or effective width of an exit is the clear width of the exit less the boundary layers. Table 92 outlines the boundary layers and exit flow rates used in the assessment to determine the queuing time at exits[70].

Table 92 Boundary layers and flow rates for exit elements

Exit route element	Boundary layer	Exit flow rate	
	(m)	Persons/min/m	Persons/s/m
Doorways – with self-closing doors that need to be held open*	NA	Single leaf door = 50 Double leaf door = 100	Single leaf door = 0.83 Double leaf door = 1.66
Doorways – unobstructed**	0.15	78	1.3
Corridor, ramp	0.2	78	1.3
Stairs – wall or side of tread	0.15	60	1.01
Stairs – handrail	0.09	60	1.01

Note:
* Fixed flow rate irrespective of door width.
** A minimum flow rate of 50 persons/min is assumed for single doors.

F.5.3 Calculation of travel time

The evacuation calculations are included in Table 93 to Table 96, with the results summarised in Table 97 and Table 99.

Table 93 Occupant evacuation time, proposed design, all exits available

Effective flow rates of elements		
Exit element	**Effective width (m)**	**Effective flow rate (persons/min)**
Stair 5 Stairs (handrails both sides)	1.32	80
Stair 8 Stairs (handrails both sides)	0.82	50
Queuing calculation		
Population	33	
Total effective flow rate (persons/min)	130	From SFPE Handbook 5th ed, chapter 59
Queuing time (s)	**16**	= 0.3 mins
Travel time calculation		
Travel distance (m)	63	
Travel speed (m/s)	1	From SFPE Handbook 5th ed, chapter 59
Travel time (s)	**63**	= 1.1 mins
Summary		
Total evacuation time (s)	**63**	= 1.1 mins
Note: Travel time exceeds queuing time		

QA version: 24 July 2024

[70] Gwynne SMV and Rosenbaum ER, 2016, Employing the hydraulic model in assessing emergency movement, The SFPE Handbook of Fire Protection Engineering, 5th edition, SFPE, Springer, chapter 59.

Table 94 Occupant evacuation time, proposed design, one exit blocked

Effective flow rates of elements		
Exit element	**Effective width (m)**	**Effective flow rate (persons/min)**
Stair 5 Stairs (handrails both sides)	1.32	80
Stair 8 Stairs (handrails both sides)	0.82	50
Queuing calculation		
Population	33	
Total effective flow rate (persons/min)	130	From SFPE Handbook 5th ed, chapter 59
Queuing time (s)	**16**	= 0.3 mins
Travel time calculation		
Travel distance (m)	168	
Travel speed (m/s)	1	From SFPE Handbook 5th ed, chapter 59
Travel time (s)	**168**	= 2.8 mins
Summary		
Total evacuation time (s)	**168**	= 2.8 mins
Note: Travel time exceeds queuing time		

QA version: 24 July 2024

Table 95 Occupant evacuation time, base case, all exits available

Effective flow rates of elements		
Exit element	**Effective width (m)**	**Effective flow rate (persons/min)**
Stair 5 Stairs (handrails both sides)	1.32	80
Stair 8 Stairs (handrails both sides)	0.82	50
Queuing calculation		
Population	33	
Total effective flow rate (persons/min)	130	From SFPE Handbook 5th ed, chapter 59
Queuing time (s)	**16**	= 0.3 mins
Travel time calculation		
Travel distance (m)	40	
Travel speed (m/s)	1	From SFPE Handbook 5th ed, chapter 59
Travel time (s)	**40**	= 0.7 mins
Summary		
Total evacuation time (s)	**40**	= 0.7 mins
Note: Travel time exceeds queuing time		

QA version: 24 July 2024

Table 96 Occupant evacuation time, base case, on exit blocked

Effective flow rates of elements		
Exit element	**Effective width (m)**	**Effective flow rate (persons/min)**
Stair 5 Stairs (handrails both sides)	1.32	80
Stair 8 Stairs (handrails both sides)	0.82	50
Queuing calculation		
Population	33	
Total effective flow rate (persons/min)	130	From SFPE Handbook 5th ed, chapter 59
Queuing time (s)	**16**	= 0.3 mins
Travel time calculation		
Travel distance (m)	100	
Travel speed (m/s)	1	From SFPE Handbook 5th ed, chapter 59
Travel time (s)	**100**	= 1.7 mins
Summary		
Total evacuation time (s)	**100**	= 1.7 mins
Note: Travel time exceeds queuing time		

QA version: 24 July 2024

Table 97 Calculated movement period – travel to a point of choice

Building	Travel distance a point of choice (m)	Movement period (s)
Proposed design	23	23
Base case	20	20

Table 98 Calculated movement period – travel to the nearest exit

Building	Travel distance to nearest exit (m)	Movement period (s)
Proposed design	63	63
Base case	40	40

Table 99 Calculated movement period – travel to the alternative exit

Building	Travel distance to alternative exit (m)	Movement period (s)
Proposed design	140	168
Base case	100	100

F.6 RSET summary

The RSETs for the proposed design and the base case are summarised in Table 100. It is noted that the queuing at the exit is the determining factor when travelling to the nearest exit and to an alternative exit.

Table 100 Comparison of RSETs

Building	Measure	Cue period (s)	Pre-movement phase	Movement period (s)	RSET excl. pre-movement phase (s)
Proposed design	Point of choice	53	Equivalent	25	78
	Nearest exit	53	Equivalent	63	116
	Alternative exit	53	Equivalent	168	221
Base case	Point of choice	137	Equivalent	25	162 (>78)
	Nearest exit	137	Equivalent	60	197 (>113)
	Alternative exit	137	Equivalent	100	237 (>221)

Appendix G Sprinkler and smoke detector activation – level 3 CMO office

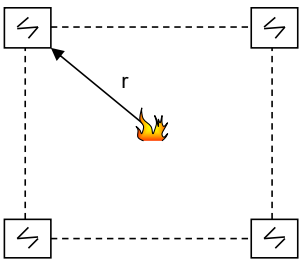
G.1 Smoke detector activation – proposed design

Detector activation

QA version: 18 July 2023

Nomenclature

H	height of ceiling above the fire (m)
u	gas velocity (m/s)
T_a	ambient temperature (deg C)
T_g	ceiling jet temperature (deg C)
Q	fire heat release rate (kW)
r	radial distance from the plume to the detector location (m)
T_d	detector temperature (deg C)
RTI	response time index ($m^{0.5}s^{0.5}$)
C	C factor ($m^{0.5}s^{-0.5}$)



Note: Clause 1.6.1 of AS 1670.1-2015 allows 5% tolerance.

Formulae (based on Alpert's correlations)

$T_g - T_a = 16.85\ Q^{2/3}\ H^{-5/3}$ r/H <= 0.18

$T_g - T_a = 5.36\ (Q/r)^{2/3} / H$ r/H > 0.18

$u = 0.945\ (Q/H)^{1/3}$ r/H <= 0.15

$u = 0.197\ Q^{1/3}\ H^{1/2}\ r^{-5/6}$ r/H > 0.15

$dTd = (u^{0.5} / RTI)\ [(T_g - T_{room}) - (1 + C\ u^{-0.5})(T_d - T_{room})]\ dt$

Source: Alpert R L (1972), Calculation of response time of ceiling mounted fire detectors, *Fire Technology*, 8(3), pages 181 - 195

Source: Heskestad G and Bill R G (1988), Conduction heat-loss effect on thermal response of automatic sprinklers, *Fire Safety Journal*, v.14, pages 113-125

Ambient temperature 20 °C

Fire scenario	Fire growth	H	r	Act. °C	RTI	Act. time (s)	Fire size (MW)
Proposed design - level 3 offices	Fast	2.7	7.1	33	1	**53**	**0.12**

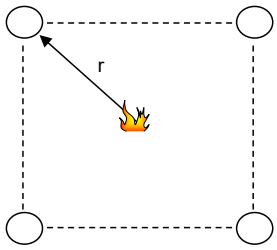
G.2 Sprinkler activation – base case

Sprinkler activation

QA version: 18 July 2023

Nomenclature

H	height of ceiling above the fire (m)
u	gas velocity (m/s)
T_a	ambient temperature (deg C)
T_g	ceiling jet temperature (deg C)
Q	fire heat release rate (kW)
r	radial distance from the plume to the sprinkler location (m)
T_d	detector temperature (deg C)
RTI	response time index ($m^{0.5}s^{0.5}$)
C	C factor ($m^{0.5}s^{-0.5}$)



Formulae (based on Alpert's correlations)

$T_g - T_a = 16.85\ Q^{2/3}\ H^{-5/3}$ r/H <= 0.18

$T_g - T_a = 5.36\ (Q/r)^{2/3} / H$ r/H > 0.18

$u = 0.945\ (Q/H)^{1/3}$ r/H <= 0.15

$u = 0.197\ Q^{1/3}\ H^{1/2}\ r^{-5/6}$ r/H > 0.15

$dTd = (u^{0.5} / RTI)\ [(T_g - T_{room}) - (1 + C\ u^{-0.5})(T_d - T_{room})]\ dt$

Source: Alpert R L (1972), Calculation of response time of ceiling mounted fire detectors, *Fire Technology*, 8(3), pages 181 - 195

Source: Heskestad G and Bill R G (1988), Conduction heat-loss effect on thermal response of automatic sprinklers, *Fire Safety Journal*, v.14, pages 113-125

Ambient temperature 20 °C

Fire location	Fire growth	H	r	Act. °C	RTI	C	Act. time (s)	Fire size (MW)
Base case - level 3 offices	Fast	2.7	3.3	68	50	0	**137**	**0.83**

Appendix H FDS smoke modelling assessment

H.1 Introduction

This section provides a brief overview of Fire Dynamics Simulator (FDS) version 6[71,72] for the purposes of familiarisation. The theoretical basis of FDS is described in detail within the FDS Technical Reference Guide. The FDS User's Guide provides a thorough explanation of how to setup and perform simulations.

The FDS model was developed specifically for modelling building fires. FDS is a computational fluid dynamics (CFD) model generally applied to fire-driven fluid flow. In FDS, the computational domain is discretised into three dimensional rectilinear volumes referred to as the grid or mesh. The partial derivatives of the conservation equations of mass, momentum and energy are approximated as finite differences, and the solution is updated in time on the rectilinear grid.

The geometry specified by the user in FDS conforms to the rectilinear grid and hence is limited by the resolution of the grid. Similarly, boundary conditions such as vents are applied as patches on the exterior of the domain which will also conform to the rectilinear grid.

Output from the simulation is included in this appendix at various times so the ability of occupants to safely evacuate from the fire and smoke affected areas can be assessed.

H.2 FDS input parameters

Parameter	Data input	Comment
General		
Program and version	FDS 6.7.6	Current release.
Simulation mode	Very Large Eddy Simulation (VLES)	FDS default[72]. In a VLES, the larger geometry dependant eddies are solved explicitly and the smaller eddies are filtered using a sub-grid scale model.
Simulation time	900 s	
Ambient conditions		
Ambient temperature	Air at 20 °C	
Wind conditions	NA	
Modelled grid resolution		
Fire region grid resolution	S1-8,11 and 12 0.2 m x 0.2 m x 0.2 m S9, 10 and 13 0.2 m x 0.2 m x 0.1 m	
Non-fire region grid resolution	S1-8,11 and 12 0.4 m x 0.4 m x 0.2 m S9, 10 and 13 0.2 m x 0.2 m x 0.2 m	

[71] National Institute of Standards and Technology (NIST), FDS and Smokeview (SMV), https://pages.nist.gov/fds-smv/downloads.html, accessed 15 September 2020, United States Department of Commerce, USA.
[72] McGrattan K et al, 2020, NIST Special Publication 1019: 6th edition, Fire Dynamics Simulator user's guide, United States Department of Commerce, USA.

Parameter	Data input	Comment
Characteristic fire diameter[73] (D*) within the fire region	Design scenario (S1,2,4,5,7,9 and 11) D*(1.5 MW) = 1.13 m Sensitivity analysis (S3, 6,8,10 and 12) S3: D*(2.8 MW) = 1.49 m S6,8,10 and 12: D*(3.5 MW) = 1.59 m	Modelled grid resolution maintains D*/5 within the critical fire region and D*/4 in non-critical regions. This is consistent with the recommendations of available research[74,75,76,77].
Cell aspect ratio	Zone of fire origin 1:1:1 Remote from fire origin 2:2:1	Provides reasonable agreement with the recommended maximum ratio of 1:2 to reduce numerical instabilities[72].
Design fire properties		
Combustion model	Single-step, mixing-controlled combustion	Uses three lumped species – ie air, fuel, and products. In this model, *'the reaction of fuel and oxygen is infinitely fast and controlled only by mixing'*.[78]
Fire growth rate	Design scenario (S1,2,4,5,7,9, 11 and 13) 1.5 MW Fast t^2 Sensitivity analysis (S3, 6,8,10 and 12) S3: 3.5 MW Fast t^2 S6,8,10 and 12: 2.8 MW Fast t^2	Refer to section 13.6.1 Activation of the sprinkler system is assumed to control the fire rather than suppressing the fire – ie maintain the heat release rate at sprinkler activation.
Heat release rate per unit area (HRRPUA)	1,000 kW/m^2	Typical range for of HRRPUA for building fires[79,80,81] varies between 250 – 1,000 kW/m^2. The modelled HRRPUA is considered a reasonable estimate.

[73] McGrattan K et al, 2020, NIST Special Publication 1019: 6th edition, Fire Dynamics Simulator user's guide, Equation 6.2, pp 44, United States Department of Commerce, USA.
[74] McGrattan K et al, 2020, NIST Special Publication 1018: 6th edition, Fire Dynamics Simulator technical reference guide volume 3: Validation, United States Department of Commerce, USA.
[75] Petterson N, 2002, Assessing the feasibility of reducing the grid resolution in FDS field modelling, University of Canterbury, NZ.
[76] Davis W et al, 1996, Comparison of fire model predictions with experiments conducted in hangar with a 15m ceiling', NISTIR 5927, US.
[77] NUREG- 1824, May 2007, Verification and validation of selected fire models for nuclear power plant applications, Volume 7: FDS, US Nuclear Regulatory Commission.
[78] McGrattan K et al, 2020, NIST Special Publication 1019: 6th edition, Fire Dynamics Simulator user's guide, Chapter 5, United States Department of Commerce, USA.
[79] New Zealand Government Ministry of Business, Innovation and Employment, C/VM2 – Verification Method: Framework for fire safety design, Amendment 6, 5 November 2020.
[80] EN 1991-1-2:2002, Eurocode 1: Actions on structures - Part 1-2: General actions - Actions on structures exposed to fire, European Standard.
[81] Hopkin C, Spearpoint M and Hopkin D, 2019, A Review of Design Values Adopted for Heat Release Rate Per Unit Area, Fire technology, vol 55, no 5, pp 1599–1618.

Parameter	Data input	Comment
Reaction parameters	&REAC ID='NZBC_VM2' C = 1.0 H =2.222 O = 0.624 CO_YIELD = 0.04 SOOT_YIELD = 0.07 IDEAL = .FALSE. /	The reaction has been calculated based on the yields specified within the New Zealand Building Code – Verification Method C/VM2[79] for fire modelling in buildings. The fire properties within the NZ Verification Method are over specified requiring variation to at least one input value. The heat of combustion was reduced as this maintains all combustion yields but results in more soot being produced on an absolute basis. Fire Safety Verification Method[82] indicates that the characteristic soot yield and heat of combustion specified by NZ Verification Method C/VM2 are appropriate for pre-flashover fires where the composition of the fire load is unknown. These values are more conservative than those provided in the example within the NSW Society of Fire Safety (SFS) practice note for design fires[83] for an '*average value based on mix of plastic and cellulosic materials*' – ie soot yield of 0.06 kg/kg; heat of combustion 30 MJ/kg.
Radiative fraction	0.35	FDS default[72]. This is considered reasonable based on the recommendations of NZ Verification Method C/VM2[79] and Karlsson and Quintiere[84].
Smoke visibility	VISIBILITY_FACTOR = 3	Based on visibility to light reflecting surfaces. This is considered to be reasonable in a public building provided with good ambient lighting and conservatively ignores illuminated exit signage provided.
Physical geometry		
Material properties	All walls, columns, ceilings and floors are assumed to be INERT	Inert materials are non-reacting solid boundary fixed at ambient temperature. This is considered an acceptable approximation as the heat transfer from the smoke to surrounding structures for areas remote from the fire is relatively low for localised fires.
Natural ventilation openings	Modelled as passive openings to an infinite reservoir.	No significant over or under pressure can be created, with outside temperature the same as the initial internal temperature.
Fire safety systems		
Mechanical smoke exhaust	S1-6,11 and 12: 240 m^3/s between 6 outlets. S7 and 8: 80 m^3/s between 2 outlets. S9 and 10: 50 m^3/s between 5 outlets. S13: 30m^3 between three outlets	Modelled as volumetric flow (m^3/s) from the domain. Mechanical exhaust is activated on smoke detector activation.

[82] Fire Safety Verification Method Data Sheets Handbook Annex, Australian Building Codes Board, 2020, Datasheet B2.
[83] Engineer Australia Society of Fire Safety NSW Chapter, Practice note for design fires, Version 1.1, 6 December 2012.
[84] Karlsson B and Quintiere J, 1999, Enclosure fire dynamics, CRC press.

Parameter	Data input	Comment
Mechanical supply air	S1-6 172 m^3/s between 20 inlets. S6-13: N/A	Modelled as volumetric flow (m^3/s) into the domain. Mechanical supply is activated on smoke detector activation.
Sprinklers	Response time index (RTI): 50 $(ms)^{1/2}$ Activation temperature: 68 °C Sprinkler head spacing around fire: 3 m x 4 m.	Based on a fast response sprinkler system.
Smoke detection	Smoke detection was specified using the Heskestad model: • Characteristic length: 2 • Activation obscuration: 20% Obs/m Detector spacing around fire: 10 m x 10 m.	A characteristic length of 2 m has been selected based on the recommendations of Bukowski and Averill[85] and an activation obscuration of 20% Obs/m. It is noted the selected activation obscuration conservatively exceeds the maximum response threshold value nominated by AS 7240.7:2018[86] for point type photoelectric smoke detectors.
Assumed building leakage	N/A	

[85] Bukowski RW and Averill JD, 1998, Methods for predicting smoke detector activation, Fire Suppression and Detection Research Application Symposium, Research and Practice: Bridging the Gap, NIST, USA.
[86] AS 7240.7:2018, Fire detection and alarm systems – Point type smoke detectors using scattered light, transmitted light or ionization, Standards Australia, Australia, table 1.

H.3 Model geometry

The model geometry for fire scenarios 1 and 3 are shown in Figure 134 to Figure 137. The geometry for fire scenarios 2, 4, 5 6, 11 and 12 is identical with the exception of the fire location. The typical spacing of smoke detectors around the fire is shown in Figure 141.

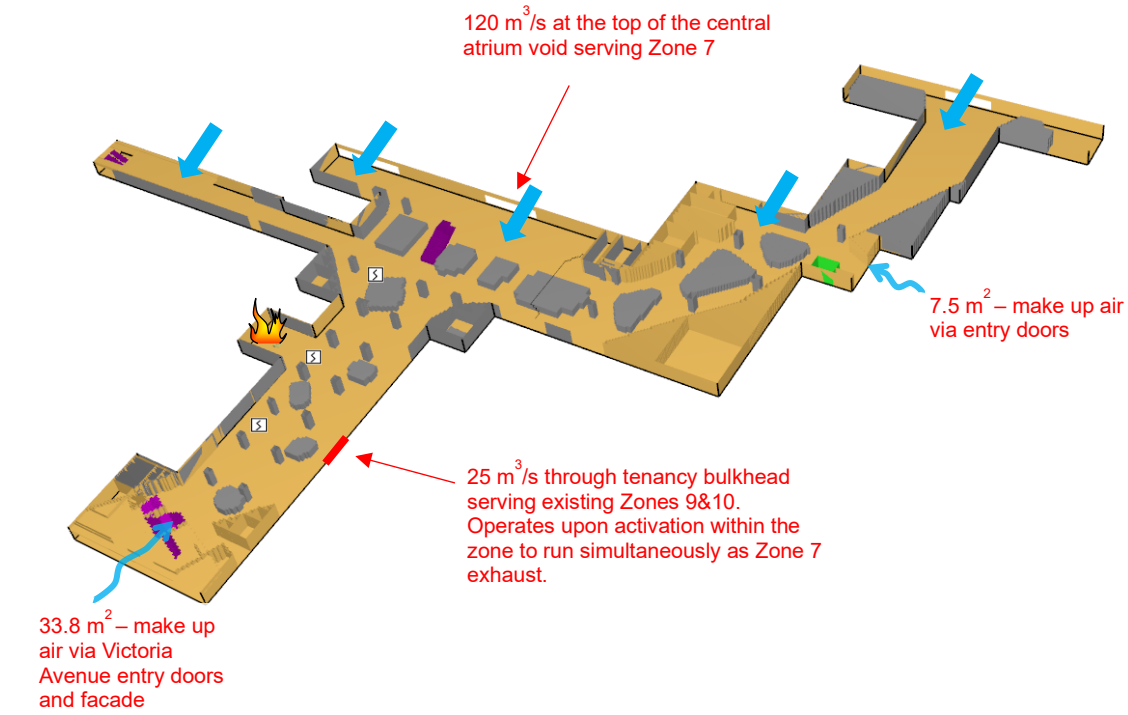


Figure 134 Model geometry – Lower ground floor

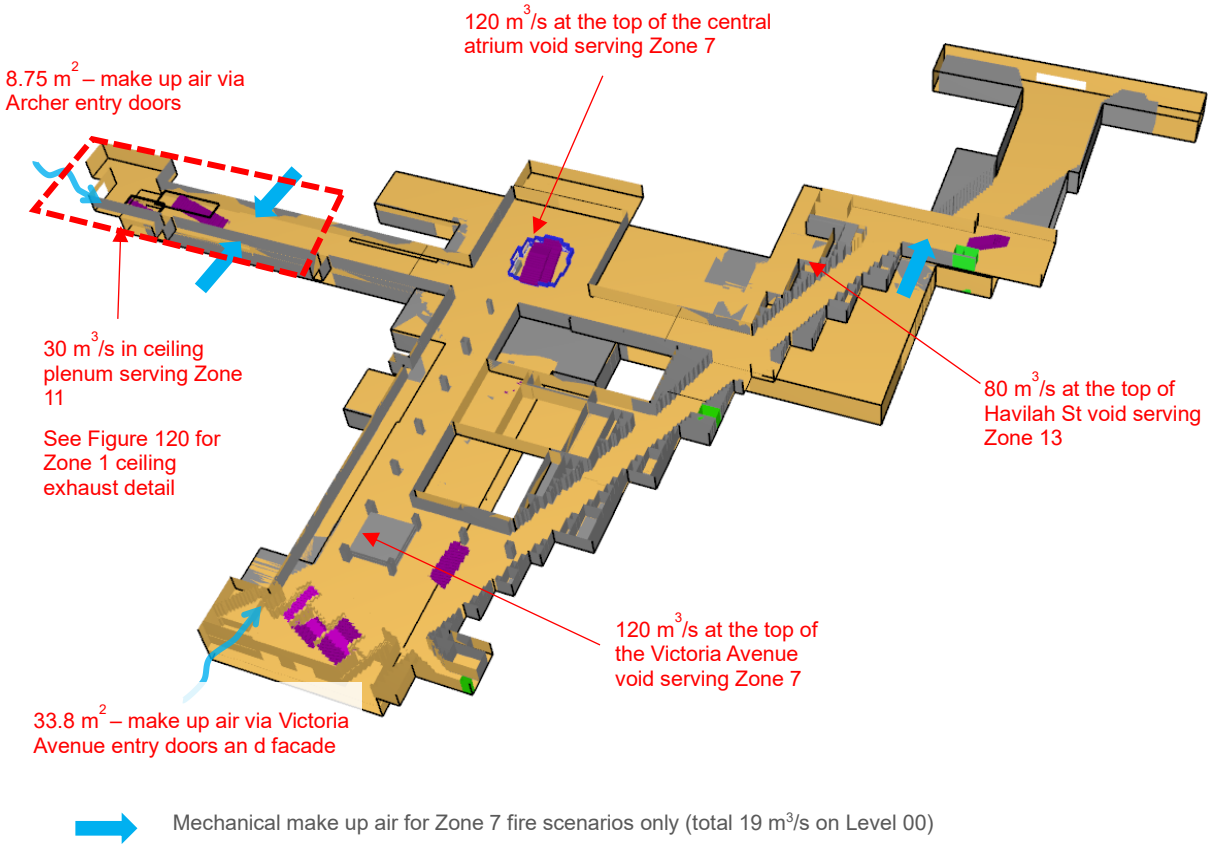


Figure 135 Model Geometry – Level 00 (ground)

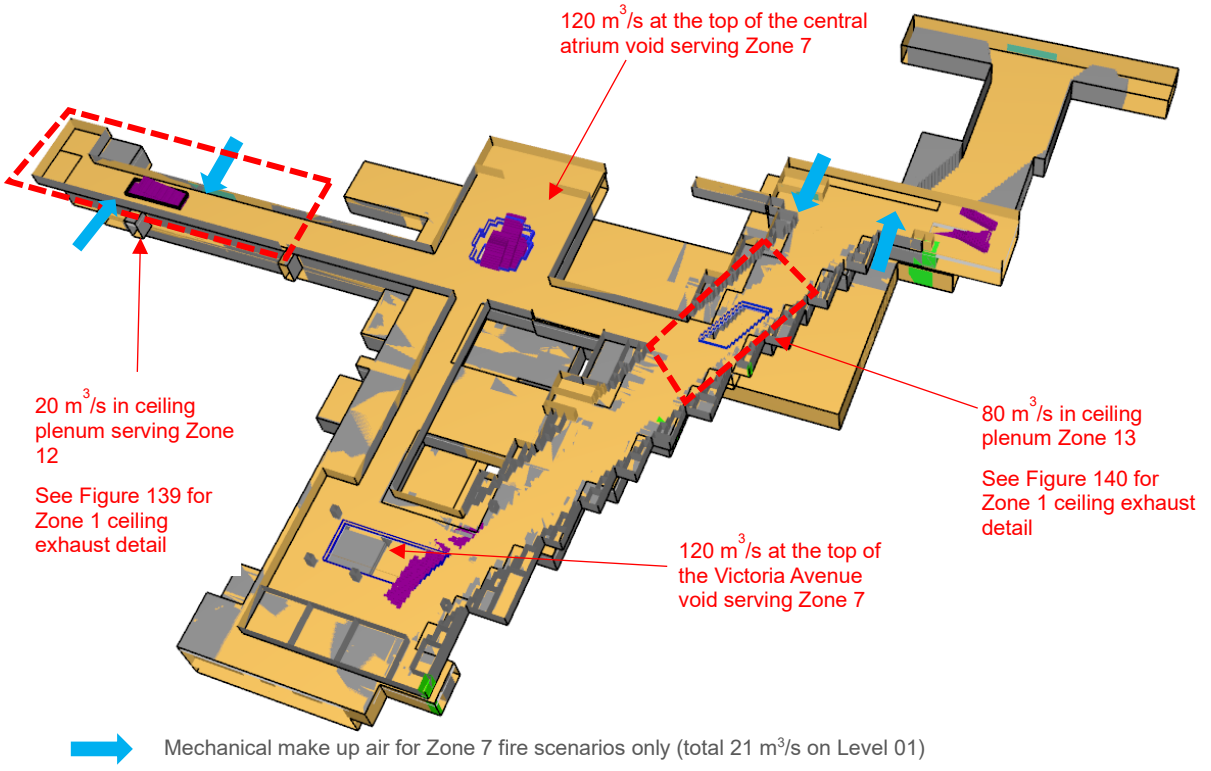


Figure 136 Model geometry – Level 01

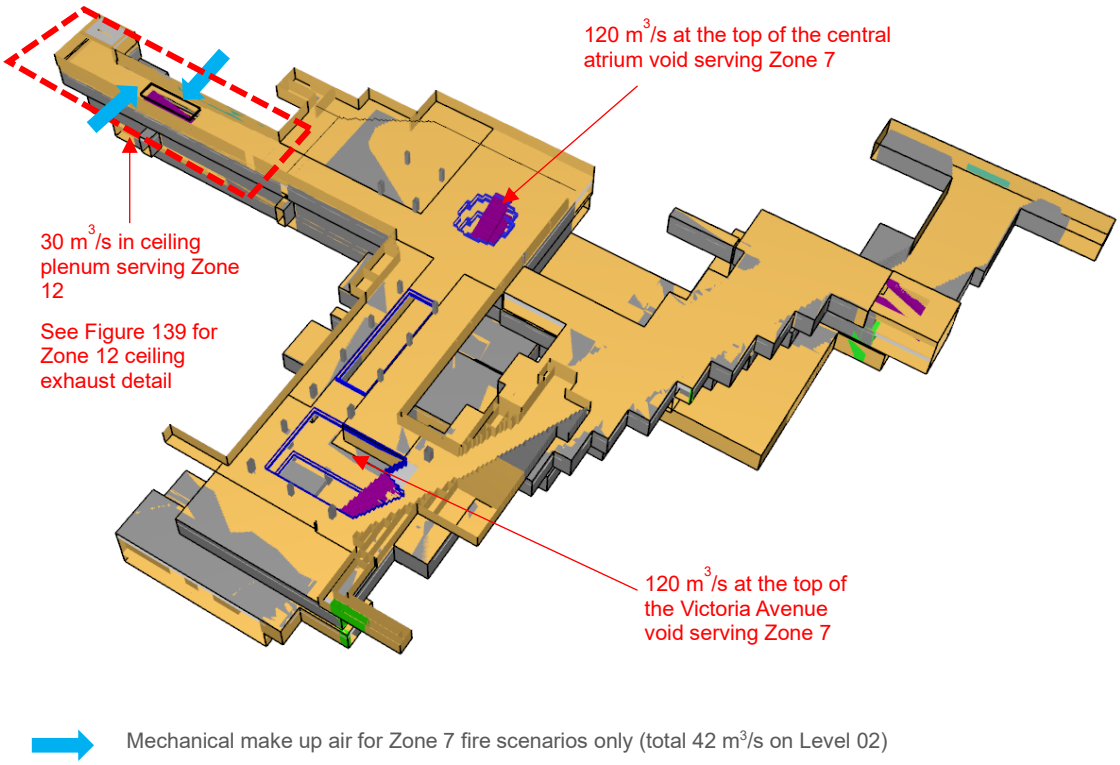


Figure 137 Model geometry – Level 02



Figure 138 Model geometry – section

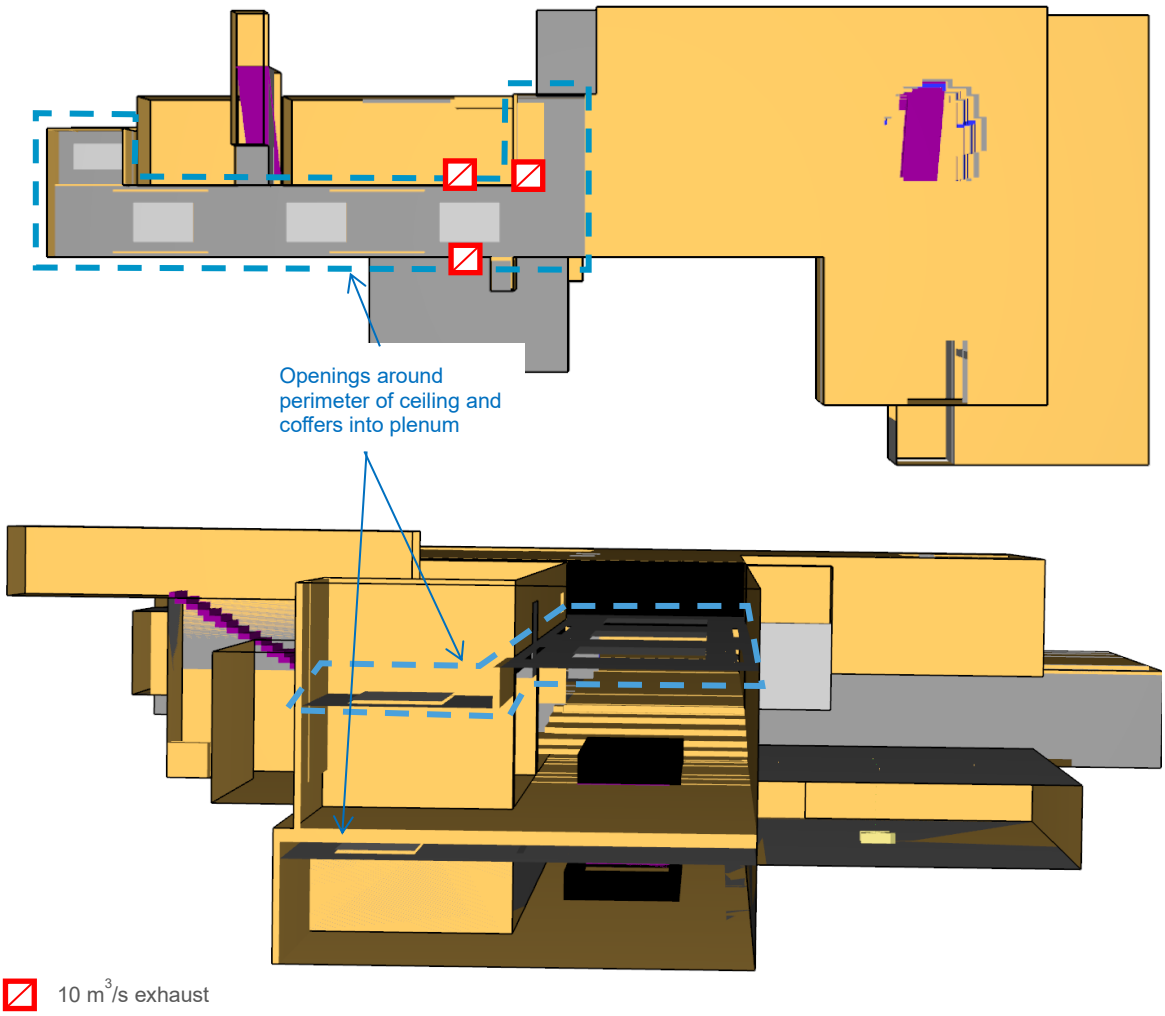


Figure 139 Zones 11 and 12 (Archer Street) mall ceiling plenum – Level 2 (ground and level 1 typical)

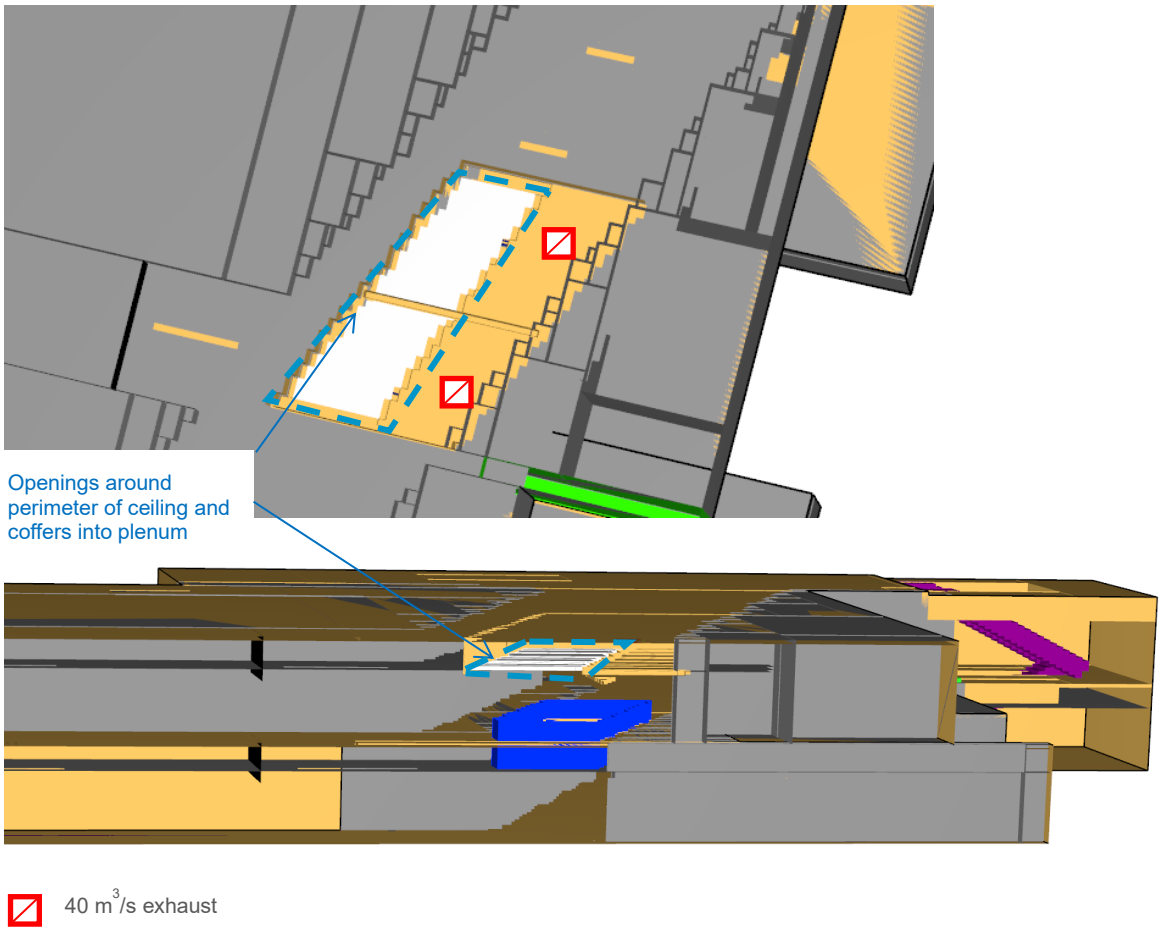


Figure 140 Zone 13 (Havilah Street) mall ceiling plenum – Level 1

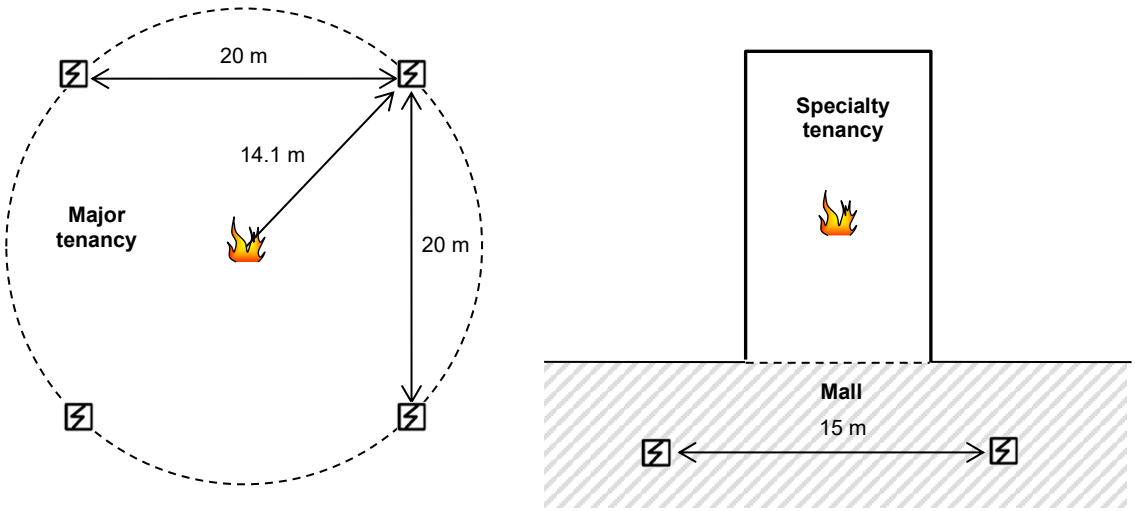
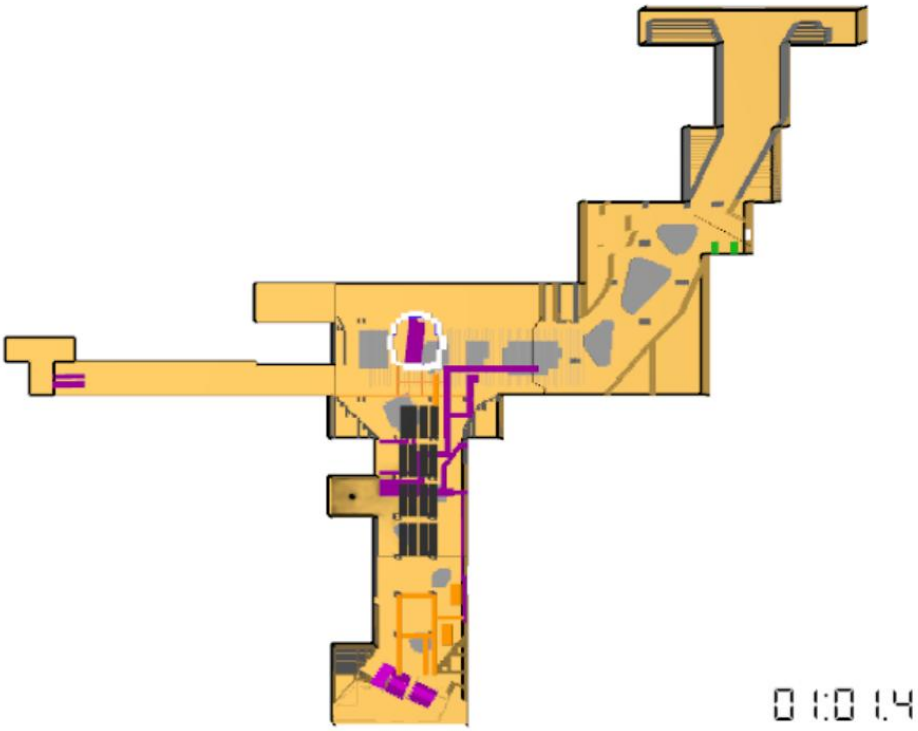


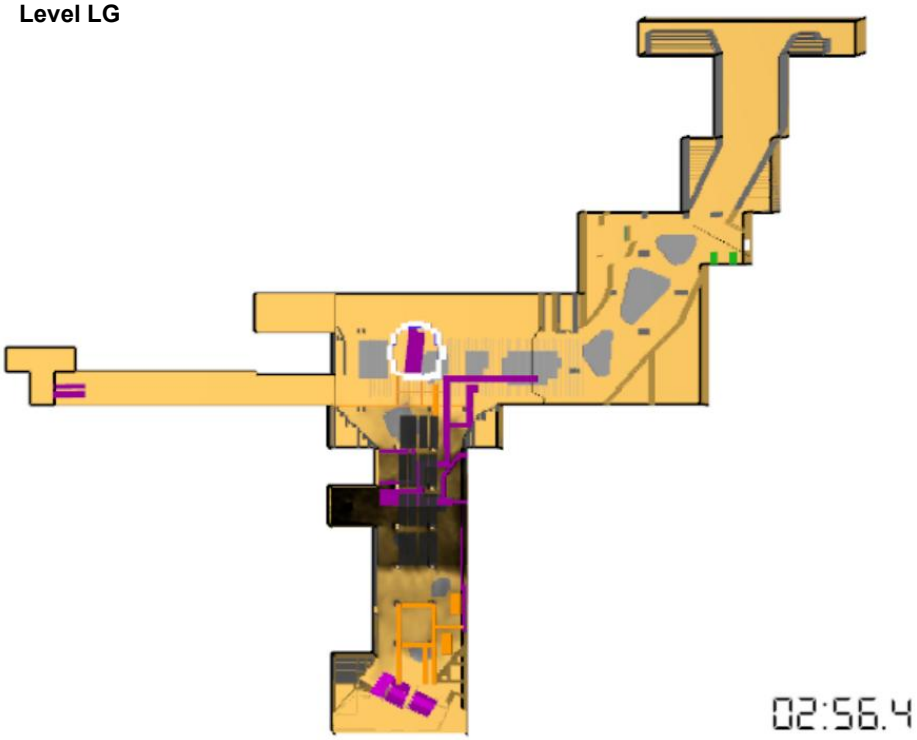
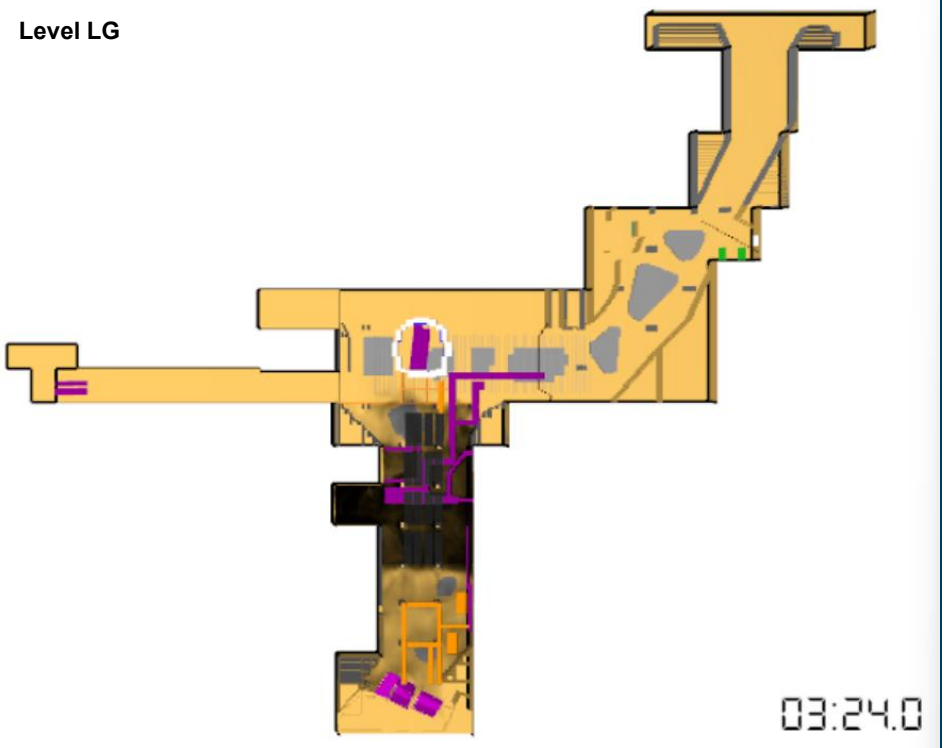
Figure 141 Location of smoke detectors in FDS models

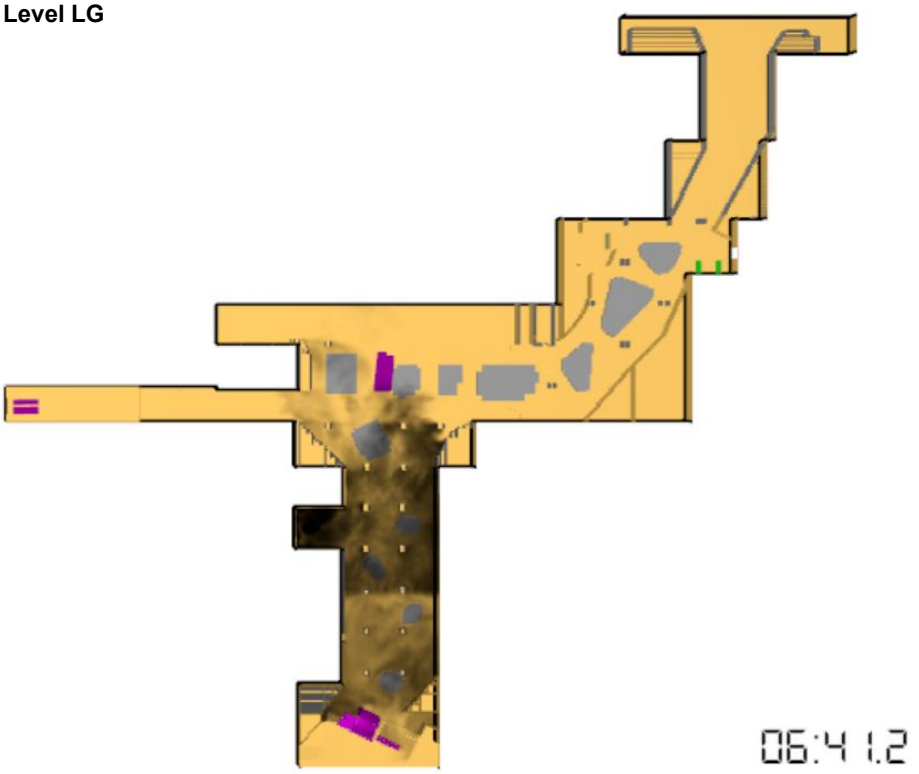
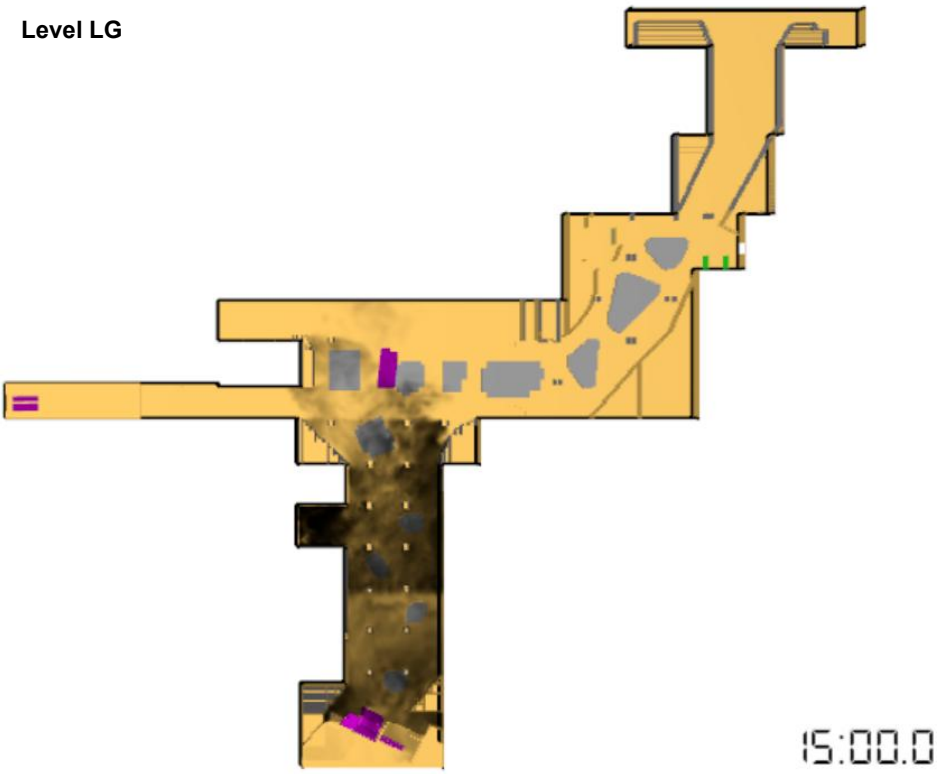
H.4 Scenario 1 results – Fire in Tenancy B-031 (LGF) [87]

H.4.1 Smoke spread

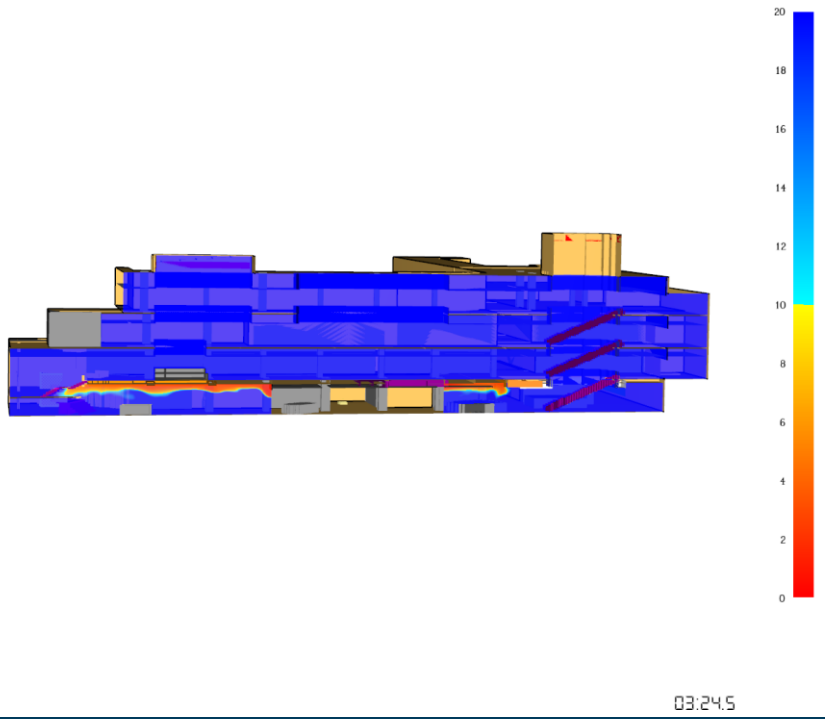
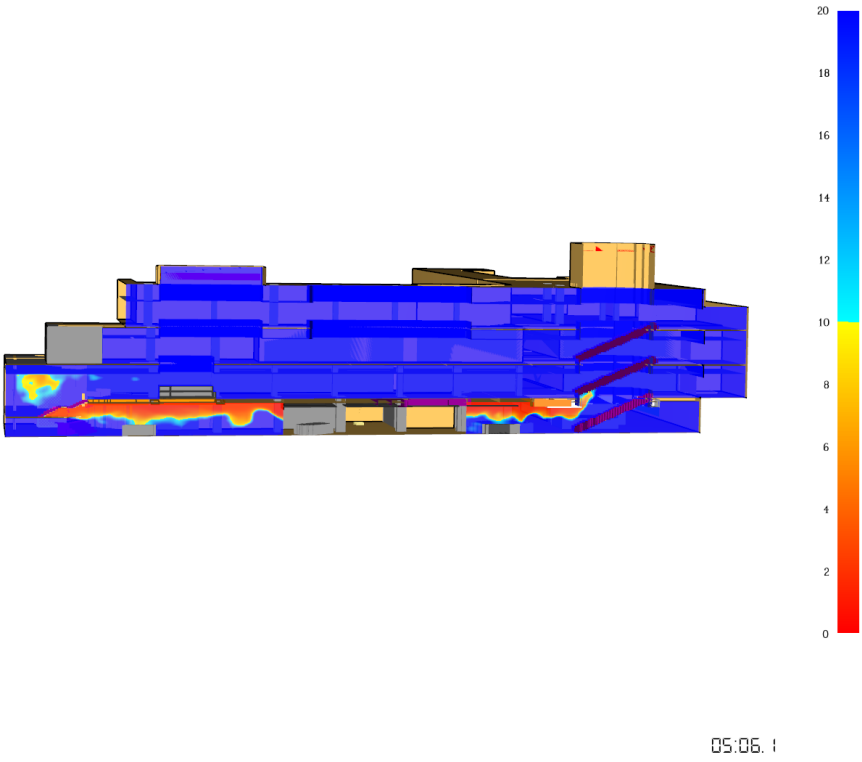
Timeline (mm:ss)	
1:00 minutes Smoke begins to spread out of fire-affected tenancy. Occupants within smoke zone 7 on LGF receive visual cues of the fire.	**Level LG** 

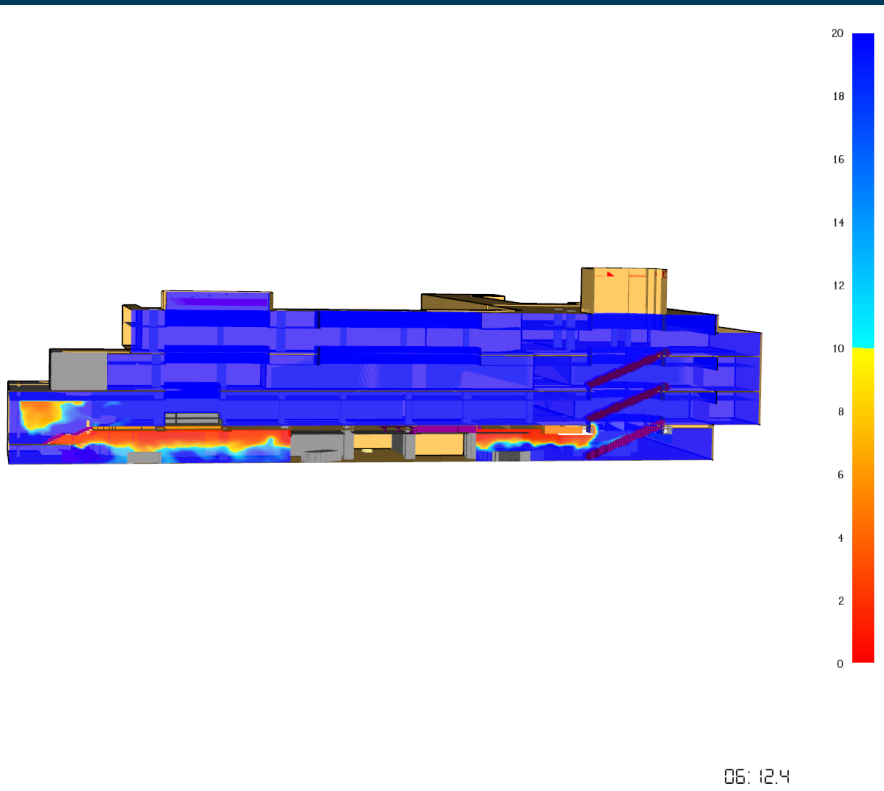
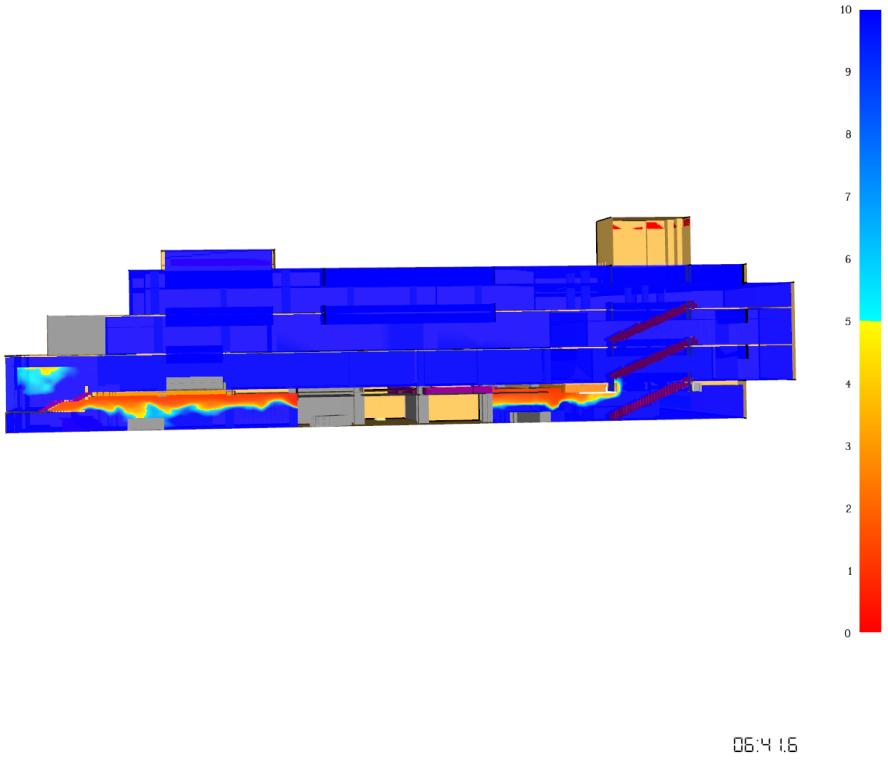
[87] Jensen Hughes, 2025, Fire in tenancy B-301 –S4m.fds

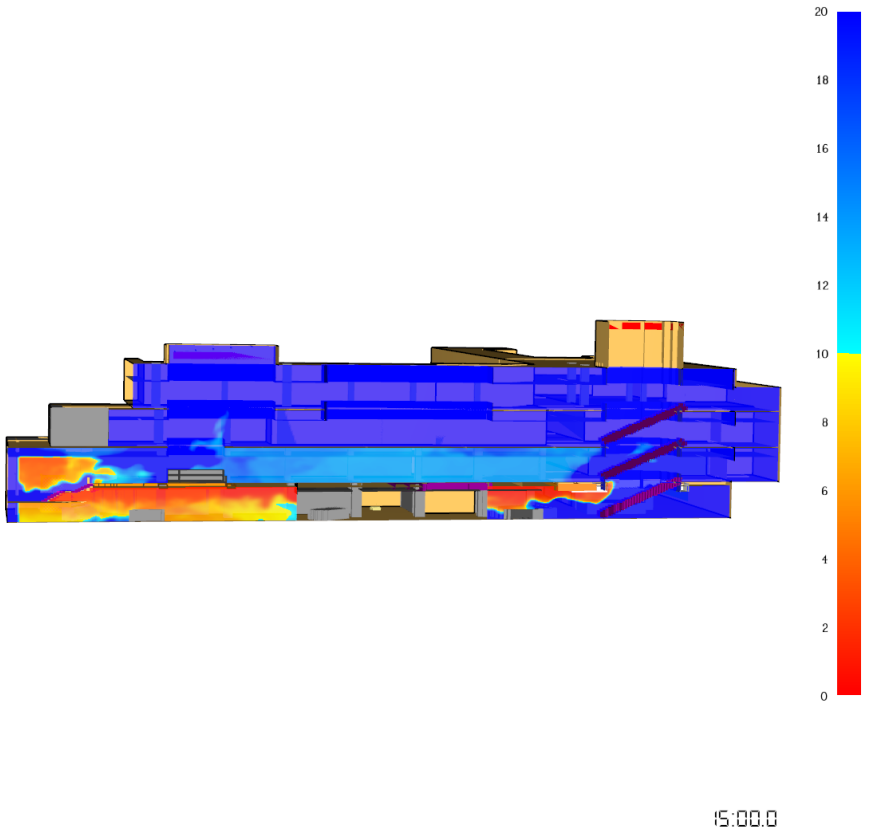
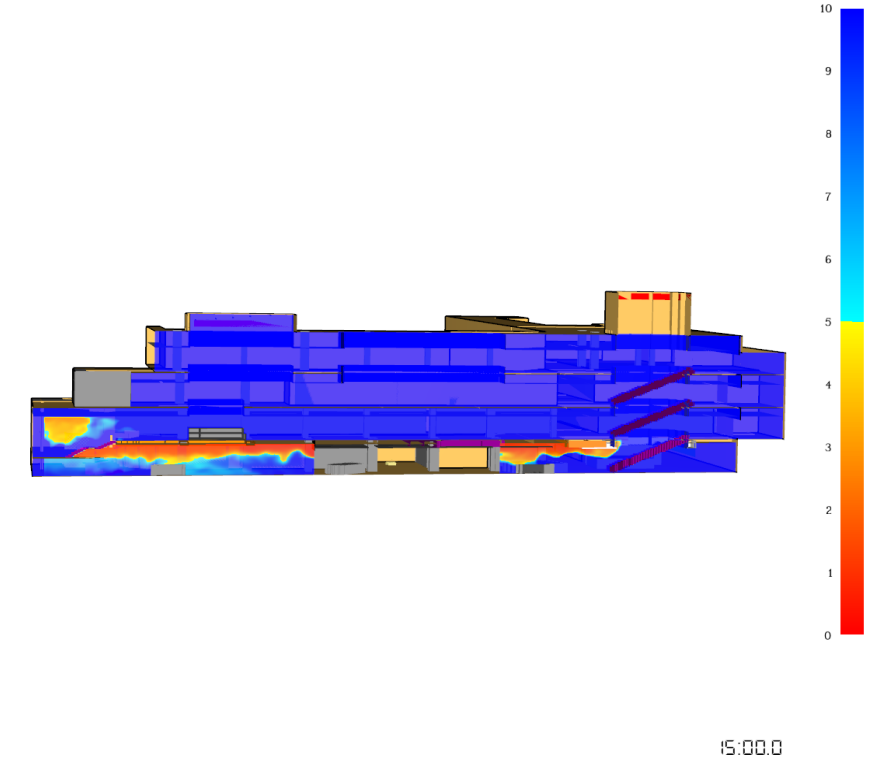
Timeline (mm:ss)	
2:56 minutes Smoke continues to spread out of the tenancy and into LGF smoke zone 7 and up the central atrium. Smoke begins to spread into the food court smoke zone (zones 9&10) All occupants within the fire-affected LGF smoke zone 7 and the adjacent food court zone have moved away from the impacted smoke zones. Some occupants are queuing at the Victoria Avenue exit.	**Level LG** 
3:24 minutes Smoke continues to spread through LGF smoke zones 2 as well as 9&10. All occupants within the impacted smoke zones have evacuated the smoke zones.	**Level LG** 

Timeline (mm:ss)	
6:41 minutes Smoke continues to spread through LGF smoke zones 2 as well as 9&10. All occupants within the impacted LGF mall have evacuated.	**Level LG** 
15:00 minutes End of modelling duration. Smoke spread on lower ground floor limited to the food court smoke zone and the majority of smoke zone 7.	**Level LG** 

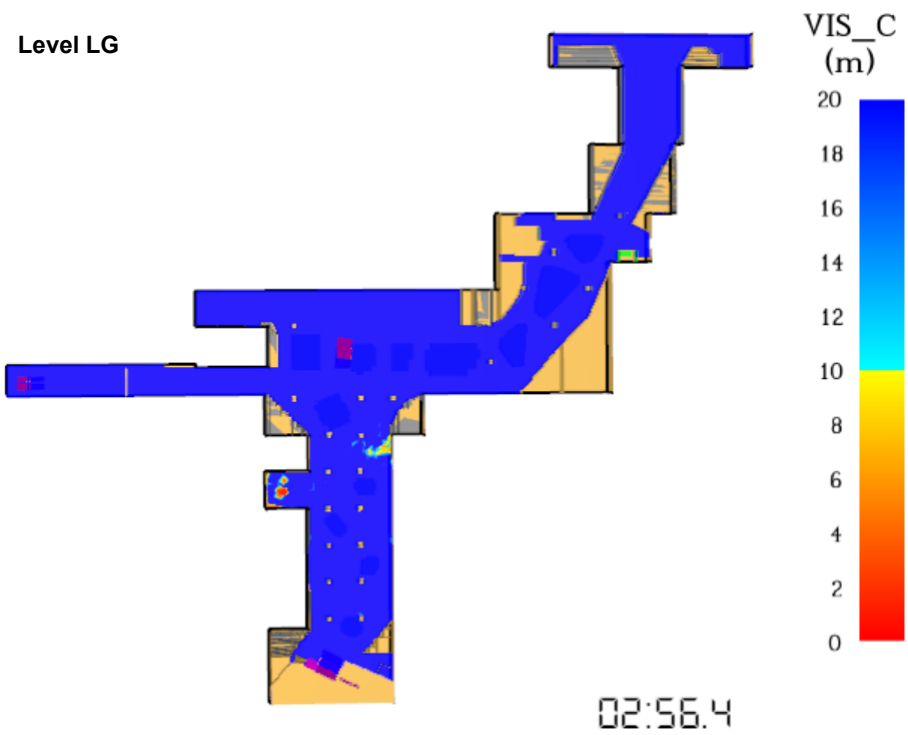
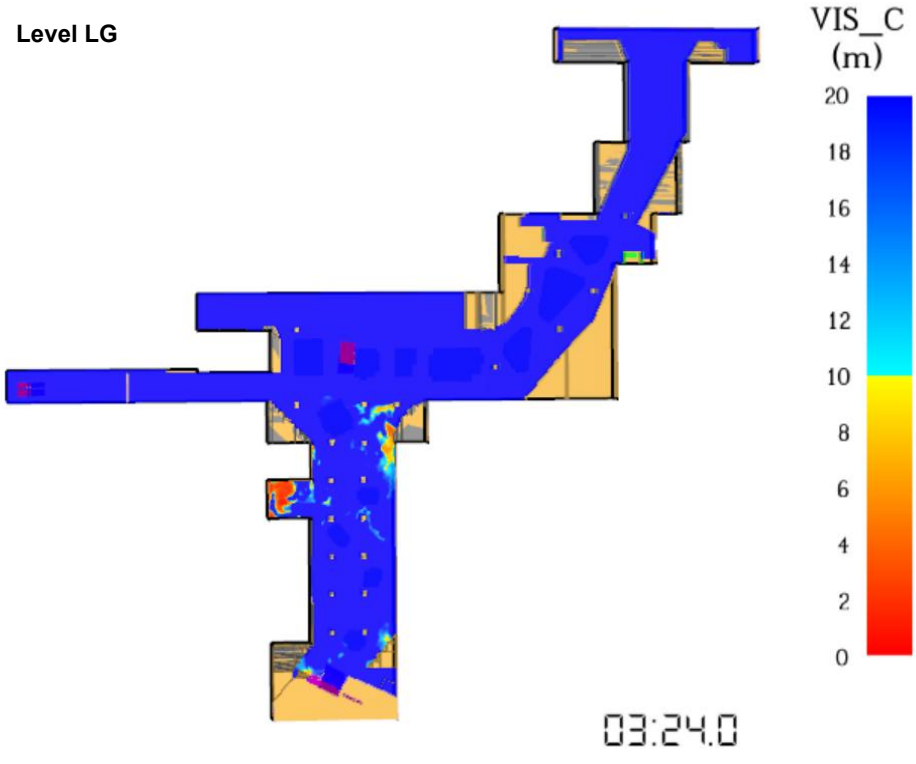
H.4.2 Visibility – section

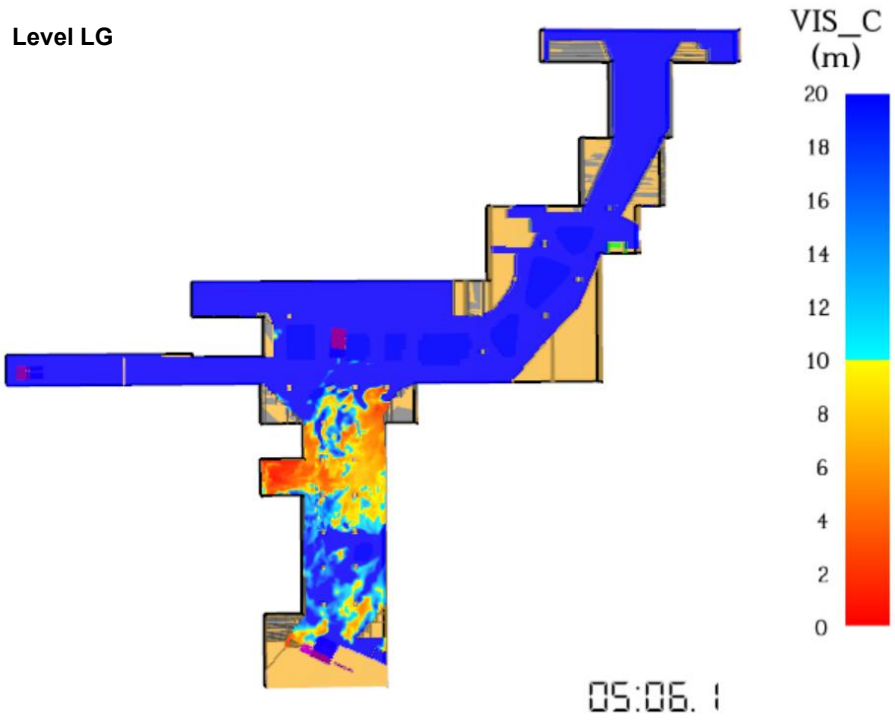
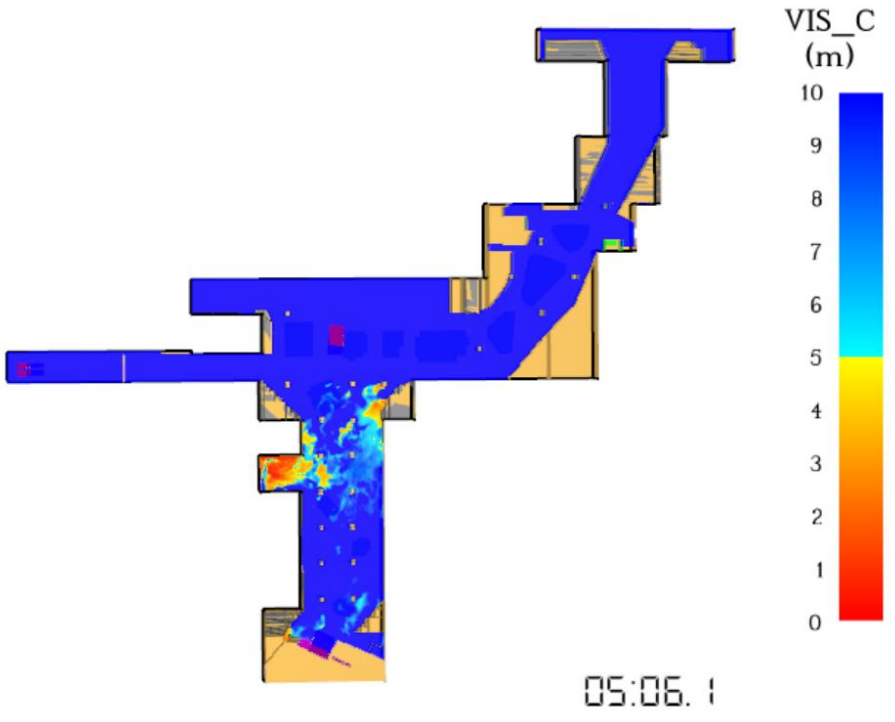
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:24 minutes Required time for occupants within the fire-affected smoke zone to evacuate. With the exception of the fire affected floor visibility exceeds 10m for the majority of the mall on all levels above.	
5:06 minutes Required time for occupants within the fire-affected smoke zone to evacuate with a 1.5x safety factor. With the exception of the fire affected floor visibility exceeds 10m for the majority of the mall on all levels above.	

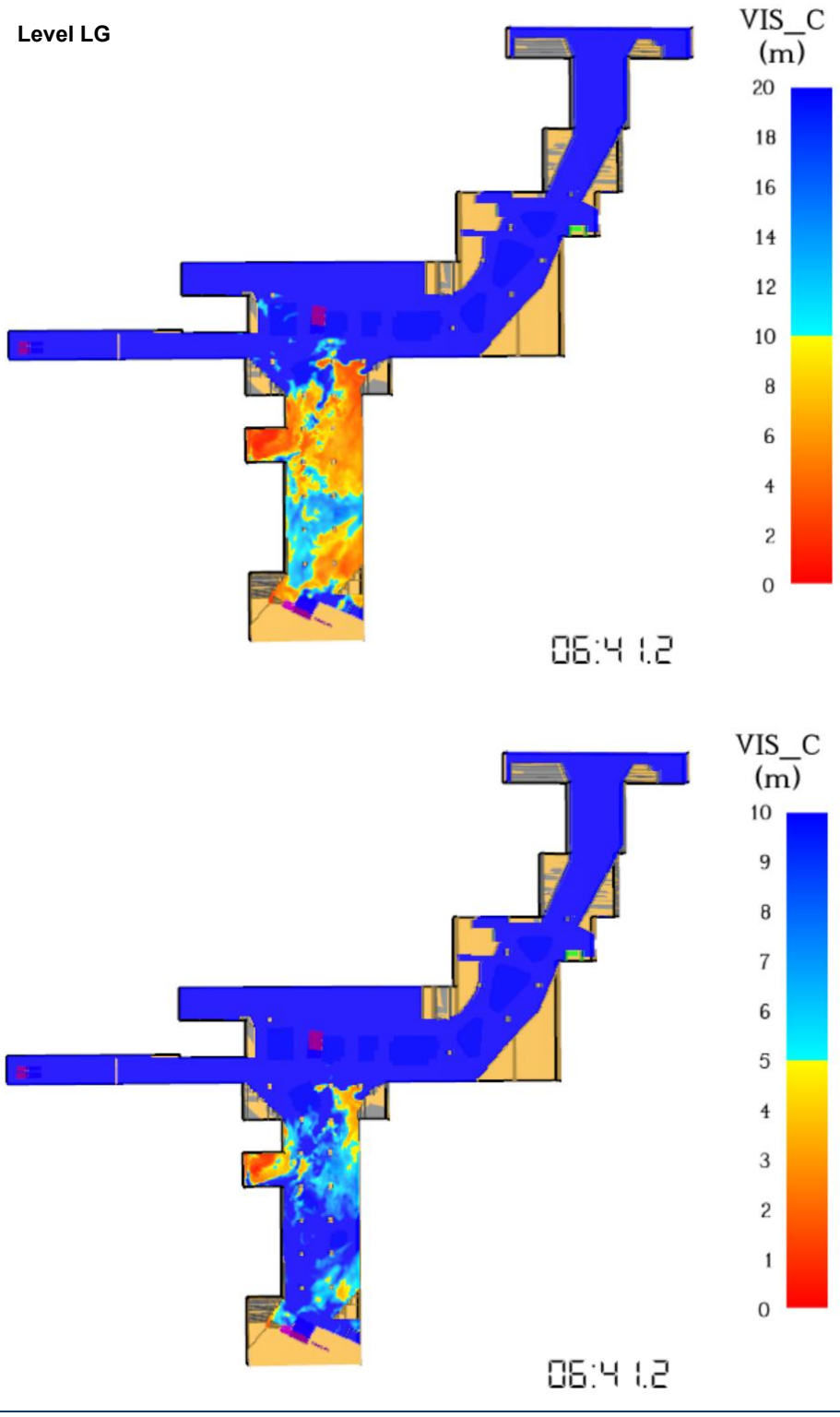
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
6:12 minutes Evacuation from lower ground floor using Victoria Avenue exit complete. Visibility exceeds 5m at the exit.	
6:41 minutes Evacuation of lower ground floor complete. Visibility exceeds 5m at the Victoria Avenue exit.	

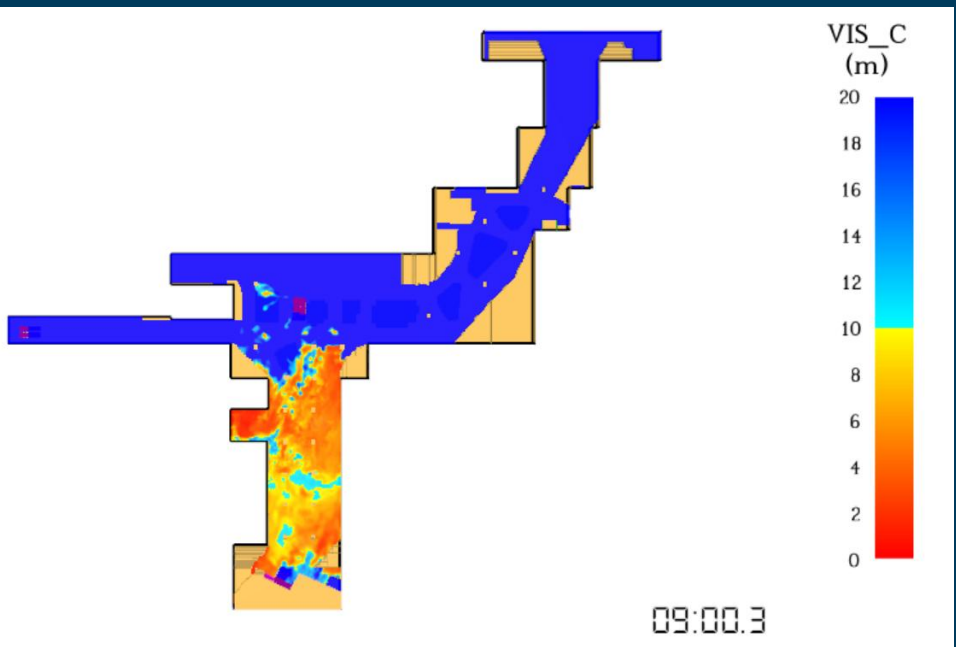
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. With the exception of the fire affected floor and at the Victoria Avenue exit, visibility exceeds 10m for the majority of the mall on all levels above the fire affected level.	 

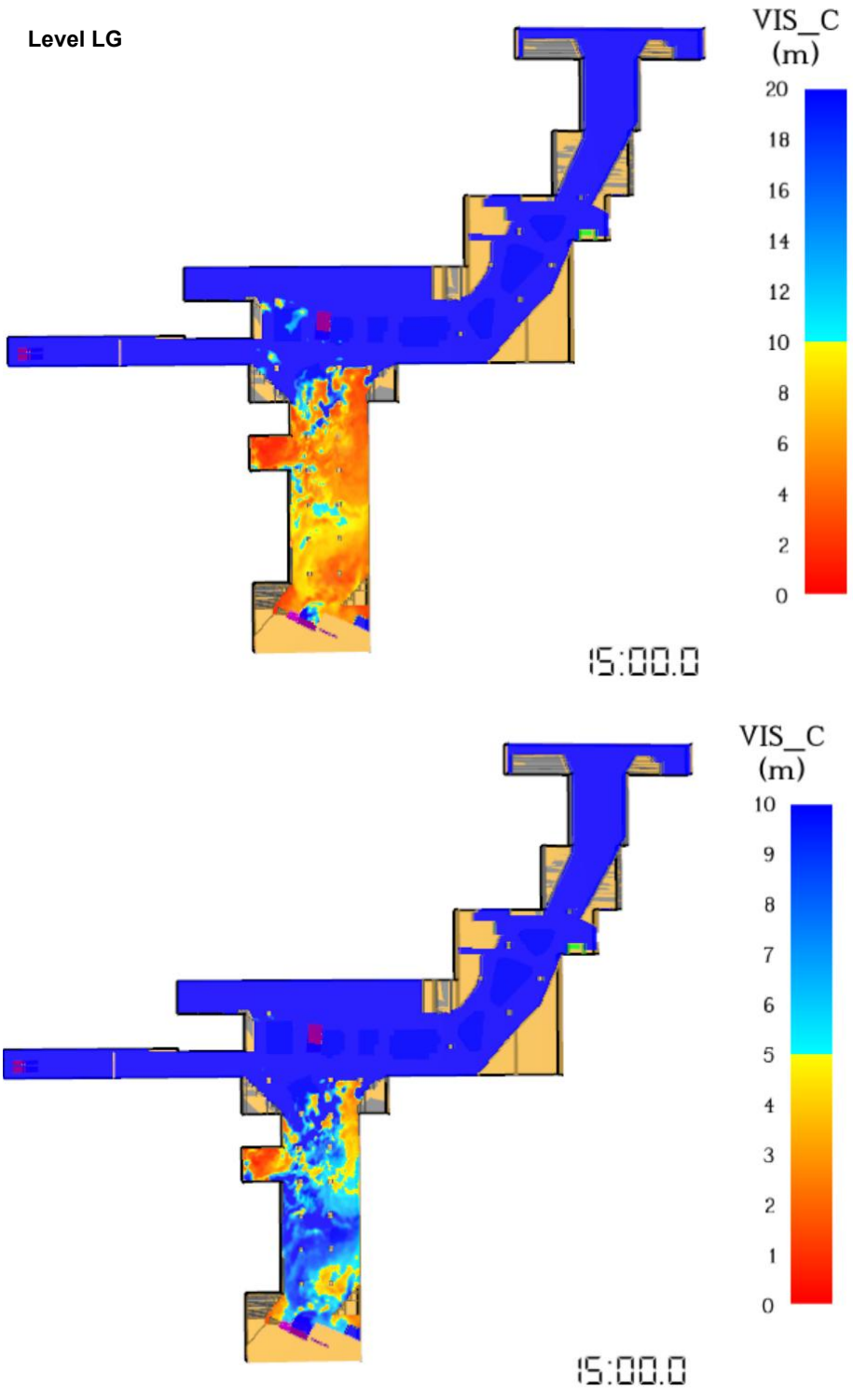
H.4.3 Visibility at 2m above floor level

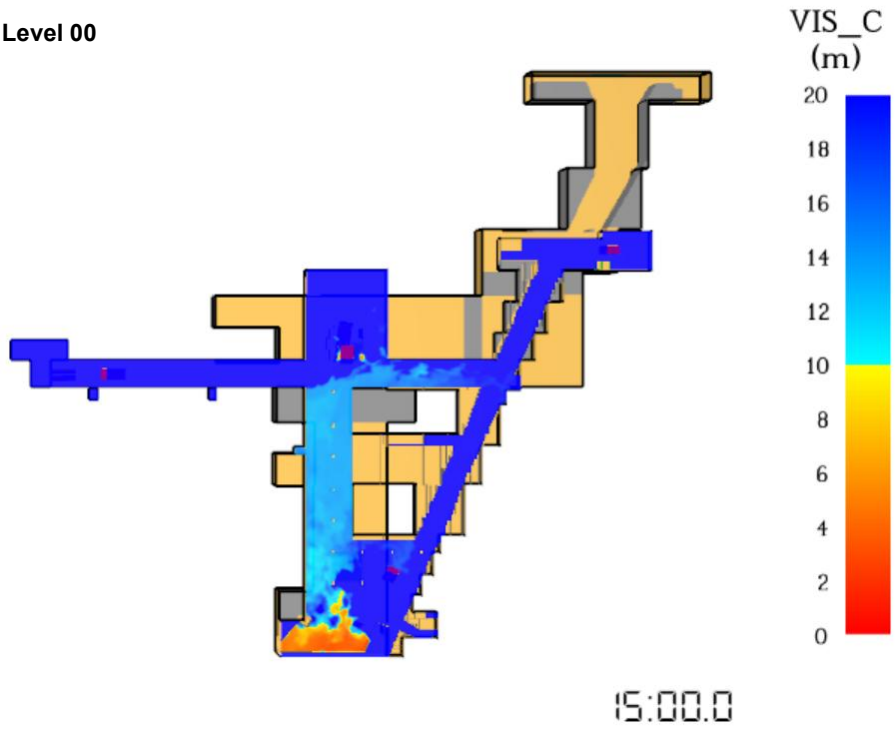
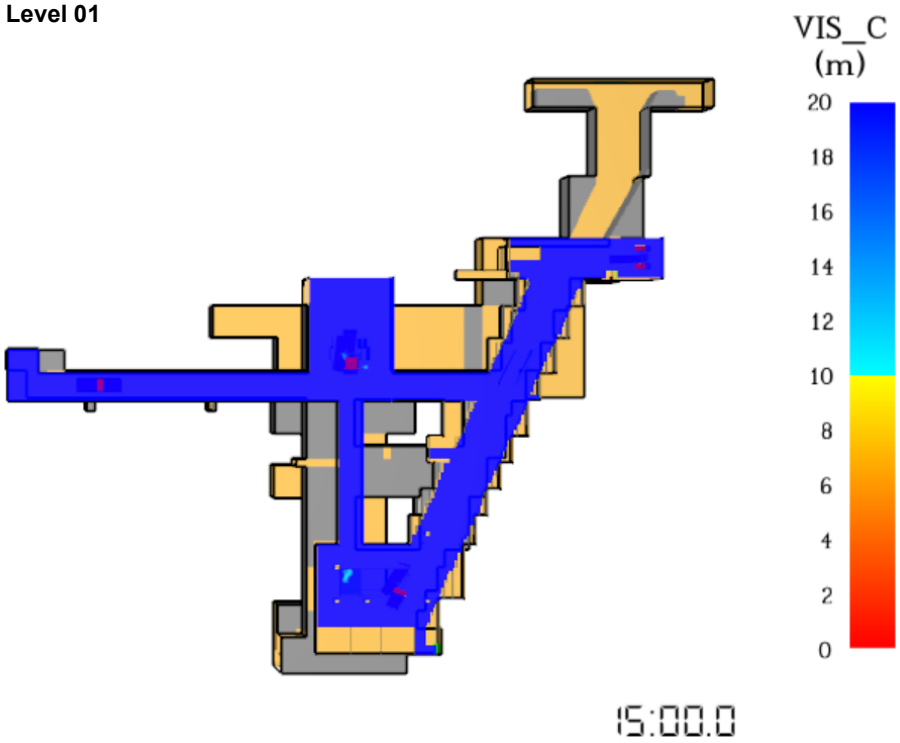
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
2:56 minutes All occupants within the impacted smoke zone have moved away from the impacted smoke zones. Some occupants are queuing at the Victoria Avenue exit. Visibility within the majority of the mall exceeds 10 m.	
3:24 minutes All occupants within the impacted smoke zone have evacuated from the smoke zone. Visibility within the majority of the mall exceeds 10 m.	

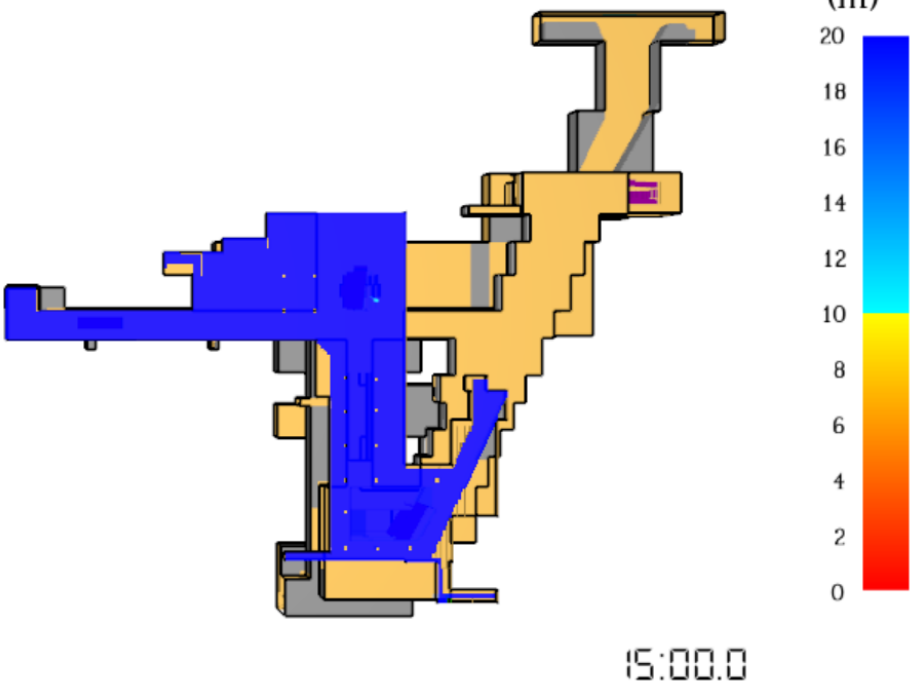
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
5:06 minutes Required time for occupants within the fire-affected smoke zone to evacuate with a 1.5x safety factor. Visibility within a portion of the fire-affected zone and adjacent zone is reduced to below 10 m. The visibility within the majority of the mall, including at the Victoria Avenue exit exceeds 5 m.	**Level LG**  

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
6:41 minutes ASET for the affected smoke zones. RSET for rest of lower ground level mall. Visibility less than 10 m for the majority of LGF smoke zone 7 as well as the food court zone (zone 9 & 10). Tenability considered lost in the fire-affected smoke zones. The majority of the affected zones, including at the Victoria Avenue exit is maintained above 5 m. Visibility exceeds 10 m for the remainder of the level.	**Level LG** 

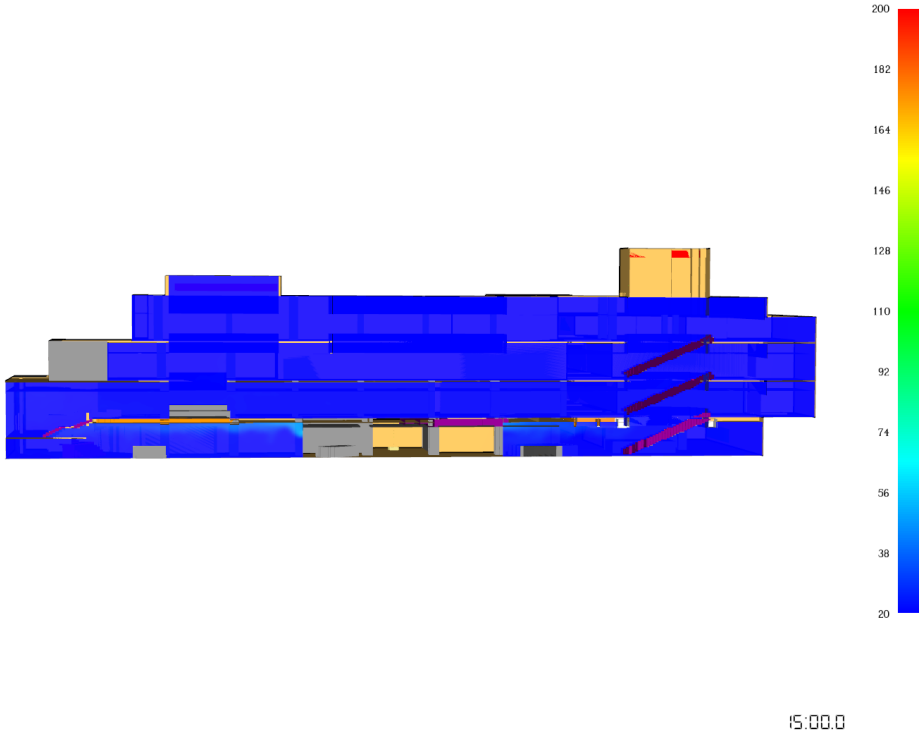
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
9:00 minutes Steady state reached for the fire scenario.	

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility is below 10 m within the majority of LGF smoke zones 2 and adjacent food court zone (zone SZ 9&10). Visibility exceeds 5 m for the majority of the impacted zones Visibility exceeds 10 m within the remainder of the floor.	**Level LG** 

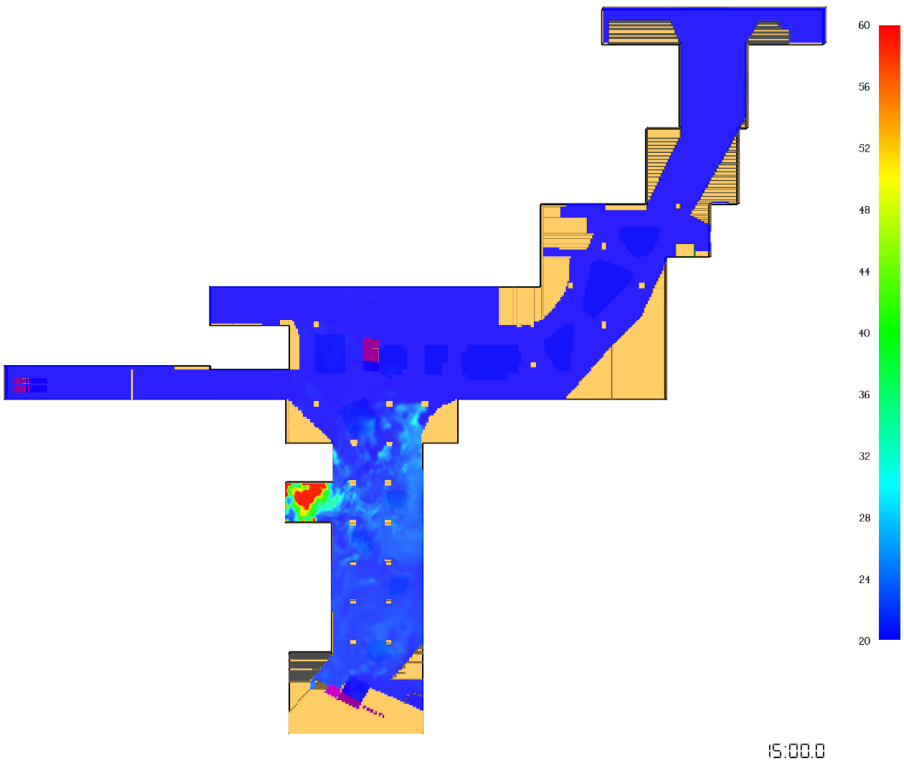
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10 m within smoke zone 7 on the levels above, except locally at the Victoria Avenue exit.	**Level 00**  **Level 01** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10 m throughout level 02.	**Level 02** 

H.4.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

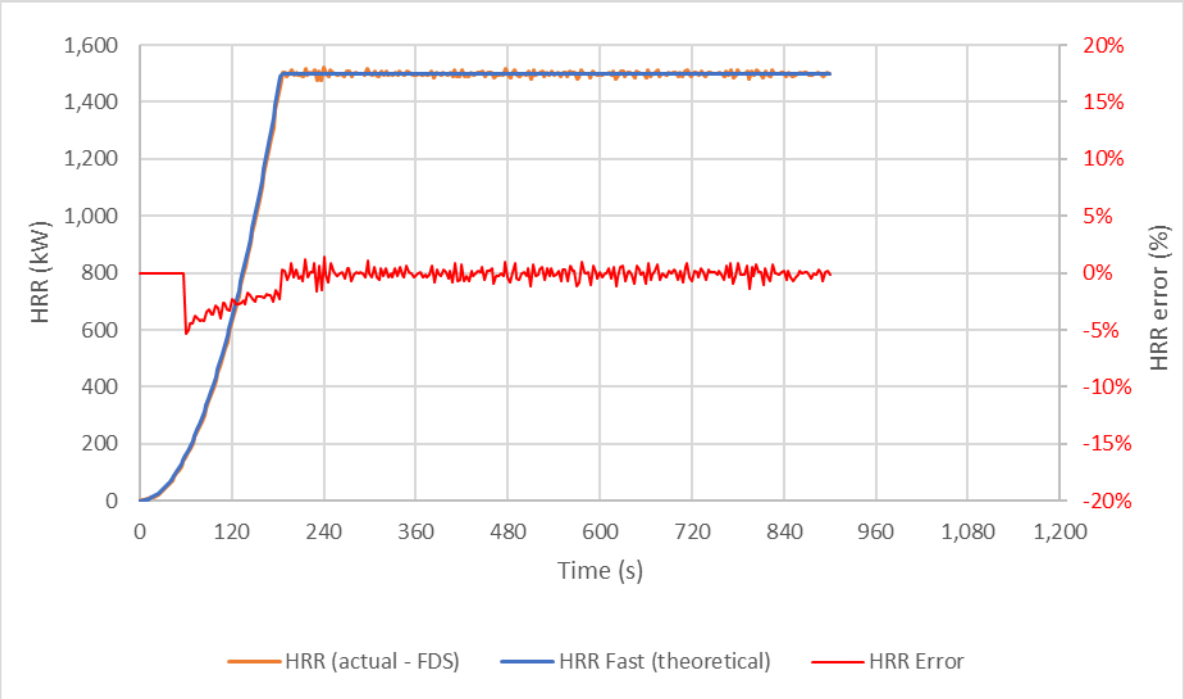
H.4.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the lower ground floor mall at 2 m above floor level, except for the area around the fire.	**Level LG** 

H.4.6 Error checking

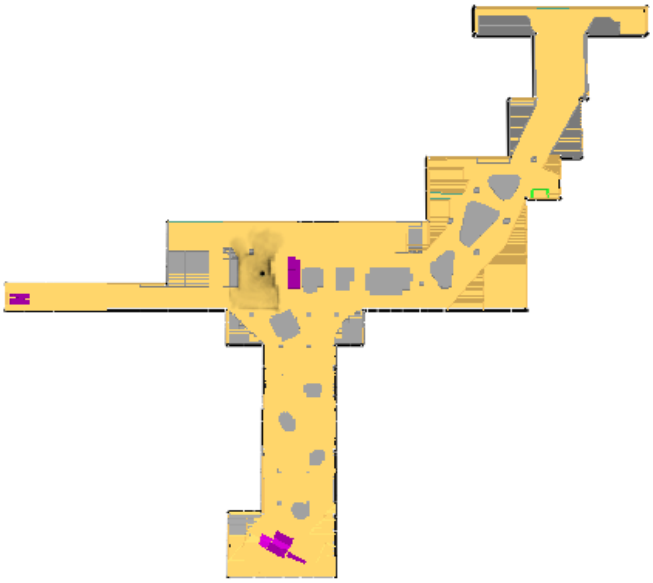
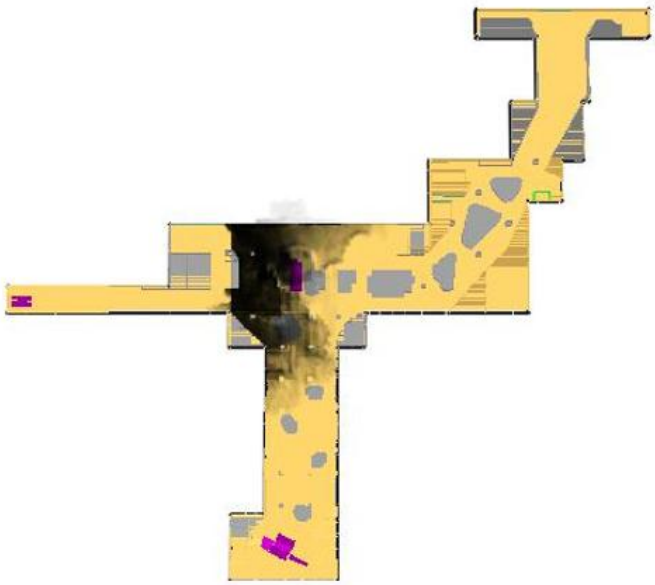
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

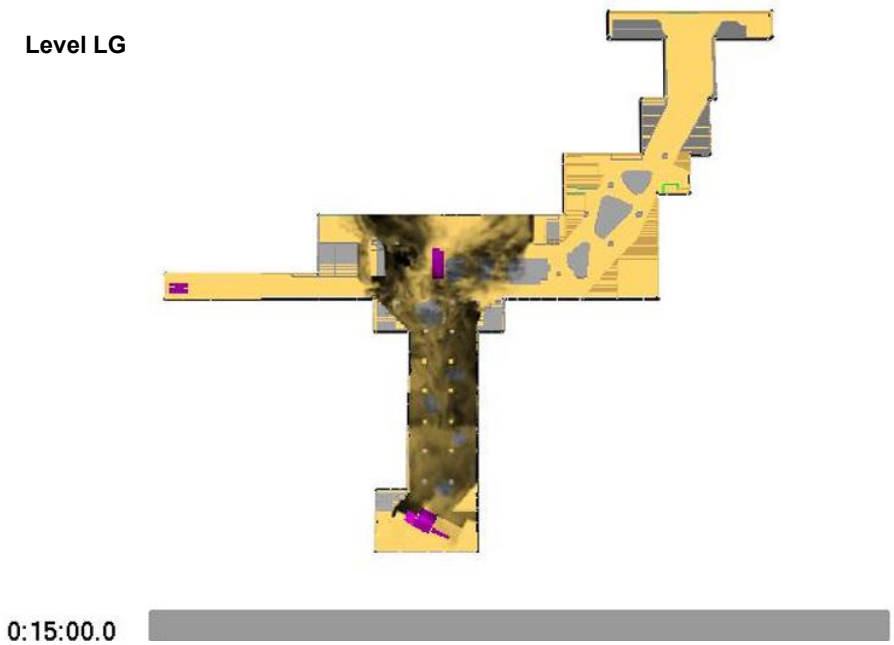


H.5 Scenario 2 results – Kiosk fire (LGF) [88]

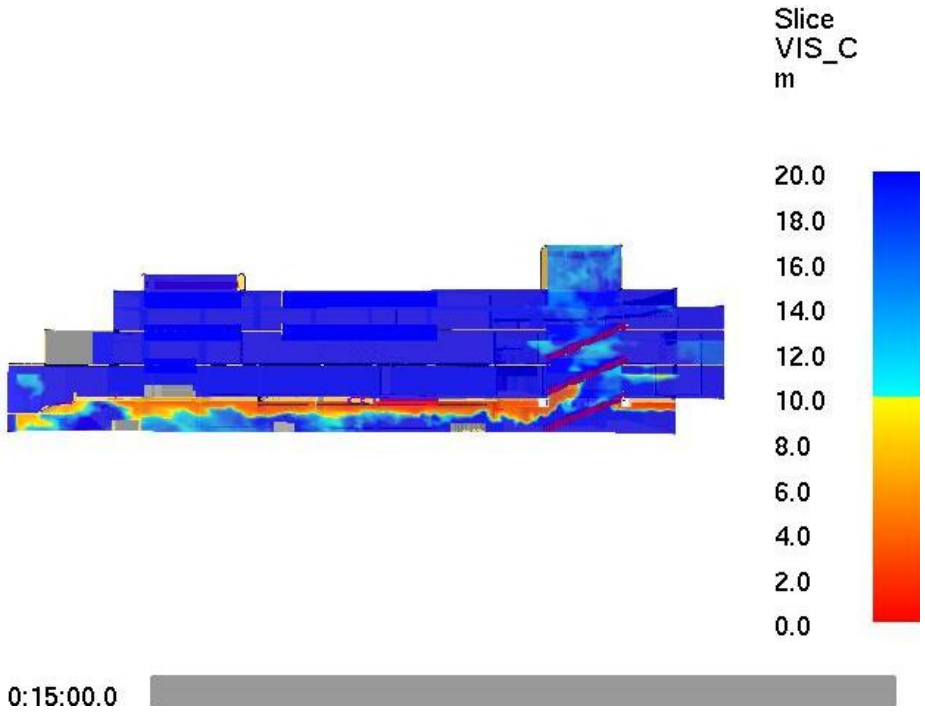
H.5.1 Smoke spread

Timeline (mm:ss)	
0:48 minutes Activation of 2nd smoke detector. Smoke spreads to the mall from the fire-affected kiosk.	**Level LG**  0:00:48.0
2:44 minutes Smoke continues to spread through LGF smoke zone 7 and up to the top of the central atrium void where it is exhausted. All occupants within the impacted smoke zone have moved away from the impacted smoke zones. Some occupants are queuing at the Victoria Avenue exit.	**Level LG**  0:02:45.0

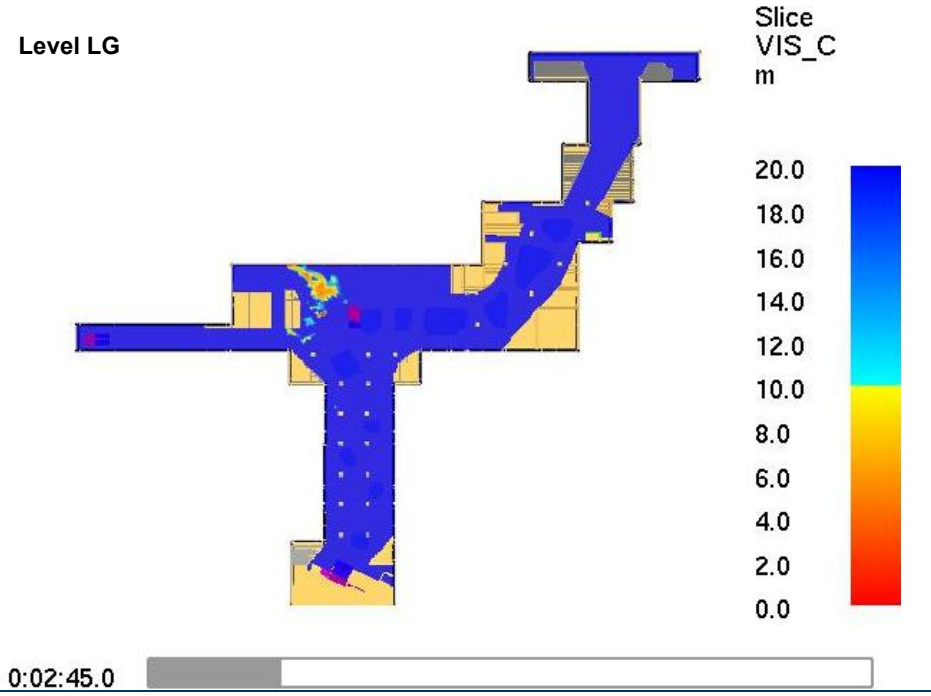
[88] Jensen Hughes, 2025, LGF Kiosk fire – S1j fds

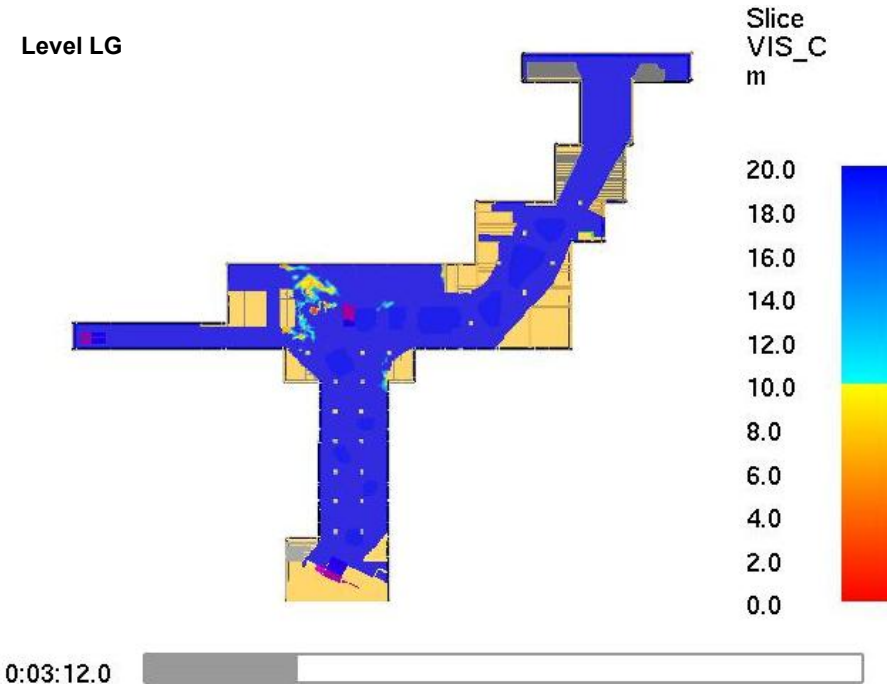
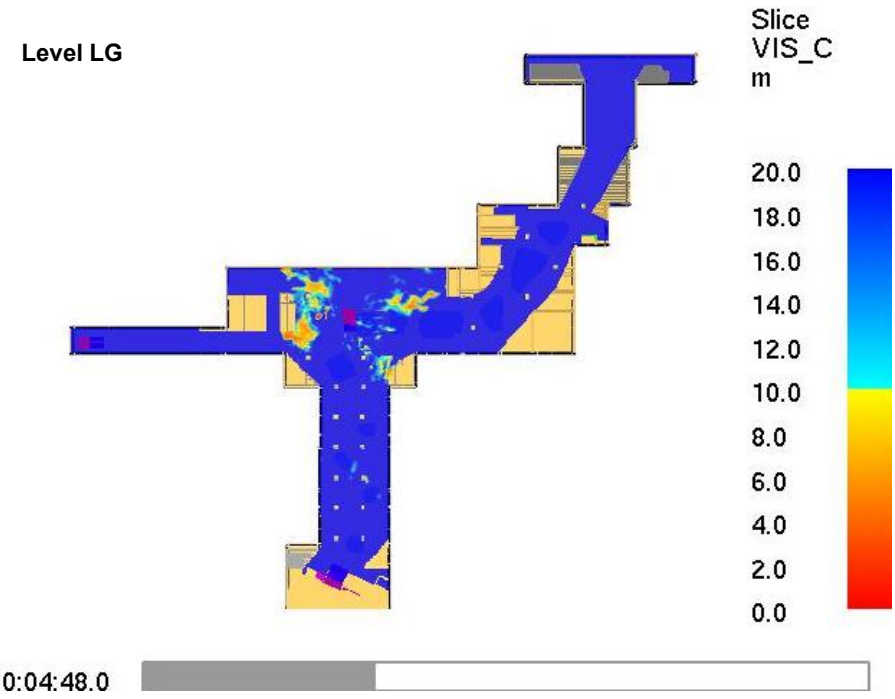
Timeline (mm:ss)	
3:12 minutes Smoke continues to spread through smoke zone 7 and up the central atrium void. All occupants within the impacted smoke zone have evacuated.	**Level LG**  0:03:15.0
15:00 minutes Smoke has spread throughout the lower ground floor smoke zone 7 with minor amounts of smoke spread into the adjacent Archer St zone (zones 5&6) End of modelling duration	**Level LG**  0:15:00.0

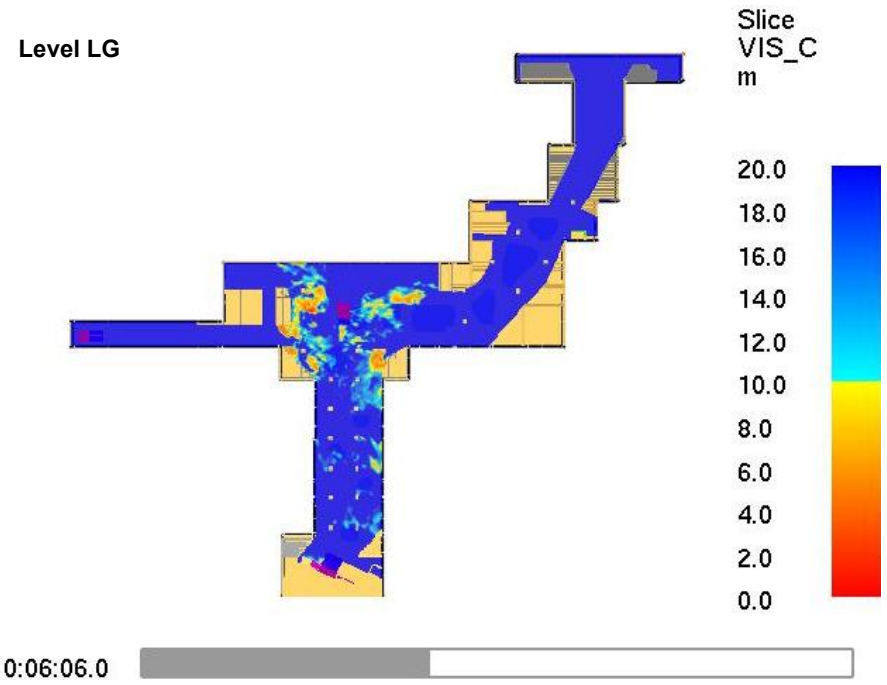
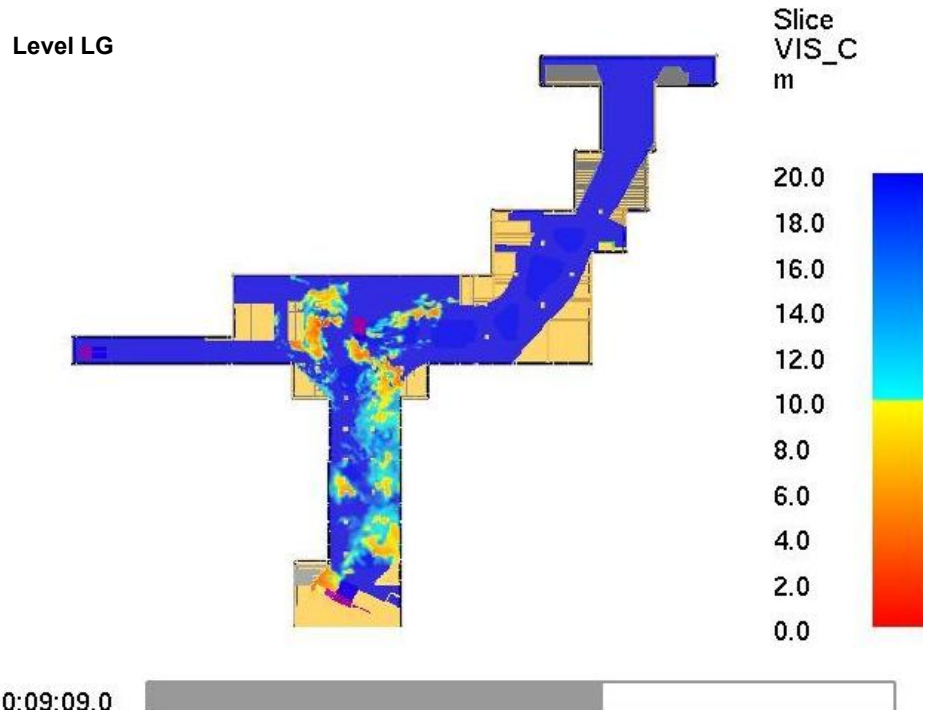
H.5.2 Visibility – section

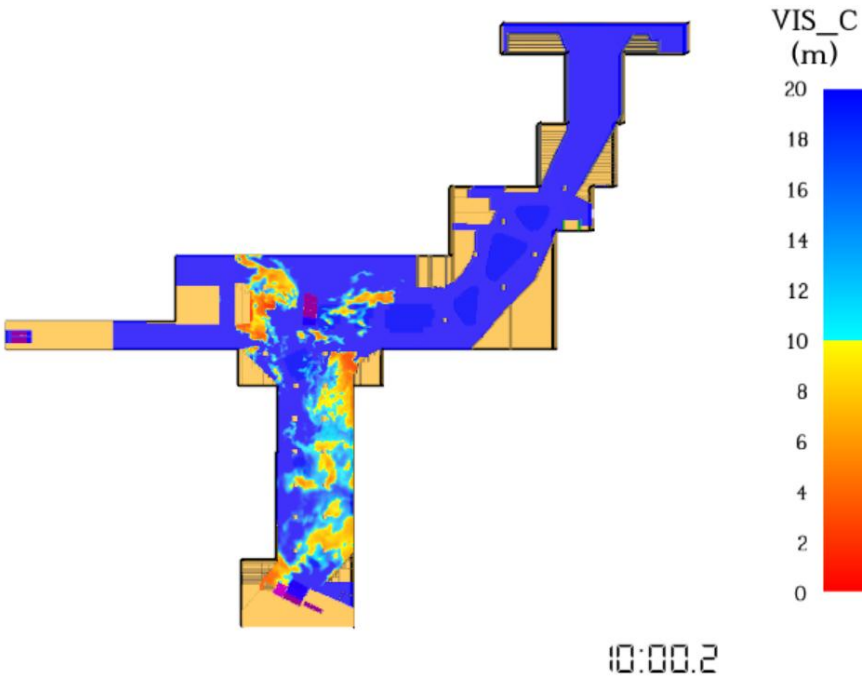
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Apart from the fire affected floor and the central atrium void, visibility exceeds 10 m for the majority of the mall on all levels above.	

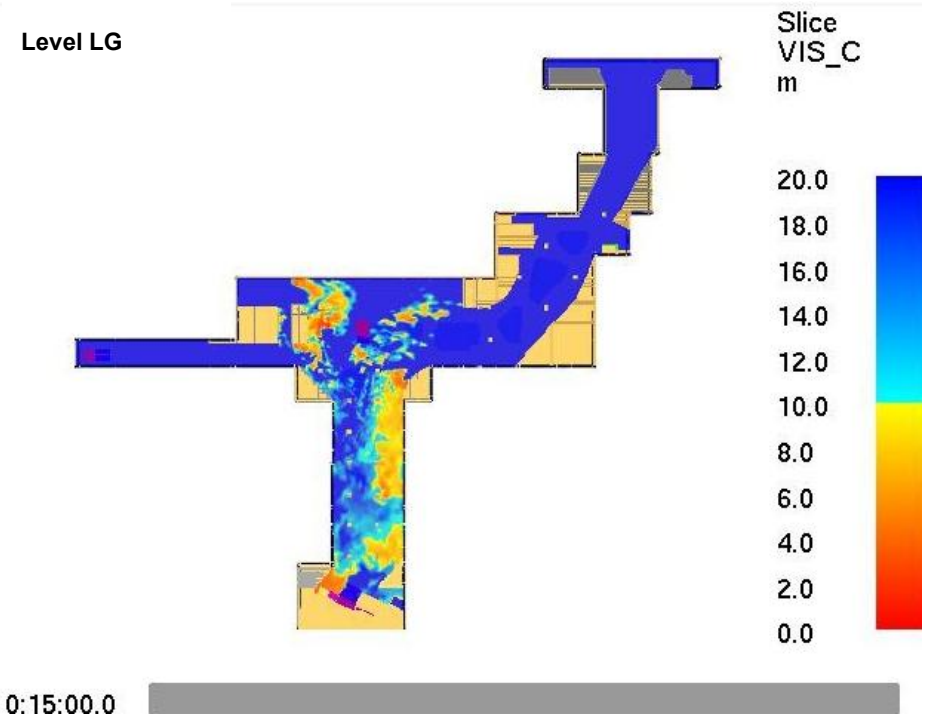
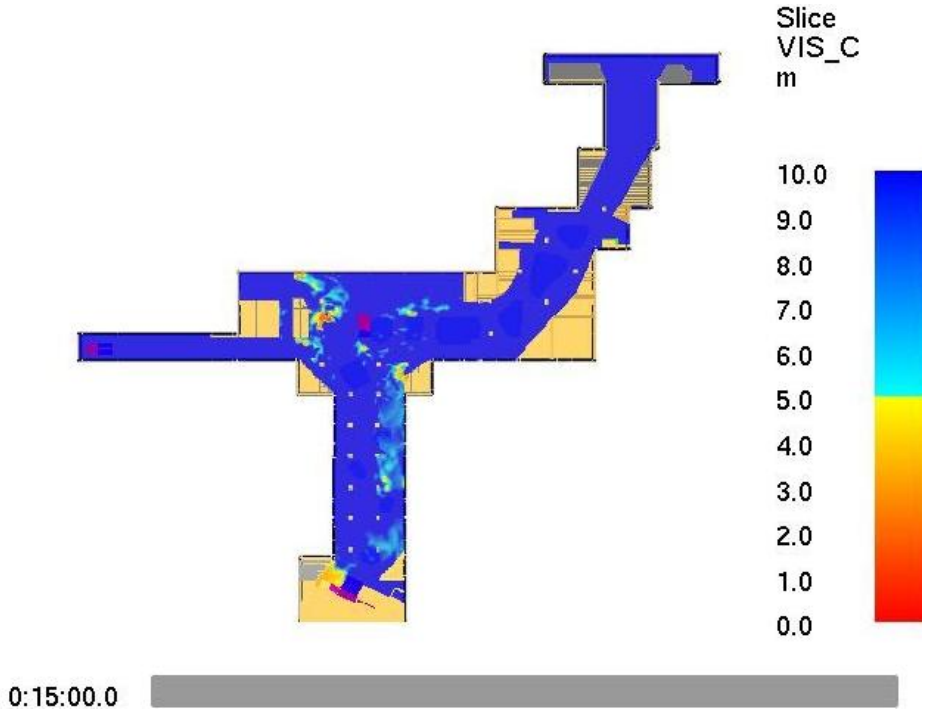
H.5.3 Visibility at 2m above floor level

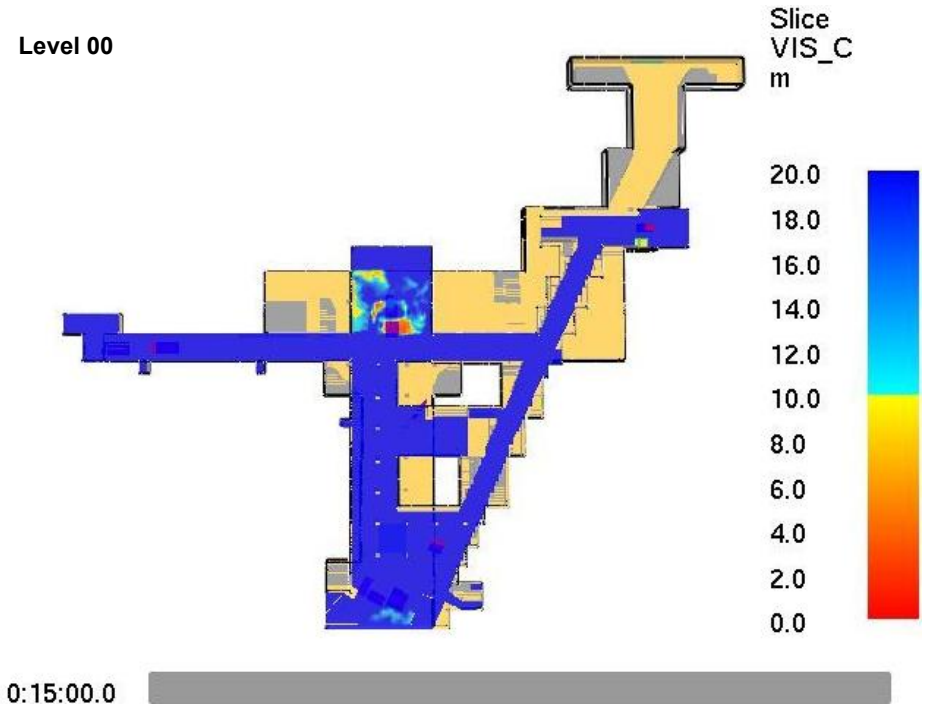
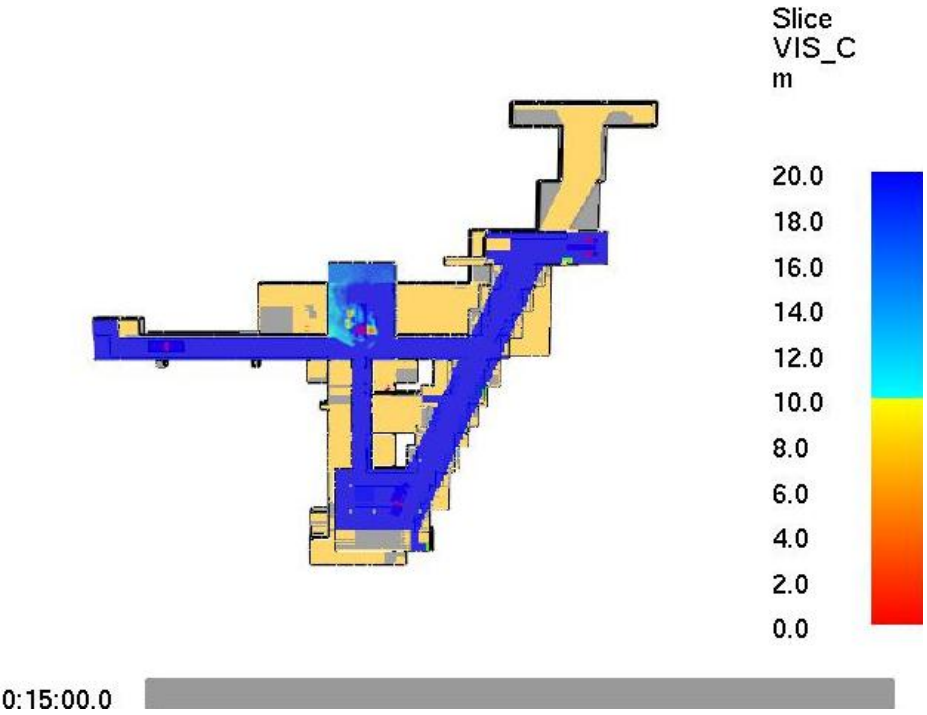
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
2:44 minutes All occupants within the impacted smoke zone have moved away from the impacted smoke zones. Some occupants are queuing at the Victoria Avenue exit. Visibility within the majority of the fire-affected floor exceeds 10 m.	

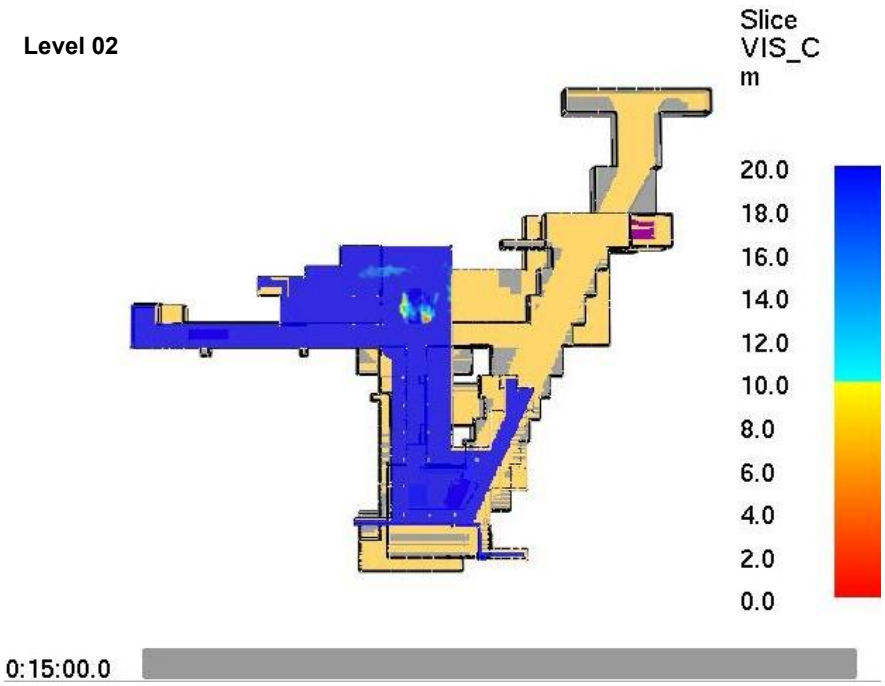
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:12 minutes All occupants within the impacted smoke zone evacuated from the smoke zone. Visibility within the majority of the fire-affected floor exceeds 10 m.	
4:48 minutes Required time for occupants within the affected smoke zones to evacuate the smoke zone with a 1.5x safety factor. Visibility within the majority of the fire-affected floor exceeds 10 m.	

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
6:05 minutes All occupants within the lower ground floor have evacuated. Visibility within the majority of the fire-affected floor exceeds 10 m.	
9:08 minutes Required time for occupants within the lower ground floor to evacuate with a 1.5x safety factor. Visibility exceeds 10 m for the majority the lower ground floor.	

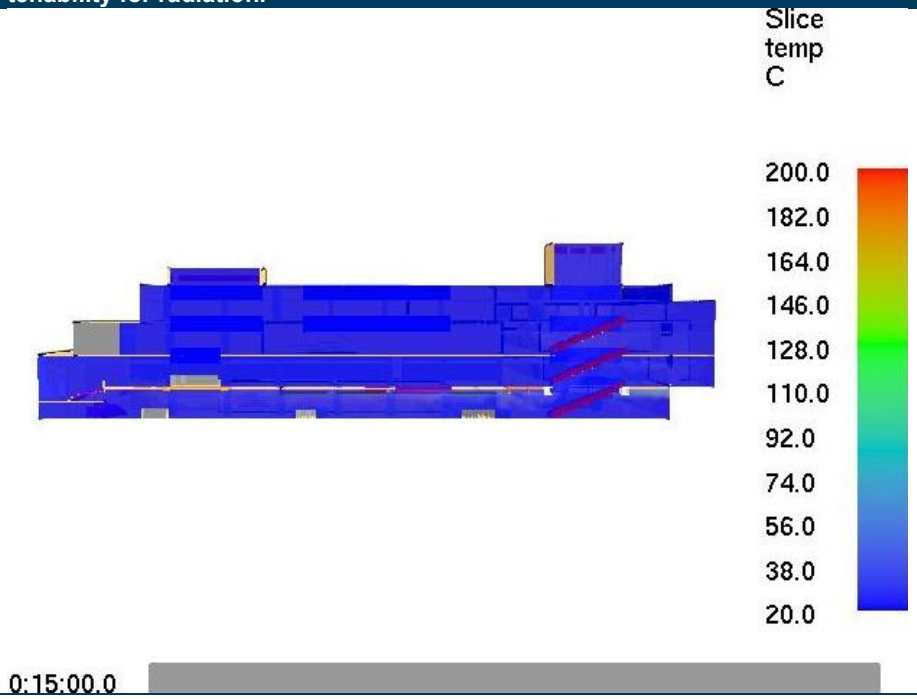
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
10:00 minutes Steady state reached for the fire scenario.	

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility drops below 10 m for the majority of the fire-affected smoke zone. Visibility throughout the majority of the mall, including at exits exceeds 5 m.	 

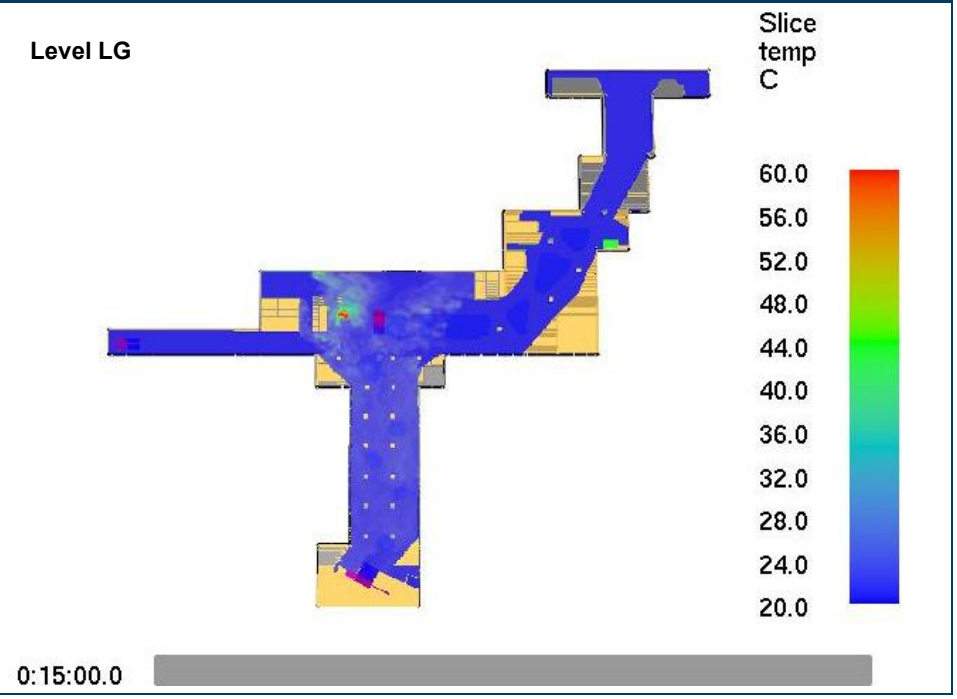
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10 m for the majority of the levels above except for the areas adjacent to the central atrium and Victoria Avenue voids.	 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10 m for the majority of the levels above except for the areas adjacent to the central atrium and Victoria Avenue voids.	

H.5.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the fire-affected floor shows that the smoke layer is less than 200°C	

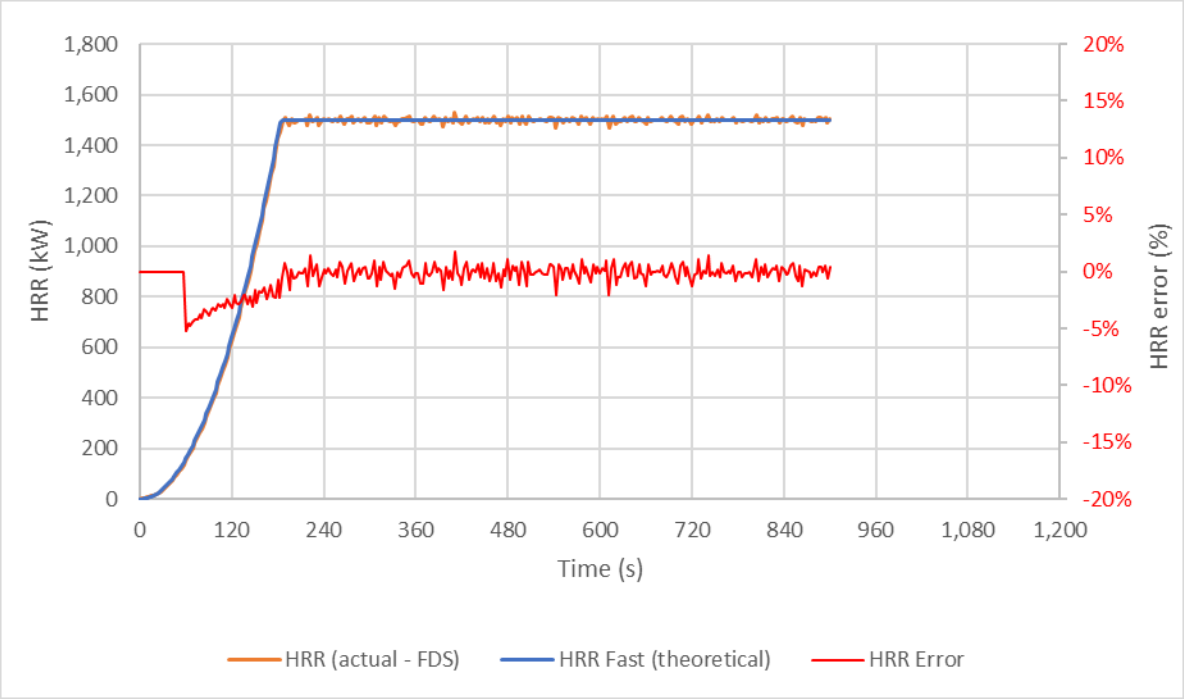
H.5.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the lower ground floor mall at 2 m above floor level, with the exception of the area around the fire.	

H.5.6 Error checking

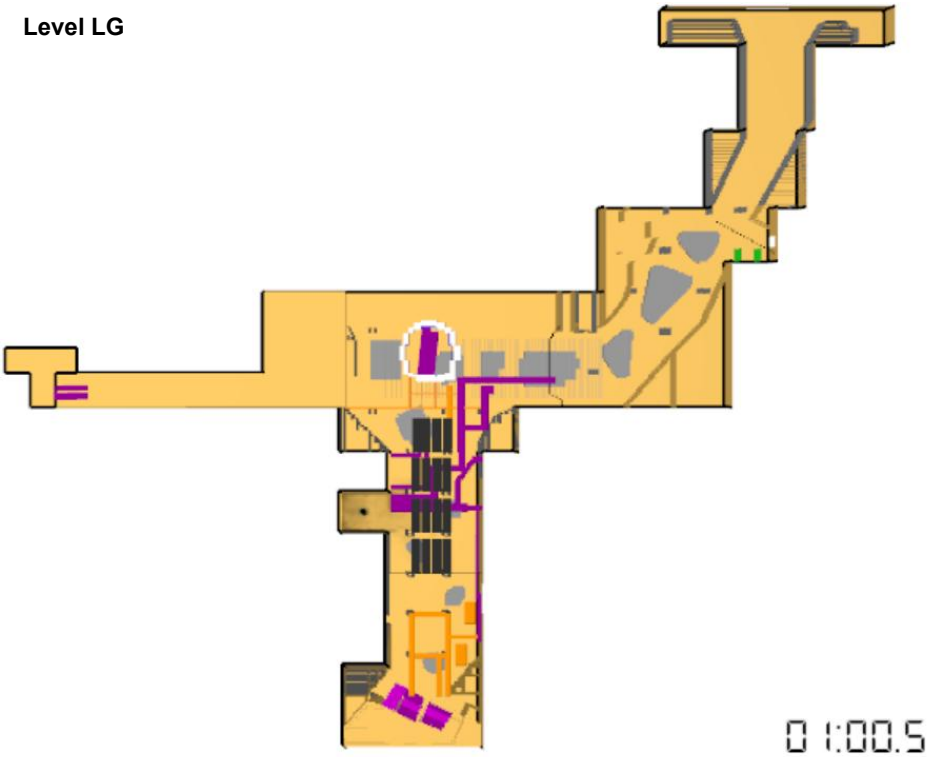
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

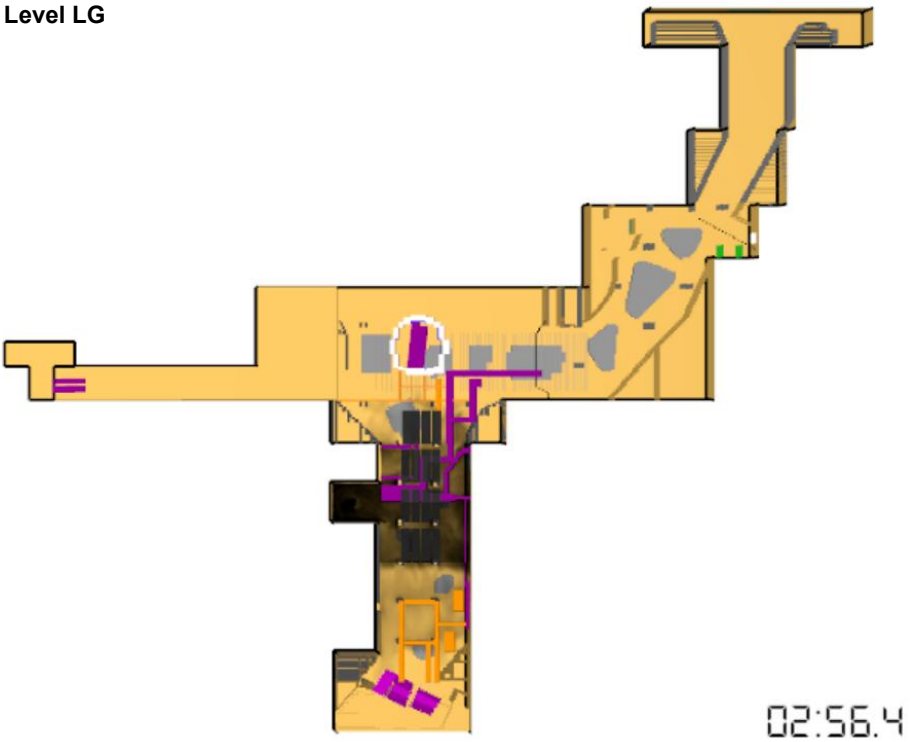
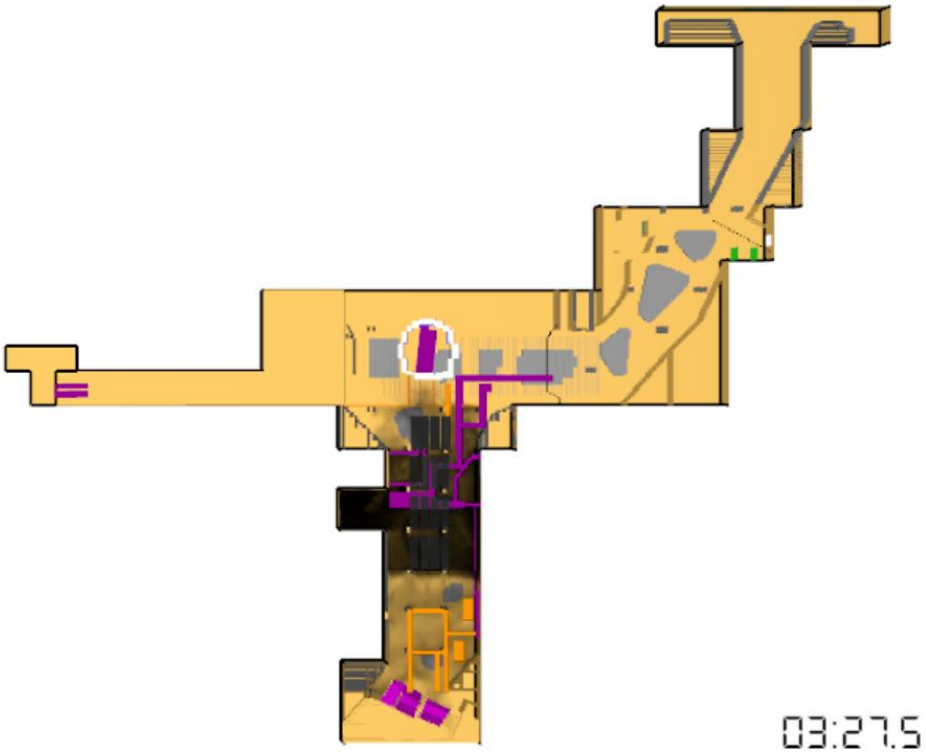


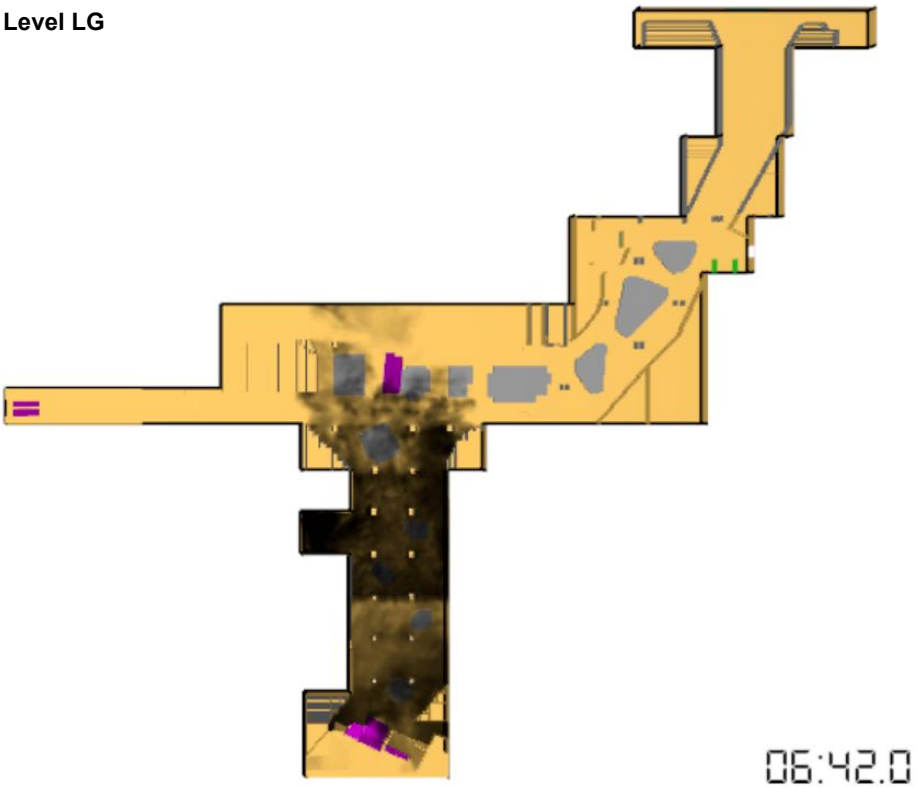
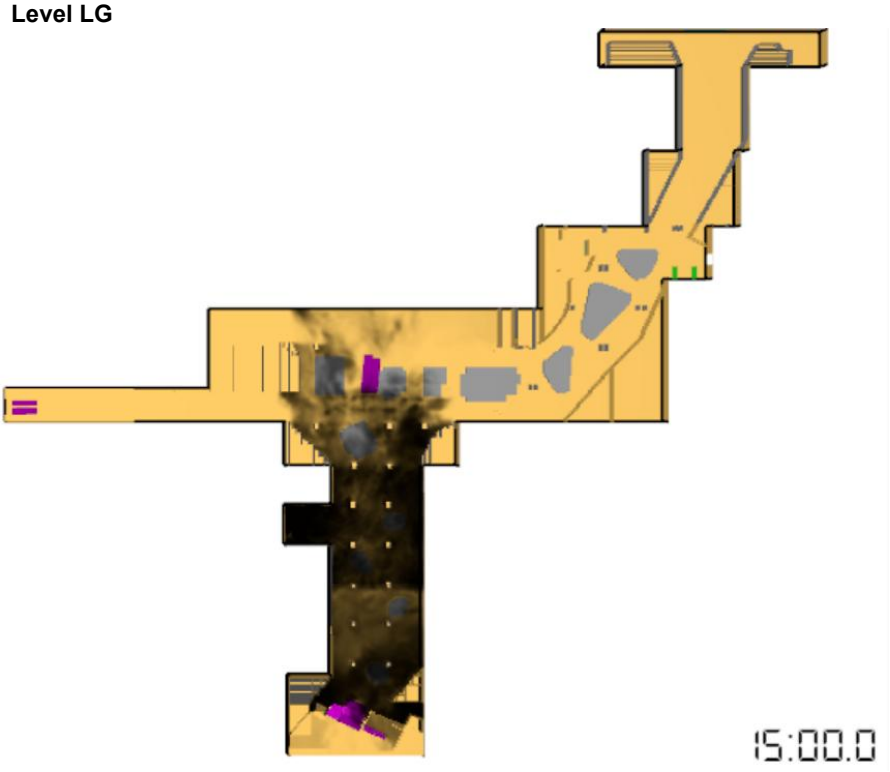
H.6 Scenario 3 results – Fire in Tenancy B-031 (LGF) [89] - sensitivity analysis

H.6.1 Smoke spread

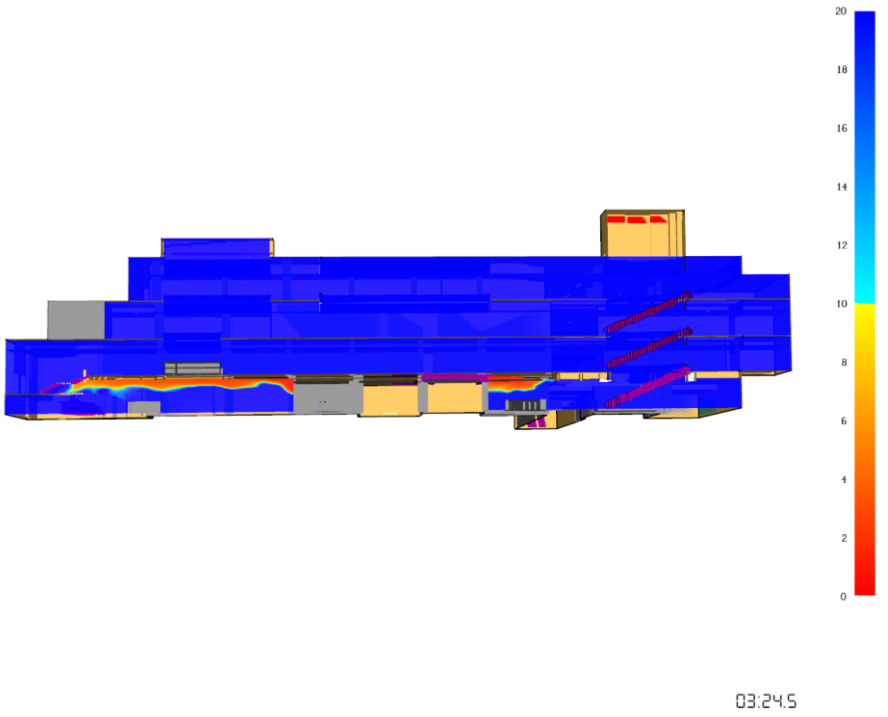
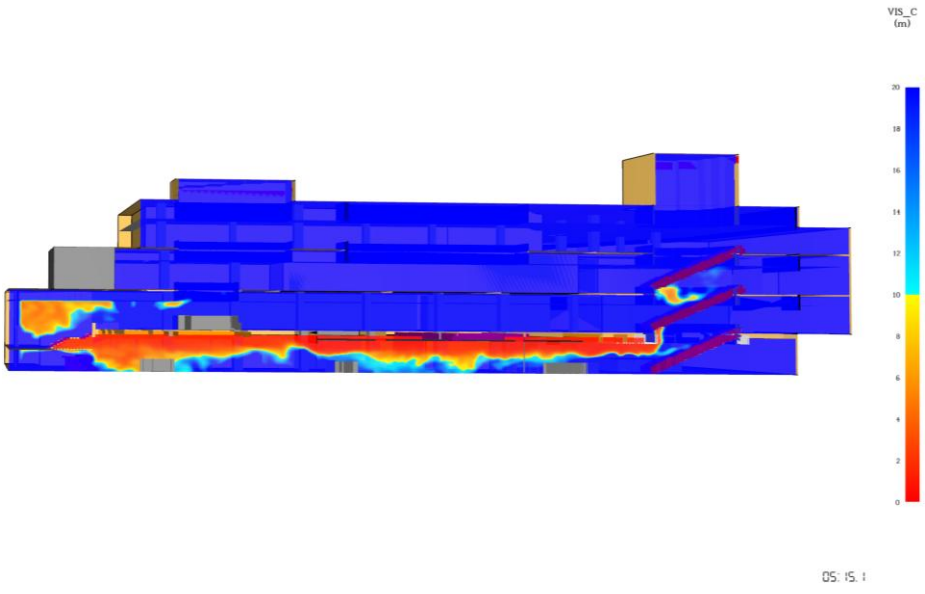
Timeline (mm:ss)	
1:00 minutes Smoke begins to spread out of fire-affected tenancy. Occupants within smoke zone 7 on LGF receive visual cues of the fire.	**Level LG** 

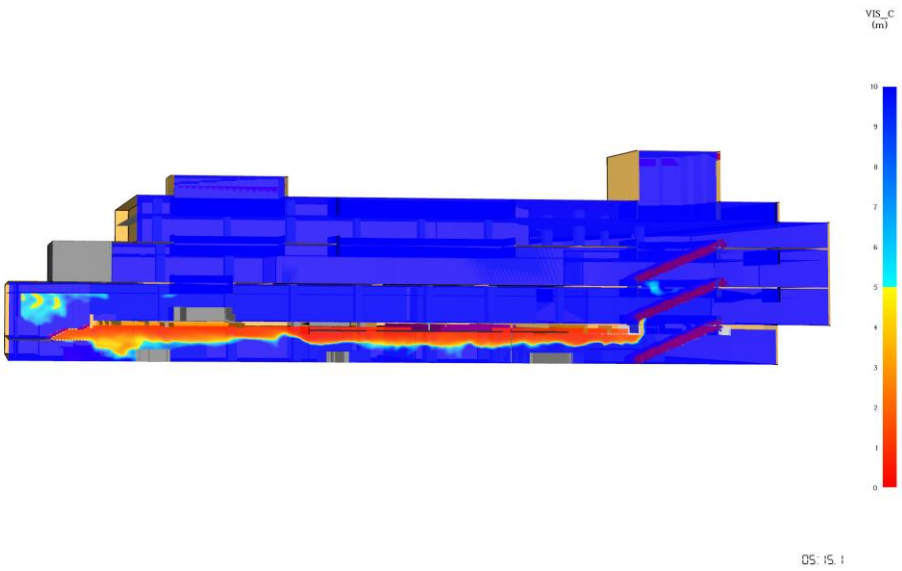
[89] Jensen Hughes, 2025, Fire in tenancy B-301 sensitivity–S7f.fds

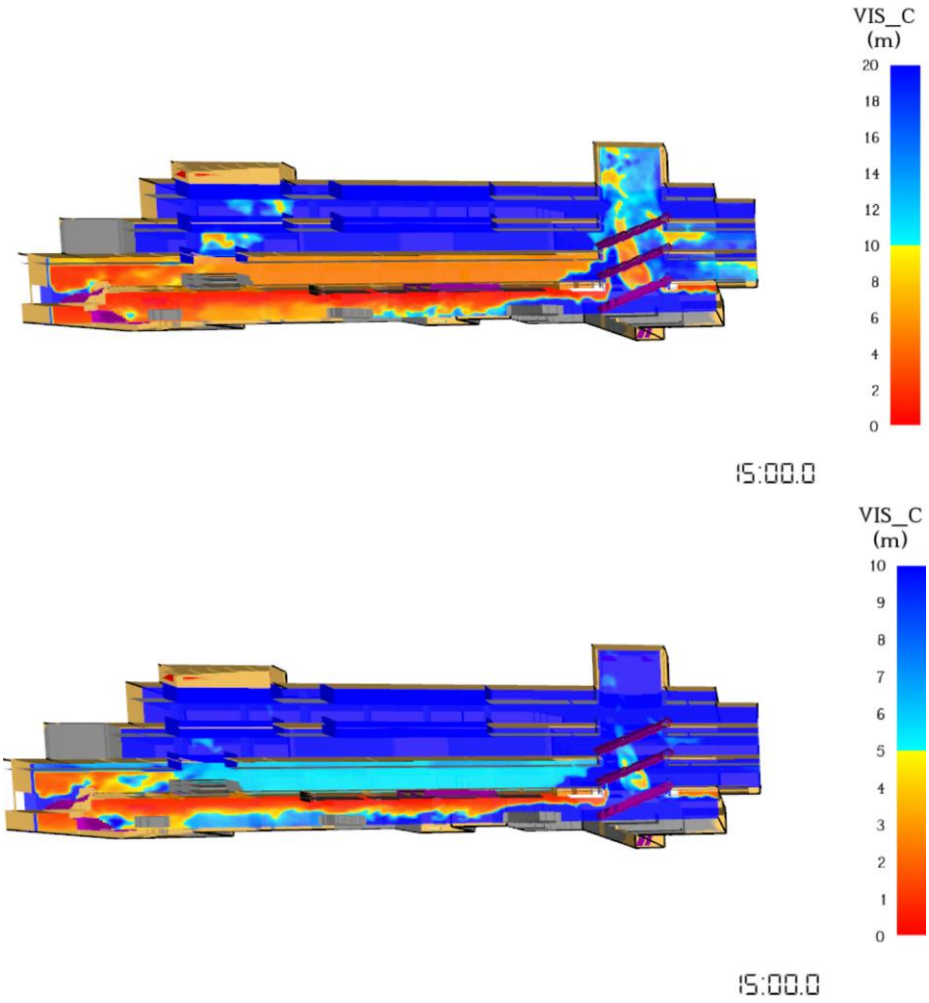
Timeline (mm:ss)	
2:56 minutes Smoke continues to spread out of the tenancy and into LGF smoke zone 7 and up the central atrium. Smoke begins to spread into the food court smoke zone (zones 9&10) All occupants within the impacted smoke zone have moved away from the impacted smoke zones. Some occupants are queuing at the Victoria Avenue exit.	**Level LG** 
3:27 minutes Smoke continues to spread through LGF smoke zones 2 as well as 9&10. All occupants within the impacted smoke zone have evacuated.	

Timeline (mm:ss)	
6:41 minutes Smoke continues to spread through LGF smoke zones 2 as well as 9&10. All occupants within the LG level have evacuated.	**Level LG** 
15:00 minutes Smoke continues to spread through LGF smoke zones 2 as well as 9&10. End of modelling duration.	**Level LG** 

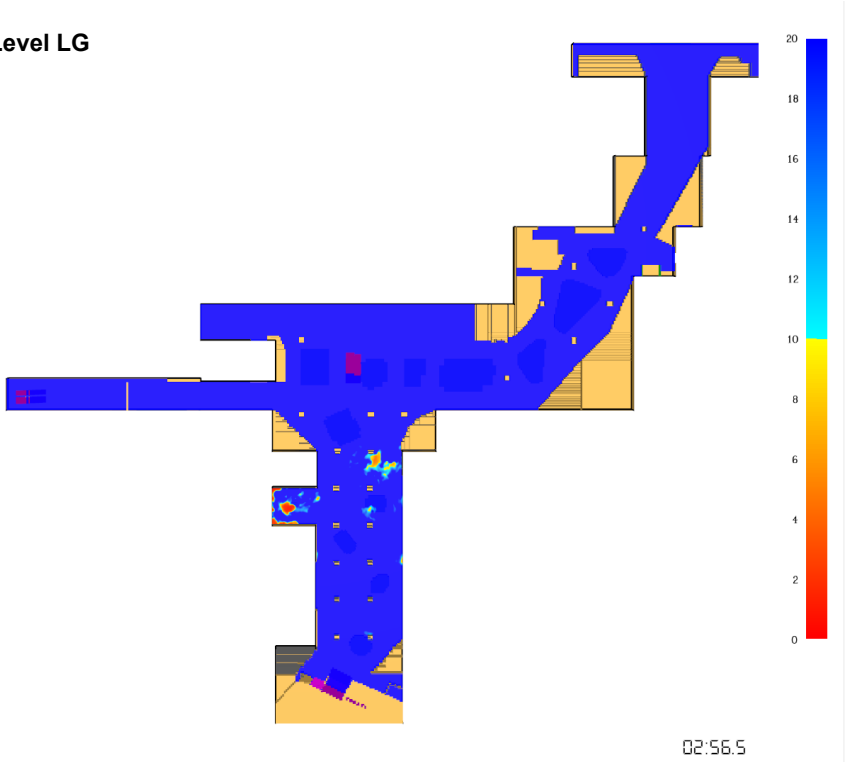
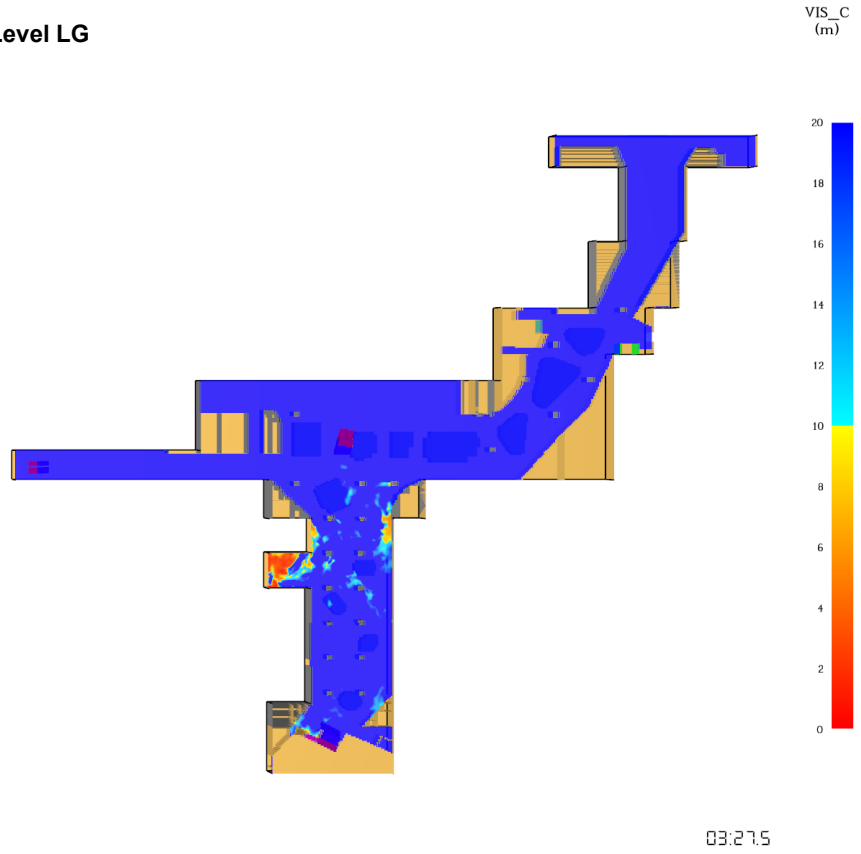
H.6.2 Visibility – section

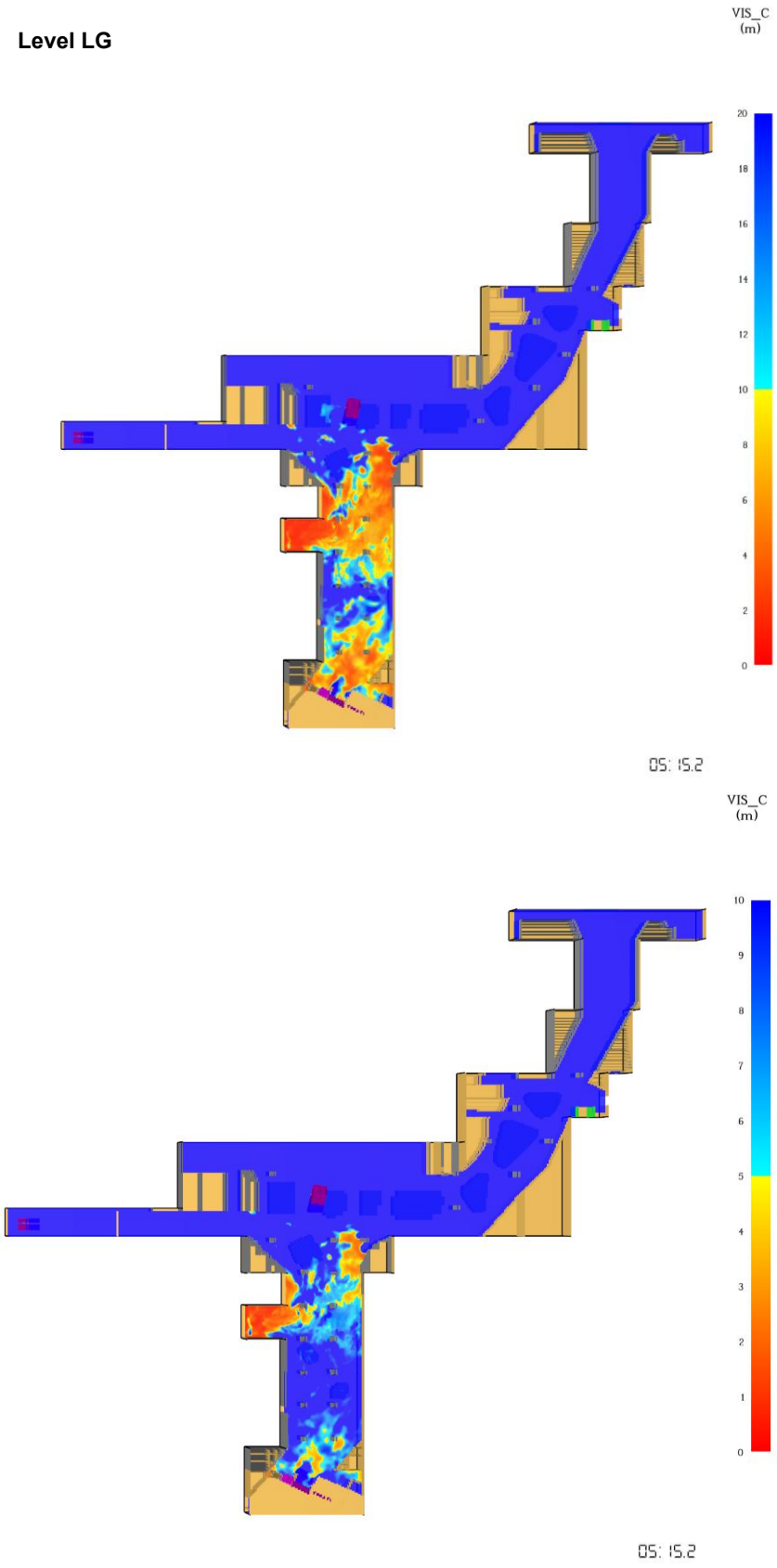
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:24 minutes All occupants within the impacted lower ground smoke zones have evacuated. Visibility of area in front of the Victoria Avenue exit remains above 10m.	
5:15 minutes The area in front of Victoria avenue exit drops below 10m and is considered no longer available. Whilst visibility around this area remains above 5m, the remaining occupants utilising the exit on ground floor are expected to seek alternative exits.	

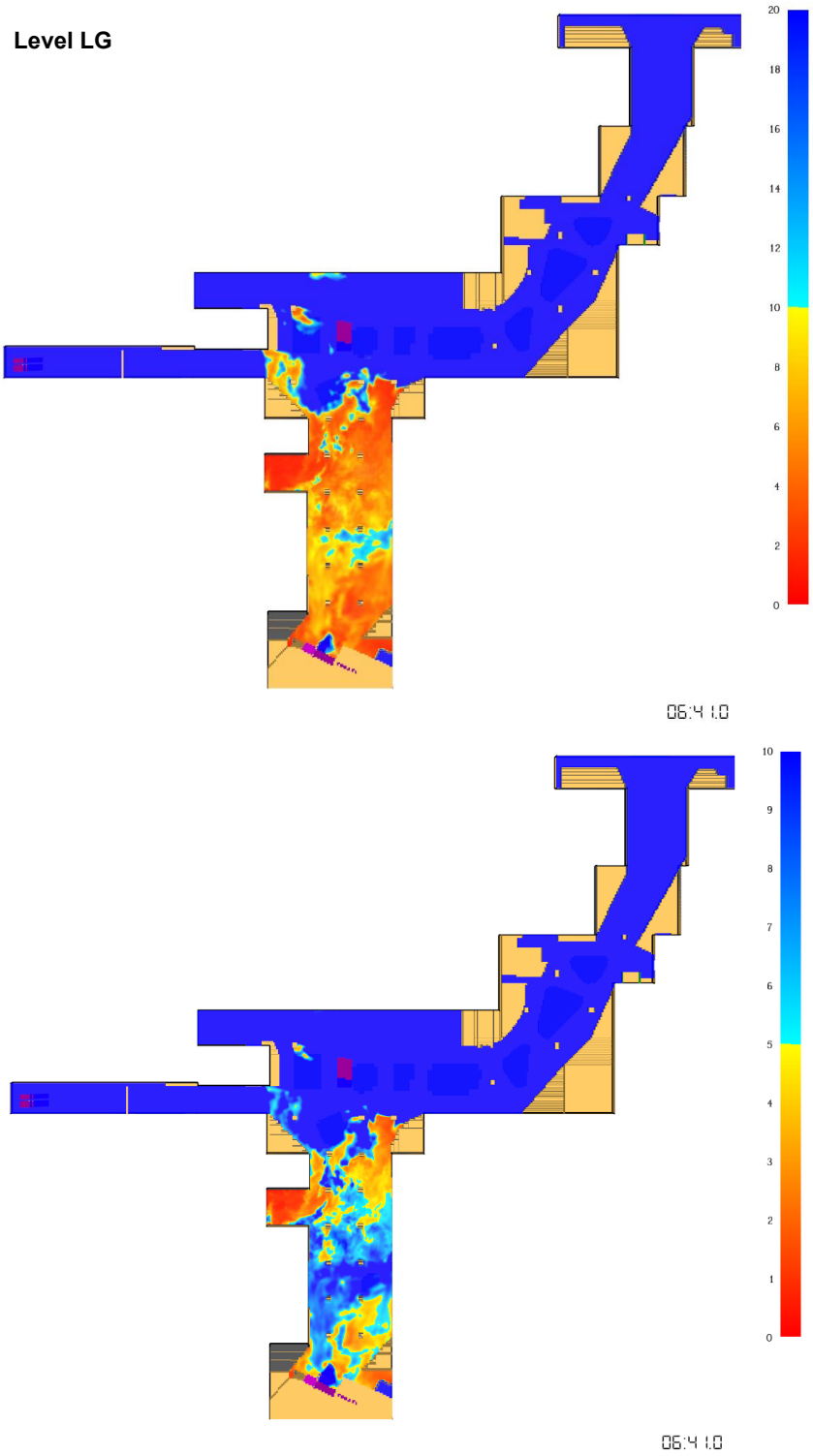
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
5:15 minutes The area in front of Victoria avenue exit drops below 10m and is considered no longer available. Whilst visibility around this area remains above 5m, the remaining occupants utilising the exit on ground floor are expected to seek alternative exits.	

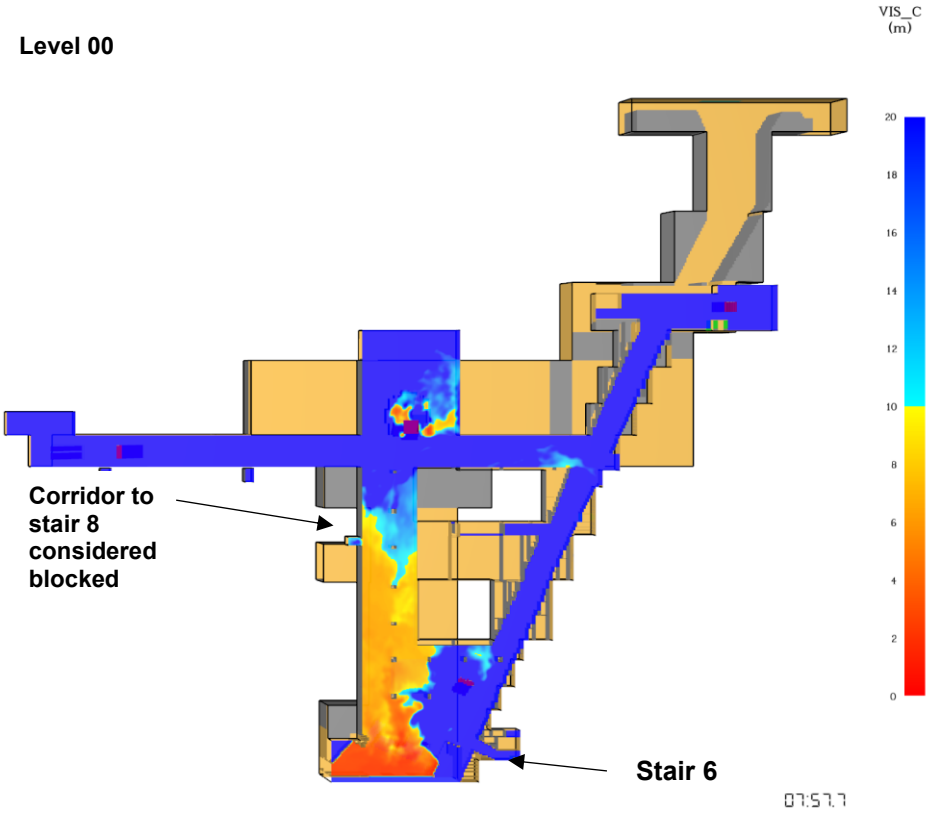
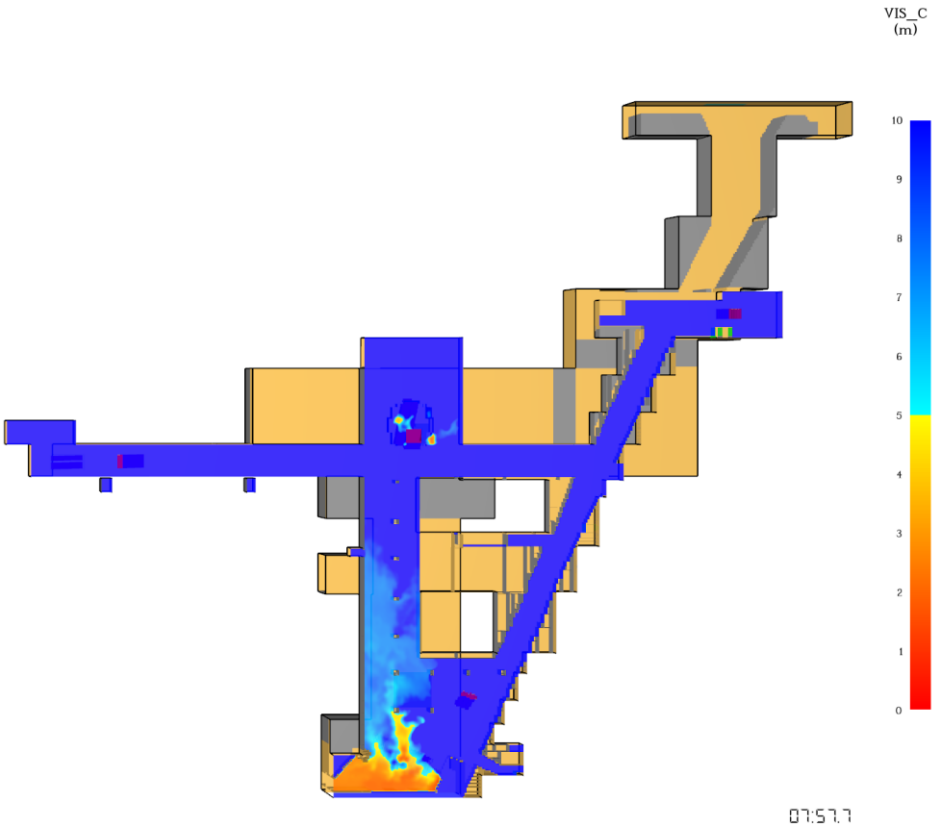
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. With the exception of the fire affected floor, the level 00 mall and the area around the central atrium void, visibility exceeds 10m for the majority of the mall on all levels above. Visibility within the level 00 mall exceeds 5 m throughout the majority of the mall.	

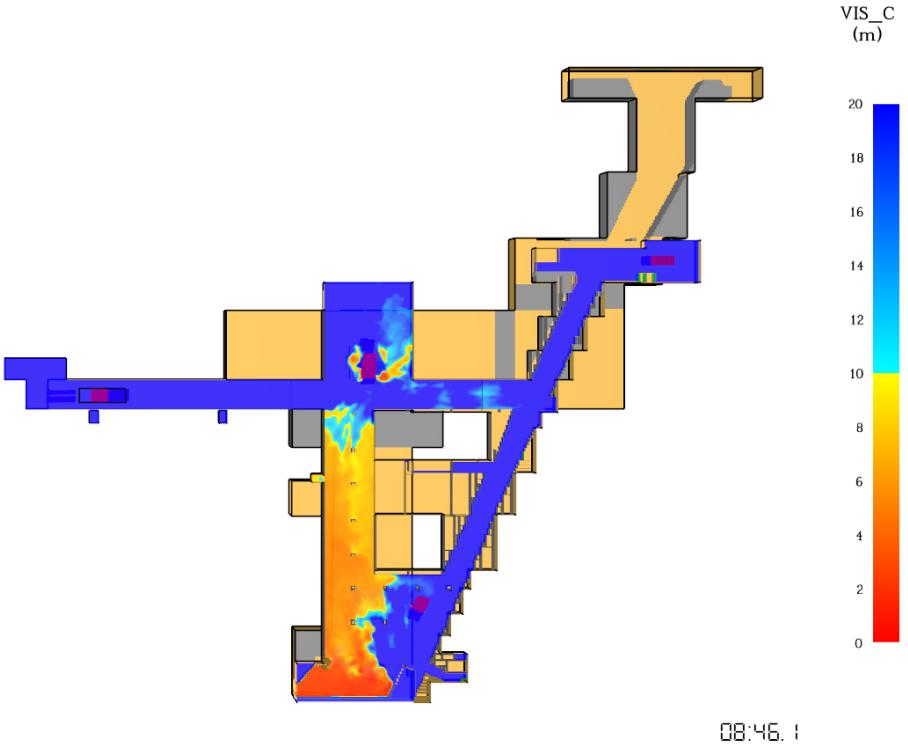
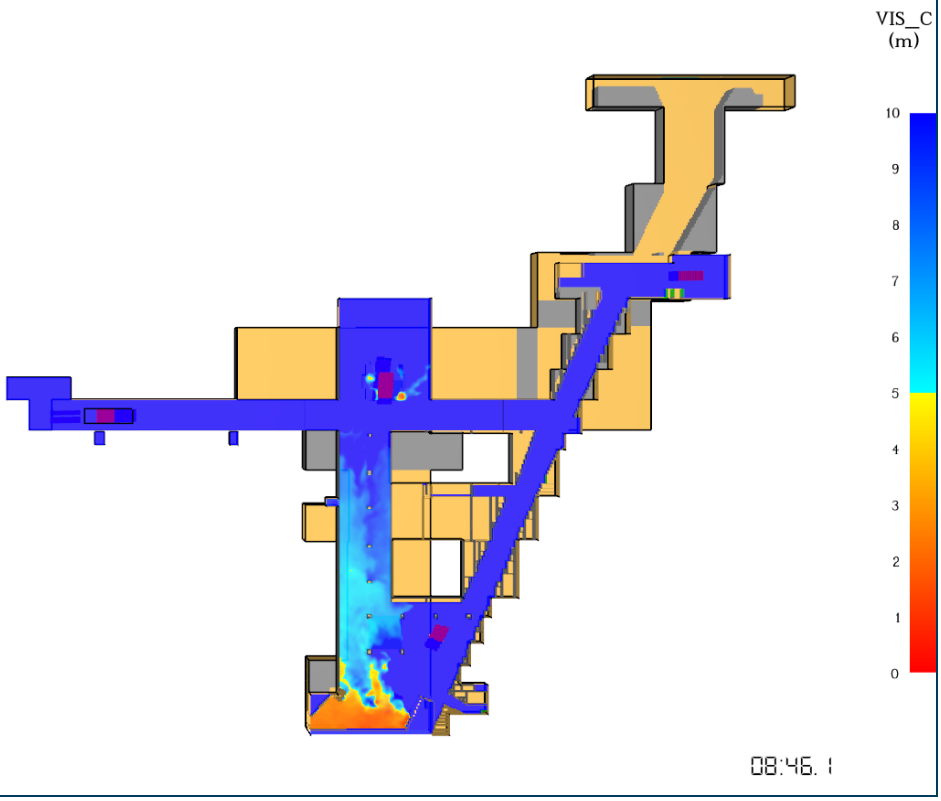
H.6.3 Visibility at 2m above floor level

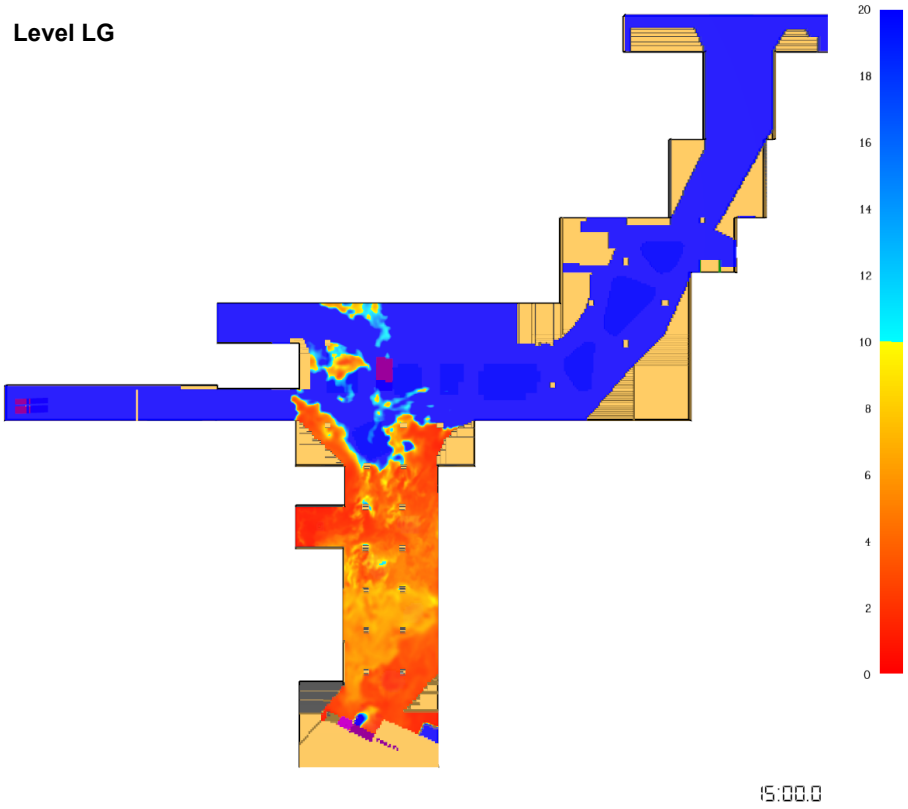
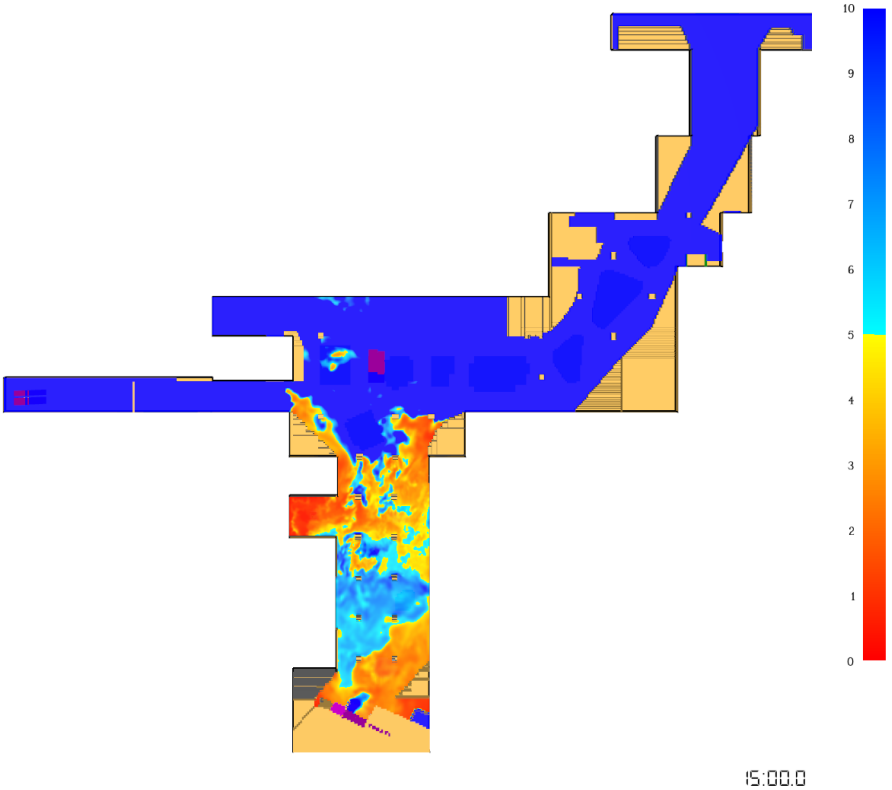
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
2:56 minutes All occupants within the impacted smoke zone have moved away from the impacted smoke zones. Some occupants are queuing at the Victoria Avenue exit. Visibility within the majority of the fire-affected floor exceeds 10 m.	**Level LG** 
3:27 minutes All occupants within the impacted smoke zone have evacuated from the smoke zone. Visibility within the majority of the mall exceeds 10 m.	**Level LG** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
5:15 minutes ASET Visibility less than 10 m for the majority of smoke zone 7 as well as the food court zone (zone 9 & 10). Tenability considered to be lost in the fire-affected zones. Visibility exceeds 10 m for the remainder of the mall. Visibility still exceeds 5m within the majority of the impacted smoke zones.	**Level LG** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
6:41 minutes Evacuation of the lower ground floor mall complete. With the exception of the fire-affected zones, visibility exceeds 10 m for the majority of the lower ground floor mall. The majority of the area still exceeds 5 m visibility.	**Level LG** 

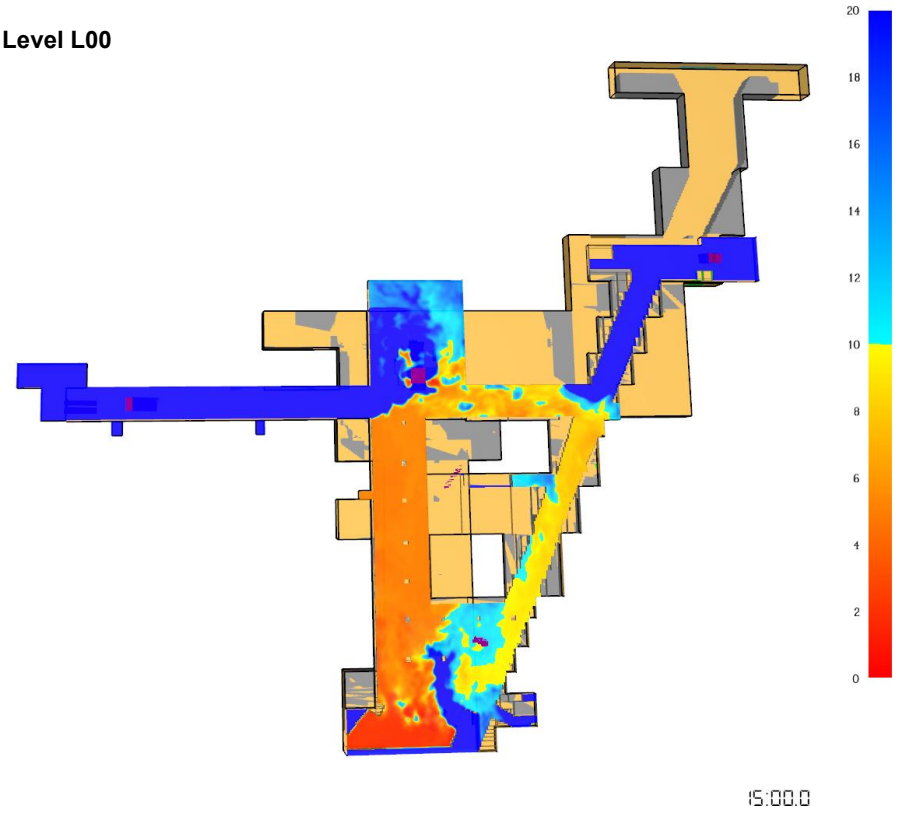
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
7:57 minutes The majority of occupants have evacuated the level 00 mall complete. The remaining occupants are queuing outside Stair 6. Visibility begins to fall under 10m within the central mall portion. Visibility exceeds 10m at all exits with the exception of fire-isolated stair 8, which is considered blocked for this scenario. Visibility exceeds 5m at all exits.	**Level 00**  

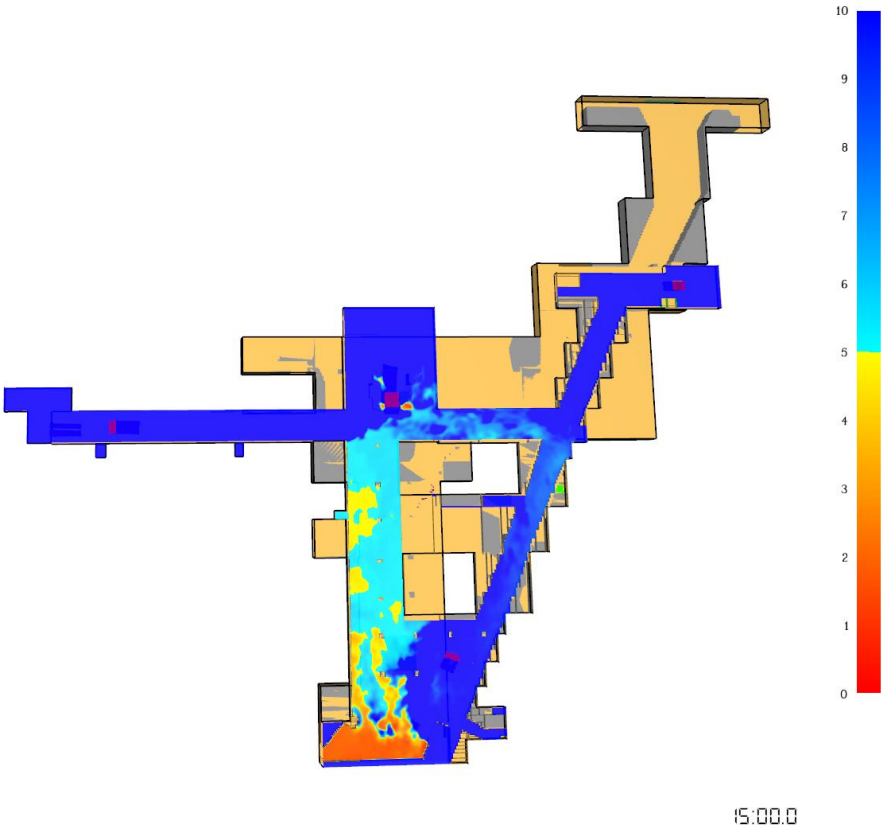
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
8:46 minutes ASET for the affected smoke zone on level 00. Evacuation of level 00 mall complete. Visibility to the central portion of level 00 mall falls below 10m visibility. Tenability considered lost within level 00 of smoke zone 7. It is noted that the level 00 still maintains visibility of 5m or more.	**Level 00** 
	Level 00 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility is below 5 m within the majority of the fire affected zones. Visibility is below 10m but above 5m within the majority of the level 00 mall Visibility exceeds 10 m for the majority of the levels above, except for the areas adjacent to the central atrium and Victoria Avenue voids.	**Level LG**  

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.

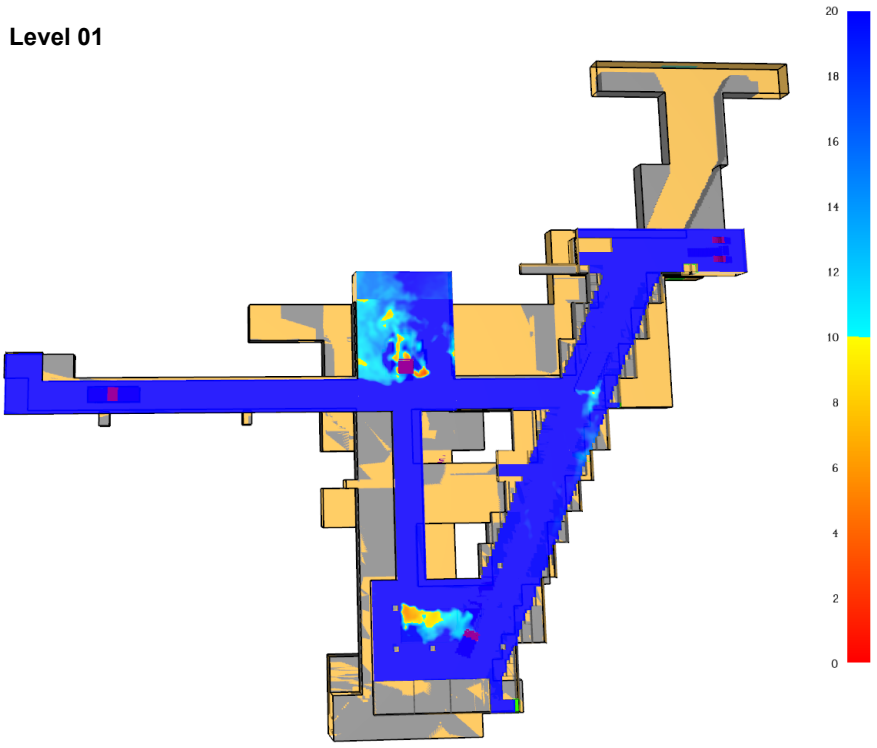
Level L00





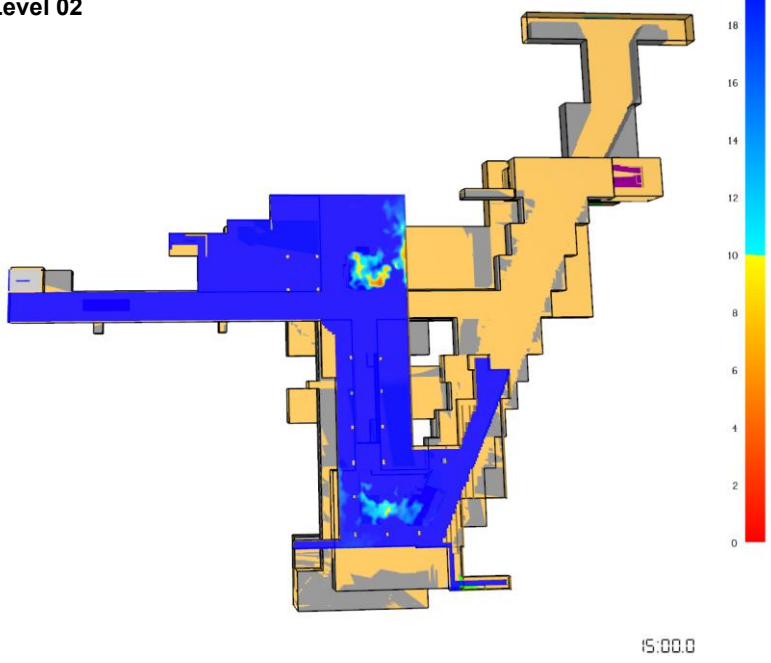
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.

Level 01

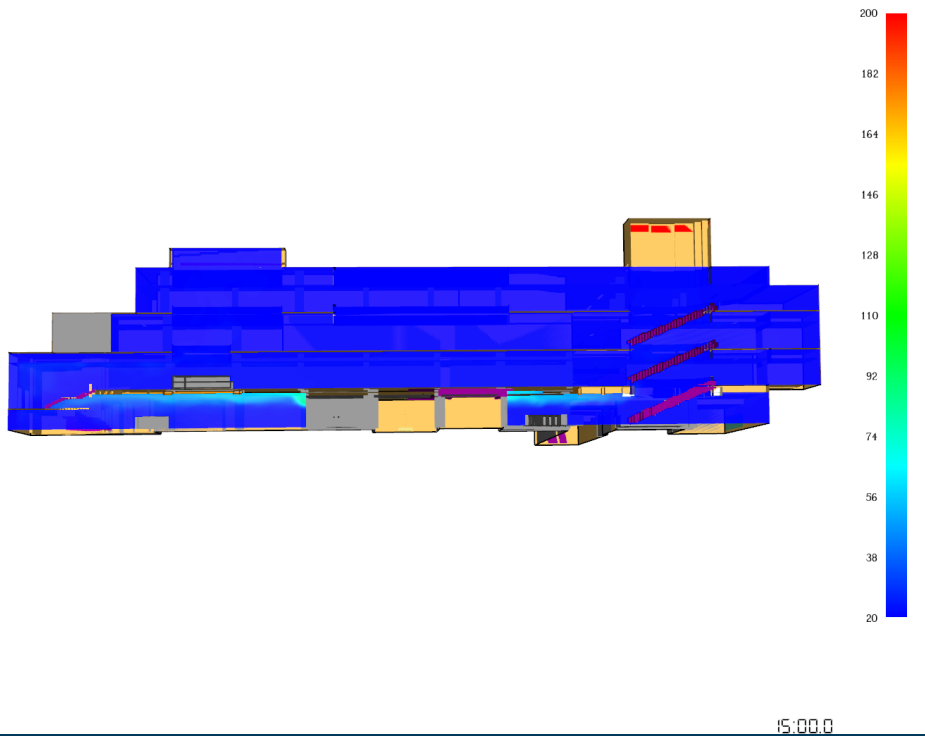




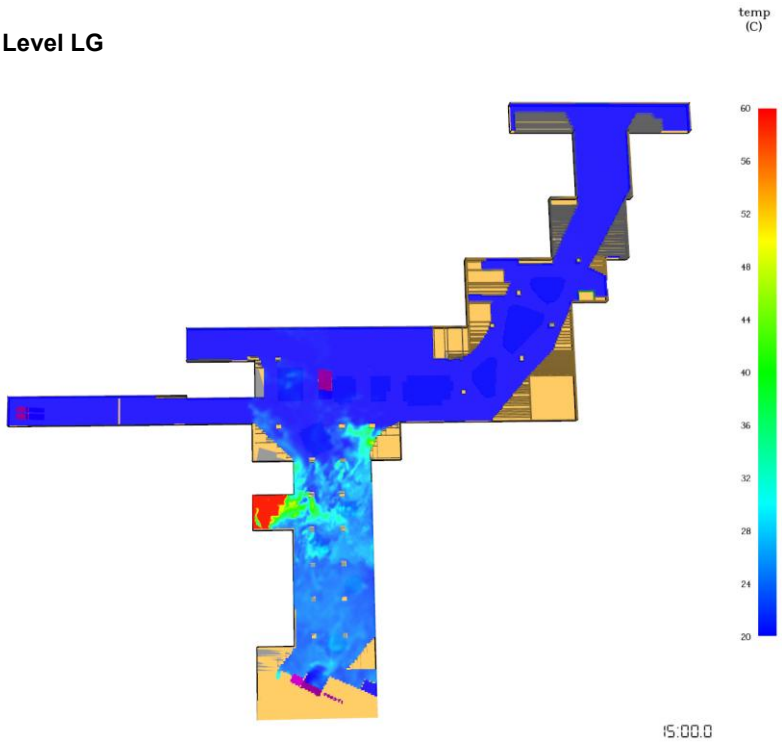
Level 02



H.6.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C.	

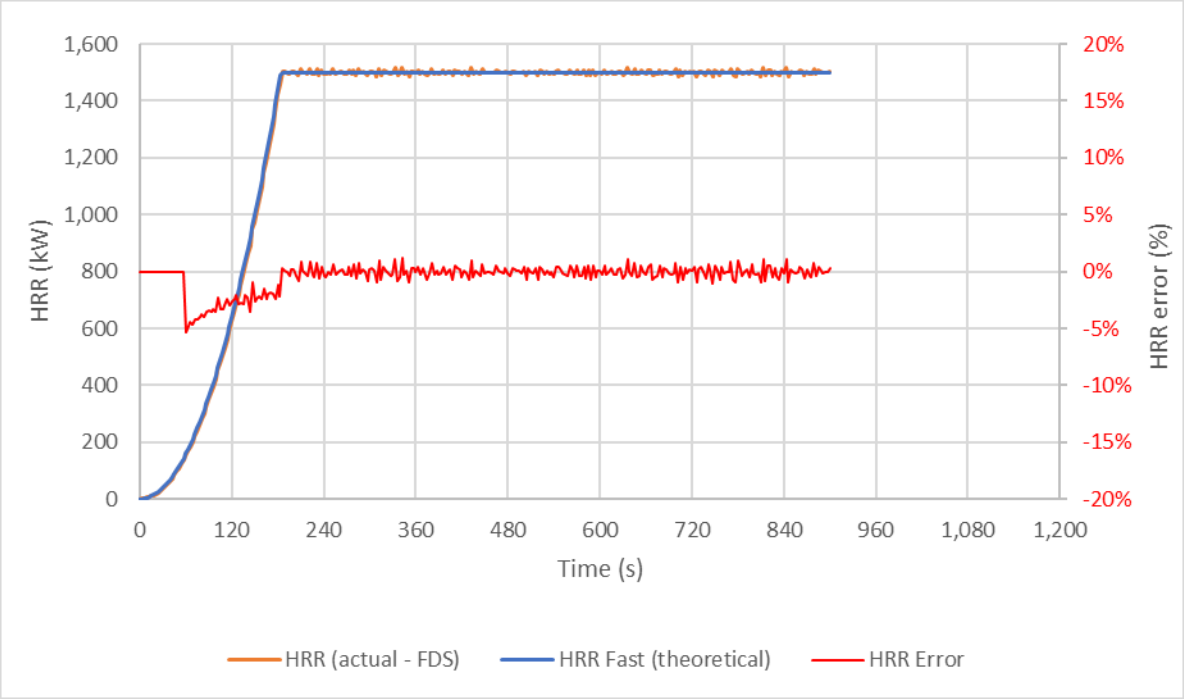
H.6.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the lower ground floor mall at 2 m above floor level, with the exception of the area around the fire.	**Level LG** 

H.6.6 Error checking

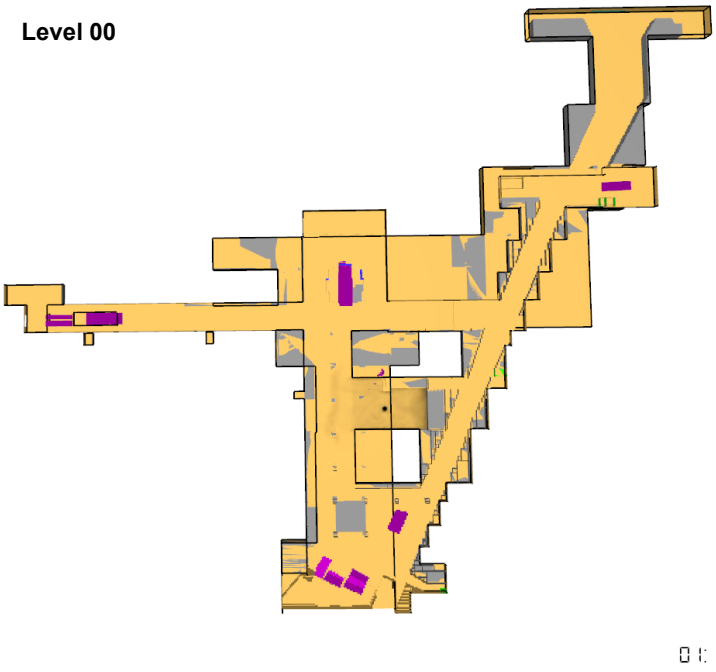
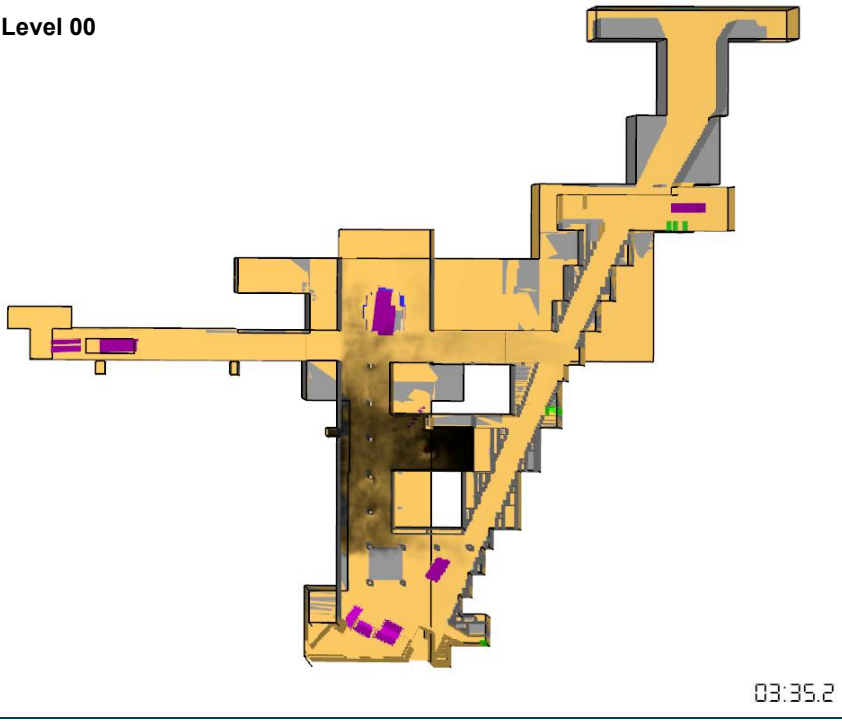
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

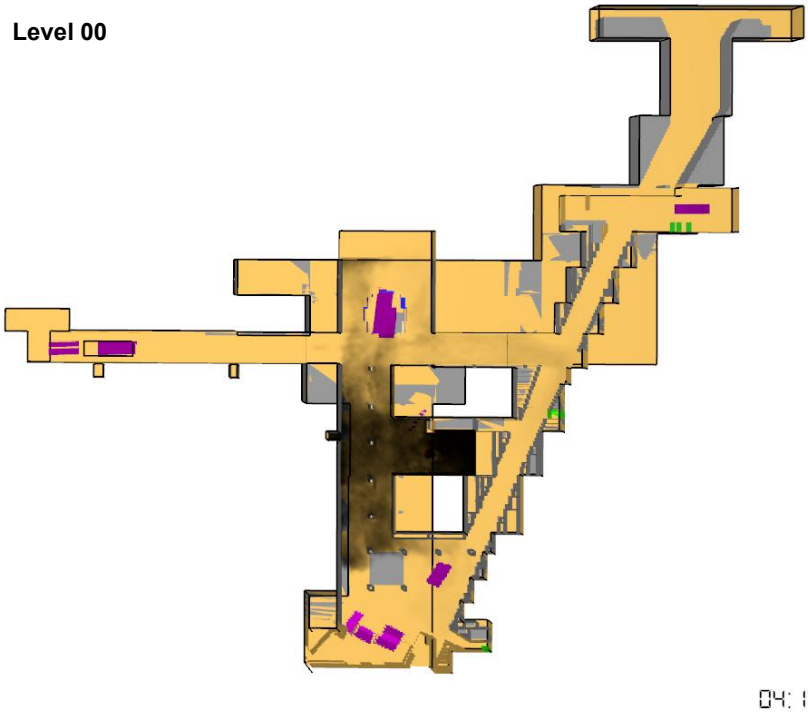
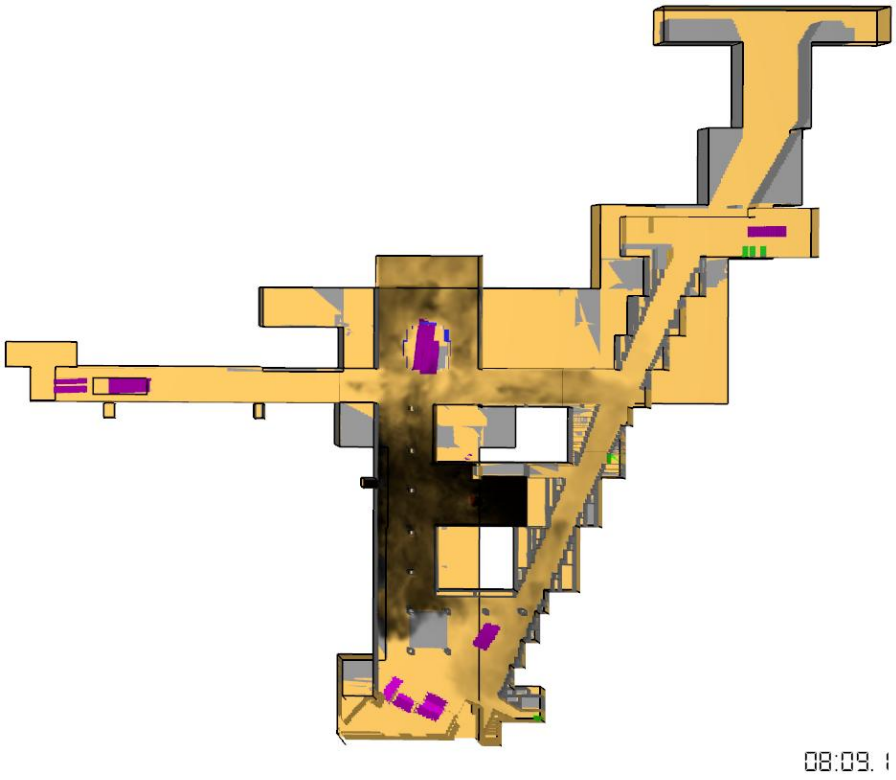


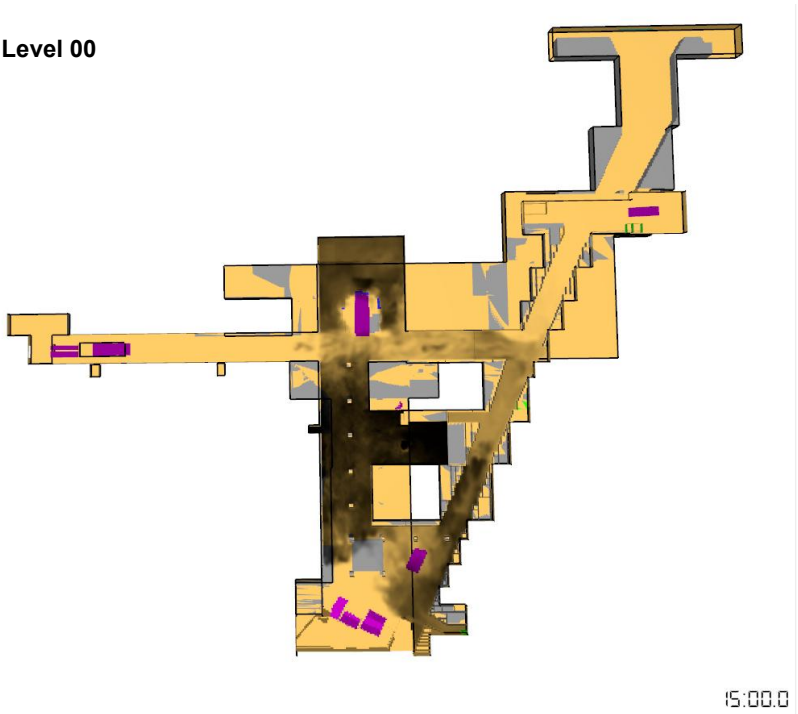
H.7 Scenario 4 results – Fire in Tenancy G-034 (L00) [90]

H.7.1 Smoke spread

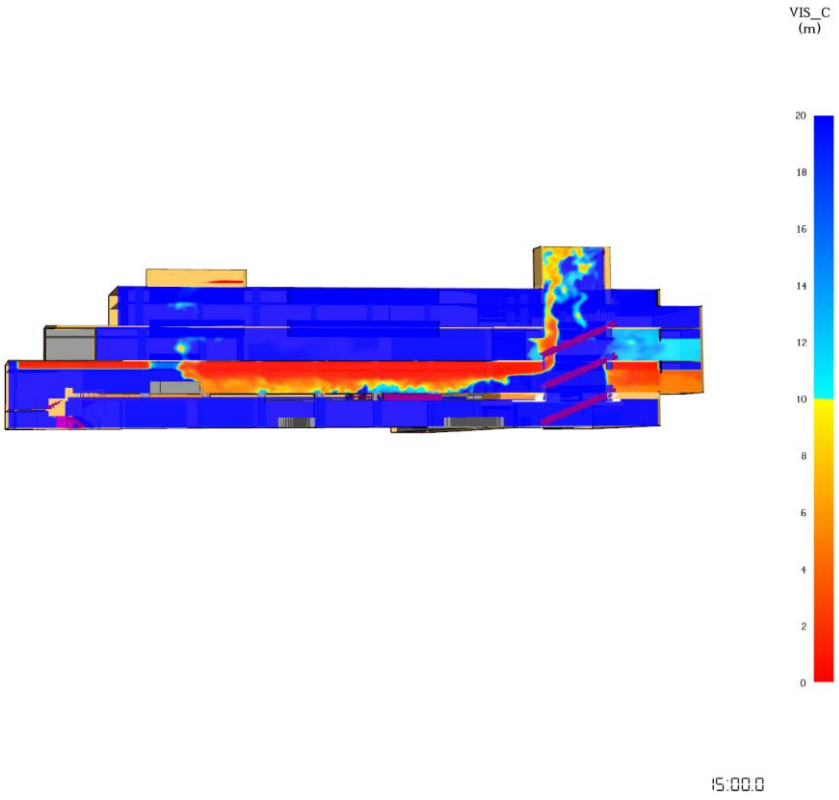
Timeline (mm:ss)	
1:10 minutes Smoke begins to spread out of fire-affected tenancy. Occupants within smoke zone 7 on L00 receive visual cues of the fire.	
3:35 minutes Smoke continues to spread out of the tenancy and into L00 smoke zone 7. Smoke begins spreading up the Victoria Avenue void and where it is exhausted at the top of the void. All occupants within the L00 smoke zone 7 have either moved away from the impacted smoke zones or queuing at the Victoria Avenue exit.	

[90] Jensen Hughes, 2025, Fire in tenancy G-034–S6m.fds

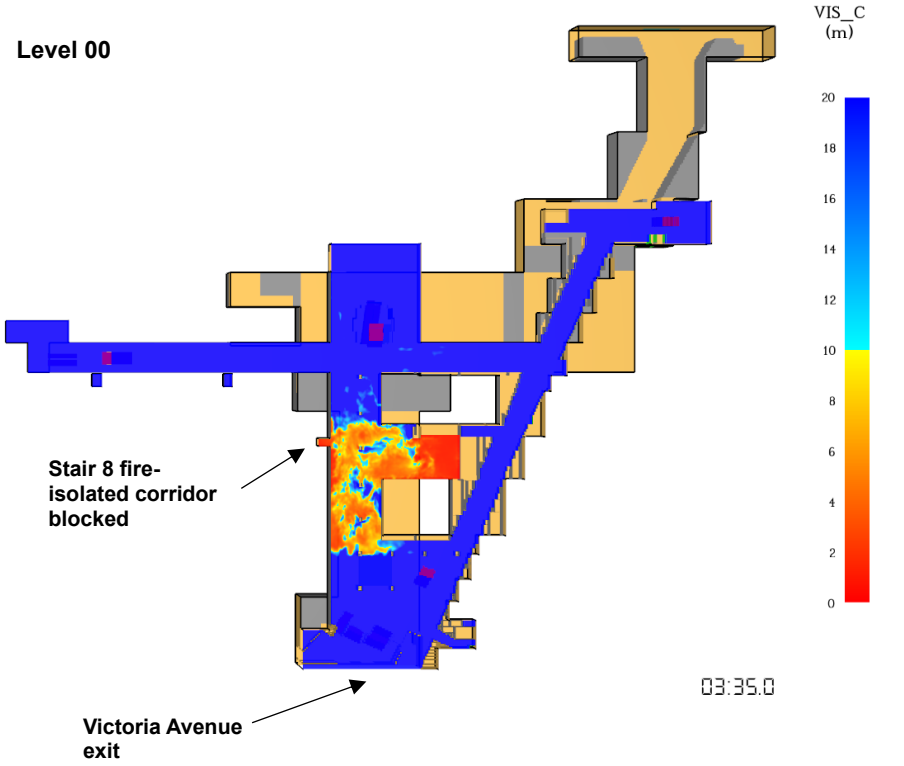
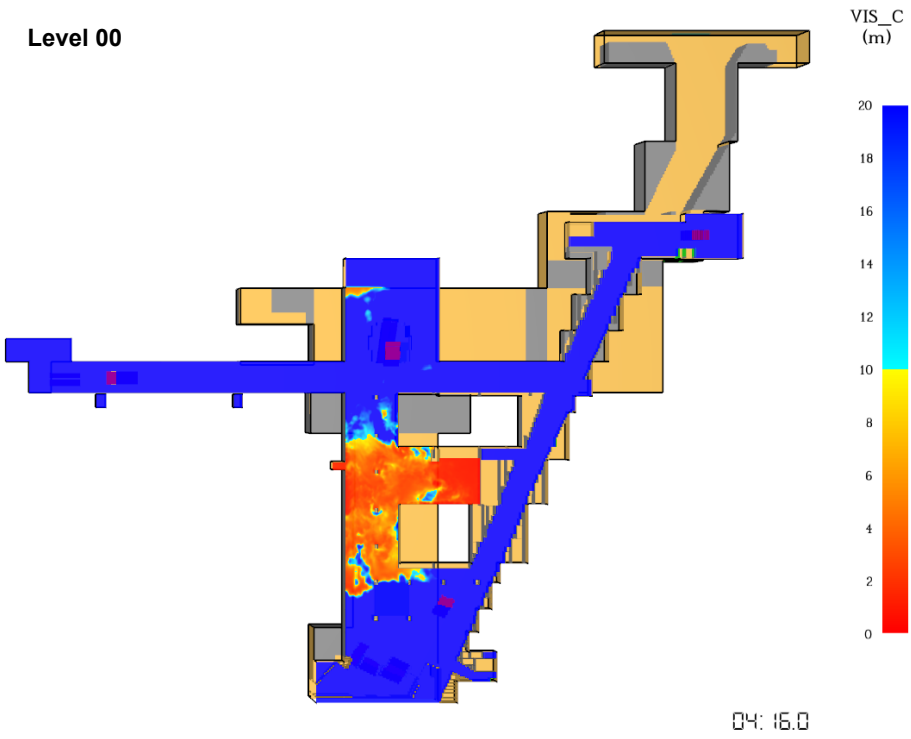
Timeline (mm:ss)	
4:16 minutes Smoke continues to spread out of the tenancy and into L00 smoke zone 7. Smoke begins spreading up the Victoria Avenue void and where it is exhausted at the top of the void. All occupants within the L00 smoke zone 7 have either exited or moved away from the smoke zone.	
8:09 minutes Smoke continues to spread throughout L00 smoke zone 7. Smoke begins spreading to Havilah St zone (smoke zone 13) All occupants within L00 have evacuated.	

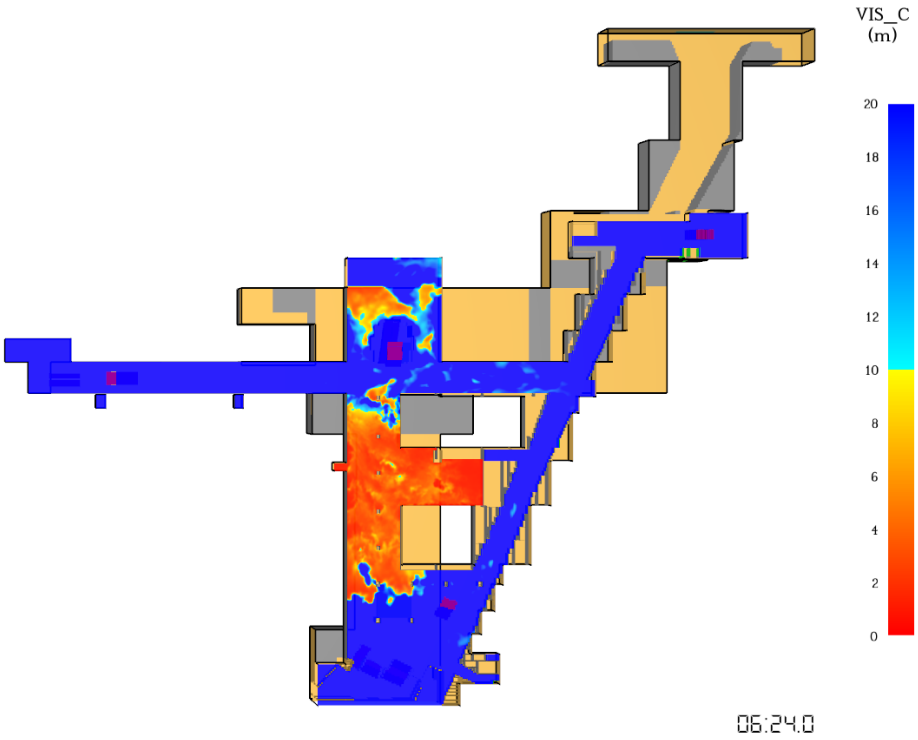
Timeline (mm:ss)	
15:00 minutes Smoke has spread throughout L00 smoke zone and into the Havilah St zone (smoke zone 13).	**Level 00** 

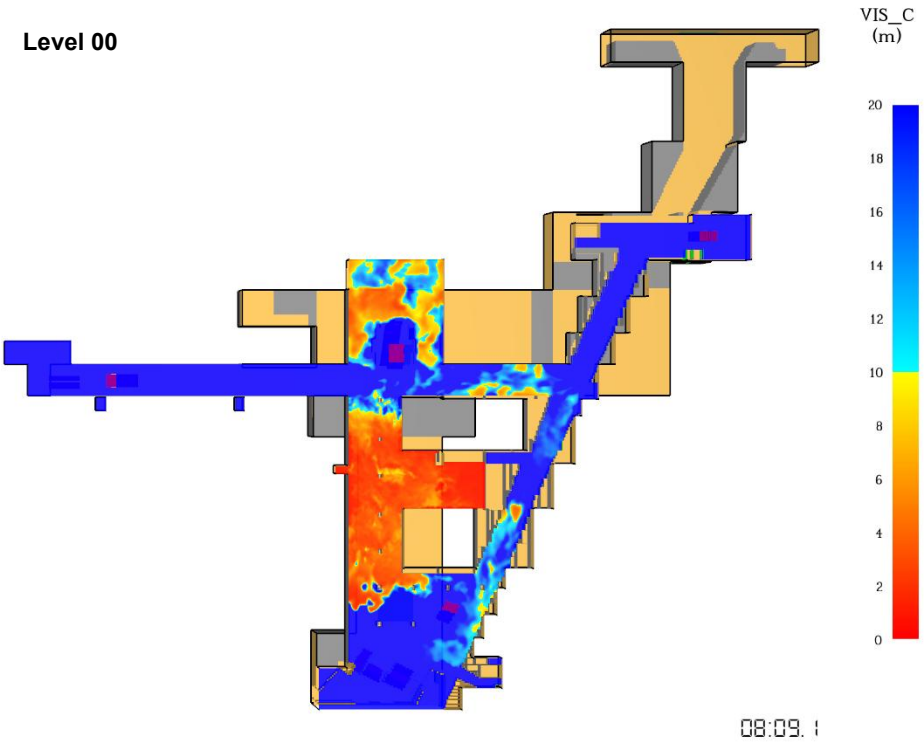
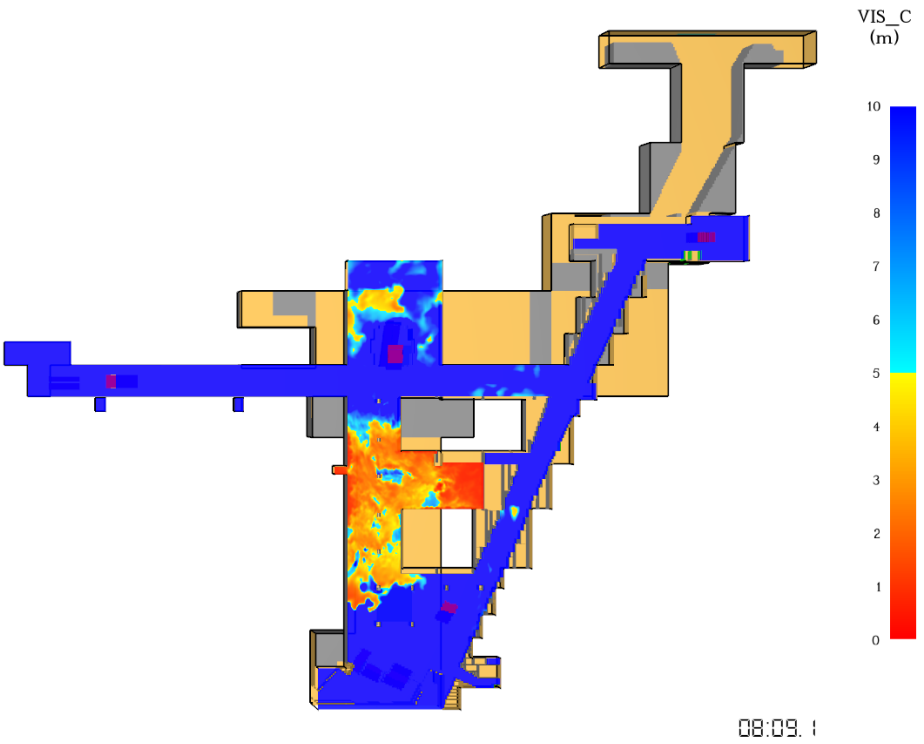
H.7.2 Visibility – section

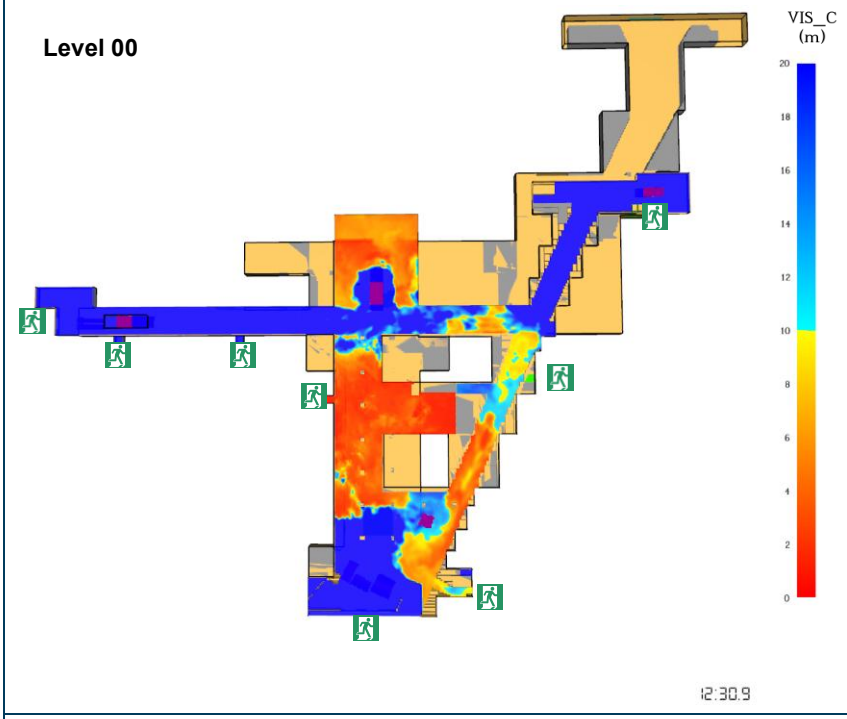
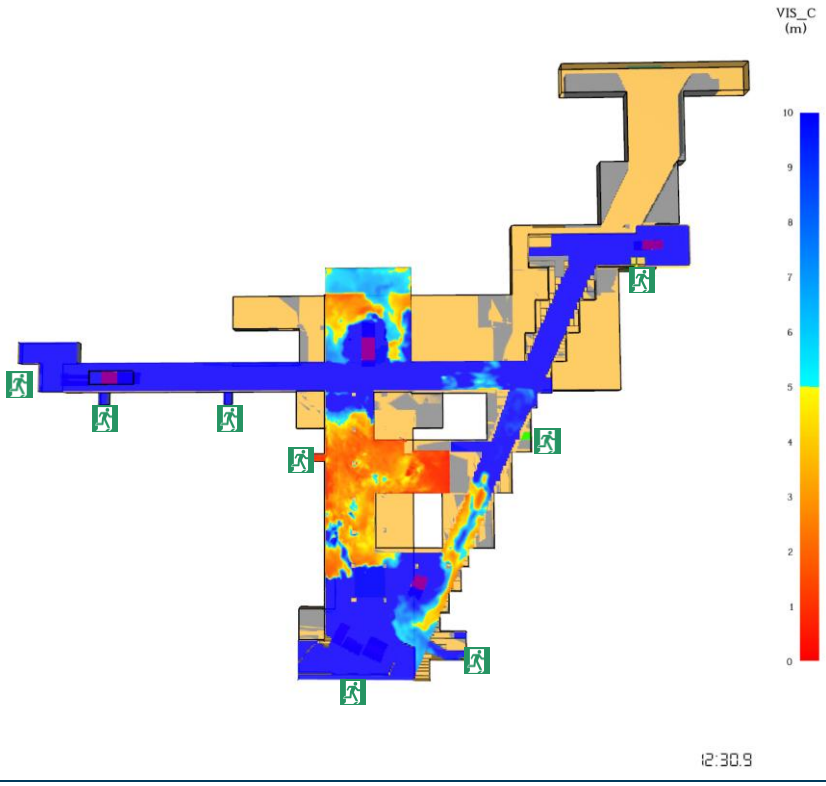
Timeline (mm:ss)	**The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.**
15:00 minutes End of modelling duration. With the exception of the fire affected floor, and the area around the Victoria Avenue void, visibility exceeds 10m for the majority of the mall on all levels above the fire.	

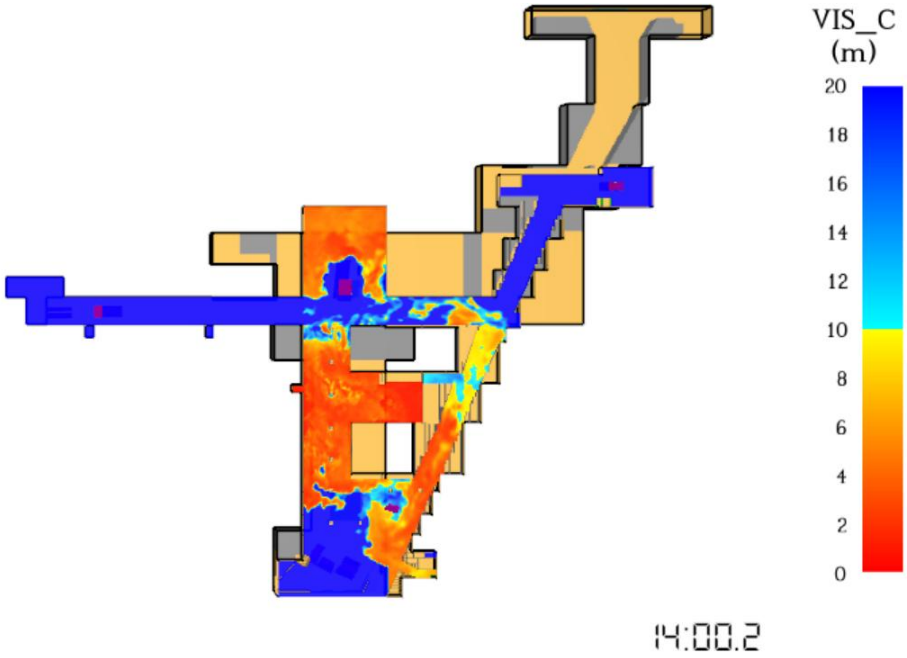
H.7.3 Visibility at 2m above floor level

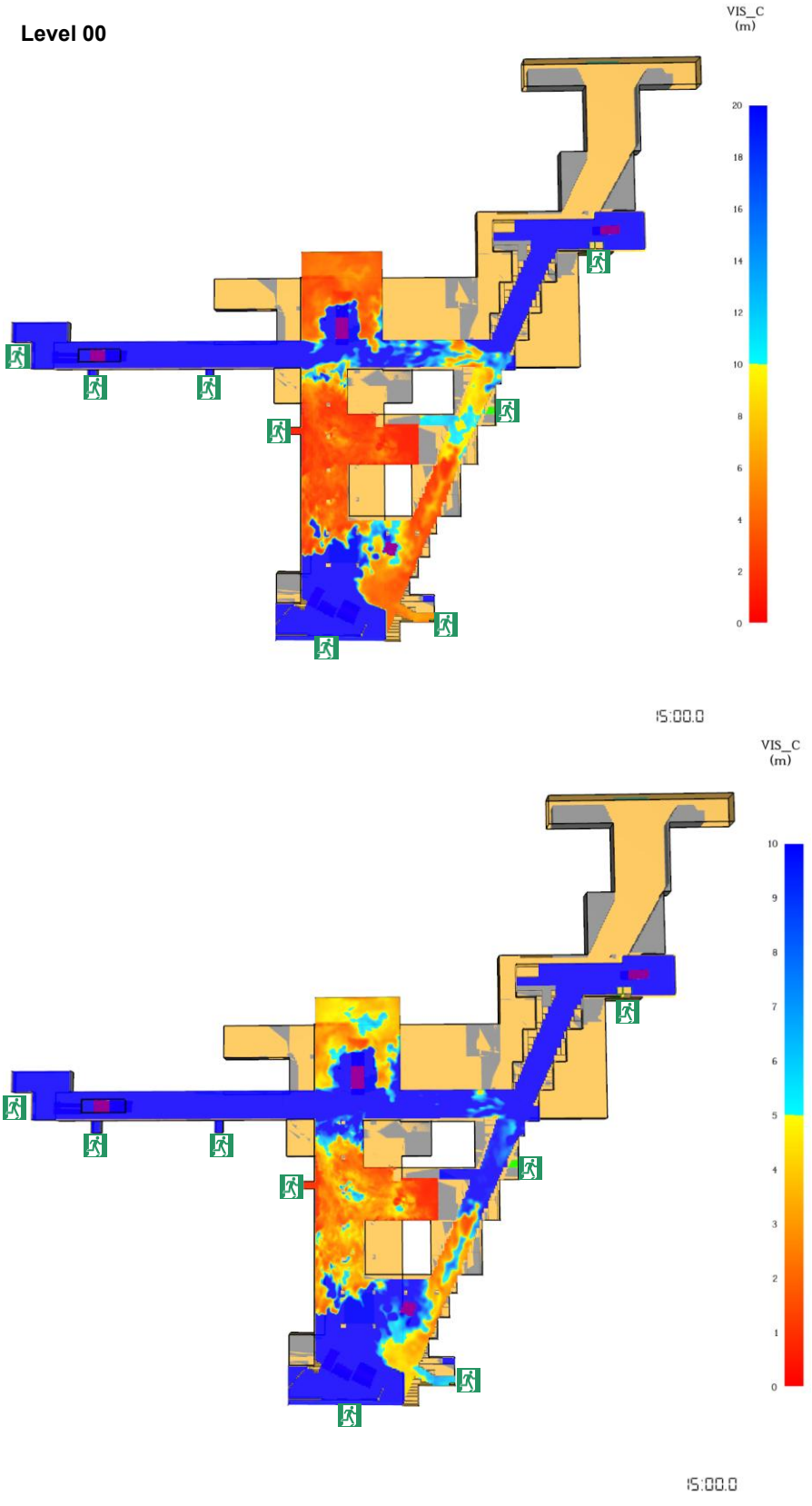
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:35 minutes Visibility exceeds 10 m for the majority of L00 with exception of the mall area in front of the fire-affected tenancy. Stair 8 fire-isolated exit from Zone 7 on L00 considered blocked for this scenario. All occupants within the L00 smoke zone 7 have either moved away from the impacted smoke zones or are queuing at the Victoria Avenue exit.	
4:16 minutes Visibility maintained above 10 m of the majority of L00 except for the mall area in front of the fire-affected tenancy. Visibility exceeds 10 m at the Victoria Avenue mall exit. All occupants within the L00 smoke zone 7 have either moved away from the impacted smoke zones or evacuated through the Victoria Avenue mall exit.	

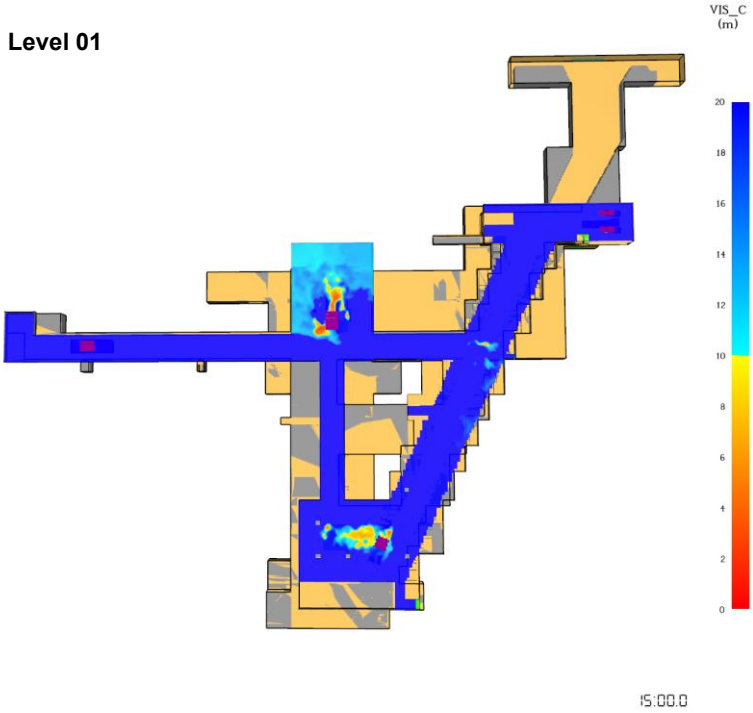
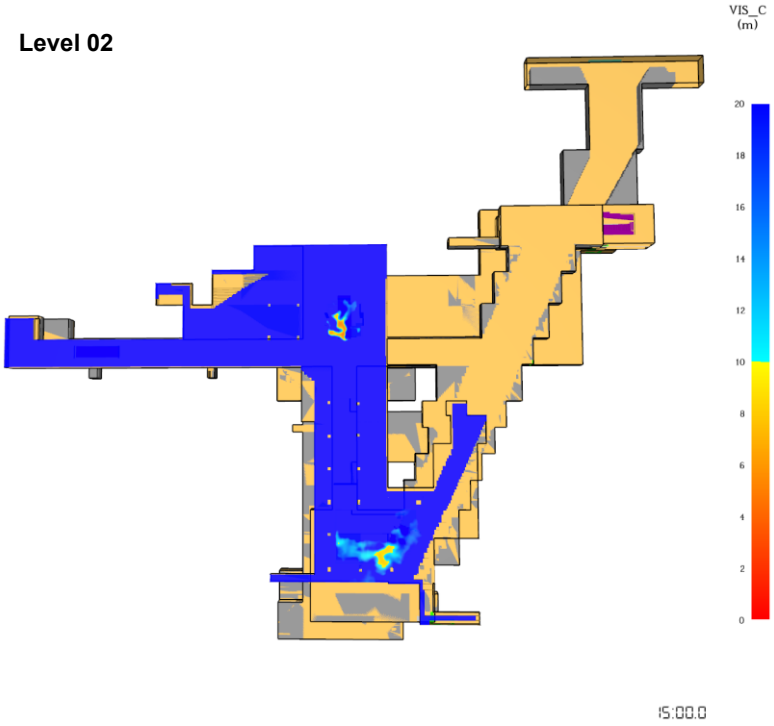
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
6:24 minutes Required time for occupants within the fire-affected smoke zone to evacuate to an exit or an adjacent zone with a 1.5x safety factor. Visibility within the central mall area of smoke zone 7 on L00 is below 10 m. However apart from Stair 8 fire-isolated corridor in L00 smoke zone 7 visibility exceeds 10 m at all exits within L00.	**Level 00** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
8:09 minutes Except for L00 smoke zone 7, visibility exceeds 10 m for the majority of L00. Apart from the Stair 8 fire-isolated corridor in L00 smoke zone 7 and the Victoria Avenue exit, visibility exceeds 10 m at all exits within L00. All occupants within the L00 have evacuated. Visibility exceeds 5m throughout L00 except for the area of the mall directly outside the tenancy of origin.	**Level 00**  

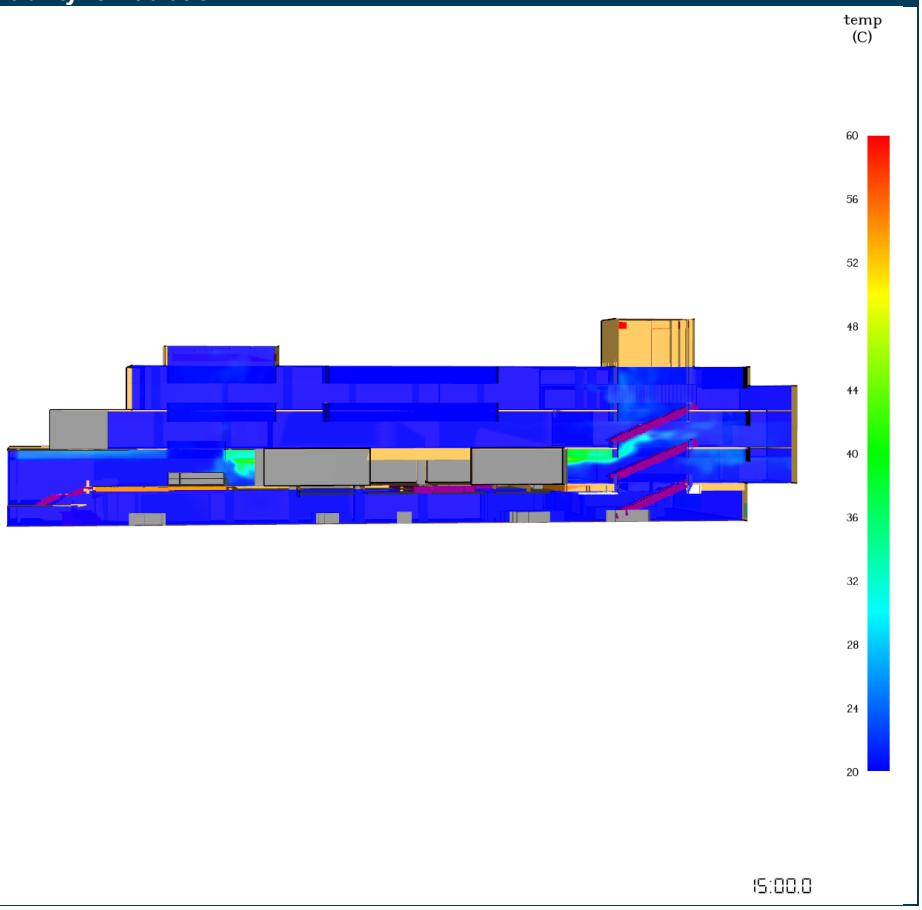
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
12:30 minutes ASET for the affected smoke zone. Required time for occupants within remainder of level 00 mall to evacuate to an exit with a 1.5x safety factor. Except for L00 smoke zone 7, visibility falls below 10 m within the central and south-eastern portions of the L00 mall area. Apart from the Stair 8 fire-isolated corridor in L00 smoke zone 7 visibility exceeds 5 m at all exits within L00.	**Level 00**  

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
14:00 minutes Steady state reached for this fire scenario.	

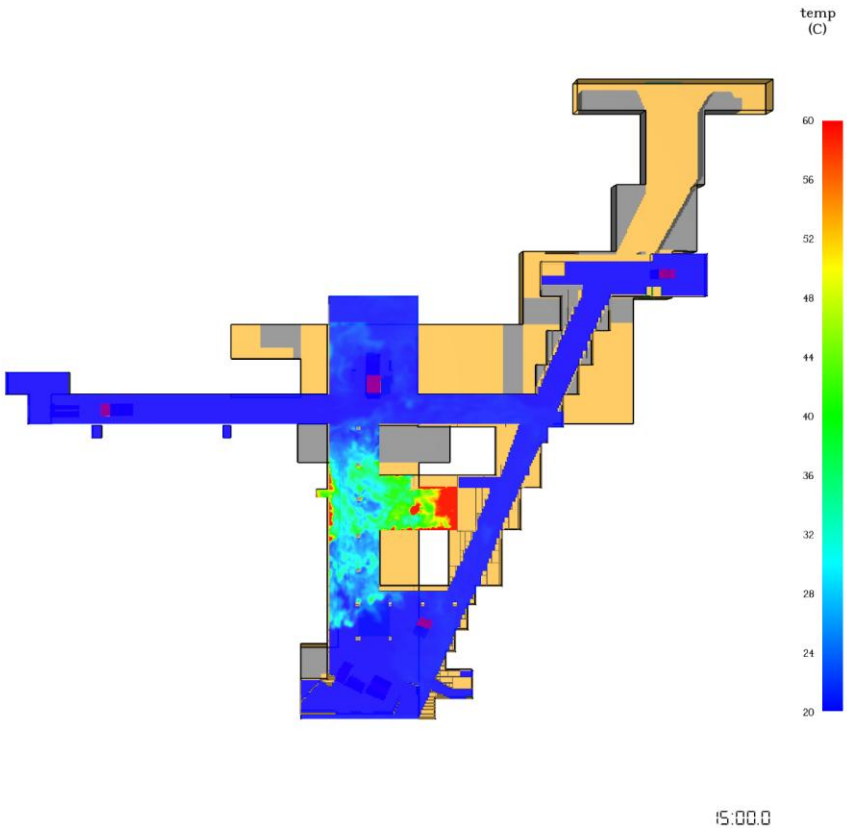
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Except for the Stair 8 fire-isolated corridor in L00 smoke zone 7 and stair 6, visibility exceeds 5 m at all exits within L00.	**Level 00** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10 m for the levels above, with the exception of localised areas adjacent to the Victoria Avenue void. Visibility at all exits on the levels above exceed 10 m.	**Level 01**  **Level 02** 

H.7.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

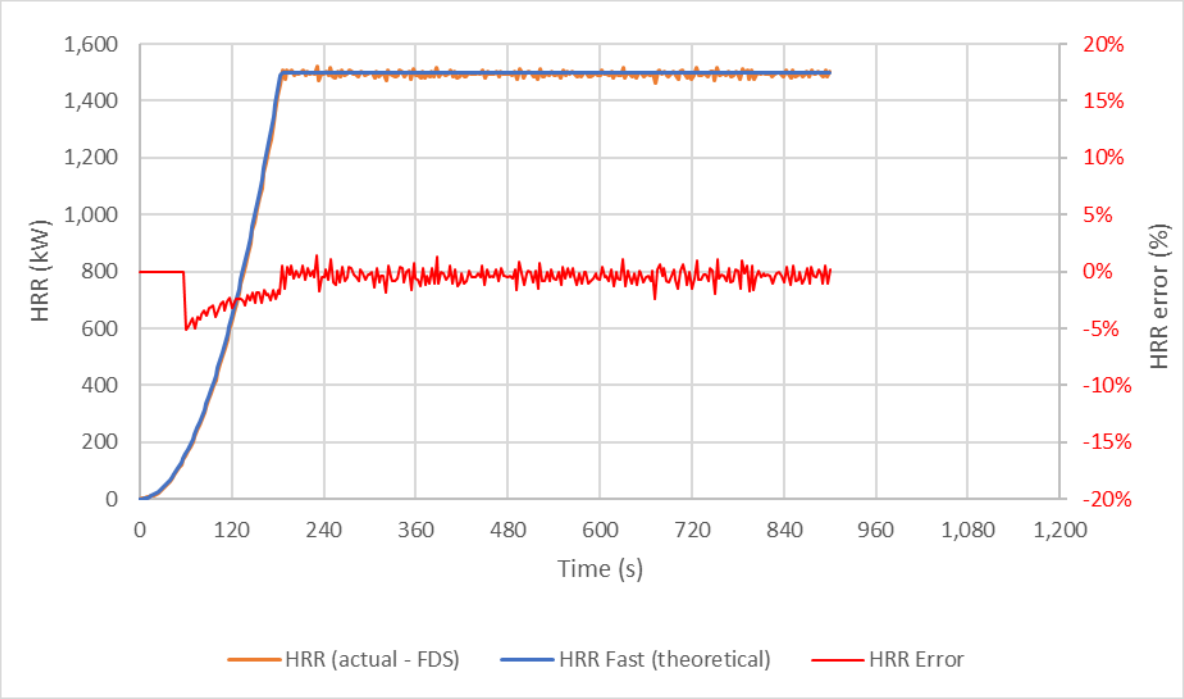
H.7.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, except for the area around the fire.	

H.7.6 Error checking

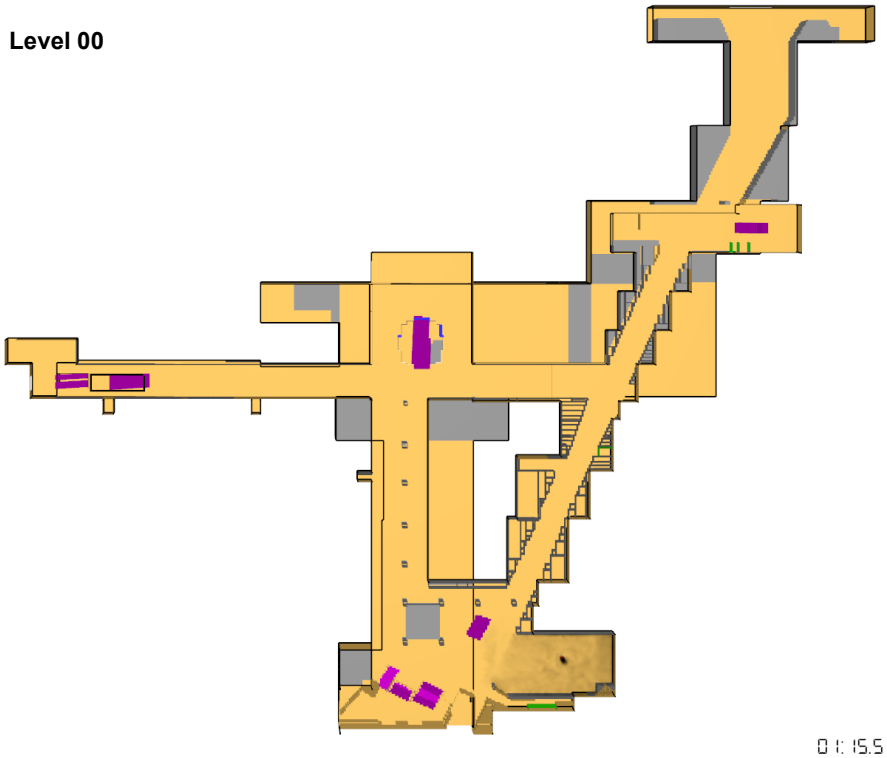
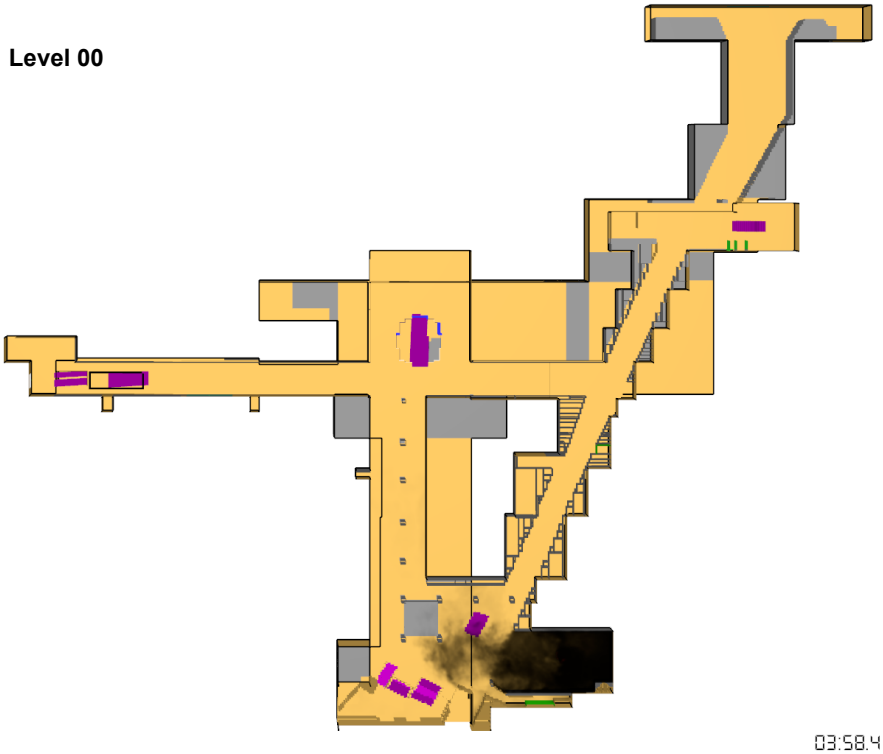
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

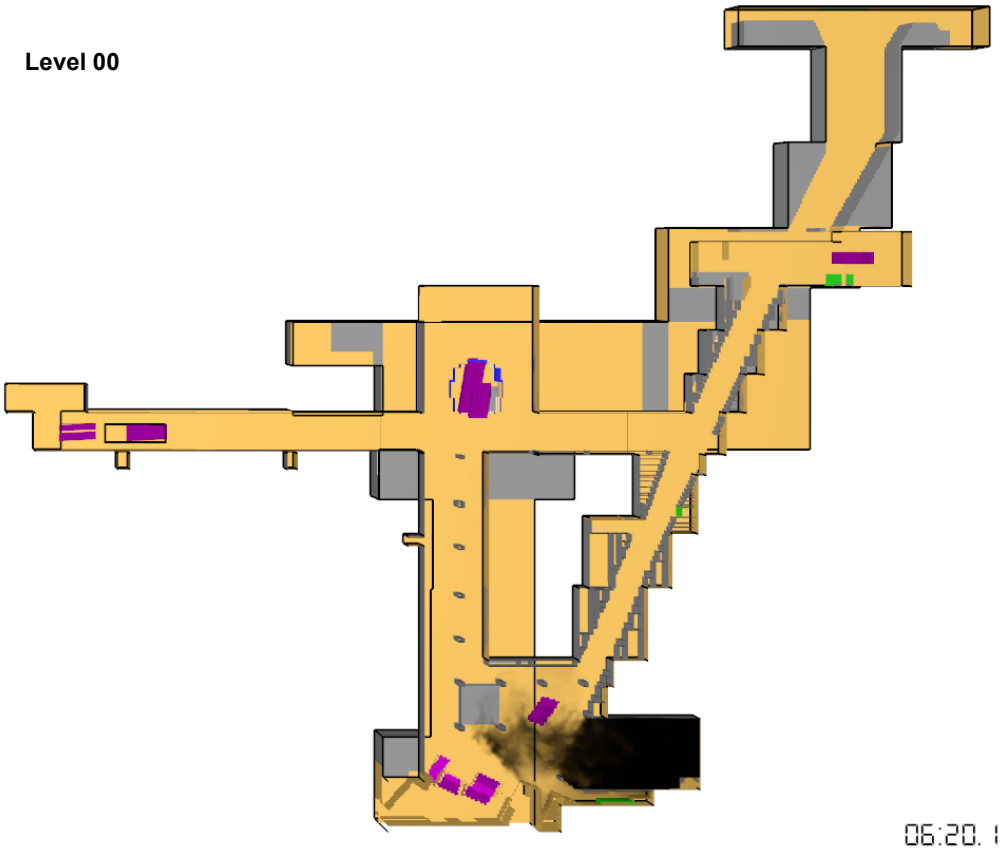
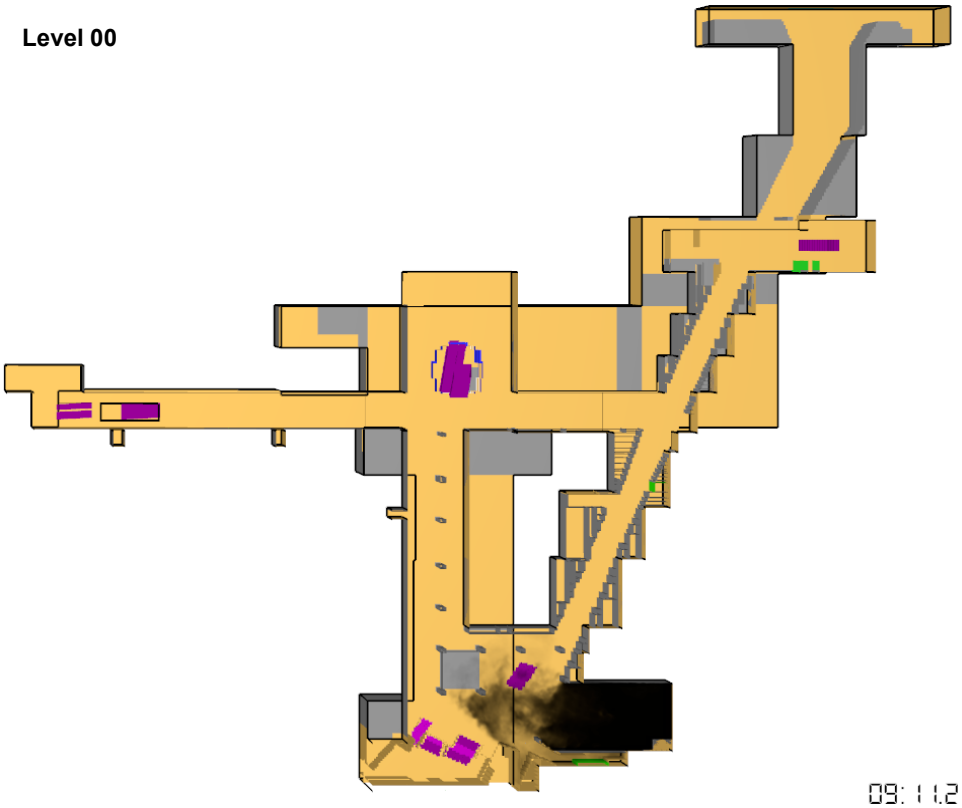


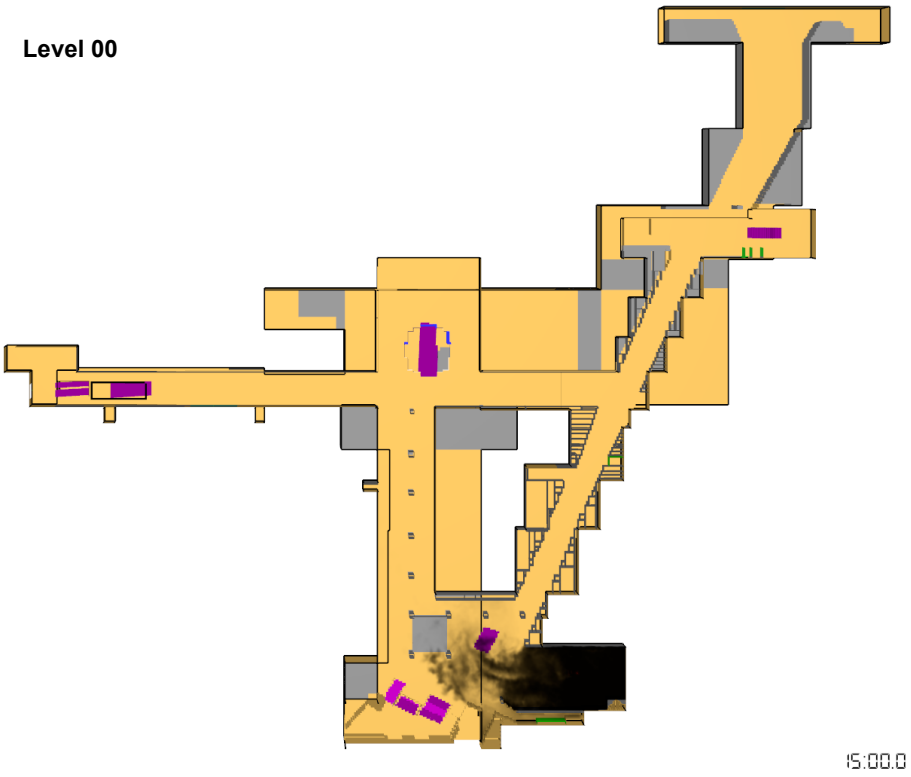
H.8 Scenario 5 results – Fire in Tenancy G-031 (L00) [91]

H.8.1 Smoke spread

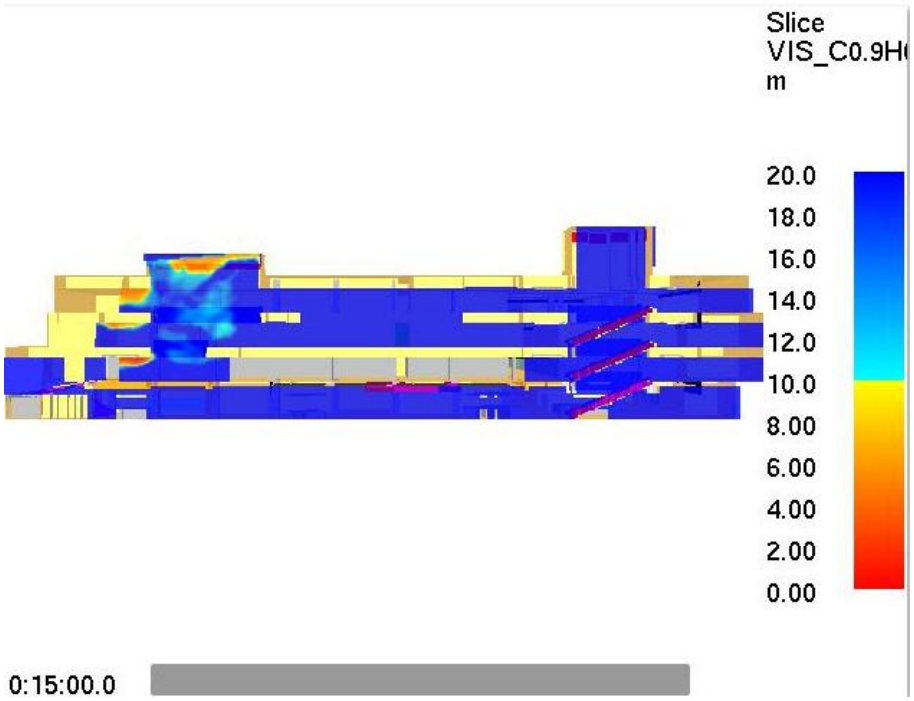
Timeline (mm:ss)	
1:15 minutes Smoke begins to spread out of fire-affected tenancy. Occupants within smoke zone 7 on L00 receive visual cues of the fire.	**Level 00** 
3:58 minutes Smoke continues to spread out of the tenancy and into L00 smoke zone 7. Smoke begins spreading up the Victoria Avenue void and is exhausted at the top of the void. All occupants within the L00 smoke zone 7 have either moved away from the impacted smoke zones or queuing at the Victoria Avenue exit.	**Level 00** 

[91] Jensen Hughes, 2025, Fire in tenancy B-301 sensitivity–S6j.fds

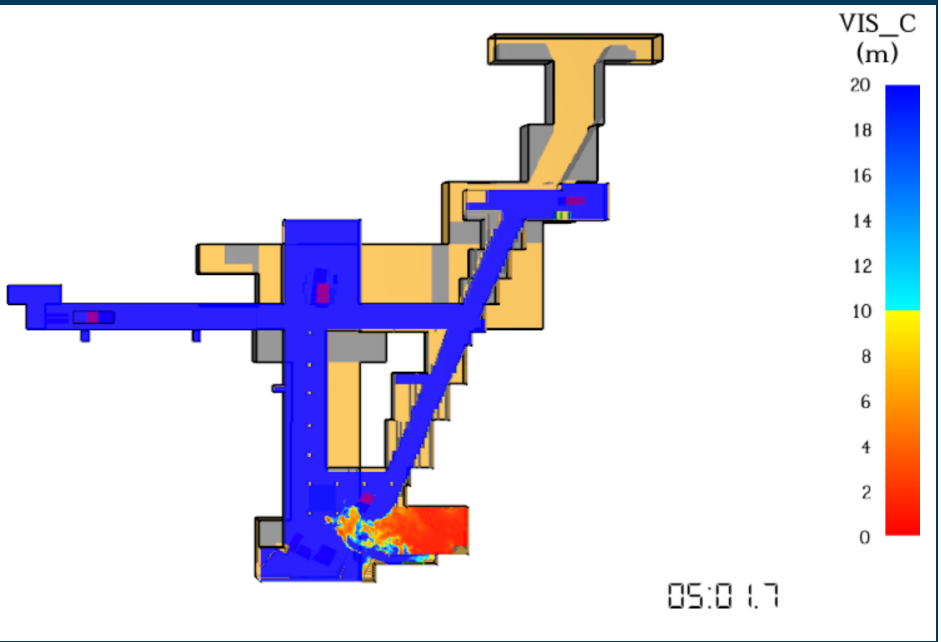
Timeline (mm:ss)	
6:20 minutes Smoke continues to spread through the smoke zone and up the Victoria Avenue void. All occupants within the impacted zone 7 on level 00 have evacuated.	**Level 00** 
9:11 minutes Smoke continues to spread through the smoke zone and up the Victoria Avenue void. All occupants within level L00 have evacuated.	**Level 00** 

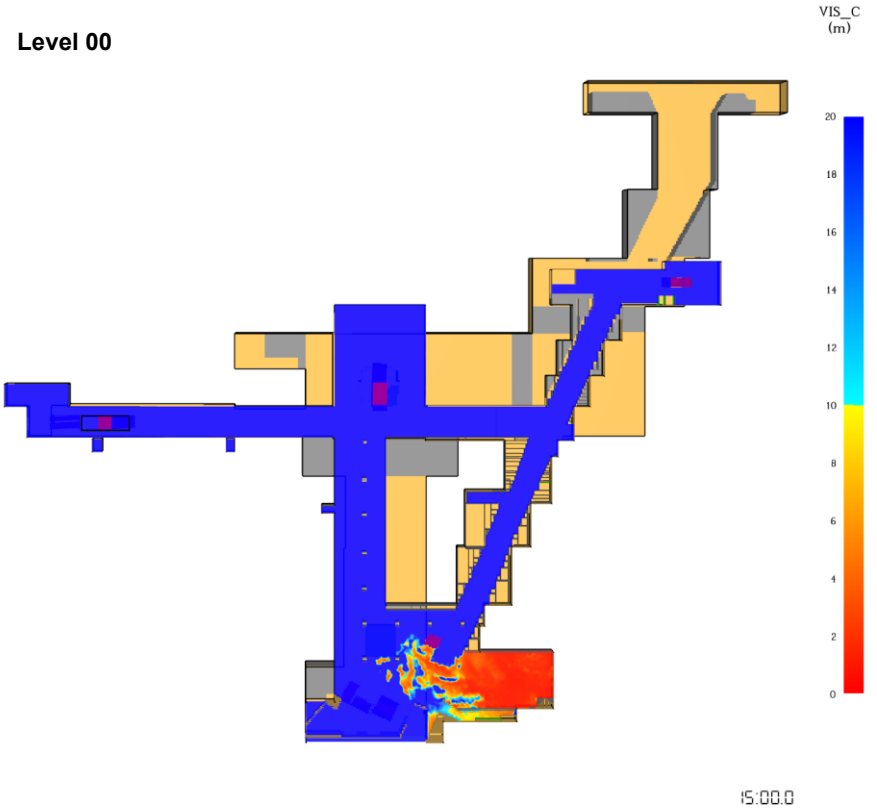
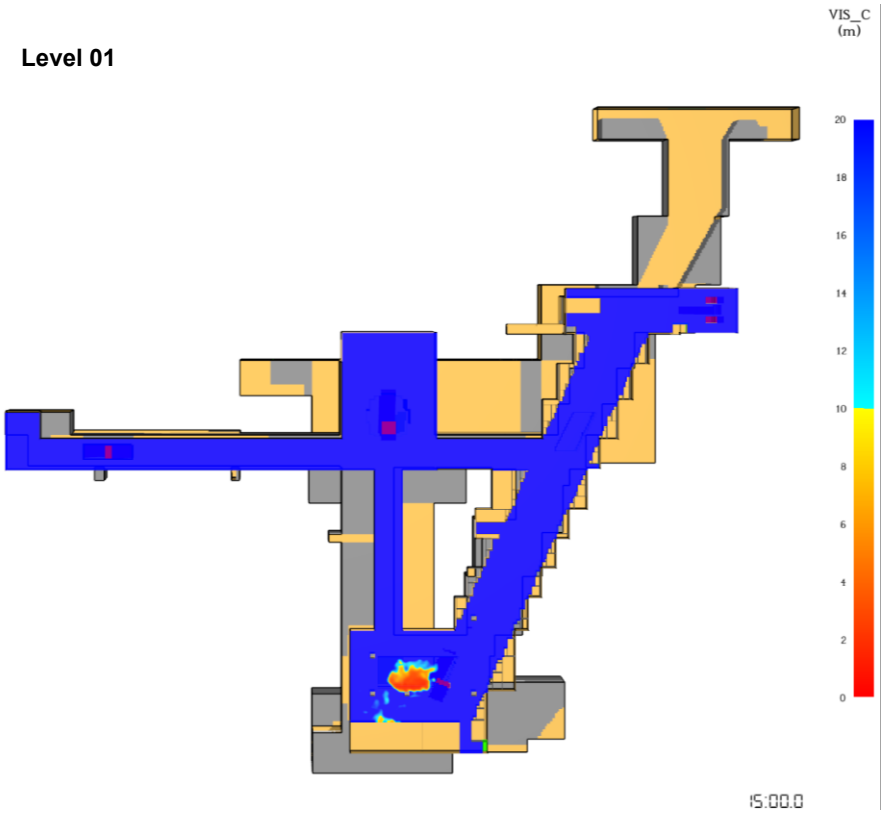
Timeline (mm:ss)	
15:00 minutes Smoke spread limited to the southern portion of smoke zone 7.	**Level 00** 

H.8.2 Visibility – section

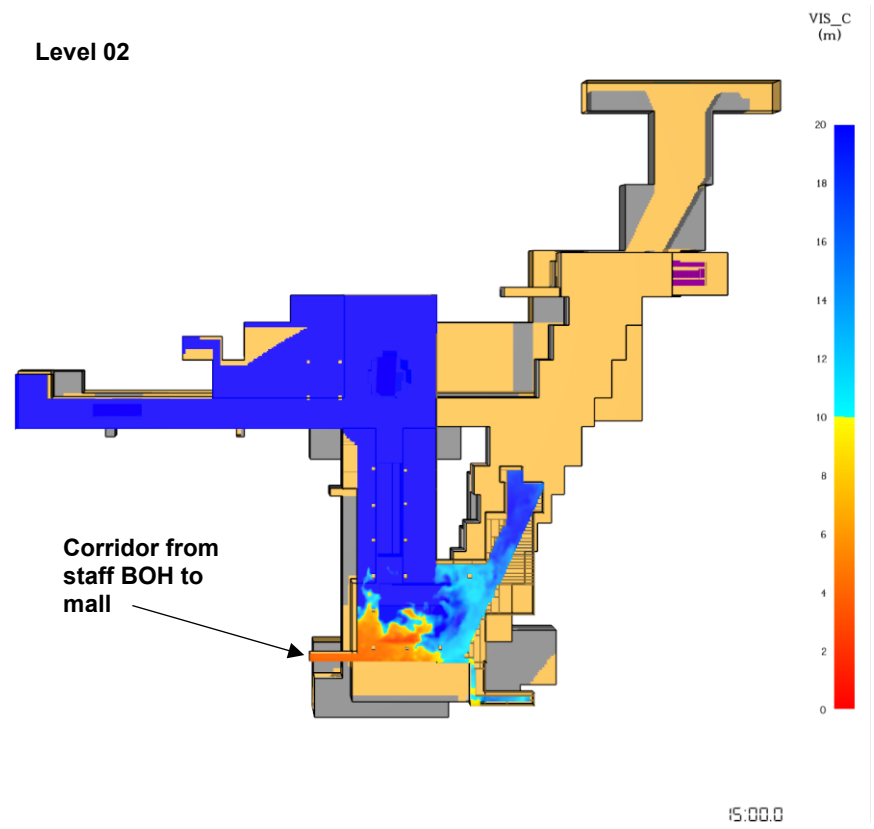
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. With the exception of the fire affected floor, and the area around the Victoria Avenue void, visibility exceeds 10 m for the majority of the mall on all levels above.	

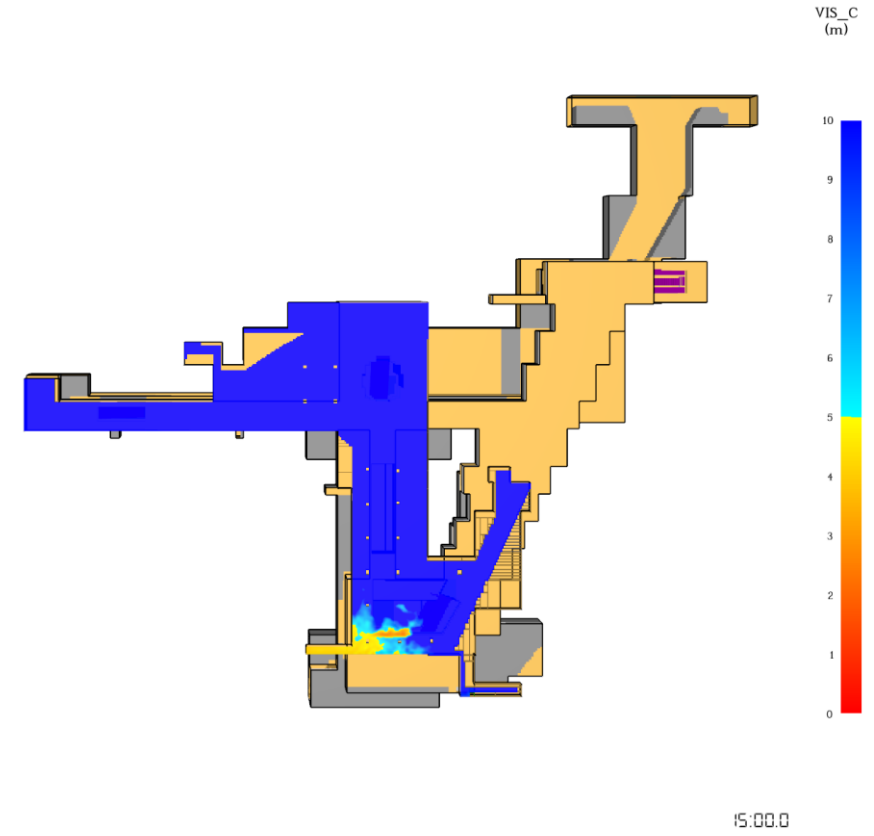
H.8.3 Visibility at 2m above floor level

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
5:00 minutes Steady state reached for this fire scenario.	

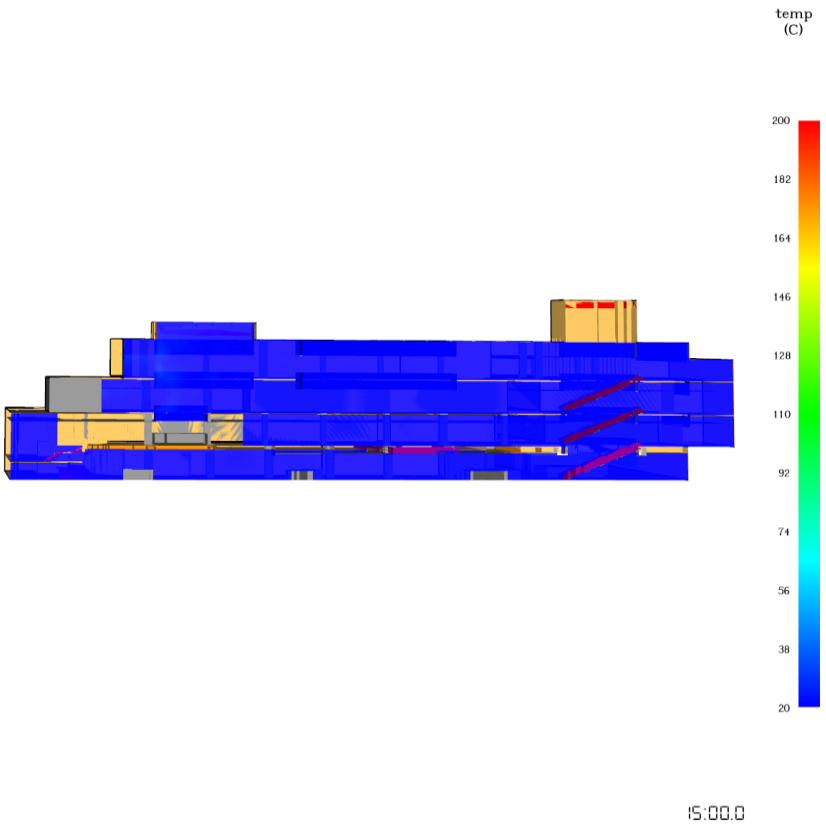
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility within the majority of the mall exceeds 10 m on L00. Except for Stair 6 (which has been considered blocked in this scenario), visibility exceeds 10 m at all other exits on L00. On the levels above visibility exceeds 10 m throughout level L01. All exits on the level remain available. Visibility exceeds 10 m level L02, except for the south-eastern mall and the corridor from a staff back of house area (which has access directly to a fire stair), to the mall. Visibility at all exits remain above 5 m on this level.	**Level 00**  **Level 01** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.

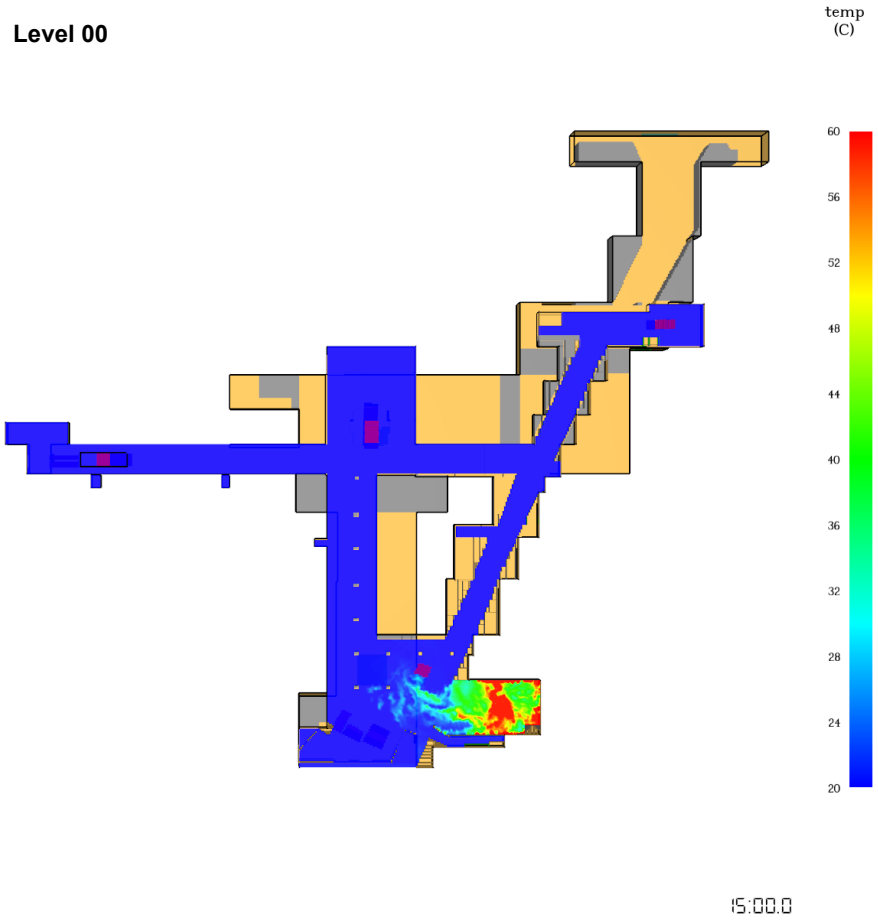




H.8.4 Temperature section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20°C. The colour red indicates temperatures greater than 200°C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

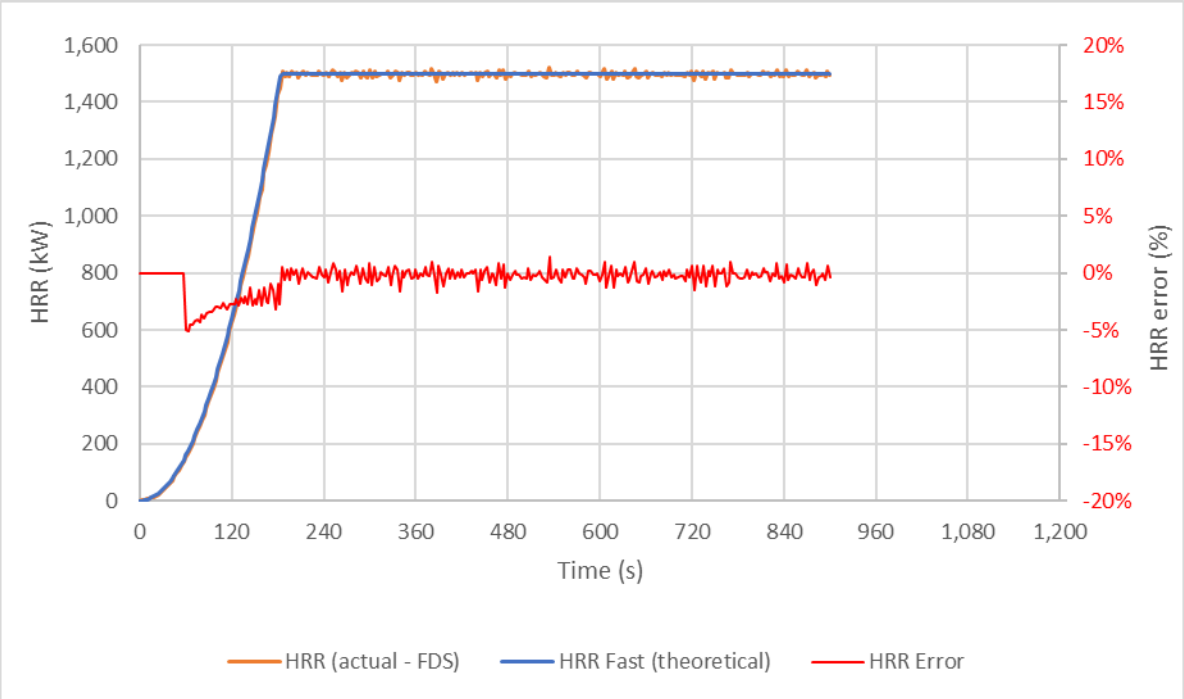
H.8.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, with the exception of the area around the fire.	**Level 00** 

H.8.6 Error checking

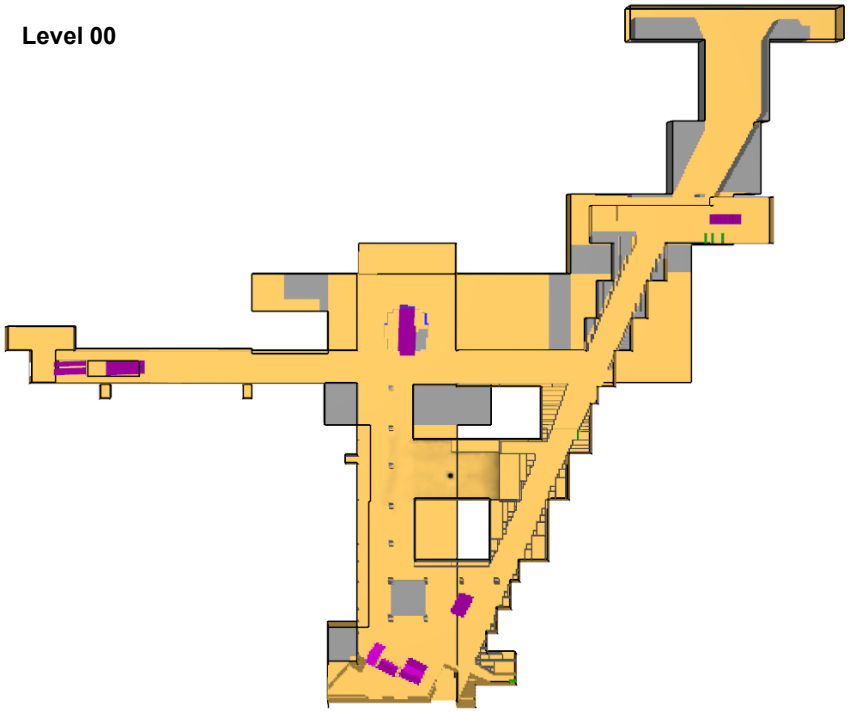
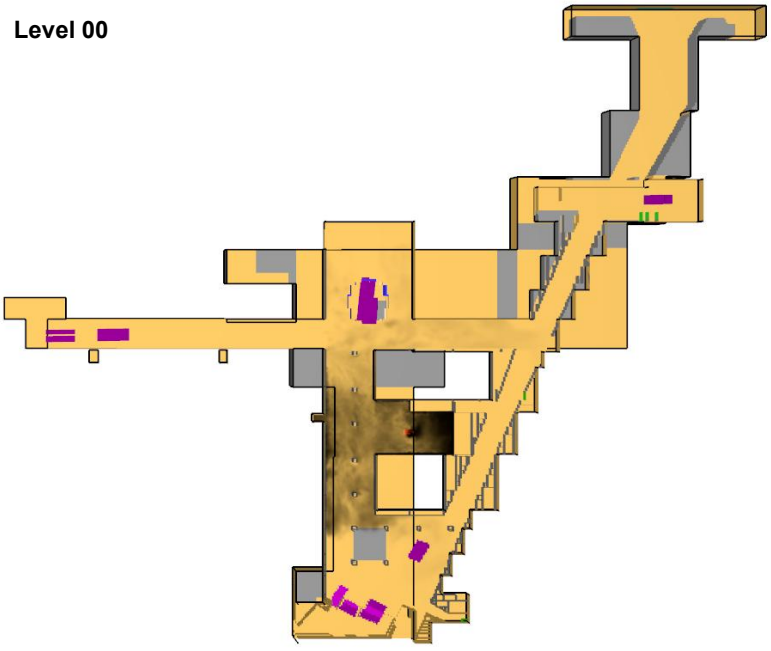
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

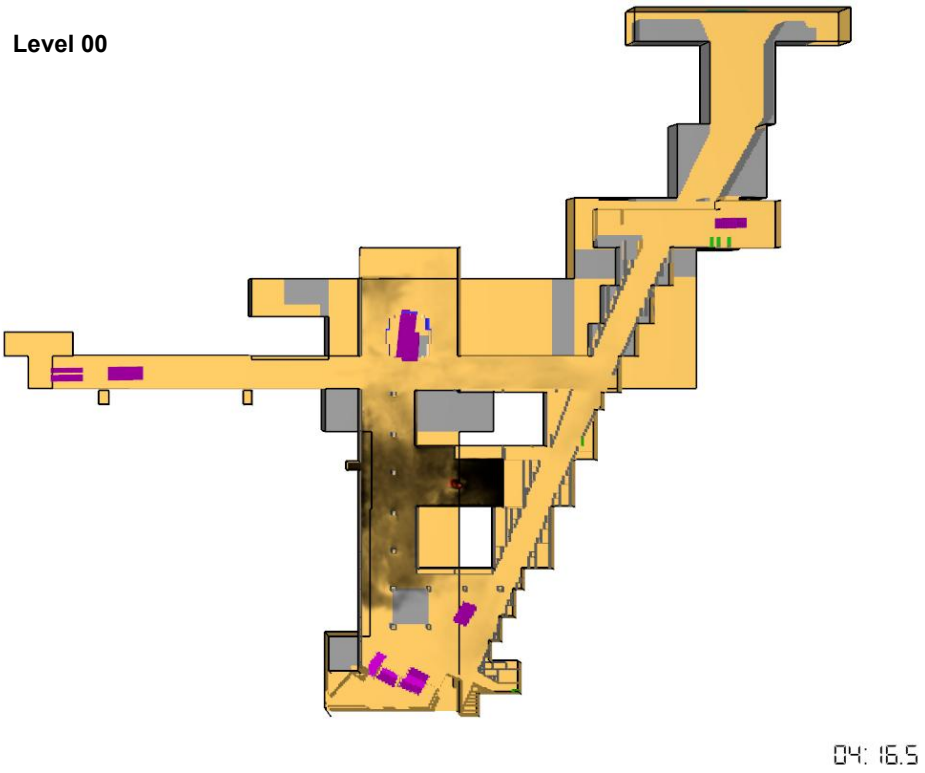
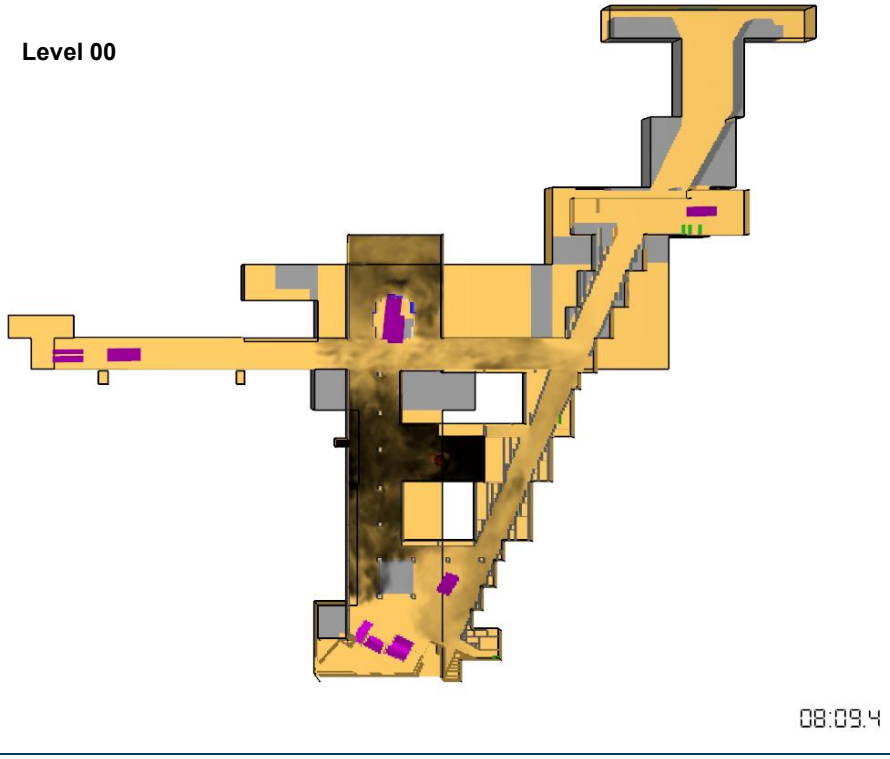


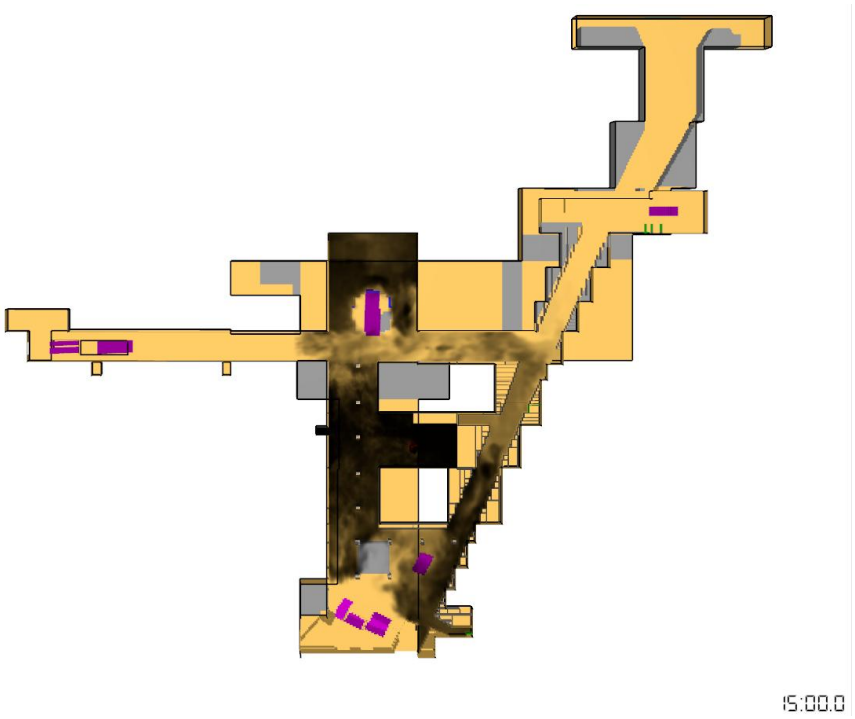
H.9 Scenario 6 results – Fire in Tenancy G-034 (L00)[92] – Sensitivity

H.9.1 Smoke spread

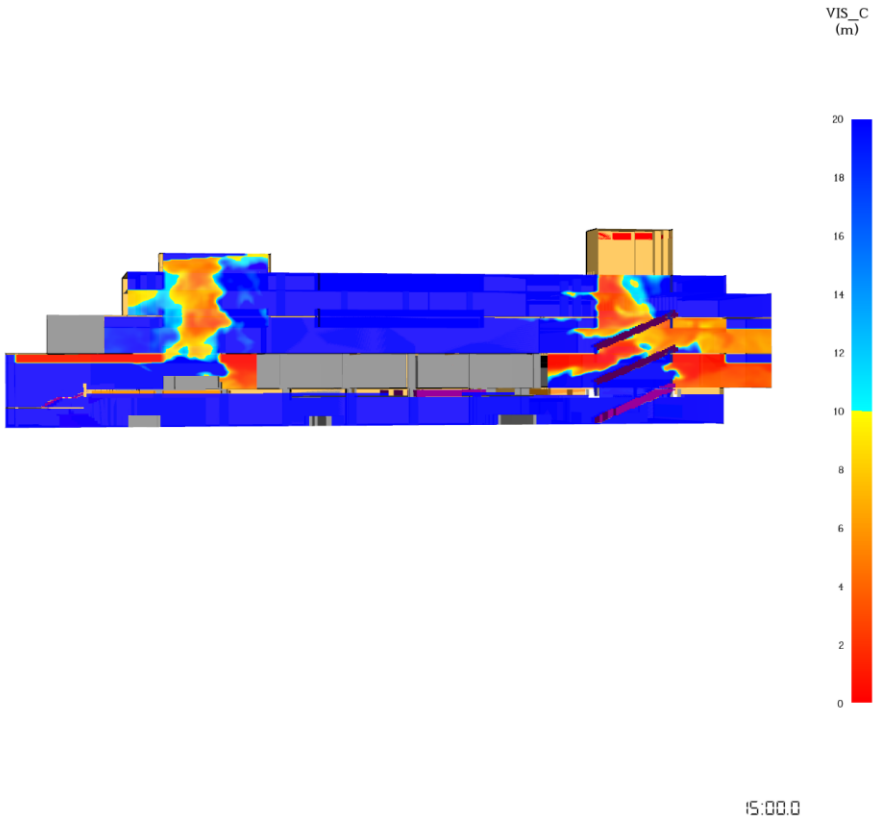
Timeline (mm:ss)	
1:10 minutes Smoke begins to spread out of fire-affected tenancy. Occupants within smoke zone 7 on L00 receive visual cues of the fire.	**Level 00** 
3:35 minutes Smoke continues to spread out of the tenancy and into L00 smoke zone 7. Smoke begins spreading up the Victoria Avenue void and is exhausted at the top of the void. All occupants within the L00 smoke zone 7 have either moved away from the impacted smoke zones or queuing at the Victoria Avenue exit.	**Level 00** 

[92] Jensen Hughes, 2025, Fire in tenancy G-034 sensitivity–S9a.fds

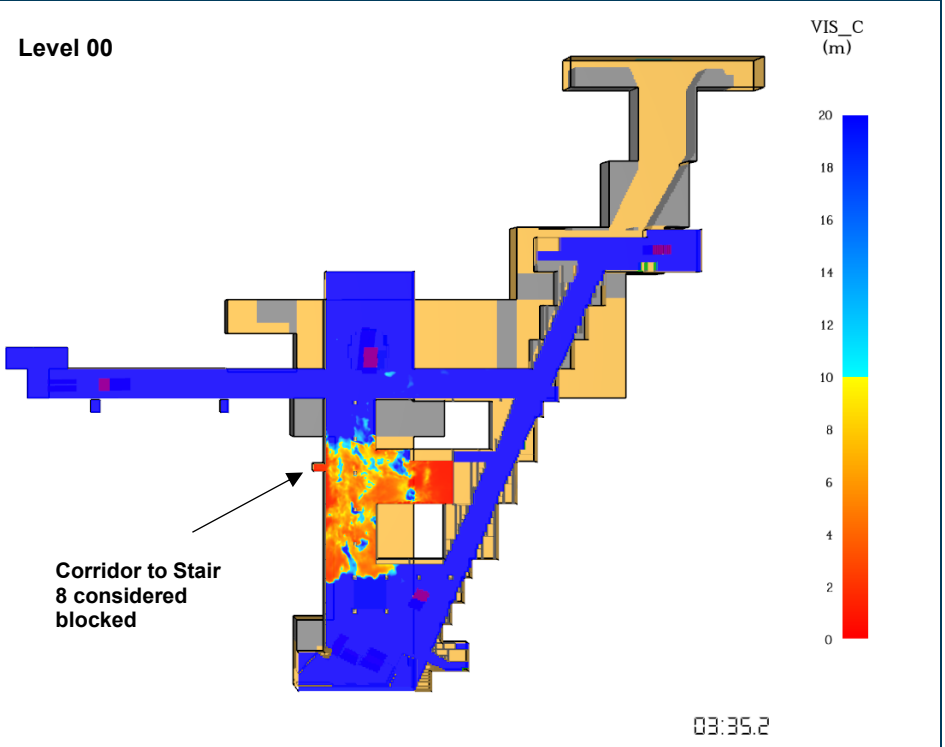
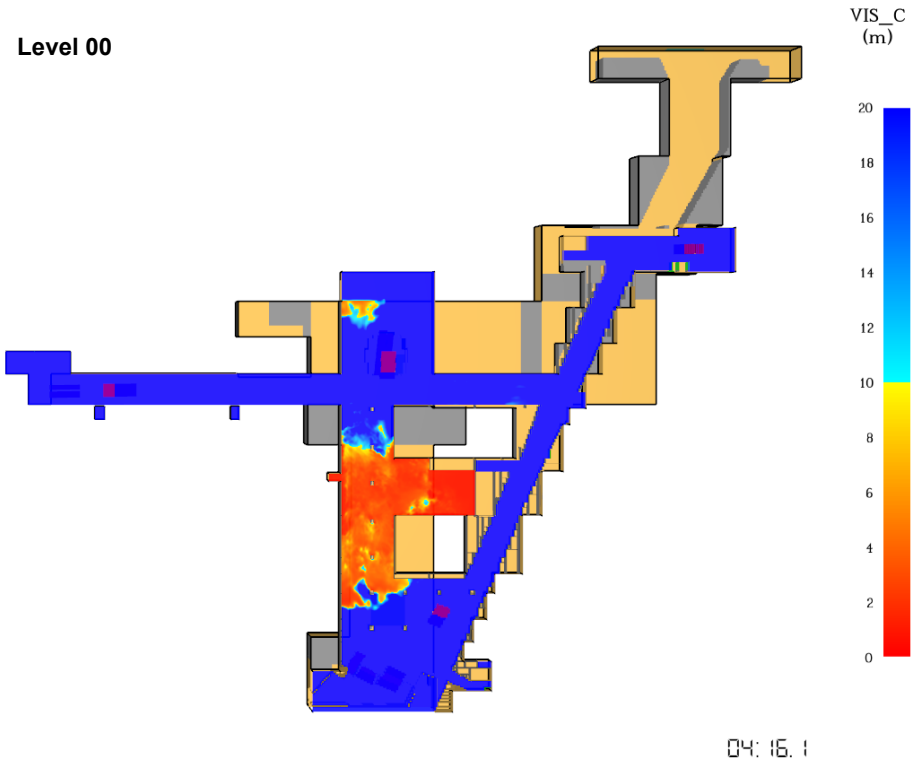
Timeline (mm:ss)	
4:16 minutes Smoke continues to spread out of the tenancy and into L00 smoke zone 7. Smoke begins spreading up the Victoria Avenue void and where it is exhausted at the top of the void. All occupants within the L00 smoke zone 7 have either exited or moved away from the smoke zone.	
8:09 minutes Smoke continues to throughout smoke zone 7 on L00. Smoke begins spreading to Havilah St zone (smoke zone 13) All occupants within the L00 have evacuated.	

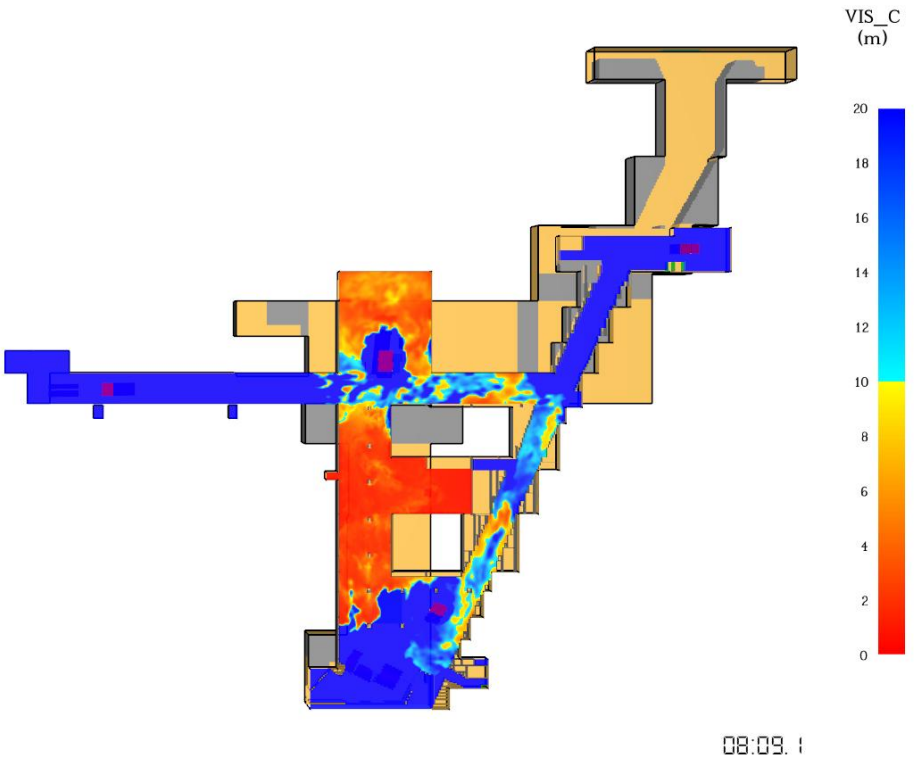
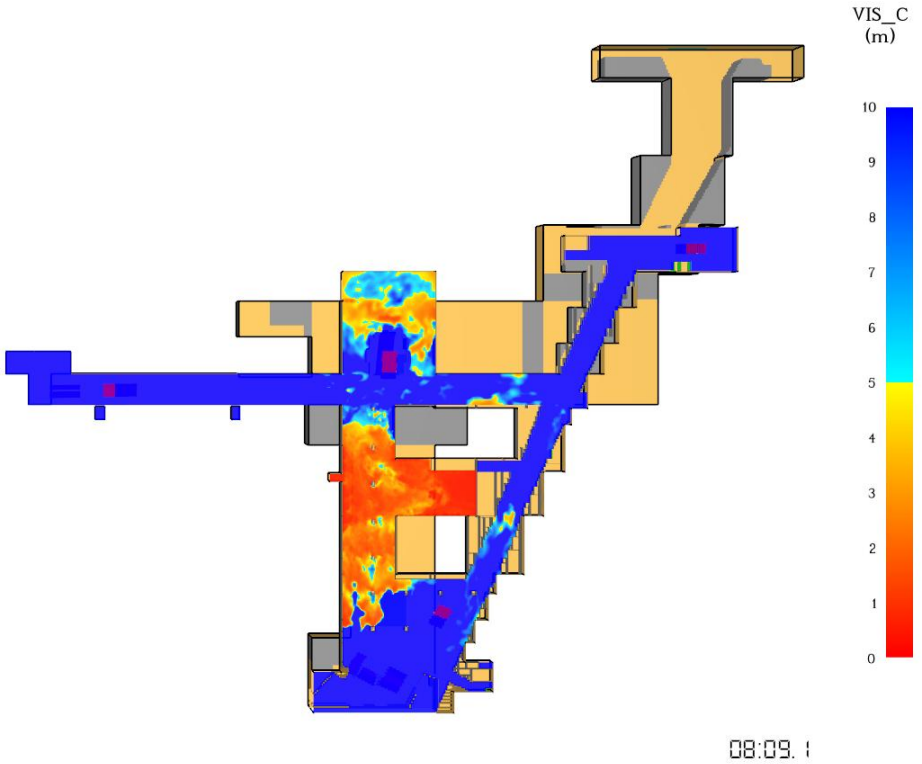
Timeline (mm:ss)	
15:00 minutes Smoke has spread throughout L00 smoke zone and into the Havilah St zone (smoke zone 13).	

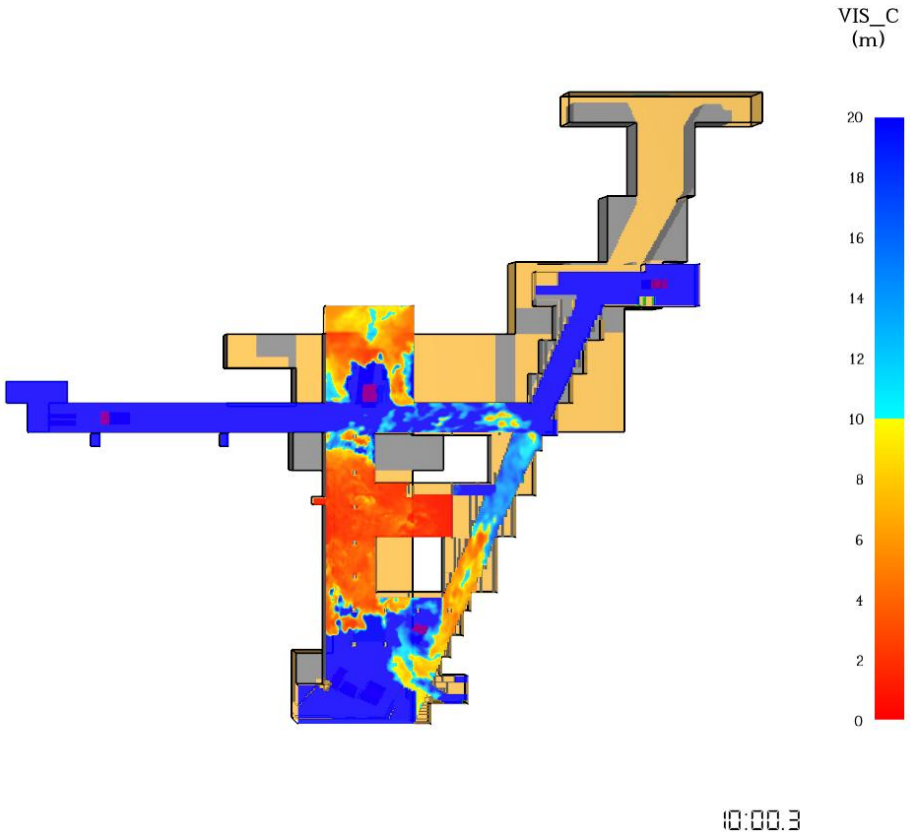
H.9.2 Visibility – section

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. With the exception of the fire affected floor, and the area around the central atrium and Victoria Avenue voids, visibility exceeds 10m for the majority of the mall on all levels above.	

H.9.3 Visibility at 2m above floor level

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:35 minutes Smoke continues to spread out of the tenancy and into L00 smoke zone 7. Smoke begins spreading up the Victoria Avenue void and is exhausted at the top of the void. Stair 8 fire-isolated exit from Zone 7 on L00 considered blocked for this scenario. All occupants within the L00 smoke zone 7 have either moved away from the impacted smoke zones or queuing at the Victoria Avenue exit.	
4:16 minutes Visibility with the localised area of the mall adjacent to the fire-affected tenancy drops below 10 m. All occupants within the L00 smoke zone 7 have either exited or moved away from the smoke zone	

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
8:09 minutes Visibility in a significant portion of the mall area in front of the fire-affected tenancy drop below 10 m. Except for the corridor from L00 smoke zone 7 into Stair 8, visibility exceeds 5 m at the remaining exits within L00. Occupants throughout level 00 have evacuated via the available exits.	 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
10:00 minutes ASET for affected zone. Visibility in a significant portion Zone 7 on level 00 has dropped below 10 m. Tenability considered lost. Except for the corridor from L00 smoke zone 7 into Stair 8, visibility exceeds 10m at the remaining exits within L00.	

15:00 minutes

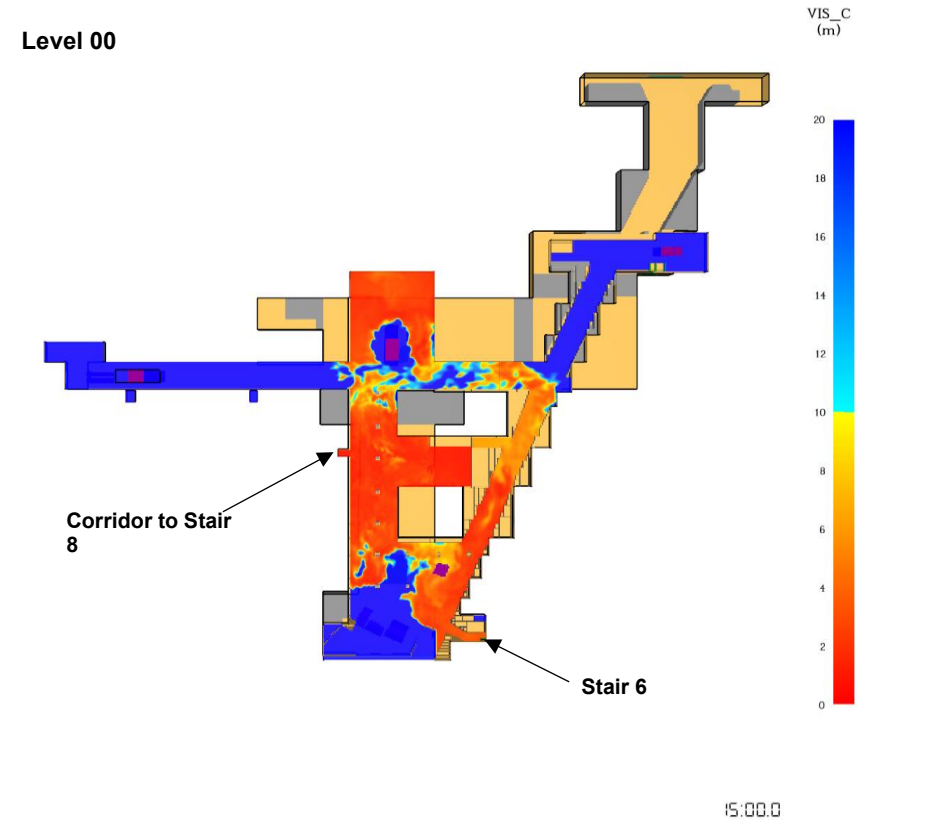
End of modelling duration.

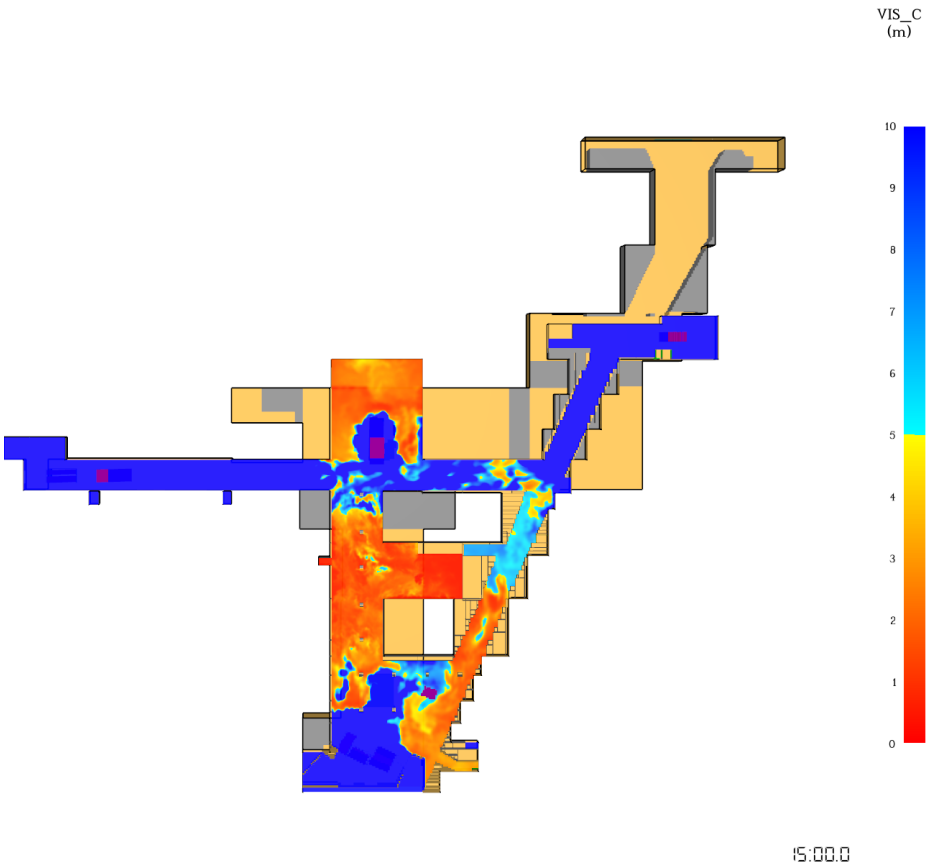
Except for the corridor from L00 smoke zone 7 into Stair 6 and 8, visibility exceeds 5 m at the remainder of exits within L00.

Visibility is below 10 m for the majority of L00 smoke zone 7.

On the levels above apart from localised areas adjacent to the central atrium and Victoria Avenue voids, visibility exceeds 10 m, including at all exits.

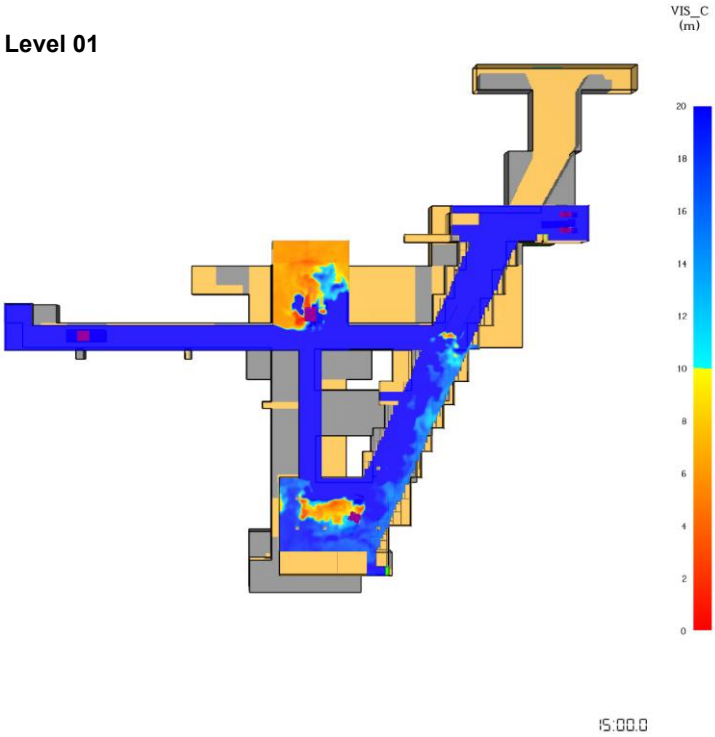
Level 00



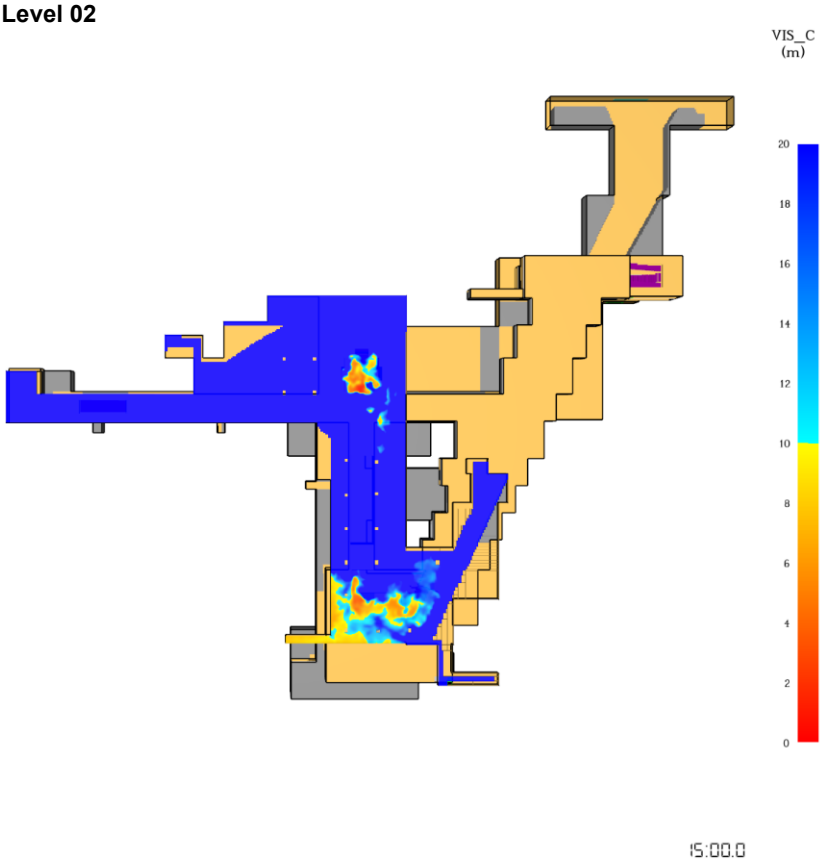


Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.

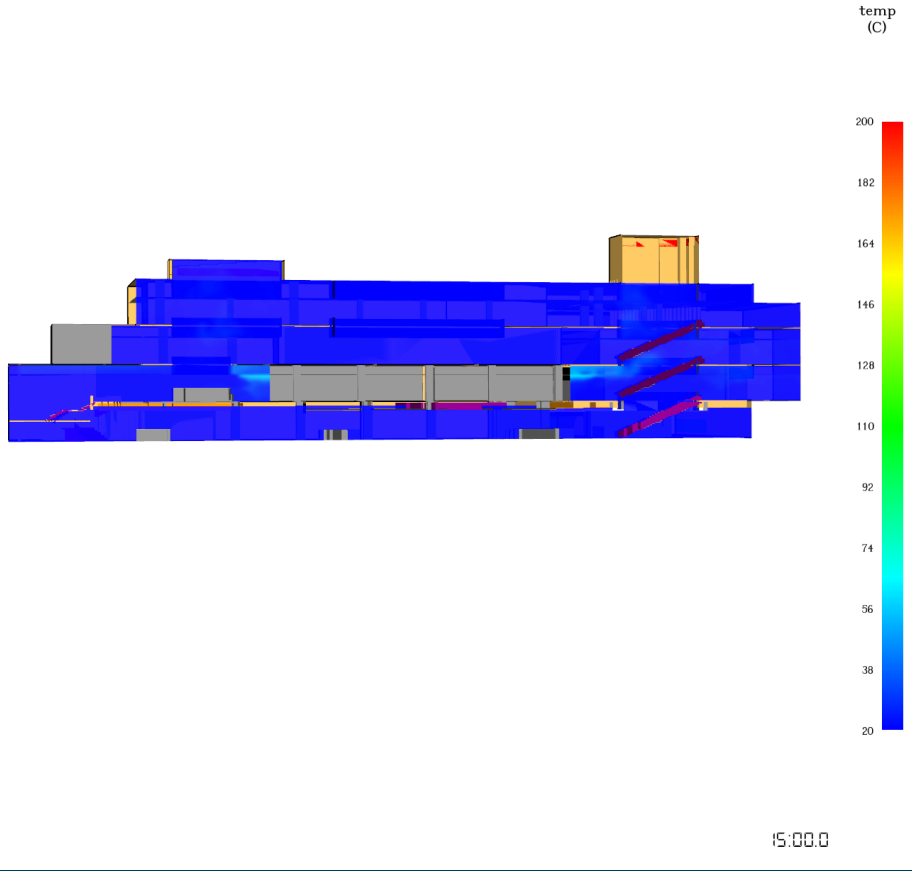
Level 01



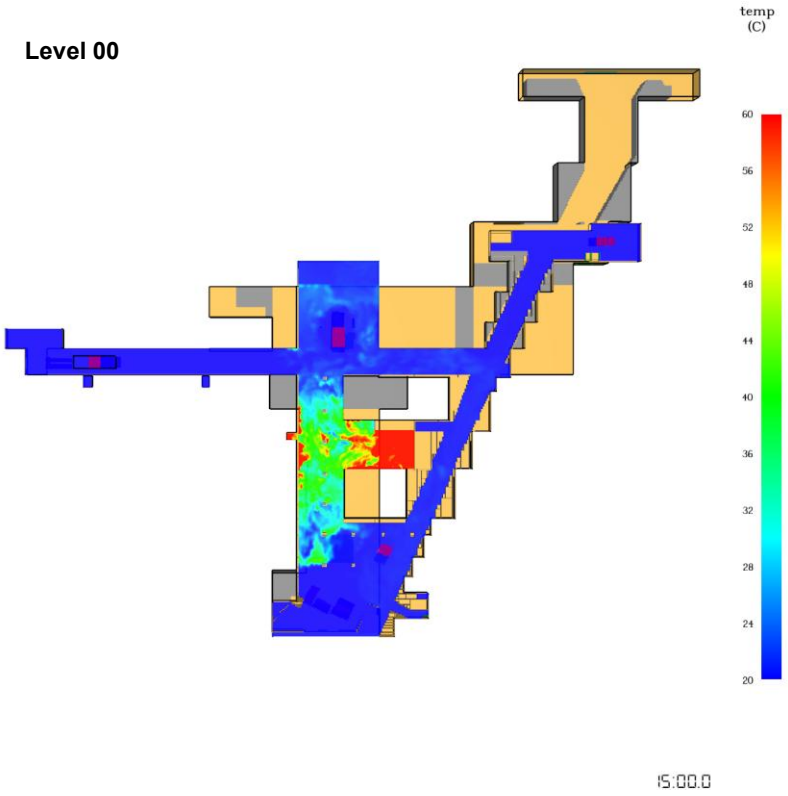
Level 02



H.9.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

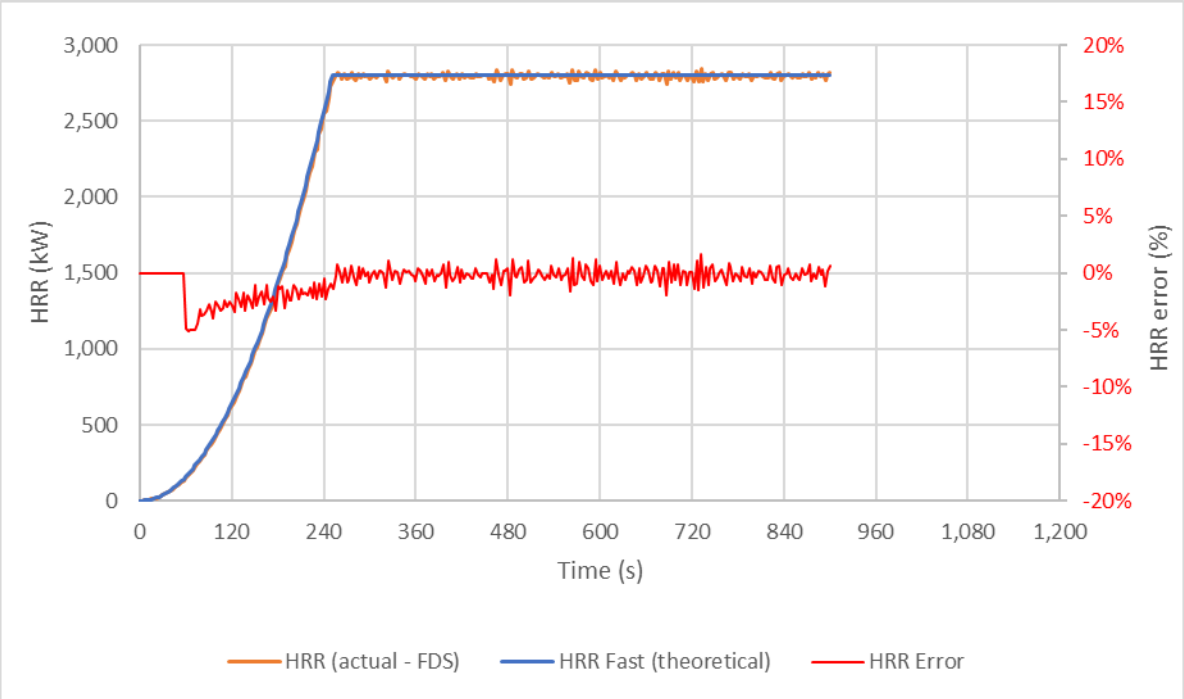
H.9.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, except for the area around the fire.	**Level 00** 

H.9.6 Error checking

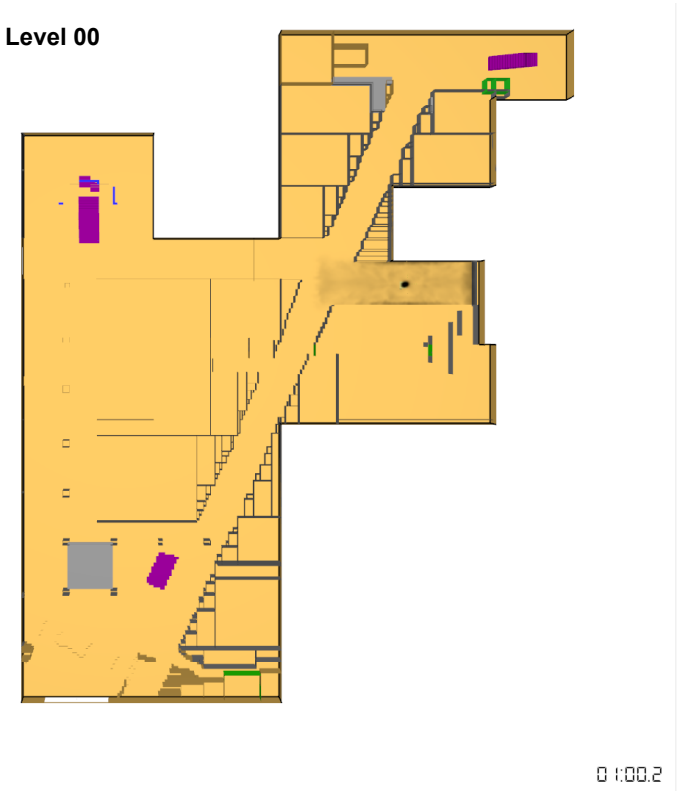
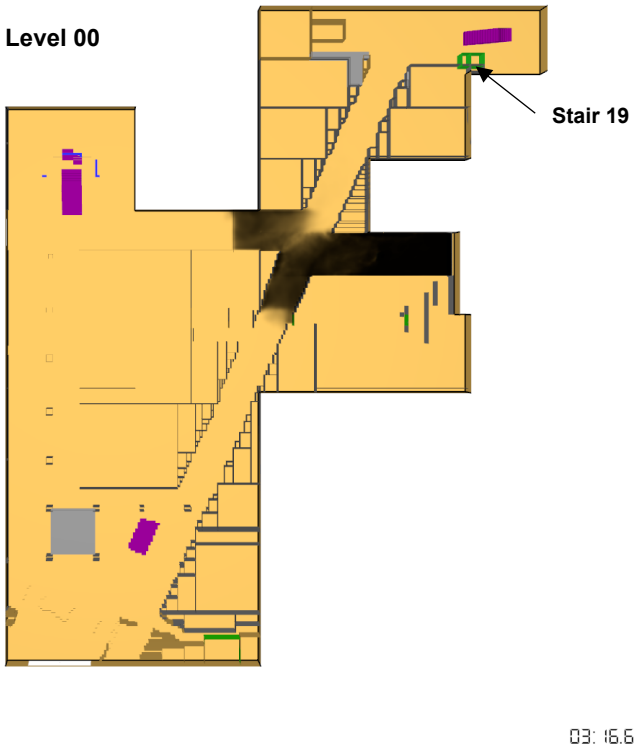
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

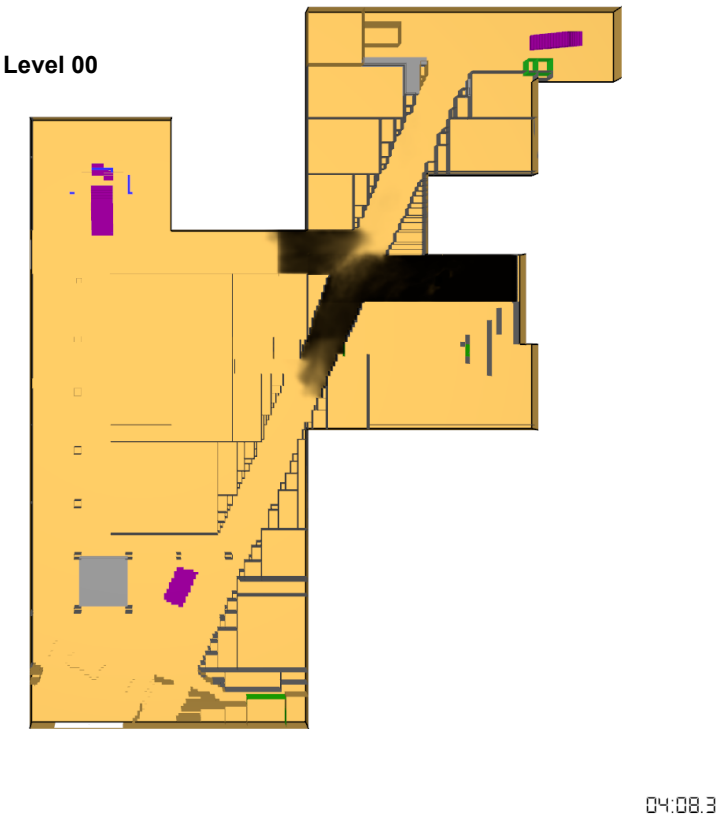
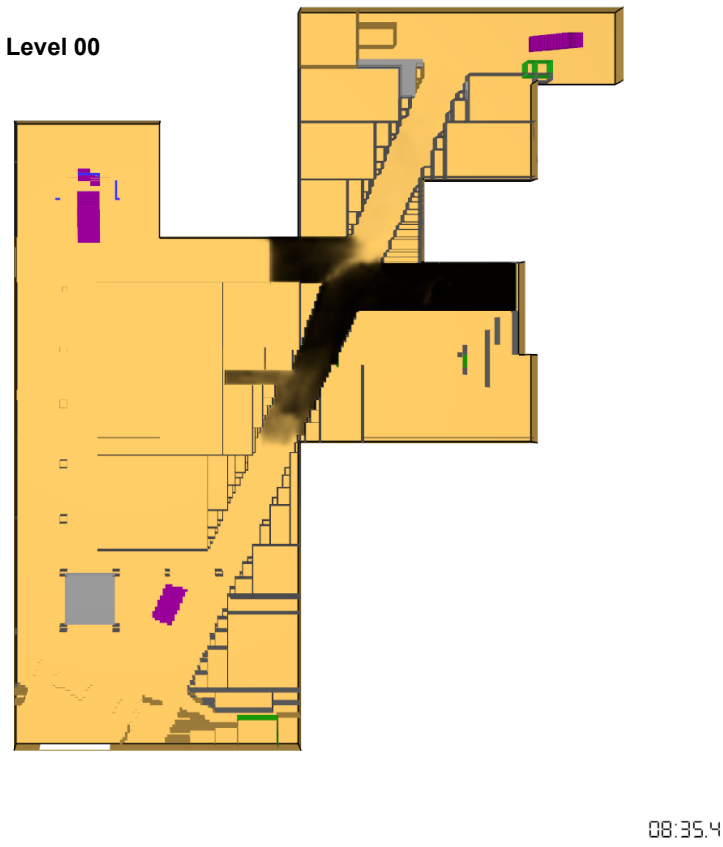


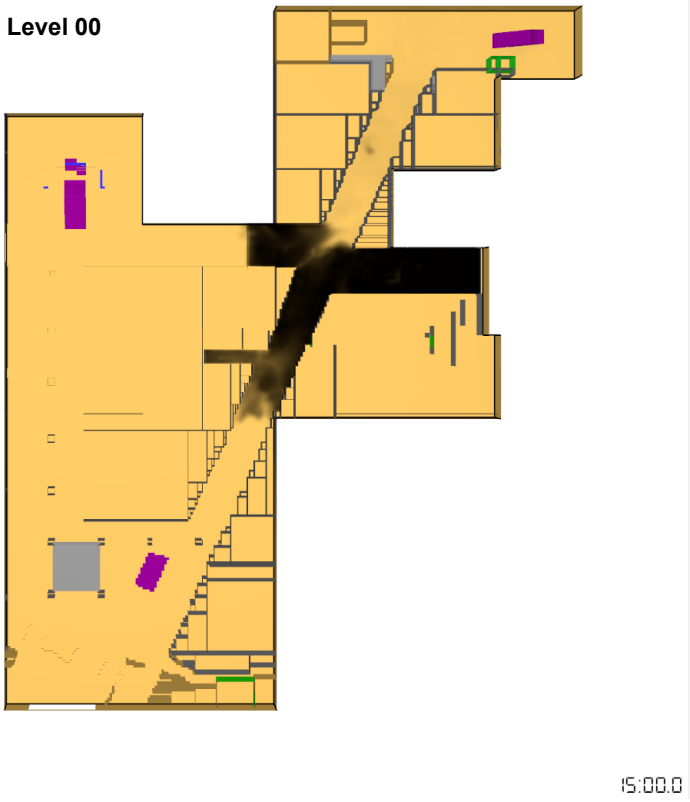
H.10 Scenario 7 results – Fire in Tenancy G-027 (L00)[93]

H.10.1 Smoke spread

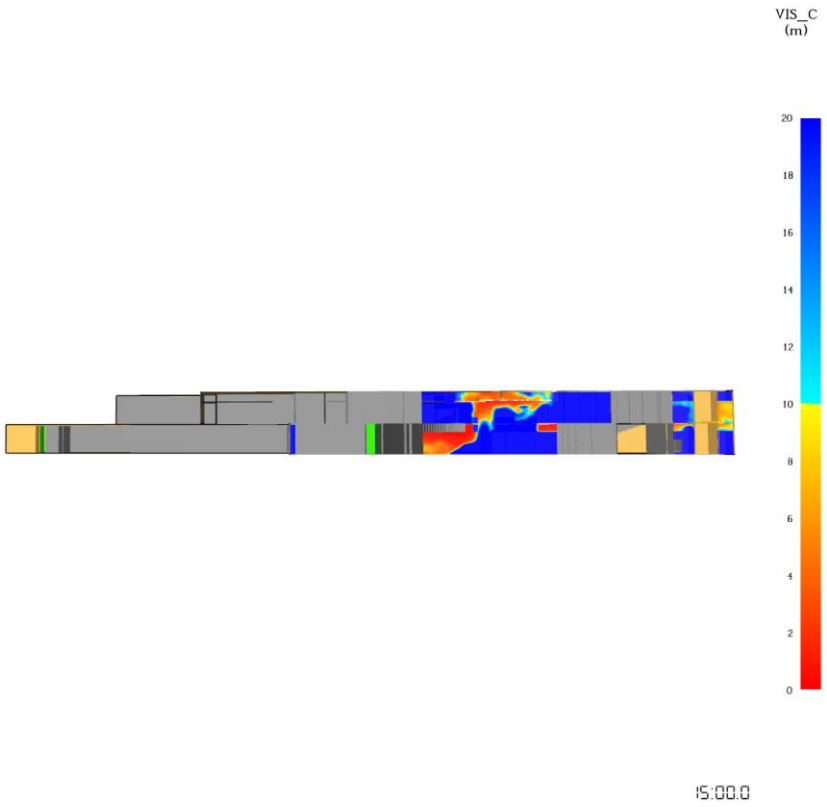
Timeline (mm:ss)	
1:00 minutes Smoke begins to spread out of fire-affected tenancy. Occupants within smoke zone 13 on L00 receive visual cues of the fire.	
3:16 minutes Smoke continues to spread out of the tenancy and into smoke zone 13 on L00. Smoke begins spreading up the Havilah St void and is exhausted at the top of the void. All occupants within smoke zone 13 on L00 have either moved away from the impacted smoke zones or area queuing at Stair 19.	

[93] Jensen Hughes, 2025, Fire in tenancy G-027–S3f.fds

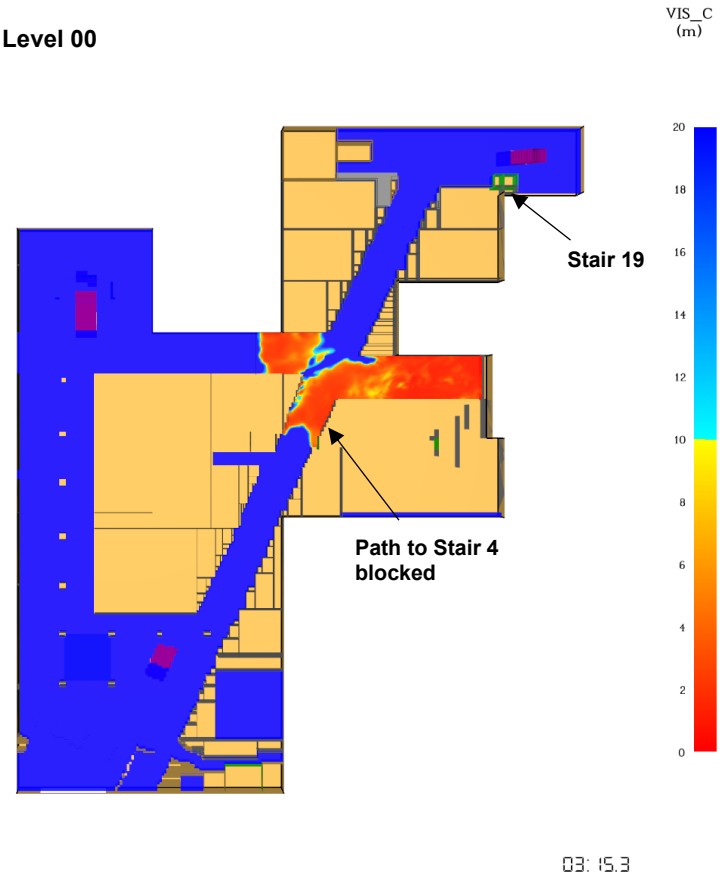
Timeline (mm:ss)	
4:08 minutes Smoke begins spreading to south smoke zone 7. All occupants within smoke zone 13 on L00 have evacuated.	
8:36 minutes Smoke has not continued to spread further into smoke zone 7. All occupants within the L00 have evacuated.	

Timeline (mm:ss)	
15:00 minutes End of modelling duration. Smoke has spread throughout the majority of smoke zone 13 on level 00 and a minor portion of smoke zone 7.	

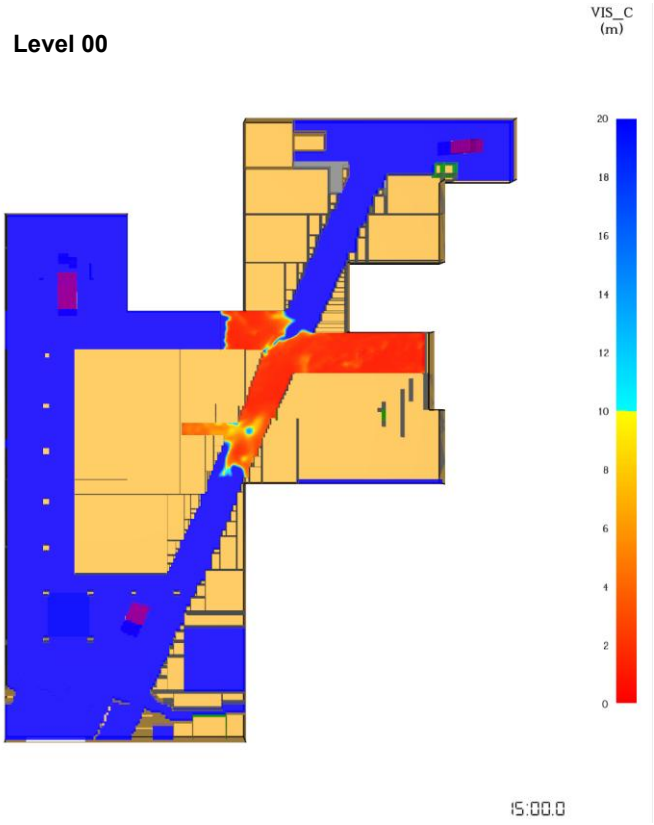
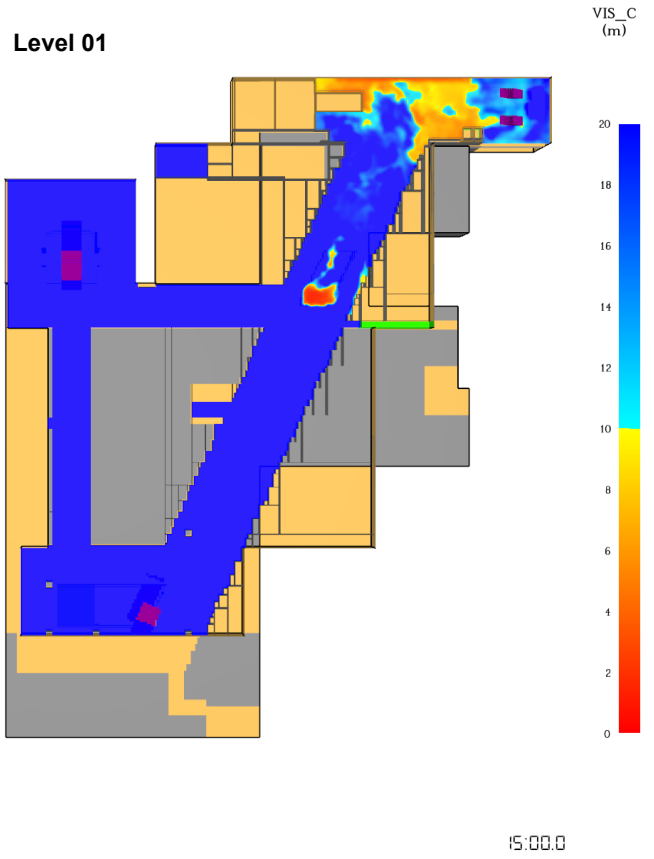
H.10.2 Visibility – section

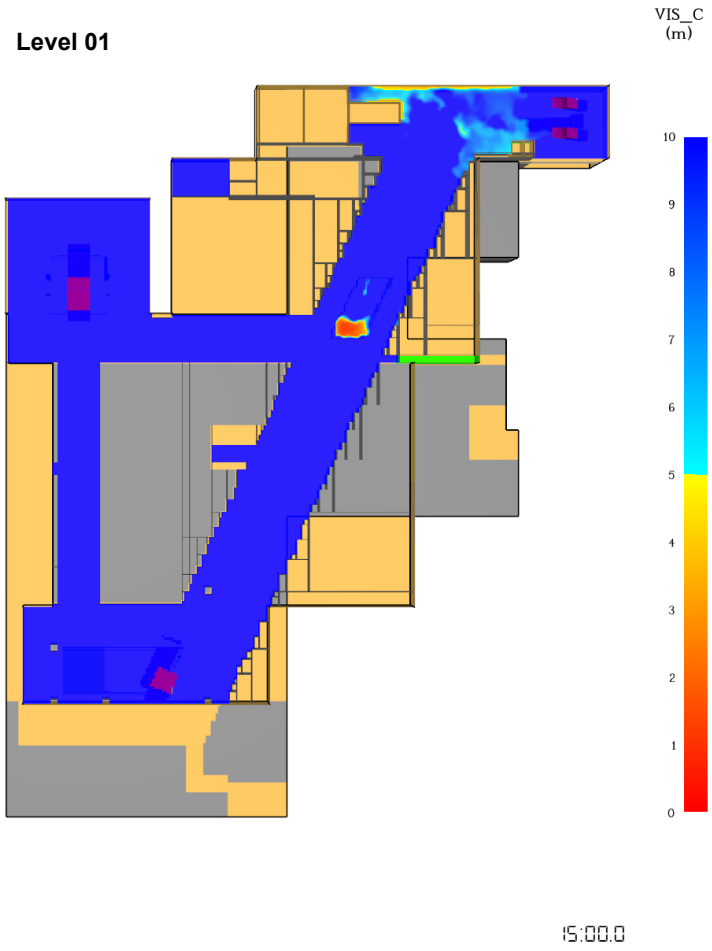
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Except for the fire affected floor and areas immediately above voids, visibility exceeds 10 m for the mall on all levels above of the smoke zone.	

H.10.3 Visibility at 2m above floor level

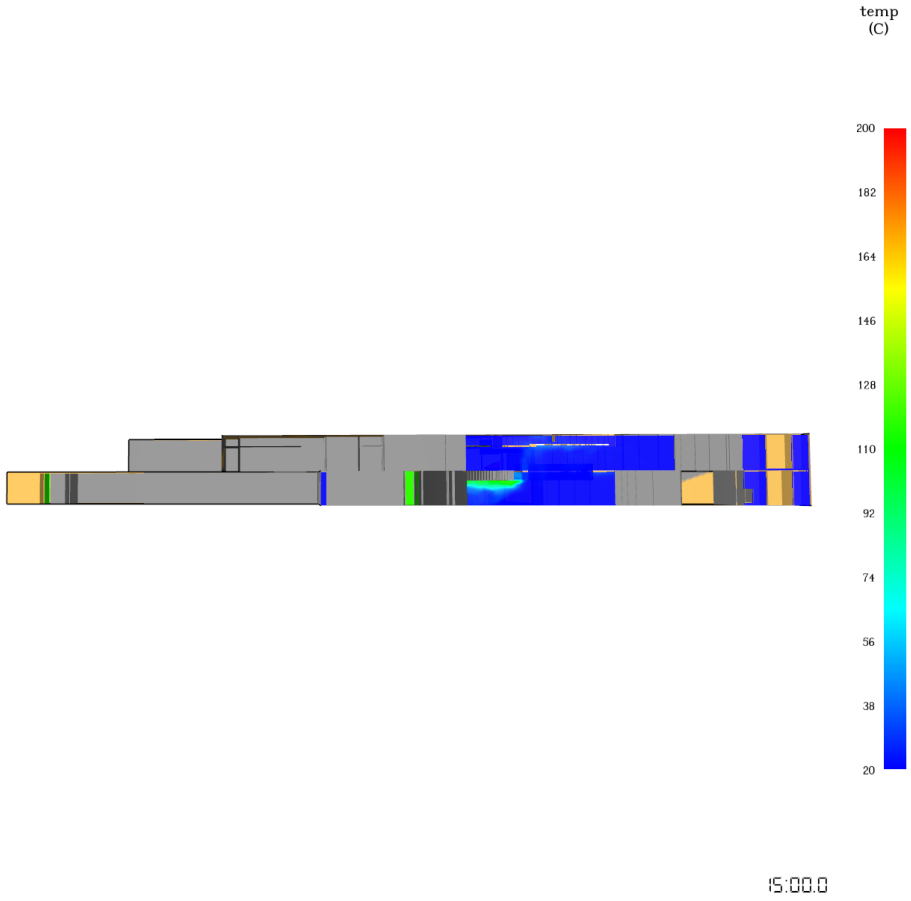
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:15 minutes All occupants within the L00 smoke zone 7 have either moved away from the impacted smoke zones or are queuing at Stair 19. Stair 4 considered blocked for this scenario Tenability exceeds 10 m for the majority of the impacted smoke zone, with the exception of the localised area adjacent to the fire-affected tenancy.	

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
8:36 minutes All occupants within smoke zone 13 on level 00 have evacuated. Visibility exceeds 10 m for the portion of the corridor north of the fire-affected tenancy. Visibility drops below 10 m for the southern portion of smoke zone 13 on level 00 and a portion the south-eastern mall in smoke zone 7. Except for Stair 4 visibility exceeds 10 m at the remainder of the exits on level 00.	

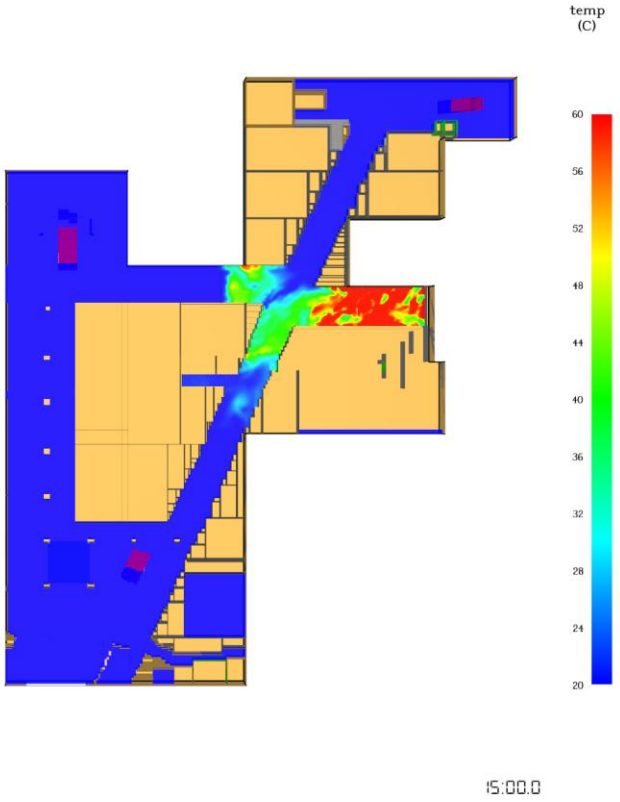
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10 m for the portion of the corridor north of the fire-affected tenancy. Visibility drops below 10 m for the southern portion of smoke zone 13 on L00. Except for Stair 4 visibility exceeds 10 m at the remainder of the exits on level 00. On L01 visibility drops below 10 m at localised areas within the smoke zone. Visibility exceeds 10 m at exits with the exception of Stair 19. Visibility remains about 5m at Stair 19	**Level 00**  **Level 01** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
	Level 01 

H.10.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

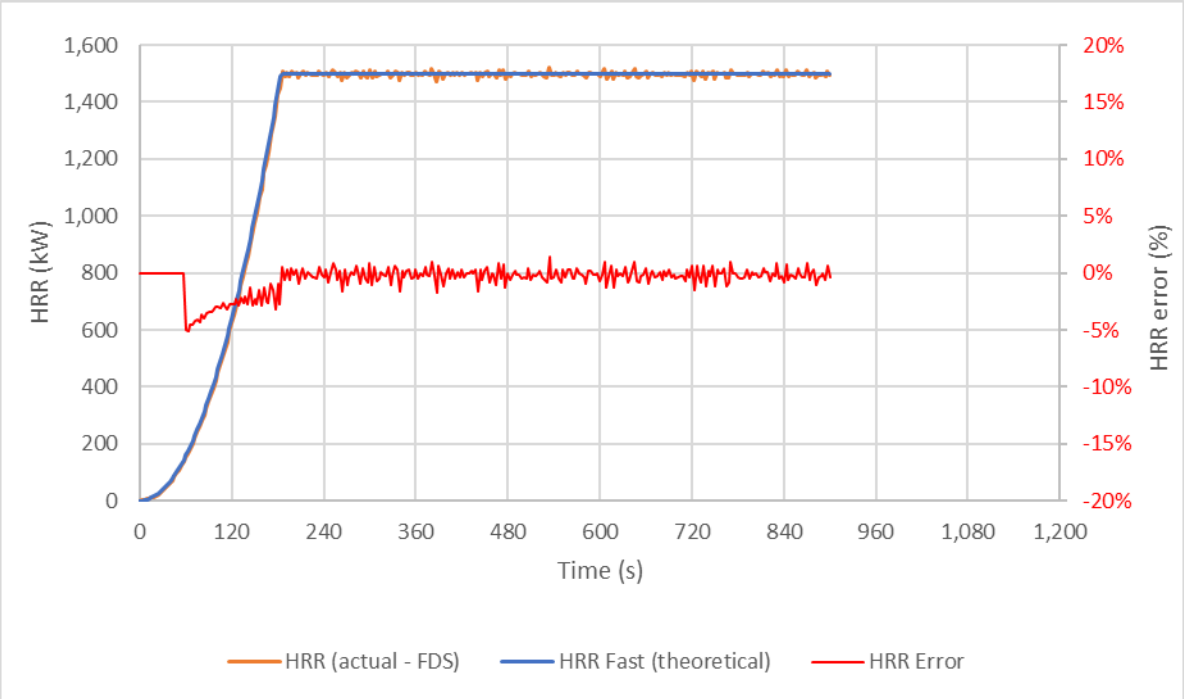
H.10.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, except for the area around the fire.	

H.10.6 Error checking

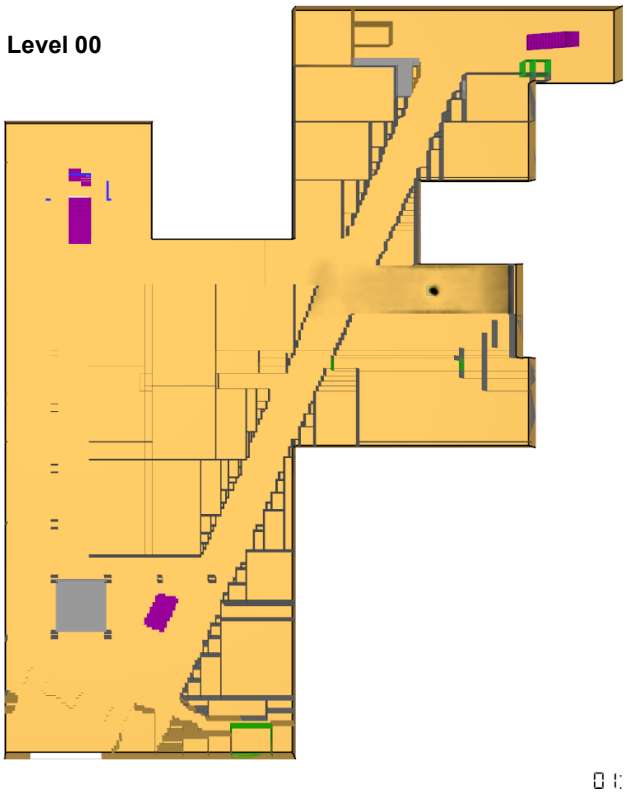
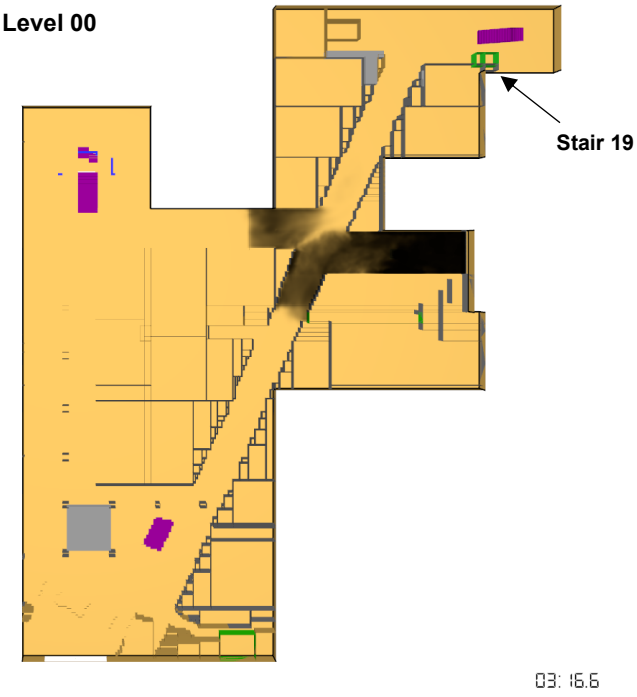
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

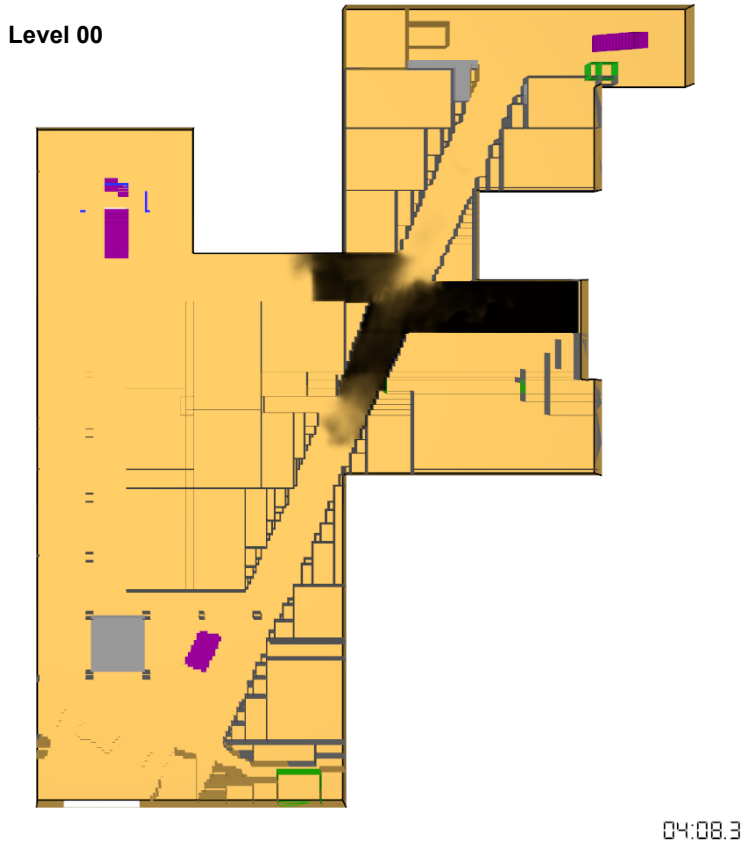
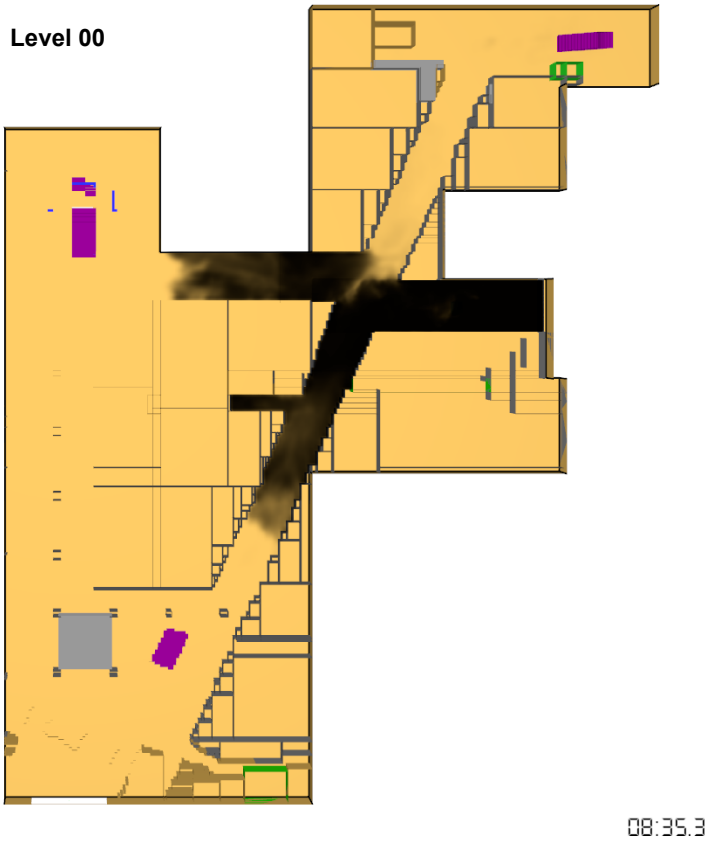


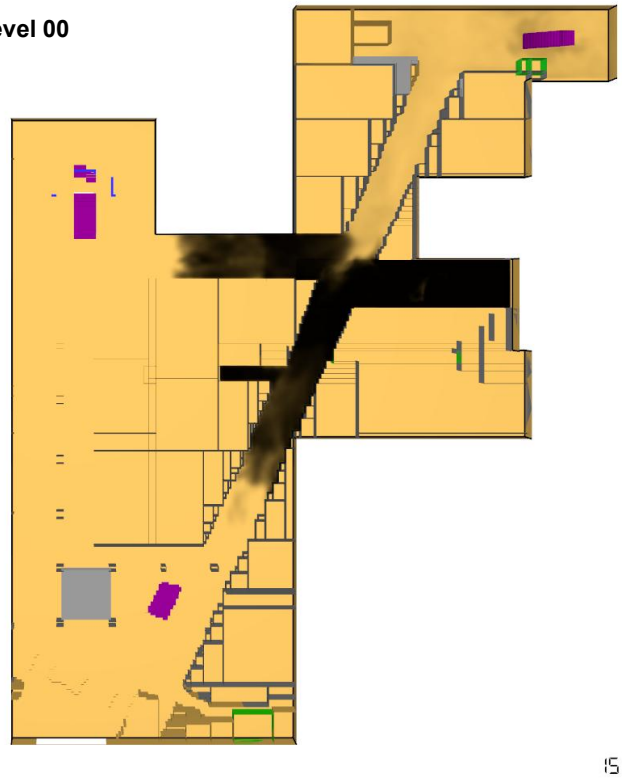
H.11 Scenario 8 results – Fire in Tenancy G-027 (L00)[94] – Sensitivity

H.11.1 Smoke spread

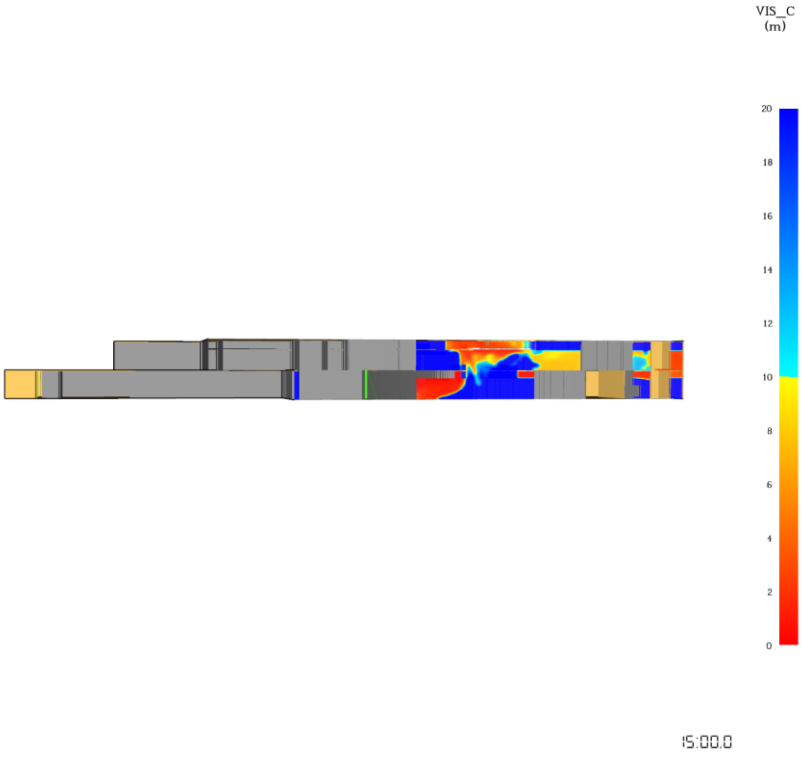
Timeline (mm:ss)	
1:00 minutes Smoke begins to spread out of fire-affected tenancy. Occupants within smoke zone 13 on L00 receive visual cues of the fire.	
3:16 minutes Smoke continues to spread out of the tenancy and into smoke zone 13 on L00. Smoke begins spreading up the Havilah St void and is exhausted at the top of the void. All occupants within smoke zone 13 on L00 have either moved away from the impacted smoke zones or queuing at Stair 19.	

[94] Jensen Hughes, 2025, Fire in tenancy G-027 sensitivity–S8b.fds

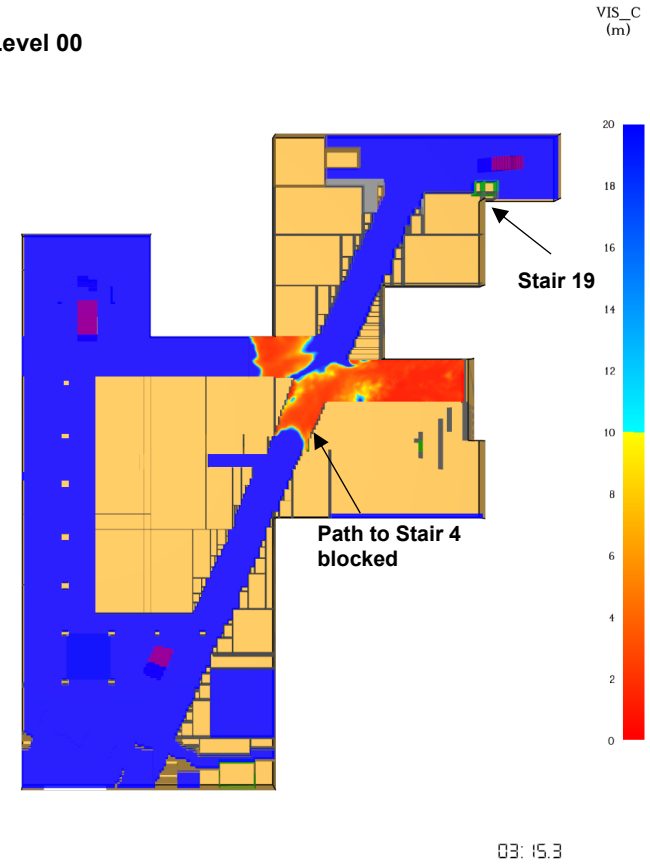
Timeline (mm:ss)	
4:08 minutes Smoke begins spreading to south smoke zone 7. All occupants within smoke zone 13 on L00 have evacuated.	
8:36 minutes Smoke has not continued to spread further into smoke zone 7. All occupants within L00 have evacuated.	

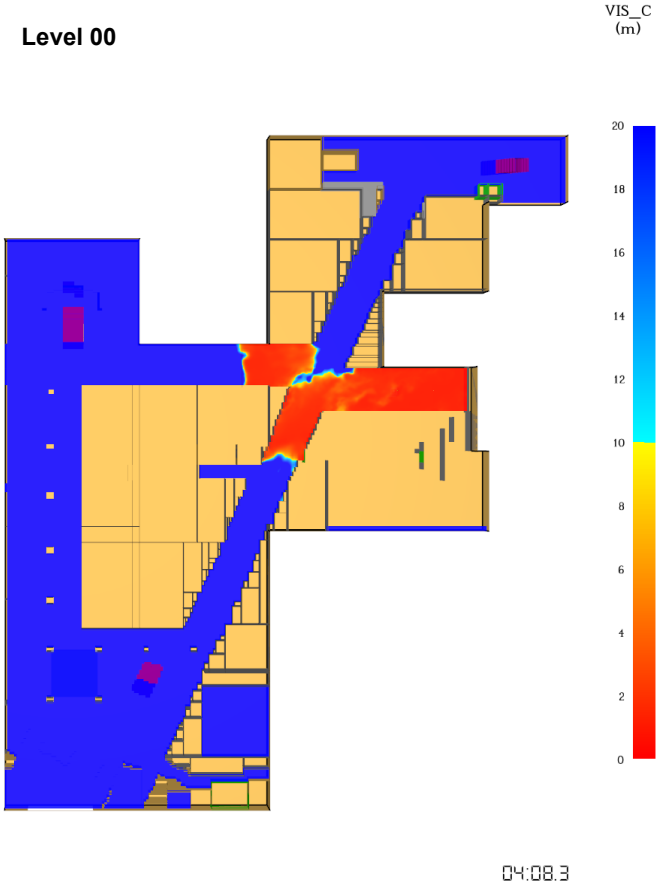
Timeline (mm:ss)	
15:00 minutes End of modelling duration. Smoke has spread throughout the majority of smoke zone 13 on level 00.	**Level 00** 

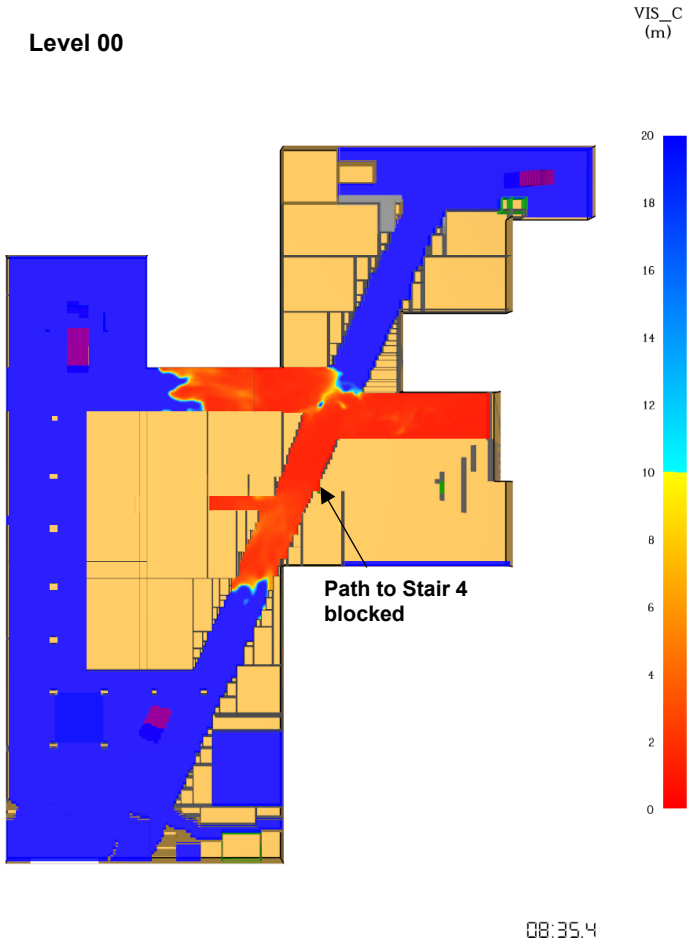
H.11.2 Visibility – section

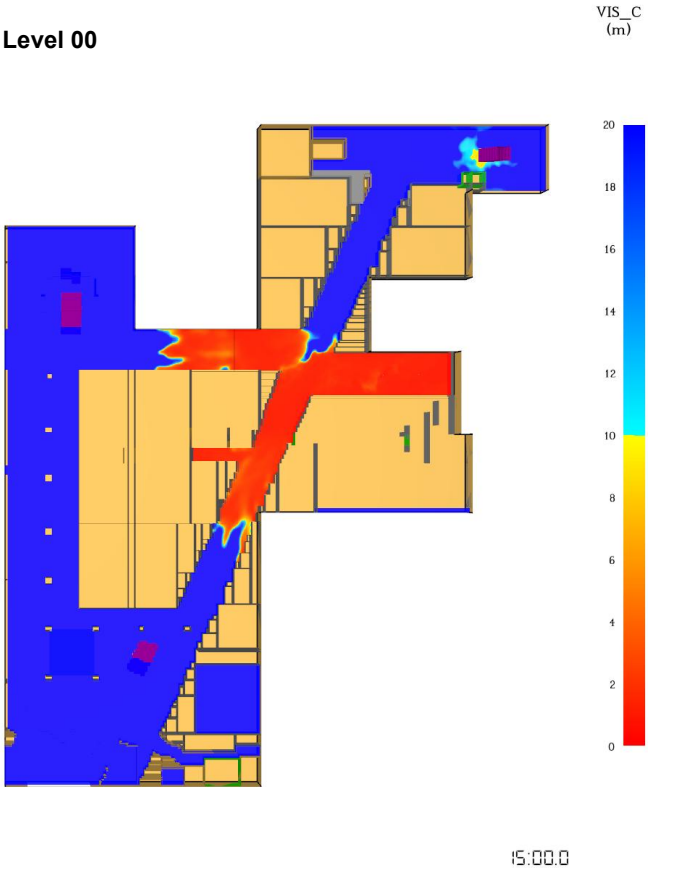
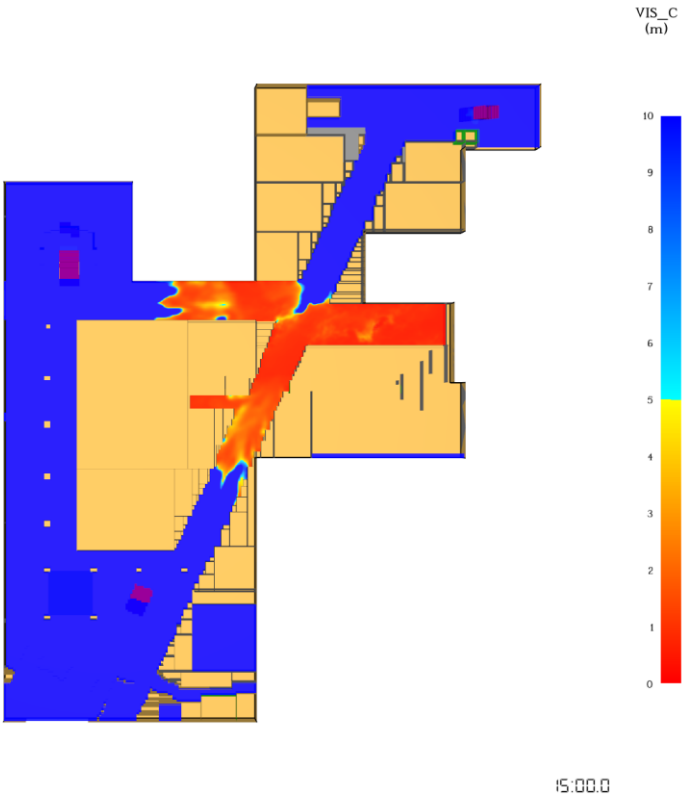
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration.	

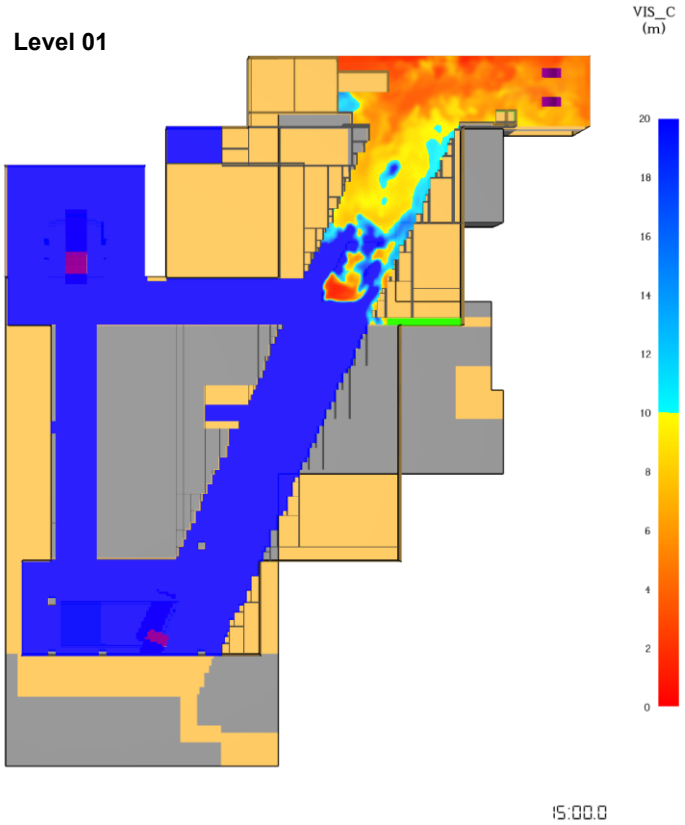
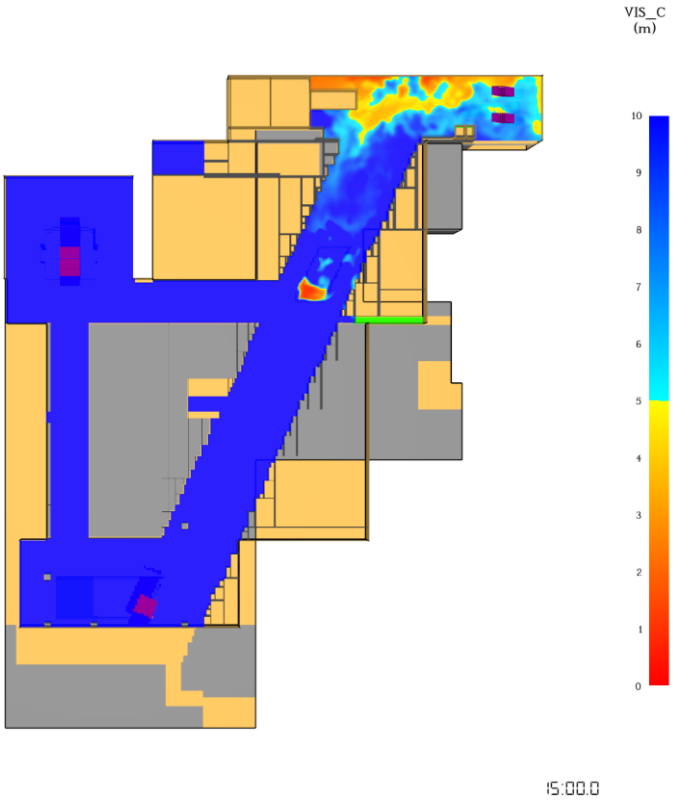
H.11.3 Visibility at 2m above floor level

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:15 minutes Visibility exceeds 10 m for the majority of the impacted smoke zone, with the exception of the localised area adjacent to the fire-affected tenancy. Stair 4 considered blocked for this scenario All occupants within the L00 smoke zone 7 have either moved away from the impacted smoke zones or queuing at Stair 19.	

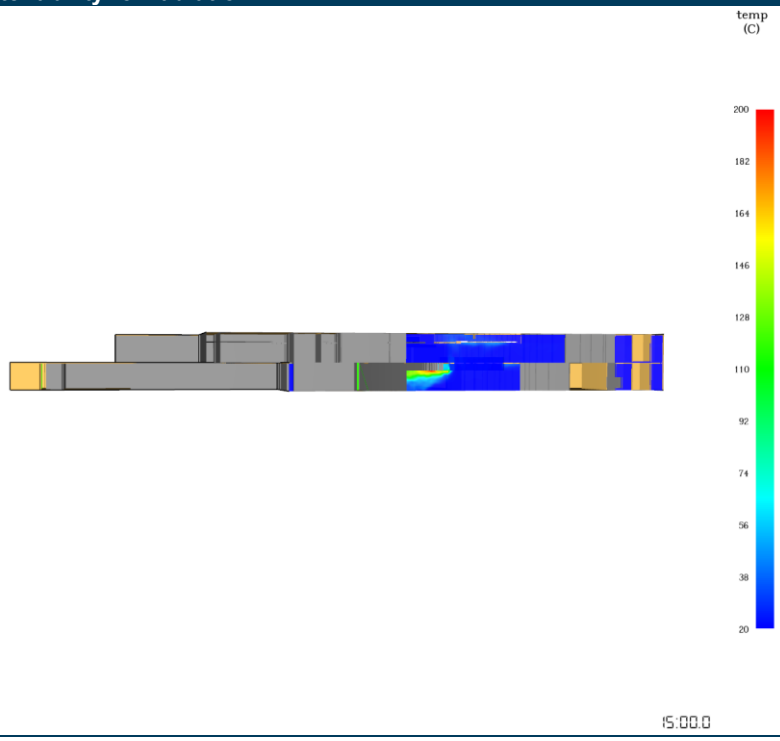
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
4:08 minutes Visibility with the localised area of the mall adjacent to the fire-affected tenancy drops below 10 m. All occupants within the L00 smoke zone 7 have evacuated.	**Level 00** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
8:36 minutes All occupants within smoke zone 13 on level 00 have evacuated. Visibility exceeds 10 m for the portion of the corridor north of the fire-affected tenancy. Visibility drops below 10 m for the southern portion of smoke zone 13 on level 00 and portion the south-eastern mall in smoke zone 7. Except for Stair 4 visibility exceeds 10 m at the remainder of the exits on level 00.	

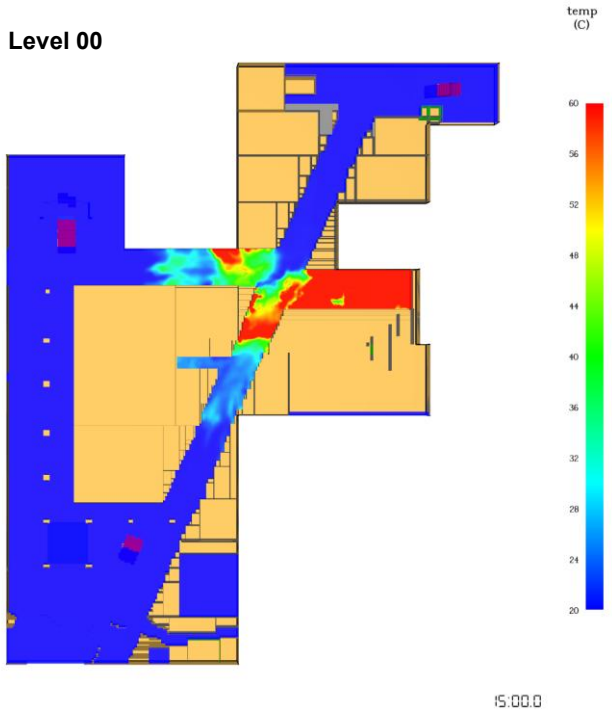
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes All occupants within zone 13 on level 01 have evacuated from the area. Visibility exceeds 10 m for the portion of the corridor north of the fire-affected tenancy. Visibility drops below 10 m for the southern portion of smoke zone 13 on level 00 and portion the south-eastern mall in smoke zone 7. Visibility at the area in front of Stair 19 on the level exceeds 10 m.	**Level 00**  

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes All occupants within zone 13 on level 01 have evacuated from the area. Visibility on level 01 of smoke zone 13 exceeds 5 m, with the exception of a localised area adjacent to the switch back escalator void.	**Level 01**  

H.11.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

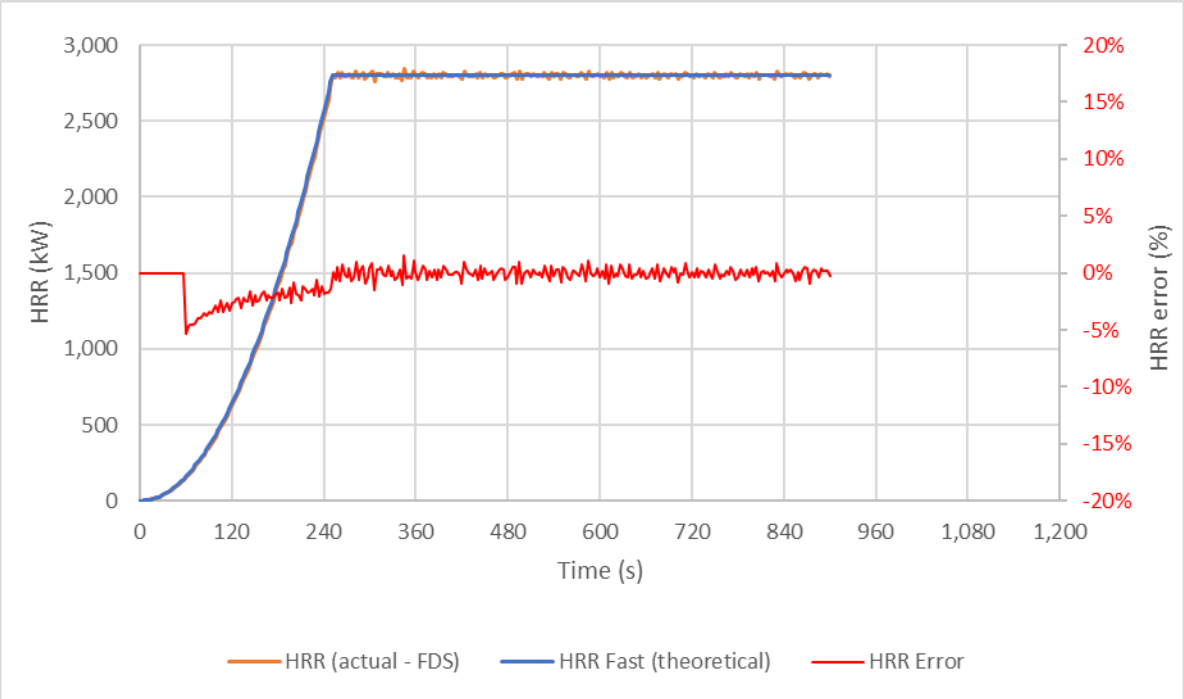
H.11.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, except for the area around the fire.	**Level 00** 

H.11.6 Error checking

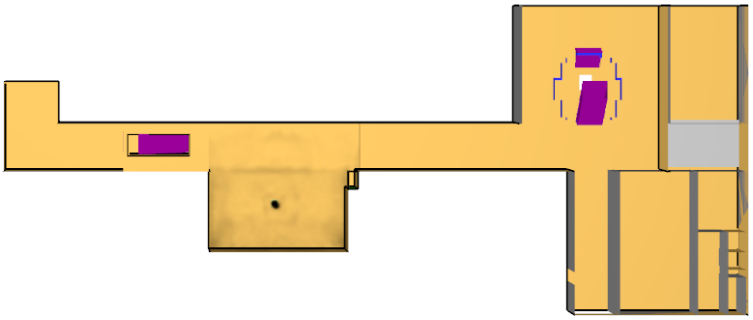
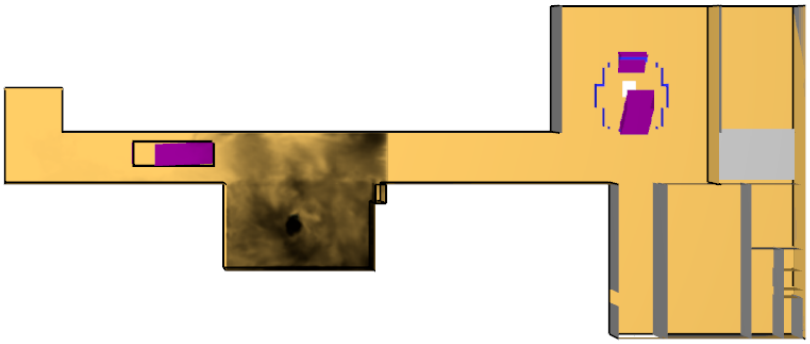
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 10% error once the peak fire size is reached.

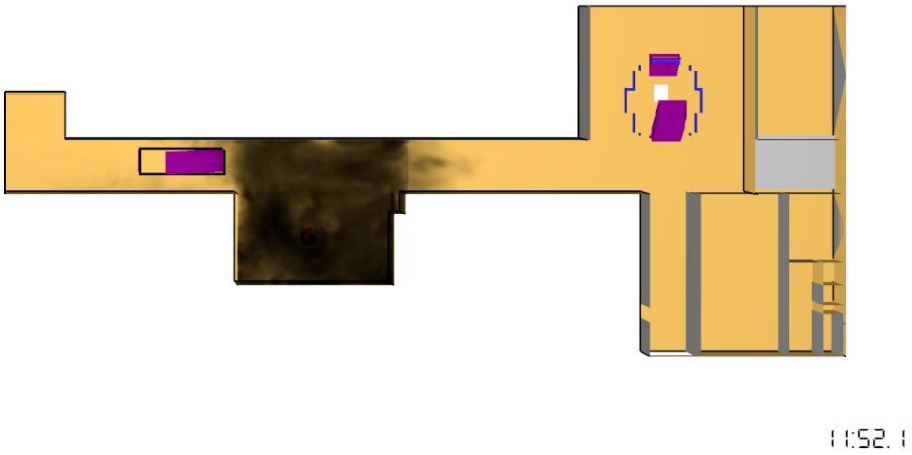
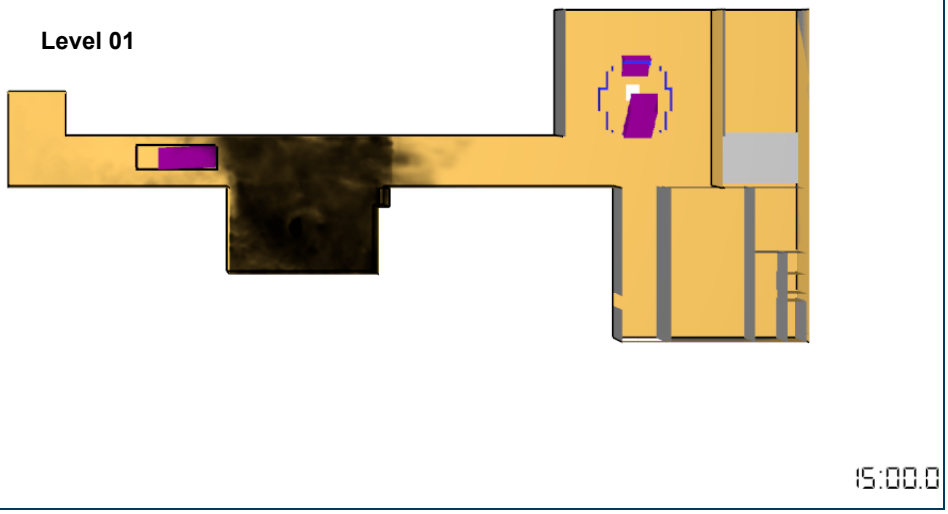


H.12 Scenario 9 results – Fire in Tenancy 1-009 (Zone 12)[95]

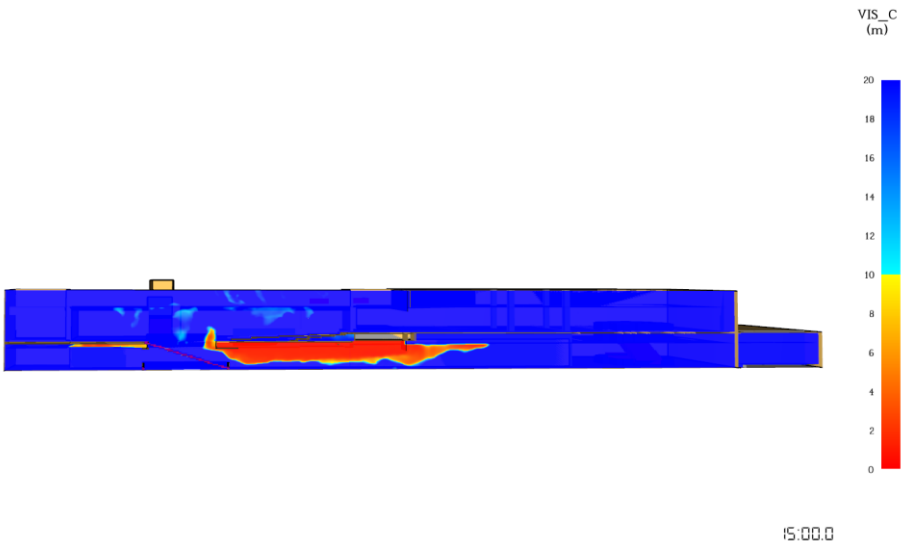
H.12.1 Smoke spread

Timeline (mm:ss)	
01:10 minutes Cue time for the fire affected floor. Smoke begins to spread out of fire-affected tenancy.	**Level 01**  01:10.1
3:15 minutes Smoke continues to spread out of the tenancy and into smoke zone 12. All occupants within the smoke zone have evacuated the smoke zone.	**Level 01**  03:15.4

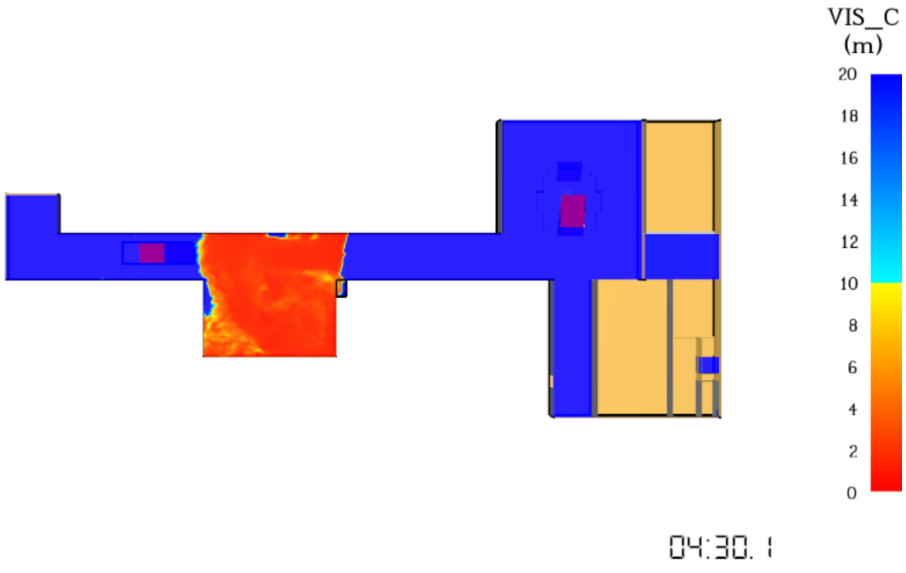
[95] Jensen Hughes, 2025, Fire in tenancy 1-009 –S2i.fds

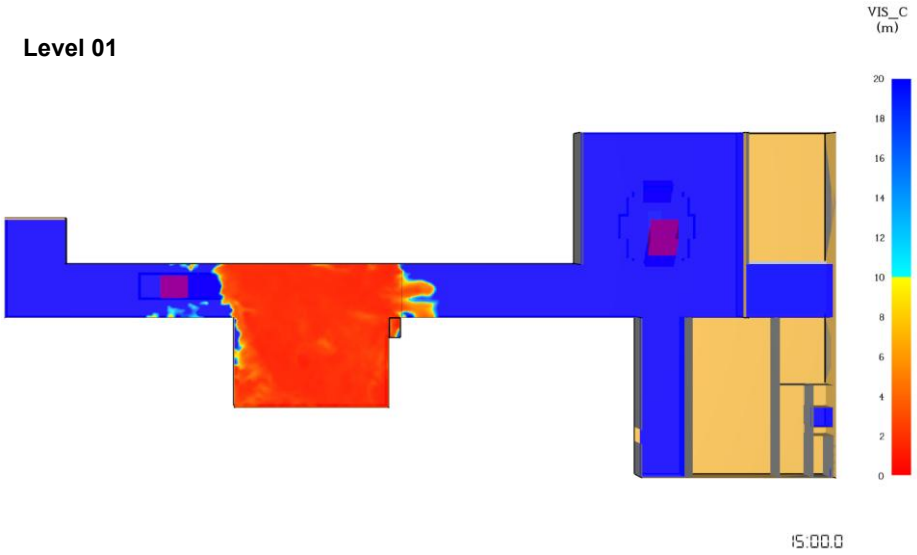
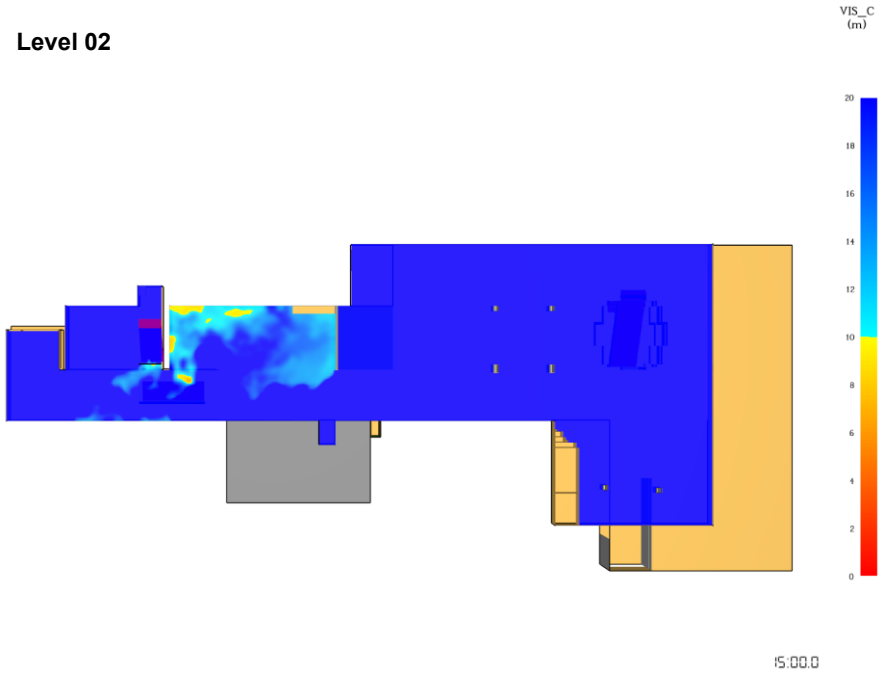
Timeline (mm:ss)	
11:52 minutes Smoke continues to spread out of the tenancy and into smoke zone 12. There is limited smoke spread into the adjacent zone. All occupants within the L01 evacuated.	
15:00 minutes End of modelling duration. Smoke has to throughout L00 smoke zone and into the Havilah St zone (smoke zone 13).	

H.12.2 Visibility – section

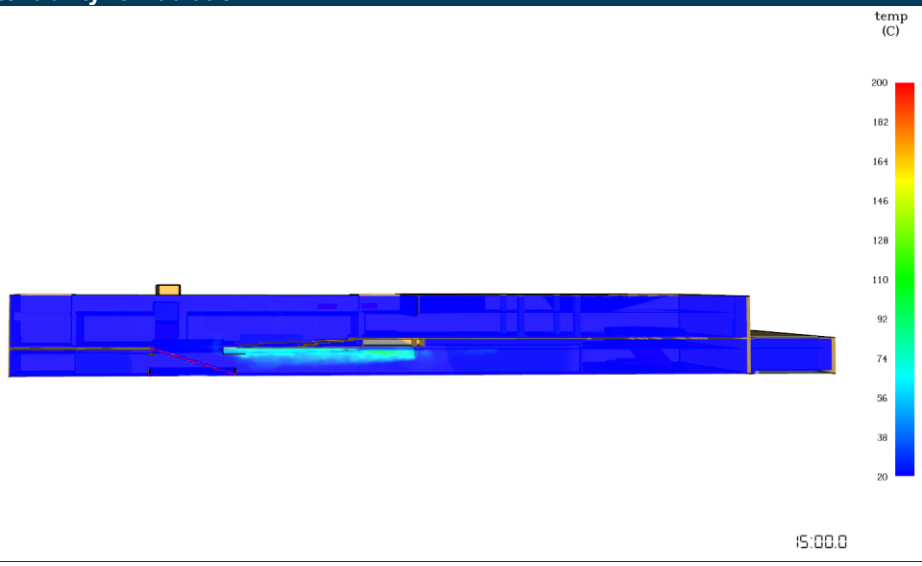
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. With the exception of the fire affected smoke zone, visibility exceeds 10 m for all other levels.	

H.12.3 Visibility at 2m above floor level

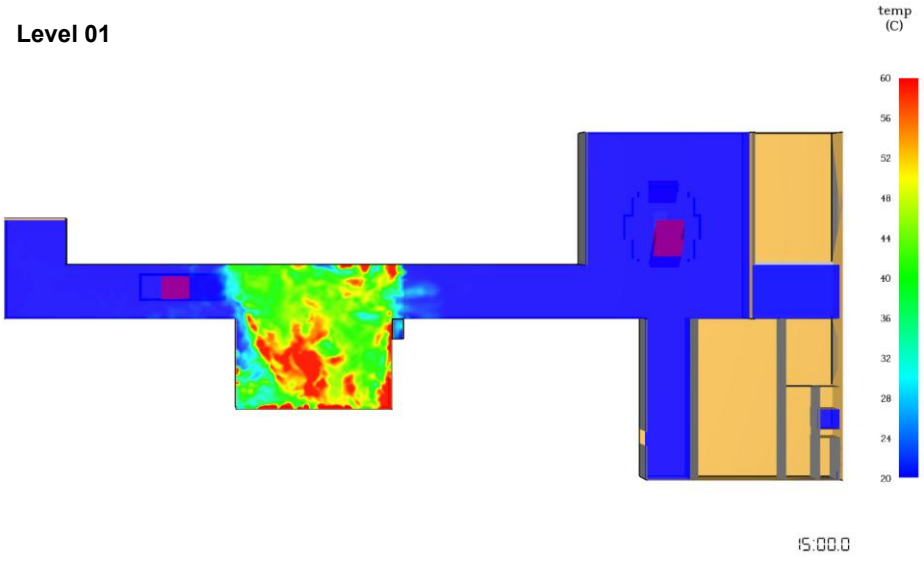
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
4:30 minutes Steady state reached for this fire scenario.	

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10 m for the majority of the smoke zone with the exception of the fire affected tenancy and a localised area of the mall.	**Level 01** 
15:00 minutes End of modelling duration.	**Level 02** 

H.12.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C.	

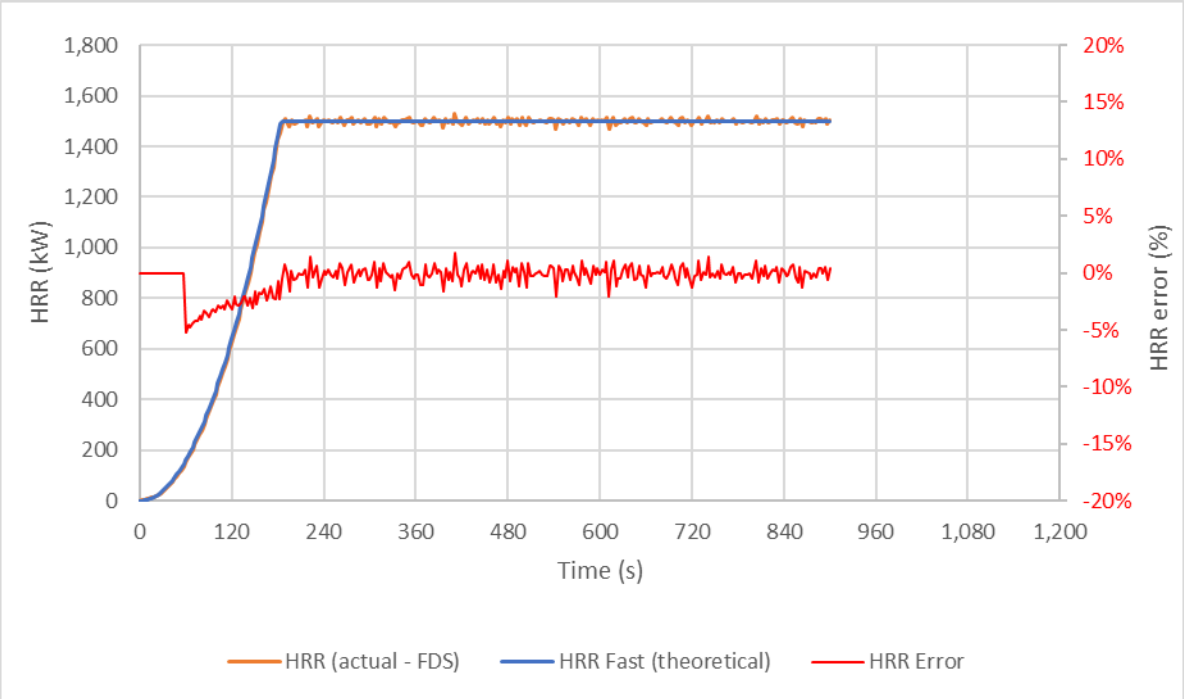
H.12.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, with the exception of the area around the fire.	**Level 01** 

H.12.6 Error checking

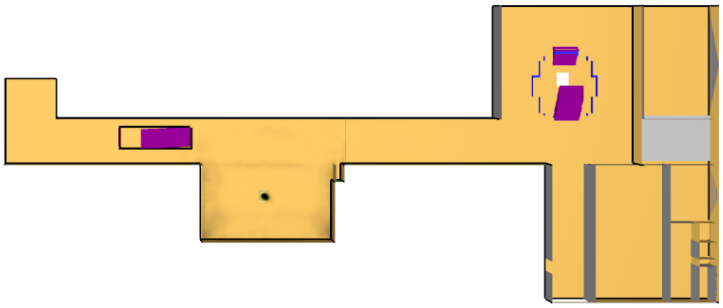
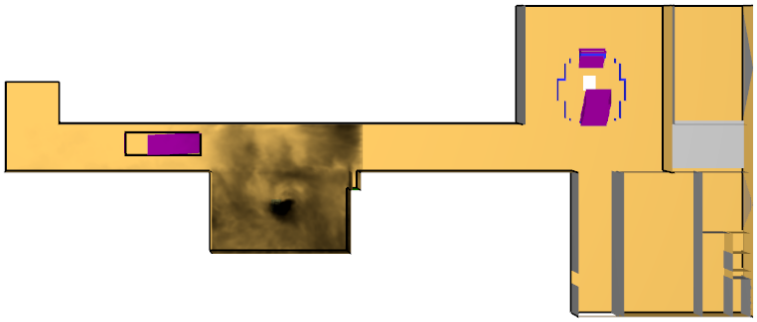
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 5% during the early growth phase when the fire size is small and less than 10% error once the peak fire size is reached.



H.13 Scenario 10 results – Fire in Tenancy 1-009 (L01)[96] – Sensitivity

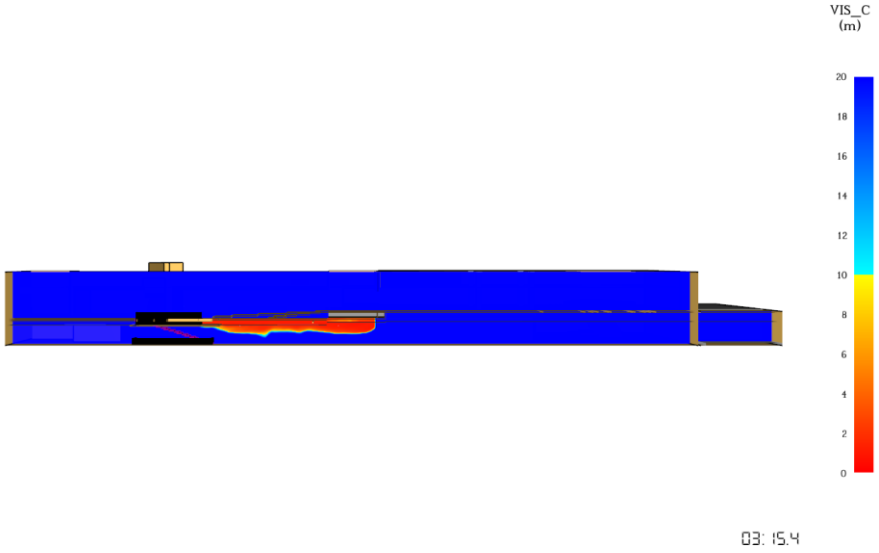
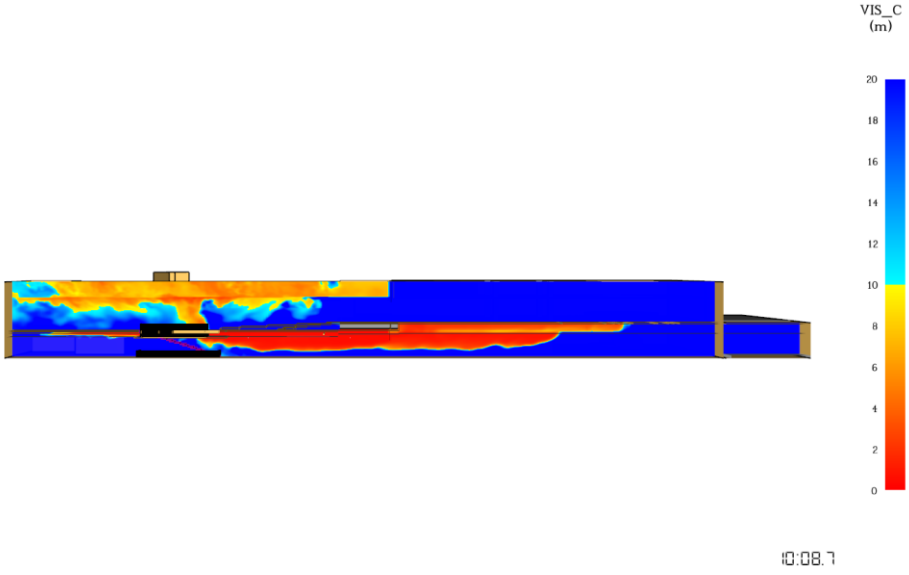
H.13.1 Smoke spread

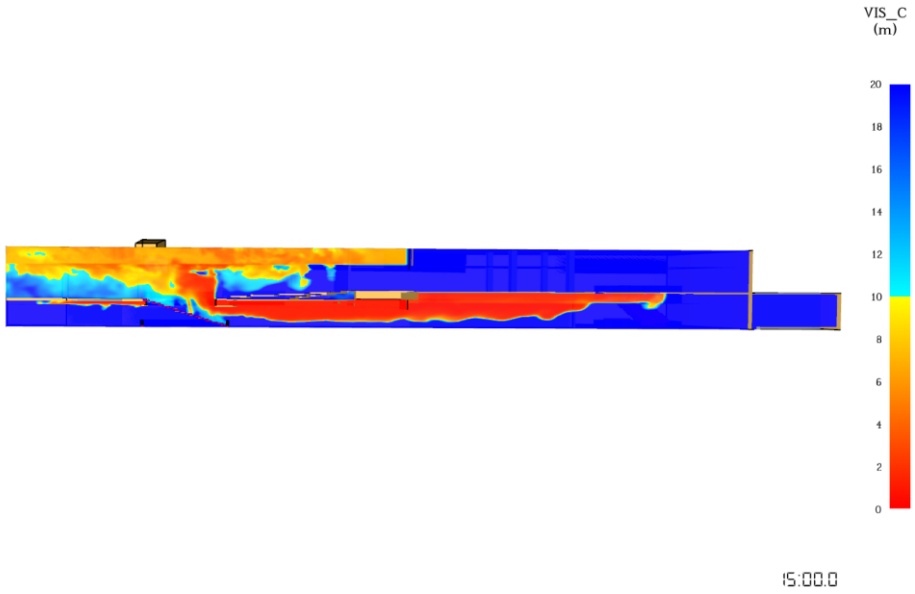
Timeline (mm:ss)	
01:10 minutes Cue time for the fire affected floor. Smoke begins to spread out of fire-affected tenancy.	**Level 01**  01:10.1
3:15 minutes Smoke continues to spread out of the tenancy and into smoke zone 12. All occupants within the smoke zone have evacuated the smoke zone.	**Level 01**  03:15.4

[96] Jensen Hughes, 2025, Fire in tenancy 1-009 sensitivity–S8d.fds

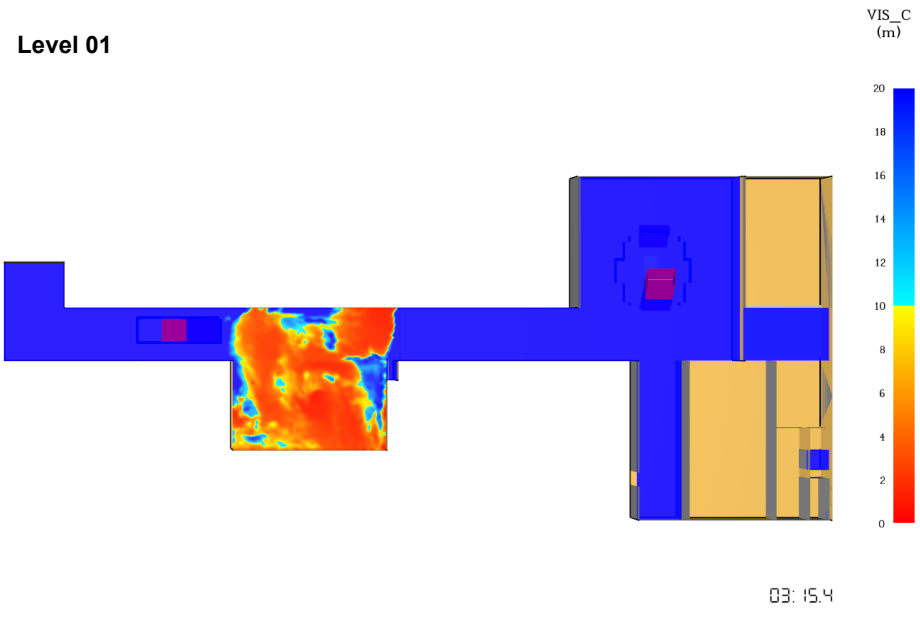
Timeline (mm:ss)	
11:52 minutes Smoke continues to spread out of the tenancy and into smoke zone 12. Smoke has spread into the adjacent zone and up the escalator void. All occupants within the L01 evacuated.	**Level 01** 
15:00 minutes End of modelling duration. Smoke has spread throughout smoke zone 12, into the adjacent zone and up the escalator void.	**Level 01** 

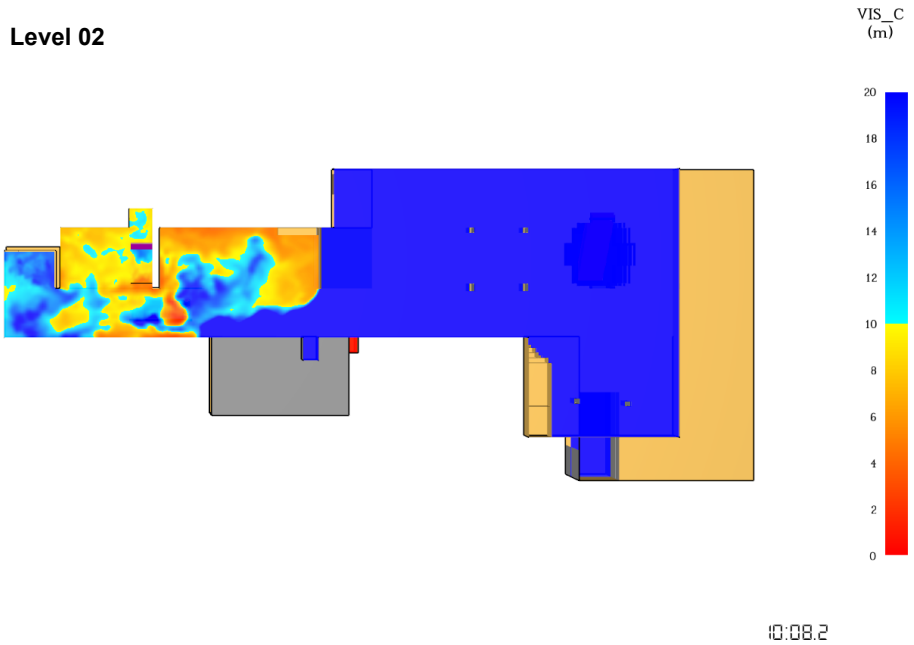
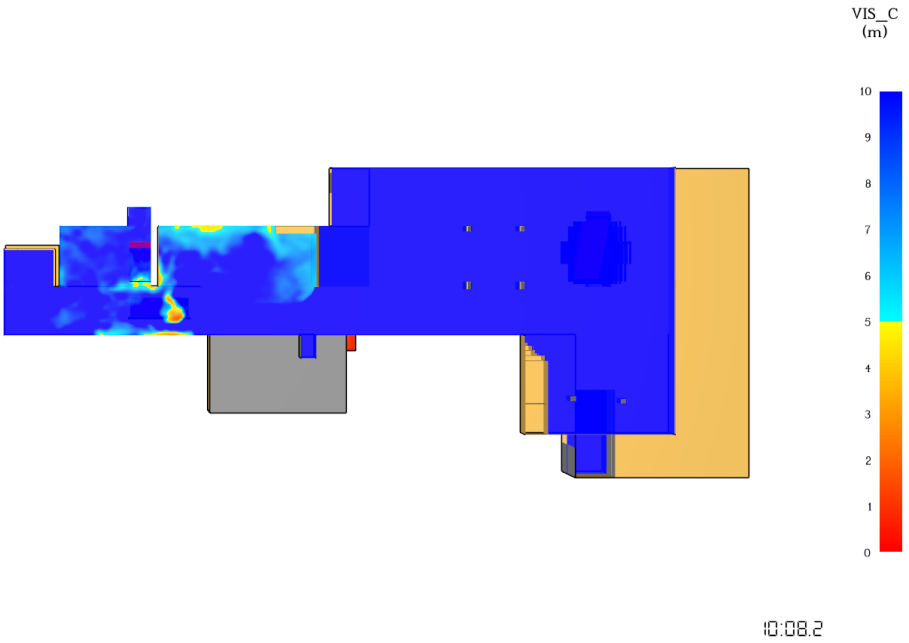
H.13.2 Visibility – section

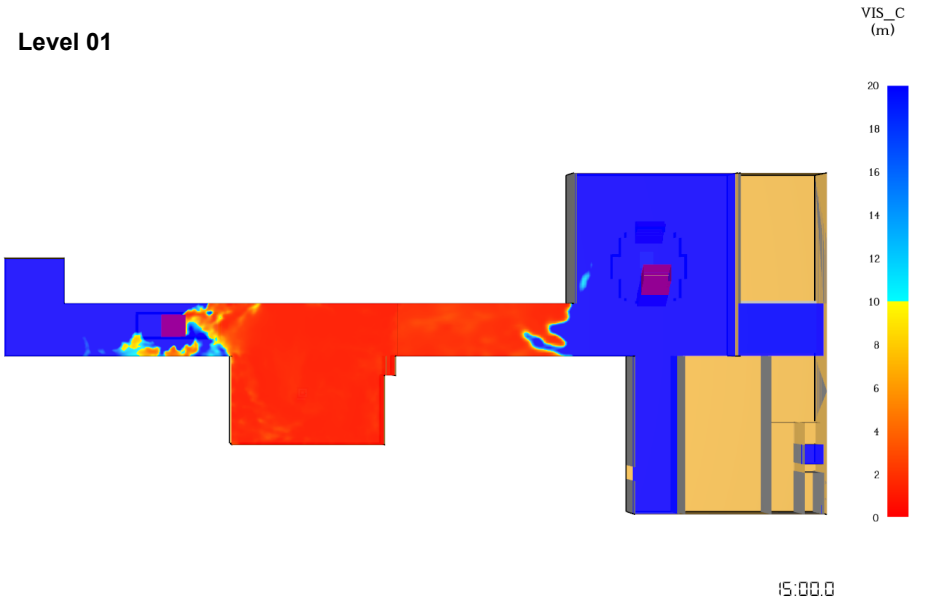
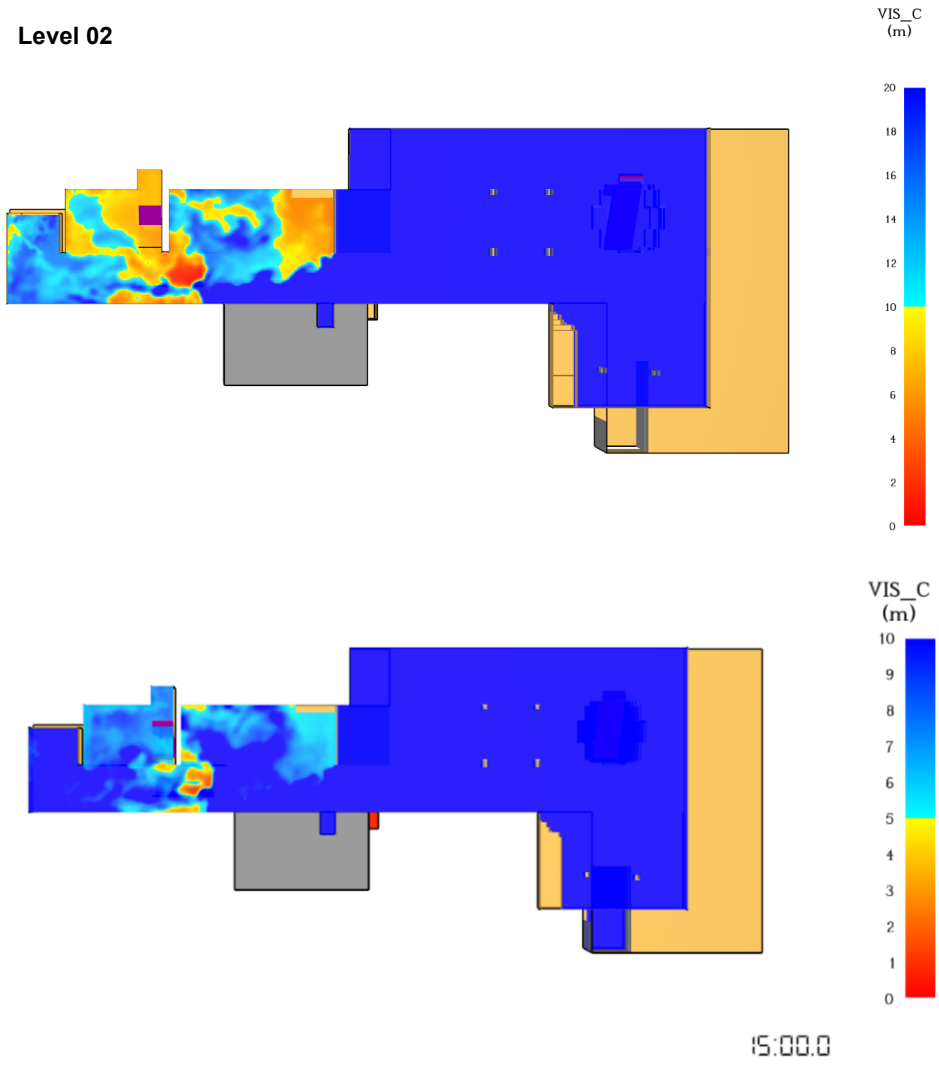
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:15 minutes Visibility within Zone 12 within both levels 1 and 2 remains above 10m for the majority of the zone. All occupants from the affected zone on level 1 have evacuated.	
10:08 minutes All occupants from the affected zone on level 2 have evacuated. Visibility within Zone 12 on level 2 remains above 10m for the majority of the zone.	

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Except for the fire affected smoke zone and a portion of the smoke zone on level 01, visibility within the remainder of the mall exceeds 10 m.	

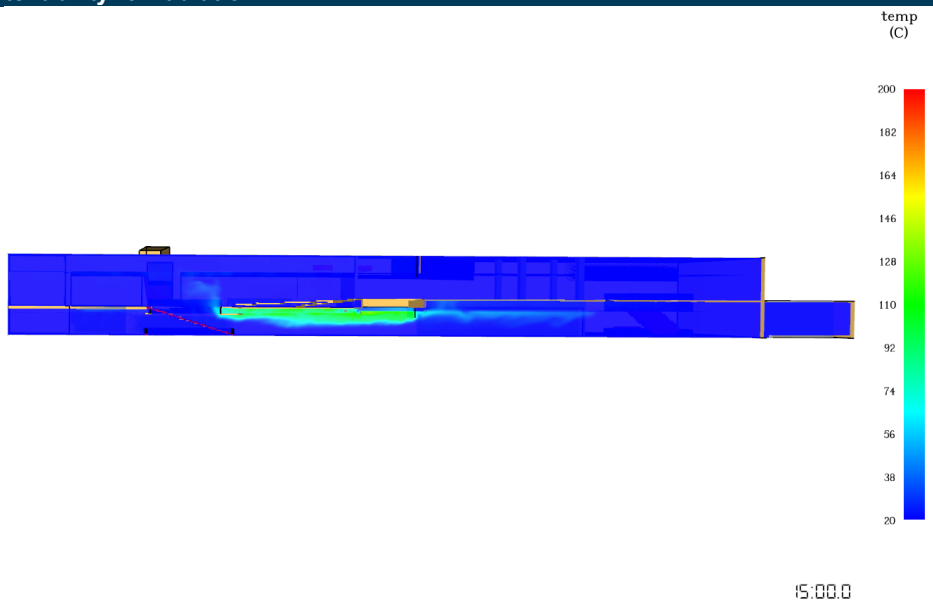
H.13.3 Visibility at 2m above floor level

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:15 minutes Visibility within Zone 12 within level 1 remains above 10m for the majority of the zone. All occupants from the affected zone on level 1 have evacuated.	**Level 01** 

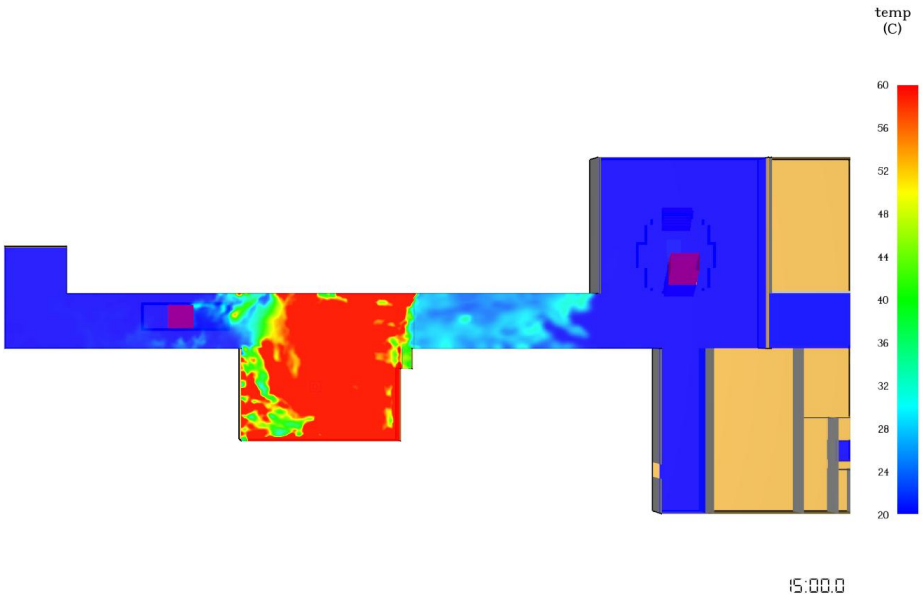
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
10:08 minutes Visibility within Zone 12 within level 2 remains above 10m for the majority of the zone. All occupants from the affected zone on level 2 have evacuated.	**Level 02**  

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10 m for the majority of the impact smoke zone, with the exception of the fire affected tenancy and the mall area in front of the impacted tenancy. Visibility drops below 10m within a portion of the adjacent smoke zone. Visibility exceeds 5 m for the majority of the smoke zone on level 2.	**Level 01**  **Level 02** 

H.13.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

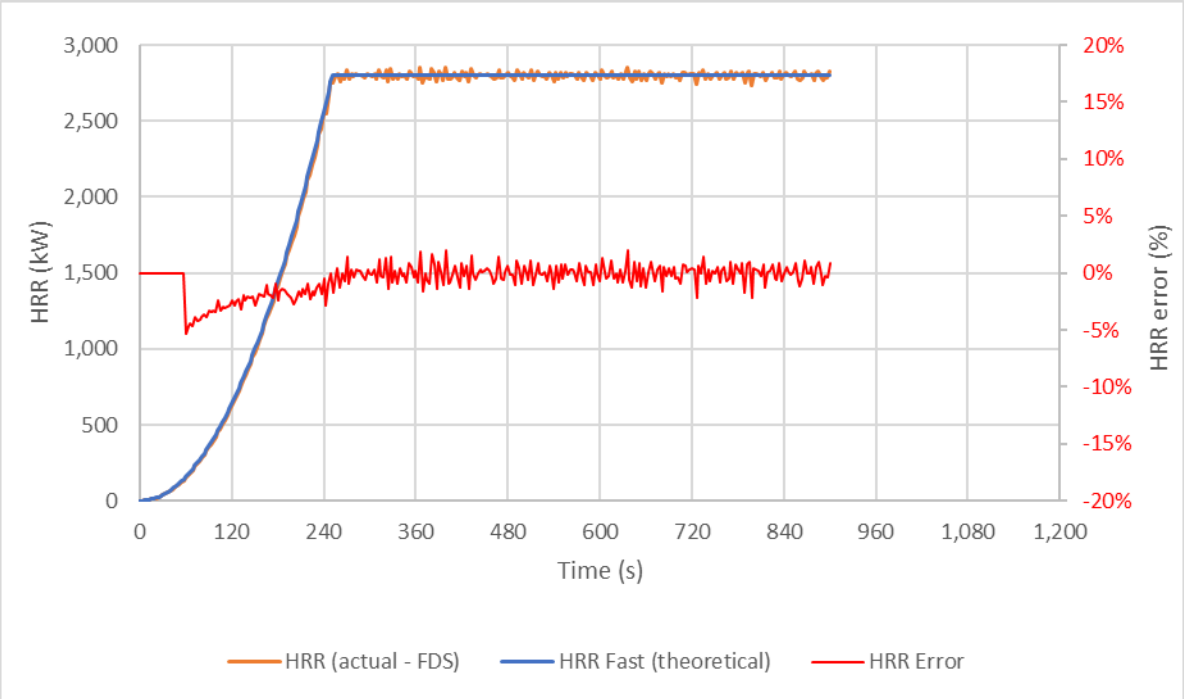
H.13.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, except for the fire affected tenancy and the mall area in front of the impacted tenancy.	**Level 01** 

H.13.6 Error checking

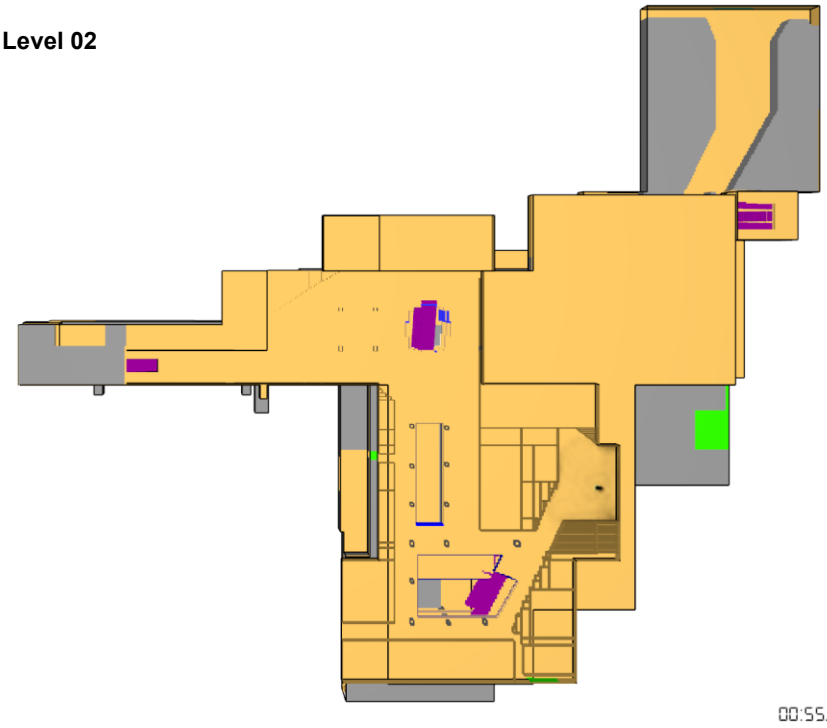
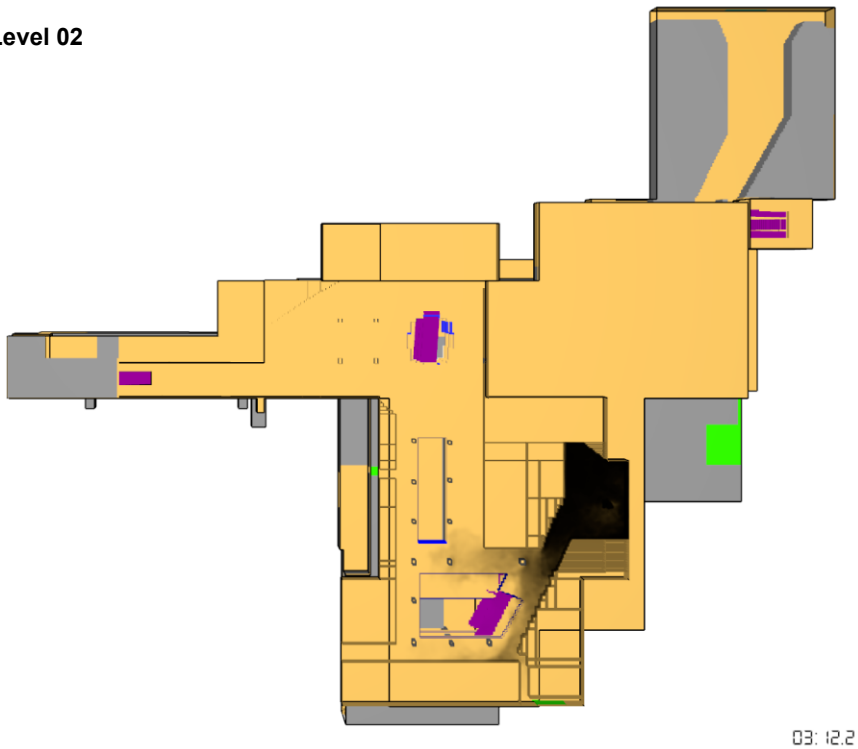
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

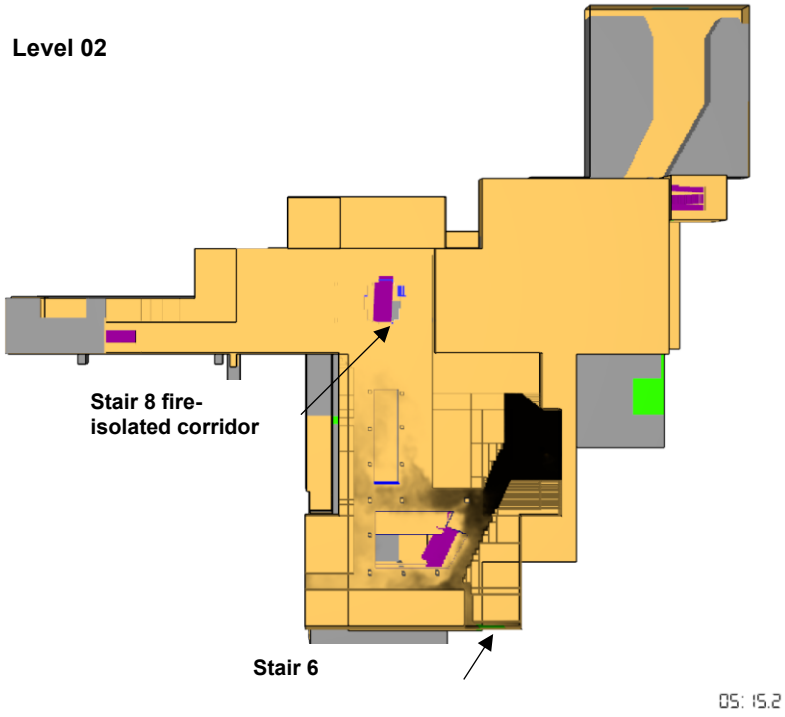
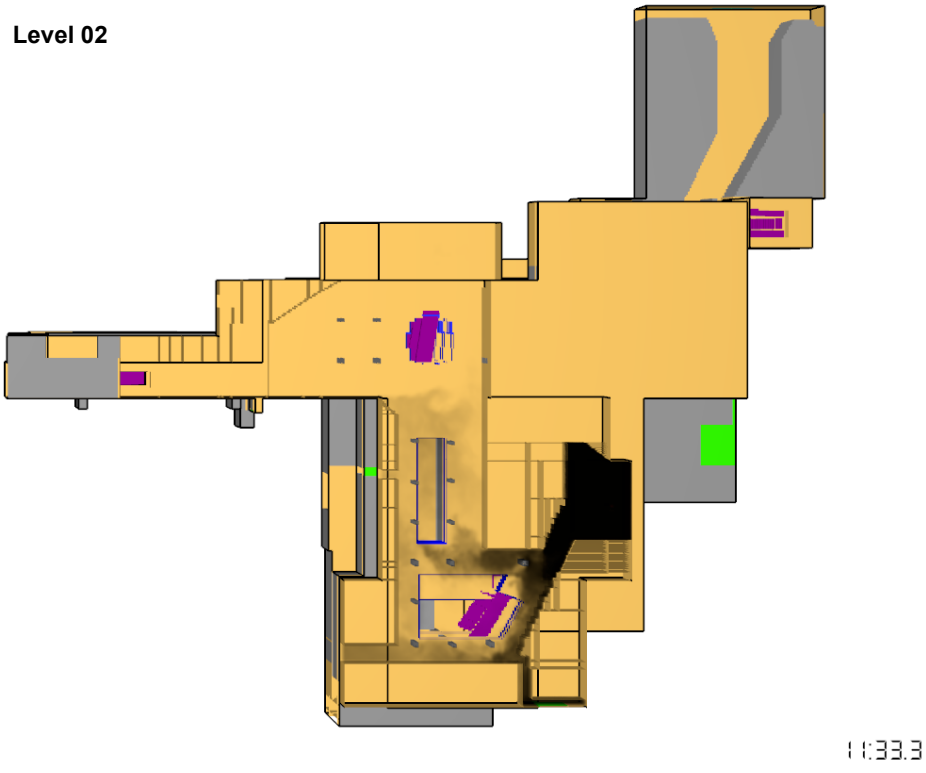


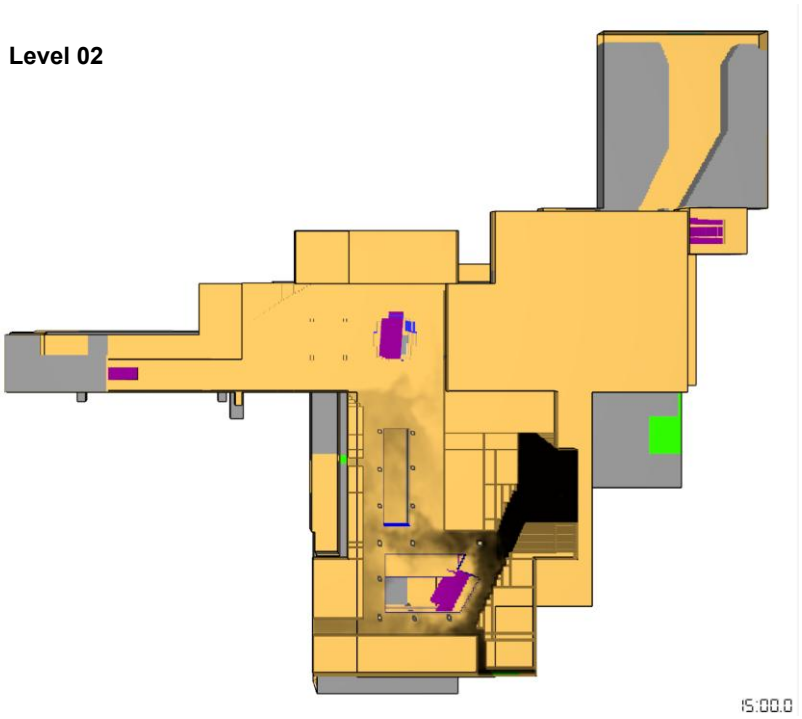
H.14 Scenario 11 results – Fire in specialty tenancy 2-024 (Zone 7)[97]

H.14.1 Smoke spread

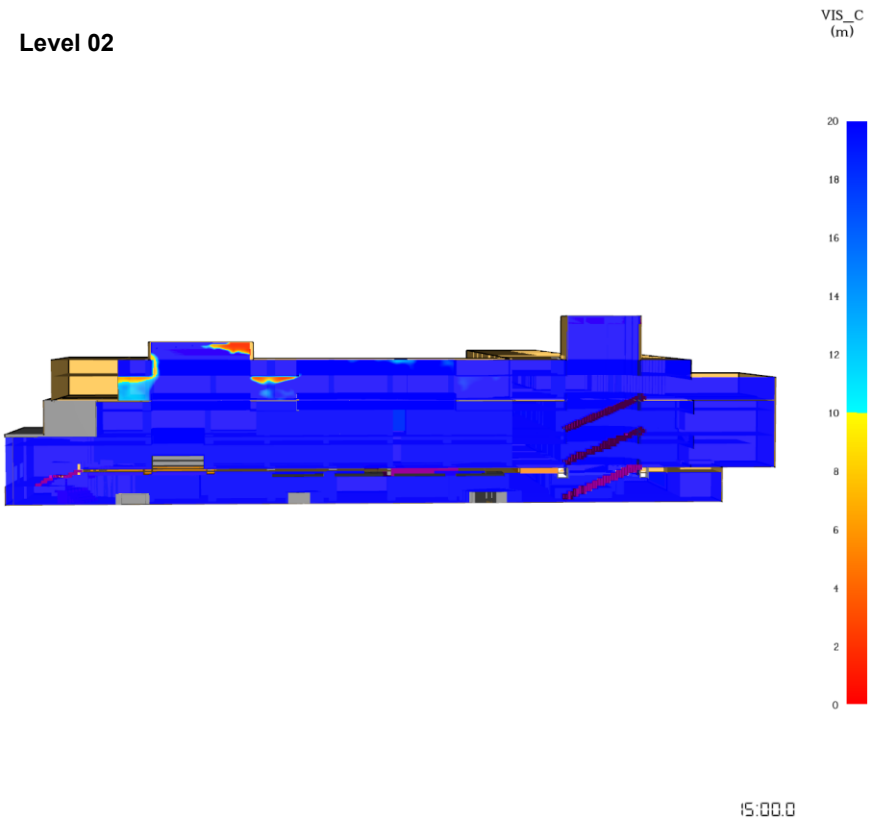
Timeline (mm:ss)	
0:55 minutes Cue time from smoke detector activation. Smoke begins to spread out of fire-affected tenancy.	**Level 02** 
3:12 minutes Smoke continues to spread out of the tenancy. Smoke begins spreading up the Victoria Avenue void and is exhausted at the top of the void. All occupants within the smoke zone 7 on L02 have moved away from the fire and are queuing in front of exits.	**Level 02** 

[97] Jensen Hughes, 2025, Fire in tenancy 2-024–S12b.fds

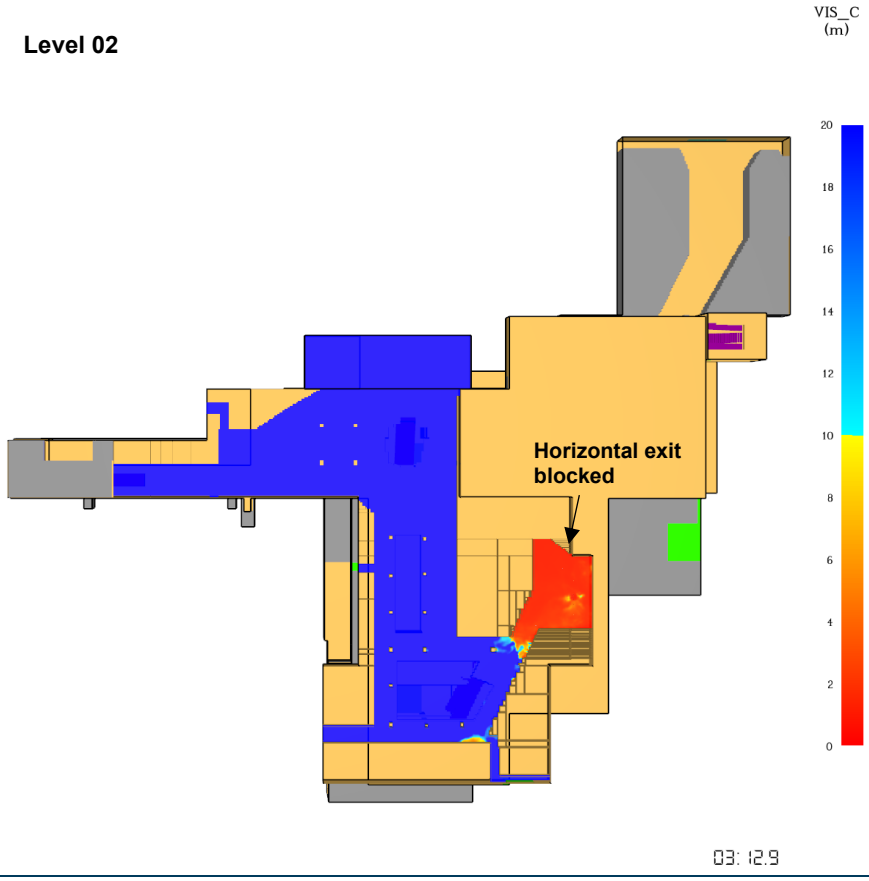
Timeline (mm:ss)	
5:15 minutes Smoke continues to spread throughout the south-eastern corridor of smoke zone 7 on L02. All occupants within Smoke spreads into the corridor leading to Stair 6. Exit considered blocked.	
11:33 minutes Smoke continues to spread through smoke zone 7 on L02. All occupants within L02 have evacuated.	

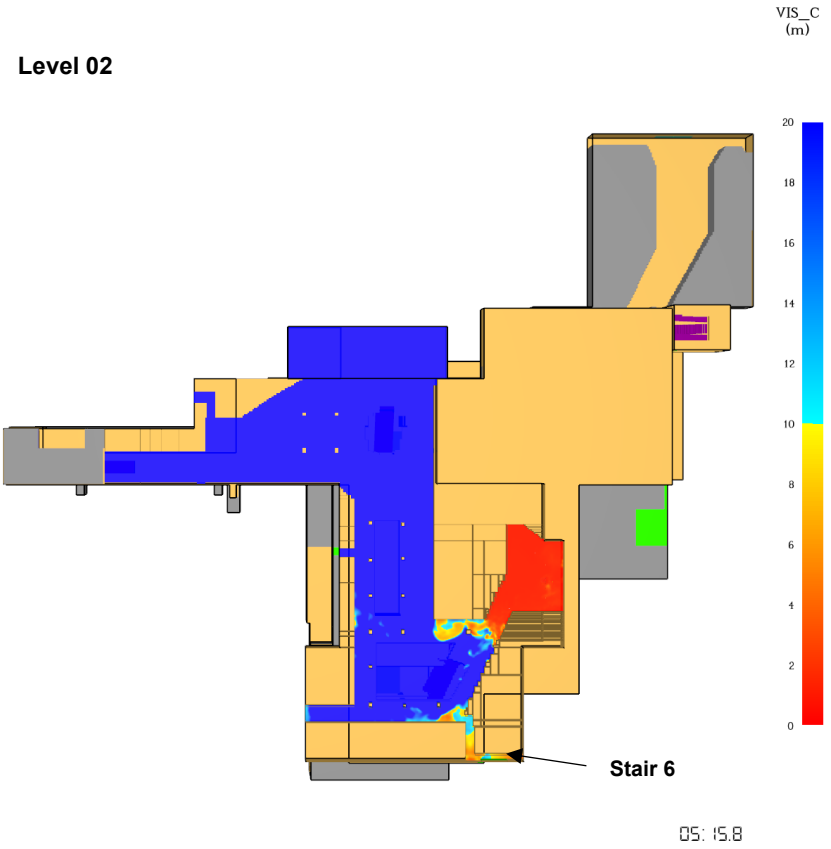
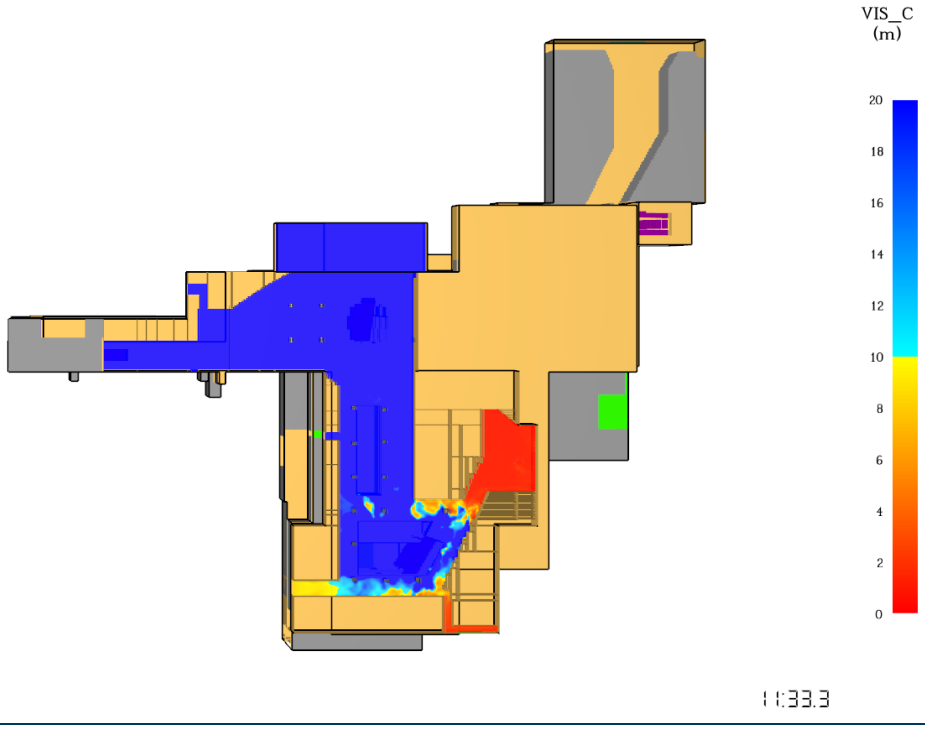
Timeline (mm:ss)	
15:00 minutes End of modelling duration. Smoke has spread to the majority of the smoke zone on level 02.	**Level 02** 

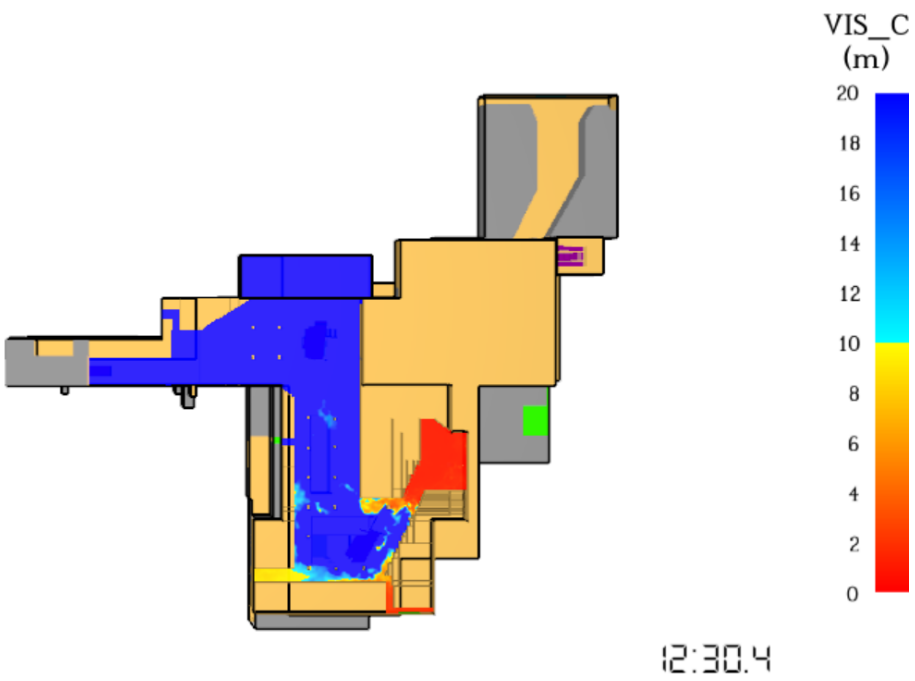
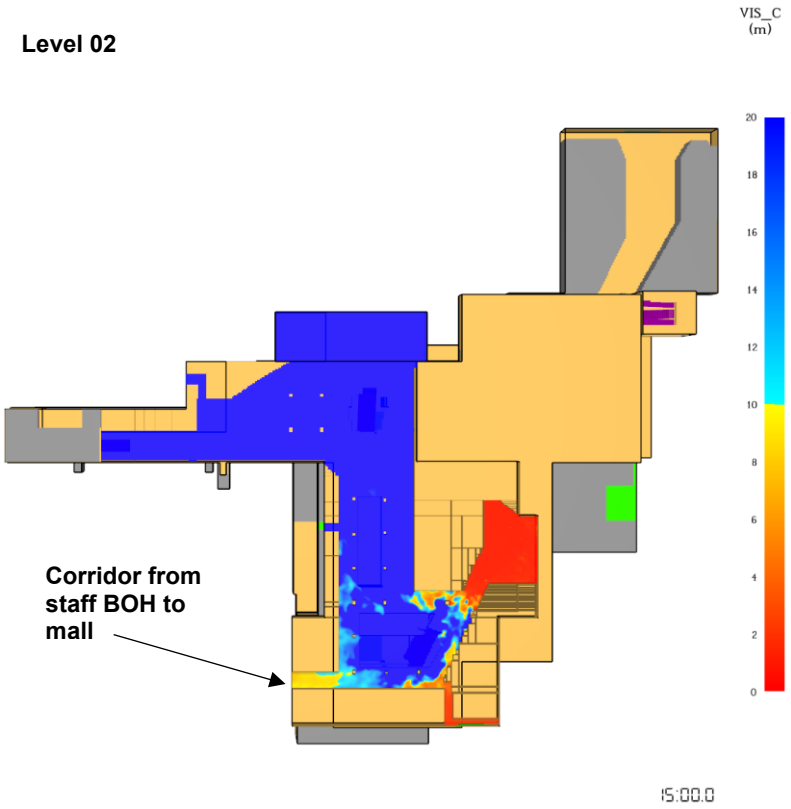
H.14.2 Visibility – section

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. End of modelling duration. Visibility exceeds 10m for the majority of the mall.	**Level 02** 

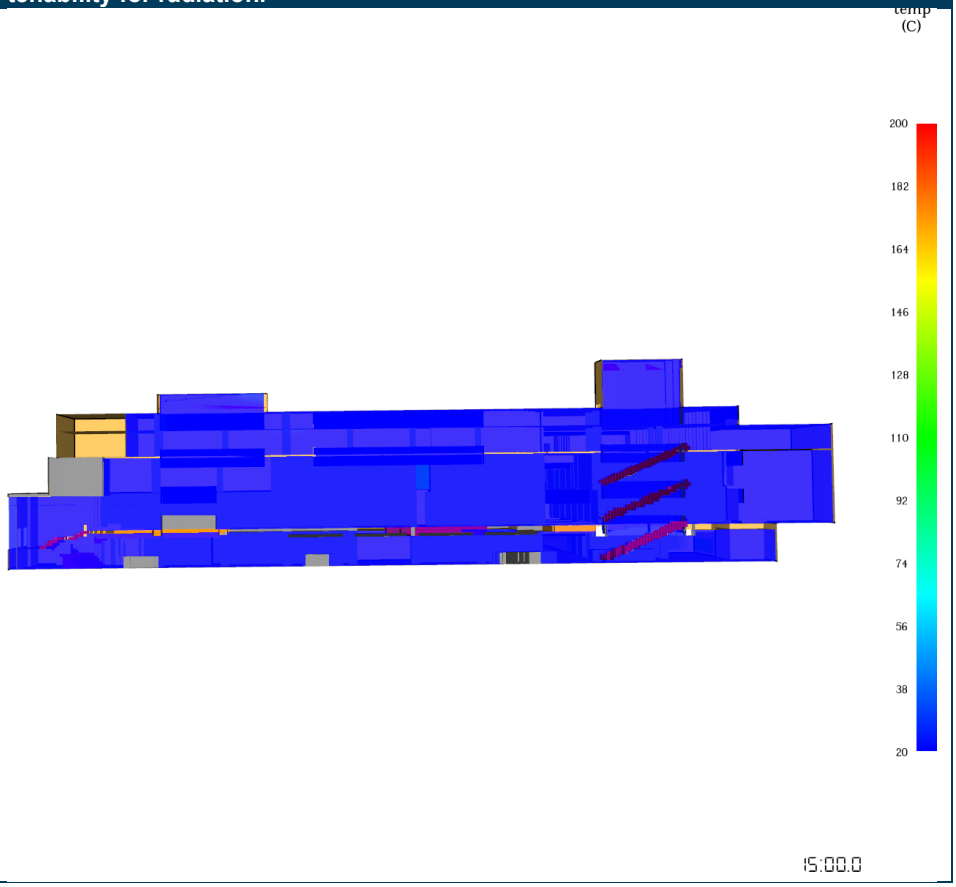
H.14.3 Visibility at 2m above floor level

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:12 minutes Visibility throughout the majority of smoke zone 7 on level 2 exceeds 10 m with the exception of the localised mall area adjacent to the fire-affected tenancy. Horizontal exit to the carpark considered blocked for this scenario. All occupants within L02 smoke zone 7 have moved away from the fire and are queuing at exits.	

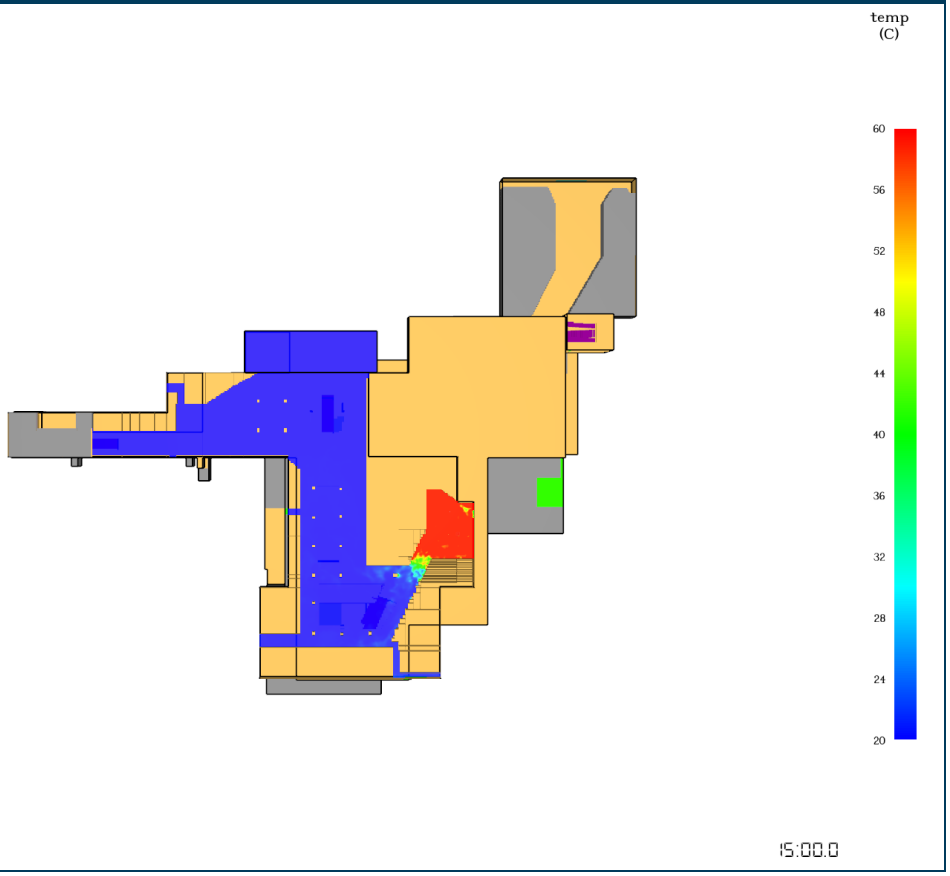
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
5:30 minutes Visibility throughout the majority of the smoke zone exceeds 10 m with the exception of the localised area of the mall adjacent to the fire-affected tenancy. Visibility within the corridor leading to Stair 6 begins to drop. Stair 6 considered blocked.	
11:33 minutes Visibility throughout the majority of the smoke zone exceeds 10 m with the exception of the localised area of the mall adjacent to the fire-affected tenancy and corridor leading to Stair 6.	

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
12:30 minutes Steady state reached for this fire scenario.	
15:00 minutes End of modelling duration. Visibility throughout the majority of the smoke zone exceeds 10 m with the exception of the localised area of the mall adjacent to the fire-affected tenancy, the corridor from a staff back of house area (which is provided access directly to a fire stair), and the corridor leading to Stair 6. With the exception of Stair 6 all exits remain available in the mall.	**Level 02** 

H.14.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

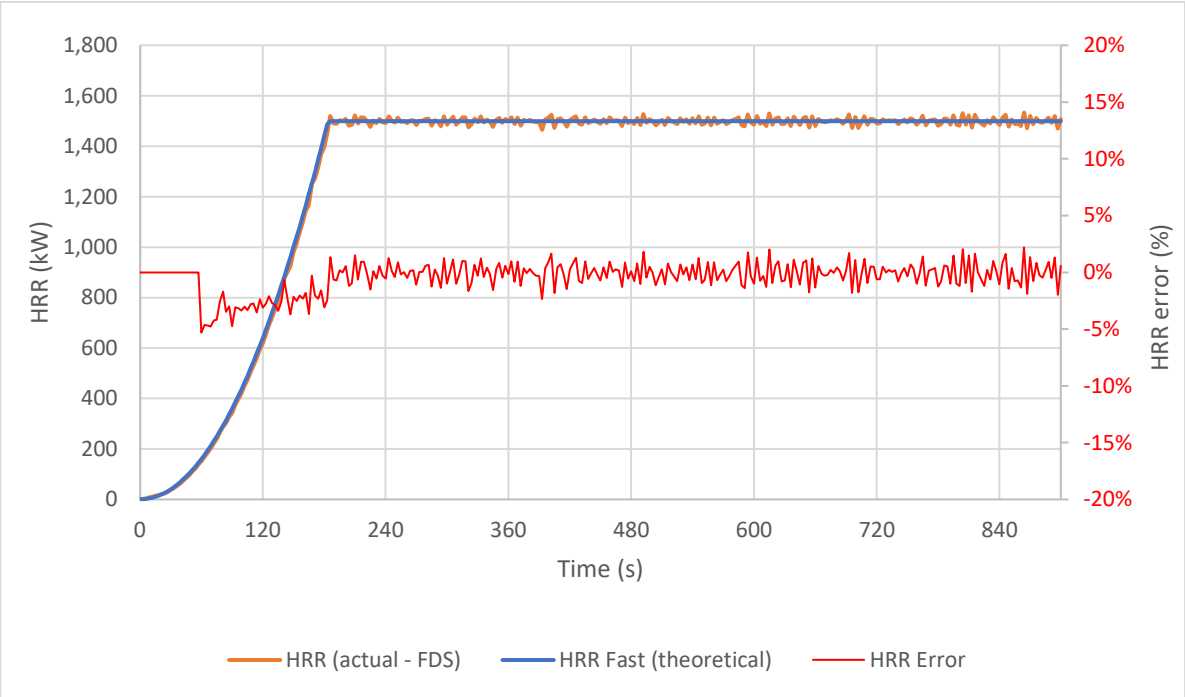
H.14.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, with the exception of the area around the fire.	

H.14.6 Error checking

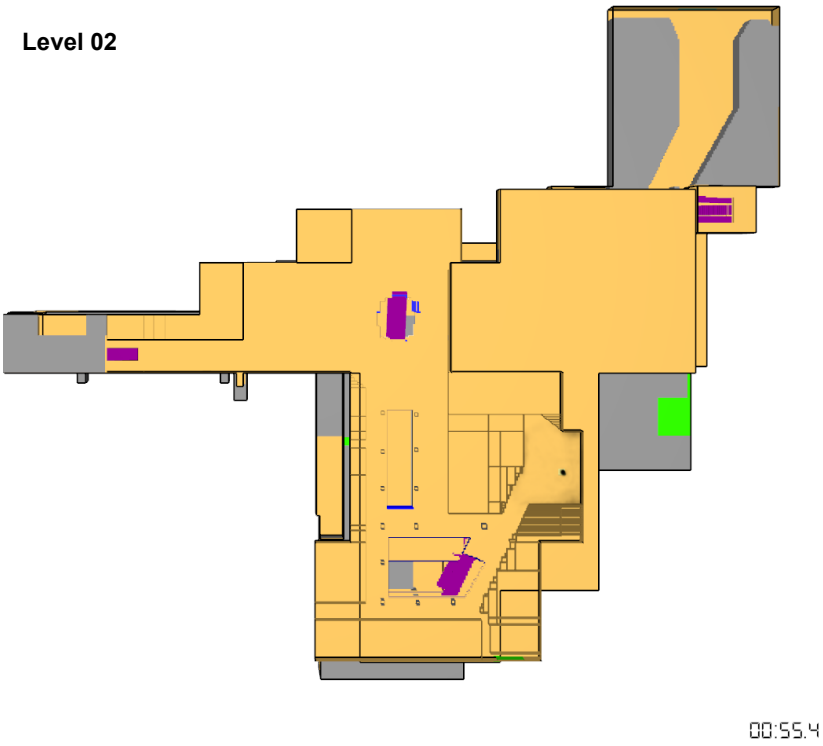
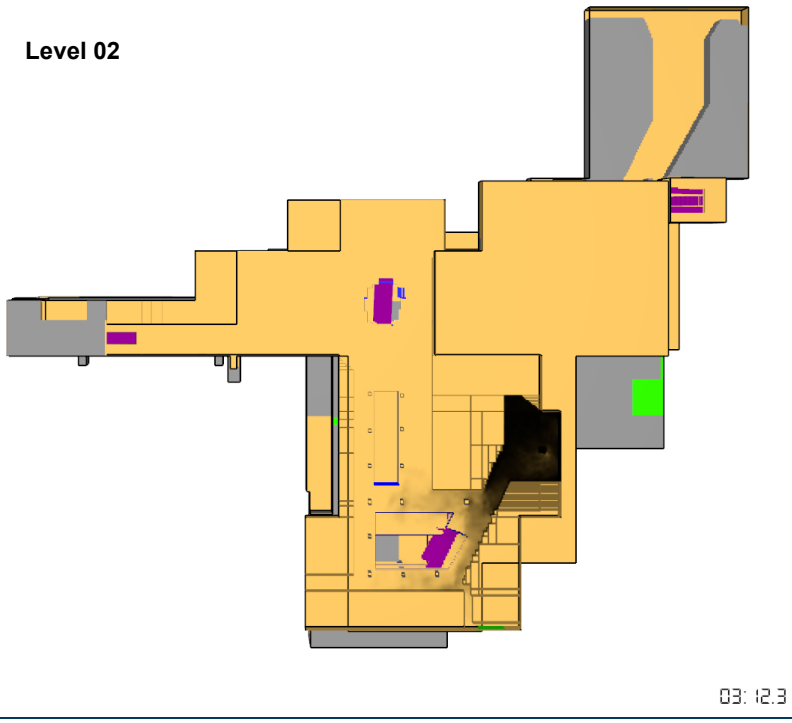
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 5% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

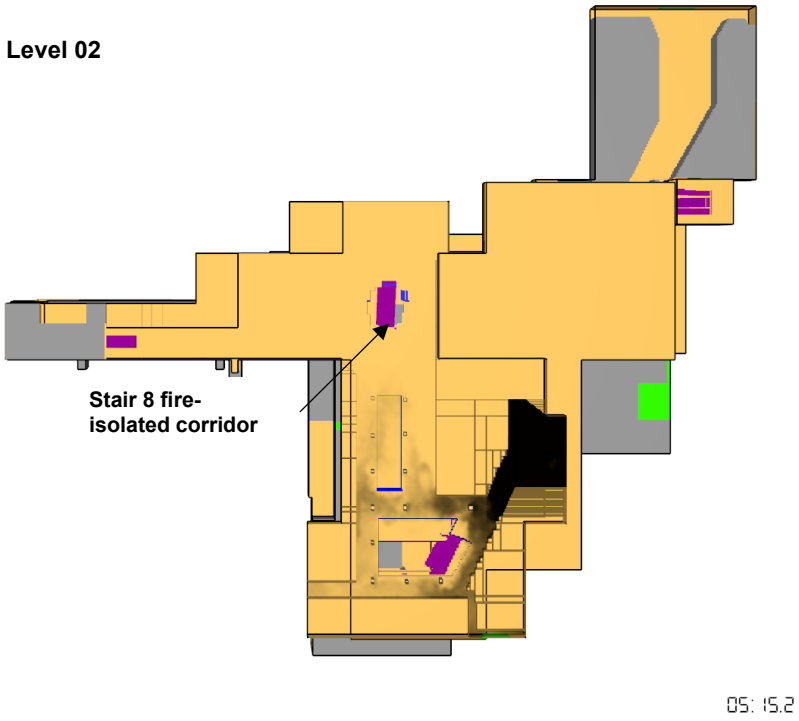
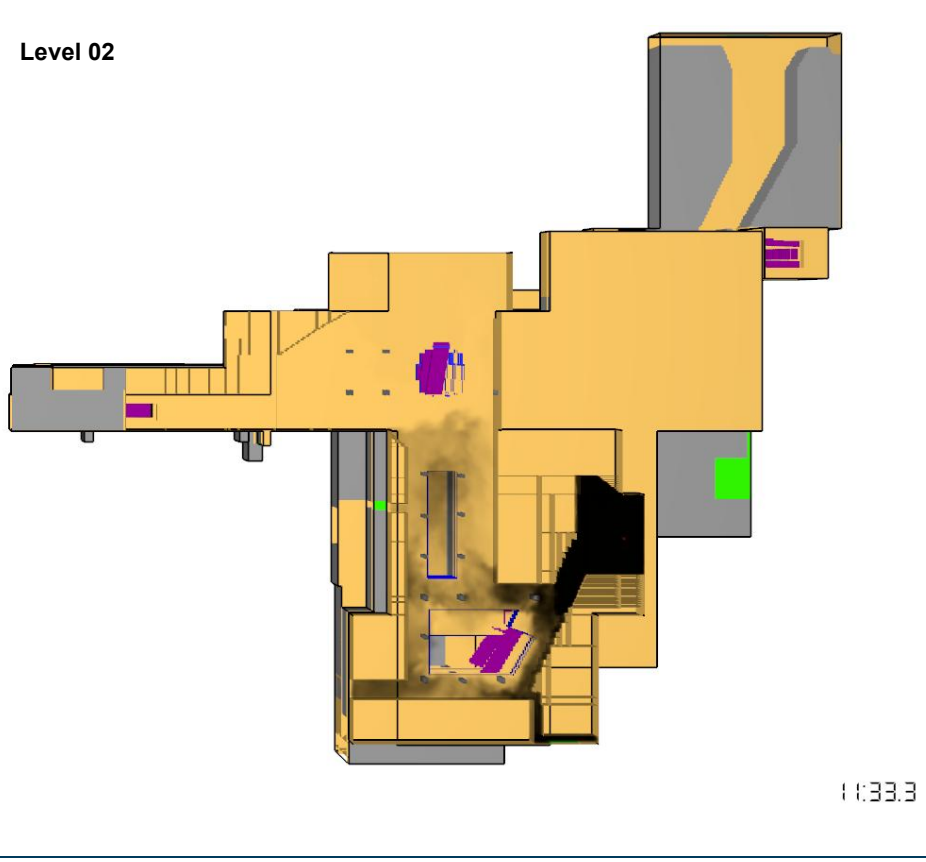


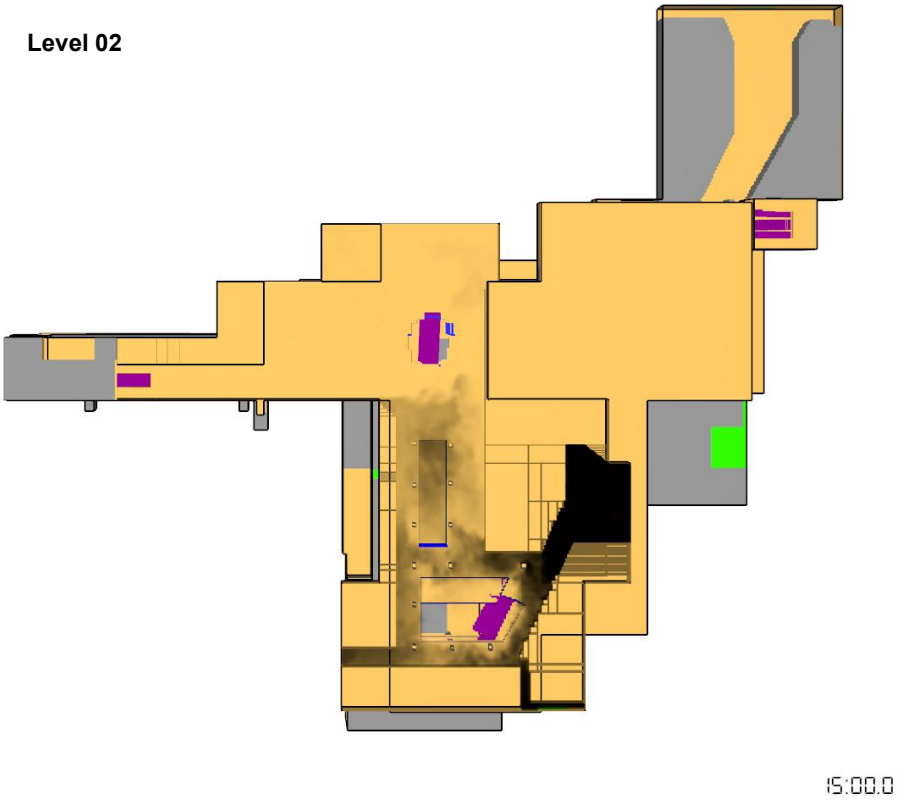
H.15 Scenario 12 results – Fire in Tenancy 2-024 (L02)[98] – Sensitivity analysis

H.15.1 Smoke spread

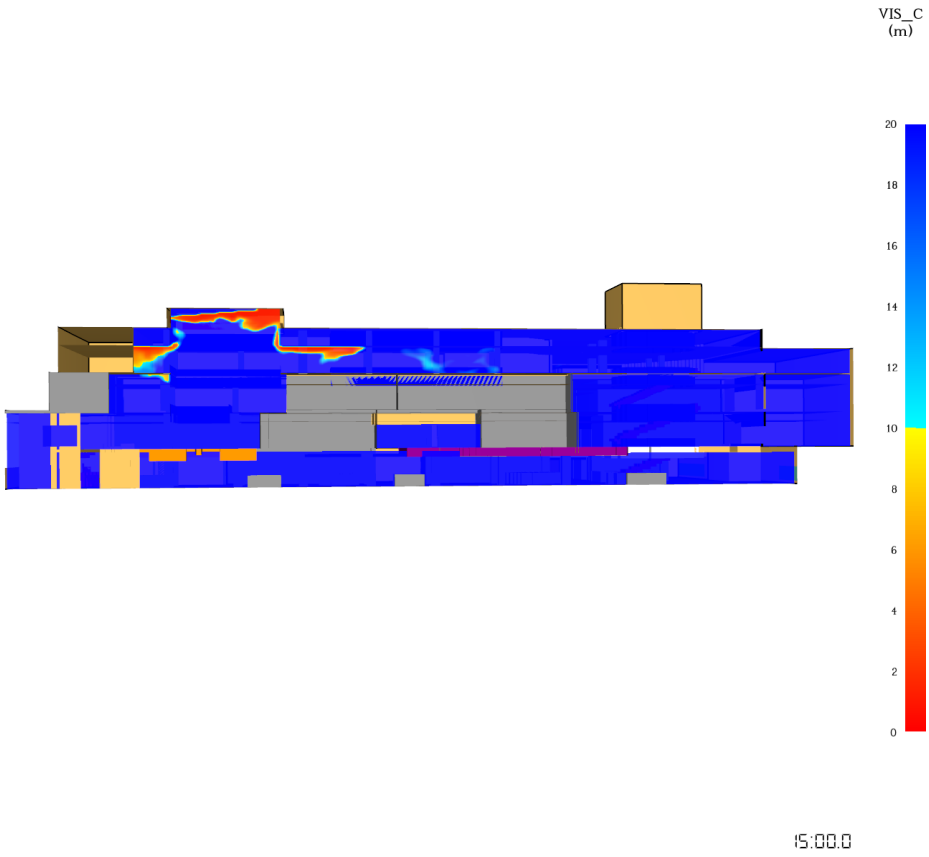
Timeline (mm:ss)	
0:55 minutes Cue time from smoke detector activation. Smoke begins to spread out of fire-affected tenancy.	**Level 02** 
3:12 minutes Smoke continues to spread out of the tenancy. Smoke begins spreading up the Victoria Avenue void and is exhausted at the top of the void. All occupants within the smoke zone 7 on L02 have moved away from the fire and are queuing in front of exits.	**Level 02** 

[98] Jensen Hughes, 2025, Fire in tenancy 2-024 sensitivity–S13c.fds

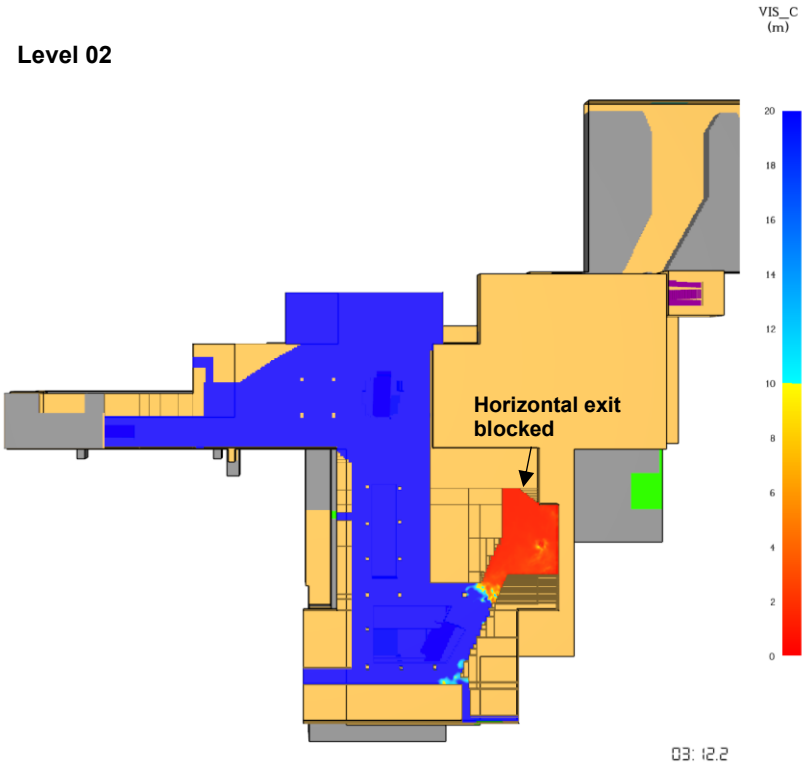
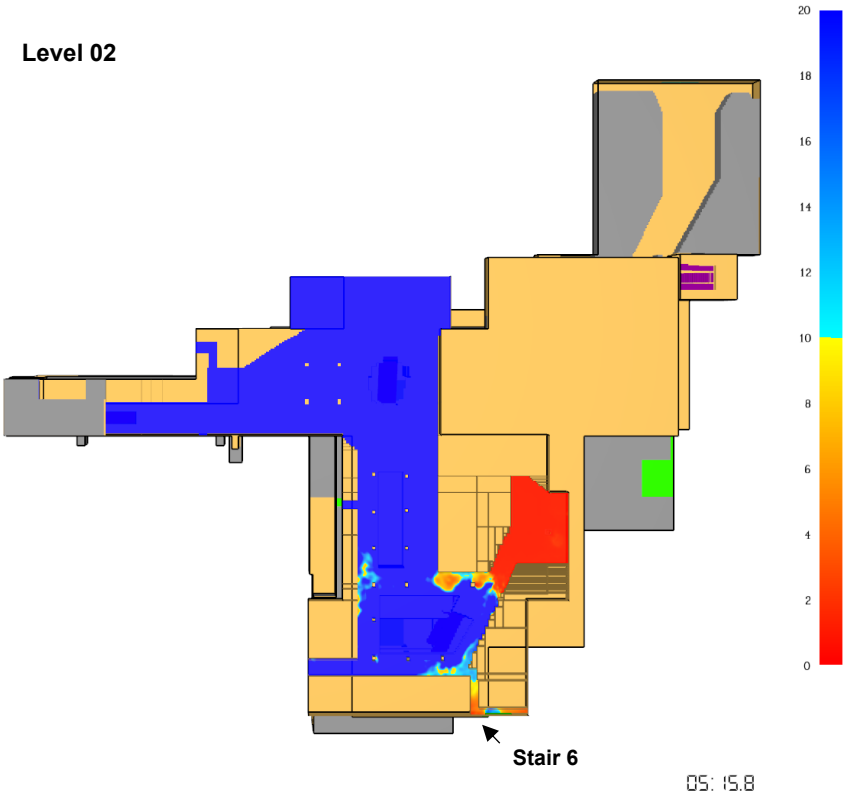
Timeline (mm:ss)	
5:15 minutes Smoke continues to spread throughout the south-eastern corridor of smoke zone 7 on L02. All occupants within Smoke spreads into the corridor leading to Stair 6. Exit considered blocked.	
11:33 minutes Smoke continues to spread through smoke zone 7 on L02. All occupants within L02 have evacuated.	

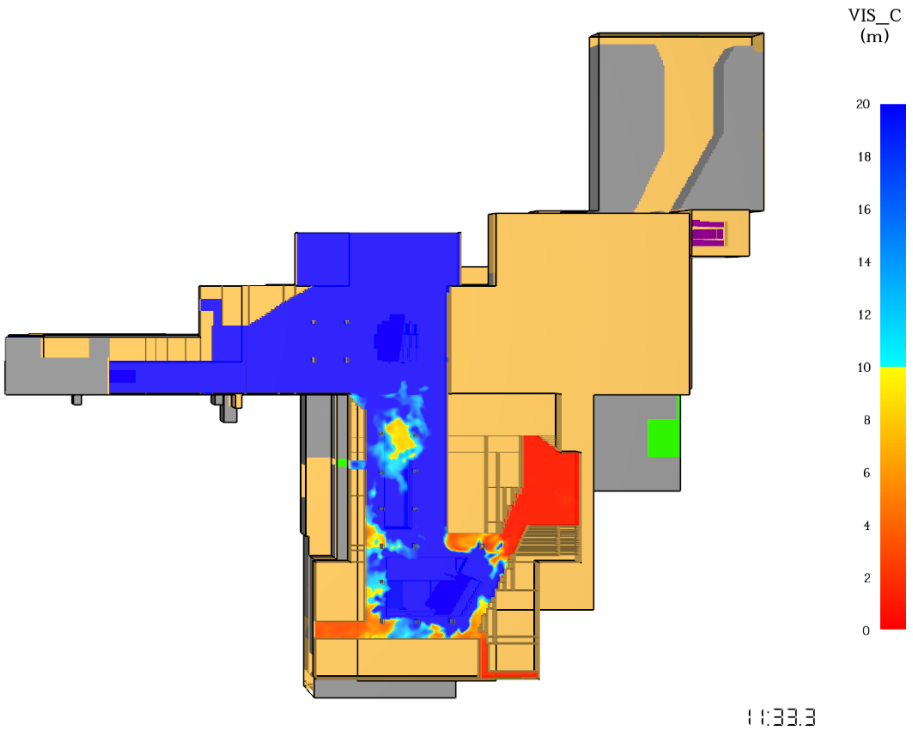
Timeline (mm:ss)	
15:00 minutes Smoke has to throughout L00 smoke zone and into the Havilah St zone (smoke zone 13).	**Level 02** 

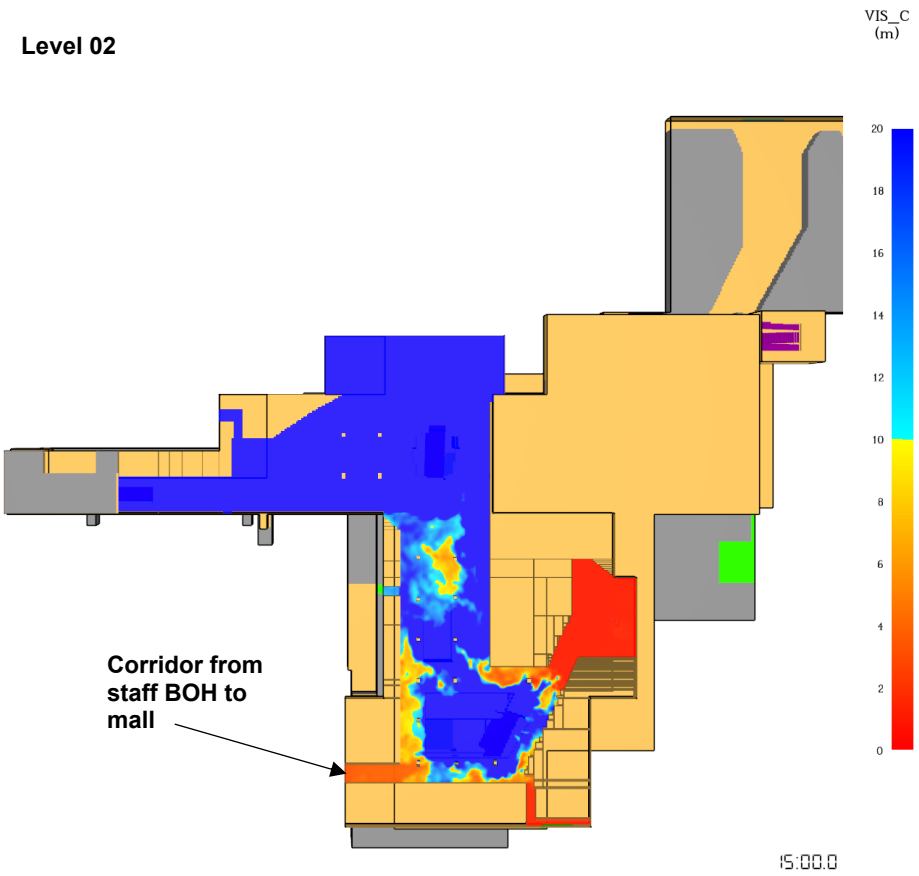
H.15.2 Visibility – section

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Visibility exceeds 10m for the majority of the mall.	

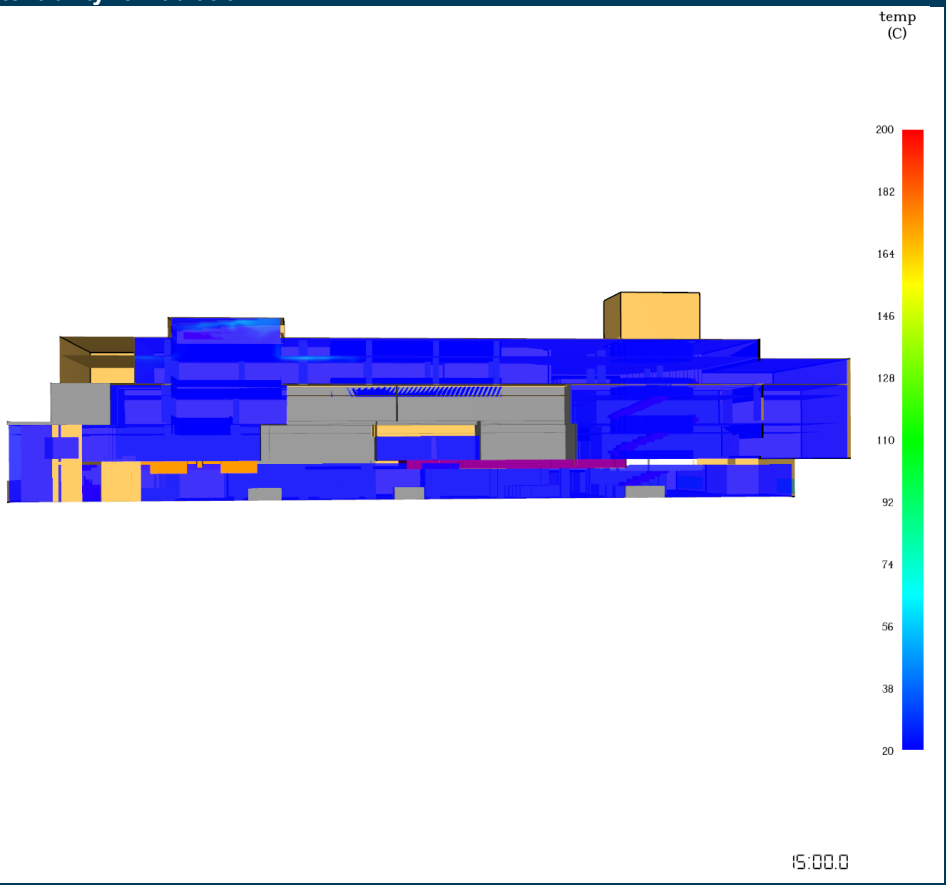
H.15.3 Visibility at 2m above floor level

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
3:12 minutes Visibility throughout the majority of smoke zone 7 on level 2 exceeds 10 m with the exception of the localised mall area adjacent to the fire-affected tenancy. Horizontal exit to the carpark considered blocked for this scenario. All occupants within L02 smoke zone 7 have moved away from the fire and are queuing at exits.	
5:15 minutes Visibility throughout the majority of the smoke zone exceeds 10 m with the exception of the localised area of the mall adjacent to the fire-affected tenancy. Visibility within the corridor leading to Stair 6 begins to drop. Stair 6 considered blocked.	

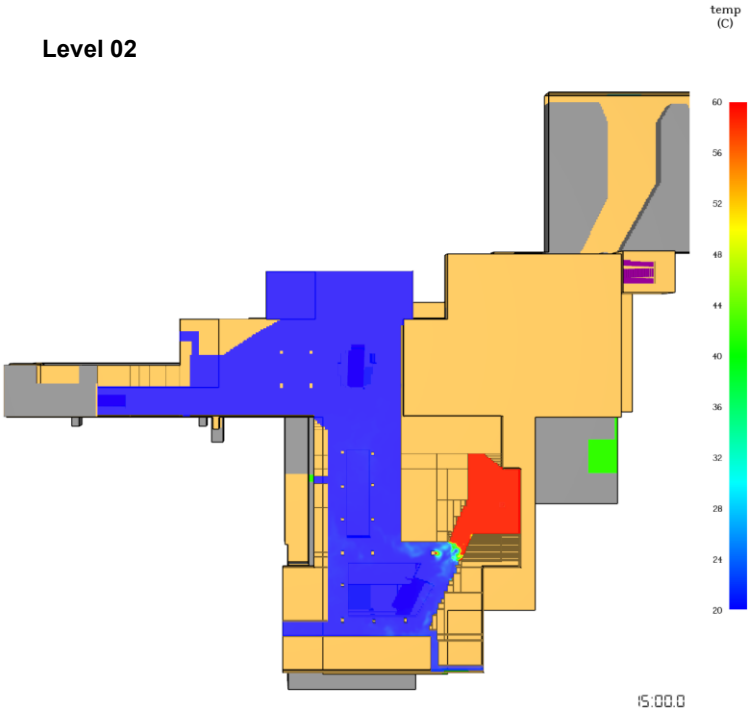
Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
11:33 minutes Visibility throughout the majority of the smoke zone exceeds 10 m with the exception of the localised area of the mall adjacent to the fire-affected tenancy and corridor leading to Stair 6.	**Level 02** 

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling. Visibility throughout the majority of the smoke zone exceeds 10 m with the exception of the localised area of the mall adjacent to the fire-affected tenancy, the corridor from a staff back of house area (which is provided access directly to a fire stair), and the corridor leading to Stair 6. With the exception of Stair 6 all exits remain available in the mall.	

H.15.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

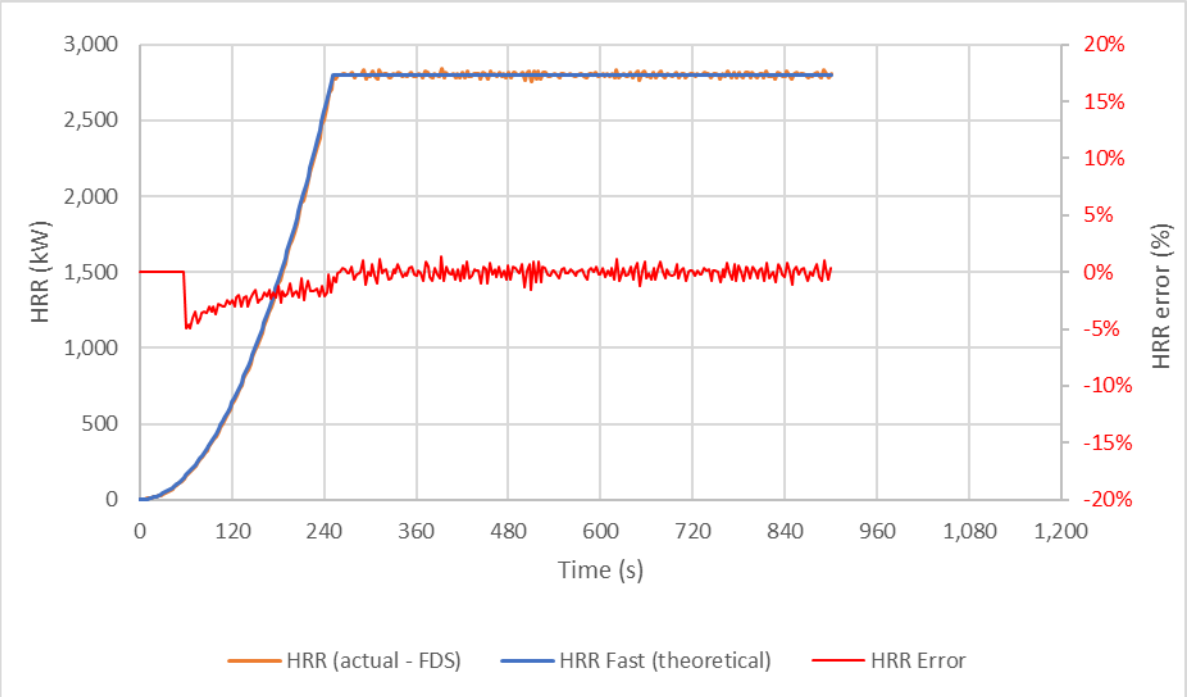
H.15.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, with the exception of the area around the fire.	**Level 02** 

H.15.6 Error checking

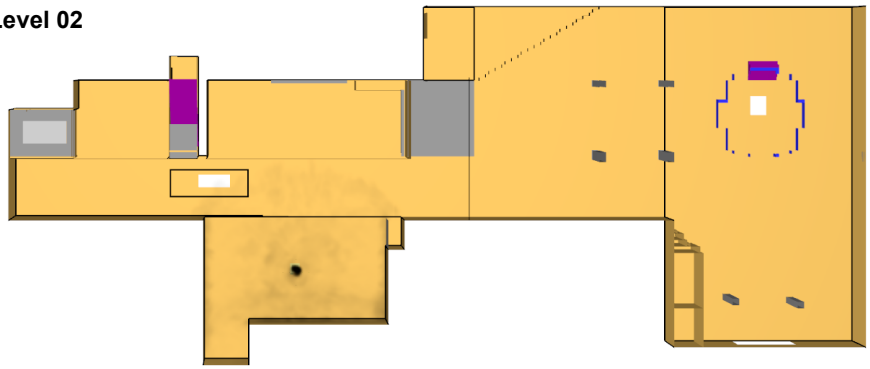
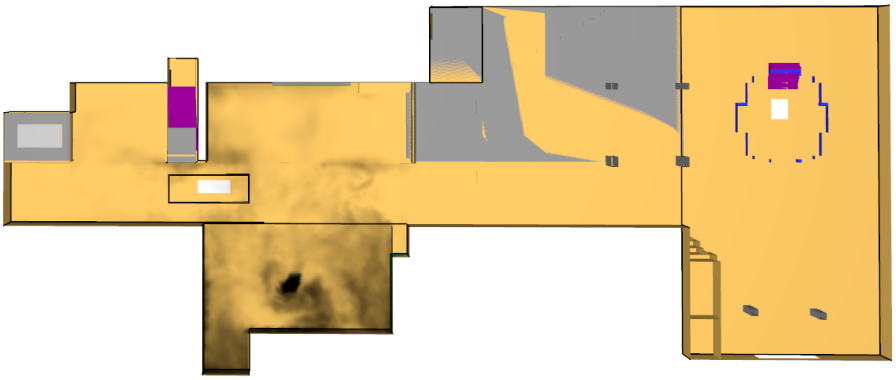
Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 5% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.

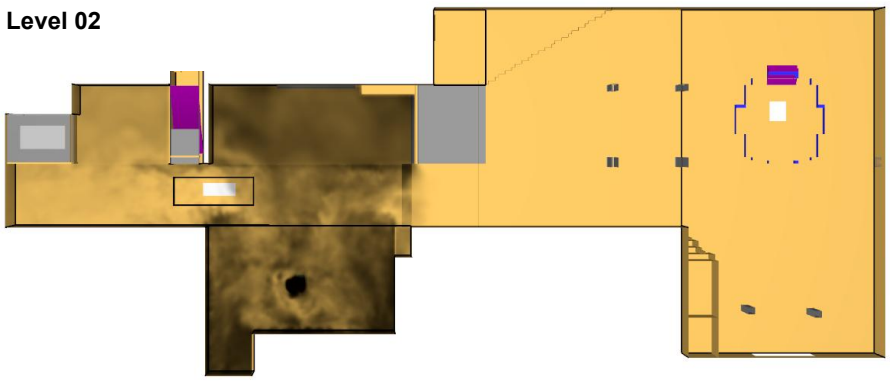


H.16 Scenario 13 results – Fire in Tenancy 2-010 (L02)[99] – Sensitivity

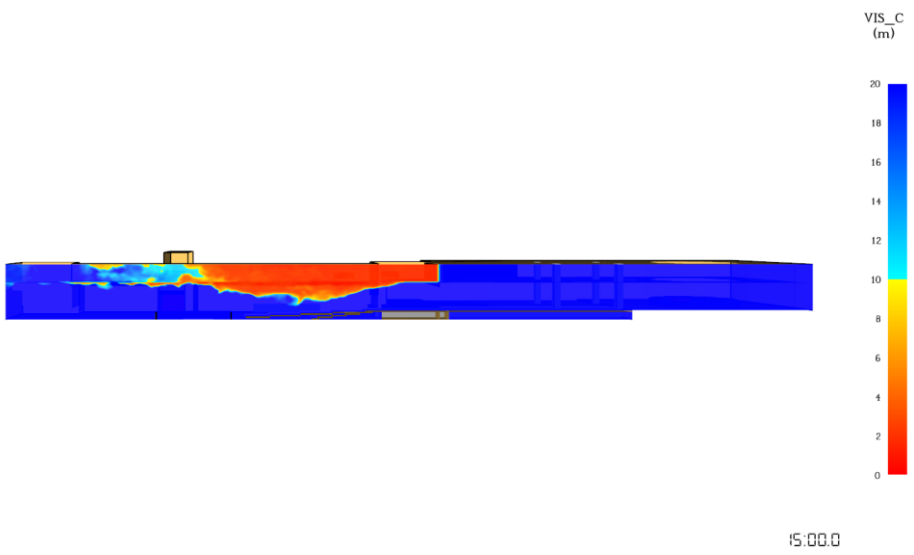
H.16.1 Smoke spread

Timeline (mm:ss)	
01:00 minutes Cue time for the fire affected floor. Smoke begins to spread out of fire-affected tenancy.	**Level 02**  01:00.1
2:57 minutes Smoke continues to spread out of the tenancy and into smoke zone 12 on level 2. All occupants within the smoke zone have evacuated the smoke zone.	**Level 02**  02:57.4

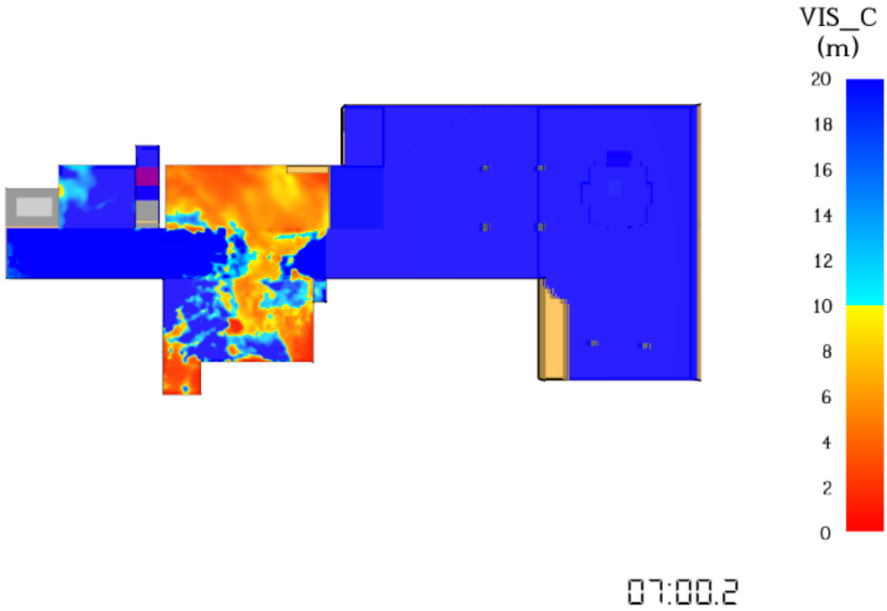
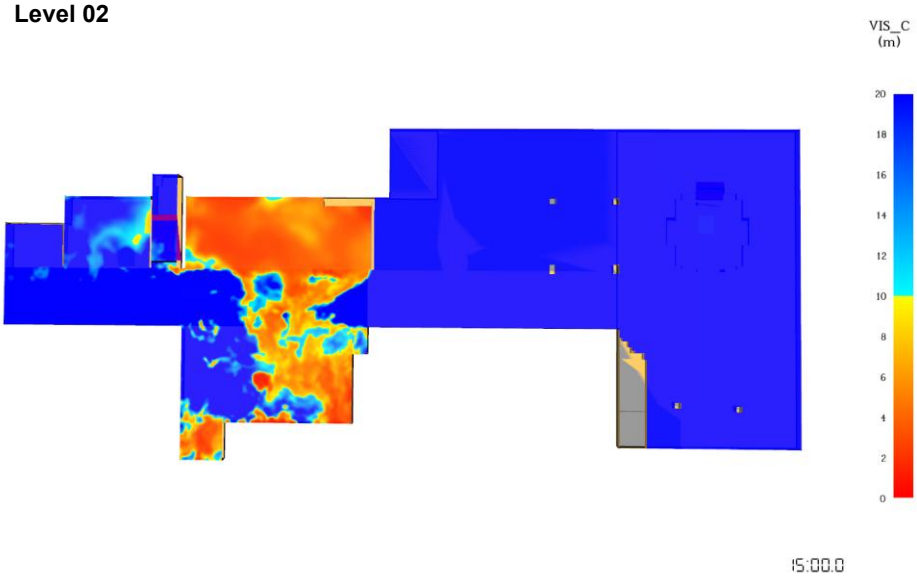
[99] Jensen Hughes, 2025, Fire in tenancy 2-010–S12a.fds

Timeline (mm:ss)	
15:00 minutes End of modelling duration. Smoke has spread throughout smoke zone 12 on level 2.	**Level 02** 

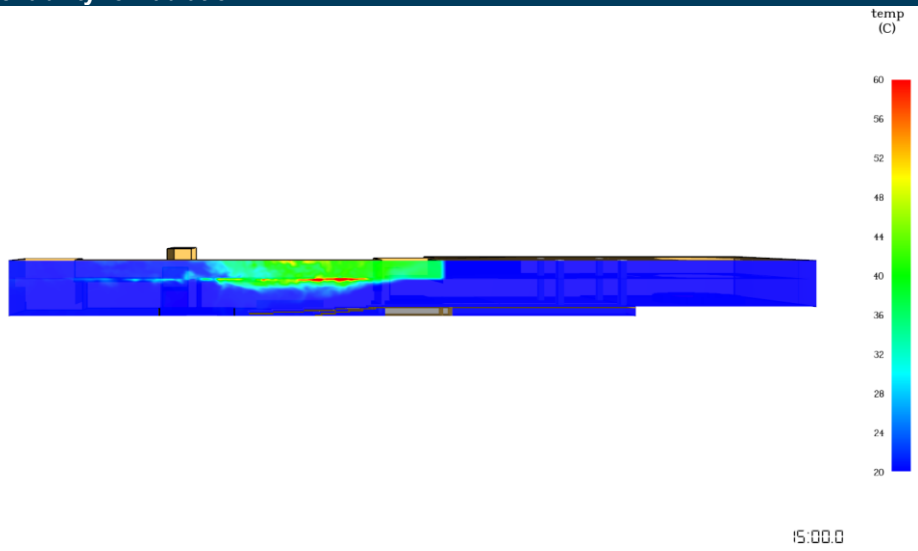
H.16.2 Visibility – section

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
15:00 minutes End of modelling duration. Except for the fire affected smoke zone and a portion of the smoke zone on level 01, visibility within the remainder of the mall exceeds 10 m.	

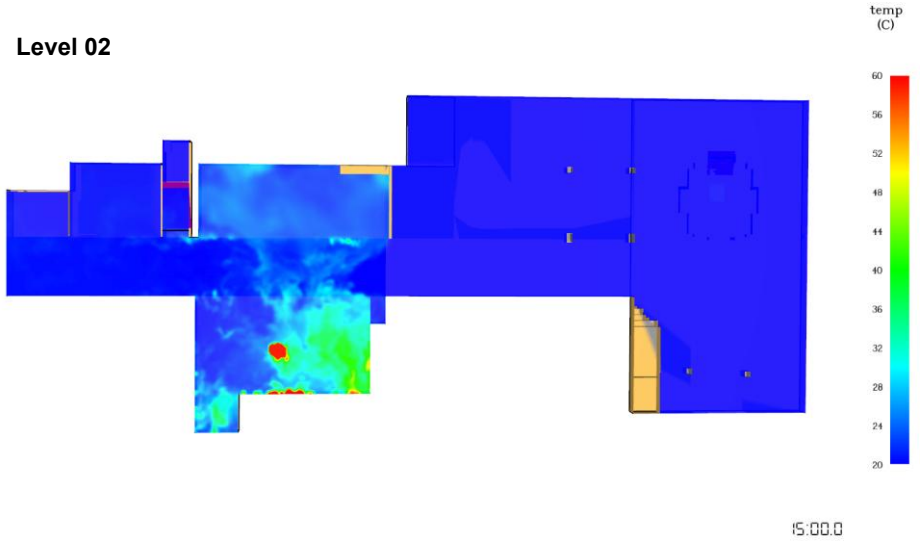
H.16.3 Visibility at 2m above floor level

Timeline (mm:ss)	The colour blue indicates visibility exceeding 10 m to non-illuminated walls and obstructions. Other colours indicate a visibility of less than 10 m.
7:00 minutes Steady state reached for this fire scenario.	
15:00 minutes Visibility within Zone 12 within level 2 remains above 10m for the majority of the zone, except for the localised mall in front of the impacted tenancy, and a portion of the mini-major opposite to it.	**Level 02** 

H.16.4 Temperature – section

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 200 °C, which corresponds to the limit for tenability for radiation.
15:00 minutes End of modelling duration. The temperature section through the mall shows that the smoke layer is less than 200°C	

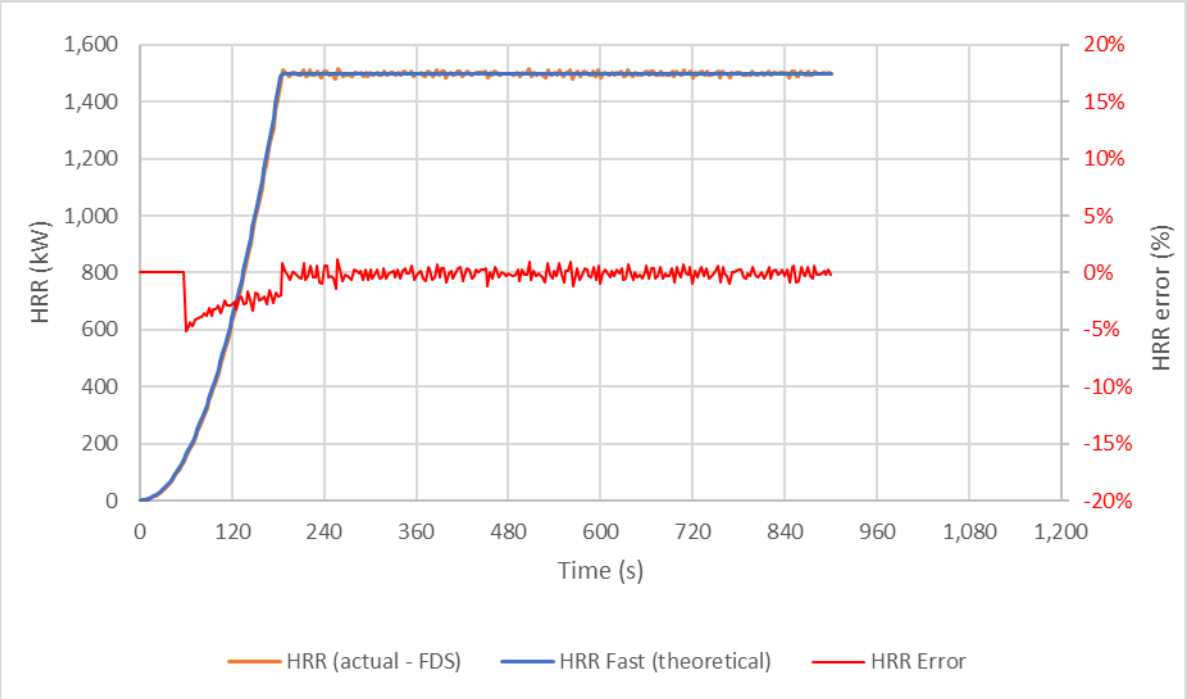
H.16.5 Temperature at 2m above floor level

Timeline (mm:ss)	The colour blue indicates temperatures of approximately 20 °C. The colour red indicates temperatures greater than 60 °C, which is the limit for tenability.
15:00 minutes Temperatures are less than 60°C throughout the ground floor mall at 2 m above floor level, except for the fire affected tenancy and the mall area in front of the impacted tenancy.	

H.16.6 Error checking

Heat release rate

The following graph compares the heat release rate specified in the FDS input file with the actual heat release rate measured in the output to confirm consistency. The graph shows consistency between input and output data with errors of less than 10% during the early growth phase when the fire size is small and less than 5% error once the peak fire size is reached.



Appendix I Evacuation modelling (retail)

I.1 Evacuation assessment framework

The AFEG states that the RSET is the time from when a fire initiates to the time when occupants reach a place of safety. The framework used to calculate the RSET has previously been detailed in Appendix F and is based on Equation 5 below.

RSET = cue period + response period + delay period + movement period

Equation 5 Calculation of RSET

I.1.1 Evacuation scenarios

The evacuation scenarios described in Table 101 have been formulated based on the fire scenarios outlined in section 13.6 of this report and the results of the smoke modelling presented in 13.6.

The following is noted regarding the evacuations assessment:

- The evacuation of the whole building, including basement levels and the level 3 gym and new retail fire compartment was considered for each scenario given the fire-isolated exits shared between the retail levels and these areas.
- Occupants outside the smoke zone of fire origin were assigned to exits away from this zone in the evacuation modelling undertaken.
- For fire scenarios in smoke zone 7 (central smoke zone), occupants within any mini-major and major tenancies opening into the mall in zone 7 from the level of fire origin or the levels above were assigned to exits provided within the tenancies or through common back-of-house corridors such that they do not evacuate through the mall.
- The exit elements from each level of the building, including stair numbers and exit widths, are shown in Appendix D. The evacuation assessment should be read in conjunction with Appendix D and the FDS smoke modelling results in Appendix H.

Table 101 Evacuation scenarios

Fire scenario	Area considered	Blocked exits	Cue type
Lower ground level			
Scenario 1 – Fire in specialty tenancy B-031 (Zone 7) **Scenario 2** – Fire in kiosk site 11 (Zone 7)	Zone 7 (central atrium smoke zone) and lower ground food court (zone number 9/10 in NDY fire engineering reports)	All exits available	Fire alarm + visual cue
Scenario 3 – Fire in specialty tenancy B-031 (Zone 7, sensitivity)	Rest of lower ground level mall	All exits available outside smoke zone of fire origin	Fire alarm + visual cue
	Zone 7 on ground level, level 01 and level 02	All exits available	Fire alarm + visual cue
Ground level (level 00)			
	Zone 7 on level 00	Stair 8 from zone 7 blocked	Fire alarm + visual cue
	Rest of level 00 mall	All exits available outside smoke zone of fire origin	Fire alarm + visual cue

Fire scenario	Area considered	Blocked exits	Cue type
Scenario 4 – Fire in specialty tenancy G-034 (Zone 7) **Scenario 6** – Fire in specialty tenancy G-034 (Zone 7, sensitivity)	Zone 7 on level 01 and level 02	All exits available	Fire alarm + visual cue
Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)	Zone 7 on level 00	Stair 6 and main entry to Victoria Avenue from level 00 blocked	Fire alarm + visual cue
	Rest of level 00 mall	All exits available outside smoke zone of fire origin	Fire alarm + visual cue
	Zone 7 on level 01 and level 02	All exits available	Fire alarm + visual cue
Scenario 7 – Fire in specialty tenancy G-027A (Zone 13) **Scenario 8** – Fire in specialty tenancy G-027A (Zone 13, sensitivity)	Zone 13 on level 00	Stair 4 blocked	Fire alarm + visual cue
	Rest of level 00 mall	All exits available outside smoke zone of fire origin	Fire alarm + visual cue
	Zone 13 on level 01	All exits available	Fire alarm + visual cue
Level 01			
Scenario 9 – Fire in specialty tenancy 1-009 (Zone 12) **Scenario 10** – Fire in specialty tenancy 1-009 (Zone 12, sensitivity)	Zone 12 on level 01	Corridor to Stair 8 from Zone 12 blocked.	Fire alarm + visual cue
	Rest of level 01 mall	All exits available outside smoke zone of fire origin	Fire alarm + visual cue
	Zone 12 on level 02	All exits available	Fire alarm + visual cue
Level 02			
Scenario 11 – Fire in specialty tenancy 2-024 (Zone 7) **Scenario 12** – Fire in specialty tenancy 2-024 (Zone 7, sensitivity)	Zone 7 on level 02 – only localised area near tenancy of fire origin	Horizontal exit into carpark blocked	Fire alarm + visual cue
	Rest of level 02 mall	All exits available outside smoke zone of fire origin	Fire alarm + visual cue
Scenario 13 – Fire in specialty tenancy 2-010 (Zone 12)	Zone 12 on level 02	Corridor to Stair 8 from Zone 12 blocked.	Fire alarm + visual cue
	Rest of level 02 mall	All exits available outside smoke zone of fire origin	Fire alarm + visual cue

I.1.2 Populations nominated

Table 102 summarises the population densities used for the retail levels in this assessment which have been calculated based on Fire Code Reform Centre Project 6 population densities.

Table 102 Population estimate – retail levels within the existing retail compartment

Retail area	Estimated population
Lower ground level	3223
Ground level (level 00)	2658
Level 01	2855
Level 02	2214

Table 103 summarises the population densities used for the carpark, loading dock and commercial office areas in the building. Populations in the carpark / loading dock areas (30 m^2/person) and the level 03 office (10 m^2/person) are based on the population densities prescribed in table D2D18 of the National Construction Code (NCC).

Note that the population considered in the carpark and loading dock areas is limited to occupants sharing an exit with the retail levels of the building. This population is a percentage of the total population based on the percentage of total egress width represented by the width of the shared exits.

Table 103 Population estimate – other areas

Area	Estimated population
Basement 2 – general	240
Basement 2 – loading dock	14
Basement 1	377
Level 00 carpark	139
Level 00A carpark	93
Level 01 carpark	149
Level 01A carpark	149
Level 02 carpark	199
Level 02A carpark	199
Level 03	906

Table 104 summarises the populations relevant for each of the fire scenarios assessed. For all fire scenarios, at least 50% of the population from mini-major and major tenancies on lower ground level and ground level (level 00) that do not open directly into the zone of fire origin use the main shopping centre entrances to evacuate. Exits that are obstructed for each scenario are detailed in Table 104.

Table 104 Populations used in evacuation assessment

Fire scenario	Area considered	Estimated population
Lower ground level		
Scenario 1 – Fire in specialty tenancy B-031 (Zone 7) **Scenario 2** – Fire in kiosk site 11 (Zone 7) **Scenario 3** – Fire in specialty tenancy B-031 (Zone 7, sensitivity)	Zone 7 (central atrium smoke zone) and lower ground food court (zone number 9/10 in NDY fire engineering reports)	575
	Rest of lower ground level	2648
	Zone 7 on level 00	849
	Zone 7 on level 01	1007
	Zone 7 on level 02	893
Ground level (level 00)		
Scenario 4 – Fire in specialty tenancy G-034 (Zone 7) **Scenario 6** – Fire in specialty tenancy G-034 (Zone 7, sensitivity)	Zone 7 on level 00	849
	Rest of level 00	2087
	Zone 7 on level 01	1007
	Zone 7 on level 02	893
Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)	Zone 7 on level 00	849
	Rest of level 00	2087
	Zone 7 on level 01	1007
	Zone 7 on level 02	893

Fire scenario	Area considered	Estimated population
Scenario 7 – Fire in specialty tenancy G-027A (Zone 13) **Scenario 8** – Fire in specialty tenancy G-027A (Zone 13, sensitivity)	Zone 13 on level 00	311
	Rest of level 00	2625
	Zone 13 on level 01	431
Level 01		
Scenario 9 – Fire in specialty tenancy 1-009 (Zone 12) **Scenario 10** – Fire in specialty tenancy 1-009 (Zone 12, sensitivity)	Zone 12 on level 01	318
	Rest of level 01	2618
Level 02		
Scenario 11 – Fire in specialty tenancy 2-024 (Zone 7) **Scenario 12** – Fire in specialty tenancy 2-024 (Zone 7, sensitivity)	Zone 7 on level 02 – only localised area near tenancy of fire origin*	617
	Rest of level 02	1597
Scenario 13 – Fire in specialty tenancy 2-010 (Zone 12)	Zone 12 on level 02	259
	Rest of level 02	1955
*Note: Given the relatively large size of smoke zone 7 and the location of the fire, only a portion of the occupants within zone 7 close to the fire – ie around the Victoria Avenue void – are considered to receive early cues from smoke spread and have a shorter pre-movement time of up to 1 minute as discussed in Appendix I.3.		

Table 105 summarises the populations relevant for an additional fire scenario considered for the new retail fire compartment on level 3, in relation to Performance solution 27 – Reduction of retail FRLs on level 3.

Table 105 Populations used in level 03 evacuation assessment

Fire scenario	Area considered	Estimated population
Level 03		
Scenario 14 – Fire in tenancy 3-002	Internal areas of level 03	906

I.2 Cue period

The cue period is dependent on the fire location, the fire growth rate and the active detection systems provided within the area of fire origin.

A 'double knock' system is proposed to be used in the building. The activation of a smoke detector initiates a 3 minute investigation period, but the activation of a second smoke detector immediately operates the building's EWIS.

Smoke detectors spaced in accordance with clause S20C6 of specification 20 of the NCC were located around the fires for each scenario in the FDS models – see Appendix H for detailed smoke detector properties.

The cue period for this assessment for occupants in the smoke zone of fire origin is based upon the time for operation of the *second* smoke detector included in the FDS models, except where significant smoke spread occurs within the mall prior to the operation of the second detector. In these instances, the cue time adopted is the time at which significant smoke spread is considered to have occurred based on the FDS results. Smoke spread results for each scenario are included in Appendix H.

For non-fire-affected smoke zones, the cue period is based on the time of activation of the second smoke detector in the FDS model.

The cue periods for each scenario are summarised in Table 106.

Table 106 Cue period

Fire scenario	FDS detector activation times (mm:ss)	Visual cues for smoke spread in fire zone (mm:ss)	Cue period assumed for smoke zone of fire origin (mm:ss)	Cue period assumed for other areas in the building (mm:ss)
Scenario 1 – Fire in specialty tenancy B-031 (Zone 7)	1:24	1:00	**1:00**	**1:24**
Scenario 2 – Fire in kiosk Site 11 (Zone 7)	0:48	1:00	**0:48**	**0:48**
Scenario 3 – Fire in specialty tenancy B-031 (Zone 7, sensitivity)	1:24	1:00	**1:00**	**1:24**
Scenario 4 – Fire in specialty G-034 (Zone 7)	1:32	1:10	**1:10**	**1:32**
Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)	2:23	1:15	**1:15**	**2:23**
Scenario 6 – Fire in specialty G-034 (Zone 7, sensitivity)	1:32	1:10	**1:10**	**1:32**
Scenario 7 – Fire in specialty tenancy G-027A (Zone 13)	1:37	1:00	**1:00**	**1:37**
Scenario 8 – Fire in specialty tenancy G-027A (Zone 13, sensitivity)	1:37	1:00	**1:00**	**1:37**
Scenario 9 – Fire in specialty tenancy 1-009 (Zone 12)	1:43	1:10	**1:10**	**1:43**

Fire scenario	FDS detector activation times (mm:ss)	Visual cues for smoke spread in fire zone (mm:ss)	Cue period assumed for smoke zone of fire origin (mm:ss)	Cue period assumed for other areas in the building (mm:ss)
Scenario 10 – Fire in specialty tenancy 1-009 (Zone 12, sensitivity)	1:43	1:10	**1:10**	**1:43**
Scenario 11 – Fire in specialty tenancy 2-024 (zone 7)	1:50	1:30	**1:30**	**1:50**
Scenario 12 – Fire in specialty tenancy 2-024 (zone 7, sensitivity)	0:55	1:00	**0:55**	**0:55**
Scenario 13 – Fire in specialty tenancy 2-010	0:57	1:00	**1:00**	**1:00**

The cue period for the additional fire scenario on level 3 considered is conservatively taken as the sprinkler activation time of 3:43 – refer to Appendix E.

I.3 Pre-movement phase

The pre-movement phase is the time taken between when the cue was first received and the movement phase to a place of safety. The pre-movement phase comprises two components – the response and the delay periods.

The occupant response period involves the process of interpreting the automatic or intrinsic fire cue and identifying it as a cause for evacuation.

Following the time for the occupants to interpret the cue and identify it as a cause for evacuation, occupants undertake actions such as collecting belongings, looking for other occupants and investigating to obtain further information prior to beginning to move towards the exits.

The pre-movement phase will vary between different occupants in the population. Occupants in the same room or area as the fire with visual access are likely to react faster than occupants in adjacent areas due to the increased sense of threat. The type of fire cue received will also influence the pre-movement phase – ie smell of smoke, standard alert tones or verbal evacuation message.

The pre-movement phase for occupants within the zone of fire origin, who are assumed to receive visual and olfactory cues of a fire, is expected to range between almost no delay in the direct vicinity of the fire, up to 2 minutes further away from the fire – see Figure 142[100].

Occupants within the smoke zone of fire origin are assumed to commence movement towards exits based on a normal distribution of pre-movement times between 0 to 60 seconds, with a mean of 30 seconds and a standard deviation of 10 seconds. For scenarios 11 and 12 as detailed in Table 104, this pre-movement time is only applied to occupants in the localised area near the tenancy of fire origin within zone 7 – ie around the Victoria Avenue void. At this time, some smoke spread can be observed in the smoke zone of fire origin – see smoke modelling results in Appendix H – and those occupants closest to the fire can be expected to have commenced evacuation.

Occupants in non-fire-affected zones are assumed to commence movement towards exits based on a normal distribution of pre-movement times between 0 to 180 seconds, with a mean of 90 seconds and a standard deviation of 10 seconds.

The pre-movement period was incorporated in the Pathfinder evacuation modelling undertaken for the assessment as detailed in Appendix I.4.

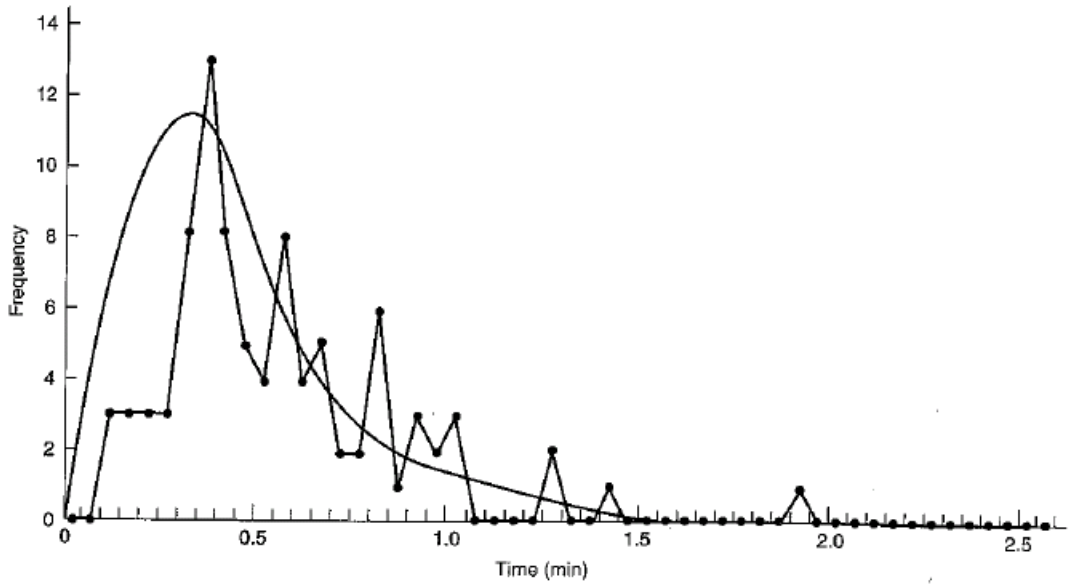


Figure 142 Experimental and theoretical pre-movement period

[100] Human Behaviour in Fire Emergencies, 2003, NFPA, USA.

I.4 Movement period

I.4.1 Pathfinder

The movement period has been modelled using the software package Pathfinder[101]. In Pathfinder, an initial delay can be nominated. This delay can include the cue period and pre-movement phase. Once the initial delay expires, the movement period is calculated by the software. The cue period and pre-movement phase are included in Appendix I.2 and Appendix I.3 respectively.

Pathfinder is an agent based egress simulator that uses steering behaviours to model occupant motion. It provides a graphical user interface for simulation design and execution as well as 2D and 3D visualisation tools for results analysis.

The simulation design environment within Pathfinder is 3D. Within the 3D model is a *'navigation mesh'* which is defined as a continuous 2D triangulated surface in the plane of occupant travel. Walls and other impassable areas are represented as gaps in a navigation mesh.

Doors and stairs are represented as special navigation mesh edges and provide a mechanism for joining rooms and tracking occupant flow. Depending on the specific selection of simulation options, doors may also be used to explicitly control occupant flow. On stairs, the travel speed is reduced proportionally to the horizontal travel speed of occupants based on the incline of the stairway.

Occupants are modelled as upright cylinders on the navigation mesh. Travel on the mesh is based on either:

- an agent-based motion technique known as inverse 'steering' or
- the hydraulic model / empirical correlations contained within the SFPE Handbook.

Each occupant calculates movements independently and can be given a unique set of parameters – ie maximum speed, exit choice, proximity to other occupants, minimum distances from wall etc. Occupants can be assigned to use specific exits based on the fire scenario being assessed.

In *'steering'* mode, doors do not act to limit the flow of occupants. Occupants use the steering system to maintain a reasonable separation distance from walls, other occupants etc. In the SFPE mode, occupants do not attempt to avoid one another and are allowed to interpenetrate. Doors impose a flow limit and velocity is controlled by density. Steering mode was used for this assessment as it provides more realistic representation of occupant movement.

I.4.2 Steering mode

The steering mode in Pathfinder is based on the idea of inverse steering behaviours[102,103] which is the process of evaluating a set of discrete movements for an occupant and choosing an optimum direction. Steering mode allows more complex behaviour to naturally emerge as a by-product of the movement algorithms, eliminating the need for explicit door queues and density calculations[104].

In steering mode, Pathfinder uses a combination of steering mechanisms and collision handling to control how the occupant follows a path to a destination – eg to a designated intermediate point or an exit. The steering system in Pathfinder allows occupants to respond to a changing environment.

Several types of steering behaviours are evaluated in Pathfinder to produce a 'cost function':

- Separate – steers the occupant to maintain a desired distance away from other occupants.
- Seek – steers the occupant to travel along a seek curve.
- Avoid walls – detects walls and steers the occupant to avoid collisions with walls.
- Avoid occupants – steers the occupant to avoid collisions with other occupants.

[101] Pathfinder 2020, Thunderhead Engineering Consultants, downloaded 19 February 2021, https://support.thunderheadeng.com/pathfinder/.
[102] Reynolds CW, Steering behaviors for autonomous characters, Proceedings of the Game Developers Conference 1999
[103] Amor HB, Murray J and Obst O, Fast, neat and under control: inverse steering behaviors for physical autonomous agents, Institut f¨ur Informatik, Universit¨at Koblenz-Landau, 2003
[104] Thunderhead Engineering Consultants Inc, Technical reference – Pathfinder 2020, https://www.thunderheadeng.com/pathfinder/, 2020.

The cost function is used to evaluate the steering direction and velocity of an occupant at each time step. The *'cost'* of travel in a particular direction is calculated for each steering behaviour and for several sample directions – see Figure 143. The number of samples taken by Pathfinder depends on whether occupants are idling or seeking – ie their state. A cost between 0 and 1 is allocated to each steering behaviour and each sample direction.

The net cost for a specific direction is the weighted sum of all of the costs taking into consideration any penalties which are applied to the occupant – ie travel distance, queuing etc. Once the lowest cost direction has been determined, the steering velocity and acceleration are calculated. These move the occupant in the direction of the target – ie exit.

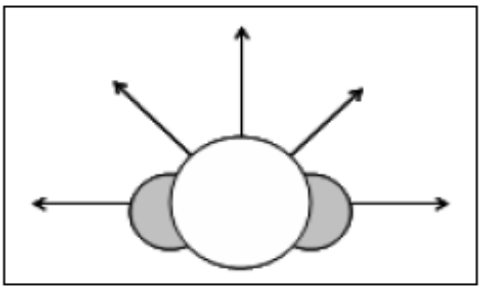


Figure 143 Sample inverse steering directions

I.4.3 Model layout and occupant distribution

The navigation mesh, starting location of the occupants and the exit locations for the retail levels of the building are shown in Figure 144 to Figure 147. The exit stair numbers and widths are shown in detail in Appendix D. Occupants have been randomly distributed throughout the navigation mesh based on the calculated populations detailed in Appendix I.1.2.

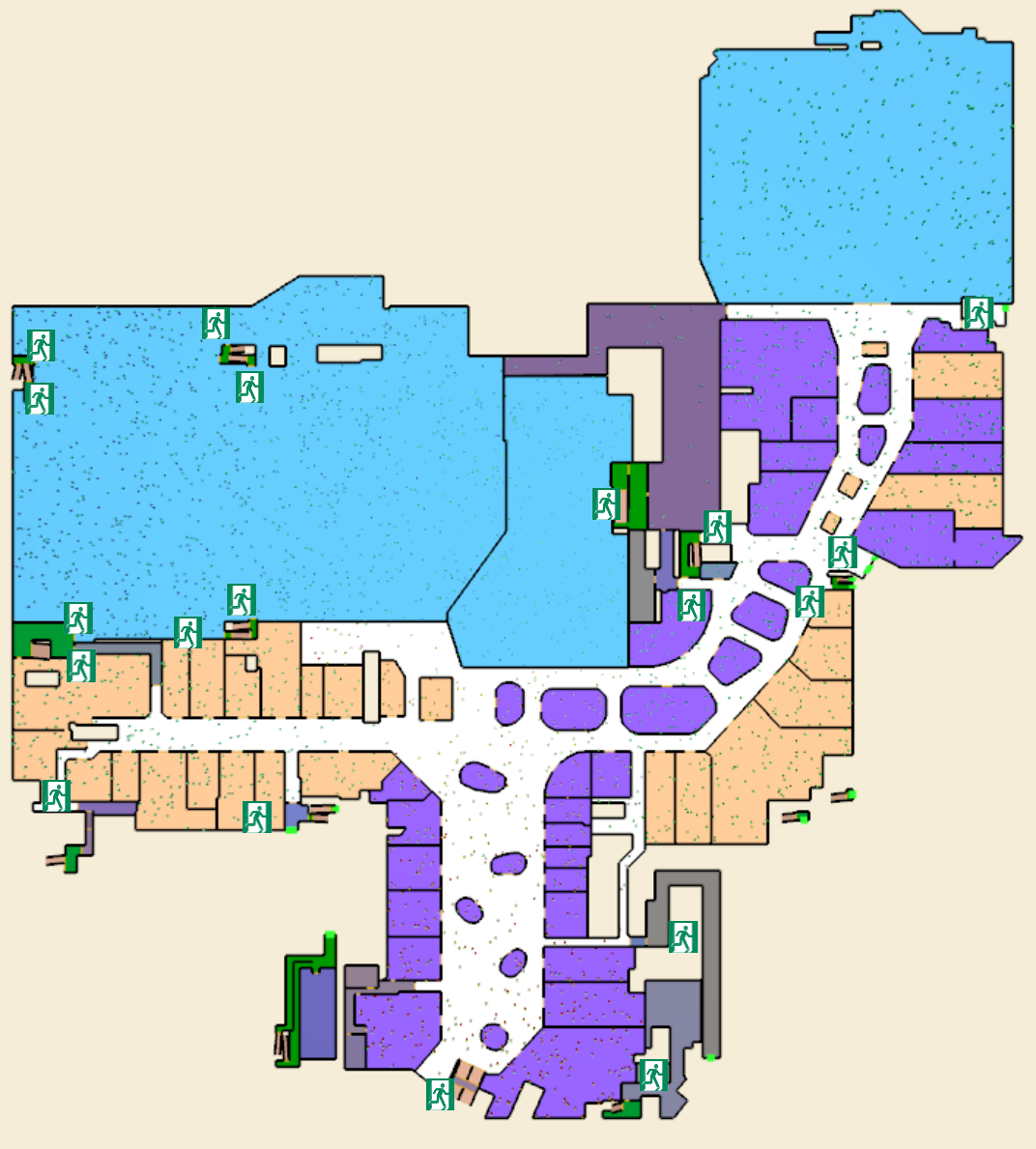


Figure 144 Lower ground level modelled areas – starting position of occupants

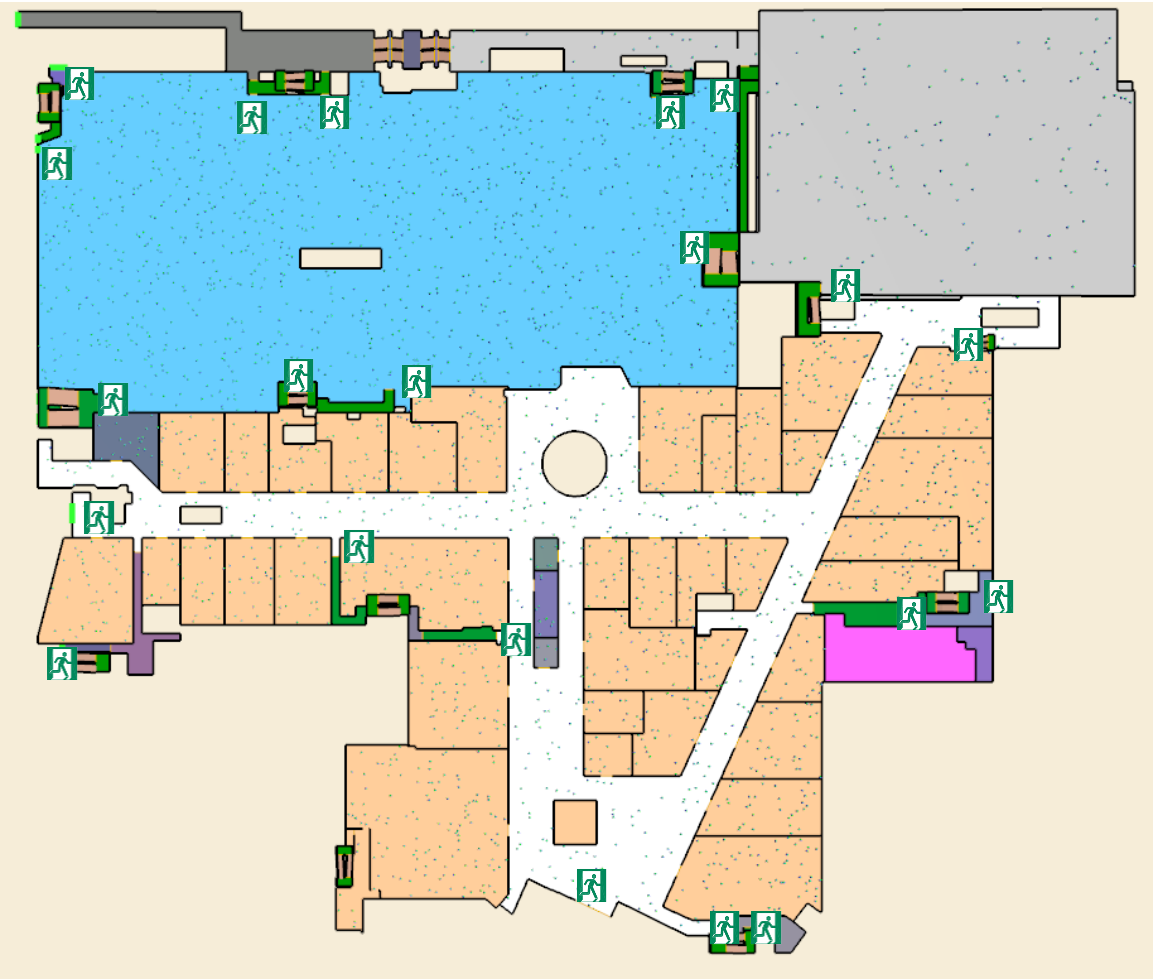


Figure 145 Ground level (level 00) modelled areas – starting position of occupants

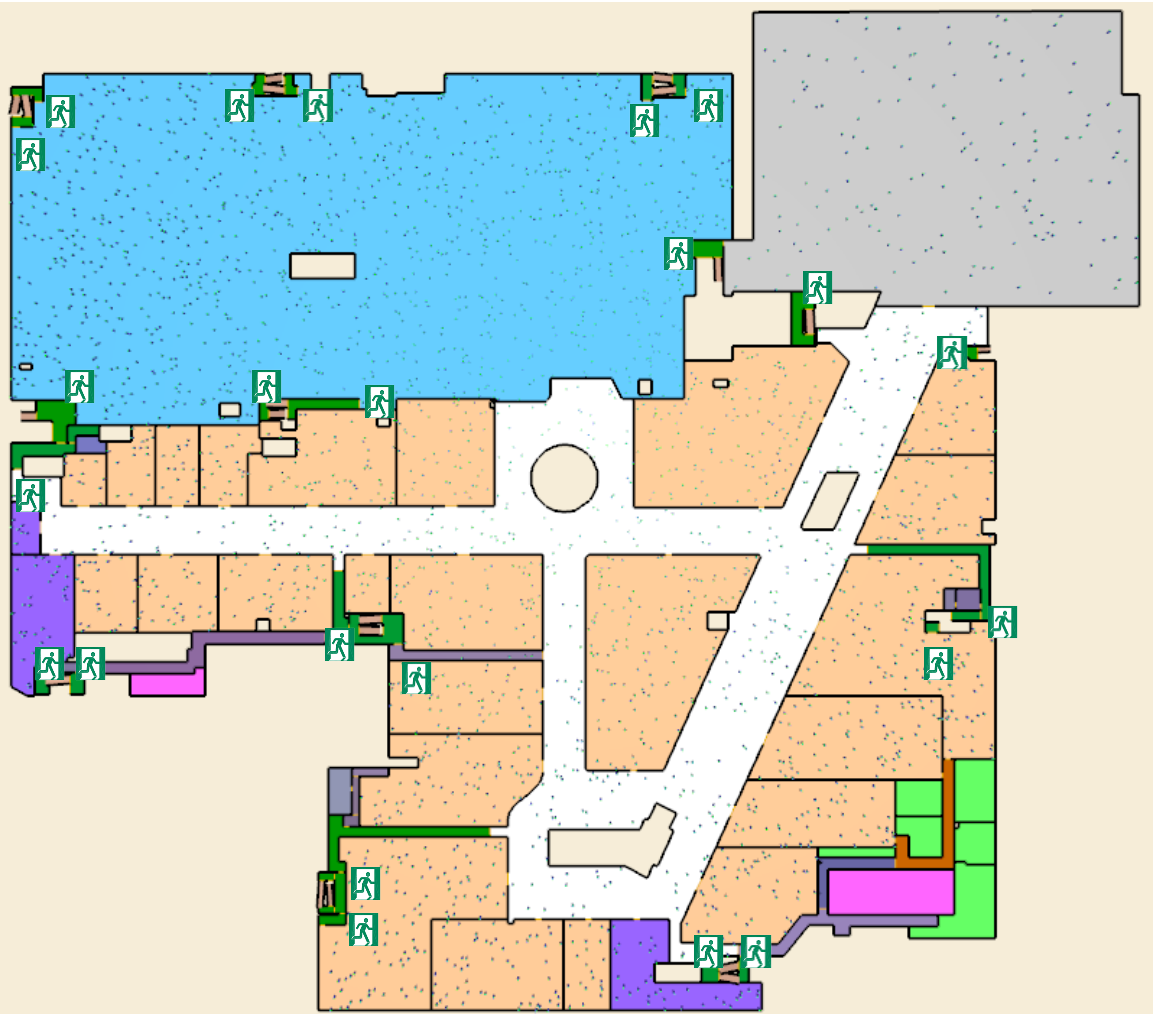


Figure 146 Level 01 modelled areas – starting position of occupants

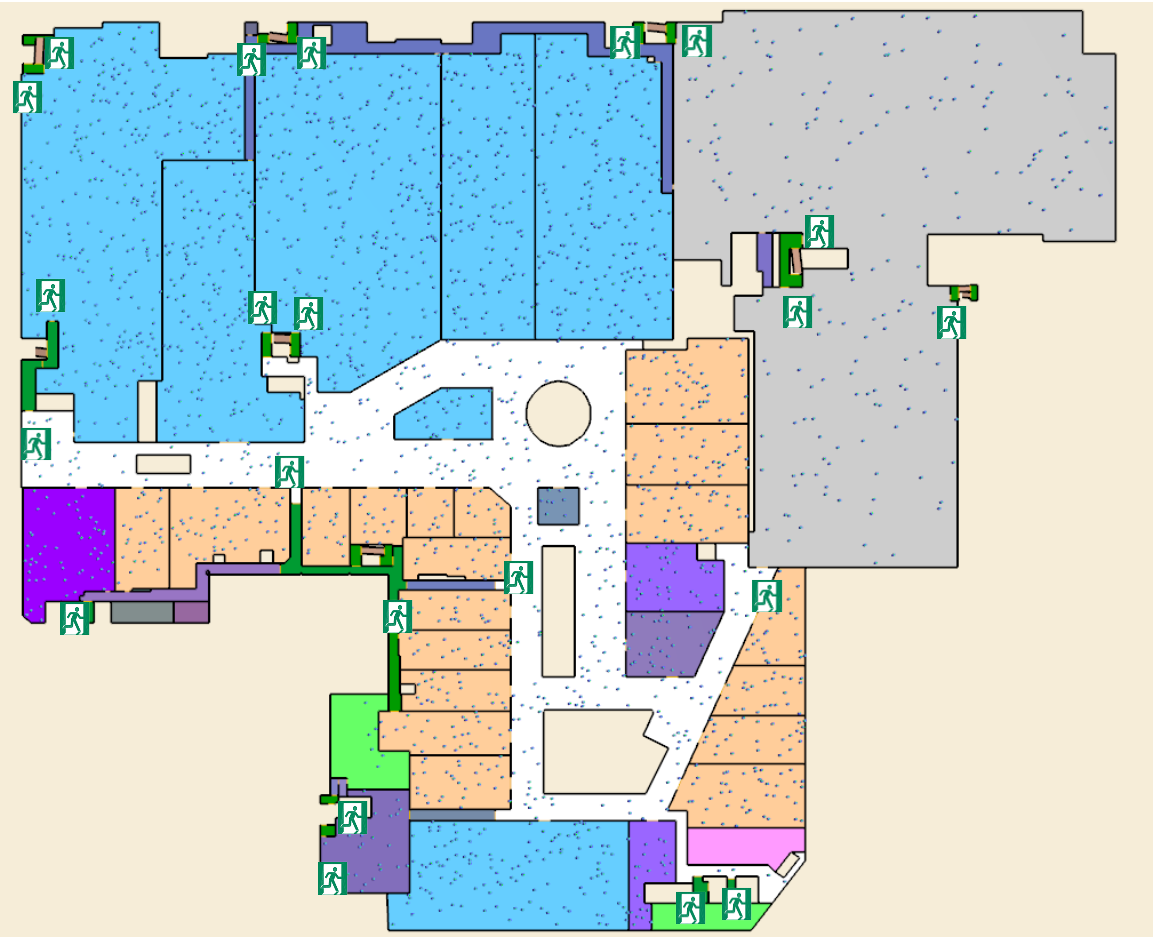


Figure 147 Level 02 modelled areas – starting position of occupants

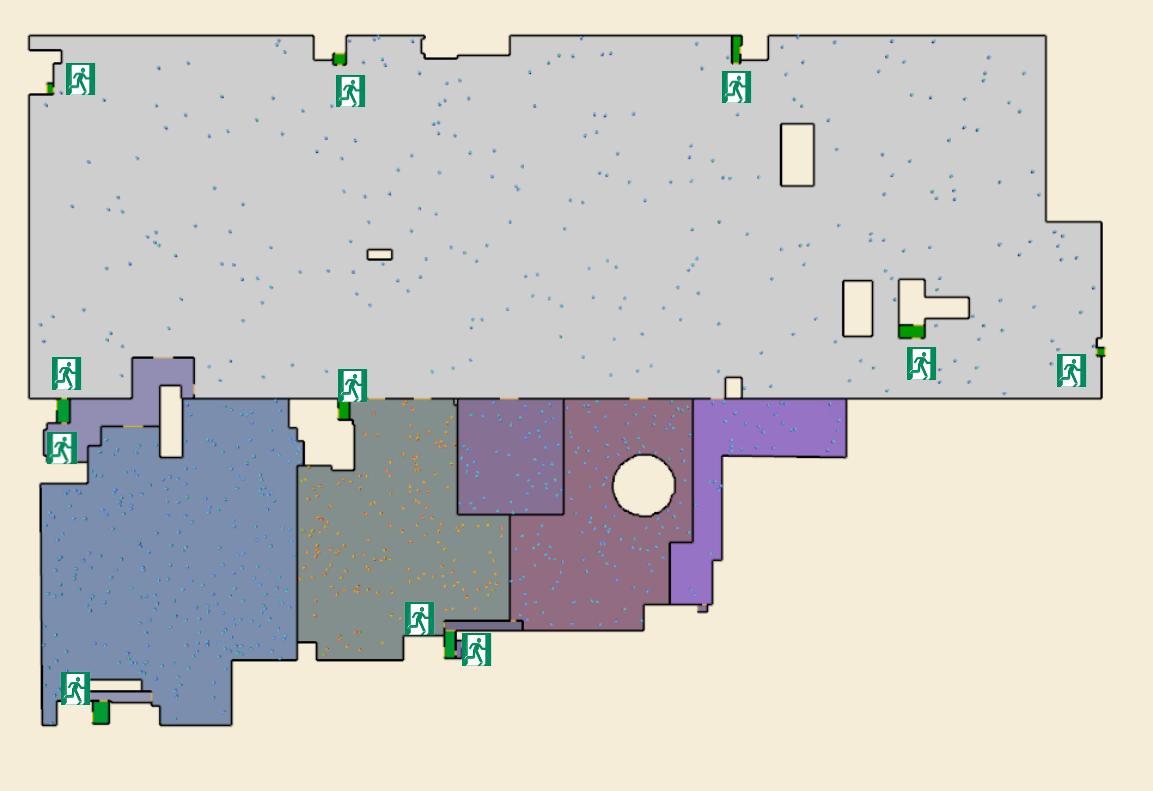


Figure 148 Level 02 modelled areas – starting position of occupants

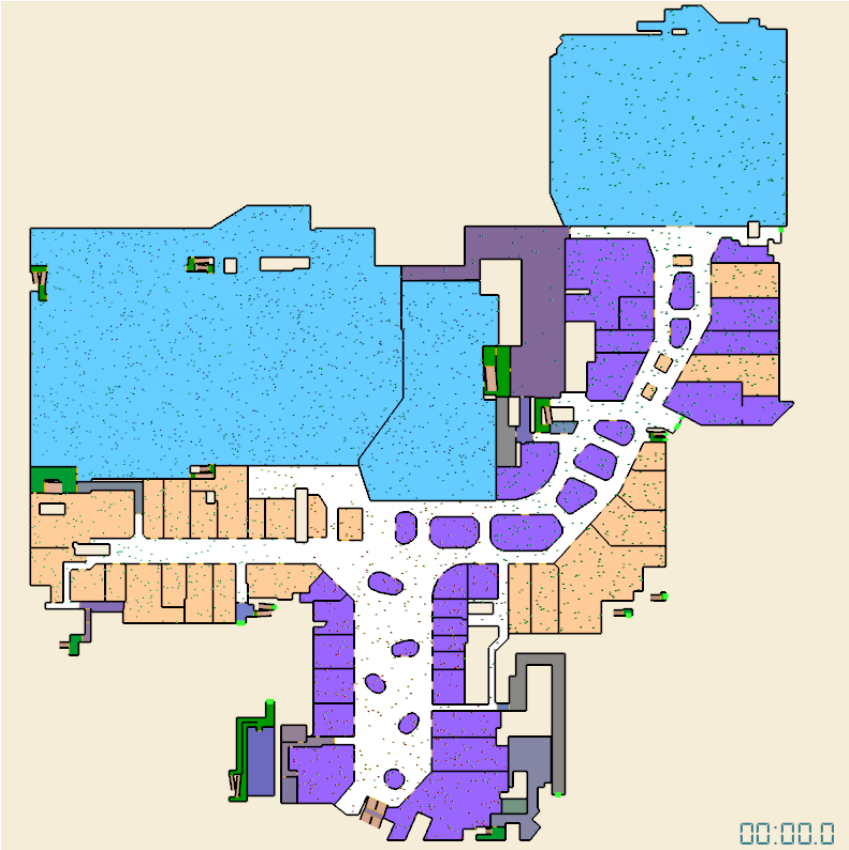
I.4.4 Travel to exits

Observations and experiments have shown that evacuation flow speed of a group is a function of the population density. On flat surfaces where the occupant density is less than 0.5 person/m^2, the SFPE Handbook[105] and CIBSE Guide E[106] specify walking speeds of approximately 1.2 m/s. A walking speed of 1.0 m/s is conservatively adopted for this assessment to account for variations in occupant characteristics.

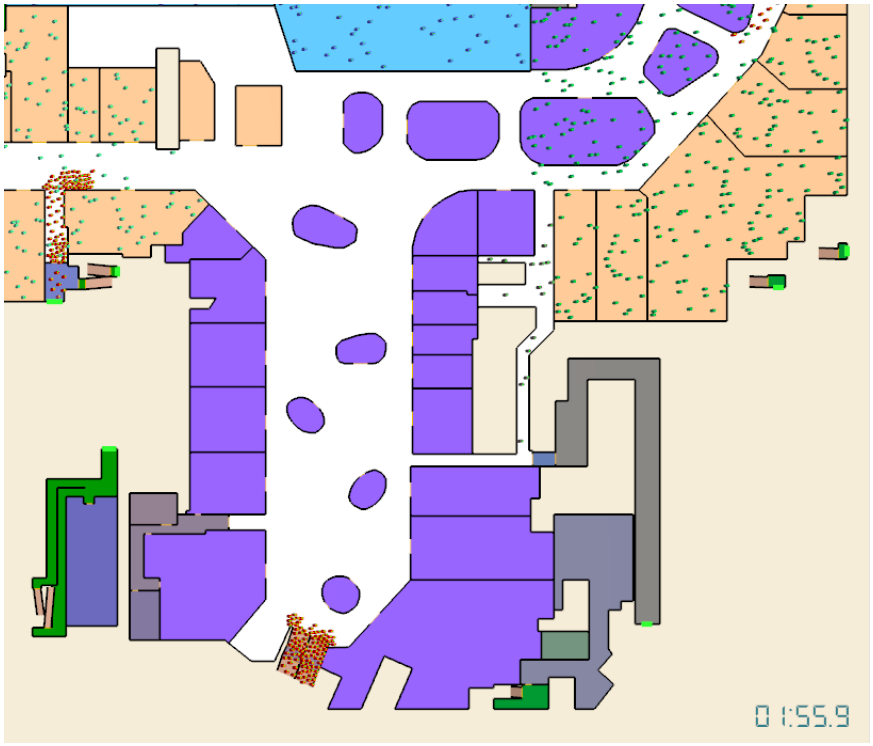
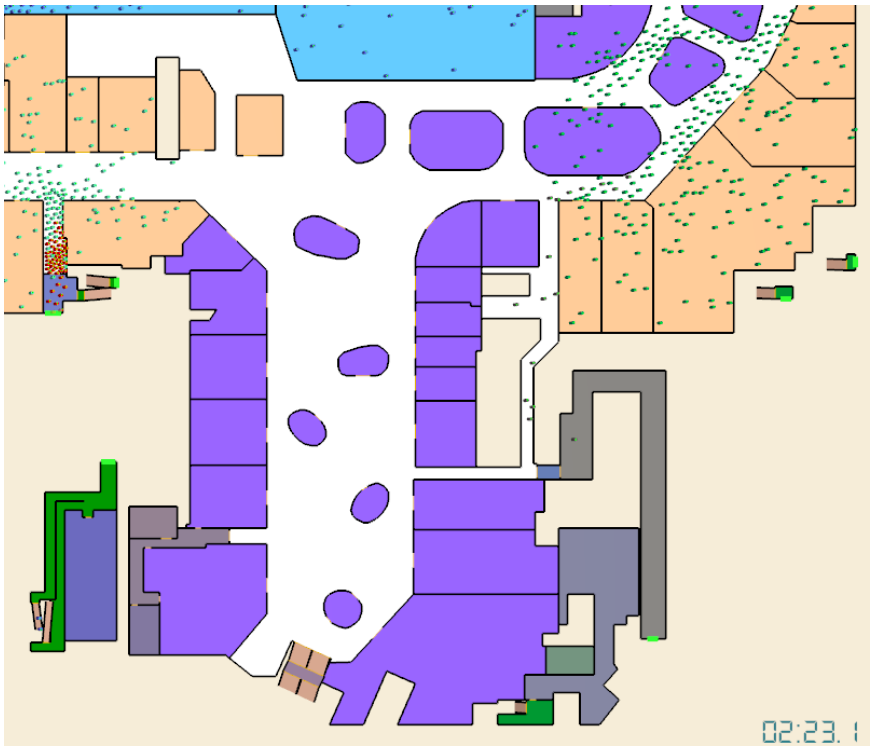
[105] Gwynne SMV and Rosenbaum ER, 2016, Chapter 59: Employing the hydraulic model in assessing emergency movement, The SFPE Handbook of Fire Protection Engineering, 5th edition, Springer, New York.
[106] Fire engineering – CIBSE Guide E, 4th edition, 2019, CIBSE Publications Department, pp 7-12.

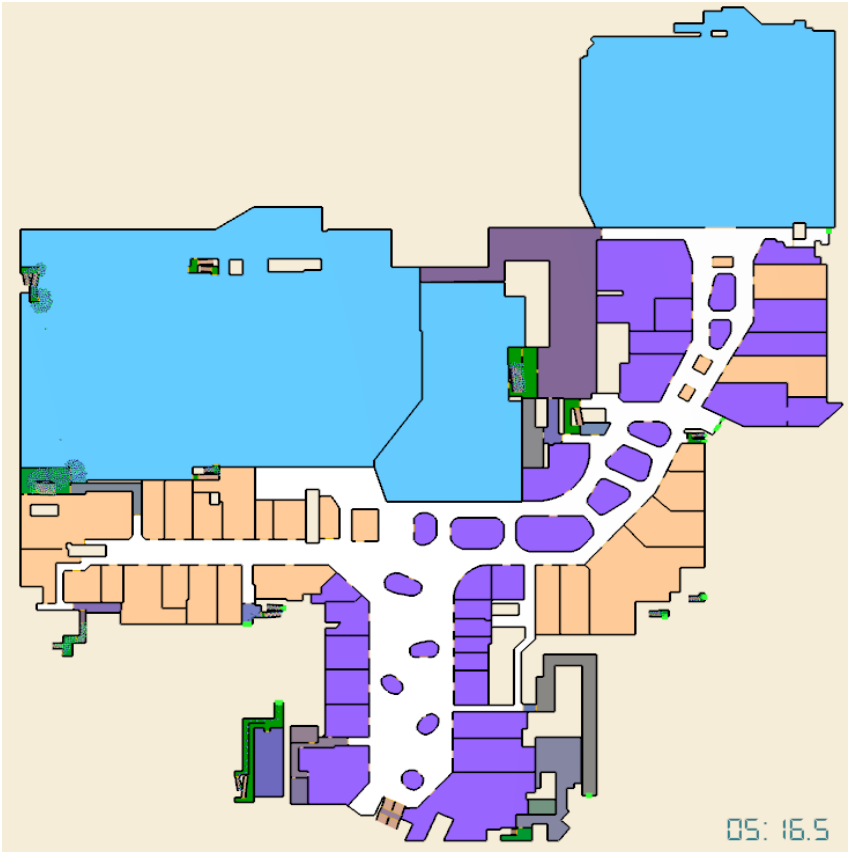
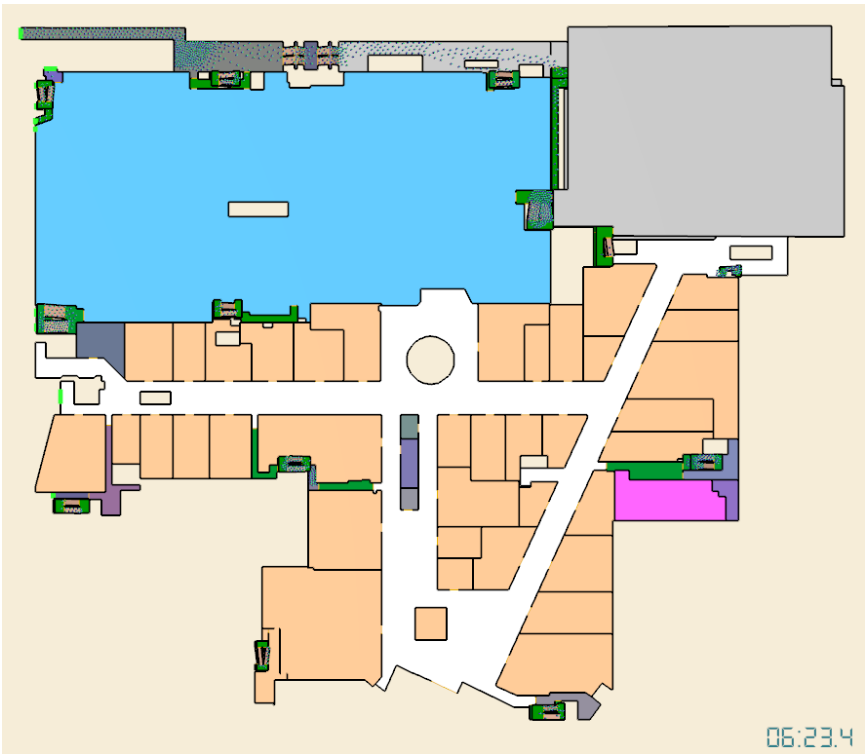
I.5 Scenarios 1– Fire in specialty tenancy B-031 (Zone 7)[107]

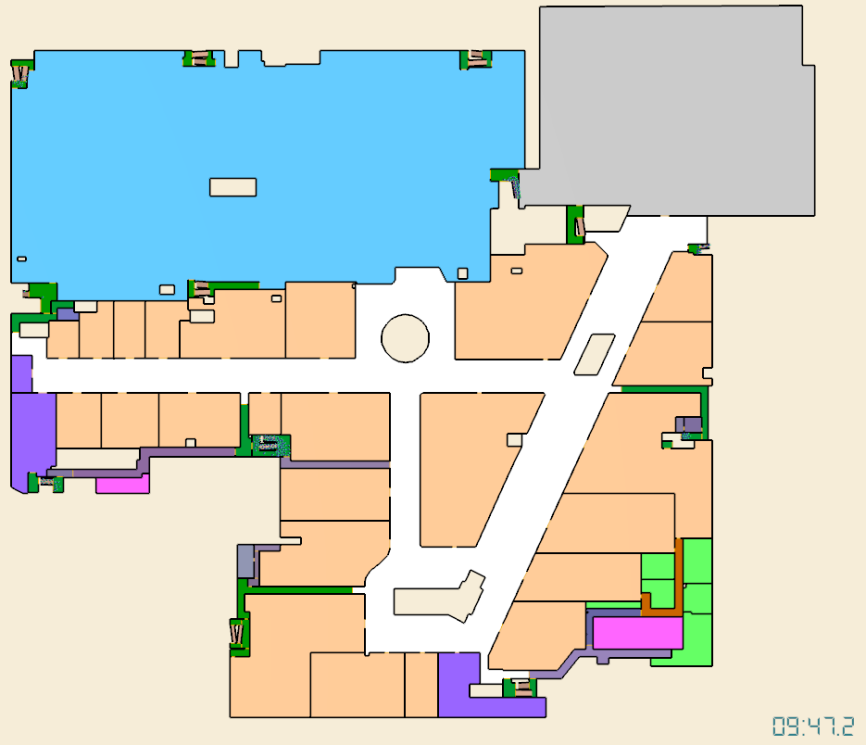
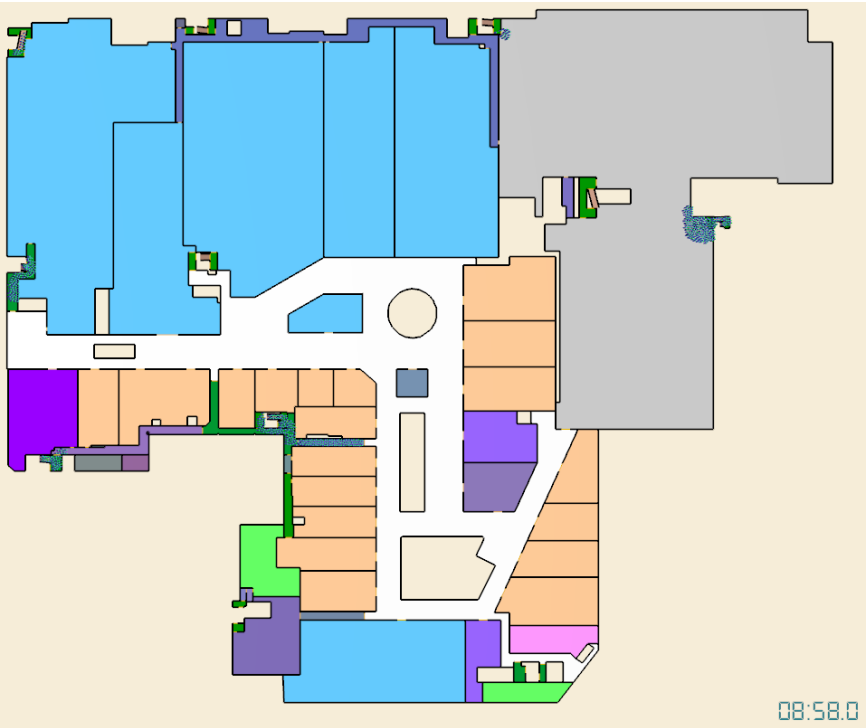
The results of the evacuation assessment for Scenario 1 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin on lower ground level does not occur. Adjacent smoke zones on the other retail levels of the building are therefore not assessed.

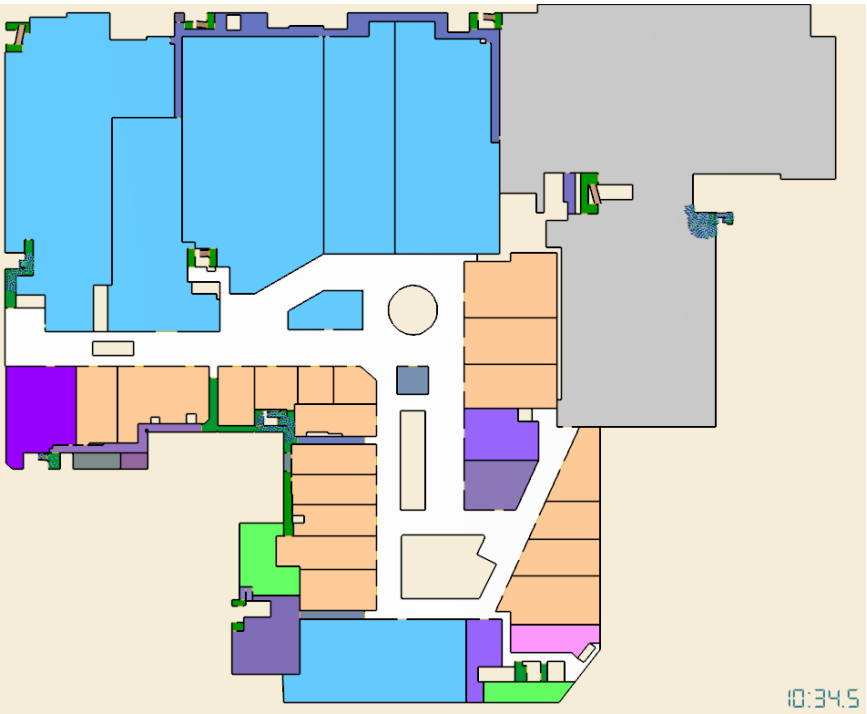
Timeline (mm:ss)	Results
00:00 Starting positions of occupants on lower ground level.	

[107] Jensen Hughes, 2025, Fire in B-031 Scenario 1

Timeline (mm:ss)	Results
2:56 (including 1:00 cue) All occupants within the impacted central smoke zone on lower ground level have moved away from the areas close to the fire. Occupants have either moved to an adjacent smoke zone already or have reached the queue to exit the building via the main entry from Victoria Avenue to the south.	
3:24 (including 1:00 cue) RSET – lower ground zone 7 All occupants within the impacted central smoke zone on lower ground level have evacuated from the area.	

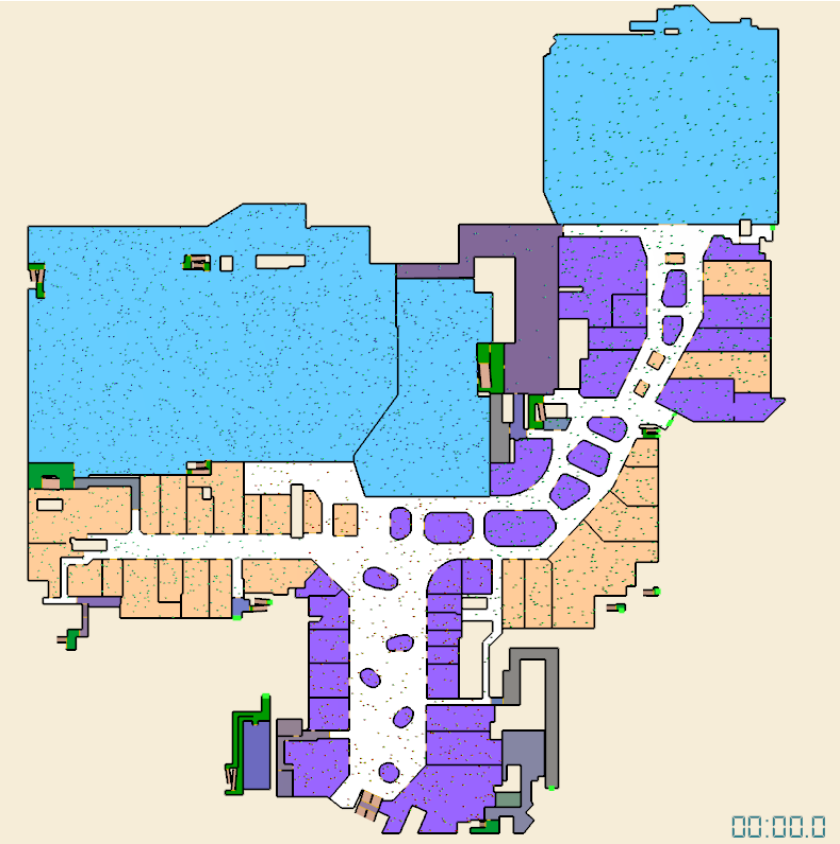
Timeline (mm:ss)	Results
6:41 (including 1:24 cue period) RSET – rest of lower ground level mall Occupants throughout the lower ground level mall have evacuated via the available exits. Some occupants within the K-Mart major tenancy can be seeing queuing at the exits from the tenancy. However, the tenancy forms its own smoke compartment and is not considered to be impacted by the fire scenario assessed.	
7:48 (including 1:24 cue period) RSET – Zone 7 on level 00 and rest of level 00 All occupants within zone 7 – ie the central smoke zone – on level 00 have evacuated from the area.	

Timeline (mm:ss)	Results
11:12 (including 1:24 cue period) RSET – Zone 7 on level 01 and rest of level 01. All occupants within zone 7 – ie the central smoke zone – on level 01 have evacuated from the area	
10:22 (including 1:24 cue period) All of occupants within zone 7 – ie the central smoke zone – on level 02 have either evacuated or are queuing within the corridor level to Stair 8 from Zone 8. All occupants within the remainder of the level have evacuated.	

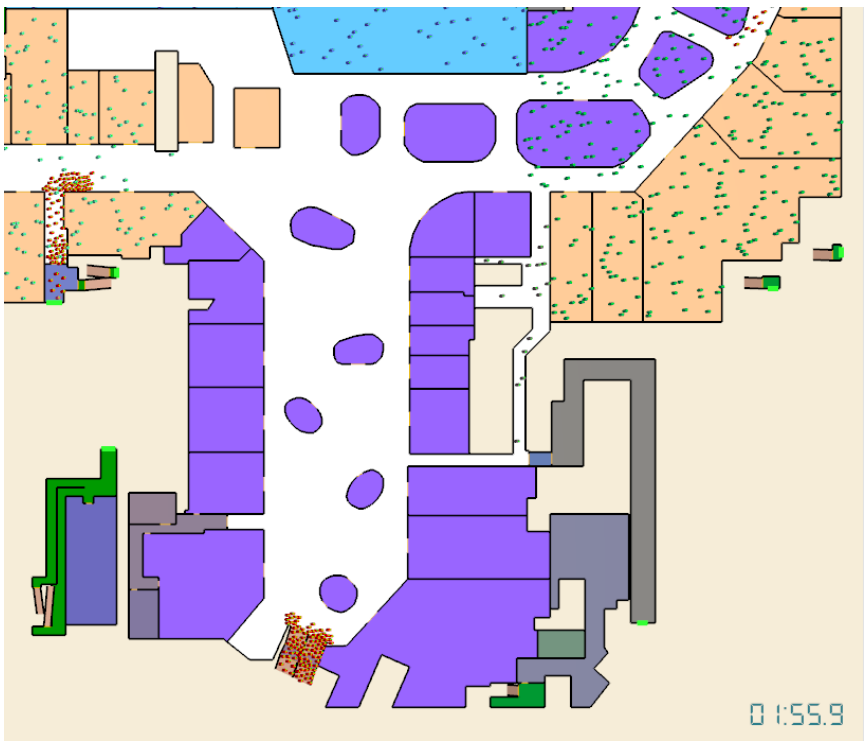
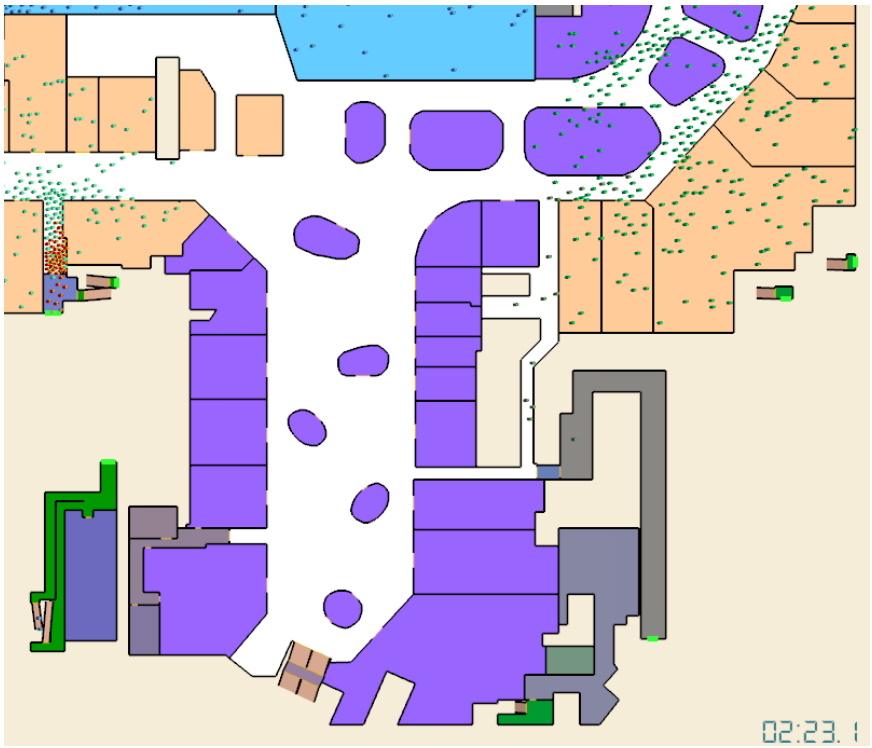
Timeline (mm:ss)	Results
11:59 (including 1:24 cue period) RSET – Zone 7 on level 02 and the rest of level 02. All occupants Zone 7 and the level 2 have evacuated.	

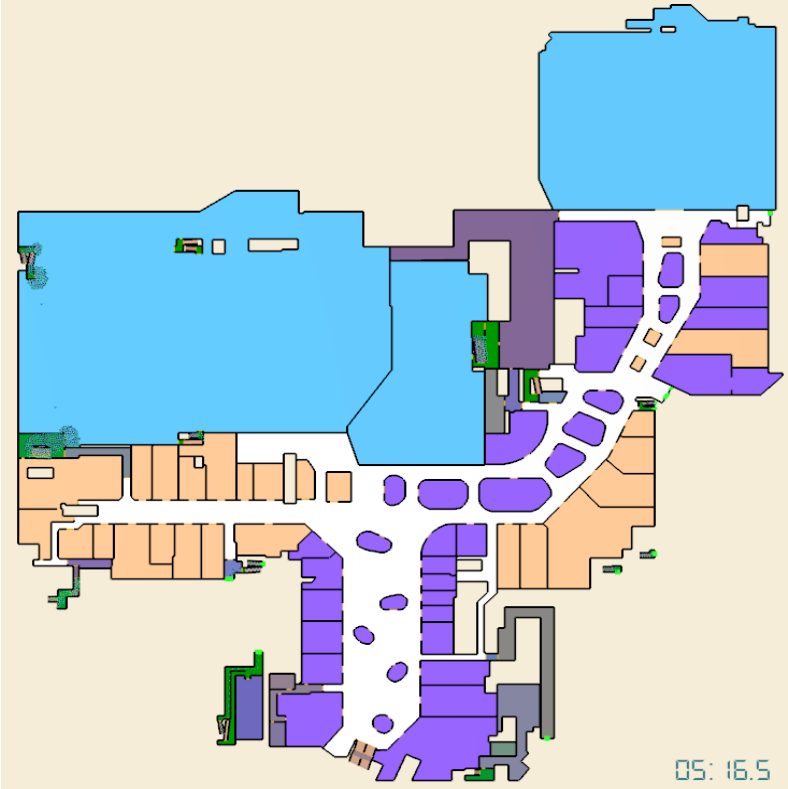
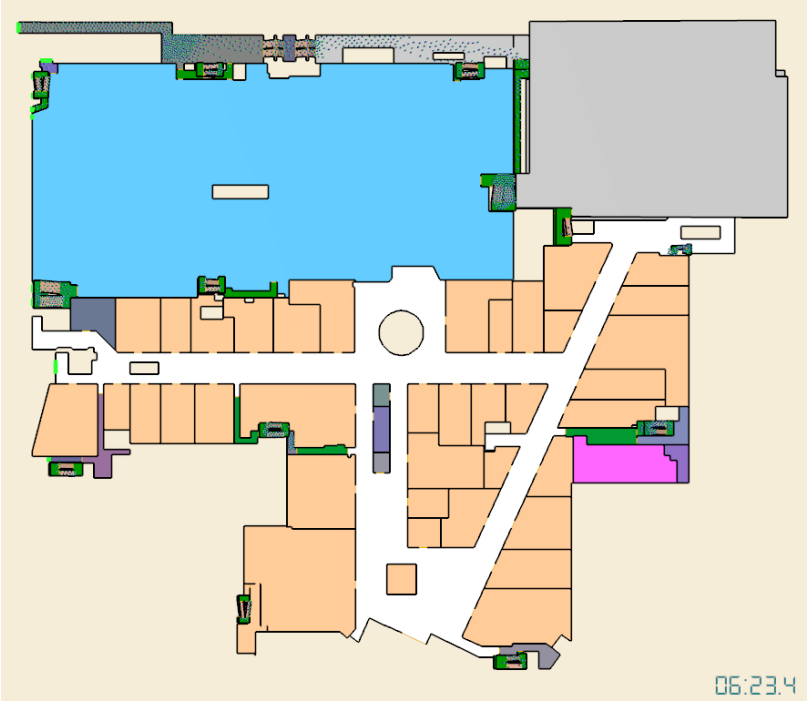
I.6 Scenario 2 – Fire in kiosk Site 11 (Zone 7)[108]

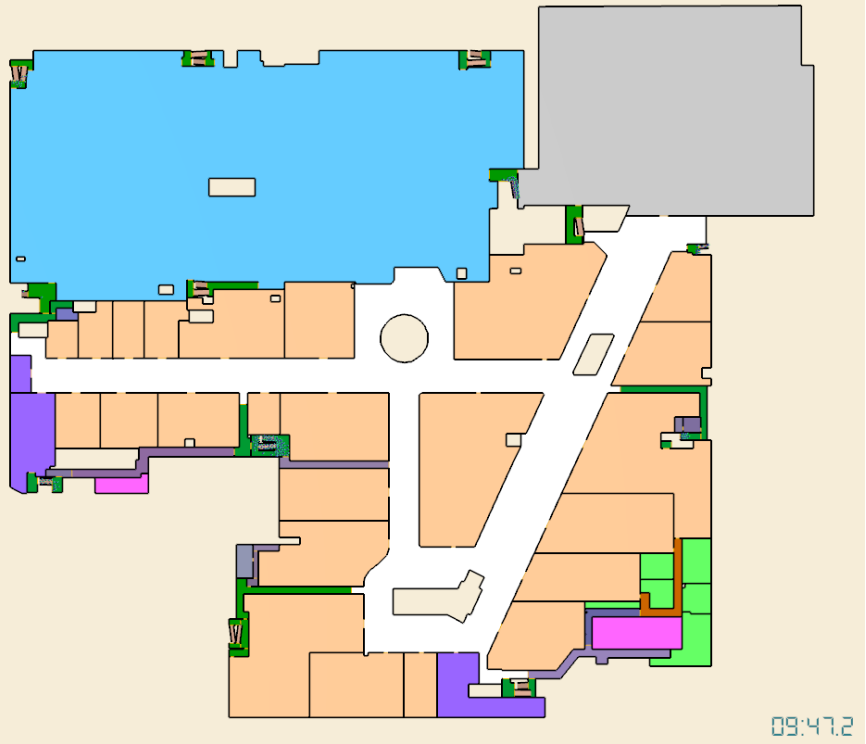
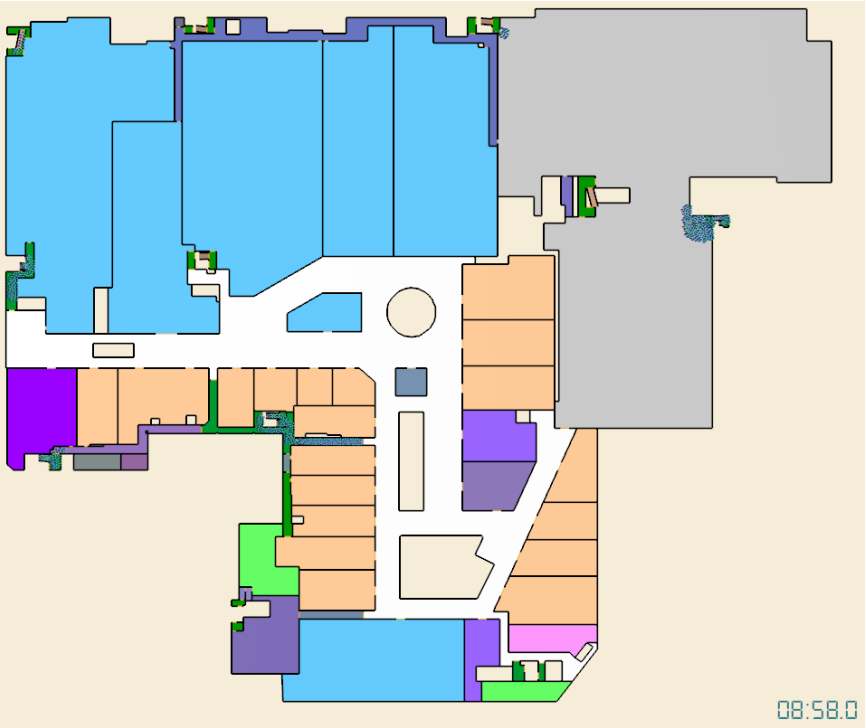
The results of the evacuation assessment for Scenario 2 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin on lower ground level does not occur. Adjacent smoke zones on the other retail levels of the building are therefore not assessed.

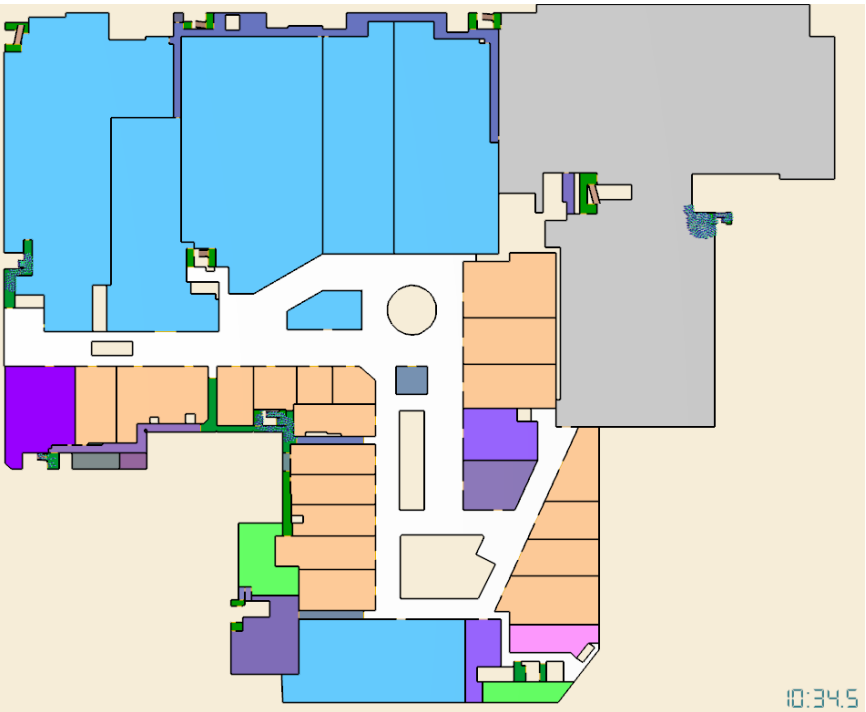
Timeline (mm:ss)	Results
00:00 Starting positions of occupants on lower ground level.	

[108] Jensen Hughes, 2025, Fire in Kiosk Scenario 1

Timeline (mm:ss)	Results
2:44 (including 0:48 cue) All occupants within the impacted central smoke zone on lower ground level have moved away from the areas close to the fire. Occupants have either moved to an adjacent smoke zone already or have reached the queue to exit the building via the main entry from Victoria Avenue to the south.	
3:12 (including 0:48 cue) RSET – lower ground zone 7 All occupants within the impacted central smoke zone on lower ground level have evacuated from the area.	

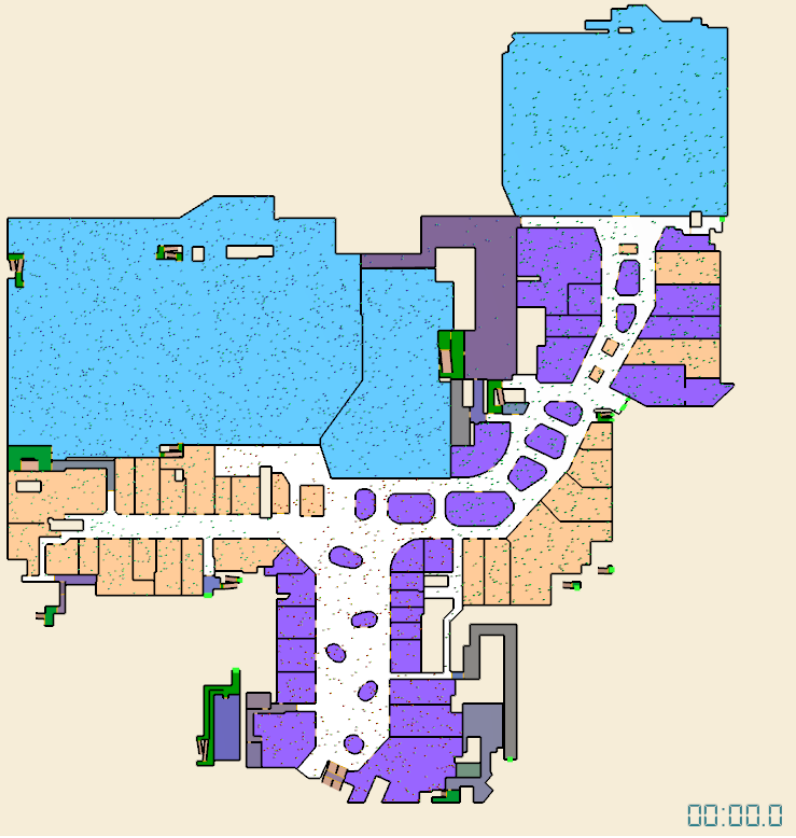
Timeline (mm:ss)	Results
6:05 (including 0:48 cue period) RSET – rest of lower ground level mall Occupants throughout the lower ground level mall have evacuated via the available exits. Some occupants within the K-Mart major tenancy can be seeing queuing at the exits from the tenancy. However, the tenancy forms its own smoke compartment and is not considered to be impacted by the fire scenario assessed.	
7:12 (including 0:48 cue period) RSET – Zone 7 on level 00 and rest of level 00 All occupants within zone 7 – ie the central smoke zone – on level 00 have evacuated from the area.	

Timeline (mm:ss)	Results
10:36 (including 0:48 cue period) RSET – Zone 7 on level 01 and the rest of level 01. All occupants within zone 7 – ie the central smoke zone – on level 01 have evacuated from the area	
9:46 (including 0:48 cue period) All of occupants within zone 7 – ie the central smoke zone – on level 02 have either evacuated or are queuing within the corridor level to Stair 8 from Zone 8. All occupants within the remainder of the level have evacuated.	

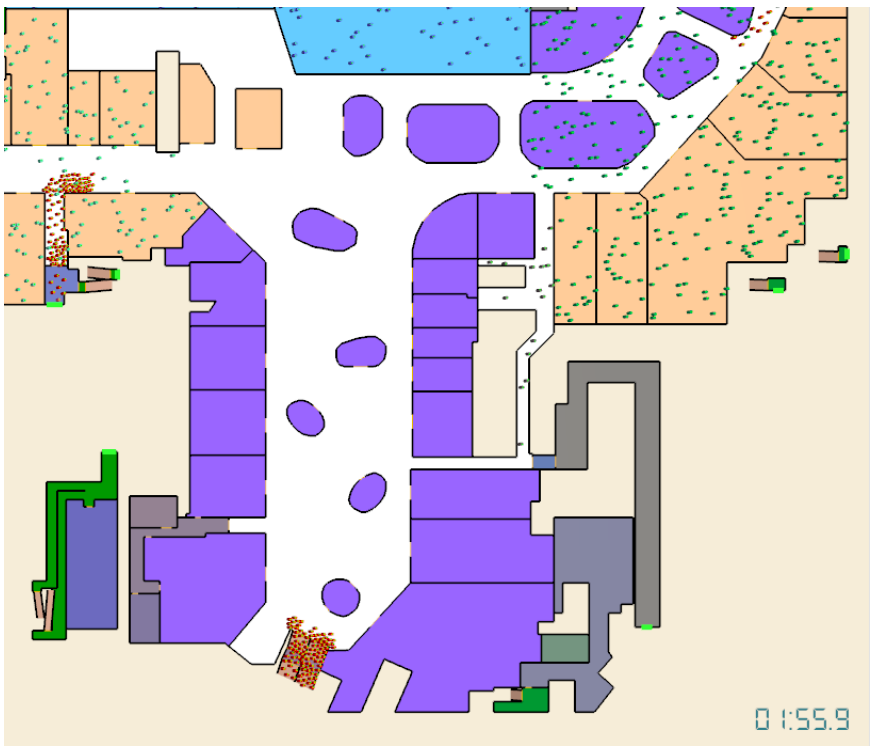
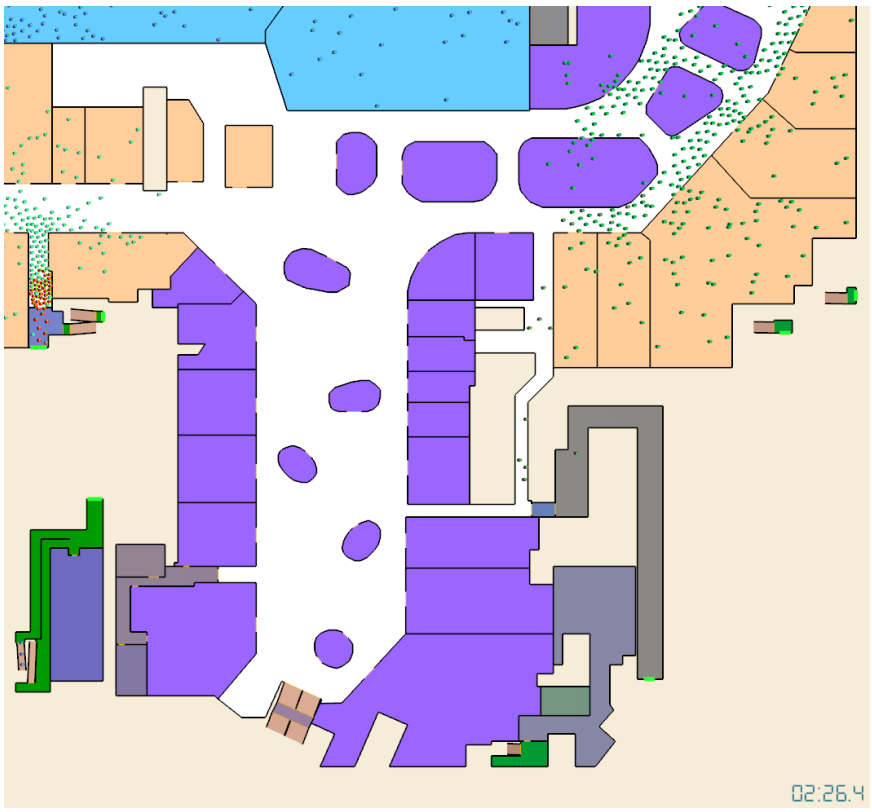
Timeline (mm:ss)	Results
11:23 (including 0:48 cue period) RSET – Zone 7 on level 02 and the rest of level 02. All occupants within zone 7 – ie the central smoke zone – on level 02 have evacuated from the area.	

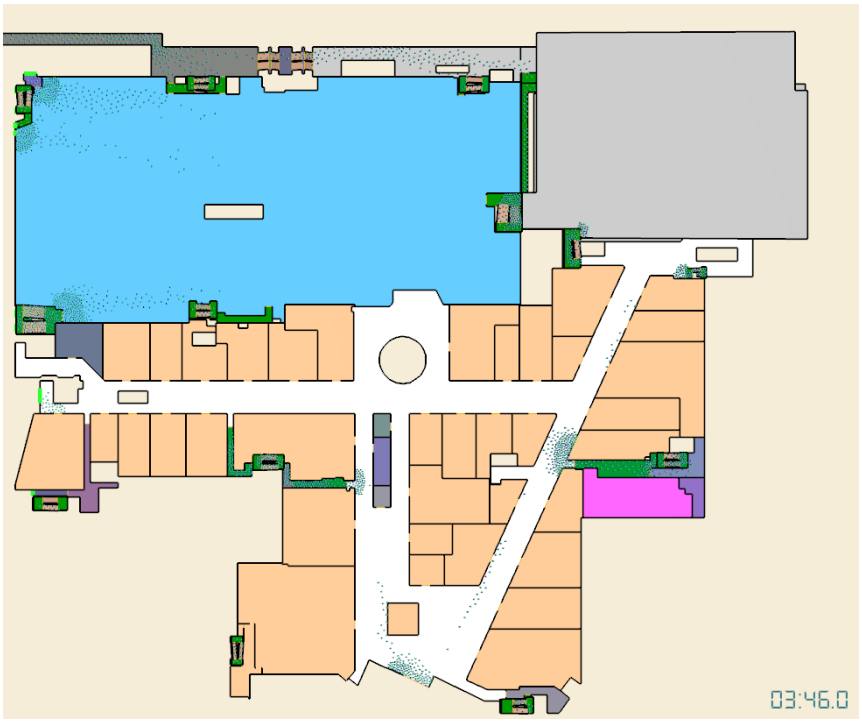
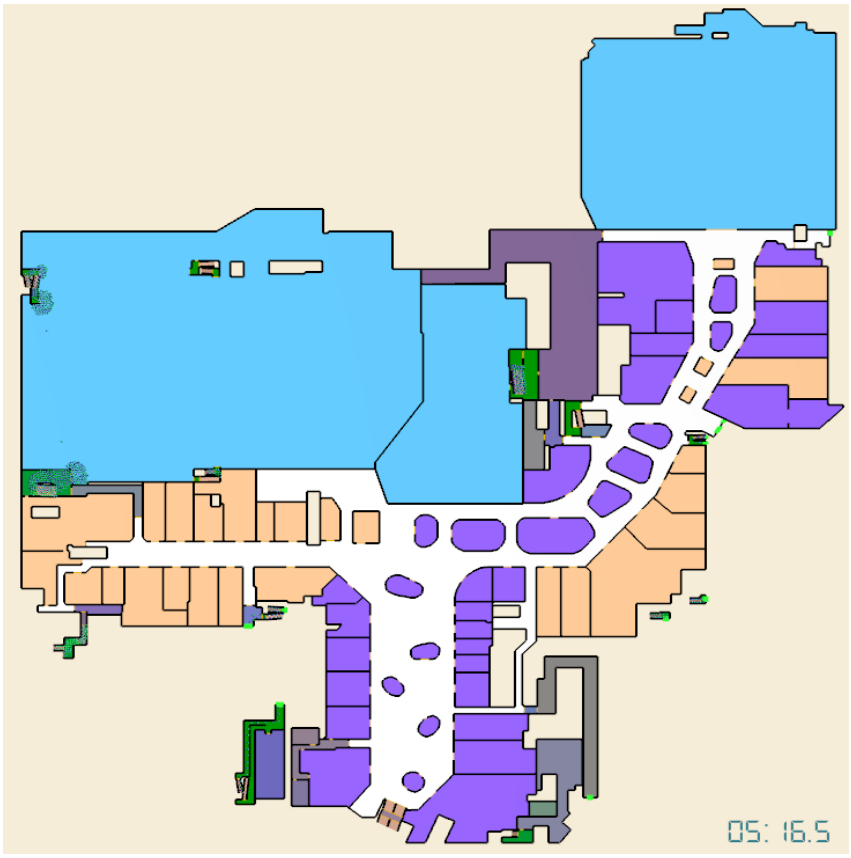
I.7 Scenarios 3 – Fire in specialty tenancy B-031 (Zone 7) – sensitivity [109]

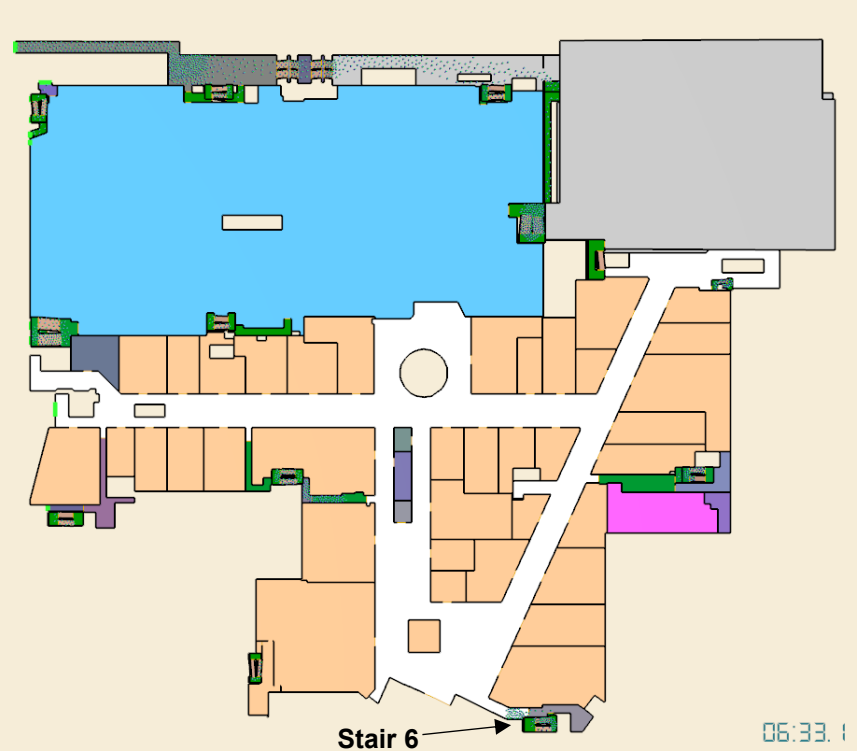
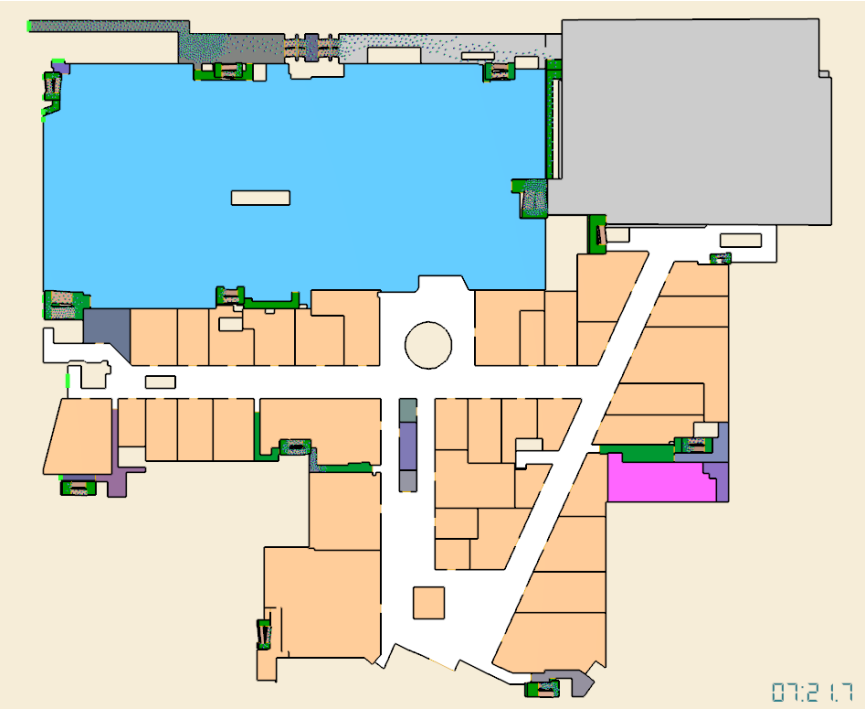
The results of the evacuation assessment for Scenario 3 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin. Adjacent smoke zones on the other retail levels of the building are therefore not assessed.

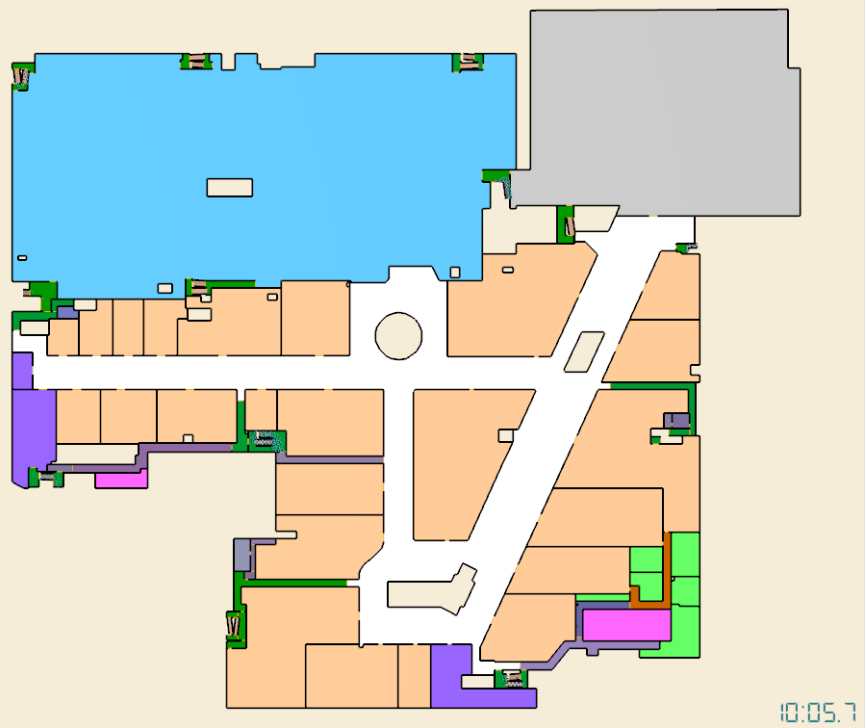
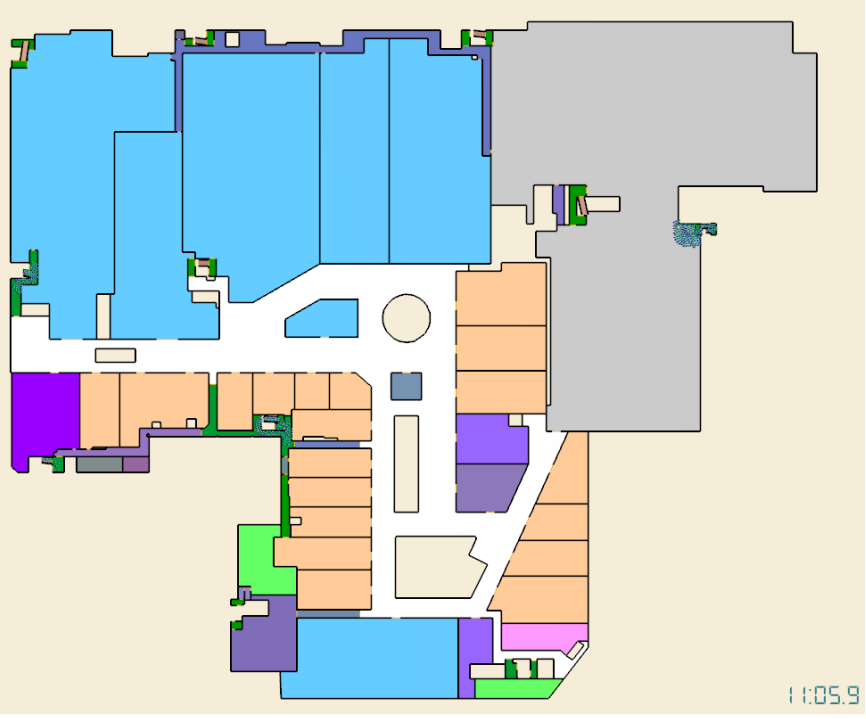
Timeline (mm:ss)	Results
00:00 Starting positions of occupants on lower ground level.	

[109] Jensen Hughes, 2025, Fire in B-031 Scenario 1

Timeline (mm:ss)	Results
2:56 (including 1:00 cue) All occupants within the impacted central smoke zone on lower ground level have moved away from the areas close to the fire. Occupants have either moved to an adjacent smoke zone already or have reached the queue to exit the building via the main entry from Victoria Avenue to the south.	
3:27 (including 1:00 cue) RSET – lower ground zone 7 All occupants within the impacted central smoke zone on lower ground level have evacuated from the area.	

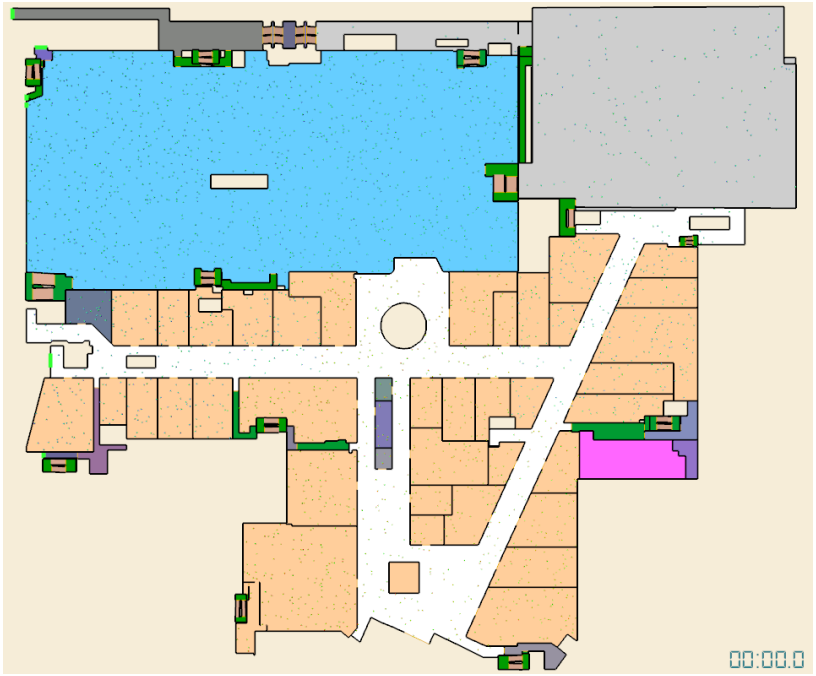
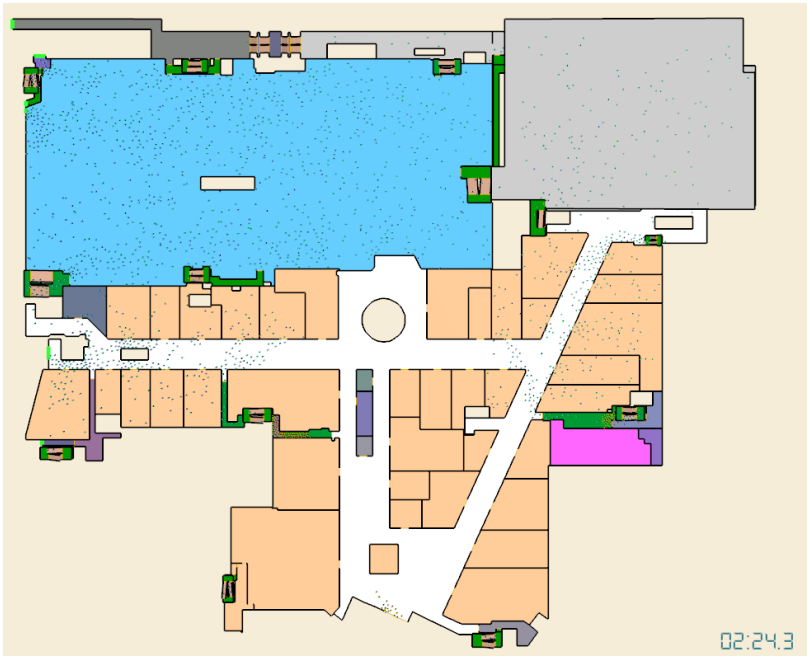
Timeline (mm:ss)	Results
5:10 (including 1:24 cue) Victoria Avenue exit considered obstructed as tenability falls below 10 m. At this point all exit no longer in use by any of the lower ground floor occupant. All occupants from level 00 seek alternative exits	
6:41 (including 1:24 cue period) RSET – rest of lower ground level mall Occupants throughout the lower ground level mall have evacuated via the available exits. Some occupants within the K-Mart major tenancy can be seeing queuing at the exits from the tenancy. However, the tenancy forms its own smoke compartment and is not considered to be impacted by the fire scenario assessed.	

Timeline (mm:ss)	Results
7:57 (including 1:24 cue period) The majority of occupants have evacuated the level 00 mall complete. The remaining occupants are queuing outside Stair 6. .	
8:46 (including 1:24 cue period) RSET – Zone 7 on level 00 and rest of level 00 All occupants within zone 7 – ie the central smoke zone – on level 00 have evacuated from the area.	

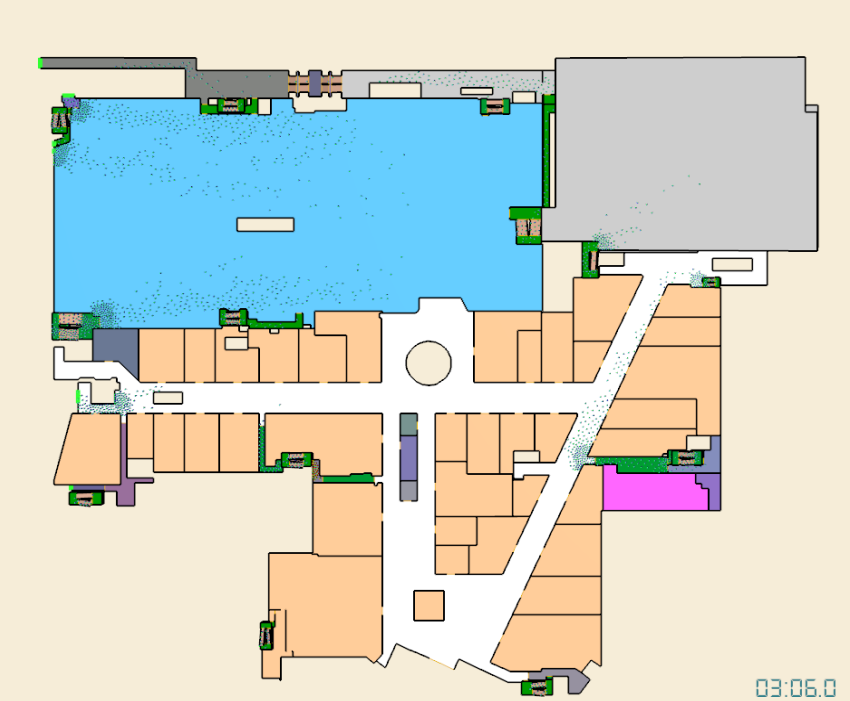
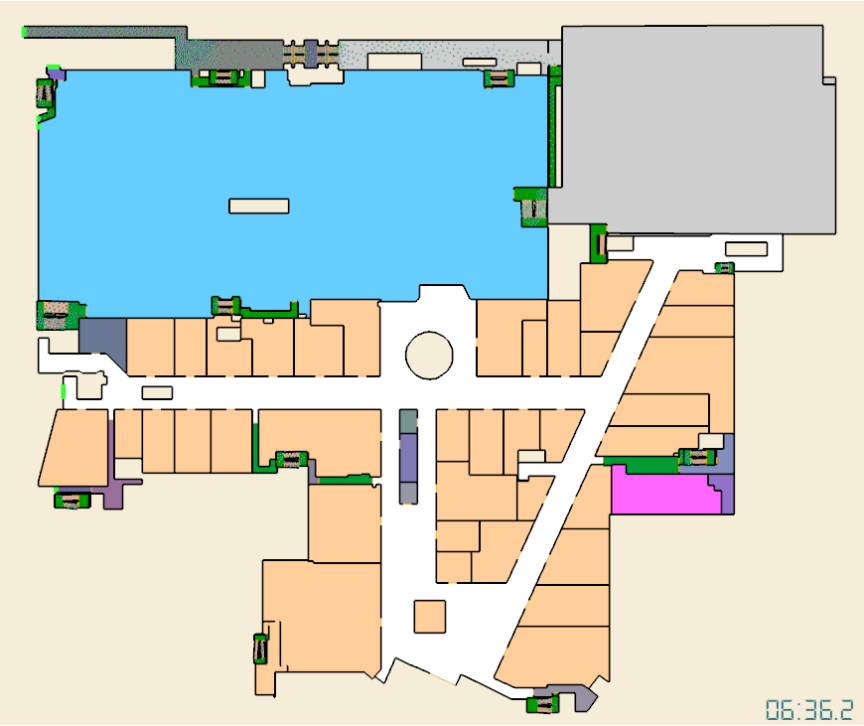
Timeline (mm:ss)	Results
11:30 (including 1:24 cue period) RSET – Zone 7 on level 01 and the rest of level 01. All occupants within zone 7 – ie the central smoke zone – on level 01 have evacuated from the area	
12:30 (including 1:24 cue period) RSET – Zone 7 on level 02 and the rest of level 02. All occupants within zone 7 – ie the central smoke zone – on level 02 have evacuated from the area	

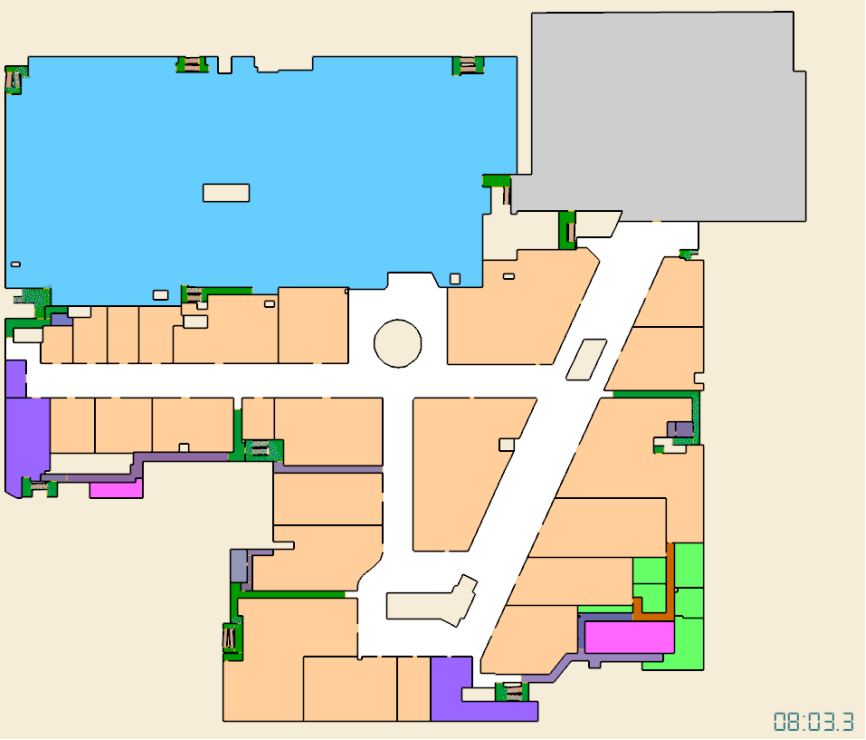
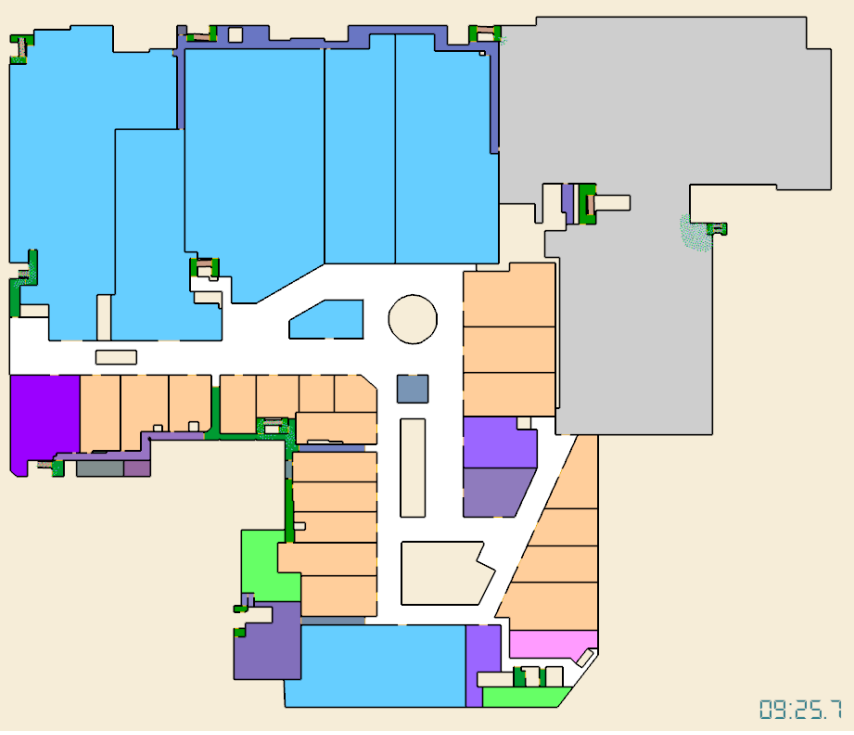
I.8 Scenarios 4 and 6 – Fire in specialty tenancy G-034 (Zone 7)[110]

The results of the evacuation assessment for Scenarios 4 and 6 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin on ground level (level 00) does not occur. Adjacent smoke zones on the other retail levels of the building are therefore not assessed.

Timeline (mm:ss)	Results
00:00 Starting positions of occupants on ground level (level 00)	
3:35 (including 1:10 cue) All occupants within zone 7 on level 00 have moved away from the areas close to the fire. Occupants have either moved to adjacent smoke zones already or have reached a queue at the top of the stairs to exit the building via the main entry from Victoria Avenue to the south.	

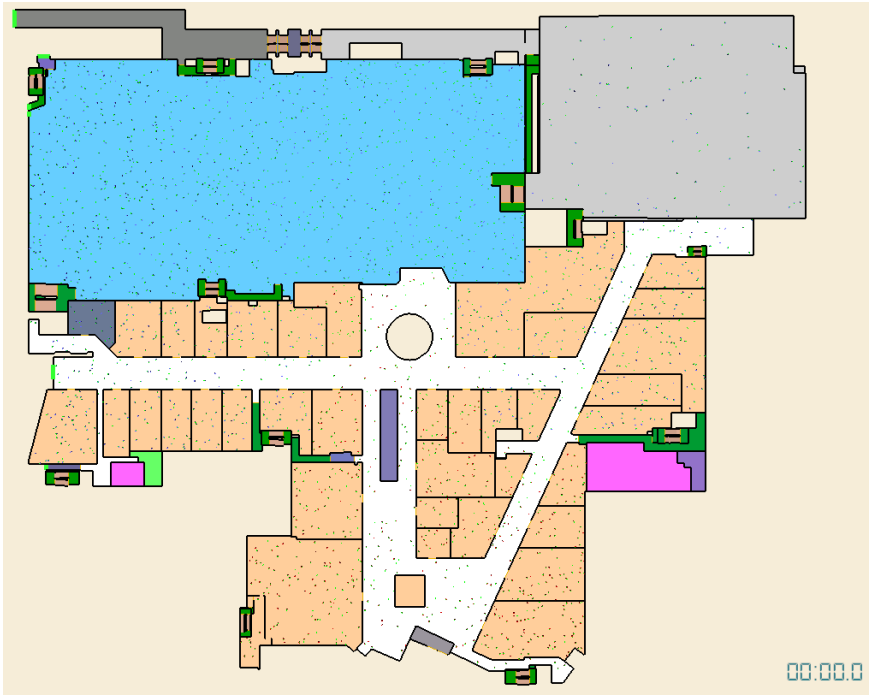
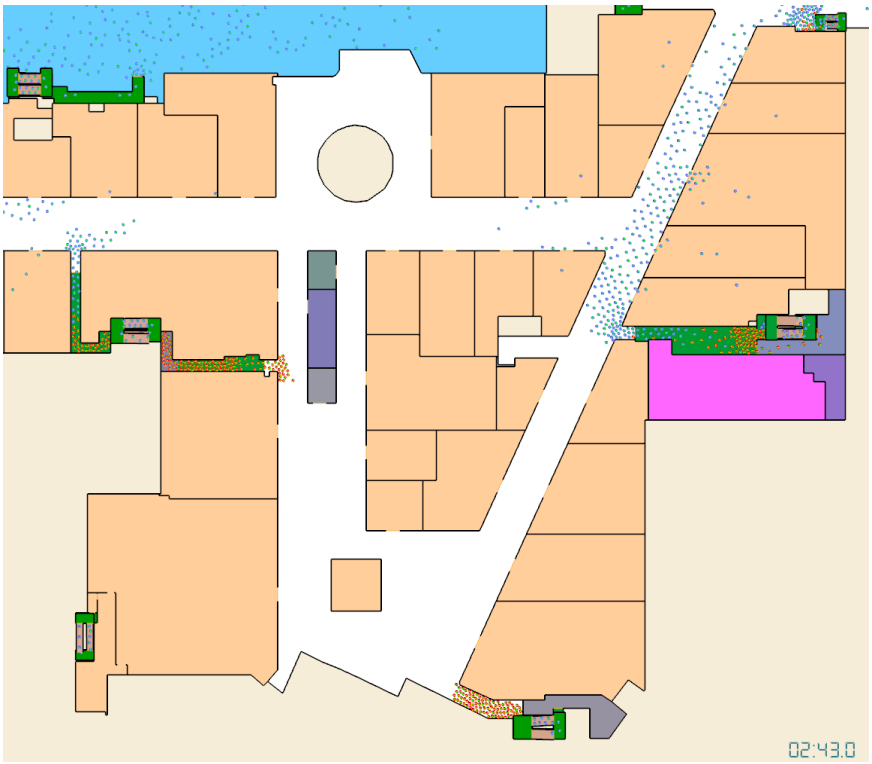
[110] Jensen Hughes, 2025, Fire in G-034 Scenario 6

Timeline (mm:ss)	Results
4:16 (including 1:10 cue) RSET – level 00 zone 7 All occupants within the impacted zone 7 on level 00 have evacuated from the area.	
8:09 (including 1:32 cue period) RSET – rest of level 00 Occupants throughout level 00 have evacuated via the available exits.	

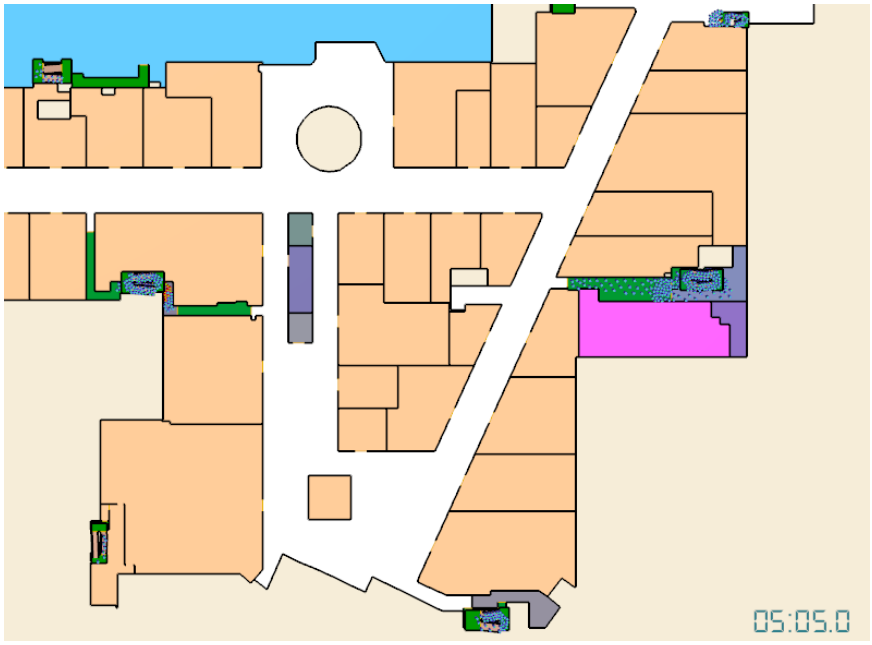
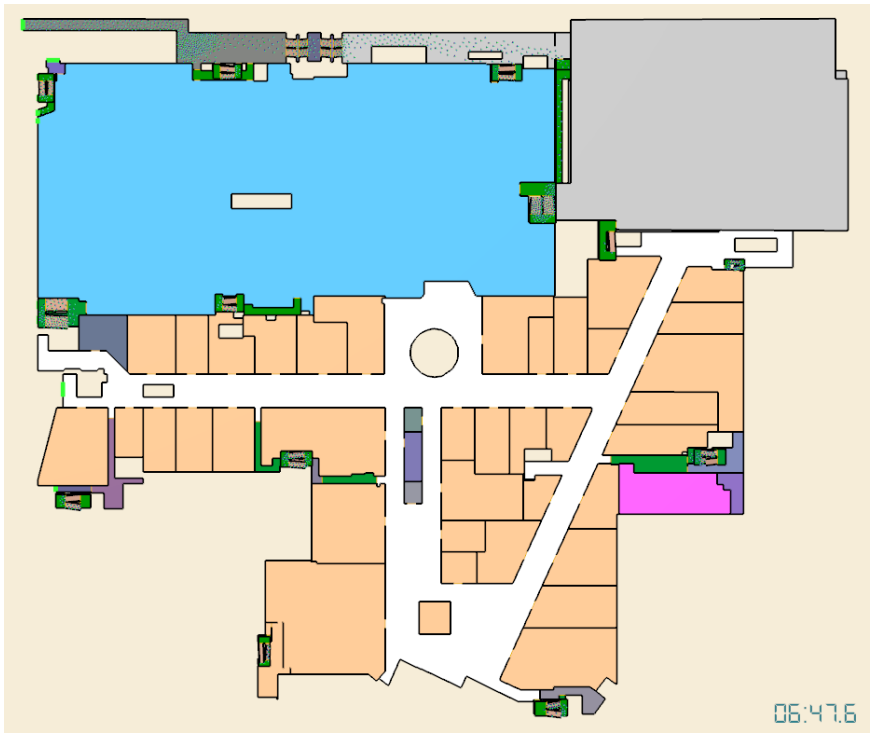
Timeline (mm:ss)	Results
09:36 (including 1:32 cue period) RSET – Zone 7 on level 01 and the rest of level 01 All occupants within zone 7 – ie the central smoke zone – on level 01 have evacuated from the area.	
10:58 (including 1:32 cue period) RSET – Zone 7 on level 02 and the rest of level 02. All occupants within zone 7 – ie the central smoke zone – on level 02 have evacuated from the area.	

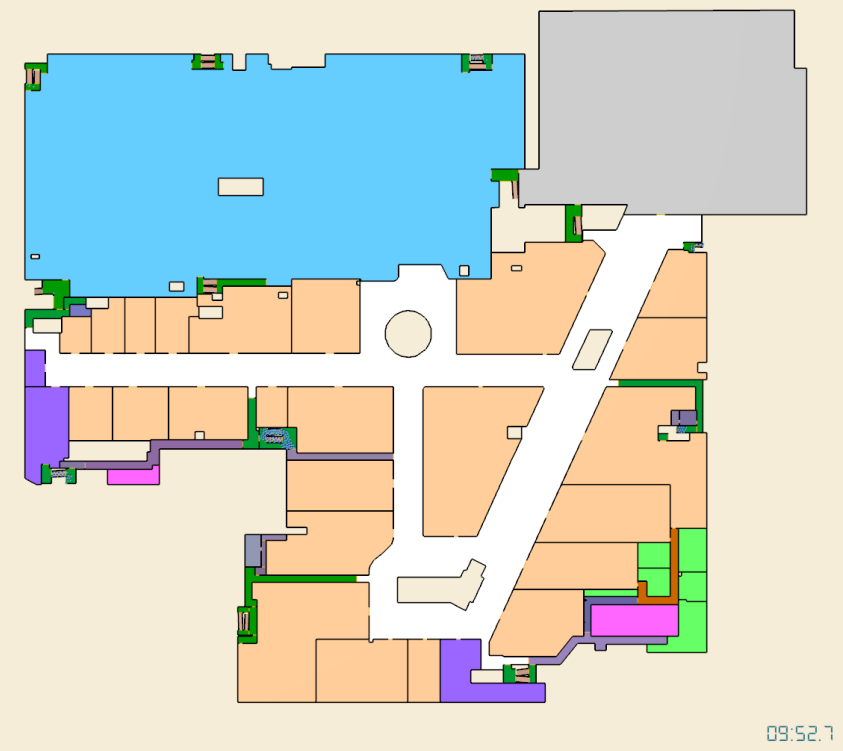
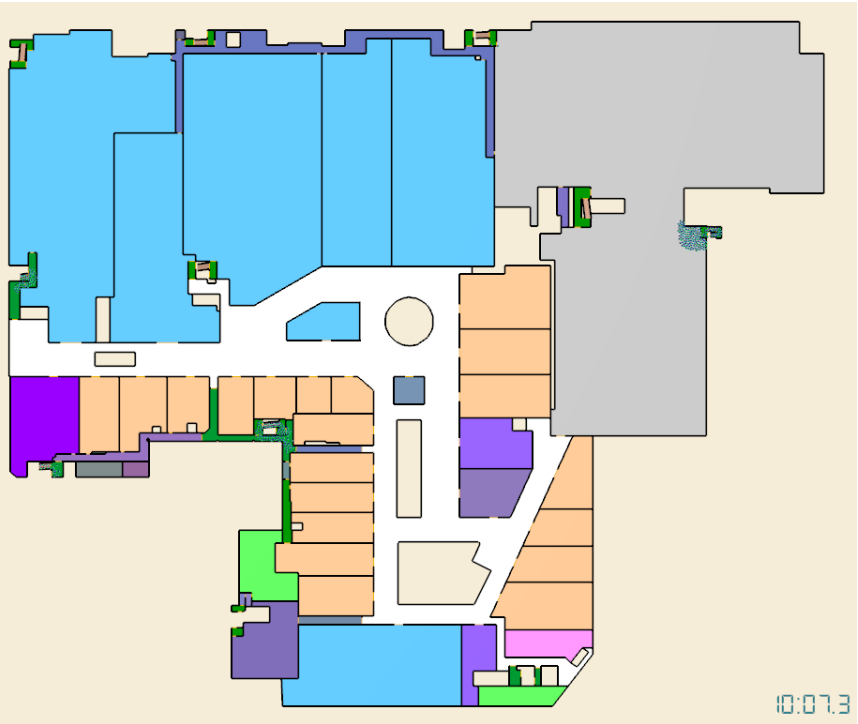
I.9 Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)[111]

The results of the evacuation assessment for Scenario 5 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin on ground level (level 00) does not occur. Adjacent smoke zones on the other retail levels of the building are therefore not assessed.

Timeline (mm:ss)	Results
00:00 Starting positions of occupants on ground level (level 00)	
3:58 (including 1:15 cue) All occupants within zone 7 on level 00 have moved away from the areas close to the fire. Occupants have either moved to adjacent smoke zones already or have reached a queue to exit the building via a fire-isolated exit stair.	

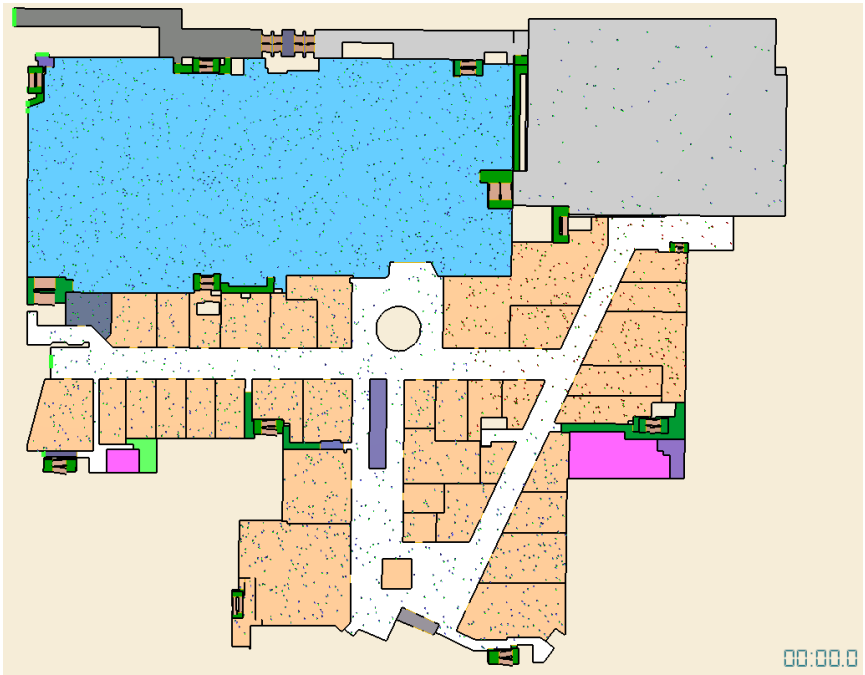
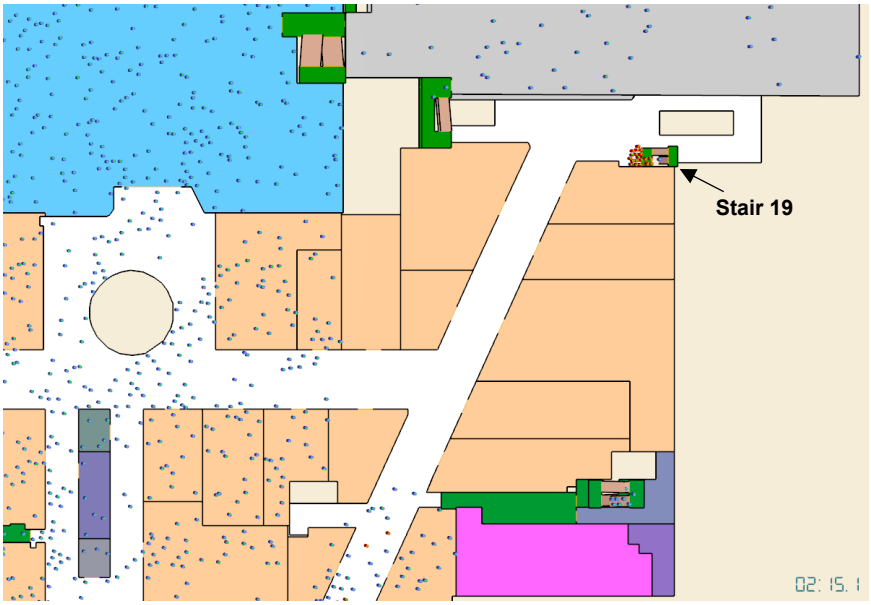
[111] Jensen Hughes, 2025, Fire in G-031 Scenario 10

Timeline (mm:ss)	Results
6:20 (including 1:15 cue) RSET – level 00 zone 7 All occupants within the impacted zone 7 on level 00 have evacuated from the area.	
9:11 (including 2:23 cue period) RSET – rest of level 00 Occupants throughout level 00 have evacuated via the available exits.	

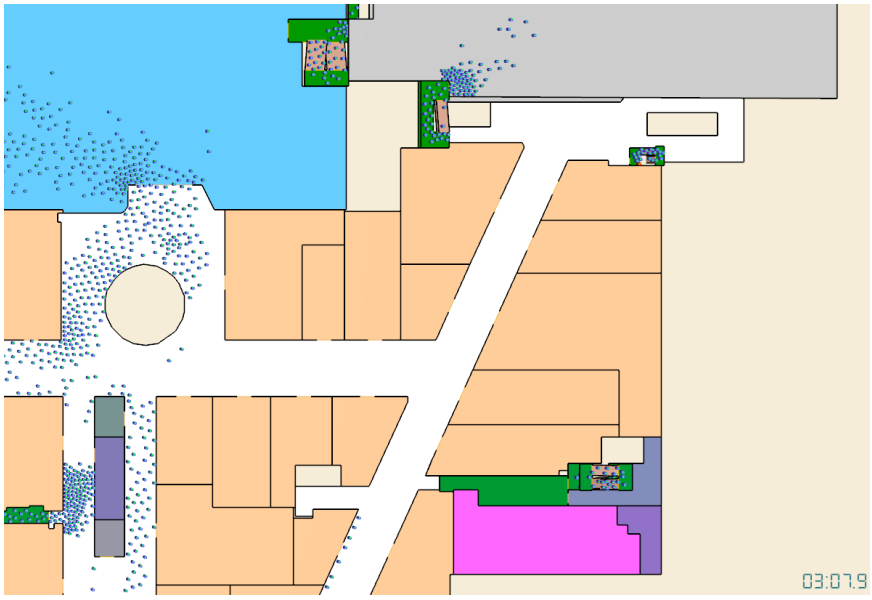
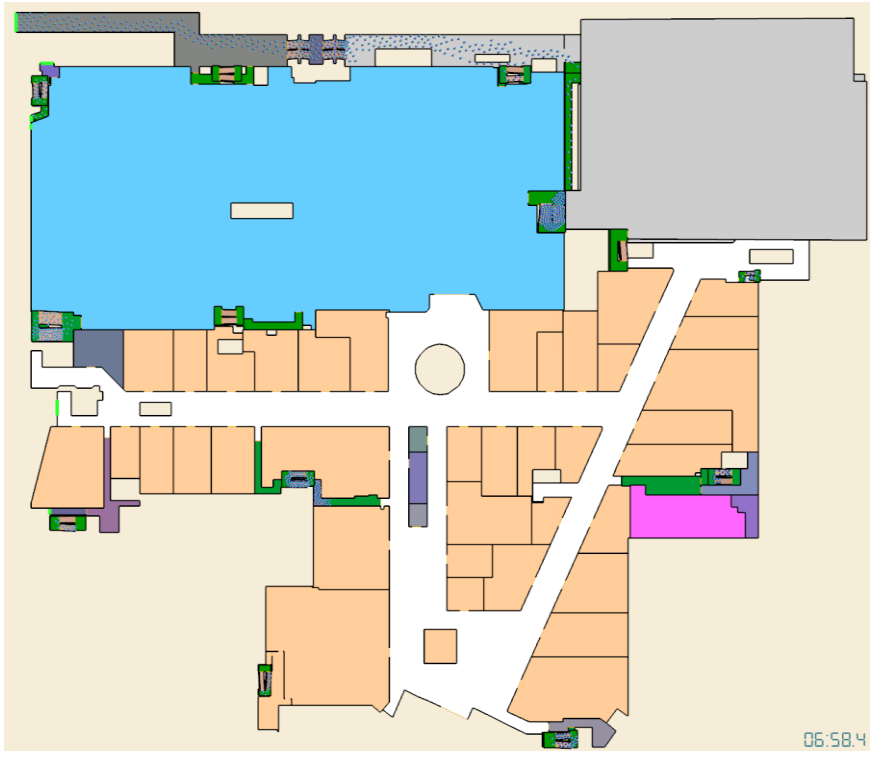
Timeline (mm:ss)	Results
12:16 (including 2:23 cue period) RSET – Zone 7 on level 01 and the rest of level 01. All occupants within zone 7 – ie the central smoke zone – on level 01 have evacuated from the area.	
12:31 (including 2:23 cue period) RSET – Zone 7 on level 02 and the rest of level 02. All occupants within zone 7 – ie the central smoke zone – on level 02 have evacuated from the area.	

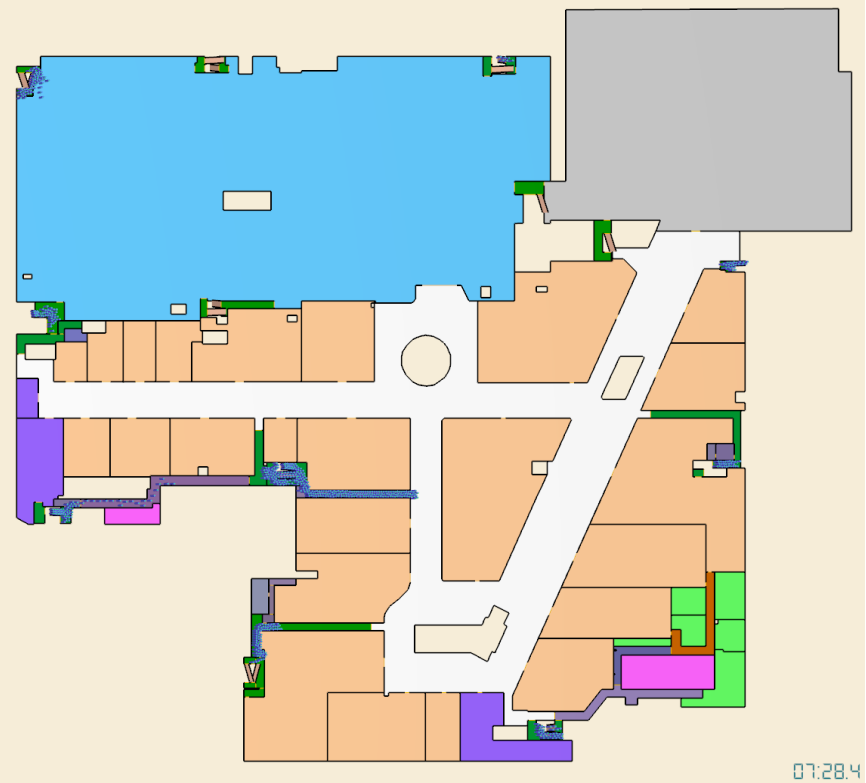
I.10 Scenarios 7 and 8 – Fire in specialty tenancy G-027A (Zone 13)[112]

The results of the evacuation assessment for Scenarios 7 and 8 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin on ground level (level 00) does not occur. Adjacent smoke zones on the other retail levels of the building are therefore not assessed.

Timeline (mm:ss)	Results
00:00 Starting positions of occupants on ground level (level 00)	
3:16 (including 1:00 cue) All occupants within zone 13 on level 00 have moved away from the areas close to the fire. Occupants have either moved to adjacent smoke zones already or have reached a queue to exit the building via stair 19 to the north-east.	

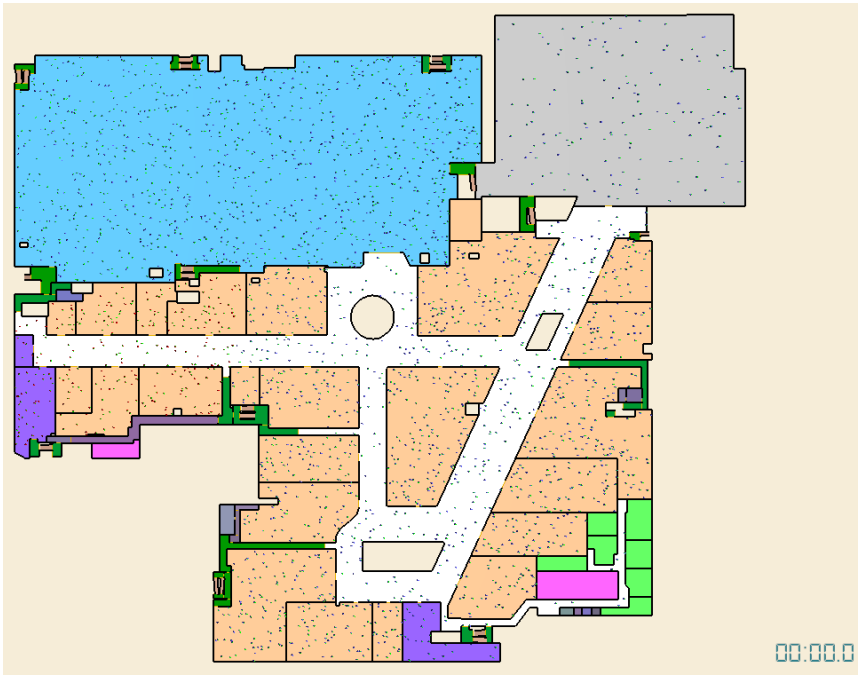
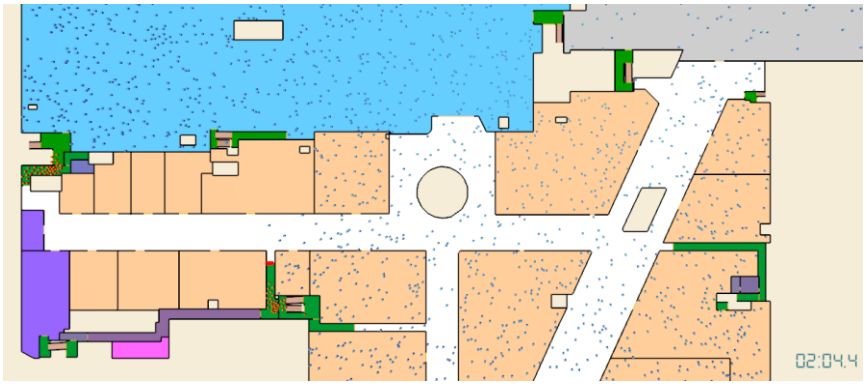
[112] Jensen Hughes, 2025, Fire in G-027 Scenario 3

Timeline (mm:ss)	Results
4:08 (including 1:00 cue) RSET – level 00 zone 13 All occupants within the impacted zone 13 on level 00 have evacuated from the area.	
8:36 (including 1:37 cue period) RSET – rest of level 00 Occupants throughout level 00 have evacuated via the available exits.	

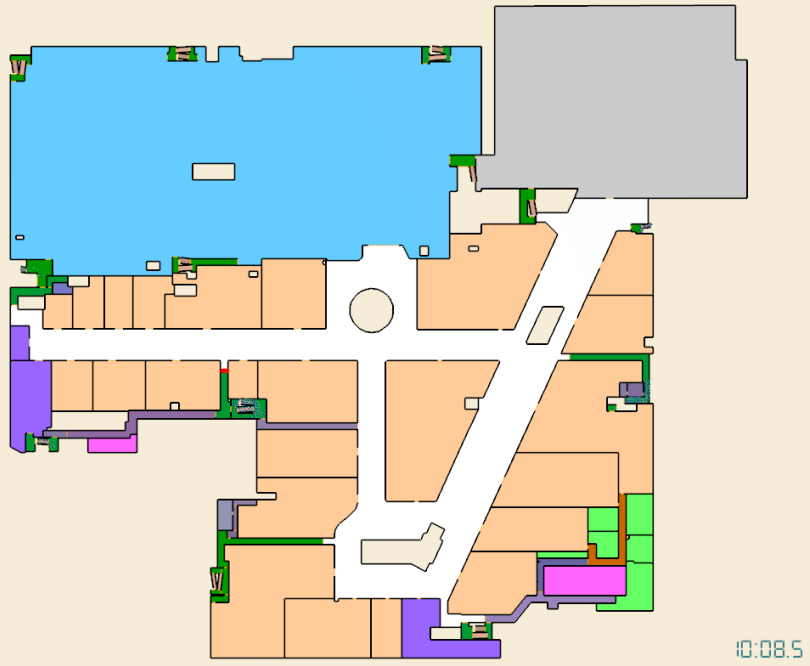
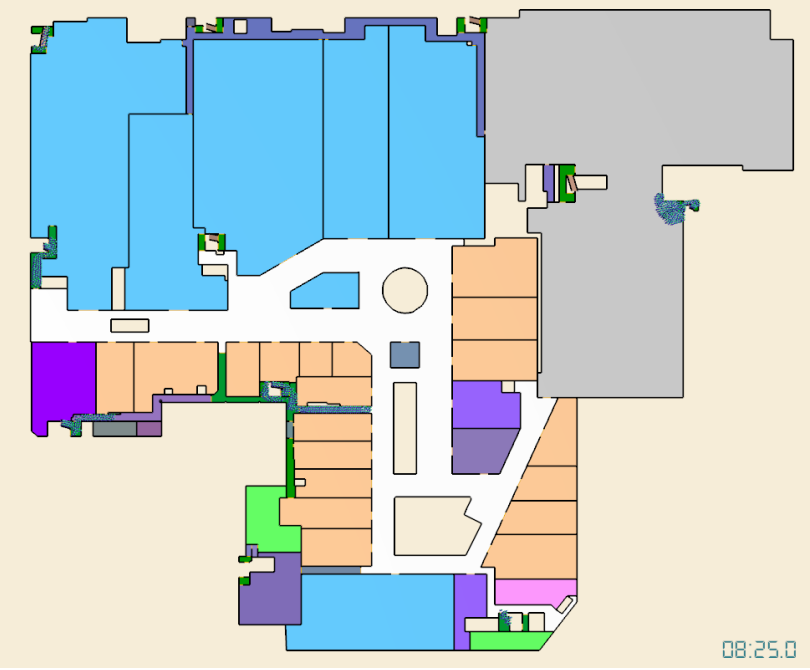
Timeline (mm:ss)	Results
9:06 (including 1:37 cue period) RSET – level 01 zone 13 Occupants throughout level 00 have evacuated via the available exits.	

I.11 Scenarios 9 and 10 – Fire in specialty tenancy 1-009 (Zone 12)[113]

The results of the evacuation assessment for Scenarios 9 and 10 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin on level 01 does not occur. Adjacent smoke zones on the other retail levels of the building are therefore not assessed.

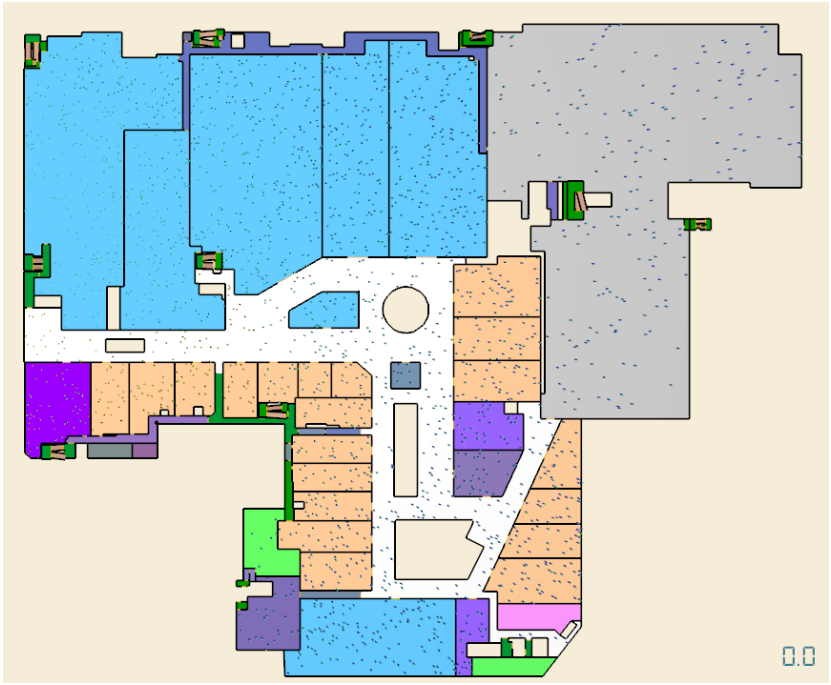
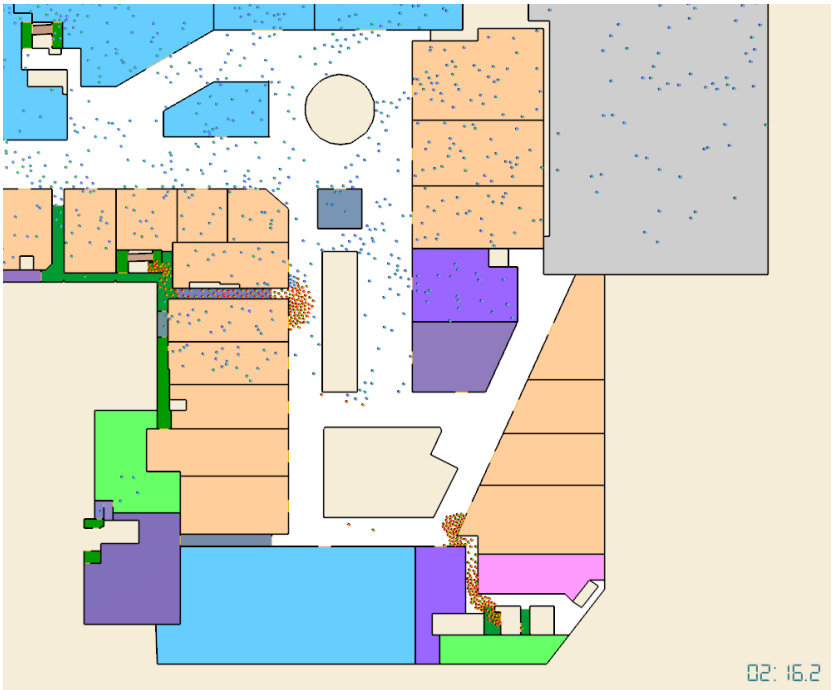
Timeline (mm:ss)	Results
00:00 Starting positions of occupants on level 01.	
3:15 (including 1:10 cue) RSET – level 01 zone 12 All occupants within the impacted zone 12 on level 01 have evacuated from the area.	

[113] Jensen Hughes, 2025, Fire in 1-009 Scenario 2

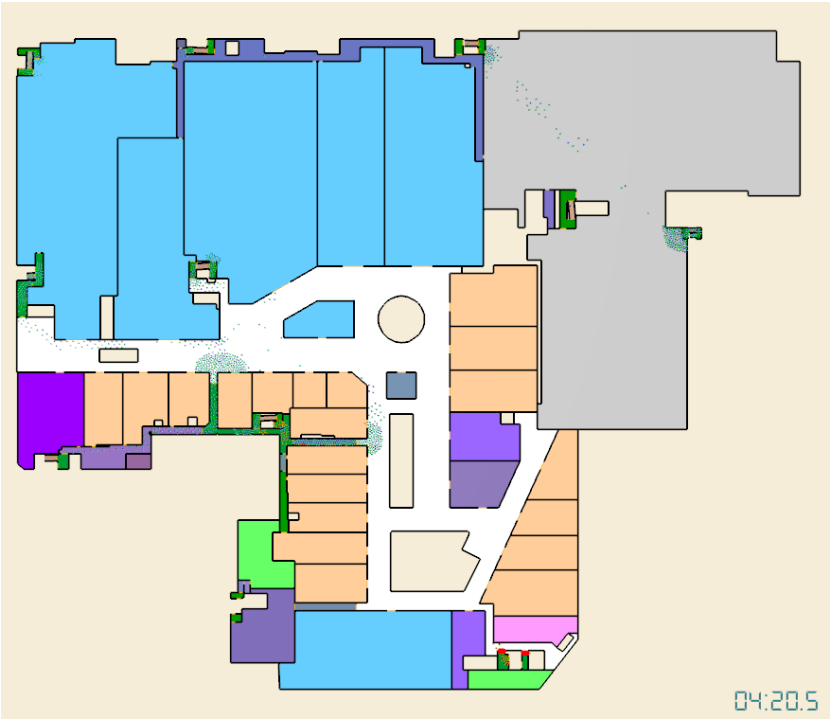
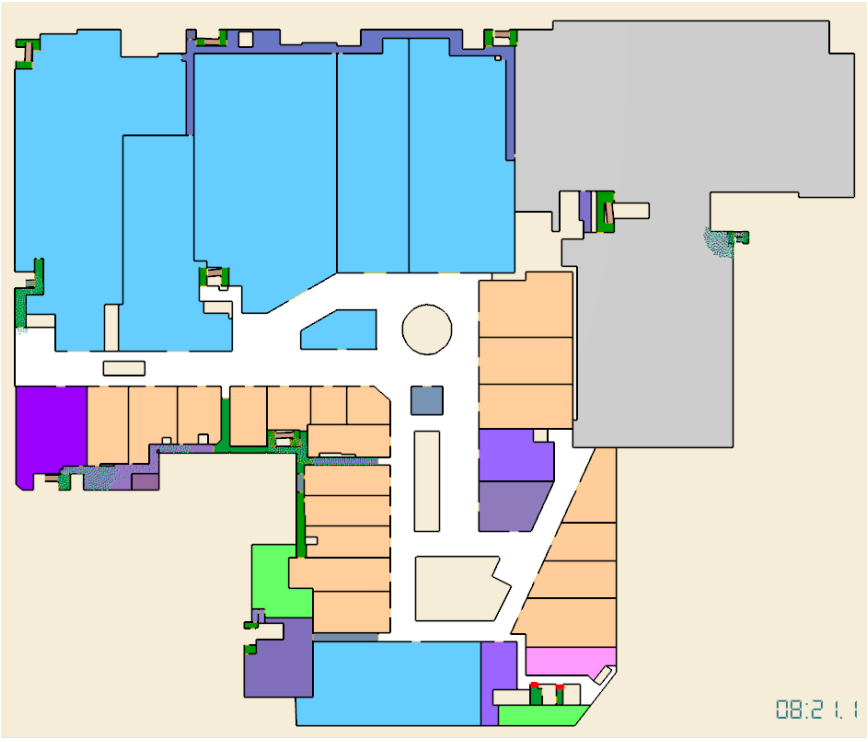
Timeline (mm:ss)	Results
11:52 (including 1:43 cue period) RSET – rest of level 01 Occupants throughout level 01 have evacuated via the available exits.	
10:08 (including 1:43 cue period) RSET – Zone 12 level 2 Occupants have evacuated Zone 12 on level 2. The majority of occupants within greater level 2 have evacuated, with a small remaining number queuing outside the Stair 8 passage.	

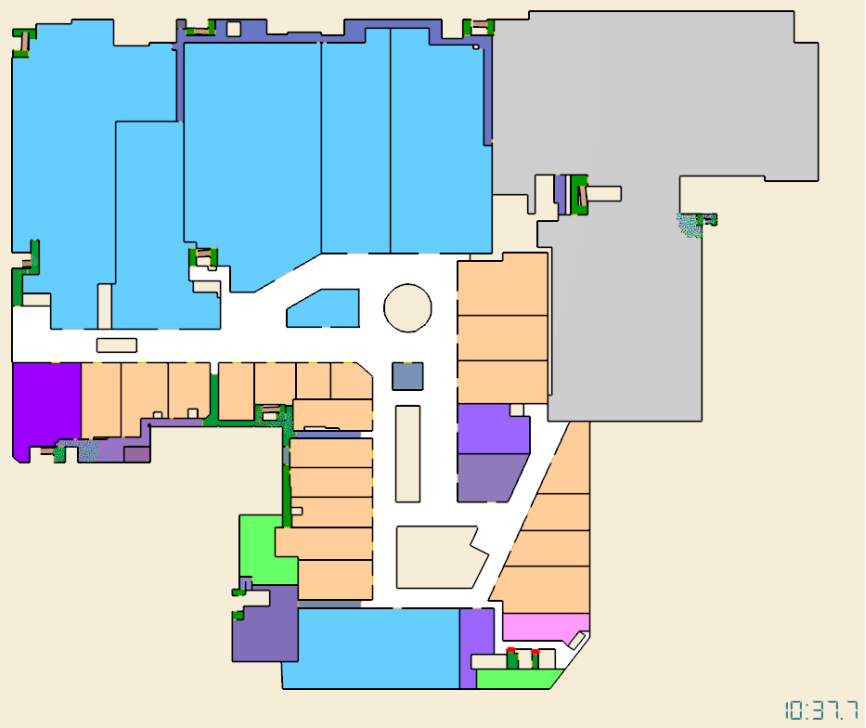
I.12 Scenarios 11 and 12 – Fire in specialty tenancy 2-024 (Zone 7)[114]

The results of the evacuation assessment for Scenarios 11 and 12 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin on level 02 does not occur. Given the buoyancy of hot smoke, significant smoke spread to the levels below is also not expected to occur. The retail levels below are therefore not assessed for this scenario.

Timeline (mm:ss)	Results
00:00 Starting positions of occupants on level 02.	
3:12 (including 0:55 cue) Occupants close to the fire within zone 7 on level 02 – ie near the Victoria Avenue void – have moved away from the areas close to the fire. These occupants are represented by red cylinders in the adjacent figure. The subject occupants have reached a queue to evacuate the building via a fire-isolated exit stair.	

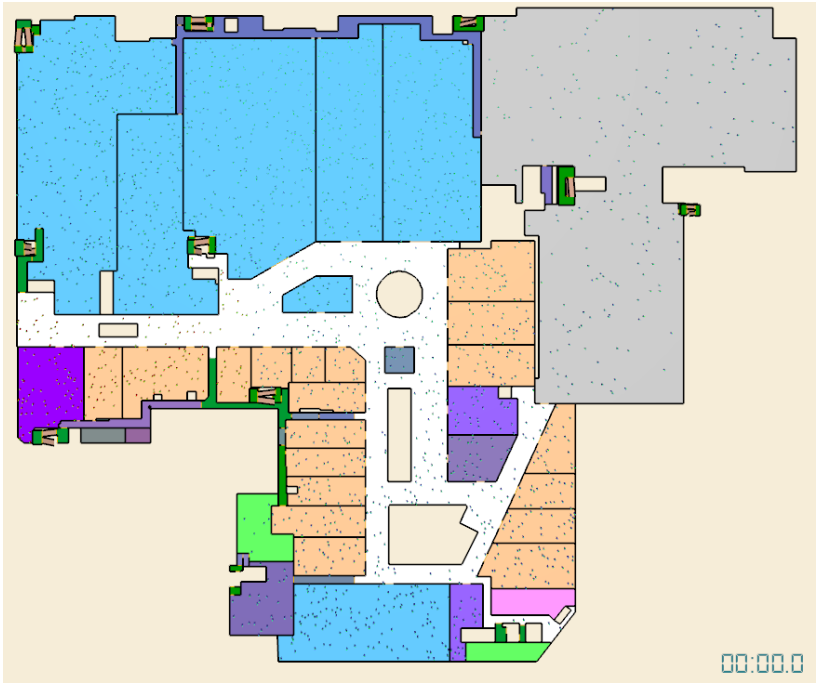
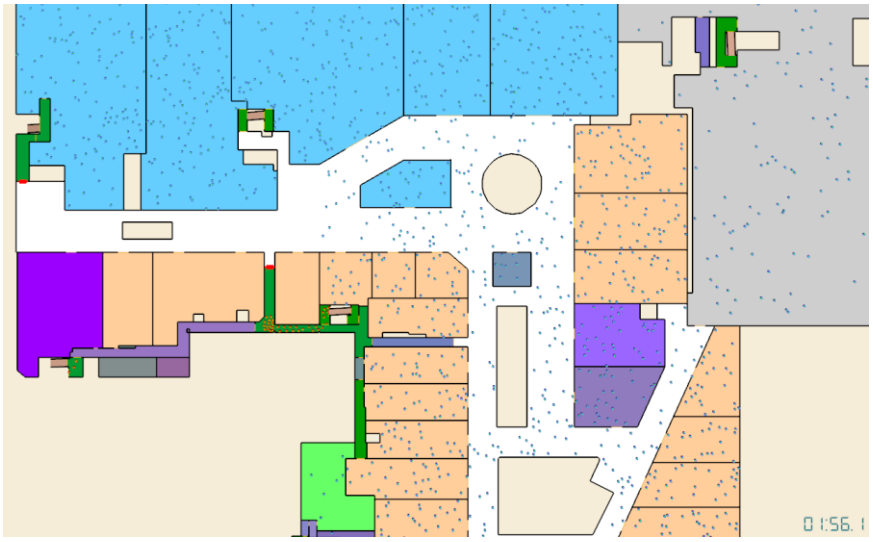
[114] Jensen Hughes, 2025, Fire in 2-024 Scenario 12

Timeline (mm:ss)	Results
5:15 (including 0:55 cue period) As visibility begins to drop below 10 m within the corridor from Stair 6 occupants start moving away from the area to seek egress elsewhere. Other occupants are present within smoke zone 7 but are located away from the fire and untenable areas.	
10:12 (including 0:55 cue period) Occupants close to the fire within zone 7 on level 02 have either evacuated via the available exits or are queuing with the passageway leading to Stair 8. This corridor is not openly connected to the mall area.	

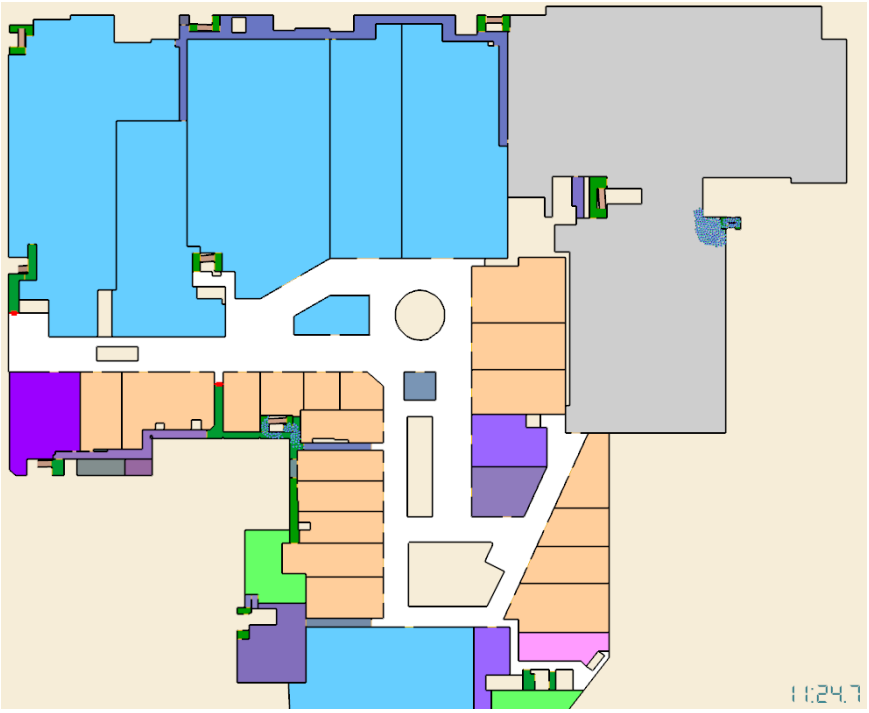
Timeline (mm:ss)	Results
11:33 (including 0:55 cue period) – level 02 zone 7 and rest of mall Occupants close to the fire within zone 7 on level 02 have evacuated via the available exits. Occupants throughout level 02 have also evacuated via the available exits.	

I.13 Scenarios 13 – Fire in specialty tenancy 2-010 (Zone 1)[115]

The results of the evacuation assessment for Scenarios 11 and 12 are summarised in Table 107 and shown below. The smoke modelling in Appendix H shows that significant smoke spread beyond the smoke zone of fire origin on level 02 does not occur. Given the buoyancy of hot smoke, significant smoke spread to the levels below is also not expected to occur. The retail levels below are therefore not assessed for this scenario.

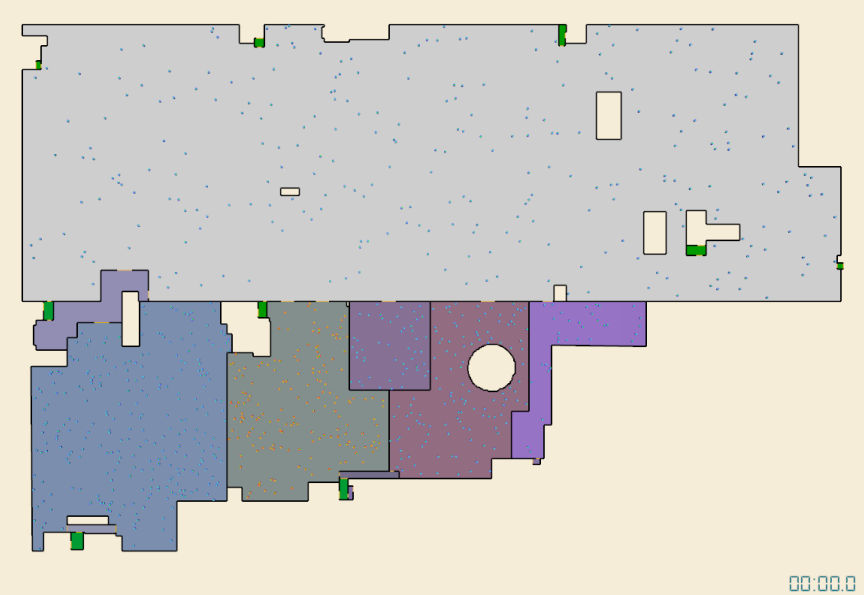
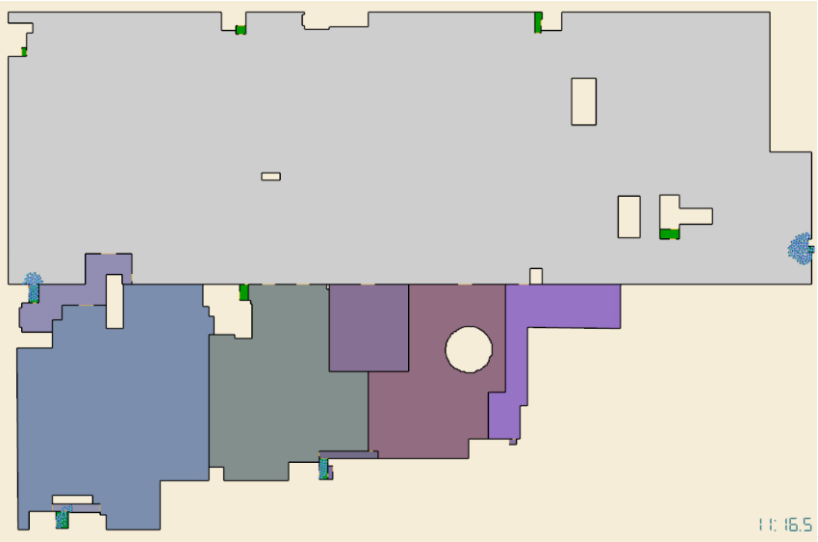
Timeline (mm:ss)	Results
00:00 Starting positions of occupants on level 02.	
2:57 (including 1:00 cue) RSET – level 02 zone 12 All occupants within the impacted zone 12 on level 01 have evacuated from the area.	

[115] Jensen Hughes, 2025, Fire in 2-010 Scenario 13

Timeline (mm:ss)	Results
12:25 (including 1:00 cue period) RSET – rest of level 02 Occupants throughout level 02 have evacuated via the available exits.	

I.14 Scenario 14 – Fire in level 3 retail tenancy 3-002

The results of the evacuation assessment for Scenario 15 is summarised in Table 107 and shown below. The level 3 retail tenancies form a separate fire compartment to the existing retail compartment below. The gym is further separated from the retail areas of the existing retail fire compartment. Given the buoyancy of hot smoke, significant smoke spread to the levels below is also not expected to occur The retail levels below are therefore not considered for this scenario.

Timeline (mm:ss)	Results
00:00 Starting positions of occupants on level 03.	
15:00 (including 3:43 cue) RSET – level 03 internal areas All occupants within internal areas of level 03 have evacuated. Occupants within the external carpark area have either evacuated or queuing at fire-isolated exits	

I.15 RSET summary

A summary of the RSET for occupants from each area considered for each fire scenario is provided in Table 107 below.

Table 107 RSET summary

Fire scenario	Area considered	Cue period (mm:ss)	Pre-movement + movement period (mm:ss)	RSET (mm:ss)
Lower ground level				
Scenario 1 – Fire in specialty tenancy B-031 (Zone 7)	Zone 7 and lower ground food court	1:00	2:24	**3:24**
	Rest of lower ground level mall	1:24	5:17	**6:41**
	Level 00	1:24	6:24	**7:48**
	Level 01	1:24	10:48	**11:12**
	Level 02	1:24	8:58	**10:22**
Scenario 2 – Fire in kiosk site 11 (Zone 7)	Zone 7 and lower ground food court	0:48	2:24	**3:12**
	Rest of lower ground level mall	0:48	5:17	**6:05**
	Level 00	0:48	6:23	**7:12**
	Level 01	0:48	9:48	**10:36**
	Level 02	0:48	10:34	**11:23**
Scenario 3 – Fire in specialty tenancy B-031 (Zone 7, sensitivity)	Zone 7 and lower ground food court	1:00	2:27	**3:27**
	Rest of lower ground level mall	1:24	5:17	**6:41**
	Level 00	1:24	7:22	**8:46**
	Level 01	1:24	9:06	**11:30**
	Level 02	1:24	11:06	**12:30**
Ground level (level 00)				
Scenario 4 – Fire in specialty tenancy G-034 (Zone 7) **Scenario 6** – Fire in specialty tenancy G-034 (Zone 7, sensitivity)	Zone 7 on level 00	1:10	3:06	**4:16**
	Rest of level 00 mall	1:32	6:36	**8:09**
	Level 01	1:32	8:04	**9:36**
	Level 02	1:32	9:26	**10:58**
Scenario 5 – Fire in specialty tenancy G-031 (Zone 7)	Zone 7 on level 00	1:15	5:05	**6:20**
	Rest of level 00 mall	2:23	6:48	**9:11**
	Level 01	2:23	9:53	**12:16**
	Level 02	2:23	10:08	**12:31**

Fire scenario	Area considered	Cue period (mm:ss)	Pre-movement + movement period (mm:ss)	RSET (mm:ss)
Scenario 7 – Fire in specialty tenancy G-027A (Zone 13) **Scenario 8** – Fire in specialty tenancy G-027A (Zone 13, sensitivity)	Zone 13 on level 00	1:00	3:08	**4:08**
	Rest of level 00 mall	1:37	6:59	**8:36**
	Zone 13 on level 01	1:37	7:29	**9:06**
Level 01				
Scenario 9 – Fire in specialty tenancy 1-009 (Zone 12) **Scenario 10** – Fire in specialty tenancy 1-009 (Zone 12, sensitivity)	Zone 12 on level 01	1:10	2:05	**3:15**
	Rest of level 01 mall	1:43	10:09	**11:52**
	Zone 12 on level 2	1:43	8:25	**10:08**
Level 02				
Scenario 11 – Fire in specialty tenancy 2-024 (Zone 7) **Scenario 12** – Fire in specialty tenancy 2-024 (Zone 7, sensitivity)	Zone 7 on level 02 – only localised area near tenancy of fire origin	0:55	10:38	**11:33**
	Rest of level 02 mall	0:55	10:38	**11:33**
Scenario 13 – Fire in specialty tenancy 2-010 (Zone 1)	Zone 1 on level 02 – only localised area near tenancy of fire origin	1:00	1:57	**2:57**
	Rest of level 02 mall	1:00	11:25	**12:25**
Level 03				
Scenario 14 – Fire in specialty tenancy 2-010 (Zone 1)	Internal level 03 areas	3:43	11:17	**15:00**

Appendix J Internal columns supporting level 3 roof

J.1 Structural engineer advice

Chatswood Chase Main Scheme (2023)
345 Victoria Ave
Chatswood
NSW 2067 Australia

ARUP
www.arup.com

MAIL TYPE	MAIL NUMBER	REFERENCE NUMBER
General Correspondence	Arup NSW-GCOR-000002	RLB-NSW-RFI-000002

Re: Structural Steel 2 Hour Fire Rating

From Mr Xavier Nuttall - Arup (NSW)

To Ms Grace Huang - Warringtonfire

Cc (4) Mark Fyson - Arup Group
Mr David Patterson - Multiplex Constructions Pty Ltd
Mr Chris Jamieson - Warringtonfire
Mr Malhar Bhadbhade - Warringtonfire

Sent Wednesday, 10 April 2024

MESSAGE

Hi Grace,

Arup comments for the L3 roof steelwork below in Green. Thanks,

Xav

From: G Huang
Sent: 25/03/2024 11:20:23 AM AEDT (GMT +11:00)
To: Mark Fyson, David Patterson
Cc: Malhar Bhadbhade, Chris Jamieson
Mail Number: WFIRE-RFI-000011
Subject: Re: Structural Steel 2 Hour Fire Rating

Hi Mark,

For this performance solution relating to rationalising the FRLs of the level 3 commercial columns, could we please get confirmation of the following in terms of the structural design:

a. The roof structure is designed such that failure of the non-fire-rated internal columns on level 3 supporting the roof

will only cause localised failure of the roof structure.
Arup Comment - Failure of any one non-fire rated L3 steel column will not lead to a global instability under the fire load case, and hence only a local failure of the immediately surrounding roof structure may occur.

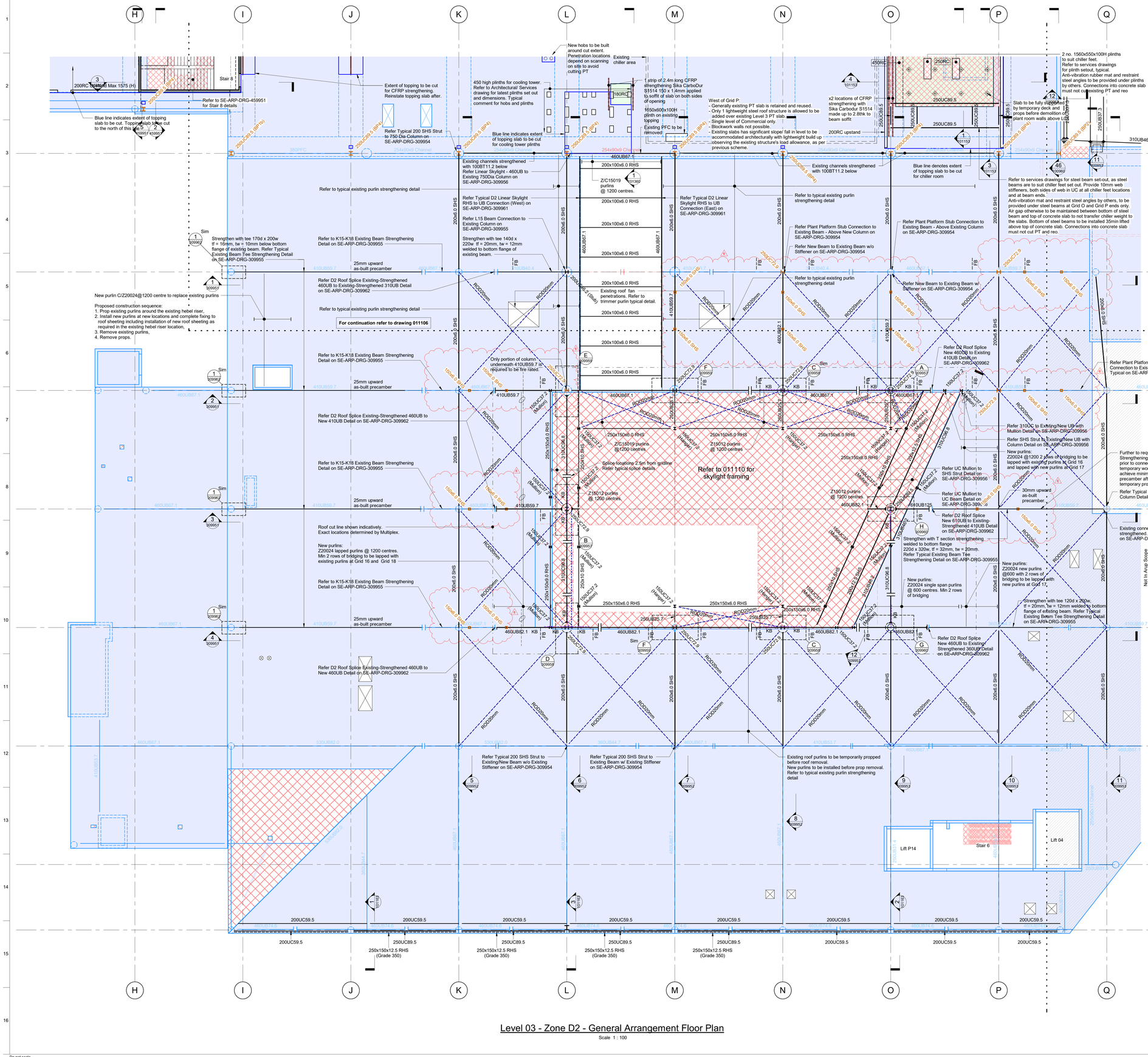
b. Failure of the non-fire-rated level 3 internal columns supporting the non-fire-rated roof must not result in the outwards collapse of the level 3 external walls.
Arup comment - Failure of any one non-fire rated L3 steel column will not lead to a global instability under the fire load case, hence will not lead to outwards collapse of the L3 external walls. Fire protection to structural elements providing immediate support to the external walls (wind beams and adjacent columns) will be required to achieve this.
Note - Our understanding is that this requirement applies to all elevations of the L3 steelwork - if the extent of this requirement could be refined, so could be extent of fire rating.

This confirmation is required to finalise the draft fire engineering report for the main scheme.
Additionally (though this is not as urgent), is there an updated markup of the extent of structural steel fire rating since the one Nick issued below in OveArup-GCOR-000288?

Kind regards,
Grace
Warringtonfire
0419 102 654

J.2 Fire rating of structural elements

See next page.



Notes:

1. On plan 200 denotes slab thickness other than typical
2. Concrete Strength to be f'c=40 MPa unless noted otherwise
3. All concrete folds to be 300mm wide unless noted otherwise
4. Kerbs / Plinths / Hobs are not included in size of Structural elements U.N.O.
5. For sizes and locations of Kerbs / Plinths / Hobs refer to Architects concrete set-out drawings
6. For details of falls in slab refer to Architects and Hydraulic Engineers drawings
7. For details of Rebates, Cast-In angles and Covers to access Hatches, Sumps, Pits, Drains and Floor Wastes etc, refer to Architects and Hydraulic Engineers drawings
8. Any additional topping not shown on Structural drawings, must be approved by Structural Engineer
9. Maintain a 300mm min. clear Structural width between Slab Penetrations U.N.O.
10. All Door Openings and Services Penetrations are Not shown on drawings refer to Architects wall elevations for details
11. All Existing Structures, Services and Utilities are to be located by the Contractor prior to Construction
12. Refer to Existing Structural Documents for details of existing structure
13. Refer to Wall Elevations for stitching requirements between new shear walls and existing structure (typical)

Suspended Slab (New) Notes:

1. All concrete folds to be 1200mm wide unless noted otherwise
2. Concrete Strength to be f'c=40 MPa unless noted otherwise
3. All beams under ramps to have sloped soffits Typical unless noted otherwise

Typical Concrete Repair Note:

Make good at the exposed face, and protect the exposed reinforcement within 24hrs of cutting.
Locally cut back exposed reinforcement 20mm Below surface.
Prime reinforcement with Nitoprime Zinc-Rich and allow to dry.
Apply Nitobond HAR Primer then reinstate with Renderoc HB40 and matching concrete grade or approved equivalent standard manufacturer's procedures apply.

PT to be designed by specialist trade subcontractor. Minimum service stress to achieve 1.6 MPa for undercover slabs and 2.2 MPa for exposed slabs.

Water proofing by others

All Raised floor and ramping to be as per drawing SE-ARP-DRG-000933 typical false floor details or similar lightweight build up.

Steelwork Notes:

1. When Steelwork is to be installed within an existing structure, site measure prior to fabrication of steelwork.
2. All steelwork to achieve 120 /-- fire rating provided by vermiculite wet spray or approved alternative when hidden from view, hidden from weathering and when permitted by Architect. When exposed to view, or exposed to weathering or when required by Architect for aesthetics or for head room, epoxy intumescent is to be provided to steel work. If offsite application is adopted, consideration of damage resistance is to be undertaken. Exception is lightweight steel roof members including steel columns, where they do not require fire protection unless denoted clearly on plans in colour as per legend.
3. For composite metal deck slab, provide 120thk slab on Condeck HP 1.00mm BMT metal deck sheeting in new slab zones typ. UNO. Provide 150thk slab on KingFlor KF57 1.00mm BMT metal deck sheeting in new landscape/outdoor slab zones typ. UNO. Unpropped construction satisfies slab deflection L/150 for continuous metal deck span where the secondary beams are spaced at 2.73m centres. Allow for propping to metal decking where secondary beam spacing exceeds 2.73m.
4. Provide two rows of 19 dia. x 90 min. long shear studs at 300 max. centres welded to top flange of steel beams.
5. All steel beam to steel beam connections to have full height stiffeners and web side cleat, UNO.

RC Slab on Metal Deck Notes:

On plan ——— denotes direction of metal deck sheeting
Condeck HP 1.00mm BMT / KingFlor KF57 1.00mm BMT with ribs and not dovetail (lost formwork)
Metal Deck or approved equivalent unless noted otherwise

P1	SZ250-19 purlins at 1200c/c continuous, lapped, spanning east-west with 1 row of bridging per span, for 8.2m maximum span. 8.8 grade purlin bolts. Provide fly bracing at 2400 maximum centres to North-South beams - For details refer to drawing SE-ARP-DRG-000983
P2	Z200-15 purlins at 1200c/c continuous, lapped, spanning east-west with 2 rows of bridging for 8.2m maximum span
P3	SZ200-19 purlins at 1200c/c continuous, lapped, double spanning east-west with 1 row of bridging per span.
P4	SZ300-30 purlins at 1200c/c single spanning east-west
P5	C250-19 purlins at 600c/c single spanning with 1 row of bridging midspan

General Notes:
- Secondary Structure and steelwork to be hung off primary steel provided and designed by others, not shown, typical.
- Skylight beam sizes assume that no additional load from the mechanical ducts.
- Refer to structural loading plan for allowable design loads to the roof structure

Note:
This drawing is to be read in conjunction with the sections and details drawings SE-ARP-DRG-101151 to 101156 and SE-ARP-DRG-309951 to 309962

Existing 200Z purlins (assumed two rows of bridging)

New C purlin 20024 with two rows of bridging to be teck screwed to existing purlins at 500mm centres with Buildex 12-24 Hex Head Series 500 Teks Screws. New purlins to be installed 300mm from ends of existing purlins

Typical Existing Purlin Strengthening Detail

Note: Existing purlins to be temporarily propped before existing roof removal. New purlins to be installed before prop removal.

Notes:

1. Design has assumed Grade 460 steel. Material test conducted by Mahaffey in WS223798-1 has confirmed yield stress of 597 MPa.
2. As there are no existing drawings available, the grade of the existing steel is unknown. G250 steel has been assumed. Material test conducted by Mahaffey in Mahaffey WS223798-2 has confirmed yield stress of 330 MPa.

FB — Denotes 90x6EA fly braces from beams to purlins. Refer to SE-ARP-DRG-309951 for details

KB — Denotes 150x100x12 UA knee braces

3. Temporary works engineer to ensure temporary lateral stability of the roof structure at all stages of construction.

For Strengthening of Existing Continuous Beams:

1. Prop adjacent continuous spans. Design of propping system by temporary works engineer. Stiffness of temporary works must ensure minimal (<1mm) vertical displacement relative to current position.
2. For the span that is to be strengthened, determine the RL of:
   - Beam ends
   - Midspan of beam
3. Prop the span that is to be strengthened.
4. Apply strengthening detail to the beam.
5. Propping of adjacent and strengthened spans to be removed after weld testing is completed and closed out.

Building Joint Legend

- Construction Joint
- New Movement Joint
- Existing Movement Joint

NOTE:
Existing movement joints derived from historical drawings and may not reflect the as built conditions. Subject to variation on site.

All drawings are to be printed **IN COLOUR**

Note (Existing Structure):

The existing structure shown has been derived from documentation of past developments and may not reflect the as-built condition. The information should be regarded as indicative and is provided to inform the design process. Where affected by the new development, the existing condition of structure should be confirmed by survey prior to any demolition or construction works.

Legend:

- Denotes Existing Structure to be demolished
- Denotes Existing Structure to be retained
- Denotes New Infill Slab

Reference Drawings:

1. For General Notes Refer to drawing SE-ARP-DRG-000011
2. For Reinforcement Tables Refer to drawing SE-ARP-DRG-000021
3. For Coating Notes Refer to drawings SE-ARP-DRG-000031 & 000032
4. For Piling Notes Refer to drawing SE-ARP-DRG-000041
5. For Loading Plans, Refer to drawings SE-ARP-DRG-001001 to 001007
6. For Typical Details Refer to drawing SE-ARP-DRG-000900 series

Legend:

A3C1	Denotes Zone A3 - New RC Column
A3C1 Type Sx	Denotes Zone A3 - Existing RC Column that requires strengthening Type Sx
TBP	Top Bonded Plate
BBP	Bottom Bonded Plate
<20>	Denotes +20mm precamber at midspan of beam
(VS)	Denotes Vertical Slotted Holes required in connection
(FR)	Denotes that Roof Beam Only provides lateral restraint to facade. Facade must be dead loaded down
(TF)	Denotes TF Bolts to be used at connections
(COS)	Check / Survey on Site
	Denotes Moment Connection
	Denotes Full Moment Splice Connection
	Denotes Steelwork that requires Fire Protection in Accordance with the Fire Engineers report

Note:
1. For Column Strengthening Details Refer to drg's SE-ARP-DRG-000945 to 000950
2. All strengthening elements (with the exception of carbon fibre strips) to be fire protected i.e. steel beams, steel brackets and steel plates.
3. For Column Schedules Refer to drawing SE-ARP-DRG-359000 series

For strengthening steel beams added under existing slabs, the top of the new steel beam level typically follows the soffit level of the existing concrete beams in order for new steel beams to run unobstructed under the existing concrete beams and to connect to existing columns.
Allow for additional piggyback steel beams 180UB22 to run along the length of new steel beams added under existing slab to infill the gap between the soffit of existing slab and the top of new steel beam. (PB) on plan indicates piggyback steel beam. (CR) on plan indicates cranking steel beam.

Only penetrations shown on the structural drawings are approved

Rev	Date	Description
6	28/03/25	Construction Issue
5	12/03/25	Construction Issue
4	14/02/25	Construction Issue
3	10/12/24	Construction Issue
2	25/10/24	Construction Issue
1	23/10/24	Construction Issue
E	18/10/24	For Coordination
D	26/02/24	For Construction Certificate
C	28/04/23	70% Design Development
B	02/12/22	Schematic Design Issue
A	18/11/22	Draft Schematic Design

0 1 2 3 4 5 m

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Fax +61 (02) 9320 9321
www.arup.com

Client
Vicinity Centres

Project Title
Chatswood Chase Sydney
345 Victoria Avenue
Chatswood NSW 2067

Key Plan

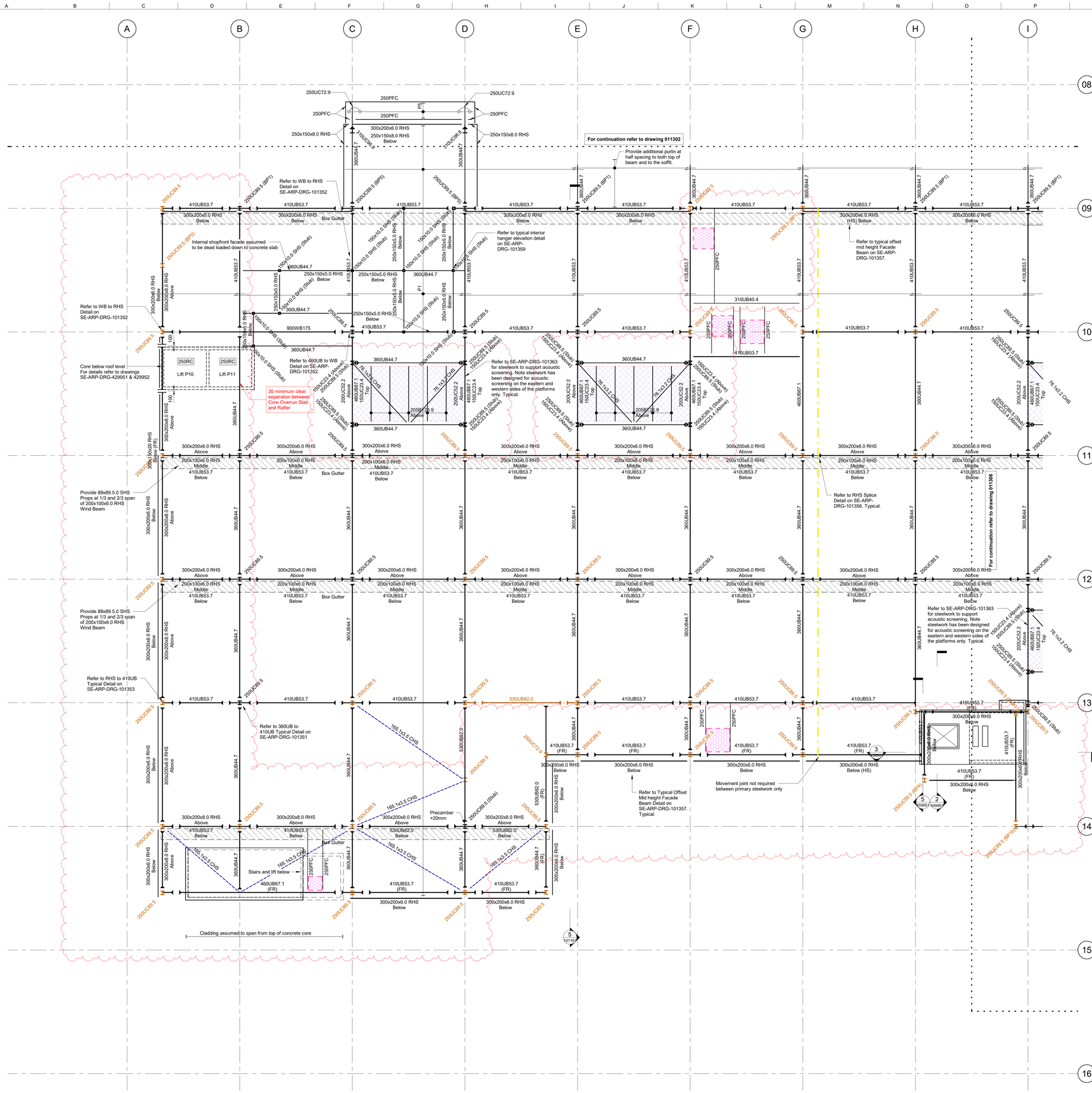

Drawing Title
Level 03 Zone D2 General Arrangement Floor Plan

Scale at A0	1 : 100
By / Chkd / Appd	SL/WK/MF
Role	Structural
Suitability	For Construction
Arup Job No	254810
Rev	6

Drawing Number
SE-ARP-DRG-011108

28/03/2025 4:21:17 PM

Do not scale
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Level 04 - Zone C1 - General Arrangement Floor Plan

Scale 1 : 100

Do not scale

Notes:

1. On plan 200 denotes slab thickness other than typical
2. Concrete Strength to be f'c=40 MPa unless noted otherwise
3. All concrete folds to be 300mm wide unless noted otherwise
4. Kerbs / Plinths / Hobs are not included in size of Structural elements U.N.O.
5. For sizes and locations of Kerbs / Plinths / Hobs refer to Architects concrete set-out drawings
6. For details of falls in slab refer to Architects and Hydraulic Engineers drawings
7. For details of Rebates, Cast-In angles and Covers to access Hatches, Sumps, Pits, Drains and Floor Wastes etc. refer to Architects and Hydraulic Engineers drawings
8. Any additional topping not shown on Structural drawings, must be approved by Structural Engineer
9. Maintain a 300mm min. clear Structural width between Slab Penetrations U.N.O.
10. All Door Openings and Services Penetrations are Not shown on drawings refer to Architects wall elevations for details
11. All Existing Structures, Services and Utilities are to be located by the Contractor prior to Construction
12. Refer to Existing Structural Documents for details of existing structure
13. Refer to Wall Elevations for stitching requirements between new shear walls and existing structure (typical)

Suspended Slab (New) Notes:

1. All concrete folds to be 1200mm wide unless noted otherwise
2. Concrete Strength to be f'c=40 MPa unless noted otherwise
3. All beams under ramps to have sloped soffits Typical unless noted otherwise

Typical Concrete Repair Note:

Make good at the exposed face, and protect the exposed reinforcement within 24hrs of cutting.
Locally cut back exposed reinforcement 20mm Below surface.
Prime reinforcement with Nitoprime Zinc-Rich and allow to dry.
Apply Nitobond HAR Primer then reinstate with Renderoc HB40 and matching concrete grade or approved equivalent standard munufacturer's procedures apply.

Steelwork Notes:

1. When Steelwork is to be installed within an existing structure, site measure prior to fabrication of steelwork.
2. All steelwork to achieve 120/-/- fire rating provided by vermiculite wet spray or approved alternative when hidden from view, hidden from weathering and when permitted by Architect. When exposed to view, or exposed to weathering or when required by Architect for aesthetics or for head room, epoxy intumescent is to be provided to steel work. If offsite application is adopted, consideration of damage resistance is to be undertaken. Exception is lightweight steel roof members including steel columns, where they do not require fire protection unless denoted clearly on plans in colour as per legend.
3. For composite metal deck slab, provide 120thk slab on Condeck HP 1.00mm BMT metal deck sheeting in new slab zones typ. UNO. Provide 150thk slab on KingFlor KF57 1.00mm BMT metal deck sheeting in new landscape/outdoor slab zones typ. UNO. Unpropped construction satisfies slab deflection L/150 for continuous metal deck span where the secondary beams are spaced at 2.73m centres. Allow for grouping to metal decking where secondary beam spacing exceeds 2.73m.
4. Provide two rows of 19 dia. x 90 min. long shear studs at 300 max. centres welded to top flange of steel beams.
5. All steel beam to steel beam connections to have full height stiffeners and web side cleat, UNO.

RC Slab on Metal Deck Notes:

On plan ——→ denotes direction of metal deck sheeting
Condeck HP 1.00mm BMT / KingFlor KF57 1.00mm BMT with ribs and not dovetail (lost formwork)
Metal Deck or approved equivalent unless noted otherwise

P1	SZ250-19 purlins at 1200c/c continuous, lapped, spanning east-west with 1 row of bridging per span, for 8.2m maximum span. 8.8 grade purlin bolts. An additional purlin is to be placed at a maximum of 300mm from all gutter purlins. Provide fly bracing at 2400 maximum centres to North-South beams - For details refer to drawing SE-ARP-DRG-000983
P2	Z200-15 purlins at 1200c/c continuous, lapped, spanning east-west with 2 rows of bridging for 8.2m maximum span
P3	SZ200-19 purlins at 1200c/c continuous, lapped, double spanning east-west with 1 row of bridging per span.
P4	SZ300-30 purlins at 1200c/c single spanning east-west
P5	C250-19 purlins at 600c/c single spanning with 1 row of bridging midspan
P6	C200-19 purlins at 600c/c, with 1 row of bridging per span, 8.8 grade purlin bolts

General Notes:
- Secondary Structure and steelwork to be hung off primary steel provided and designed by others, not shown, typical.
- Skylight beam sizes assume that no additional load from the mechanical ducts.
- (R) denotes beam rotated 90 degrees (for Gucci Riser only).
- Where columns are vertically slotted, typical base plate (BP5) can be used UNO

Commercial Roof Legend:

BP1 - Denotes Northern Facade Hob Base Plate Detail
BP2 - Denotes Eastern Facade Hob Base Plate Detail
BP3 - Denotes Eastern Base Plate Details
BP4 - Denotes Southern Facade Hob Detail
BP5 - Denotes Pinned Base Plate Detail
BP6 - Refer to base plate detail on drawing SE-ARP-DRG-101358
HS - Denotes Horizontal Slotted Holes Required at One End of RHS Facade Beam
NB - Denotes Purlins Not to Apply Dead Load to Roof Beam

Typical Base Plate detail shown on SE-ARP-DRG-101351. Base Plate details for BP1 to BP6 are shown on SE-ARP-DRG-101358 and 101359.

For all roof mounted fans on commercial roof refer to detail on SE-ARP-DRG-101363.

Indicates extent of Mezzanine platform above. Webforge C205MPU (or similar lightweight) metal mesh deck - maximum span 1400mm on 205BT26.9 beams equally spaced at 1400 maximum centres (point load from plant equipment of 5 kN at maximum 1400 centres) Additional 205BT26.9 beams may be required directly underneath the ahu point loads. Refer to details on SE-ARP-DRG-101355 for platform steelwork details.

Indicates an inline fan support upstand. Refer to detail on SE-ARP-DRG-101363
Note that all inline fan SHS column stubs are to be fire rated in accordance with fire engineers report.

Indicates Box Gutter. Additional purlin to be provided for box gutter. Refer to gutter purlin detail on SE-ARP-DRG-101358

Building Joint Legend

- Construction Joint
- New Movement Joint
- Existing Movement Joint

NOTE:
Existing movement joints derived from historical drawings and may not reflect the as built conditions. Subject to variation on site.

All drawings are to be printed **IN COLOUR**

Note (Existing Structure):

The existing structure shown has been derived from documentation of past developments and may not reflect the as-built condition. The information should be regarded as indicative and is provided to inform the design process. Where affected by the new development, the existing condition of structure should be confirmed by survey prior to any demolition or construction works.

Legend:

- Denotes Existing Structure to be demolished
- Denotes Existing Structure to be retained
- Denotes New Infill Slab

Reference Drawings:

1. For General Notes Refer to drawing SE-ARP-DRG-000011
2. For Reinforcement Tables Refer to drawing SE-ARP-DRG-000021
3. For Coating Notes Refer to drawings SE-ARP-DRG-000031 & 000032
4. For Piling Notes Refer to drawing SE-ARP-DRG-000041
5. For Loading Plans, Refer to drawings SE-ARP-DRG-001001 to 001007
6. For Typical Details Refer to drawing SE-ARP-DRG-000900 series

Legend:

A3C1	Denotes Zone A3 - New RC Column
A3C1 Type Sx	Denotes Zone A3 - Existing RC Column that requires strengthening Type Sx
TBP	Top Bonded Plate
BBP	Bottom Bonded Plate
<20>	Denotes +20mm precamber at midspan of beam
(VS)	Denotes Vertical Slotted Holes required in connection
(FR)	Denotes that Roof Beam Only provides lateral restraint to facade. Facade must be dead loaded down
(TF)	Denotes TF Bolts to be used at connections
(COS)	Check / Survey on Site
	Denotes Moment Connection
	Denotes Full Moment Splice Connection
	Denotes Steelwork that requires Fire Protection in Accordance with the Fire Engineers report

Note:
1. For Column Strengthening Details Refer to drg's SE-ARP-DRG-000945 to 000950
2. All strengthening elements (with the exception of carbon fibre strips) to be fire protected i.e. steel beams, steel brackets and steel plates.
3. For Column Schedules Refer to drawing SE-ARP-DRG-359000 series

For strengthening steel beams added under existing slabs, the top of the new steel beam level typically follows the soffit level of the existing concrete beams in order for new steel beams to run unobstructed under the existing concrete beams and to connect to existing columns.
Allow for additional piggyback steel beams 180UB22 to run along the length of new steel beams added under existing slab to infill the gap between the soffit of existing slab and the top of new steel beam.
(PB) on plan indicates piggyback steel beam.
(CR) on plan indicates cranking steel beam.

Only penetrations shown on the structural drawings are approved

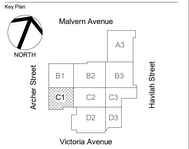
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4	03/09/24	Construction Issue
3	06/08/24	Construction Issue
2	04/07/24	Construction Issue
1	15/05/24	Construction Issue
G	19/04/24	For Approval
F	25/03/24	For Information
E	21/03/24	For Information - Work in Progress
D	26/02/24	For Construction Certificate
C	28/04/23	70% Design Development
B	02/12/22	Schematic Design Issue
A	18/11/22	Draft Schematic Design

0 1 2 3 4 5 m (1:100 @ A0)

ARUP
Barrack Place, Level 5, 151 Clarence Street
Sydney NSW 2000 Australia
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Fax +61 (0)2 9320 9321
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Client
Vicinity Centres

Project Title
Chatswood Chase Sydney
345 Victoria Avenue
Chatswood NSW 2067

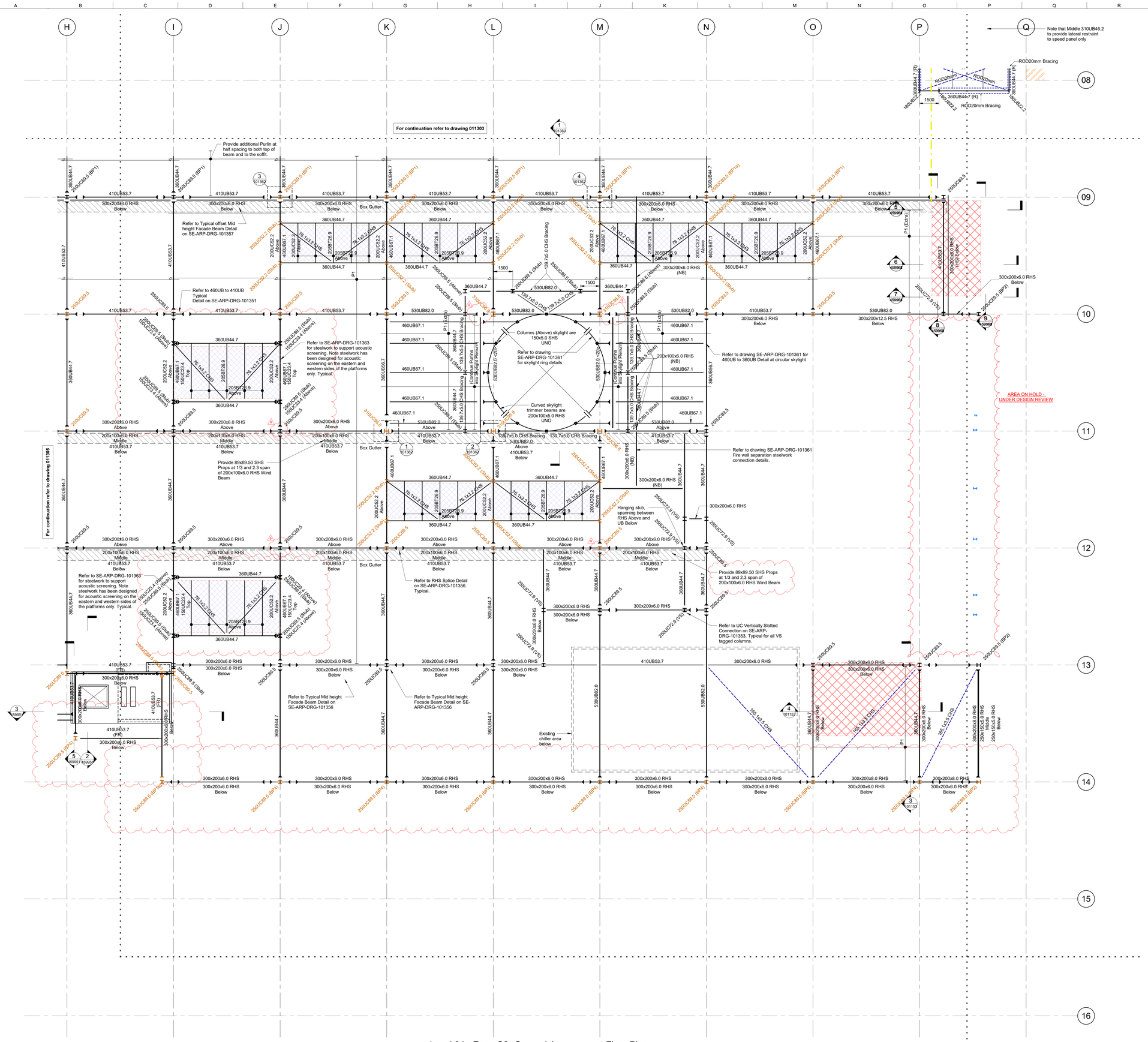
Key Plan


Drawing Title
Level 04 Zone C1 General Arrangement Floor Plan

Scale at A0	1 : 100
By / Chkd / Appd	WJN/JKM/F
Role	Structural
Suitability	For Construction
Arup Job No	254810
Rev	9
Drawing Number	SE-ARP-DRG-011305

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Level 04 - Zone C2 -General Arrangement Floor Plan

Scale 1 : 100

Do not scale

Notes:

1. On plan 200 denotes slab thickness other than typical
2. Concrete Strength to be f'c=40 MPa unless noted otherwise
3. All concrete folds to be 300mm wide unless noted otherwise
4. Kerbs / Plinths / Hobs are not included in size of Structural elements U.N.O.
5. For sizes and locations of Kerbs / Plinths / Hobs refer to Architects concrete set-out drawings
6. For details of falls in slab refer to Architects and Hydraulic Engineers drawings
7. For details of Rebates, Cast-In angles and Covers to access Hatches, Sumps, Pits, Drains and Floor Wastes etc. refer to Architects and Hydraulic Engineers drawings
8. Any additional topping not shown on Structural drawings, must be approved by Structural Engineer
9. Maintain a 300mm min. clear Structural width between Slab Penetrations U.N.O.
10. All Door Openings and Services Penetrations are Not shown on drawings refer to Architects wall elevations for details
11. All Existing Structures, Services and Utilities are to be located by the Contractor prior to Construction
12. Refer to Existing Structural Documents for details of existing structure
13. Refer to Wall Elevations for stitching requirements between new shear walls and existing structure (typical)

Suspended Slab (New) Notes:

1. All concrete folds to be 1200mm wide unless noted otherwise
2. Concrete Strength to be f'c=40 MPa unless noted otherwise
3. All beams under ramps to have sloped soffits Typical unless noted otherwise

Typical Concrete Repair Note:

Make good at the exposed face, and protect the exposed reinforcement within 24hrs of cutting.
Locally cut back exposed reinforcement 20mm Below surface.
Prime reinforcement with Nitoprime Zinc-Rich and allow to dry.
Apply Nitobond HAR Primer then reinstate with Renderoc HB40 and matching concrete grade or approved equivalent standard munufacturer's procedures apply.

PT to be designed by specialist trade subcontractor. Minimum service stress to achieve 1.6 MPa for undercover slabs and 2.2 MPa for exposed slabs.

Water proofing by others

Steelwork Notes:

1. When Steelwork is to be installed within an existing structure, site measure prior to fabrication of steelwork.
2. All steelwork to achieve 120/-/- fire rating provided by vermiculite wet spray or approved alternative when hidden from view, hidden from weathering and when permitted by Architect. When exposed to view, or exposed to weathering or when required by Architect for aesthetics or for head room, epoxy intumescent is to be provided to steel work. If offsite application is adopted, consideration of damage resistance is to be undertaken. Exception is lightweight steel roof members including steel columns, where they do not require fire protection unless denoted clearly on plans in colour as per legend.
3. For composite metal deck slab, provide 120thk slab on Condeck HP 1.00mm BMT metal deck sheeting in new slab zones typ. UNO. Provide 150thk slab on KingFlor KF57 1.00mm BMT metal deck sheeting in new landscaped/outdoor slab zones typ. UNO. Unpropped construction satisfies slab deflection L/150 for continuous metal deck span where the secondary beams are spaced at 2.73m centres. Allow for propping to metal decking where secondary beam spacing exceeds 2.73m.
4. Provide two rows of 19 dia. x 90 min. long shear studs at 300 max. centres welded to top flange of steel beams.
5. All steel beam to steel beam connections to have full height stiffeners and web side cleat, UNO.

RC Slab on Metal Deck Notes:

On plan ——— denotes direction of metal deck sheeting
Condeck HP 1.00mm BMT / KingFlor KF57 1.00mm BMT with ribs and not dovetail (lost formwork)
Metal Deck or approved equivalent unless noted otherwise

P1	SZ250-19 purlins at 1200c/c continuous, lapped, spanning east-west with 1 row of bridging per span, for 8.2m maximum span. 8.8 grade purlin bolts. An additional purlin is to be placed at a maximum of 300mm from all gutter purlins. Provide by bracing at 2400 maximum centres to North-South beams - For details refer to drawing SE-ARP-DRG-000983
P2	Z200-15 purlins at 1200c/c continuous, lapped, spanning east-west with 2 rows of bridging for 8.2m maximum span
P3	SZ200-19 purlins at 1200c/c continuous, lapped, double spanning east-west with 1 row of bridging per span.
P4	SZ300-30 purlins at 1200c/c single spanning east-west
P5	C250-19 purlins at 600c/c single spanning with 1 row of bridging midspan
P6	C200-19 purlins at 600c/c, with 1 row of bridging per span, 8.8 grade purlin bolts

General Notes:
- Secondary Structure and steelwork to be hung off primary steel provided and designed by others, not shown, typical.
- Skylight beam sizes assume that no additional load from the mechanical ducts.
- (R) denotes beam rotated 90 degrees (for Gucci Riser only).
- Where columns are vertically slotted, typical base plate (BP5) can be used UNO

Note:
This drawing is to be read in conjunction with the sections and details drawings SE-ARP-DRG-101351 to 101360

Allow for 35kg/m secondary steelwork to support façade elements surrounding the steel roofs.

Commercial Roof Legend:

BP1 - Denotes Northern Facade Hob Base Plate Detail
BP2 - Denotes Eastern Facade Hob Base Plate Detail
BP3 - Denotes Eastern Base Plate Details
BP4 - Denotes Southern Facade Hob Detail
BP5 - Denotes Pinned Base Plate Detail
BP6 - Refer to base plate detail on drawing SE-ARP-DRG-101358
HS - Denotes Horizontal Slotted Holes Required at One End of RHS Facade Beam
NB - Denotes Purlins Not to Apply Dead Load to Roof Beam

Typical Base Plate detail shown on SE-ARP-DRG-101351. Base Plate details for BP1 to BP6 are shown on SE-ARP-DRG-101358 and 101359.

For all roof mounted fans on commercial roof refer to detail on SE-ARP-DRG-101363.

Indicates extent of Mezzanine platform above. Webforge C205MPU (or similar lightweight) metal mesh deck - maximum span 1400mm on 205BT26.9 beams equally spaced at 1400 maximum centres (point load from plant equipment of 5 kN at maximum 1400 centres) Additional 205BT26.9 beams may be required directly underneath the ahu point loads. Refer to details on SE-ARP-DRG-101355 for platform steelwork details.

Indicates an inline fan support upstand. Refer to detail on SE-ARP-DRG-101363
Note that all inline fan SHS column stubs are to be fire rated in accordance with fire engineers report.

Indicates Box Gutter. Additional purlin to be provided for box gutter. Refer to gutter purlin detail on SE-ARP-DRG-101358

Building Joint Legend

Construction Joint
New Movement Joint
Existing Movement Joint

NOTE:
Existing movement joints derived from historical drawings and may not reflect the as built conditions. Subject to variation on site.

All drawings are to be printed **IN COLOUR**

Note (Existing Structure):

The existing structure shown has been derived from documentation of past developments and may not reflect the as-built condition. The information should be regarded as indicative and is provided to inform the design process. Where affected by the new development, the existing condition of structure should be confirmed by survey prior to any demolition or construction works.

Legend:

Denotes Existing Structure to be demolished
Denotes Existing Structure to be retained
Denotes New Infill Slab

Reference Drawings:

1. For General Notes Refer to drawing SE-ARP-DRG-000011
2. For Reinforcement Tables Refer to drawing SE-ARP-DRG-000021
3. For Coating Notes Refer to drawings SE-ARP-DRG-000031 & 000032
4. For Piling Notes Refer to drawing SE-ARP-DRG-000041
5. For Loading Plans, Refer to drawings SE-ARP-DRG-001001 to 001007
6. For Typical Details Refer to drawing SE-ARP-DRG-000900 series

Legend:

A3C1	Denotes Zone A3 - New RC Column
A3C1 Type Sx	Denotes Zone A3 - Existing RC Column that requires strengthening Type Sx
TBP	Top Bonded Plate
BBP	Bottom Bonded Plate
<20>	Denotes +20mm precamber at midspan of beam
(VS)	Denotes Vertical Slotted Holes required in connection
(FR)	Denotes that Roof Beam Only provides lateral restraint to facade. Facade must be dead loaded down
(TF)	Denotes TF Bolts to be used at connections
(COS)	Check / Survey on Site
	Denotes Moment Connection
	Denotes Full Moment Splice Connection
	Denotes Steelwork that requires Fire Protection in accordance with the Fire Engineers report

Note:
1. For Column Strengthening Details Refer to drgs SE-ARP-DRG-000945 to 000950
2. All strengthening elements (with the exception of carbon fibre strips) to be fire protected i.e. steel beams, steel brackets and steel plates.
3. For Column Schedules Refer to drawing SE-ARP-DRG-359000 series

For strengthening steel beams added under existing slabs, the top of the new steel beam level typically follows the soffit level of the existing concrete beams in order for new steel beams to run unobstructed under the existing concrete beams and to connect to existing columns.
Allow for additional piggyback steel beams 180UB22 to run along the length of new steel beams added under existing slab to infill the gap between the soffit of existing slab and the top of new steel beam.
(PB) on plan indicates piggyback steel beam.
(CR) on plan indicates cranking steel beam.

Only penetrations shown on the structural drawings are approved

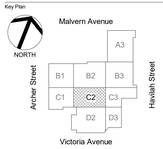
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3	06/09/24	Construction Issue
2	04/07/24	Construction Issue
1	15/05/24	Construction Issue
G	19/04/24	For Approval
F	25/03/24	For Information
E	21/03/24	For Information - Work in Progress
D	26/02/24	For Construction Certificate
C	28/04/23	70% Design Development
B	02/12/22	Schematic Design Issue
A	18/11/22	Draft Schematic Design

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Barrack Place, Level 5, 151 Clarence Street
Sydney NSW 2000 Australia
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Fax +61 (0)2 9320 9321
www.arup.com

Client
Vicinity Centres

Project Title
Chatswood Chase Sydney
345 Victoria Avenue
Chatswood NSW 2067

Key Plan


Drawing Title
Level 04 Zone C2 General Arrangement Floor Plan

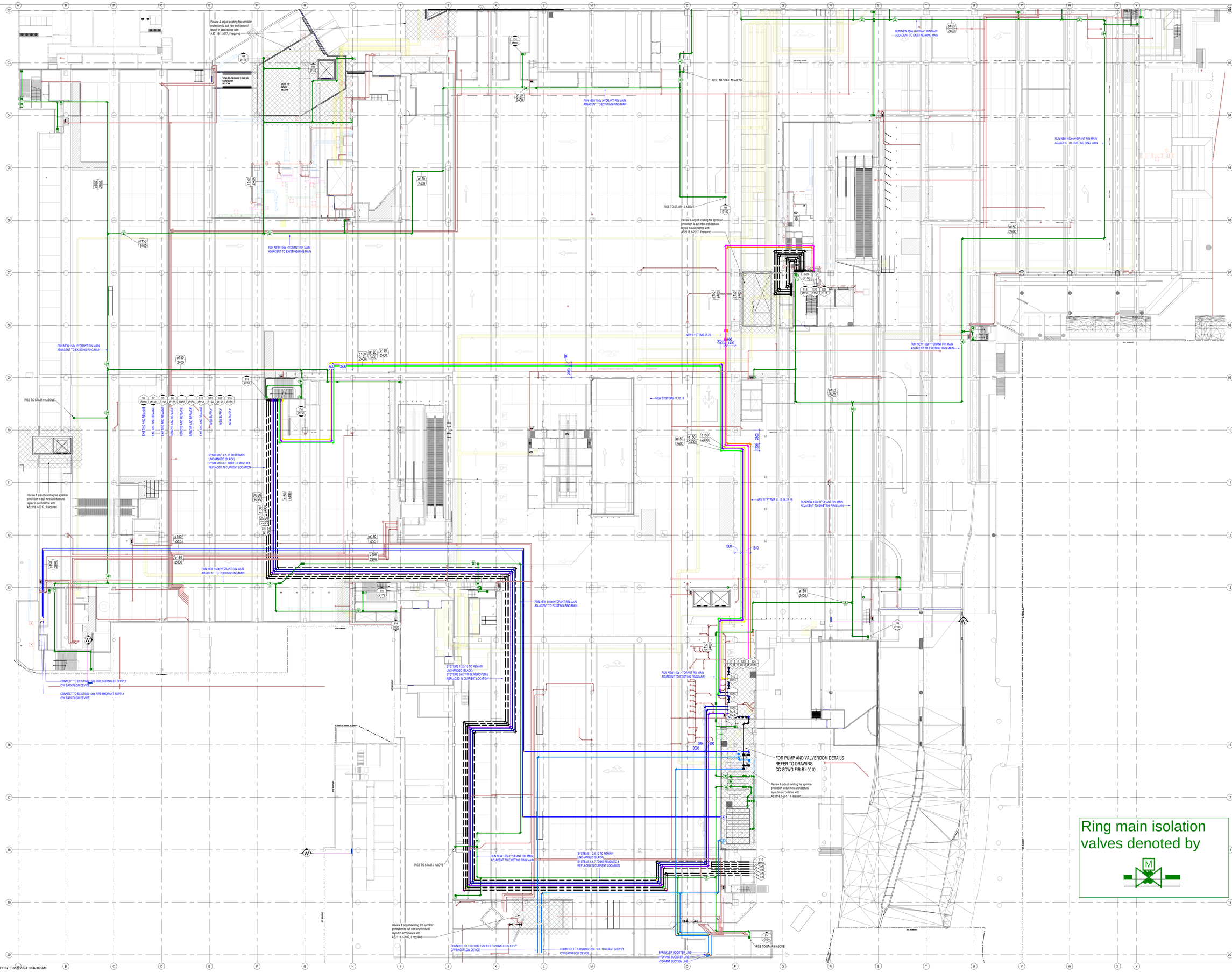
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By / Chkd / Appd	WJN/JMJMF
Role	Structural
Suitability	For Construction
Arup Job No	254810
Rev	9
Drawing Number	SE-ARP-DRG-011306

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Appendix K Location of hydrant ring main isolation valves

See next page.



ISSUE QUALITY CONTROL	
S	REV
ARCHITECTURAL 1	
ARCHITECTURAL 2	
ARCHITECTURAL 3	
STRUCTURAL	
HYDRAULIC	
ELECTRICAL/COMMS	
FIRE	
MEDICAL GAS	
PNEUMATIC TUBE	

APP PM DATE

Approver

DSGN CHECK DATE

Checker

ISSUE	REV	DATE	REVISION DESCRIPTION	DRAWN
1		25/01/24	FOR APPROVAL	PRH
A		6/5/24	ISSUE FOR CONSTRUCTION	

LEGEND

Symbol	Description
	EXPOSED SPRINKLER HEAD 15mm BRASS PENDANT 68C FAST RESPONSE
	UPRIGHT EXPOSED SPRINKLER 15mm BRASS UPRIGHT 68C FAST RESPONSE
	EXPOSED SPRINKLER HEAD UNDER DUCT 15mm BRASS PENDANT 68C FAST RESPONSE
	BELOW CEILING SPRINKLER HEAD 15mm WHITE PENDANT 68C FAST RESPONSE WITH 2 PCE PLATE
	FLUSH MOUNT BELOW CEILING SPRINKLER HEAD 15mm WHITE PENDANT 68C FAST RESPONSE
HT	141°C SPRINKLER IN LIFT PIT 15mm BRASS PENDANT 141C FAST RESPONSE
E	'E' DENOTES EXTENDED COVERAGE SPRINKLER
	CONCEALED SPACE SPRINKLER 15mm BRASS PENDANT 68C FAST RESPONSE
	SIDEWALL SPRINKLER HEAD 15mm BRASS HORIZONTAL SW 68C FAST RESPONSE
	HYDRANT MAINS ZONE 1
	HYDRANT MAINS ZONE 2
	HYDRANT MAINS ZONE 3
	DRAIN/TEST LINE

DESIGN CRITERIA

DESIGN CODE : AS2118.1 2017
CATEGORY : ORDINARY HAZARD GROUP 2
DESIGN DENSITY : 5.0mm/min
AREA OPERATION : 12 SPRINKLERS
MINIMUM PRESSURE : 70 kPa
K FACTOR : 8.0
OTHER : CARPARK AREAS

INSTALLATION CONTRACTOR

Innovative Fire Services Pty Ltd
Clemton Business Park
Unit 13, 20-22 St Albans Road
Kingsgrove NSW 2208

CLIENT

VICINITY CENTRES

PROJECT

CHATSWOOD CHASE SHOPPING CENTRE

INNOVATIVE PROJECT NUMBER

TRUE NORTH PROJECT NORTH

SCALE	DRAWN	DATE
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STATUS

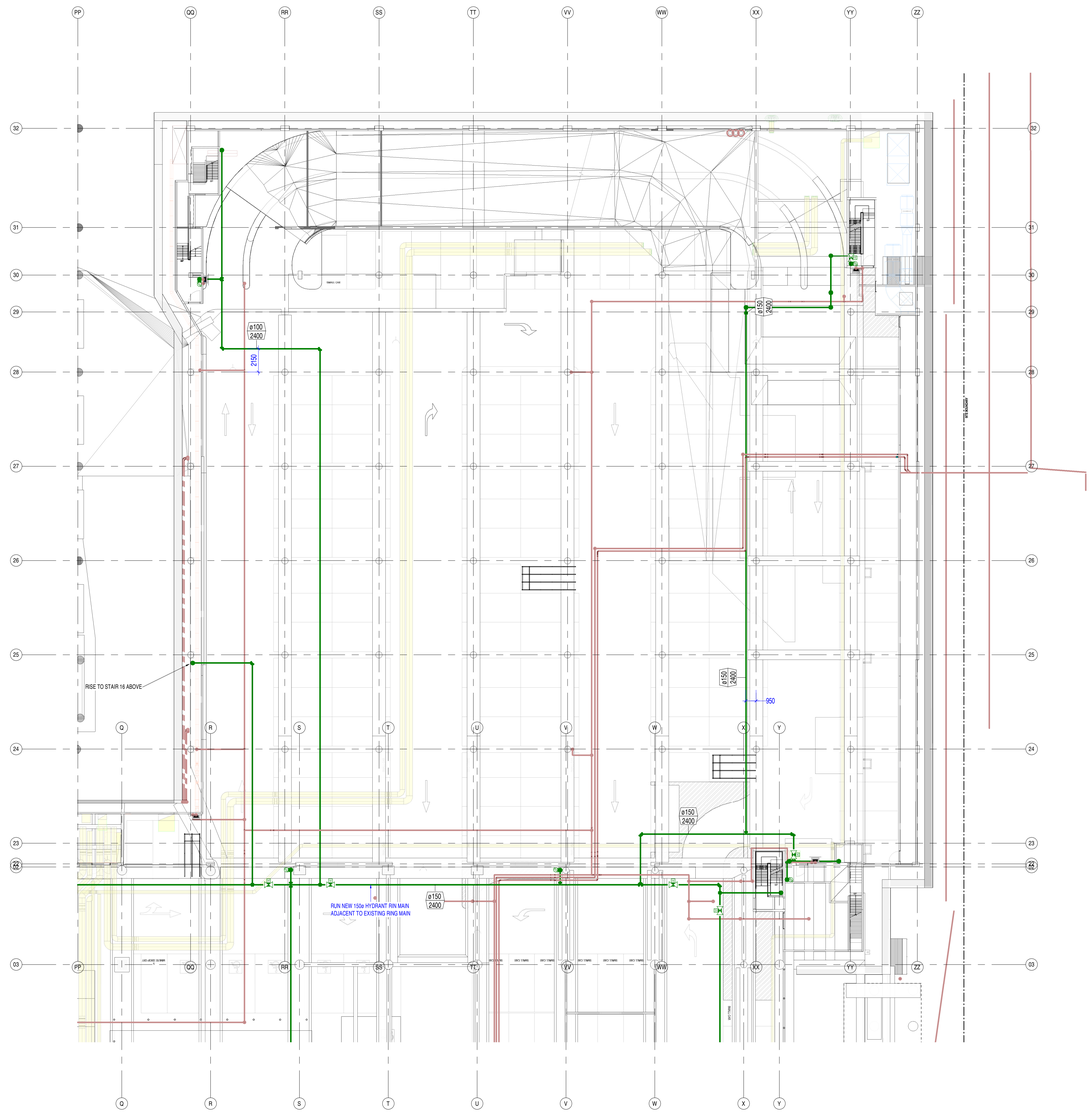
ISSUE FOR CONSTRUCTION

DRAWING

Fire Sprinkler System

BASEMENT 01 PART 1 SPRINKLER & HYDRANT PLAN

DRAWING NUMBER	ISSUE
CC-SDWG-FIR- B1-0001	A



Ring main isolation valves denoted by

M

INDEX SHEET				
QUALITY CONTROL				
S		L		REV
ARCHITECTURAL 1				
ARCHITECTURAL 2				
ARCHITECTURAL 3				
STRUCTURAL				
HYDRAULIC				
ELECTRICAL/COMMS				
FIRE				
MEDICAL GAS				
PNEUMATIC TUBE				

APP.PM DATE

Approver

DSGN CHECK DATE

Checker

ISSUE	REV	DATE	REVISION DESCRIPTION	DRAWN
1		25/01/24	FOR APPROVAL	PMH
A		6/5/24	ISSUE FOR CONSTRUCTION	

LEGEND

Symbol	Description
○	EXPOSED SPRINKLER HEAD 15mm BRASS PENDANT 68C FAST RESPONSE
⌀	UPRIGHT EXPOSED SPRINKLER 15mm BRASS UPRIGHT 68C FAST RESPONSE
⊠	EXPOSED SPRINKLER HEAD UNDER DUCT 15mm BRASS PENDANT 68C FAST RESPONSE
◉	BELOW CEILING SPRINKLER HEAD 15mm WHITE PENDANT 68C FAST RESPONSE WITH 2 PCE PLATE
f ◉	FLUSH MOUNT BELOW CEILING SPRINKLER HEAD 15mm WHITE PENDANT 68C FAST RESPONSE
HT ○	141°C SPRINKLER IN LIFT PIT 15mm BRASS PENDANT 141C FAST RESPONSE
E	'E' DENOTES EXTENDED COVERAGE SPRINKLER
●	CONCEALED SPACE SPRINKLER 15mm BRASS PENDANT 68C FAST RESPONSE
▷	SIDEWALL SPRINKLER HEAD 15mm BRASS HORIZONTAL S/W 68C FAST RESPONSE
	HYDRANT MAINS ZONE 1
	HYDRANT MAINS ZONE 2
	HYDRANT MAINS ZONE 3
	DRAIN/TEST LINE

DESIGN CRITERIA

DESIGN CODE : AS2118.1 2017
CATEGORY : ORDINARY HAZARD GROUP 2
DESIGN DENSITY : 5.0mm/min
AREA OPERATION : 12 SPRINKLERS
MINIMUM PRESSURE : 70 kPa
K FACTOR : 8.0
OTHER : CARPARK AREAS

INSTALLATION CONTRACTOR

innovative fire services

Innovative Fire Services Pty Ltd
Clempton Business Park
Unit 13, 20-22 St Albans Road
Kingsgrove NSW 2208

CLIENT

VICINITY CENTRES

PROJECT

CHATSWOOD CHASE SHOPPING CENTRE

INNOVATIVE PROJECT NUMBER

TRUE NORTH PROJECT NORTH

SCALE	DRAWN	DATE
1 : 200 @B1	Author	02/19/24

STATUS

ISSUE FOR CONSTRUCTION

DRAWING

Fire Sprinkler System

BASEMENT 01 PART 2 SPRINKLER & HYDRANT PLAN

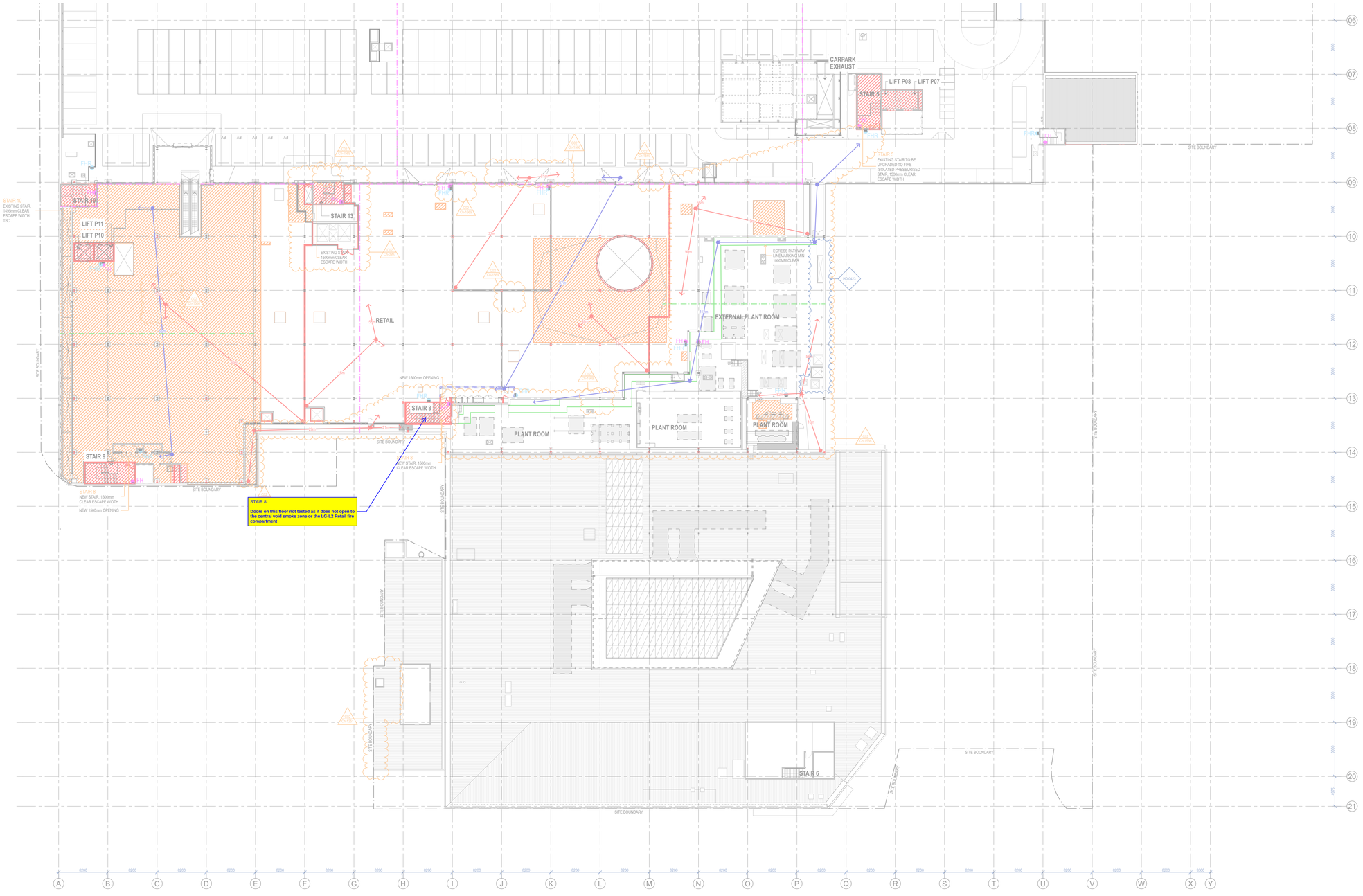
DRAWING NUMBER	ISSUE
CC-SDWG-FIR- B1-0002	A

Appendix L Stair pressurisation airflow paths

See next page.

LEVEL 3

CONTINUES ON 501101



FIRE SEPARATION LEGEND:

- 2 HOUR FIRE RATED SHAFTS, STAIR SHAFTS, LIFT SHAFTS AND FIRE CORRIDORS
- 2 HOUR FIRE RATED FLOOR SLAB
- NON COMBUSTIBLE ROOF
- 60 MINUTE FIRE SEPARATION
- 90 MINUTE FIRE SEPARATION
- 120 MINUTE FIRE SEPARATION
- 180 MINUTE FIRE SEPARATION
- 240 MINUTE FIRE SEPARATION
- EXISTING RISER WALLS FOR NEW WORK AREAS (LG0 - LG04) - REQUIRES 2 HOUR FIRE RATED - TO BE CHECKED & CONFIRMED FOR COMPLIANCES

FIRE COMPARTMENTATION LEGEND:

- RISER VOID
- CLASS 7a FIRE COMPARTMENT
- SUBSTATION COMPARTMENT
- CLASS 6 RETAIL COMPARTMENT
- CLASS 5 OFFICE COMPARTMENT
- FHR — FIRE HOSE REEL
- FH — FIRE HYDRANT
- SMOKE PROOF WALL
- SMOKE PROOF SHOPFRONT
- SMOKE BAFFLES TO U/S OF FLOOR SLAB
- SMOKE BAFFLES DTS OF THE NCC
- SMOKE COMPARTMENTATION WALLS TO U/S OF FLOOR SLAB.
- EXISTING 120 MINUTE FIRE RATED WALL
- EXISTING SMOKE WALL
- EXISTING MOVEMENT JOINT
- MAKEUP AIR LOUVRES

NOTE:
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ALL DOORS TO FIRE EGRESS STAIRS REQUIRE -/60/30 FRL, ALL OTHER DOORS REQUIRE THE SAME FIRE RATING AS THE WALL ADJACENT.

ALL DOORS AND WALLS TO ELECTRICAL AND COMMS CUPBOARDS TO BE NON-COMBUSTIBLE SMOKE SEALED DOORS. ALL PENETRATION WITHIN ELECTRICAL CUPBOARD TO BE FIRE SEALED AT SLAB LEVEL.

ALL PENETRATIONS THROUGH FIRE RATED FLOOR SLABS AND WALLS TO BE FIRE SEALED.

ALL HYDRAULIC PIPES THROUGH FLOOR SLABS TO BE INSTALLED WITH FIRE STOP COLLARS UNLESS WITHIN A BLOCKOUT WHERE THE WALLS ARE FIRE RATED.

ALL MECHANICAL DUCTWORK THROUGH WALLS AND LOUVRES WITHIN WALL TO BE INSTALLED WITH FIRE DAMPERS TO MECHANICAL ENGINEERS DETAIL.

ALL EXISTING FIRE RATED WALLS TO BE CONFIRMED BY THE HEAD CONTRACTOR FOR STRUCTURAL ADEQUACY, INTEGRITY AND INSULATION.

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KEY NORTH



ZONE PLAN NUMBERING CONVENTION

LEVEL CODE	(YY)
GENERAL	00
BASEMENT 2	01
BASEMENT 1	02
LOWER GROUND	03
LOWER GROUND A	04
LEVEL 00	05
LEVEL 00A	06
LEVEL 01	07
LEVEL 01A	08
LEVEL 02	09
LEVEL 02A	10
LEVEL 03	11
LEVEL 03A	12
LEVEL 04	13
ROOF	14

PACKAGE CODE	(X)
EARLY WORKS	0
FLOOR PLANS	1
PARTITION PLANS	2
CONCRETE	3
CEILINGS	4
OTHER PLANS	5
ELEVS & SECTNS	6
DETAILS	7
PACKAGES	8
SCHEDULES	9

ZONE CODE	
GENRL	00
A1	
B1	
B2	
B3	
C1	
C2	
C3	
D2	
D3	

DRAWING No.
LEVEL CODE — UNIQUE ID
XX YY ZZ
PACKAGE

ON-HOLD REGISTER
HD.XXXX
REFER TO EA-WEA-BOH-00-000001 FOR FURTHER INFO/DETAILS

ISSUE TITLE
ISSUED FOR CONSTRUCTION - DRAWING UPDATES

REV	CHNG	DESCRIPTION	DATE
	Ch-1569	FHR / FH REMOVED / RELOCATED	
	Ch-1566	FIRE TRAVEL DISTANCES UPDATED / ADDED	
C02	Ch-1251	EXISTING CONDITIONS UPDATED AS PER SURVEYED INFORMATION	15/1/2025
	Ch-0907	MECH / PLANT ROOM ACCESS UPDATED	
	Ch-0929	EXISTING MOVEMENT JOINT ADDED	
	Ch-0951	LAYOUT UPDATED FOR LEVEL 3 DESCOPE	
C01	Ch-0340	LEGEND UPDATED	15/7/2024
	Ch-0334	NOTES ADJUSTED/ADDED	
P02	Ch-0103	MEANS OF EGRESS AND EGRESS DISTANCES INCORPORATED	9/10/2023
P01	Ch-07	TENDER PHASE 1 ISSUE	28/4/2023

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PROJECT
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345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

TITLE
FIRE RATING AND EGRESS PLAN - LEVEL 03 SOUTH

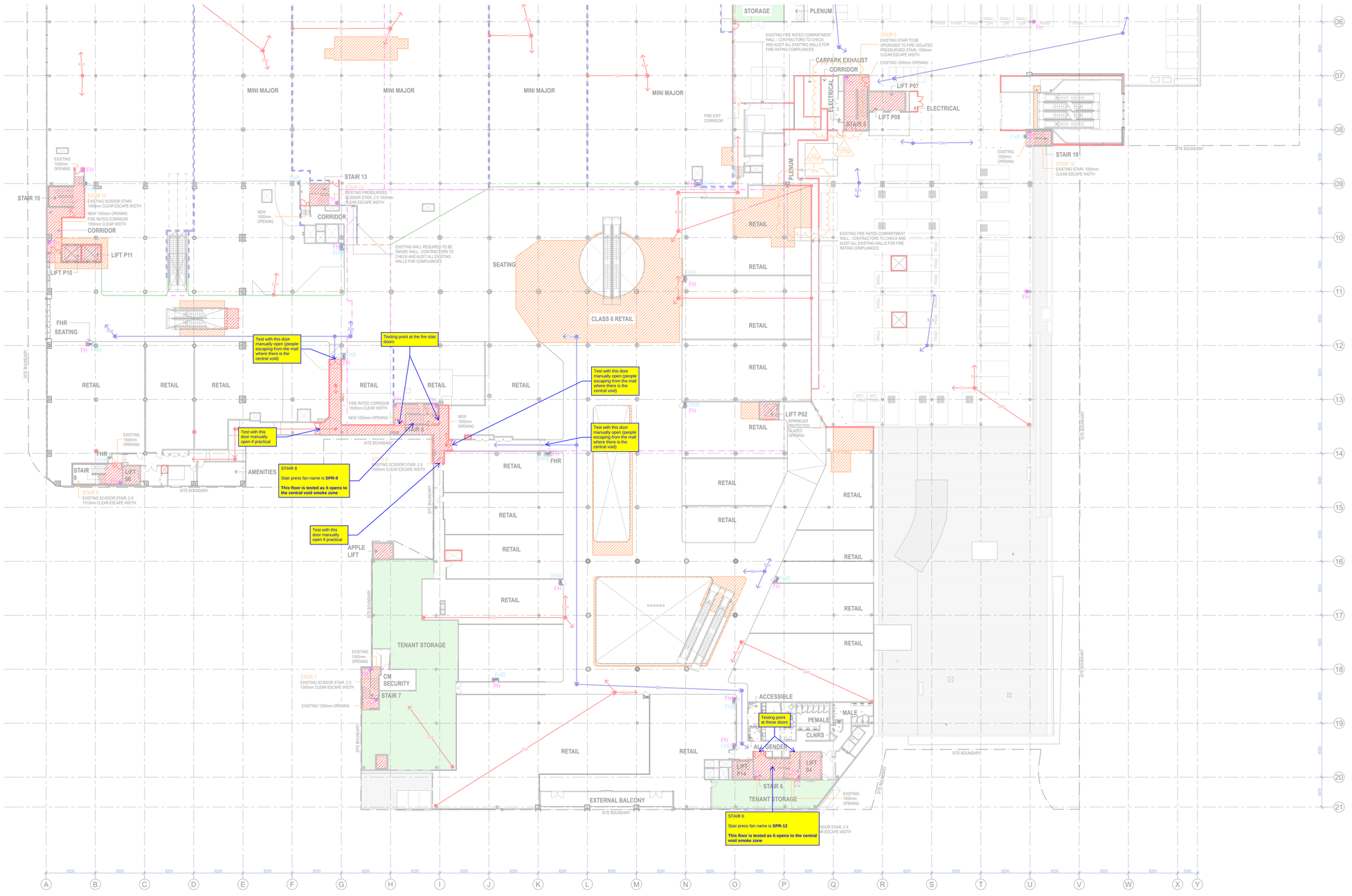
ISSUED STATUS
FOR CONSTRUCTION

PROJECT #	SCALE @ A0	AUTHORED	APPROVED	FIRST ISSUE
23300	1:250	WEB	PB	28/4/2023
ORIGINATOR	ROLE	ZONE	SHEET NO.	REVISION
WEA	EA	00	501102	C02

Date Printed: 16/1/2025

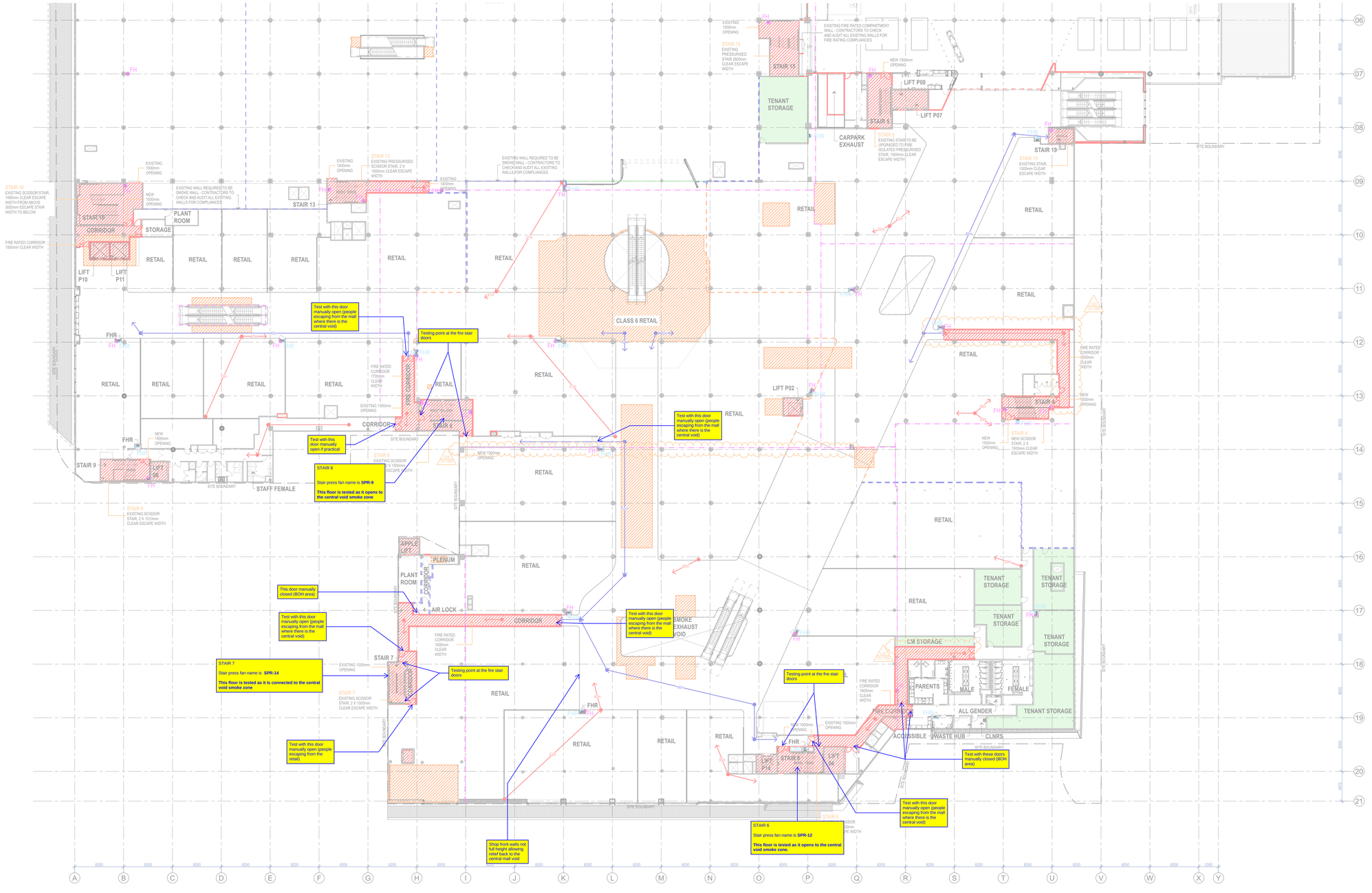
LEVEL 2

CONTINUES ON 500901


STORAGE
PLENUM
CARPARK EXHAUST
CORRIDOR
ELECTRICAL
LIFT P07
LIFT P08
STAIR 5
STAIR 19
MINI MAJOR
MINI MAJOR
MINI MAJOR
MINI MAJOR
STAIR 10
STAIR 13
CORRIDOR
LIFT P11
LIFT P10
SEATING
CLASS 6 RETAIL
RETAIL
RETAIL

LEVEL 1

CONTINUES ON 500701



FIRE SEPARATION LEGEND:

- 2 HOUR FIRE RATED SHAFTS, STAIR SHAFTS, LIFT SHAFTS AND FIRE CORRIDORS
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- NON COMBUSTIBLE ROOF
- 60 MINUTE FIRE SEPARATION
- 90 MINUTE FIRE SEPARATION
- 120 MINUTE FIRE SEPARATION
- 180 MINUTE FIRE SEPARATION
- 240 MINUTE FIRE SEPARATION
- EXISTING RISER WALLS FOR NEW WORK AREAS (LOD - LOD4) - REQUIRES 2 HOUR FIRE RATED - TO BE CHECKED & CONFIRMED FOR COMPLIANCES

FIRE COMPARTMENTATION LEGEND:

- RISER VOID
- CLASS 7a FIRE COMPARTMENT
- SUBSTATION COMPARTMENT
- CLASS 6 RETAIL COMPARTMENT
- CLASS 5 OFFICE COMPARTMENT
- FHR — FIRE HOSE REEL
- FH — FIRE HYDRANT
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- SMOKE PROOF SHOPFRONT
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- SMOKE BAFFLES DTS OF THE NCC
- SMOKE COMPARTMENTATION WALLS TO U/S OF FLOOR SLAB.
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- EXISTING SMOKE WALL
- EXISTING MOVEMENT JOINT
- MAKEUP AIR LOUVRES

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KEY NORTH



ZONE PLAN NUMBERING CONVENTION

LEVEL CODE	(YY)	PACKAGE CODE	(X)	ZONE_CODE
GENERAL	00	EARLY WORKS	0	GENRL_00
BASEMENT 2	01	FLOOR PLANS	1	A3
BASEMENT 1	02	PARTITION PLANS	2	B1
LOWER GROUND	03	CONCRETE	3	B2
LOWER GROUND A	04	CEILINGS	4	B3
LEVEL 00	05	OTHER PLANS	5	C1
LEVEL 00A	06	ELEVS & SECTNS	6	C2
LEVEL 01	07	DETAILS	7	C3
LEVEL 01A	08	PACKAGES	8	D2
LEVEL 02	09	SCHEDULES	9	D3
LEVEL 02A	10			
LEVEL 03	11			
LEVEL 03A	12			
LEVEL 04	13			
ROOF	14			

DRAWING No.
LEVEL CODE — UNIQUE ID
XX YY ZZ
PACKAGE

ON-HOLD REGISTER



REFER TO EA-WEA-BOH-00-000001 FOR FURTHER INFO/DETAILS

ISSUE TITLE
ISSUED FOR CONSTRUCTION - DRAWING UPDATE

C05	Ch-1389	COLUMNS, MOVEMENT JOINT, PARTITIONS ADJUSTED AS PER MPX-RFI-001857	19/12/2024
C04	Ch-1353	STAIR 19 L01 OPENING UPDATED AS PER MPX-SCOR-017378	8/11/2024
	Ch-1350	SMOKE PROOF WALL CORRECTED	
	Ch-1251	EXISTING CONDITIONS UPDATED AS PER SURVEYED INFORMATION	
	Ch-1167	DEMOLITION EXTENT UPDATED PER MPX-SCOR-013763	
	Ch-1062	DOOR TO 1-012 ADDED PER ACONEX MPX-SI-000466	
	Ch-0968	FIRE RATING UPDATED	
C03	Ch-0929	EXISTING MOVEMENT JOINT ADDED	18/7/2024
C02	Ch-0900	FHR AND HYDRANT ADDED	15/7/2024
	Ch-0899	FIRE RATING CORRECTED	
	Ch-0897	FHR RELOCATED	
C01	Ch-0734	FHR REMOVED FROM SHOPFRONT	3/6/2024
	Ch-0729	FHR ADDED	
	Ch-0675	AIRLOCK REMOVED	
	Ch-0629	WALLS UPDATED TO ACCOMODATE MSSB	
P05	HD-0209	2 X FHRs (1-023) TBC IF REQUIRED	19/4/2024
	Ch-0576	FIRE-RATED WALL ADDED/ADJUSTED	
	Ch-0565	DOOR UPDATED	
	Ch-0560	TENANCY LAYOUT UPDATED, IT WALLS ADDED / ADJUSTED	
	Ch-0544	STORAGE SPACE ADDED/ADJUSTED	
REV	CHNG	DESCRIPTION	DATE

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PROJECT
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345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

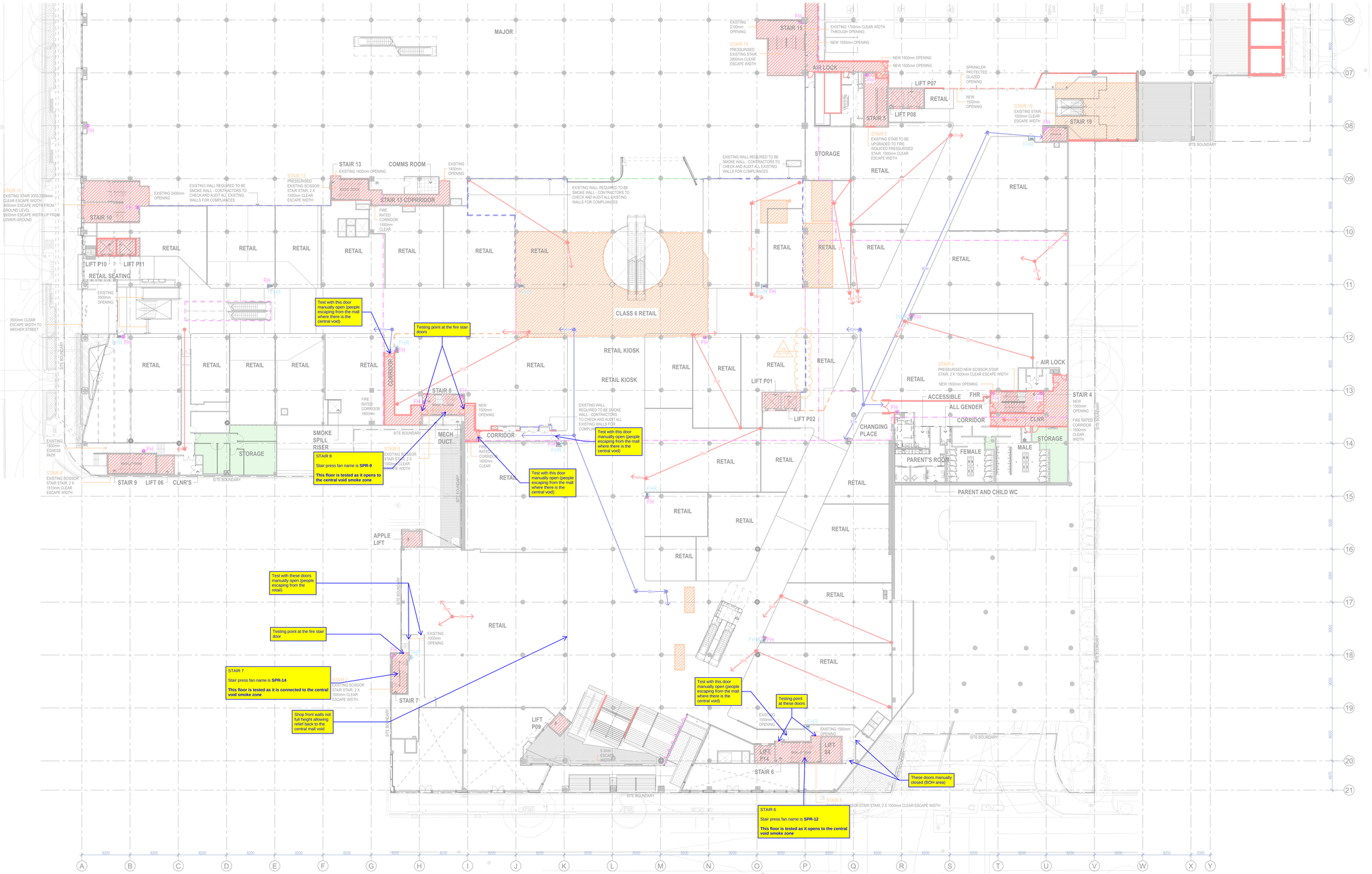
TITLE
FIRE RATING AND EGRESS PLAN - LEVEL 01 SOUTH

ISSUED STATUS				
FOR CONSTRUCTION				
PROJECT #	SCALE @ A0	AUTHORED	APPROVED	FIRST ISSUE
23300	1:250	WEB	PB	28/4/2023
ORIGINATOR	ROLE	ZONE	SHEET NO.	REVISION
WEA	EA	00	500702	C05

Date Printed: 19/12/2024

LEVEL 00

CONTINUES ON 500501



FIRE SEPARATION LEGEND:

- 2 HOUR FIRE RATED SHAFTS, STAIR SHAFTS, LIFT SHAFTS AND FIRE CORRIDORS
- 2 HOUR FIRE RATED FLOOR SLAB
- NON COMBUSTIBLE ROOF
- 60 MINUTE FIRE SEPARATION
- 90 MINUTE FIRE SEPARATION
- 120 MINUTE FIRE SEPARATION
- 180 MINUTE FIRE SEPARATION
- 240 MINUTE FIRE SEPARATION
- EXISTING RISER WALLS FOR NEW WORK AREAS (L00 - L02A) - REQUIRES 2 HOUR FIRE RATED - TO BE CHECKED & CONFIRMED FOR COMPLIANCES

FIRE COMPARTMENTATION LEGEND:

- RISER VOID
- CLASS 7a FIRE COMPARTMENT
- SUBSTATION COMPARTMENT
- CLASS 6 RETAIL COMPARTMENT
- CLASS 5 OFFICE COMPARTMENT
- FHR FIRE HOSE REEL
- FH FIRE HYDRANT
- SMOKE PROOF WALL
- SMOKE PROOF SHOPFRONT
- SMOKE BAFFLES TO U/S OF FLOOR SLAB
- SMOKE BAFFLES DTS OF THE NCC
- SMOKE COMPARTMENTATION WALLS TO U/S OF FLOOR SLAB.
- EXISTING 120 MINUTE FIRE RATED WALL
- EXISTING SMOKE WALL
- EXISTING MOVEMENT JOINT
- MAKEUP AIR LOUVRES

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KEY

NORTH



ZONE PLAN NUMBERING CONVENTION

LEVEL CODE	(YY)
GENERAL	00
BASEMENT 2	01
BASEMENT 1	02
LOWER GROUND	03
LOWER GROUND A	04
LEVEL 00	05
LEVEL 00A	06
LEVEL 01	07
LEVEL 01A	08
LEVEL 02	09
LEVEL 02A	10
LEVEL 03	11
LEVEL 03A	12
LEVEL 04	13
ROOF	14

PACKAGE CODE	(X)
EARLY WORKS	0
FLOOR PLANS	1
PARTITION PLANS	2
CONCRETE	3
CEILINGS	4
OTHER PLANS	5
ELEVS & SECTNS	6
DETAILS	7
PACKAGES	8
SCHEDULES	9

ZONE CODE	
GENRL	00
A1	
B1	
B2	
B3	
C1	
C2	
C3	
D2	
D3	

DRAWING No.

LEVEL CODE - UNIQUE ID

XX YY ZZ

PACKAGE

ON-HOLD REGISTER

HD-XXXX

REFER TO EA-WEA-SCH-00-000001 FOR FURTHER INFO/DETAILS

ISSUE TITLE

ISSUED FOR CONSTRUCTION - UPDATED DRAWINGS

REV	CHNG	DESCRIPTION	DATE
C06	Ch-1728	SMOKE BULKHEAD & WALLS ADJUSTED TO SUIT TENANCY RE-CARVE HCV233	19/2/2025
	Ch-1400	SMOKE PROOFING REMOVED	
C05	Ch-1367	L00 SMOKE BAFFLE REMOVED AS PER MPX-GCOR-017593	19/12/2024
	Ch-1262	GLAZED ENTRY SCREEN ALIGNING WALLS MOVED	
C04	Ch-1251	EXISTING CONDITIONS UPDATED AS PER SURVEYED INFORMATION	8/11/2024
	Ch-1214	HCV08MA L00 & L02 AMENITIES REPURPOSING & TENANCY UPDATE	
	Ch-1034	FHR CUPBOARD MOVED	
	Ch-0968	FIRE RATING UPDATED	
C03	Ch-0929	EXISTING MOVEMENT JOINT ADDED	18/7/2024
	Ch-0900	FHR AND HYDRANT ADDED	
C02	Ch-0899	FIRE RATING CORRECTED	15/7/2024
	Ch-0897	FHR RELOCATED	
	Ch-0815	ELECTRICAL CUPBOARD UPDATED	
	Ch-0672	FIRE ESCAPE DISTANCE ADJUSTED	
C01	Ch-0671	SMOKE WALL / SMOKEPROOF SHOPFRONT CORRECTED	3/6/2024
	Ch-0670	FHR DELETED	
	Ch-0636	SMOKE WALLS ADJUSTED	
	Ch-0626	RISER ADDED	
P05	Ch-0576	FIRE-RATED WALL ADDED/ADJUSTED	19/4/2024
	Ch-0575	SMOKE WALL ADJUSTED	

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PROJECT

CHATSWOOD CHASE
345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

TITLE

FIRE RATING AND EGRESS PLAN - LEVEL 00 SOUTH

ISSUED STATUS

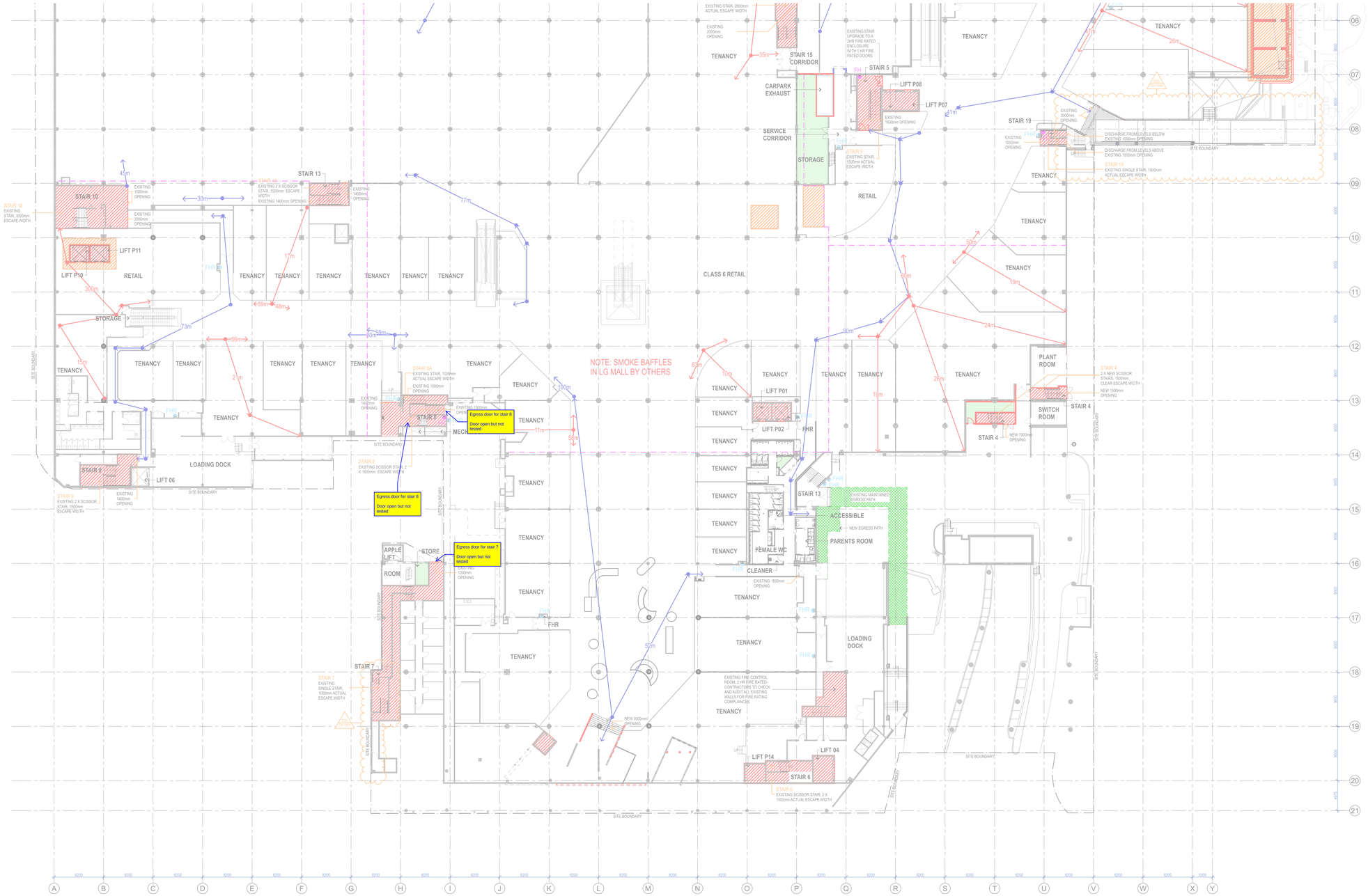
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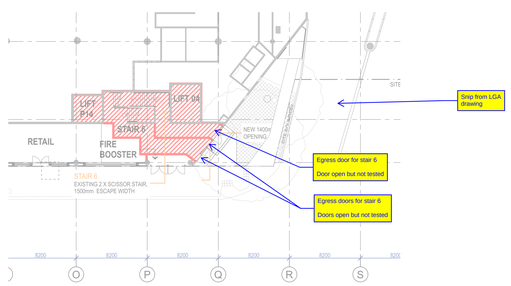
PROJECT #	SCALE @ A3	AUTHORED	APPROVED	FIRST ISSUE
23300	1:250	WEB	PB	28/4/2023
ORIGINATOR	ROLE	ZONE	SHEET NO.	REVISION
WEA	EA	00	500502	C06

Date Printed: 19/2/2025

LEVEL LG

CONTINUES ON 500301





FIRE SEPARATION LEGEND:

- 2 HOUR FIRE RATED SHAFTS, STAIR SHAFTS, LIFT SHAFTS AND FIRE CORRIDORS
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- EXISTING SMOKE WALL
- EXISTING MOVEMENT JOINT
- MAKEUP AIR LOUVRES

NOTE:
THIS DRAWING REPRESENTS MINIMUM FIRE SEPARATION REQUIREMENTS - FOR FRL OF STRUCTURAL LOAD BEARING ELEMENTS REFER TO STRUCTURAL ENGINEERS' DRAWINGS - FRL REQUIREMENTS MAY BE HIGHER THAN THE INDICATED SEPARATION REQUIREMENTS.

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE BCA REPORT, FIRE ENGINEERING REPORT, FEBQ AND PARTITION CONSTRUCTION DETAILS.

ALL DOORS TO FIRE EGRESS STAIRS REQUIRE -/60/30 FRL, ALL OTHER DOORS REQUIRE THE SAME FIRE RATING AS THE WALL ADJACENT.

ALL DOORS AND WALLS TO ELECTRICAL AND COMMS CUPBOARDS TO BE NON-COMBUSTIBLE SMOKE SEALED DOORS. ALL PENETRATION WITHIN ELECTRICAL CUPBOARD TO BE FIRE SEALED AT SLAB LEVEL.

ALL PENETRATIONS THROUGH FIRE RATED FLOOR SLABS AND WALLS TO BE FIRE SEALED.

ALL HYDRAULIC PIPES THROUGH FLOOR SLABS TO BE INSTALLED WITH FIRE STOP COLLARS UNLESS WITHIN A BLOCKOUT WHERE THE WALLS ARE FIRE RATED.

ALL MECHANICAL DUCTWORK THROUGH WALLS AND LOUVRES WITHIN WALL TO BE INSTALLED WITH FIRE DAMPERS TO MECHANICAL ENGINEERS DETAIL.

ALL EXISTING FIRE RATED WALLS TO BE CONFIRMED BY THE HEAD CONTRACTOR FOR STRUCTURAL ADEQUACY, INTEGRITY AND INSULATION.

NOTES

This drawing is copyright and the property of WEBBER Australia and must not be used without written authorisation.

Do not scale this drawing.

All dimensions are to be verified on site and any discrepancies reported before commencement of any work or shop drawing.

KEY

NORTH



ZONE PLAN NUMBERING CONVENTION

LEVEL CODE	(YY)
GENERAL	00
BASEMENT 2	01
BASEMENT 1	02
LOWER GROUND	03
LOWER GROUND A	04
LEVEL 00	05
LEVEL 00A	06
LEVEL 01	07
LEVEL 01A	08
LEVEL 02	09
LEVEL 02A	10
LEVEL 03	11
LEVEL 03A	12
LEVEL 04	13
ROOF	14

PACKAGE CODE	(XX)
EARLY WORKS	0
FLOOR PLANS	1
PARTITION PLANS	2
CONCRETE	3
CEILINGS	4
OTHER PLANS	5
ELEVS & SECTNS	6
DETAILS	7
PACKAGES	8
SCHEDULES	9

ZONE CODE	
GENRL	00
A1	
B1	
B2	
B3	
C1	
C2	
C3	
D2	
D3	

DRAWING No.

LEVEL CODE — UNIQUE ID

XX YY ZZ

PACKAGE

ON-HOLD REGISTER

HD.XXXX

REFER TO EA-WEA-SCH-XX-000001 FOR FURTHER INFO/DETAILS

ISSUE TITLE

ISSUED FOR CONSTRUCTION - DRAWING UPDATE A39 FIRE RATING AND EGRESS PLANS AND L01 CEILING SERVICES SETOUTS

C03	Ch-1346	RAMPS AND STAIR UPDATED	8/11/2024
	Ch-1251	EXISTING CONDITIONS UPDATED AS PER SURVEYED INFORMATION	
C02	Ch-0929	EXISTING MOVEMENT JOINT ADDED	18/7/2024
	Ch-0926	ROLLER DOOR ADDED	
	Ch-0899	FIRE RATING CORRECTED	
	Ch-0778	LG-04 LIFT LOBBY REVERT TO EXISTING	
C01	Ch-0701	ISSUED FOR CONSTRUCTION	3/6/2024
P05	Ch-0651	LG-04, LG-04A AND FIRE EGRESS UPDATED	19/4/2024
	Ch-0539	FUEL POINT MOVED	
	Ch-0465	LEGEND UPDATED	
P04	Ch-0443	UPDATED TO REFLECT DESCOPE	28/3/2024
	Ch-0398	VICTORIA AVE ENTRY UPDATED	
P03	Ch-0340	LEGEND UPDATED	12/1/2024
	Ch-0334	NOTES ADJUSTED/ADDED	
P02	Ch-0103	MEANS OF EGRESS AND EGRESS DISTANCES INCORPORATED	9/10/2023
P01	Ch-07	TENDER PHASE 1 ISSUE	28/4/2023
REV	CHNG	DESCRIPTION	DATE

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PROJECT

CHATSWOOD CHASE
345 VICTORIA AVENUE
CHATSWOOD, NSW, 2067

TITLE

FIRE RATING AND EGRESS PLAN - LOWER GROUND SOUTH

ISSUED STATUS

FOR CONSTRUCTION

PROJECT #	SCALE @ A3	AUTHORED	APPROVED	FIRST ISSUE
23300	1:250	WEB	PB	28/4/2023
ORIGINATOR	ROLE	ZONE	SHEET NO.	REVISION
WEA	EA	00	500302	C03

Date Printed: 8/11/2024

Appendix M Certifier endorsement on sidewall sprinkler issue (performance solution 6)

Huang, Grace

From: Luke Denny <auto-reply-au1@au.aconex.com>
Sent: Tuesday, 12 August 2025 12:04 PM
To: Huang, Grace
Subject: SWP-CADV-000055: Re: Rectangular skylight void - Rationalisation of sprinkler coverage ACNXREF<K8FXXnQiTHKJ9WjFkUdulB>

[CAUTION - EXTERNAL SENDER] Warning this email comes from an external source.

When replying, do not delete the content below this line.

You have received a new Consultant Advice: SWP-CADV-000055

Project:	CC-Main Scheme
Type:	Consultant Advice
Mail Number:	SWP-CADV-000055
Reference Number:	WFIRE-GCOR-000512
To:	Mr Jarrod Sharrock, Multiplex Constructions Pty Ltd
Cc:	Mr Adam Deller, Innovative Fire Services
	Ms Grace Huang, Jensen Hughes Fire Testing Pty Ltd (Formerly Warringtonfire)
	Kingsley Lunt, McKenzie Group Consulting (NATIONAL)
	Mr David Patterson, Multiplex Constructions Pty Ltd
	Mr Farshid Salehi, Multiplex Constructions Pty Ltd
	Mr Paul Brodala, WEBBER Australia
From:	L Denny, Steve Watson & Partners
Sent:	12/08/2025 12:04:18 PM AEST (GMT +10:00)
Status:	N/A
Subject:	**Re: Rectangular skylight void - Rationalisation of sprinkler coverage**

no issue with that

Regards,

Luke Denny
Senior Associate
Steve Watson & Partners Pty Ltd
Level 17, 456 Kent Street, Sydney NSW 2000
Phone: (02) 9283 6555
Fax: (02) 9283 8500
www.swpartners.com.au

1

From: G Huang
Sent: 07/08/2025 10:29:50 AM AEST (GMT +10:00)
To: Luke Denny
Cc: Adam Deller, Kingsley Lunt, David Patterson, Farshid Salehi, Jarrod Sharrock, Paul Brodala
Mail Number: WFIRE-GCOR-000512
Subject: Rectangular skylight void - Rationalisation of sprinkler coverage

Hi Luke,

Please see below a summary of an additional DTS departure proposed to be addressed via performance solution in the Main Works FER.

Description	DTS clause	Performance requirement	Requirements

Sidewall sprinklers providing coverage to the rectangular void connecting levels 1 and 2 will be installed 320 mm below the ceiling/soffit instead of the 150 mm.	Clause E1D4
	
	AS 2118.1-2017
		E1P4	• The sidewall sprinklers are to be installed as high as practical.
			• The use of the are below the subject void must be restricted to mall furniture, signage elements, planters etc.
			• The area must not be used for:
			  • Rubbish bins
			  • Vehicles
			  • Permanent retail kiosks
			  • Combustible seasonal decorations exceeding 2m in height

The solution will be incorporated in the existing FER performance solution 6 - which already assesses rationalised sprinkler coverage to the Central and Vic Ave voids. We propose that the PBDB process not be revisited for this issue on the basis that the assessment will be broadly consistent with the assessment methodology and strategy previously proposed.

Could you please confirm if this approach is acceptable.

Appendix N Structural statement – Level 3 FRLs

Our ref 254810

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Jenson Hughes
Attention: Grace Huang
Senior Fire Safey Consultant
By Aconex

15 August 2025

Dear Grace,

Chatswood Chase Shopping Centre Redevelopment
Fire Engineering Report - Structural Engineering Statement

This letter has been prepared in support of the Fire Engineering Report (ref: SY180281 R2.2) for the above project being prepared by Jenson Hughes Fire Engineers.

Chatswood Chase was originally constructed in 1981 and has undergone renovations in 1995, 2007 and now in 2024/ 2025. The fire rating of the structural elements within existing retail areas have been rationalised to require 2 hours fire rating by performance solutions outlined in the existing fire engineering report prepared previously, in lieu of 3 hours compliance with BCA Section C Specification 5.

New construction for retail areas has been designed to achieve a commensurate fire rating as the existing structures, i.e. 2 hours, complying with the fire engineering report. From a structural perspective the new areas' fire rating does not impact the global stability of the existing structure under the fire load case and does not weaken the fire rating of the existing structural elements in existing retail areas. For the steel roof, the fire protection extent has followed the extent agreed and coordinated with the Fire Engineer. Should there be a local failure of the steel roof, it will not lead to a global instability of the new or existing structure under the fire load case.

It is therefore in our opinion that the 2 hours reduced fire rating of the new Level 3 Class 6 building elements has no adverse impacts on the structural design of the remainder of the building. We trust this confirmation is of assistance. Should you require any further information, please do not hesitate to contact us.

Yours sincerely,



Mark Fyson
Associate Principal
CEng, MEng, MICE

J:\254000\254810-00 CHATSWOOD CHASE\L2 RAISED\WORK\INTERNAL\REPORTS\2025-08-15 FER STATEMENT\2025-08-15_CHATSWOODCHASE_FERSTATEMENT.DOCX

Arup
Arup Pty Ltd ABN 18 000 966 165

Appendix O Radiant heat assessment

Fire dynamics simulator (FDS) has been used to undertake radiant heat calculations. These calculations do not include any modelling of a fire reaction or smoke. The calculations simply specify a hot surface and utilise the radiant heat solver in FDS to calculate the incident heat flux on a receiving surface. All calculations are based on the following input parameters and assumptions.

Parameter	Data input	Comment
Program and version	FDS 6.7.4	
Simulation mode	Very Large Eddy Simulation (VLES)	FDS default[72]. In a VLES, the larger geometry dependant eddies are solved explicitly and the smaller eddies are filtered using a sub-grid scale model.
Simulation time	0.1 s	Radiant heat results are resolved after one timestep.
Grid size	0.1 x 0.1 x 0.1	
&RADI NUMBER_RADIATION_ANGLES	1000	1000 radiation angles was found to provide good incident heat flux resolution. Further increase of the angles did not provide significant improvement in resolution and is computationally prohibitive.
TIME_STEP_INCREMENT	1	
ANGLE_INCREMENT	1	
Ambient temperature	20°C	
HUMIDITY	0	Note: Assuming no humidity results in a worst case scenario. Increased humidity reduces incident heat flux.
Emitting surface temperature	817°C	Refer to sections below.
Emissivity of hot surface	1.0	The emitting hot surface is assumed to be a black body emitter.

O.1 Opening perpendicular to the boundary

The ramp opening is perpendicular to the boundary and would not be capable of receiving the maximum level of radiant heat flux as specified by verification method CV1, since this maximum evel would occur directly in front and in the centre of the fire-source feature. Therefore, an equivalent fire-source feature is to be determined, in order to calculate the equivalent level of radiant heat flux required to be withstood by the perpendicular opening.

O.1.1 Size of fire-source feature required

Table 108 Size of fire-source feature required

Criteria	Data	Comment
Heat flux received on boundary	80 kW/m^2	In accordance with verification method CV1
Heat flux received at 3 m from boundary	20 kW/m^2	In accordance with verification method CV1
Equivalent temperature to 80 kW/m^2	817 °C See O.1.2	Conversion of heat flux into temperature
Width × height of worst case fire-source feature under verification method CV1	**3.1 m × 3.1 m** See O.1.3	Based on appendix 4 of SFPE Handbook[116]

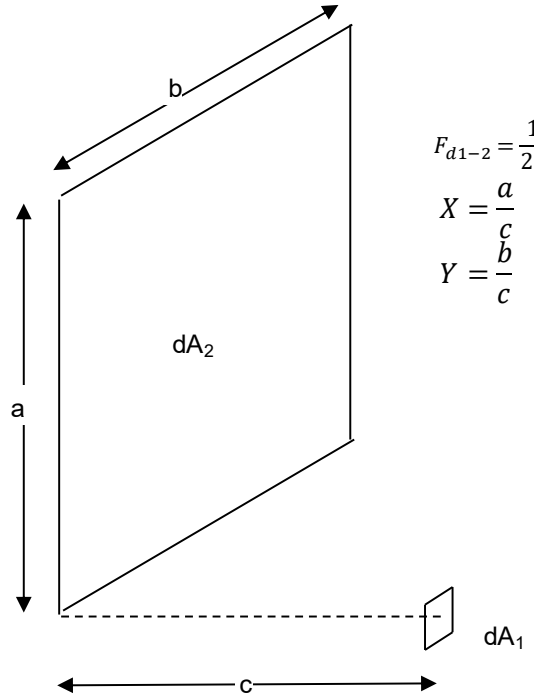
O.1.2 Calculation of equivalent temperature

Calculation of Equivalent Temperature			
Inputs			
Configuration factor	f	1	
Stephan Boltzman Constant	s	5.7E-08	W/m^2 K^4
Emmisivity	e	1	
Heat Flux	q_r	80	kW/m^2
Output			
Temperature Equivalent	**T**	**1090**	**K**
		817	**°C**
QA version: 12 October 2020			

[116] Appendix 4: Configuration Factors, The SFPE Handbook of Fire Protection Engineering, 5th edition, SFPE, Springer.

O.1.3 Calculation of equivalent temperature

Calculation of size of FSF



$$F_{d1-2} = \frac{1}{2\pi}\left[\frac{X}{\sqrt{1+X^2}}\tan^{-1}\left(\frac{Y}{\sqrt{1+X^2}}\right) + \frac{Y}{\sqrt{1+Y^2}}\tan^{-1}\left(\frac{X}{\sqrt{1+Y^2}}\right)\right]$$

$$X = \frac{a}{c}$$

$$Y = \frac{b}{c}$$

Inputs

Model parameters		
Distance to boundary	3	m
Heat flux required	20	kW/m²

Outputs

Calculation parameters			
a	1.55	X	0.516
b	1.55	Y	0.516
c	3	F_{d1-2}	0.063

Note calculation assumes a = b for simplicity

Temperature of fire source feature	**817**	**° C**
Emissivity	**1**	
Stefan Boltzmann constant	**5.67E-11**	**kW/m²K⁴**
Final configuration factor	**0.25**	
Calculated heat flux	**20.00**	**kW/m²**
Difference	0	

Size of fire source feature required

Width of FSF	3.10	m
Height of FSF	3.10	m

QA version: 12 October 2020

O.1.4 Result

Section 1

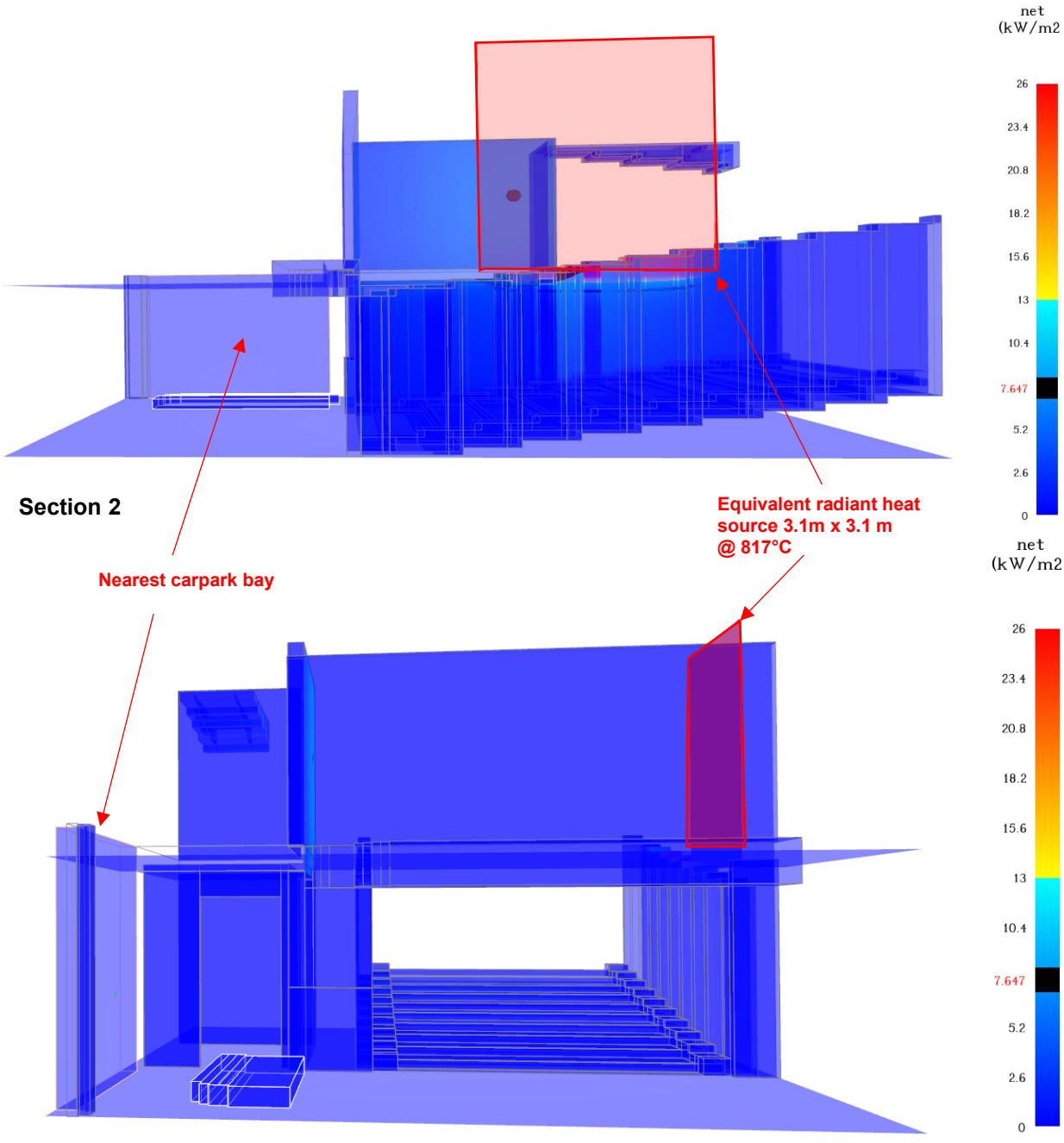


Figure 149 Radiant heat received from boundary