MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

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Geoff Merryweather
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Dear Geoff

Thank you for your email of 8 March 2017 to Emma Drysdale, Team Leader Ministerial Writing, requesting calculations that were not sent to you as part of the original response by the Ministry of Business, Innovation and Employment.

I apologise for this oversight. Please find attached, as annexes, the calculations you have asked for. The input file used with the B-Risk Design Fire Tool is also attached.

Yours sincerely

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Annex 1 Blaketown Hall Fire and Egress Analysis

This calculation is performed to assess the effect of ultra-fast fire growth rate to compare the impact of combustible surface finishes against the provision of additional exits.

As the hall is less than 500m^2, less than 25m in a single direction and its occupancy is less than 150 people an ASET/RSET analysis is not required. However, to test the impact of combustible surface finishes the principles of C/VM2 are to be used.

A fire was modelled in the hall to assess the Available Safe Egress Time (ASET) for when visibility reduced to 10m. Due to combustible linings the design fire was chosen as ultra-fast growth to include burning of the walls together with the fire load. The ASET was 81 seconds to reach 10m visibility with an ultra-fast fire.

A Required Safe Egress Time (RSET) analysis was performed based on the calculations in C/VM2. As the occupancy is in the in the room of fire origin detection and notification times were not included due to direct cues of fire in the same space. Therefore the building does not have a detection system. A pre-movement time of 30s was included as per Table 3.3.
The RSET analysis also incorporated the additional escape provided by three double doors. The RSET was flow governed due to the short travel distances and was calculated as 54 seconds.

As ASET>RSET the addition of a third exit can compensate for additional combustible surface finishes with an appropriate safety margin.

Annex 2 RSET Analysis

Verification Method C/VM2				
Project:	Blaketown Hall			
Detection Time		0	s	
Notification Time		0	s	Strandard Evac
Pre-movement Time		30	s	Enclosure of Origin, Awake and Familiar
Density of Space		0.61	p/m2	Hall is 200m2
Travel Dsitance		16	m	Nearest Exit
Travel Speed		1.172836	m/s	S = k – akD
Travel Time		13.64215	s	ttrav = Ltrav/ S Equation 3.3
Density		1.9	p/m2	Doors is 1.9
Exit Width		4.8	m	Three Double Doors
Boundary Layer		0.15		
Number of Exits		3		
k Factor		1.4		Horizontal
Flow Rate		5.13098	p/s	Fc = (1 – aD)kDWe Equation 3.4
Occupancy		122	people	
Flow Time		23.77713	s	
RSET		53.77713	s	Flow Governs

Annex 3 B-Risk Design Fire Tool input and output file

B-RISK Fire Simulator and Design Fire Tool (Ver 2015.07)
User Mode : C/VM2
Simulation Time = 300.00 seconds.
Initial Time-Step = 1.00 seconds.
Blaketown School
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Description of Rooms
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Room 1 : Hall

Room Length (m) =	16.20
Room Width (m) =	10.60
Maximum Room Height (m) =	3.75
Minimum Room Height (m) =	3.75
Floor Elevation (m) =	0.000
Absolute X Position (m) =	0.000
Absolute Y Position (m) =	0.000

Room 1 has a flat ceiling.
Shape Factor (Af/H^2) = 12.2

Wall Surface is concrete	
Wall Density (kg/m3) =	2300.0
Wall Conductivity (W/m.K) =	1.200
Wall Specific Heat (J/kg.K) =	880
Wall Emissivity =	0.88
Wall Thickness (mm) =	100.0
SQROOT Thermal Inertia (J.m-2.s-1/2.K-1) =	1558

Ceiling Surface is concrete	
Ceiling Density (kg/m3) =	2300.0
Ceiling Conductivity (W/m.K) =	1.200
Ceiling Specific Heat (J/kg.K) =	880
Ceiling Emissivity =	0.88
Ceiling Thickness (mm) =	100.0
SQROOT Thermal Inertia (J.m-2.s-1/2.K-1) =	1558

Floor Surface is concrete	
Floor Density (kg/m3) =	2300.0
Floor Conductivity (W/m.K) =	1.200
Floor Specific Heat (J/kg.K) =	880
Floor Emissivity =	0.50
Floor Thickness = (mm)	100.0
SQROOT Thermal Inertia (J.m-2.s-1/2.K-1) =	1558

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Wall Vents

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Vent 1 : vent label

From room 1 to 2
Front face of room 1
Offset (m) = 0.000
Vent Width (m) = 10.000
Vent Height (m) = 0.010
Vent Sill Height (m) = 0.000
Vent Soffit Height (m) = 0.010
Opening Time (sec) = 0
Closing Time (sec) = 0
Flow Coefficient (-) = 0.680

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Ceiling/Floor Vents

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Ambient Conditions

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Interior Temp (C) = 24.0
Exterior Temp (C) = 15.0
Relative Humidity (%) = 50

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Tenability Parameters

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Monitoring Height for Visibility and FED (m) = 2.00
Asphyxiant gas model = FED(CO) C/VM2
Visibility calculations assume: reflective signs
Egress path segments for FED calculations
1. Start Time (sec) 0
1. End Time (sec) 600
1. Room 1
2. Start Time (sec) 0
2. End Time (sec) 0
2. Room 0
3. Start Time (sec) 0
3. End Time (sec) 0
3. Room 0

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Sprinkler / Detector Parameters

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Ceiling Jet model used is NIST JET.
Sprinkler System Reliability 1.000
Sprinkler Probability of Suppression 0.000
Sprinkler Cooling Coefficient 1.000

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Smoke Detector Parameters

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Smoke Detection System Reliability 1.000

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Mechanical Ventilation (to/from outside)

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Mechanical Ventilation not installed.

Mech ventilation system reliability 1.000

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Description of the Fire

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CO Yield pre-flashover(g/g) = 0.040
CO Yield post-flashover(g/g) = 0.400
Soot Yield pre-flashover(g/g) = 0.070
Soot Yield post-flashover(g/g) = 0.140
Flame Emission Coefficient (1/m) = 1.00
Fuel - Carbon Moles 1.00
Fuel - Hydrogen Moles 2.00
Fuel - Oxygen Moles 0.50
Fuel - Nitrogen Moles 0.00

Burning objects are manually positioned in room.
Enhanced burning submodel is OFF

Burning Object No 1
Fire

Located in Room 1
Energy Yield (kJ/g) = 20.0
CO2 Yield (kg/kg fuel) = 1.500
HCN Yield (kg/kg fuel) = 0.000
H2O Yield (kg/kg fuel) = 0.818
Heat Release Rate Per Unit Area (kW/m2) = 250.0
Radiant Loss Fraction = 0.35
Fire Elevation (m) = 0.300
Location, X-coordinate (m) = 8.100
Location, Y-coordinate (m) = 5.300
Fire Location (for entrainment) = CENTRE
Plume behaviour is UNDISTURBED

Alpha T2 growth coefficient = 0.1880
Peak HRR (kW) = 20000

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Postflashover Inputs

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Postflashover model is OFF.

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Results from Fire Simulation

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0 min 00 sec

(0 sec)	Room 1	Outside
Layer (m)	3.750	
Upper Temp (C)	24.0	
Lower Temp (C)	24.0	
HRR (kW)	0.0	
Visibility (m) at 2m	20+	

FED gases on egress path = 0.000

FED thermal on egress path = 0.000

0 min 10 sec

(10 sec)	Room 1	Outside
Layer (m)	3.710	
Upper Temp (C)	28.3	
Lower Temp (C)	24.0	
HRR (kW)	18.8	
Visibility (m) at 2m	20+	

FED gases on egress path = 0.000

FED thermal on egress path = 0.000

0 min 20 sec

(20 sec)	Room 1	Outside
Layer (m)	3.619	
Upper Temp (C)	34.5	
Lower Temp (C)	24.0	
HRR (kW)	75.2	
Visibility (m) at 2m	20+	

FED gases on egress path = 0.000

FED thermal on egress path = 0.000

0 min 30 sec

(30 sec)	Room 1	Outside
Layer (m)	3.481	
Upper Temp (C)	41.5	
Lower Temp (C)	24.1	
HRR (kW)	169.2	
Visibility (m) at 2m	20+	

FED gases on egress path = 0.000

FED thermal on egress path = 0.000

0 min 40 sec

(40 sec)	Room 1	Outside
Layer (m)	3.297	
Upper Temp (C)	48.9	
Lower Temp (C)	24.3	
HRR (kW)	300.8	
Visibility (m) at 2m	20+	

FED gases on egress path = 0.000
FED thermal on egress path = 0.001

0 min 50 sec

(50 sec)	Room 1	Outside
Layer (m)	3.069	
Upper Temp (C)	56.9	
Lower Temp (C)	24.5	
HRR (kW)	470.0	
Visibility (m) at 2m	20+	

FED gases on egress path = 0.000
FED thermal on egress path = 0.001

1 min 00 sec

(60 sec)	Room 1	Outside
Layer (m)	2.788	
Upper Temp (C)	68.2	
Lower Temp (C)	25.1	
HRR (kW)	676.8	
Visibility (m) at 2m	20+	

FED gases on egress path = 0.000
FED thermal on egress path = 0.001

1 min 10 sec

(70 sec)	Room 1	Outside
Layer (m)	2.462	
Upper Temp (C)	80.1	
Lower Temp (C)	26.0	
HRR (kW)	921.2	
Visibility (m) at 2m	20+	

FED gases on egress path = 0.000
FED thermal on egress path = 0.001

1 min 20 sec

(80 sec)	Room 1	Outside
Layer (m)	2.093	
Upper Temp (C)	92.1	
Lower Temp (C)	27.4	
HRR (kW)	1203.2	

Visibility (m) at 2m 20+
FED gases on egress path = 0.000
FED thermal on egress path = 0.001

1 min 30 sec
(90 sec) Room 1 Outside

Layer (m) 1.697
Upper Temp (C) 105.4
Lower Temp (C) 29.4
HRR (kW) 1522.8
Visibility (m) at 2m 0.74
FED gases on egress path = 0.001
FED thermal on egress path = 0.018

1 min 40 sec
(100 sec) Room 1 Outside

Layer (m) 1.331
Upper Temp (C) 122.3
Lower Temp (C) 32.6
HRR (kW) 1880.0
Visibility (m) at 2m 0.64
FED gases on egress path = 0.003
FED thermal on egress path = 0.051

1 min 50 sec
(110 sec) Room 1 Outside

Layer (m) 0.927
Upper Temp (C) 143.4
Lower Temp (C) 34.8
HRR (kW) 2274.8
Visibility (m) at 2m 0.56
FED gases on egress path = 0.005
FED thermal on egress path = 0.106

2 min 00 sec
(120 sec) Room 1 Outside

Layer (m) 0.519
Upper Temp (C) 169.1
Lower Temp (C) 36.4
HRR (kW) 2707.2
Visibility (m) at 2m 0.49
FED gases on egress path = 0.008
FED thermal on egress path = 0.202

2 min 10 sec
(130 sec) Room 1 Outside

Layer (m) 0.306
Upper Temp (C) 185.0
Lower Temp (C) 40.5
HRR (kW) 943.5
Visibility (m) at 2m 0.37
FED gases on egress path = 0.012
FED thermal on egress path = 0.400

2 min 20 sec
(140 sec) Room 1 Outside

Layer (m) 0.304
Upper Temp (C) 180.7
Lower Temp (C) 44.4
HRR (kW) 812.3
Visibility (m) at 2m 0.26
FED gases on egress path = 0.019
FED thermal on egress path = 0.564

2 min 30 sec
(150 sec) Room 1 Outside

Layer (m) 0.303
Upper Temp (C) 176.4
Lower Temp (C) 47.3
HRR (kW) 720.8
Visibility (m) at 2m 0.19
FED gases on egress path = 0.028
FED thermal on egress path = 0.715

2 min 40 sec
(160 sec) Room 1 Outside

Layer (m) 0.302
Upper Temp (C) 172.4
Lower Temp (C) 49.3
HRR (kW) 665.6
Visibility (m) at 2m 0.15
FED gases on egress path = 0.039
FED thermal on egress path = 0.854

2 min 50 sec
(170 sec) Room 1 Outside

Layer (m) 0.302
Upper Temp (C) 168.6
Lower Temp (C) 50.6
HRR (kW) 615.8

Visibility (m) at 2m 0.13
FED gases on egress path = 0.052
FED thermal on egress path = 0.983

3 min 00 sec
(180 sec) Room 1 Outside

Layer (m) 0.302
Upper Temp (C) 165.0
Lower Temp (C) 51.5
HRR (kW) 570.4
Visibility (m) at 2m 0.11
FED gases on egress path = 0.066
FED thermal on egress path = 1.000

3 min 10 sec
(190 sec) Room 1 Outside

Layer (m) 0.302
Upper Temp (C) 161.6
Lower Temp (C) 52.0
HRR (kW) 528.7
Visibility (m) at 2m 0.09
FED gases on egress path = 0.082
FED thermal on egress path = 1.000

3 min 20 sec
(200 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 158.4
Lower Temp (C) 52.2
HRR (kW) 490.5
Visibility (m) at 2m 0.08
FED gases on egress path = 0.099
FED thermal on egress path = 1.000

3 min 30 sec
(210 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 155.2
Lower Temp (C) 52.3
HRR (kW) 458.0
Visibility (m) at 2m 0.08
FED gases on egress path = 0.117
FED thermal on egress path = 1.000

3 min 40 sec
(220 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 152.1
Lower Temp (C) 52.2
HRR (kW) 479.0
Visibility (m) at 2m 0.07
FED gases on egress path = 0.136
FED thermal on egress path = 1.000

3 min 50 sec
(230 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 149.1
Lower Temp (C) 52.0
HRR (kW) 442.1
Visibility (m) at 2m 0.06
FED gases on egress path = 0.157
FED thermal on egress path = 1.000

4 min 00 sec
(240 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 146.3
Lower Temp (C) 51.8
HRR (kW) 407.7
Visibility (m) at 2m 0.06
FED gases on egress path = 0.178
FED thermal on egress path = 1.000

4 min 10 sec
(250 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 143.6
Lower Temp (C) 51.5
HRR (kW) 375.6
Visibility (m) at 2m 0.05
FED gases on egress path = 0.201
FED thermal on egress path = 1.000

4 min 20 sec
(260 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 141.0
Lower Temp (C) 51.2
HRR (kW) 345.4
Visibility (m) at 2m 0.05
FED gases on egress path = 0.224
FED thermal on egress path = 1.000

4 min 30 sec
(270 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 138.5
Lower Temp (C) 50.9
HRR (kW) 317.1
Visibility (m) at 2m 0.05
FED gases on egress path = 0.248
FED thermal on egress path = 1.000

4 min 40 sec
(280 sec) Room 1 Outside

Layer (m) 0.301
Upper Temp (C) 136.1
Lower Temp (C) 50.5
HRR (kW) 290.4
Visibility (m) at 2m 0.04
FED gases on egress path = 0.272
FED thermal on egress path = 1.000

4 min 50 sec
(290 sec) Room 1 Outside

Layer (m) 0.300
Upper Temp (C) 133.8
Lower Temp (C) 50.2
HRR (kW) 265.3
Visibility (m) at 2m 0.04
FED gases on egress path = 0.297
FED thermal on egress path = 1.000

5 min 00 sec
(300 sec) Room 1 Outside

Layer (m) 0.300
Upper Temp (C) 131.6
Lower Temp (C) 49.8
HRR (kW) 241.5
Visibility (m) at 2m 0.04
FED gases on egress path = 0.323
FED thermal on egress path = 1.000

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Event Log

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Simulation Finished.
FED(thermal) Exceeded 0.3 at 126.0 Seconds.
FED(CO) Exceeded 0.3 at 292.0 Seconds.
124 sec. Ventilation Limit 2599 kW.
83 sec. Visibility at 2m above floor reduced to 10 m in room 1
0 sec. Item 1 Fire ignited.
Iteration 1

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Computer Run-Time = 1.9 seconds.

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