DA Submission Information
RAS/SOP Exhibition Halls
Royal Agricultural Society

Report ref:
44855
03 February 2010
Revision A

aurecon

Document prepared by:

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Document control

aurecon

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Rev No	Date	Revision details	Typist	Author	Verifier	Approver
01	21 December 2009	Issued for Comment	AD	PJB		
A	03 February 2010	Updated Issue	AD	PJB	GDR	

Contents

DA Submission information

RAS/SOP Exhibition Halls – DA Submission Information

The following information has been provided for inclusion in the DA submission being prepared by JBA Urban Planning Consultants.

1.0 Acoustics

The existing Acoustic Management Plan will remain unchanged. [A copy of this existing plan was forwarded under separate cover by others.]

2.0 Fire safety

New fire engineered mechanical smoke exhaust systems will be provided to Halls 2, 3 and 4 which will replace the existing natural smoke reservoir and natural ventilation via the operable louvred walls on the northern and southern sides.

Smoke exhaust will also be provided to the new Concourse entrance areas on the northern side.

Sprinklers are not installed as confirmed by the original Fire Engineered report No XR127 prepared by SSL and dated April 1997. [A copy of this report was issued to the BCA Consultant under separate cover.]

The perimeter vehicle access will be maintained.

The existing EWIS and Vesda system will be retained and extended to serve the new extension on the northern side.

A separate letter covering the above was issued on 1st February 2010

3.0 Building services

3.1 Mechanical Services will comprise of the following:

- Installation of new exposed supply air ducting across the halls connected to the existing reverse cycle air-conditioning units on the southern side and the existing relocated units on the northern side. Motorized swirl jet type diffusers will discharge air downwards as adjusted to suit cooling and heating modes.
- New reverse cycle air-conditioning systems serving the new Concourse and new meeting rooms.
- New toilet exhaust system.
- New smoke exhaust system serving halls 2, 3 and 4 and foyers respectively.
- Demolition of existing services in north pods.
- Modifications and additions to existing control systems.
- Refer to attached 3 drawings.

3.2 Electrical services will comprise of the following:

- New lighting, power and communications to the new Concourse extension.
- New dedicated supply to existing relocated and new air-conditioning plant on the northern extension.
- New electrical essential power supply to new smoke exhaust systems.
- Connection modules for tenants use.

3.3 Hydraulic services will comprise of the following:

- Relocation of inground services for new piles and connection for new stormwater and drainage from new Concourse extension.
- Reticulation of hot and cold water services.
- Sanitary drainage and plumbing.
- Stormwater from new roofs.
- Hydrants and hose reels for new extension.

- Refer to attached two drawings.

3.4 Fire services will comprise of the following:

- New smoke controls for new smoke management systems.
- Extension to existing EWIS and Vesda systems.

4.0 Traffic Assessment

The implications of the new Concourse building which will link the RAS Exhibition Halls 1,2,3 and 4 has been assessed for impact on Traffic around the Halls.

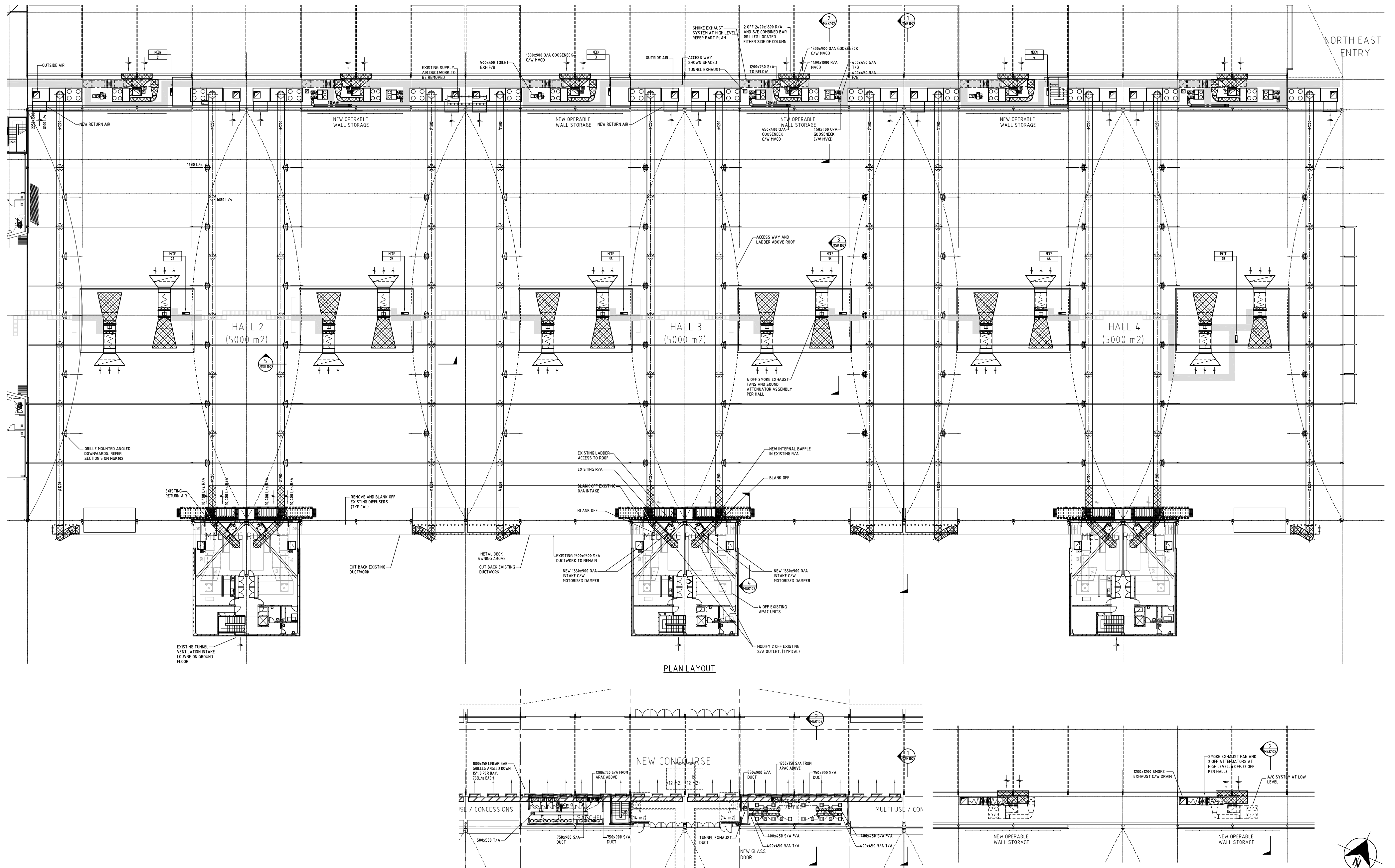
The purpose of the new Concourse is to provide a weatherproof walkway and entrance to the existing exhibition halls. The type of use and population densities of the Exhibition Halls and new Concourse will remain as originally specified.

Based on the above information, the completed concourse building is not expected to generate an increase in traffic at the site.

A separate letter covering the above was issued on the 1st February 2010

APPENDICES

- MSK 01
- MSK 02
- MSK 03
- HSK 100
- HSK 101
- Fire Safety letter dated 1st February 2010
- Traffic Assessment letter dated 1st February 2010
- Trevor House Design Certification report dated 1st May 1997 containing Fire Engineered Report no XR 127 prepared by SSL dated April 1997.



PLAN LAYOUT

TYPICAL GROUND FLOOR HALL LAYOUT
NEW CONCOURSE AND MEETING ROOM SUPPLY
TOILET EXHAUST

TYPICAL NEW CONCOURSE SMOKE EXHAUST

PRELIMINARY
NOT FOR CONSTRUCTION

Rev.	Date	Revision Details	Des.	Ver.	App.
06	04.12.09	PRELIMINARY ISSUE	GGL		
05	06.11.09	PRELIMINARY ISSUE	GGL		
04	27.10.09	PRELIMINARY ISSUE	GGL		
03	26.10.09	ISSUED FOR CHECK ON OUTLETS	GGL		
02	20.10.09	PRELIMINARY ISSUE	GGL		
01	13.10.09	PRELIMINARY ISSUE	GGL		

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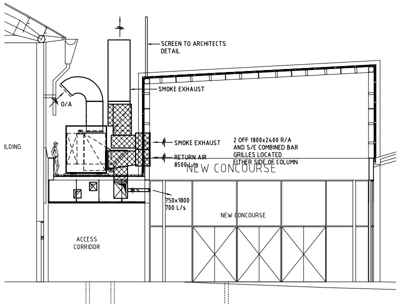
Client: ROYAL AGRICULTURAL SOCIETY NSW

Project: EXHIBITION HALLS EXPANSION
SYDNEY OLYMPIC PARK

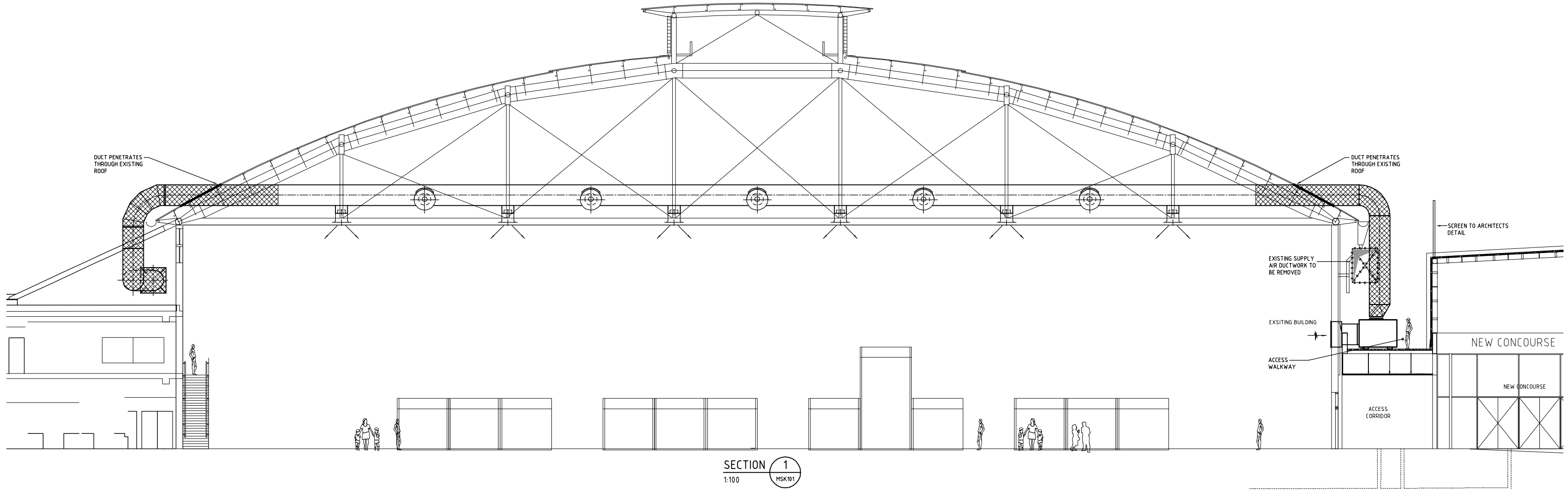
Drawn	Signed	Date
GGL		
Designed PJB	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title: MECHANICAL SERVICES
PROPOSED AIR CONDITIONING
AND VENTILATION LAYOUT
HALLS 2, 3 AND 4

Project No. 44855
Scale 1:200
Sheet Size A0
Drawing No. MSK101
Rev. 06



SECTION 2
1:100 MSK101



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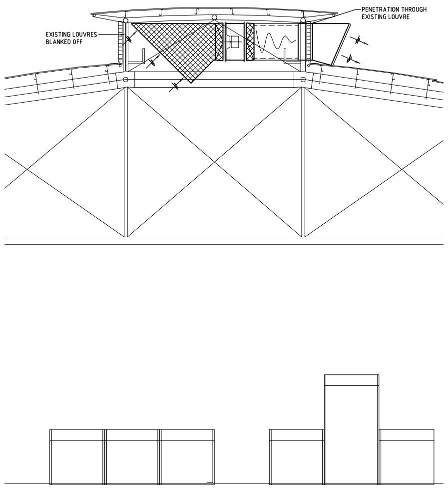
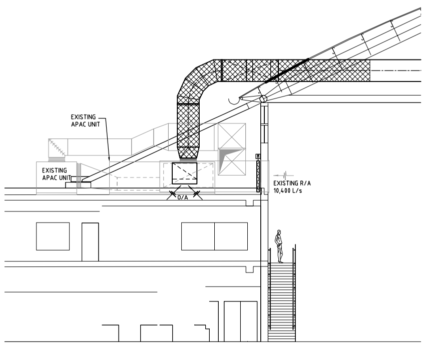
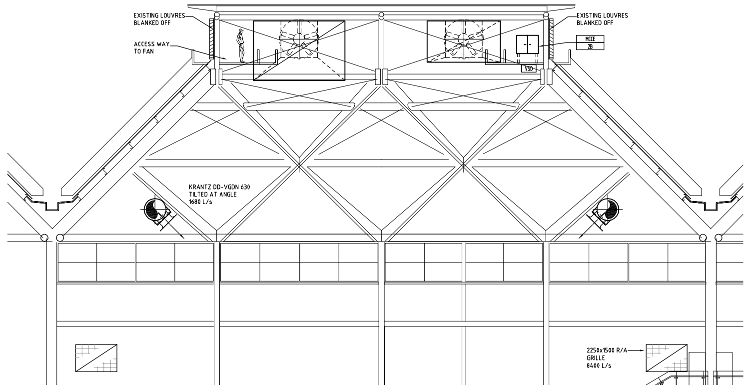


SECTION 3
1:100 MSK101



SECTION 4
1:100 MSK101



SECTION 5
1:100 MSK101

Rev.	Date	Revision Details	Des.	Ver.	App.
06	04.12.09	PRELIMINARY ISSUE	GGL		
05	06.11.09	PRELIMINARY ISSUE	GGL		
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Client: ROYAL AGRICULTURAL SOCIETY NSW

Project: EXHIBITION HALLS EXPANSION SYDNEY OLYMPIC PARK

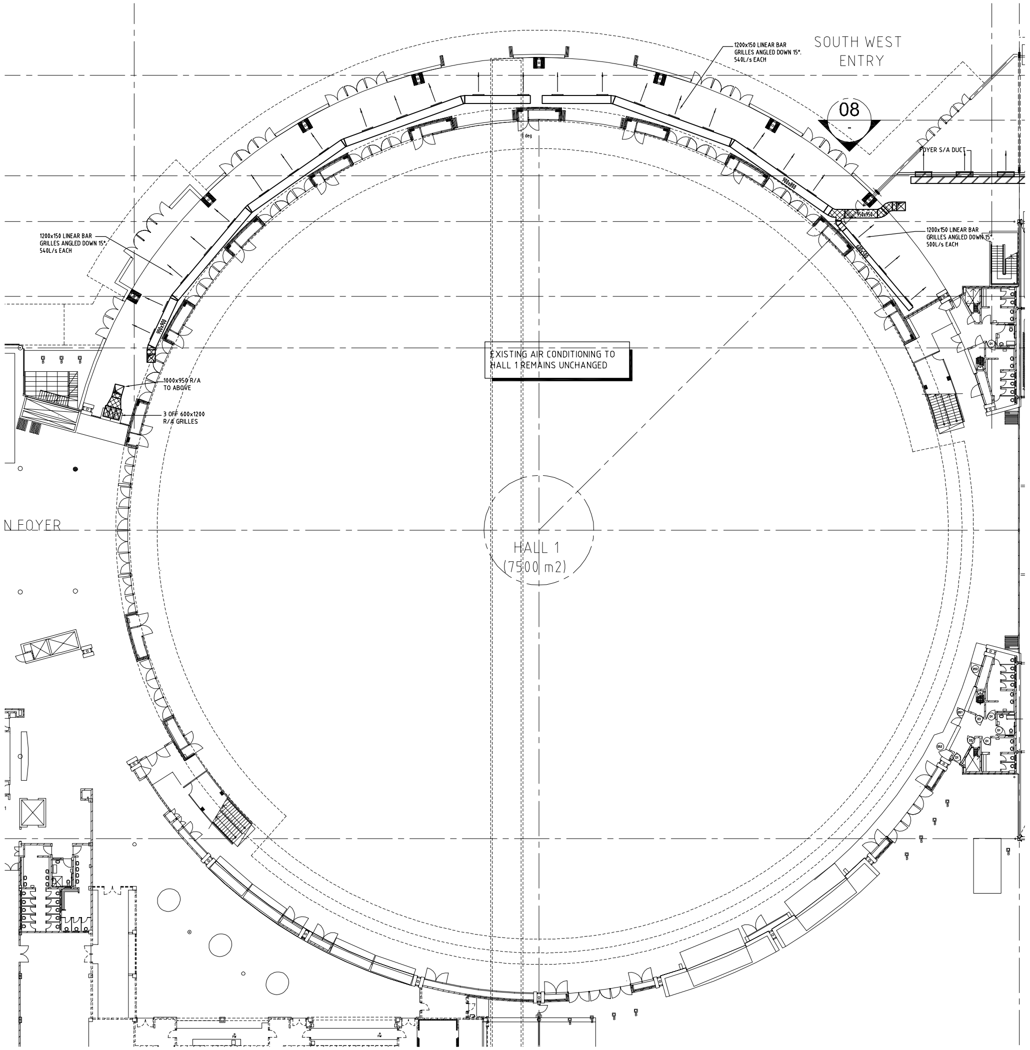
		Signed	Date
Drawn	GGL	Signed	Date
Designed	PJB	Signed	Date
Verified		Signed	Date
Approved		Signed	Date

Drawing Title: MECHANICAL SERVICES PROPOSED AIR CONDITIONING AND VENTILATION LAYOUT SECTIONS

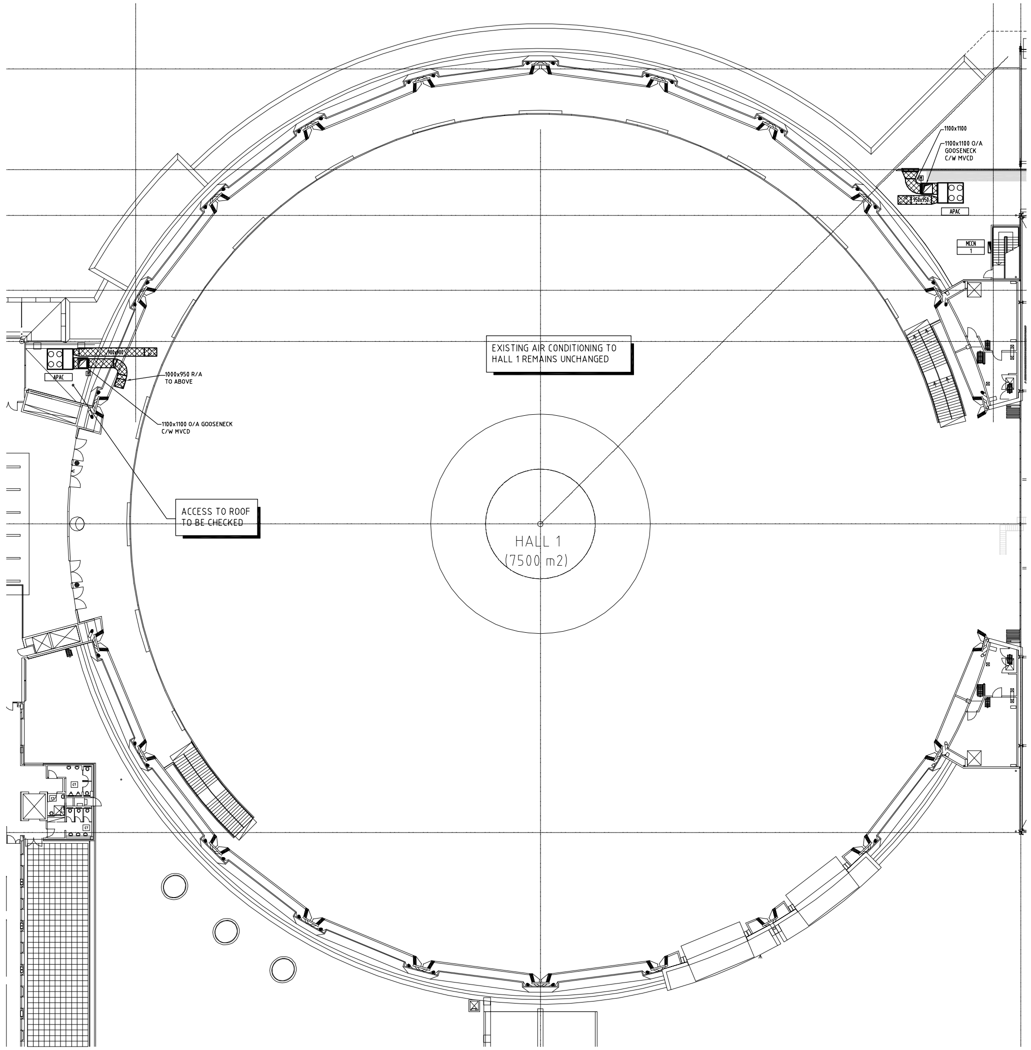
PRELIMINARY
NOT FOR CONSTRUCTION

Project No.	44855
Scale	1:100
Sheet Size	A0
Drawing No.	MSK102
Rev.	06

Cad File: S:\44855\CAD\DRGS\MECH\SKETCHES\MSK102.dwg Plot Date: 21/12/2009 8:54:23 AM Name: Gary Latham Xrefs: X-44855-DD_ADHS, Logo, Disclaimer, X-44855-A00, X-M-44855-00



GROUND FLOOR HALL 1 LAYOUT



FIRST FLOOR HALL 1 LAYOUT

PRELIMINARY
NOT FOR CONSTRUCTION

Rev.	Date	Revision Details	Des.	Ver.	App.
02	04.12.09	PRELIMINARY ISSUE	GGL		
01	06.11.09	PRELIMINARY ISSUE	GGL		

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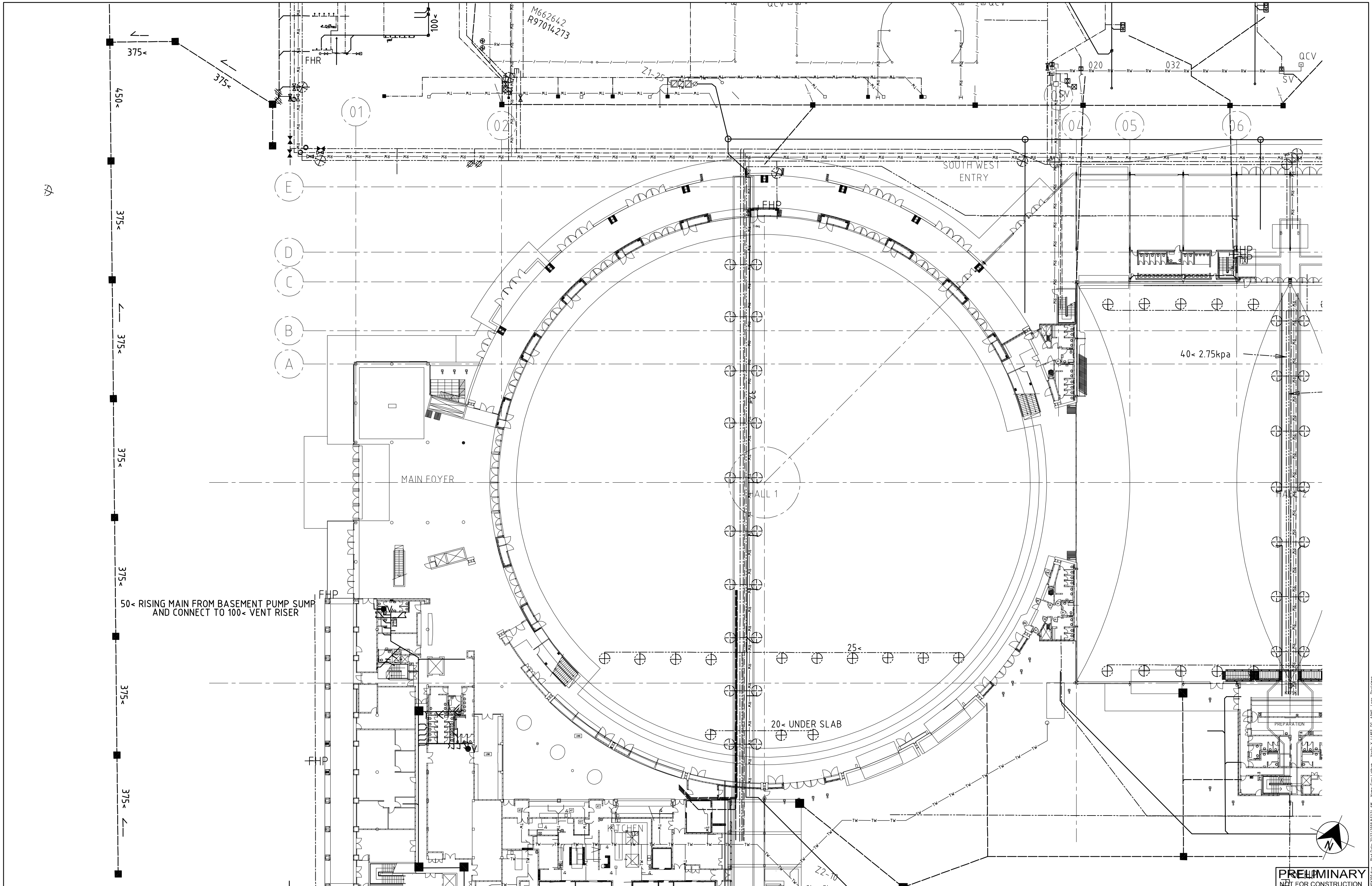
Project: EXHIBITION HALLS EXPANSION
SYDNEY OLYMPIC PARK

Drawn	Signed	Date
GGL		
Designed PJB	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title: MECHANICAL SERVICES
PROPOSED AIR CONDITIONING
AND VENTILATION LAYOUT
HALL 1

Project No.		
44855		
Scale	1:200	Sheet Size A0
Drawing No.	MSK103	Rev. 02



PRELIMINARY
NOT FOR CONSTRUCTION

Rev.	Date	Revision Details	Des.	Ver.	App.

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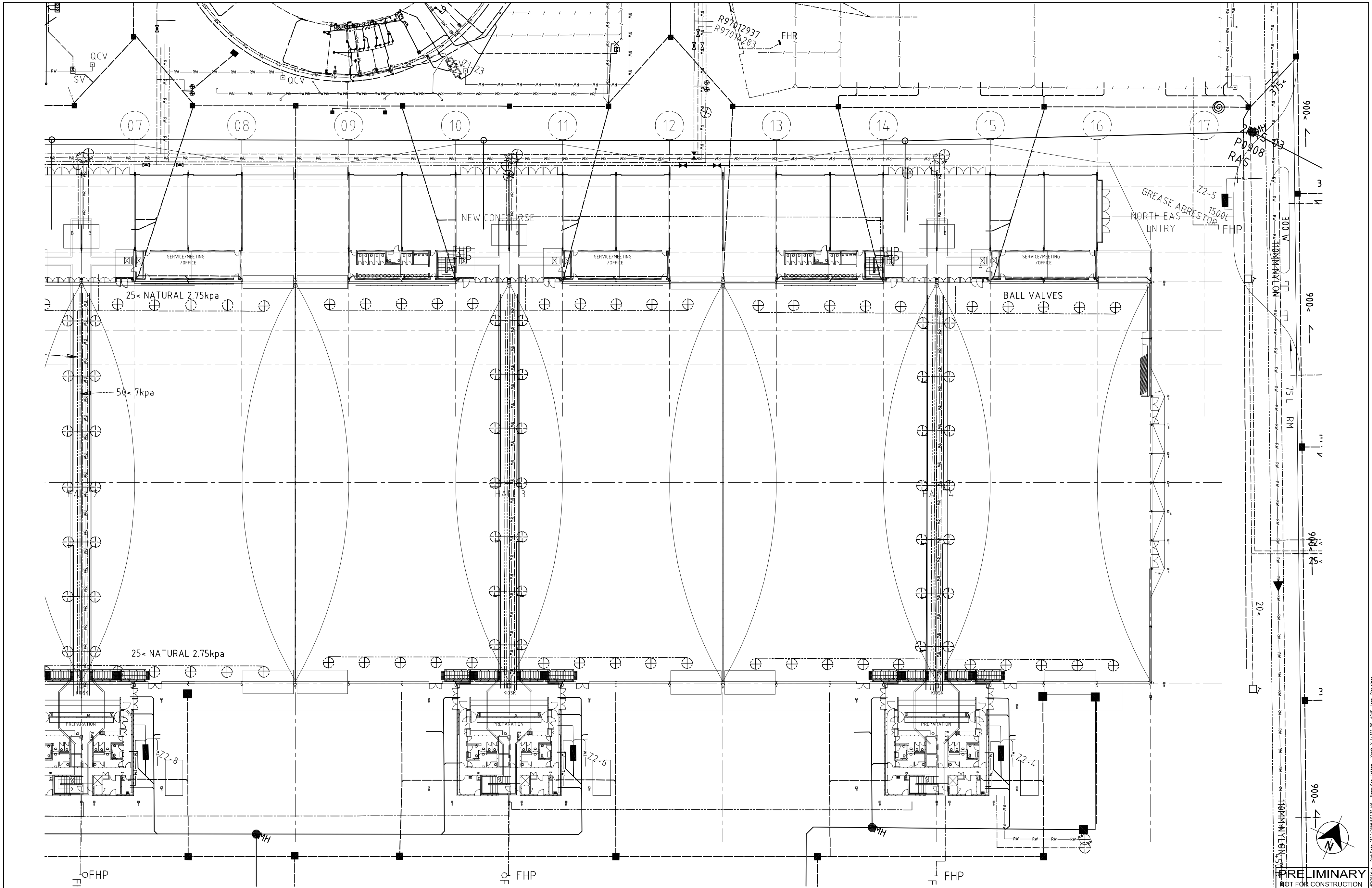
SYDNEY OLYMPIC PARK

Drawn	Signed	Date
Designed	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title:
HYDRAULIC SERVICES
EXISTING INGROUND SERVICES
SHEET 1 OF 2

Project No.	44855
Scale 1:200	Sheet Size A0
Drawing No. HSK100	Rev. 01



Rev.	Date	Revision Details	Des.	Ver.	App.

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Drawn	Signed	Date
Designed	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title: HYDRAULIC SERVICES EXISTING INGROUND SERVICES SHEET 2 OF 2

Project No. 44855
Scale 1:200
Sheet Size A0
Drawing No. HSK101
Rev. 01

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1 February 2010

Robert Marinelli
Managing Director
Philip Chun and Associates
Suite 404, 44 Hampden Road Artarmon NSW 2064

Dear Robert

RAS/SOP Exhibition Halls

Aurecon has been commissioned by ROS/SOP to undertake engineering design associated with the new concourse at the northern side of Exhibition Halls at the Sydney Olympic Park. As part of the DA submission in December 2009, the following was noted in relation to Fire Safety Engineering component of works;

"New fire engineered mechanical smoke exhaust systems will be provided to Halls 2, 3 and 4 which will replace the existing natural smoke reservoir and natural ventilation via the operable louvered walls on the northern and southern sides.

Smoke exhaust will also be provided to the new Concourse entrance areas on the northern side.

Sprinklers are not installed as confirmed by the original Fire Engineered report No XR127 prepared by SSL and dated April 1997. *(copy of report enclosed)*

The perimeter vehicle access will be maintained.

The existing EWIS and Vesda system will be retained and extended to serve the new extension on the northern side."

We trust the above information is adequate for your records. Should you require any additional information, please do no not hesitate to contact the undersigned and we will be pleased to assist.

Yours sincerely

Neno Kević

Encl. Trevor Howse's BCA report and SSL's Fire Engineering Report

cc: John Ferendinos

Cox Richardson

Level 2, 204 Clarence Street

Sydney NSW 2000

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01 February 2010

John Ferendinos
Cox Richardson
Level 2, 204 Clarence Street,
SYDNEY, NSW 2000

Dear John

Sydney Olympic Park Exhibition Hall Expansion Stage 1A – Traffic Assessment

We have assessed the implication of the new Concourse building linking the existing Royal Agricultural Society Exhibition Halls 1, 2, 3 and 4.

We understand that the purpose of the new Concourse is to provide a weatherproof walkway and entrance to the existing exhibition halls. The type of use and population densities of the Exhibition Halls and new Concourse will remain as originally specified.

Based on the above information, the completed Concourse building is not expected to generate an increase in traffic from the site.

Yours sincerely

George Reid
Principal
Aurecon Australia

COPY

TRH

Zone 2 inc. Exhalls

DATE RECEIVED
11AM
12 MAY 1997
JOHN HOLLAND CONSTRUCTION & ENGINEERING PTY LTD

APPROVED FOR CONSTRUCTION
Ref. L Cowen Date: 8/5/97

TREVOR R HOWSE & ASSOCIATES PTY LTD
ACN 003 753 839
Building Regulations Consultants

CERTIFICATION DESIGN

PREPARED FOR

Ancher Mortlock & Woolley Pty. Ltd.

BY

Trevor R. Howse & Associates Pty. Ltd.

REGARDING

New Sydney Showground, Homebush
Zone 2

Prepared under, and for the purposes of, Section 93 of the Local Government Act, 1990,

CERTIFICATION NO. : J96136

DATE : 1 May, 1997

FIRE SAFETY
BUILDING AUDIT
DESIGN ASSESSMENT
CERTIFICATION

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BUILDING DESIGN COMPLIANCE

2.0 BUILDING DESIGN COMPLIANCE

2.1 Preliminary

This certification is based on an assessment of the architectural plans and reports **(Annexure "B")** against the provisions of the Building Code of Australia (B.C.A.) and incorporates the Section 70 Objection Report in **Annexure "D"** (dated: 1 May, 1997, Ref. : J96136).

2.2 Exclusions

(a) The following areas are excluded from this Statement —

- Structural Design
- Structural Adequacy
- The operational capability of any electrical, mechanical or hydraulic fire services

(b) This certification shall not be construed to infer or imply compliance with any requirement of —

- Water, Gas, Electrical supply authorities
- Town planning authorities
- Telecommunications authorities
- Occupational Health and Safety legislation
- WorkCover (Work-safe) Authority

2.3 Description of Premises

(a) *Rise in Storeys (Clause C1.2)*

The building has a rise in storeys of three (3).

(b) *Classification (Clause A3.2)*

The building is considered to be of mixed classification namely —

- Class 5 — Offices
- Class 9b — Exhibition Halls

(c) *Type of Construction (Table C1.1)*

Type A Construction.

2.4 Conditions of Approval

(i) Structural Engineer to certify that the Design and Construction of the building is in accordance with the following Australian Standard —

(a) A.S.1170.1, 1170.2 and 1170.4 — Dead and Live Loads
(b) A.S.3600 — Concrete Construction
(c) A.S.1250 or A.S.4100 — Steel Construction
(d) A.S.3700 — Masonry Elements
(e) A.S.1288 — Glass Installations
(f) A.S.1562 — Metal Roofing
(g) A.S.1720.1 — Design of Timber Structures.

(ii) Materials used in the building are to comply with the early fire hazard indices of Specification C1.10 of the Building Code of Australia (B.C.A.).

At completion of works, certificates are to be submitted evidencing compliance with the relevant indices.

(iii) Unobstructed height of all required exit doors is to be 2,000 mm.

(iv) Paths of travel of at least the width of the required exit are to be provided from all required exit doors to a public road.

(v) All electricity/distribution boards, or central telecommunication distribution boards located in the path of travel, are to be enclosed in non-combustible construction or a fire protective covering, with doors provided with smoke seals.

(vi) Fixed platforms, walkways, stairways and ladders to plantrooms to comply with A.S.1657.

(vii) Doors serving as required exits must be readily openable without a key from the side from which a persons would be seeking egress, by a single handed downward action without use of a key. To the halls, doors are to be openable by panic bars.

(viii) Balustrades are to comply with Clause D2.16 of the B.C.A. Prior to installation, details are to be submitted for approval.

(ix) Prior to commencement of work in the kiosk areas, details are to be submitted for approval and verification by Scientific Services Laboratory (S.S.L.) on increased exit widths.

B Hardman SOPA overruled this requirement ← (x) The N.S.W. Fire Brigades is to be on site for all events undertaken in the halls.

(xi) Prior to occupation of the premises, security staff are to be trained in first-aid fire fighting and evacuation procedures. Such training is to be developed and maintained by a recognised evacuation/emergency procedures training company.

(xii) An early warning smoke detection system in the form of a VESDA is to be provided.

(xiii) Storerooms to the halls are to be enclosed in construction having an FRL of at least 60/60/60.

(xiv) The halls are to have a separate mains supply to the administration building or the sub-mains are to comply with N.S.W. Clause H101.19.3. Prior to occupation of the premises certification is to be submitted that the sub-mains comply with N.S.W. Clause H101.19.3.

(xv) Lighting switches to the halls are to be inaccessible to the public.

2.5 **Certification**

I certify that, subject to Items 2.1, 2.2, 2.3 and 2.4 above, and favourable determination of the Section 70 Submission, the building as designed complies with the principals and objectives of the Local Government (Approvals) Regulation, 1993 and the Building Code of Australia 1990) as are applicable to the premises.

Signed : ....

Trevor R. Howse

ANNEXURE "A"

ESSENTIAL SERVICES

ESSENTIAL SERVICES

Pursuant to Clause 4(i) of the Local Government (Approvals) Regulation, 1993, the following items are defined as essential services —

(a) Access Panels
(b) Emergency Lighting
(c) Emergency Warning and Intercommunication System
(d) Exit Signs
(e) Fire and Smoke Alarms (VESDA)
(f) Fire Dampers
(g) Fire Doors
(g) Fire Hydrants
(h) Fire Shutters
(i) Hose Reels
(j) Lightweight Construction
(k) Mechanical Ventilation System
(l) Portable Fire Extinguishers
(m) Required Exit Doors (automatic)
(n) Emergency and Evacuation Procedures

ANNEXURE "B"

ASSESSED DESIGN DOCUMENTATION

Date : 1 May, 1997

Our Ref.: J96136

CERTIFICATION OF BUILDING DESIGN COMPLIANCE

Annexure "B"

Assessed Design Documentation

(i) *Architectural Details* — as prepared by Ancher Mortlock & Woolley Pty. Ltd. and dated 6 September, 1996.

Drawing No.	Description
A000-C	Title Sheet and Drawing Register
A001-A	Site Plan & Setout
A100-B	Basement Level Plan - Hall 1 and Administration
A101-B	Basement Level Plan - Halls 2, 3 and 4
A102-C	Ground Level Plan - Hall 1 and Administration
A103-C	Ground Level Plan - Halls 2, 3 and 4
A104-A	Level Plan - Hall 1 and Administration
A105-A	Level Plan - Hall 2, 3 and 4
A106-A	Level 2 Plan - Administration
A107-A	Level 3 Plan - Administration/Plant
A108-B	Roof Plan - Hall 1 and Administration
A109-B	Roof Plan - Halls 2, 3 and 4
A110	Partition Plans 1 - Administration
A111	Partition Plans 2 - Administration
A112	Furniture Plans 1 - Administration
A113	Furniture Plans 2 - Administration
A200-A	Reflected Ceiling Plan - Hall 1 and Administration, Ground Level
A201-A	Reflected Ceiling Plan - Halls 2, 3 and 4, Ground Level
A202-A	Reflected Ceiling Plan - Hall 1 and Administration, Level 1
A203-A	Reflected Ceiling Plan - Halls 2, 3 and 4, Level 1
A204-A	Reflected Ceiling Plan - Hall 1 and Administration, Level 2
A300-A	North Elevation
A301-A	South Elevation
A302-A	East and West Elevations
A303-A	North Elevation (Canopy)
A400-A	Section AA
A401-A	Sections BB and CC

Drawing No.	Description
A402-A	Sections DD, EE, FF
A701-A	Roof Section - Hall 1
A702-A	Roof Section - Halls 2, 3 and 4
A703-A	Wall/Roof Sections - Hall 1
A704-A	Wall/Roof Sections - Hall 1
A705-A	Wall Sections - Hall 1
A706	Wall Sections - Hall 1
A707-A	Wall Sections - Halls 2, 3 and 4
A708-A	Wall Sections - Halls 2, 3 and 4
A709	Wall Sections - Halls 2, 3 and 4
A710-A	Roof Sections - Halls 2, 3 and 4
A711-A	Wall/Roof Sections - Halls 2, 3 and 4 (PODS)
A712-A	Wall/Roof Sections - Halls 2, 3 and 4 (PODS)
A713-A	Wall/Roof Sections - Foyer
A714-A	Wall/Roof Sections - Foyer
A715-A	Wall/Roof Sections - Administration
A716-A	Wall/Roof Sections - Administration
A717-A	Wall/Roof Sections - Administration

Signed : ....

Trevor R. Howse

ANNEXURE "C"

B.C.A. DESIGN ASSESSMENT REPORT

TREVOR R HOWSE & ASSOCIATES PTY LTI
ACN 003 753 839
Building Regulations Consultants

REPORT

PREPARED FOR

Ancher Mortlock & Woolley Pty. Ltd.

BY

Trevor R. Howse & Associates Pty. Ltd.

REGARDING

New Sydney Showground - Zone 2

For the purpose of assessment for Compliance of the Tender Issue documentation with the Building Code of Australia (B.C.A.), 1990, incorporating Amendment Numbers 1 to 10 inclusive and including the N.S.W. Appendix.

1 May, 1997

Our Ref. : J96136(R2) AP/RL

FIRE SAFETY
3UILDING AUDIT
DESIGN ASSESSMENT
CERTIFICATION

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I N D E X

CONTENTS PAGE

PART **1**

BASIS OF ASSESSMENT

1.0 BASIS OF ASSESSMENT

1.1 General

The subject building development is located within the Boundaries of the Homebush Bay Environ, and is bounded by King Avenue, Bames Road and The Avenue.

1.2 Building Code of Australia

This report is based on the Building Code of Australia, 1990 Edition incorporating Amendment No's. 1 to 10 inclusive and the N.S.W. Variation where applicable.

1.3 Design Documentation

The basis of this report is the following Design Documentation —

Drawing No.	Description	Dated
A000-C	Title Sheet & Drawing Register	6/9/96
A001-A	Site Plan & Setout	6/9/96
A100-B	Basement Level Plan - Hall 1 & Administration	6/9/96
A101-B	Basement Level Plan - Halls 2, 3 and 4	6/9/96
A102-C	Ground Level Plan - Hall 1 & Administration	6/9/96
A103-C	Ground Level Plan - Halls 2, 3 and 4	6/9/96
A104-A	Level Plan - Hall 1 & Administration	6/9/96
A105-A	Level Plan - Hall 2, 3 and 4	6/9/96
A106-A	Level 2 Plan - Administration	6/9/96
A107-A	Level 3 Plan - Administration/Plant	6/9/96
A108-B	Roof Plan - Hall 1 and Administration	6/9/96
A109-B	Roof Plan - Halls 2, 3 and 3	6/9/96
A110	Partition Plans 1 - Administration	6/9/96
A111	Partition Plans 2 - Administration	6/9/96
A112	Furniture Plans 1 - Administration	6/9/96
A113	Furniture Plans 2 - Administration	6/9/96
A200-A	Ref. Ceiling Plan - Hall 1 & Admin. Ground Level	6/9/96
A201-A	Ref. Ceiling Plan - Halls 2, 3 & 4 Ground Level	6/9/96
A202-A	Ref. Ceiling Plan - Hall 1 & Admin. Level 1	6/9/96
A203-A	Ref. Ceiling Plan - Halls 2, 3 & 4 Level 1	6/9/96

Drawing No.	Description	Dated
A204-A	Ref. Ceiling Plan - 1 & Admin Level 2	6/9/96
A300-A	North Elevation	6/9/96
A301-A	South Elevation	6/9/96
A302-A	East & West Elevations	6/9/96
A303-A	North Elevation (Canopy)	6/9/96
A400-A	Section AA	6/9/96
A401-A	Sections BB and CC	6/9/96
A402-A	Sections DD, EE, FF	6/9/96
A701-A	Roof Section - Hall 1	6/9/96
A702-A	Roof Section - Halls 2, 3 & 4	6/9/96
A703-A	Wall/Roof Sections - Hall 1	6/9/96
A704-A	Wall/Roof Sections - Hall 1	6/9/96
A705-A	Wall Sections - Hall 1	6/9/96
A706	Wall Sections - Hall 1	6/9/96
A707-A	Wall Sections - Halls 2, 3 & 4	6/9/96
A708-A	Wall Sections - Halls 2, 3 & 4	6/9/96
A709	Wall Sections - Halls 2, 3 & 4	6/9/96
A710-A	Roof Sections - Halls 2, 3 & 4	6/9/96
A711-A	Wall/Roof Sections - Halls 2, 3 & 4 (PODS)	6/9/96
A712-A	Wall/Roof Sections - Halls 2, 3 & 4 (PODS)	6/9/96
A713-A	Wall/Roof Sections - Foyer	6/9/96
A714-A	Wall/Roof Sections - Foyer	6/9/96
A715-A	Wall/Roof Sections - Administration	6/9/96
A716-A	Wall/Roof Sections - Administration	6/9/96
A717-A	Wall/Roof Sections - Administration	6/9/96

as prepared by Ancher Mortlock & Woolley Pty. Ltd.

BUILDING DESCRIPTION

2.0 BUILDING DESCRIPTION

For the purposes of the Building Code of Australia (B.C.A.) the development may be described as follows.

2.1 Rise-in-Storeys (Clause C1.2)

The building has a rise in storeys of three (3) by virtue of the administration area.

N.B.:- To enable consideration of the halls and administration building it is proposed to provide fire wall separation whereby the halls would have a rise in storeys of 2.

2.2 Classification (Clause A3.2)

The building is considered to be of mixed classification namely —

Class	Use
5	Offices
9b	Exhibition Halls/Place of Public Entertainment

2.3 Effective Height (Clause A1.1)

The building has an "effective height" of less than 25 metres.

N.B.: Effective height being measured from the floor of the top-most storey to the floor of the lowest storey providing direct egress to a road or open space.

2.4 Type of Construction Required (Table C1.1)

Type B Construction.

2.5 Floor Area Limitations (Table C2.2)

For the purposes of compartmentation, the building will be considered as a large isolated building, under Clause C2.3(b), as the floor area of the building, and volume of the building is in excess of the maximum floor area limits specified in Table C2.2.

BUILDING ASSESSMENT

3.0 **BUILDING ASSESSMENT**

3.1 **Section C – Fire Resistance**

3.1.1 *Part C — Fire Resistance and Stability (Type B Construction)*

(a) Specification C1.1 — Fire Resisting Construction

(i) External Walls (including any columns and other building element incorporated therein)

Required — Loadbearing 18 m or more to a fire source feature nil FRL.

Proposed — Steel or timber portal frame incorporated in external wall of the building located more than 18m to a fire source feature.

COMPLIES.

(ii) External Walls (Non-Loadbearing)

Required — 3 m or more to a fire source feature, nil FRL but must be non-combustible.

Proposed — Use of face brickwork, pre-finished metal panelling and metal louvres.

COMPLIES.

(iii) External Columns (not incorporated in an external wall)

NOT APPLICABLE.

(iv) Internal Walls

(A) Bounding Public Corridors, Public Hallways etc

Required — Non-loadbearing — Nil FRL

— Loadbearing FRL 120/—/—

Proposed — Non-loadbearing

COMPLIES.

(B) Between or Bounding Sole Occupancy Units

Required — Non-loadbearing — Nil FRL

Proposed — Non-loadbearing

COMPLIES.

(C) Walls Bounding Fire Resisting Lift and Stair Shafts

Required —

	Class 5 & 9b
Loadbearing	120/120/120
Non-Loadbearing	—/120/120

Proposed — Stairs to Administration building connecting 3 storeys shown in 120/120/120 fire rated shafts.

COMPLIES.

(vi) Loadbearing Internal Walls and Columns

Required — FRL of 120/—/—.

Proposed — Reinforced concrete frame to Administration building.

COMPLIES.

This FRL is only applicable to the loadbearing internal walls and columns at ground level 1 and first floor level. Supporting floors above. No FRL is required to columns and walls in the storey immediately below the roof due to the concession given by Specification C1.1/Clause 4.1(g).

(vii) Floors

Required — Nil FRL.

(viii) Roofs

Required — Nil FRL.

(b) Specification C1.10 — Early Fire Hazard Indices

Required — Compliance with spread of flame and smoke-developed indices.

Proposed — To be as required.

WILL COMPLY.

3.1.2 *Part C2 — Compartmentation and Separation*

(a) Clause C2.2 — General Floor Area Limitations for Type B Construction

Required —

Maximum Allowable	Class 6	Class 5 & 9b
Area	3,500 m^2	5,500 m^2
Volume	210,000 m^3	35,000 m^3

Proposed — The floor areas will clearly exceed the above limitations. However, as referred to in detail below, the building will be treated as a large isolated building thus, the floor area and volume limitations of Clause C2.2 do not apply.

NOT APPLICABLE.

(b) Clause C2.3 — Large Isolated Buildings

Required — Where a building exceeds 18,000 m^2 or 108,000 m^3 in volume, the building must:

(i) be fully protected by a sprinkler system;

(ii) be provided with perimeter vehicle access in accordance with Clause C2.4;

(iii) be provided with a smoke exhaust system complying with Specification E2.2.

Proposed — The building has been engineered so that sprinklers are not provided and the natural smoke reservoir and natural ventilation will be used for smoke control.

— The Administration building being separated rom the Exhibition building by a 120/120/120 fie wall will be treated as a separate building which is within the maximum prescribed floor area limits and complies fully with the prescriptive requirements of the B.C.A.

COMPLIES.

(c) Clause C2.4 — Requirements for Open Space, and Vehicle Access

Required — Must be capable of providing emergency vehicle access from a public road.

— Unobstructed width of 6 m with no part of its furthest boundary more than 18 m from the building.

— A public road may be used for this vehicular access.

Proposed — A combination of roads and hardstand areas to provide perimeter access.

COMPLIES.

(d) Clause C2.7 — Separation by fire walls

Required — Fire walls to extend through all storeys common to the buildings being separated and carried through to underside of higher roof or not less than 6m above lower roof or

— Fire wall to be carried to underside of lower roof it has an FRL of at least 120/120/120 and no openings closer than 3 m above the lower roof or

— Fire wall to be carried to lower roof if it is non-combustible and the lower part is sprinklered.

Proposed — Fire separation of offices and main hall (see Clause C2.8) by way of 120/120/120 fire wall extending to the underside of the kitchen roof which is reinforced concrete.

COMPLIES. (Subject to Engineers' Certification for FRL's of roof)

Comment — Although the Administration building has windows within 3 m of the kitchen roof, the opinion is held that the requirement of Clause C2.7 "the design of the building must otherwise restrict the spread of fire from the lower part to the higher part" is satisfied by virtue of the concrete roof to the kitchen acting as a fire wall in the horizontal plane, with no skylights closer than 3 m to the wall of the administration building.

(e) Clause C2.8 - Separation of Classifications in the Same Storey

Required — Where different classifications in a building are located alongside one another in the same storey;

- each building element in that storey must have the higher FRL for the classification concerned in accordance with Specification C1.1, or
- must be separated by a fire wall of the higher FRL for the classification concerned in accordance with Specification C1.1.

<u>Proposed</u> — The offices and hall carry the same FRL requirements under the B.C.A. so in that respect there is no need for fire separation.

WILL COMPLY.

(f) Clause C2.9 — Separation of Classifications in Different Storeys

NOT APPLICABLE.

(g) Clause C2.10 — Separation of Lift Shafts

<u>Required</u> — Lifts to office building connecting more than 3 storeys required to be non-combustible if the shaft is non loadbearing or shaft requires FRL of 120/120/120 if it is loadbearing.

<u>Proposed</u> — Reinforced concrete.

COMPLIES.

(h) Clause C2.11 — Stairways and Lifts in One (1) Shaft

<u>Required</u> — A required fire-isolated lift and stairway are not to be in the same shaft.

<u>Proposed</u> — Stairs and lifts to the building are in separate shafts.

COMPLIES.

(i) Clause C2.12 — Separation of Equipment

<u>Required</u> — Equipment such as lift motors, control panels, central smoke control plant generators and boilers etc., are to be separated from the remainder of the building by construction having an FRL of 120/120/120.

<u>Proposed</u> — Separation as required.

COMPLIES.

(b) Clause C3.8 - Openings in Fire Isolated Exits

Required — Doors that open into fire isolated stairs/passageways are required to be self closing -/60/30 fire doors.

Proposed — Fire isolated stairways to Administration building to have —/60/30 fire doors.

WILL COMPLY.

(c) Clause C3.9 - Service penetrations in fire isolated exits

Required — Services must not penetrate fire isolated exits other than electrical wiring to the emergency lighting or an intercommunication system.

Proposed — To be as required.

WILL COMPLY.

(d) Clause C3.12 - Openings in Floors for services

NOT APPLICABLE. — As building is of Type B Construction.

(e) Clause C3.13 - Openings in shafts

NOT APPLICABLE. — As building is of Type B Construction.

(f) Clause C3.14 - Openings for Service Installations

Required — Any services including electrical, electronic, plumbing, mechanical ventilation or air conditioning or other service that penetrates a structural element required to have an FRL, must not affect the fire resisting performance of that element.

Proposed — To be as required.

WILL COMPLY.

(j) Clause C2.13 — Electricity Supply System

Required — If an electricity sub-station or main switchroom, is located within a building they must be fire separated from the remainder of the building by construction having an FRL of 120/120/120, and any doorways opening into these rooms must be self-closing —/120/30 fire doors.

Proposed — Separation as required.

COMPLIES.

3.1.3 *Part C — Protection of Openings*

(a) Clause C3.2 — Protection of Openings in External Walls

Required — Openings in an external wall that is required to have an FRL must be protected in accordance with Clause C3.4 if it is situated less from a fire source feature to which it is exposed than —

(i) 3 m from a side or rear boundary of the allotment; or

(ii) 6 m from the far boundary of a road adjoining the allotment if not located in a storey at or near ground level; or

(iii) 6 m from another building on the same allotment.

Proposed — All external openings are situated away from the fire source feature so as not to require protection, and the external walls being non-loadbearing do not require to possess an FRL anyway, thus protection of openings is not required.

COMPLIES.

(b) Clause C3.8 - Openings in Fire Isolated Exits

Required — Doors that open into fire isolated stairs/passageways are required to be self closing -/60/30 fire doors.

Proposed — Fire isolated stairways to Administration building to have —/60/30 fire doors.

WILL COMPLY.

(c) Clause C3.9 - Service penetrations in fire isolated exits

Required — Services must not penetrate fire isolated exits other than electrical wiring to the emergency lighting or an intercommunication system.

Proposed — To be as required.

WILL COMPLY.

(d) Clause C3.12 - Openings in Floors for services

NOT APPLICABLE. — As building is of Type B Construction.

(e) Clause C3.13 - Openings in shafts

NOT APPLICABLE. — As building is of Type B Construction.

(f) Clause C3.14 - Openings for Service Installations

Required — Any services including electrical, electronic, plumbing, mechanical ventilation or air conditioning or other service that penetrates a structural element required to have an FRL, must not affect the fire resisting performance of that element.

Proposed — To be as required.

WILL COMPLY.

(g) Clause C3.16 - Construction Joints

<u>Required</u> — Construction joints to be suitably sealed to maintain integrity and insulation of fire resistant elements.

<u>Proposed</u> — To be as required.

WILL COMPLY.

3.2 Section D – Access and Egress

3.2.1 *Part D1 — Provision for Escape*

(a) Clause D1.2 — Number of Exits Required

<u>Required</u> — At least two (2) exits from each floor except for amenities pod which only requires one exit as it accommodates less than 50 persons.

<u>Proposed</u> — As required.

COMPLIES.

(b) Clause D1.3 — When Fire-Isolated Exits are Required

<u>Required</u> — As the stairways to the administration building connect more than three (3) consecutive storeys, they are required to be fire-isolated.

<u>Proposed</u> — Stairs shown as being fire isolated.

COMPLIES.

(c) Clause D1.4 — Exit Travel Distances

<u>Required</u> — No point on the floor more than 20 m from an exit or a point from which travel in different directions to two (2) exits is available in which case the maximum distance to the nearest exit must not exceed 40 m.

Proposed — • Ground Floor — Taking into consideration that the travel distance to the ground floor is measured from the point where open space is achieved, that is open to the sky, the current egress does not comply, i.e.

- approximately 52 m travel distance from centre of Hall 1;
- approximately 54 m travel distance from centre of Halls 2, 3 and 4;

• First Floor — Travel distances do not comply i.e. —

- approximately 82 m to an exit from viewing gallery of Hall 1;

DOES NOT COMPLY

Comment — Travel distances to the main hall space are part of the fire engineered solution and will therefore comply subject to an objection against the prescriptive requirements of the B.C.A.,

(d) Clause D1.5 — Distance between Alternative Exits

Required — Not less than 9 metres and not more than 60 metres between alternative exits.

N.B.:- Distance measured in accordance with Clause D1.15.

Proposed — Ground Floor

Distance between alternate exits to Halls 2, 3 and 4 is approximately 67 m.

Administration Building

Distance between alternative exits as required.

CURRENTLY DOES NOT COMPLY (to Exhibition Halls)

Comment — Refer to Clause D1.4

(e) Clause D1.6 — Dimensions of Exits

(i) Aggregate Exit Width (Unobstructed)

Level	Class	Required	Proposed	Compliance
Ground Floor Exhibition Spaces	9b	55 m	144 m approximately	Yes
Ground Floor Back of House Areas	9b	1 m	9 m approximately	Yes
First Floor Offices	5	3.5 m	5 m approximately	Yes
Second Floor Offices	5	3.5 m	5 m approximately	Yes

Regarding the exhibition spaces, provision of exact populations and aggregate door widths cannot be ascertained as circulation spaces etc. cannot be discounted as layouts are unknown. The above figure is based on an exhibition area of 22,000 m^2 at 4 m^2/ person (5,500 persons), this is considered to present a worse case scenario.

(ii) Exit Height

Required — Unobstructed height of 2,000 mm (Stairways and Doors).

Proposed — To be as required.

WILL COMPLY.

(iii) Dimensions of Paths of Travel

Required — (i) The width of a required exit or path of travel must be not less than 1.0 m.

(ii) Path of travel not to diminish in direction of travel.

Proposed — As required.

COMPLIES.

(f) Clause D1.7 — Travel via Fire Isolated exits.

Required — A door from a room must not open directly into a fire isolated passage, unless from a:

- public corridor/hallway
- sanitary compartment

— Fire isolated passage must discharge to a road or open space or an external stairway or a point within the confines of a building that is used for pedestrian movement or car parking and is within 20 m of travel to a road or open space, and the discharge area, is enclosed for no more than 1/3 of its perimeter.

— No more than two access doors open into the fire isolated passage from the same storey or alternatively the passageway is pressurised or a smoke lobby provided.

<u>Proposed</u> — Stairs serving administration building are fire isolated stairs discharging directly to open space.

COMPLIES.

(g) Clause D1.8 - External Stairways

NOT APPLICABLE.

(h) Clause D1.9 - Travel by Non-Fire-Isolated Stairways

<u>Required</u> — Must provide a continuous means of travel by its own flight of stairs and landing from every storey served to the level at which egress to a road or open space is provided, and must discharge at a point 20 m from a door providing direct egress to a road or open space, or 40 m from one (1) of two (2) such doorways if travel to each of them is in approximately opposite directions. Total travel distance via open stairs to open space cannot exceed 80 m.

<u>Proposed</u> — Total travel distance from Level 1 viewing gallery to open space is approximately 95 m.

DOES NOT COMPLY.

<u>Comment</u> — Egress is part of the fire engineered assessment and is subject to the objection being lodged against the prescriptive requirements of the B.C.A.

(i) Clause D1.10 — Discharge from Exits

<u>Required</u> —
(i) To be unimpeded.

(ii) Be at least the width of the exit at the point of discharge at open space.

(iii) Be a ramp or stairway complying with the B.C.A.

(iv) Where at a different level be by way of a ramp 1:14 or stairs.

(v) half the number of exits from each Class 9b storey and at least half the aggregate width must discharge other than through the main entrance.

Proposed — As required.

COMPLIES.

(j) Clause D1.13 Number of Persons Accommodated

Calculation of the number of persons is done using the following —

Exhibition Halls	—	4.0 m^2/person
Kitchen	—	10 m^2/person
Storage Area/Loading Docks/ Plantroom	—	30 m^2/person
Office Area	—	10 m^2/person

Area	Approximately Area m^2	Population
Exhibition Space	22,000 m^2	5,500
Kitchen	312 m^2	32
Ground Floor Back of house area	2,000 m^2	67
First Floor Offices	1,830 m^2	183
Second Floor Offices	1,830 m^2	183

N.B.:- Population number determined on the basis of Clause D1.13(a) (Number of persons per m^2).

(i) Clause D1.15 — Method of Measurement

(i) Distance to be measured through the point of choice in which travel in different directions takes place; and

(ii) Distance to be measured around walls.

3.2.2 *Part D2 — Construction of Exits*

(a) Clause D2.3 — Non-Fire-Isolated Stairways and Ramps

Required — To be constructed of reinforced concrete, or steel not less than 6 mm thick, or timber not less than 44 mm thick with a density of 800 kg/m^3 at a moisture content of 12%.

Proposed — Reinforced concrete.

COMPLIES.

(b) Clause D2.7 — Installation in Exits and Paths of Travel

Required — Services not to be installed —

(i) in required exits; or

(ii) in paths of travel to an exit unless enclosed in non-combustible construction or a fire protective covering with doors suitably sealed against smoke spreading from the enclosure.

Proposed — To be as required.

WILL COMPLY.

(c) Clause D2.8 — Enclosure of Space under Stairs or Ramps

Required — Area under fire isolated stairs must not be enclosed and area under non-fire-isolated stairs must not be enclosed to form a cupboard unless —

(i) enclosing walls and ceilings to have an FRL of not less than 60/60/60; and

(ii) any access doorway to the enclosed space to be self-closing —/60/30 fire doors.

Proposed — No enclosures indicated.

COMPLIES.

(d) Clause D2.9 — Width of Stairways

Required — To be measured clear of handrails and all obstructions and extend to a height of 2 m vertically above nosing of treads, and where the stair is greater than 2.0 m wide must be provided with a handrail continuous between landings.

Proposed — To be as required.

WILL COMPLY.

(e) Clause D2.11 - Fire Isolated Passageways

Required — Enclosing construction of fire isolated passage to be FRL of 60/60/60 or if connecting fire isolated stair, same FRL as stair.

Proposed — Fire isolated passageways to Administration Building linking with fire isolated stairs shown in 120/120/120 enclosure.

COMPLIES.

(f) Clause D2.13 — Treads and Risers

Required — Not more than 18 or less than 2 risers and dimensions to be in accordance with 2R + G calculations.

Proposed — As required.

COMPLIES.

(g) Clause D2.14 — Landings

Required — Not less than 750 mm long measured 500 mm from the inside edge of the landing and have a non-slip finish.

Proposed — As required.

COMPLIES.

(h) Clause D2.15 — Thresholds

Required — Doorway thresholds not to incorporate step or ramp, unless not more than 190 mm above finished ground where door opens to a road or open space.

Proposed — As required.

COMPLIES.

(i) Clause D2.16 — Balustrades

Required — In a Class 5 area - Must be 865 mm above nosings of stair treads, and 1.0 m above floor of any landing/balcony and must be constructed so that a 125 mm sphere cannot pass through any opening. This includes the area above the nosing of the stairs.

In a Class 9b area - A balustrade within a building must be 1.0 m above the nosings of the stair treads/balcony or the like, and when provided externally to the building 1.2 m above the nosings of the stair treads/balcony or the like.

Proposed — To be as required.

WILL COMPLY.

(j) Clause D2.17 — Handrails

Required — To at least one (1) side of stairs at a minimum height of 865 mm above nosings.

— Be continuous between landings.

Proposed — To be as required.

WILL COMPLY.

(k) Clause D2.18 — Fixed Platforms, Walkways, Stairway, Ladders

Required — Access to plantrooms and other maintenance areas is permissible from within the stairways, provided ladders/ stairs etc, to these areas comply with A.S.1657.

Proposed — To be as required.

WILL COMPLY.

(l) Clause D2.19 — Doorways and Doors

Required — (i) Doors serving as required exits or forming part of required exits not to be revolving or roller shutters unless area is Class 6, 7 or 8, not more than 200 m^2, and doorway is only means of egress from that area. Revolving doors are not permitted as required exits from any areas.

(ii) Sliding doors to open space must be manually operated at not more than 110N force or, if automatic, be fitted with a fail safe device and open automatically.

Proposed — Required exits shown as swinging doors.

COMPLIES.

(m) Clause D2.20 — Swinging Doors

Required — A swinging door in a required exit or forming part of a required exit, to swing in direction of egress, **unless** serving a part of the building less than 200 m^2 and provided with a hold-open device.

Proposed — As required.

COMPLIES.

(n) Clause D2.21 — Operation of a Latch

Required — An exit door must be readily openable without a key from the side that faces a person seeking egress by a single handed downward action or pushing action on a single device which is located between 900 mm and 1.2 m from the floor. To Class 9b, required to be fitted with panic bolts where required to be secured.

Proposed — To be as required.

WILL COMPLY.

(o) Clause D2.23 — Signs on Doors

Required — On the outside of doors leading into fire isolated passages signage is to be provided to the affect:

"FIRE DOOR
DO NOT OBSTRUCT
DO NOT KEEP OPEN"

and for a door discharging from a fire isolated exit on both sides of the door:

"FIRE SAFETY DOOR
DO NOT OBSTRUCT"

Proposed — To be as required.

WILL COMPLY.

3.2.3 *Part D3 - Access for People with Disabilities*

(a) Clause D3.2 - Access to Buildings

<u>Required</u> — Disabled access is required to be provided to all levels of the administration building and to within the exhibition halls.

<u>Proposed</u> — Disabled access directly from ground level and to upper levels of the administration building via passenger lifts.

COMPLIES.

3.3 **Section E — Services and Equipment**

3.3.1 *Part E1 — Fire Fighting Equipment*

(a) Clause E1.3 — Fire Hydrants

<u>Required</u> — Internal fire hydrants are to be provided to serve the building, as the floor area exceeds 500 m^2 and there is an operational fire service to attend a building fire. Fire hydrants are to be located within 4 m of a required exit and where fire isolated stairs provided, to be located within the stair.

<u>Proposed</u> — As required.

COMPLIES.

(b) Clause E1.4 — Hose Reels

<u>Required</u> — As internal hydrants are required to be provided throughout, so are hose reels to be located within 4 m of a required exit.

<u>Proposed</u> — As required.

COMPLIES.

(c) Clause E1.5 — Sprinklers

Required — As the building is being considered as a large isolated building, the sprinkler system must be installed throughout in accordance with A.S.2118.

Proposed — Refer to Clause C2.3.

(d) Clause E1.6 — Portable Fire Extinguishers

Required — To be installed in accordance with A.S.2444 and being of an extinguishing agent suitable for the risk, located adjacent to the hydrant/hose reel installation.

Proposed — To be as required.

WILL COMPLY.

(e) Clause E1.7 — Fire and Smoke Alarms

Required — E.W.I.S. and VESDA to be installed as part of the fire engineered solution.

Proposed — To be as required.

WILL COMPLY.

(f) Clause E1.8 — Fire Control Centre

Required — To be installed in accordance with Specification E1.8 where the floor area exceeds 18,000 m^2.

Proposed — Fire control centre provided to South East corner.

COMPLIES.

3.3.2 *Part E2 — Smoke Hazard Management*

Clause E2.2 — General Requirements

Required — Specification E2.2 smoke exhaust system as the building is to be treated as a large isolated building in accordance with Clause C2.3.

Proposed — Engineered smoke hazard management system. (Refer to Clause C3.2).

WILL COMPLY. (Subject to objection against prescriptive B.C.A. requirements)

3.3.4 *Part E4 — Emergency Lighting, Exit Signs and Warning Systems*

(a) Clause E4.2 — Emergency Lighting Requirements

Required — (i) In every storey of a Class 5 and 9b building where the floor area of the storey exceeds 300 m^2.

- In every passageway/ corridor that forms a path of travel to a required exit (Arcade areas)
- In any room that has a floor area greater than 100 m^2 that does not open to a corridor with emergency lighting
- In any room (tenancy) with a floor area over 300 m^2
- In every required non-fire-isolated stairway
- In every fire isolated passage.

(ii) Emergency lighting to be designed to comply with A.S.2293.1.

Proposed — To be as required.

WILL COMPLY.

(b) Clause E4.5 — Exit Signs

Required — To be provided above or adjacent to each doorway leading into a non-fire-isolated stair. Also above or adjacent to every door serving as a required exit in a storey required to be provided with emergency lighting.

Exit signs to be designed in accordance with A.S.2293.1.

Proposed — To be as required.

WILL COMPLY.

(c) Clause E4.9 — Emergency Warning and Intercommunication System (E.W.I.S.)

Required — To be installed in accordance with A.S.2220 as the Class 9b portion exceeds 1,000 m^2.

Proposed — To be as required.

WILL COMPLY.

3.4 Section F – Health and Amenity

3.4.1 *Part F2 — Sanitary and Other Facilities*

(a) Clause F2.3 — Facilities in Class 3 to 9 Buildings

Refer to **ANNEXURE "1"** — Toilet numbers as calculated by Ancher Mortlock & Woolley Pty. Ltd.

(b) Clause F2.4 — Facilities for People with Disabilities

Required — One (1) unisex facility per 100 closet pans and urinals.

Proposed — To be as required.

WILL COMPLY.

3.5 Section G - Ancillary Provisions

3.5.1 *Part G3 - Atrium Construction*

(a) Clause G3.1 Atriums effected by this part

Required — Part G3 applicable to an atrium connecting more than 2 storeys in an unsprinklered building or more than 3 storeys in a sprinklered building.

Proposed — Reception voids only connect 2 storeys, 120/120/120 separation around open stair at Level 1.

COMPLIES.

3.6 Section H – Special Use Buildings (Only relates to Exhibition Halls)

3.5.1 *N.S.W. Part H101 — Places of Public Entertainment*

(a) Clause N.S.W. H101.2 — Fire Separation

Required — Where a place of public entertainment forms only part of a building, it must be fire separated from the remaining part of the building by construction with an FRL of 60/60/60.

Proposed — 120/120/120 fire separation between halls and administration building.

COMPLIES.

(b) Clause N.S.W. H101.16 — Storerooms

Required — Storerooms must be separated from other parts of the building by construction with an FRL of 60/60/60.

Proposed — To be as required.

WILL COMPLY.

(c) Clause N.S.W. H101.19 — Electrical Mains Installation
Clause N.S.W. H101.19.1 — Main Switchboard

Required — Be located in a position readily accessible by fire brigade personnel.

— Be enclosed in construction with an FRL of 60/60/60.

Proposed — Main Switchroom in service tunnel.

COMPLIES.

(d) Clause N.S.W. H101.19.2 — Circuit Protection

Required — Protection of a final sub-circuit originating at a switchboard or distribution board must be by circuit breakers.

Proposed — To be as required.

WILL COMPLY.

(e) Clause N.S.W. H101.19.3 — Separate Sub-Mains

Required — Place of Public Entertainment must be served by an independent sub-main from the main switchboard.

— Each such sub-main, consumer main, and the supply authorities conductors to be protected from fire by:

(i) metal sheathed cables providing 2 hour protection; or

(ii) heavy duty PVC conduit concrete encased in walls or slabs with 50 mm cover; or

(iii) heavy duty PVC conduit buried 500 mm below ground level.

ANNEXURE "1"

Toilet Number Calculations by
Ancher Mortlock & Woolley Pty. Ltd.

Ancher/Mortlock/Woolley
180 Goulburn Street, Sydney NSW 2010
ACN 002 903 988
Facsimile (02) 283 2969
Telephone (02) 264 5366

Memorandum

Attachment to Sanitary Facilities

Project: NEW SYDNEY SHOWGROUND, HOMEBUSH BAY: ZONE 2

Project No.: 9602 File No.: E6

To: CPTC – PHIL HAYCOCK
DON MAZEH

Date: 22.5.96

Action

CALCULATIONS FOR TOILET NUMBERS

EXHIBITION HALLS

HALL 1
2,500 people in Banquet Mode

HALLS 2, 3 & 4
$14{,}500m^2$ floor area
Assume $4m^2$ per person (BCA table D1.13)
ie 14,500 ÷ 4 = 3,625 people

TOTAL PEOPLE = 2,500 + 3,625
= 6,125

Therefore 3,063 Males
3,063 Females

'PUBLIC HALLS' for 3063 MALES

WC's – first 300	=	2WC
Each extra 200 (1)	=	14WC
TOTAL	=	**16WC**
Urinals – First 250	=	5 urinals
Each extra 100	=	1
2,813 ÷ 100	=	29 urinals
TOTAL	=	**34 URINALS**
Basins – First 200	=	2 basins
Each extra 200	=	1
2,863 ÷ 200	=	15 basins
TOTAL	=	**17 BASINS**

ie MALE – 16WC, 34 URINALS, 17 BASINS.

Distribution : ☐ Client ☐ Consultant ☐ AMW: ☐ Other:

Purpose : ☐ General Notes ☐ Minutes of Meeting ☐ Proposed design changes ☐ Other:

Ancher Mortlock & Woolley Pty Ltd
per: [signature]

Ancher/Mortlock/Woolley
180 Goulburn Street, Sydney NSW 2010
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Memorandum
(Continued)

Attachment to Sanitary Facilities

Project: NEW SYDNEY SHOWGROUND, HOMEBUSH BAY: ZONE 2 — Project No.: 9602 — File No.:

To: — Date: 22.5.96

Action

'PUBLIC HALLS' FOR 3,063 FEMALES

WC's – First 250	=	6 WC's
Each extra 100	=	1
2,813 ÷ 100	=	29WC's
TOTAL	**= 35 WC's**	
Basins – First 150	=	6 WC's
Each extra 100	=	1
2,813 ÷ 100	=	29WC's
TOTAL	**=17 BASINS**	

ie FEMALE – 35 WC, 17 BASINS

ADMINISTRATION BUILDING – PER FLOOR
TYPICAL FOR LEVELS 2 & 3 OFFICE

1,890m^2 Floor area (excluding stairs, lobbies service ducts and other ancillary uses. BCA S1.13)

Use 10m^2 per person
ie. 1,890 ÷ 10 = 189 people

Therefore 95 Males
95 Females

FOR 95 MALES

WC's – First 40	=	2WC's
Each extra 20	=	1
55 ÷ 20	=	3WC's
TOTAL	**= 5WC's**	
Urinals – First 50	=	2 Urinals
Each extra	=	1
45 ÷ 50	=	1 Urinal
TOTAL	**=3 URINALS**	
Basins – First 60	=	2 Basins
Each extra 30	=	1
35 ÷30	=	2 Basins
TOTAL	**= 4 BASINS**	

ie MALE – 5 WC's, 3 URINALS, 4 BASINS

02/07 '96 10:18 FAX 61 2 283 2969 AMW PTY LTD +++ TREVOR HOWSE 005/010

Ancher/Mortlock/Woolley

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Memorandum
(Continued)

Attachment to Sanitary Facilities

Project: NEW SYDNEY SHOWGROUND, HOMEBUSH BAY: ZONE 2

Project No.: 9602 File No.:

To:

Date: 22.5.96

Action

FOR 95 FEMALES

WC's – First 30	=	2 WC's
Each extra 15	=	1
65 + 15	=	15 WC's
TOTAL	=	7 WC's
Basins – First 60	=	2 Basins
Each extra 30	=	1
35 + 15	=	2 Basins
TOTAL	=	4 BASINS

Ie FEMALE 7WC's. 4 BASINS

9602 NEW SYDNEY SHOWGROUND, HOMEBUSH BAY: ZONE 2

LOCATION	M/F	WCs	URINALS	BASINS	SHOWERS
HALL 1 FOYER					
Public	Male	~~3~~ 4	~~5~~ 7	~~3~~ 4	-
(75m²)	Female	~~6~~ 8	-	~~3~~ 4	-
	Accessible	1	-	1	-
BETWEEN HALLS 1 & 2 - NORTH					
Public	Male	2	4	2	-
(65m²)	Female	4	-	2	-
	Accessible	1	-	1	-
BETWEEN HALLS 1 & 2 - SOUTH					
Public	Male	2	4	2	-
(52m²)	Female	4	-	2	-
HALL 2 NORTH SERVICE POD					
Public	Male	1	3	2	-
(36m²)	Female	3	-	2	-
	Accessible	1	-	1	-
HALL 3 NORTH SERVICE POD					
Public	Male	1	3	2	-
(36m²)	Female	3	-	2	-
	Accessible	1	-	1	-
Ground Floor ADMIN.					
Heritage Area	unisex	2	-	2	-
First Aid	male	1	-	1	- (same room.)
	female	1	-	1	- (same room.)
Parent	unisex	4	-	3	-

LOCATION	M/F	WCs	URINALS	BASINS	SHOWERS
HALL 4 NORTH SERVICE POD					
Public	Male	1	3	2	-
(36m²)	Female	3	-	2	-
	Accessible	1	-	1	-
HALL 2 SOUTH SERVICE POD					
Public	Male	2	4	2	-
(20m²)	Female	4	-	2	-
Staff	Male	1	-	1	1
(15m²)	Female	1	-	1	1
HALL 3 SOUTH SERVICE POD					
Public	Male	2	4	2	-
(20m²)	Female	4	-	2	-
Staff	Male	1	-	1	1
(15m²)	Female	1	-	1	1
HALL 4 SOUTH SERVICE POD					
Public	Male	2	4	2	-
(20m²)	Female	4	-	2	-
Staff	Male	1	-	1	1
(15m²)	Female	1	-	1	1

LOCATION	M/F	WCs	URINALS	BASINS	SHOWERS
HALL 2 NORTH SERVICE POD FIRST FLOOR					
Hospitality	Male	1	-	1	-
(14m²)	Female	1	-	1	-
HALL 3 NORTH SERVICE POD FIRST FLOOR					
Hospitality	Male	1	-	1	-
(14m²)	Female	1	-	1	-
HALL 4 NORTH SERVICE POD FIRST FLOOR					
Hospitality	Male	1	-	1	-
(14m²)	Female	1	-	1	-
HALL 2 SOUTH SERVICE POD FIRST FLOOR					
Exhibitors	Male	1	-	1	-
(10m²)	Female	1	-	1	-
HALL 3 SOUTH SERVICE POD FIRST FLOOR					
Exhibitors	Male	1	-	1	-
(10m²)	Female	1	-	1	-

ANNEXURE "D"

SECTION 70 DISPENSATION REPORT

I N D E X

CONTENTS PAGE

PART **1**

INTRODUCTION

1.0 INTRODUCTION

1.1 Location

The subject development is located with the boundaries of the Homebush Bay environ, and is bounded by King Avenue, Bames Road and The Avenue.

1.2 Description of the Building Project

The building consists of 4 main halls with attached foyers, offices, cafe, meeting rooms, plantrooms and other ancillary rooms. Hall 1 is fundamentally a domed structure with a ground level diameter of approximately 97 m, with the height of the dome approximately 42 m. Halls 2, 3 and 4 each have an area of approximately 72 m x 67 m. (Refer to **Annexure "A"** - S.S.L. Report, Section 6, for a general description of the building).

1.3 Purpose of Submission

The purpose of this Submission is to assess the hazards, if any, associated with non-compliance of certain elements of the building design with specific provisions of the Building Code of Australia (B.C.A.) and to seek dispensation from the Olympic Co-ordination Authority for those areas of non-compliance.

1.4 Impact of Proposal

The proposal's impact upon certain regulatory (B.C.A.) provisions may be summarised as follows —

- Clause C2.3(b) — requirement for smoke exhaust system in accordance with Specification E2.2; and requirement for sprinkler system throughout;
- Clause D1.4(c) — Exit travel distances — Class 5 to 9 buildings;
- Clause D1.5 — Distance between alternate exits; and
- Clause D1.9 — travel via non-fire-isolated stairs.

1.5 Background to Fire Modelling (Refer Annexure "A" S.S.L. Report)

1.5.1 *Design Fires (cf. Page 8 of S.S.L. Report)*

Worst case fire scenarios were determined based on the expected quantity, nature and distribution of combustible materials. An extremely conservative ultra fast fire up to 50 MW was chosen. This was considered to be conservative as the rate of growth of the fire could drop off to a medium or fast growth rate due to horizontal fire spread.

1.5.2 *Smoke Development (cf. Section 5 of S.S.L. Report)*

The development of untenable escape Conditions was modelled using CFD modelling in order to determine smoke production and behaviour with respect to fire size and the provision of any smoke venting and extraction.

Available Safe Egress Times (ASET) were determined for each part of the building based on the worse case fire scenario expected to occur in that region.

1.5.3 *Tenability Limits (cf. Section 4 of S.S.L. Report)*

A tenable escape environment was taken to have occurred when —

(i) the smoke layer is at least 2.1 m above floor level at an average temperature of less than 183°C; or

(ii) the smoke layer provides visibility for at least 20 m and has an average temperature less than 100°C.

1.5.4 *Evacuation (cf. Section 11 of S.S.L. Report)*

Evacuation from the building is divided into three (3) main phases —

(i) Response times;

(ii) Coping times; and

(iii) Travel or exit times.

Analysis of evacuation time determines the Required Safe Egress Time (RSET) for the building occupants. The summation of the above three phases gives a RSET value which is then compared to the ASET in order to determine the level of safety in the building.

VARIATION OF STANDARD B.C.A. REQUIREMENTS

2.0 VARIATION OF STANDARD B.C.A. REQUIREMENTS

The matters referred to in Item 1.3 of this Submission are herein described for the purposes of seeking variation to the standard Building Code of Australia (B.C.A.) Clauses. The opinion is held that compliance with the subject Clauses is unnecessary in this instance, when having consideration for the particular circumstances of the case, as outlined below.

2.1 Background

It is proposed to construct the building as a large isolated building in accordance with the requirements for Type B Construction.

2.2 Building Description

For the purposes of the B.C.A., the building may be described as follows —

- Having a rise-in-storeys of :

  Two (2) — Halls

  Three (3) — Administration building

- Being of Class 5 (offices) and Class 9b (exhibition halls/place of public entertainment).

- Required to be of Type B Construction;

- Having an effective height of less than 25 m; and

- Not subject to floor area limitations as the building is to be considered as a large isolated building in accordance with Clause C2.3.

2.3 Clause C2.3(b)

(a) Clause Requirement

Clause C2.3(b) requires that a building exceeding 18,000 m^2 in area or 108,000 m^3 in volume and with a ceiling height of more than 12 m be provided with a Specification E2.2 Smoke Exhaust System and must be protected throughout with a sprinkler system.

(b) Clause Objective

The objectives of a smoke control system are illustrated in the objectives of Clause E2.2 **i.e.** a smoke control system should be designed such that tenable escape conditions are maintained so that:

(A) the temperature will not endanger human life; and

(B) the level of visibility will enable the escape route to be determined; and

(C) the level of toxicity will not endanger human life,

for the period of time the occupants would take to evacuate that part of the building.

Further, the objective of a sprinkler system can be seen to restrict fire growth, minimise damage to the building and its contents and prevent fire spread to adjoining buildings or allotments.

(C) Design Proposal

It is proposed to meet the objectives of smoke hazard management and sprinkler installation by providing for a building situation, which meets the performance requirements of smoke control instead of the prescriptive requirements of Specification E2.2. This will be achieved by early occupant warning, natural smoke venting and adequate egress to ensure that the time taken to escape the building does not exceed the available egress time.

S.S.L. have carried out modelling using Computational Fluid Dynamics to look at smoke behaviour to the building to determine the time for on-set of untenable conditions in the event of a worse case fire scenario compared to the required time for safe evacuation of all of the buildings occupants **(see Annexure "A" – S.S.L. Report)**.

(D) Design Assessment

In aligning the design proposal against the objectives of the B.C.A., the following is considered relevant —

(vi) Whilst smoke exhaust functions to maintain tenable escape conditions, it also serves to exhaust hot gases and assist in Fire Brigade access into the building. In this respect, the Fire Brigade would arrive on site within the time available for egress and would, therefore, be able to assist in evacuation if required. Staff will be trained in first-aid fire fighting procedures in order to assist in control of a fire in its early stages of development. Further, the need for the Brigade to enter the building is negated by the fact that a perimeter access road and external hydrants are available to fight a fire externally.

(vii) All of S.S.L.'s recommendations as per Section 13 of their Report will be adopted.

Having consideration for the above, the opinion is held that the non-provision of a sprinkler system and Specification E2.2 smoke exhaust system does not pose a hazard to people egressing the building, the Fire Brigade accessing the building.

2.4 **Clause D1.4(c), Clause D1.5 and Clause D1.9**

(a) Clause Requirement

Clause D1.4(c) states that in a Class 5 to 9 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 two (2) exits is available, in which case the maximum distance to one (1) of those exits must not exceed 40 m.

Clause D1.5 provides for alternate exit to be no closer than 9 m and not more than 60 m apart.

Clause D1.9 requires that the total travel distance via a non-fire-isolated stairway to open space does not exceed 80 m.

(b) B.C.A. Objective

The objectives of Section D, and in particular travel distances and distance between exits, is to ensure that there is adequate means of escape in the case of a fire or other emergency from all parts of the building to a place of safety. Setting maximum travel distance and distance between exits is meant to ensure that people have sufficient time to escape the building.

(c) Design Proposal

The worst case for egress from the building is approximately 82 m from the viewing gallery to Hall 1, approximately 54 m from the centre of Halls 2, 3 and 4 and approximately 52 m from the centre of Hall 1.

PART **3**

CONCLUSION

3.0 CONCLUSION

3.1 General

Arising from the relevant circumstances described in Part 2 of this Submission, we are of the opinion that no special hazard exists as a result of the proposal as an alternative to the required prescriptive requirements of the Building Code of Australia (B.C.A.).

S.S.L.'s Fire Engineered Assessment concludes that an acceptable level of life safety for the building exists without the provision of mechanical smoke exhaust and sprinklers.

3.2 Dispensation Sought

As a consequence of the above, we request dispensation from the following requirements of the B.C.A. On the basis that compliance is unnecessary in the particular circumstances of the case.

- *Clause C2.3(b)* — that the provision for smoke hazard management and active fire protection to the building is sufficient without installing a smoke exhaust system in accordance with Specification E2.2 or a sprinkler system throughout the building.

- *Clause D1.4(c)* — that travel distances in the building, as nominated in Item 2.4 of this Report are satisfactory in lieu of the distances prescribed in Clause D1.4(c).

- *Clause D1.5* — that a maximum distance between exits of 67 m in the halls is satisfactory in lieu of the distances prescribed in Clause D1.5.

- Clause D1.9 — that a maximum overall travel distance, from the Level 1 viewing gallery, of approximately 95 m is satisfactory in lieu of the distance prescribed in Clause D1.9.

Signed,

Anthony D. Protas,
for Trevor R. Howse & Associates Pty. Ltd.

TREVOR R HOWSE & ASSOCIATES PTY LTD
ACN 003 753 839
Building Regulations Consultants

SUBMISSION

REQUEST FOR MODIFICATION OF BUILDING REGULATIONS SECTION 70 OF THE LOCAL GOVERNMENT ACT 1993

PREPARED FOR

Ancher Mortlock & Woolley Pty. Ltd.

BY

Trevor R. Howse & Associates Pty. Ltd.

REGARDING

New Sydney Showground, Homebush
Zone 2

For the purpose of assessing the hazards, if any, associated with non-compliance of elements of the Building Design with specific provisions of the Building Code of Australia.

1 May, 1997

Our Ref. : J96136 AP/RL

FIRE SAFETY
BUILDING AUDIT
DESIGN ASSESSMENT
CERTIFICATION

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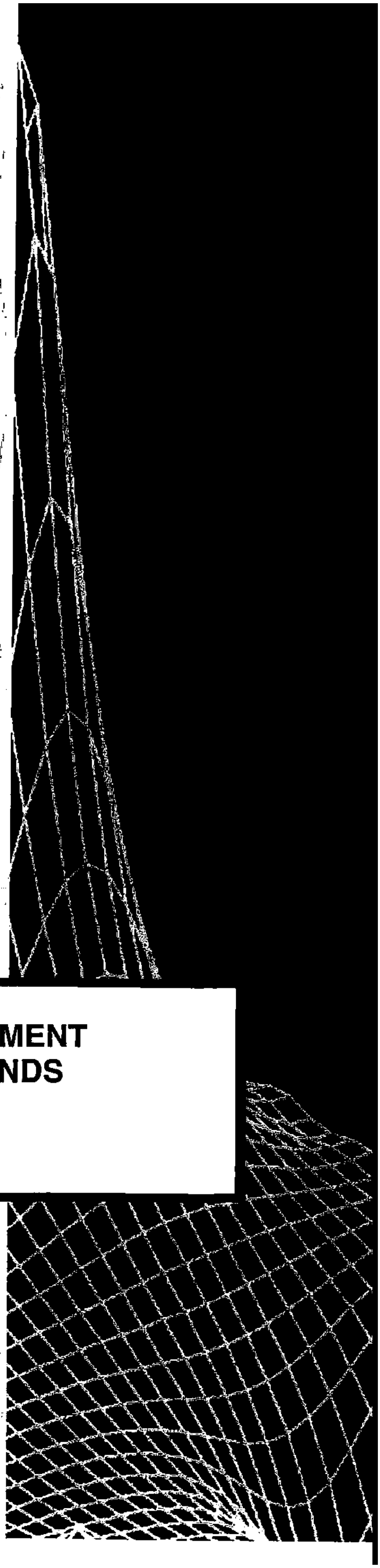
ANNEXURE "A"

S.S.L. REPORT

SCIENTIFIC SERVICES LABORATORY

BUILDING WITH SCIENCE



FIRE ENGINEERING ASSESSMENT
NEW SYDNEY SHOWGROUNDS
HOMEBUSH, NSW

A business unit of Australian Government Analytical Laboratories
Department of Administrative Services

SCIENTIFIC SERVICES LABORATORY

Fire Engineering Assessment
Fire and Egress Modelling Analysis

New Sydney Showground
Homebush, NSW
Zone 2

Report By: Michael Hildebrandt, Mahmut Horasan, Dr. G. Caird Ramsay

Report No. XR127
File No.: FD30-101
Issue Date: April 1997

SCIENTIFIC SERVICES LABORATORY
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A Business Unit of Australian Government Analytical Laboratories
Department of Administrative Services

QUALITY SYSTEM NATA CERTIFIED AS/NZS ISO 9001

Fire Engineering Assessment
Fire and Egress Modelling Analysis

New Sydney Showground
Homebush, NSW
Zone 2

1. INTRODUCTION

This assessment was commissioned by Trevor R. Howse and Associates in order to examine certain requirements for the fire protection of the exhibition halls of the New Sydney Showground at Homebush Bay, Zone 2. This assessment is based upon drawings supplied as set out in the Appendix, the report entitled "Report prepared for Ancher Morlock and Woolley Pty Ltd by Trevor R. Howse & Associates Pty Ltd regarding RAS Homebush - Zone 2 Exhibition Halls " and information supplied by the client as indicated in the text. Verification was sought regarding the Building Code of Australia (BCA) requirements for sprinklers and smoke exhaust. The large internal spaces of the halls comprising the Showground complex which also have high ceilings may render the sprinkler system less than effective. The large internal volume of the halls may fill with smoke at a rate which would allow occupants to evacuate, before the onset of untenable conditions, without mechanical smoke exhaust.

Because of the large volumes and complex architecture of the project, it was decided to conduct a Computational Fluid Dynamics assessment which has the capability of providing more accurate modelling than analyses conducted with zone models.

This assessment is only concerned with the predicted effects of heat and smoke from fire in Halls 1,2,3 and 4. No analysis has been conducted on any other compartments or spaces within the building.

2. OBJECTIVES

The fire safety objectives of the BCA are as follows:

1. Life Safety of the building occupants
2. Protection of fire fighters during rescue and initial fire fighting
3. Protection of adjoining buildings

The aim of this assessment is to predict whether the proposed fire safety systems will ensure safe egress of occupants. The protection of the building fabric and its contents is not a regulatory issue and it is understood that the client has given an assurance to members of the design team that there is no requirement to protect property as part of the building fire safety design.

The site drawings supplied indicate that there are no buildings adjoining the Showgrounds building and hence, protection of adjoining buildings does not form one of the objectives of this study.

3. GENERAL ASSUMPTIONS

The general assumptions used in the fire engineering assessment of the new Sydney Showground were;

1. Protection of property, beyond the time taken for occupant evacuation and the fire brigade to perform their rescue activities, is not an objective of this study

← Note: SOPA BAU reports this is not necessary.

2. The Fire Brigade will be on the Homebush site for all events undertaken in the Showgrounds. It was indicated, that given a brigade presence on the Homebush site that their arrival time can be assumed to be 4.5 minutes. Once at the scene a further 2 minutes can be assumed for rescue activities and 2.5 minutes for set-up to fight the fire. Fire fighting can therefore begin in 9 minutes.

3. The security staff located on the site will be trained in first aid, fire fighting and evacuation procedures

4. As a worse case scenario a fire will grow at an Ultra-fast rate up to 50 MW if not controlled. This is considered to be a very conservative assumption given that after an initial period of vertical spread, further fire development will require horizontal spread.

5. The criteria for tenability as described in Section 4, will ensure an adequate level of life safety provided the occupants evacuate the building prior to the onset of untenable conditions.

6. The CFD model Pheonics is acceptable for modelling the effects of fire growth and spread given the complexity of the building geometry

7. Evacnet+ modelling is an acceptable model for predicting occupant movement times

8. A VESDA smoke detection system will be installed throughout the facility.

4. TENABILITY LIMITS

In general, the tenability limits as described in the BCA Clause E2.2(a)(i)[1], are used as a minimum basis for maintaining life safety in this situation. For a tenable environment:

a) the smoke layer must be at least 2.1m above the relevant floor levels and have an average temperature less than 183°C, or,

b) the smoke layer must provide visibility for at least 20 metres and have an average temperature less than 100°C.

5. FIRE ENGINEERING MODELLING

This fire engineering assessment utilises a Computational Fluid Dynamics model to predict conditions within the building during the worst-probable fire scenarios in the Halls in their various configurations. The method used is a deterministic approach which is built around a time-line comparison of critical events. The time taken for smoke to cause untenable conditions is compared with the time required for occupants to escape before the onset of the untenable conditions.

This has been carried out using a Level 2 fire safety engineering assessment as described in the 'Fire Engineering Guidelines' document(2). The requirement for occupant safety is:

Time required for evacuation (T_{RE})	<	Time available for evacuation (T_{AE})

The fire scenario chosen determined the rate at which the fire develops and consequent rate of production of smoke, as well as the ultimate size of the fire. Both the development rate and size of the fire may be modified by active fire protection measures. The degree of modification will depend on the type of measure and its effectiveness in a given situation. These parameters are discussed in detail below.

The accumulation of smoke may be modified by provision of both natural and mechanical extraction measures and kept away from occupants by the provision of smoke reservoirs and smoke curtains.

Occupant behaviour is complex (see discussion below) but is triggered by cues such as alarms and sprinkler activation, as well as smoke and its smell.

5.1 Computational Fluid Dynamics (CFD) Models

The CFD model utilised in this study is the program PHOENICS by CHAM(4).

CFD models differ from Zone models by dividing the space under consideration into many more regions or 'control volumes(3). CFD models usually divide the space into hundreds or thousands of 'control volumes' whereas Zone models generally divide the space into two or three zones. In a CFD model, the fundamental equations of motion of fluids (Navier-Stokes Equations) are solved over the discretised space. Mass and energy balances are solved for each region so that the flow of smoke (and air) can be tracked through the space, along with characteristics such as enthalpy (temperature) and velocity. Therefore, CFD analysis is capable of taking into account phenomena such as localised effects.

5.2 Evacuation Modelling

A performance based evacuation investigation was conducted in this assessment. The Australian "Fire Engineering Design Guidelines"(2) and the draft "British Standard Guide to the Application of Fire Safety Engineering Principles to Fire Safety in Buildings"(5) were utilised to determine pre-movement delay times and EVACNET + evacuation modelling software was used to calculate the travel times.

During an emergency evacuation the occupants of an exhibition centre are expected to go through certain stages of actions adopting various behaviour. The behaviour model in Figure 1 aims to illustrate these stages. Figure 1 also includes an evacuation time line which indicates critical times during the evacuation.

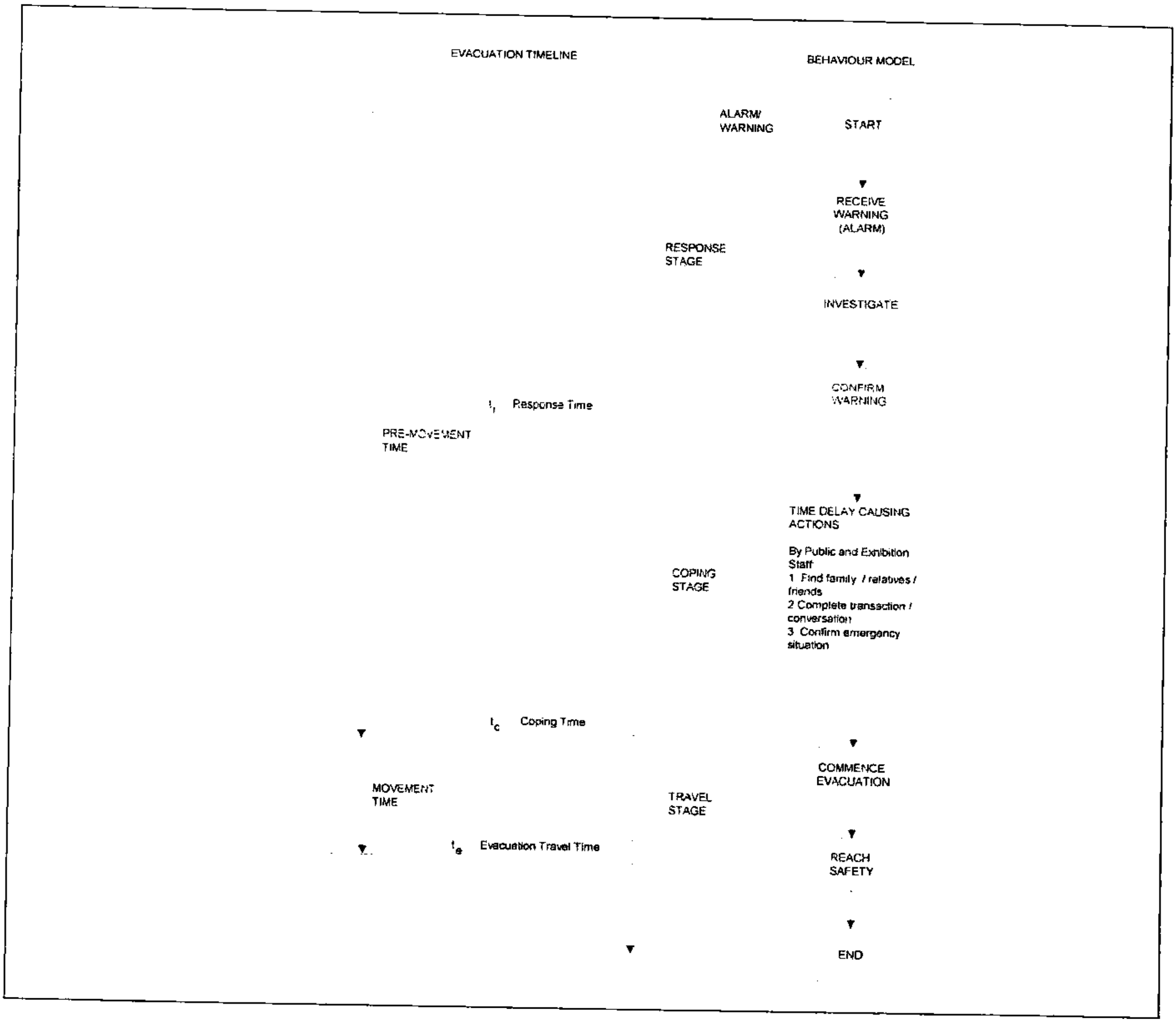


Figure 1 Behaviour Model and an Evacuation Time line for Exhibition Centre Occupants

Total evacuation time for any occupancy may be calculated as follows as recommended by the Australian "Fire Engineering Design Guidelines":

Total Evacuation Time = Alarm Time + Pre-Movement Time +Travel Time
or

$$T_{RE} = t_a + (t_r + t_c) + t_e$$

where:

T_{RE}	Total evacuation time
t_a	Alarm time
t_r	Response time
t_c	Coping time
t_e	Evacuation Travel time

5.2.1 Pre-Movement Times

Once the occupants of a building hear an alarm or warning, prior to commencing their movement they go through two phases. The first (response) phase involves the process of interpreting the alarm and identifying it as a signal for evacuation. During the second (coping) phase occupants get involved in some actions such as collecting belongings, looking for friends or relatives, investigating to obtain further information, etc, prior to starting to move towards an exit.

In calculating the pre-movement time the Australian approach(2) has been used and the British approach(5) has been referred only for comparison purposes. The Australian approach is based on the analysis of both the components of the pre-movement time. The British approach adopts a single time value as the pre-movement time.

5.2.2 People Movement Modelling and Occupant Travel Times

The performance based approach recommends the use of a hydraulic or effective width method to calculate travel times in a building. These times are adjusted using efficiency factors to reflect the characteristics of the occupancy. With this approach standard travel speeds and occupant densities are used in calculations.

An alternative method is to reflect the occupancy characteristics in the movement modelling by using travel speeds and occupant densities which are reflective of the particular occupancy being modelled. This approach avoids the need for further adjustments.

In the modelling of the people movement in Sydney Exhibition building the second approach has been adopted.

EVACNET+ (6) is an interactive computer program that allows the people movement modelling of emergency building evacuations. EVACNET+ requires a network description of a building and information about the initial placement of occupants at the beginning of the evacuation. An EVACNET+ model is a network consisting of a set of nodes connected by arcs. The nodes represent building components such as rooms, halls, landings, stairs and lobbies. The arcs represent the passageways between the building components. From this information, EVACNET+ produces results that describe optimal evacuation of the building.

For each node a capacity is defined. This is the upper limit of the number of people that can be contained in the building component the node represents. Also (optionally) the initial contents of a node may be specified. This is the number of people in the 'node' at the initiation of the evacuation. The initial contents of a node will default to zero unless the user specifies otherwise.

For each arc, an arc traversal time and arc flow capacity must be specified. The traversal time is the number of time periods it takes to traverse the passageway the arc represents. The arc flow capacity is the upper limit on the number of people that can traverse the passageway the arc represents during a time period.

EVACNET+ breaks up time into time periods of fixed length. The length of each time period is user definable. Traversal times and flow capacities are based on this time period.
EVACNET+ takes the network model and determines an optimal plan to evacuate the building in a "minimum" amount of time. This is done using an advanced capacitated network flow transhipment algorithm, a specialised algorithm used in solving linear programming problems with network structure.

EVACNET+ has been designed to be flexible enough to model the evacuation of almost any structure representable as a network. This includes office buildings, hotels, skyscrapers, auditoriums, stadiums, retail establishments, restaurants, and schools.

Entire structures or selected parts of a structure may be modelled. The cause of evacuation may be any reason requiring the quick removal of people from the building.

The first step in building an EVACNET+ model is to relate the physical building components to EVACNET+ node definitions. The building is divided up into logical sections.

The next step is to determine the node data. The node capacities are a function of the useable area associated with a node and the level of service expected for the node. The level of service is measure of average area pedestrian occupancy. The node initial contents are based on expected room occupancies at the initiation of the evacuation.

Arcs represent the possible flows of people from node to node. If the direction of flow is not known, a second oppositely directed arc can be added between the two nodes.

The first step in determining arc data is determining the Width Restriction (WR) associated with each arc. This is usually a doorway of some sort between the nodes of the arc. For arcs linking stairwells to landings, or arcs linking hallways to hallways, the minimal width of the stairwell or hallway is used.

As it is done with nodes, a level of service is selected. This then relates to an average flow volume and an average speed. The dynamic capacity is now a function of the width restriction and the average flow volume. The arc traversal time is a function of the average speed and the average distance travelled. Distances are estimated to be the median distance that people would be required to travel in passing from one node of an arc to the other.

6. GENERAL DESCRIPTION OF THE BUILDING

The building basically consists of four main halls with attached foyers, offices, cafe, meeting rooms, staff rooms, plant rooms and other ancillary rooms. There is a main architectural separation between Hall 1 - a large, domed hall; and Halls 2,3 and 4 - a long rectangular building with six, rounded roof-sections.

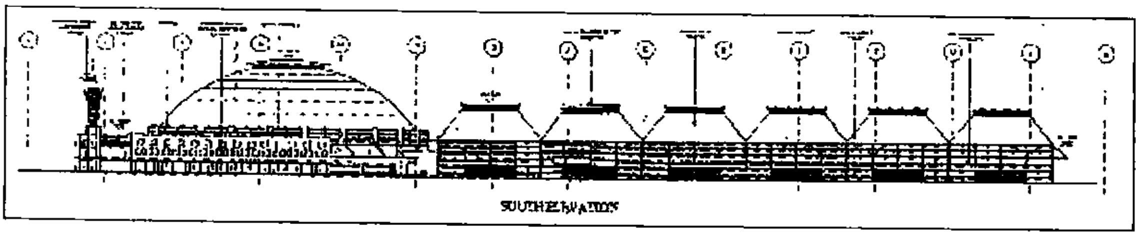


Figure 2. South Elevation of complete building

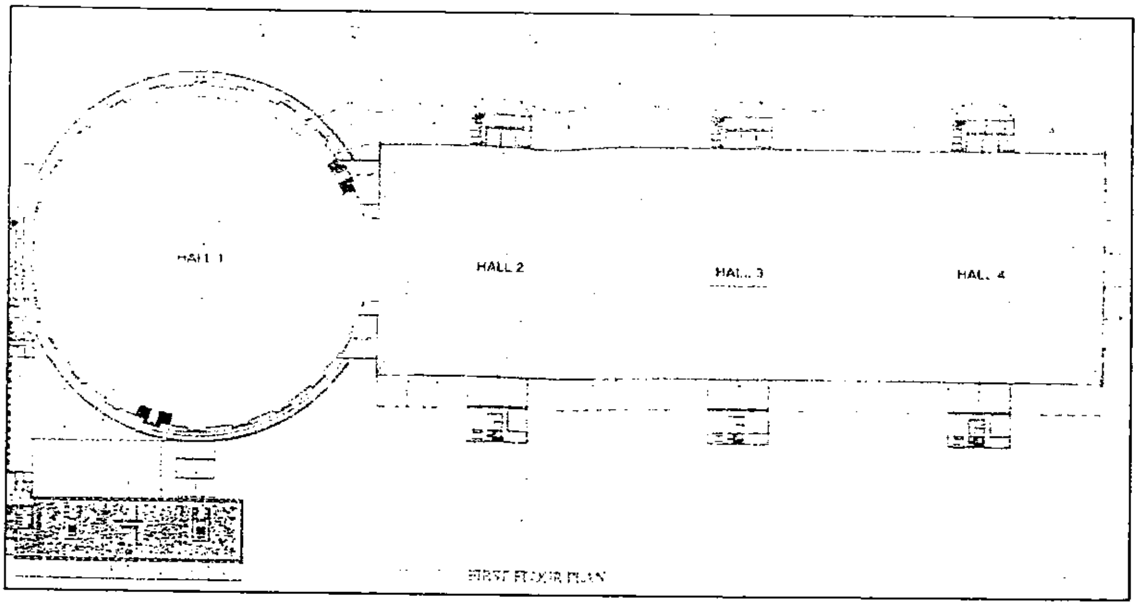


Figure 3. First Floor Plan of complete building

The structure basically consists of large laminated timber beams and steel composite frame superstructure. Louvres for natural ventilation are positioned at the top of each roof section of all halls. Operable walls are located between each hall and in the centre of Halls 2, 3 and 4.

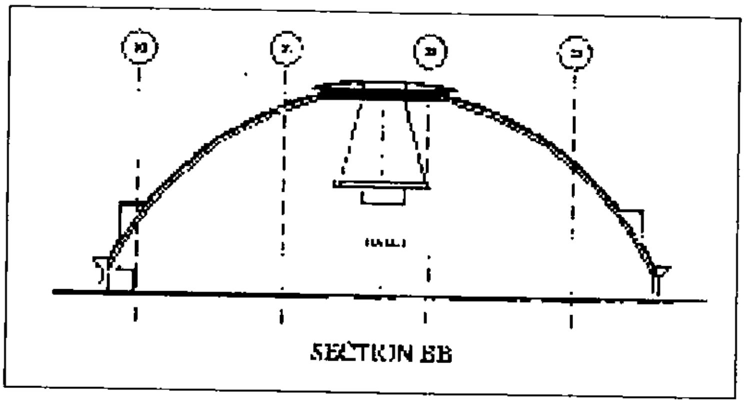


Figure 4. Section through Hall 1

Hall 1 is fundamentally a domed structure with a raised top section which accommodates the natural ventilation openings. The louvre system for this hall (and the other halls has a 50% effective free open area), with a height of approximately 3 m for Hall 1. The ground level diameter of the dome is 97 m with the height of the dome approximately 42 m. A lighting grid is suspended from the centre of the top of the dome.

This lighting grid has not been included in the modelling as it appears substantially open and not likely to significantly effect the build-up of smoke at floor level.

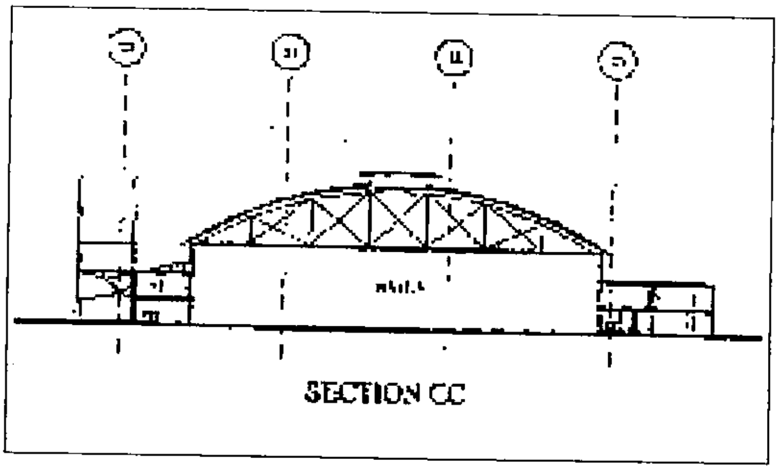
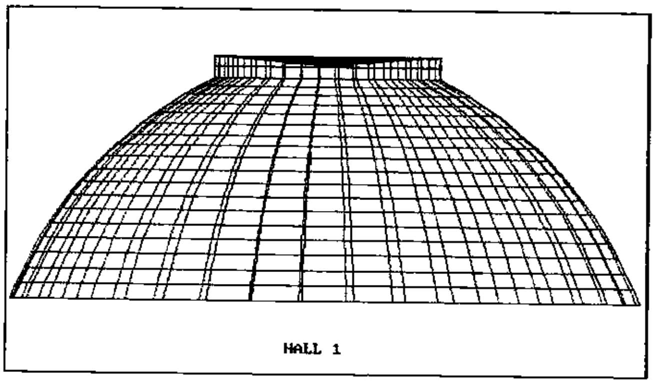


Figure 5. Section through Hall 3 (similar to Halls 2 & 4)

Halls 2, 3 and 4 are constructed in the same manner as Hall 1 and include natural ventilation louvres at the centre of each of the six roof sections. The total floor area is 216 m x 67 m, with each hall approximately 72 m x 67 m. Each hall can be further divided into two, 36 m x 67 m compartments, using the operable walls. The roof height of each hall varies between approximately 13 m and 23 m (plus the natural ventilation sections).

7. BUILDING SECTIONS FOR MODELLING PURPOSES

The following subdivisions of the building's internal volume were made and all halls and hall sections were modelled with body-fitted-coordinates (BFC's) in order to simulate the influence of the real shapes as accurately as possible. Hall 1 was generally modelled separately from Halls 2, 3 & 4, as it was substantially independent. The grid representation for Hall 1 is shown below in Figures 6 and 7. The main features are present with only slight variations due to the method of grid generation. Hall 1 was also modelled with the doors to Hall 2 open.



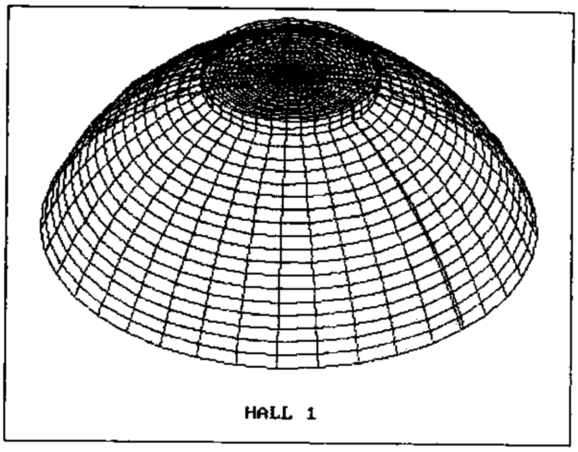


Figure 6. Side view of grid for Hall 1

Figure 7. Isometric view of grid for Hall 1

Halls 2, 3 and 4 were modelled in a variety of ways ranging from the entire three halls (Figure 8) to a single hall sub-section (Figure 9). These models included configurations with low level openings for make-up, air and natural ventilation openings at roof level (see Figure 9).

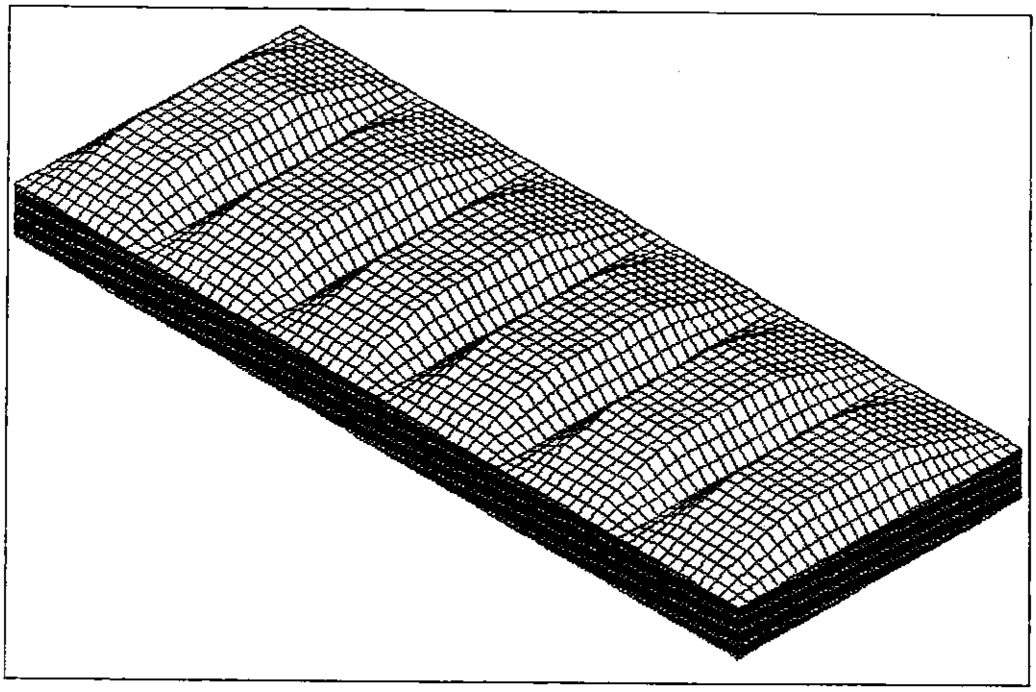


Figure 8. Grid representation for complete Halls 2,3 & 4.

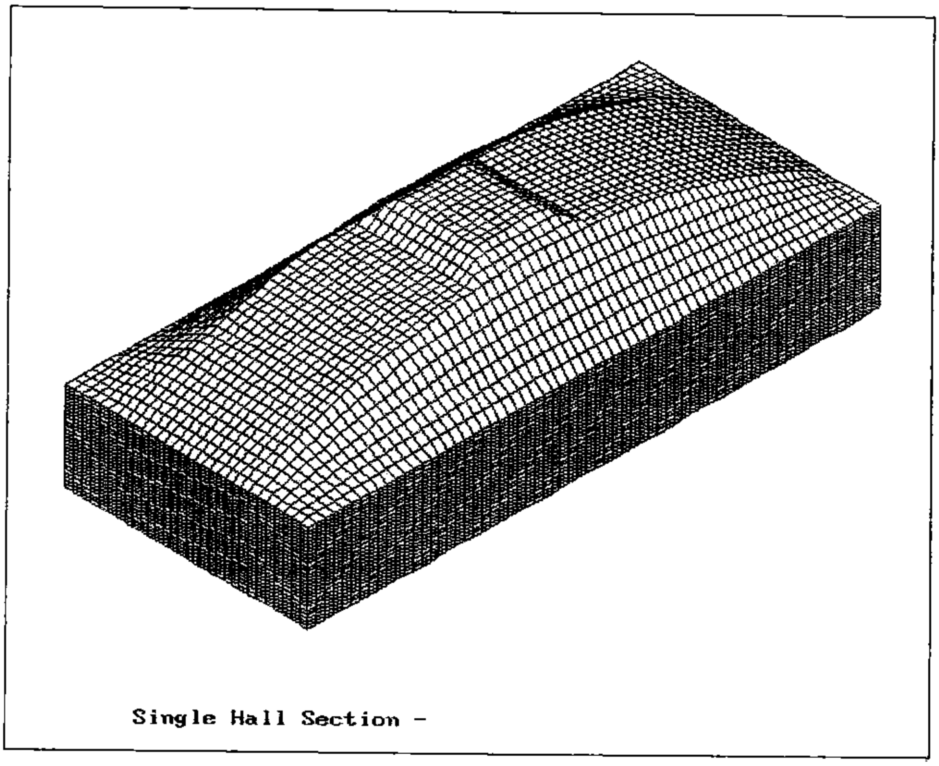


Figure 9. Single half Hall - showing extended grid for ventilation openings

8. FUEL LOAD AND FIRE GROWTH RATE

It is understood that the building will house a wide range of exhibitions comprising a wide range of fuel types and densities and ignition sources. The fire hazards will be augmented by the packaging and rubbish which accumulates in such occupancies and the ignition sources associated with the visitors.

As a worse possible case the fire is assumed to grow as an "Ultrafast t^2 " design fire up to 50 MW or to the point at which it is controlled by either the security staff or the fire brigade.

Use of an "Ultrafast t^2 " design fire is considered to be extremely conservative for most exhibitions that do not involve large fuel loads and fuel load densities. In exhibitions not involving large fuel loads or fuel load densities the fire is expected to grow in an Ultra-fast manner for an initial period after which the rate of growth could drop to that of a medium or fast growth rate due to the need for horizontal flame spread. The times to untenability for a fast or medium rate of fire growth would be expected to be longer than those predicted using an Ultrafast fire growth rate, and hence the results reported in this study are considered conservative.

The rate of heat release for such a fire conforms to the following relationship:

$$Q = kt^2$$

where Q is Heat Release Rate of Fire (MW)
t is time after ignition (s)
k is a constant which is equivalent to 1/(time to 1MW)
for an Ultrafast fire, $k = 1/(75)^2$

9. FIRE DETECTION AND VISIBILITY THROUGH SMOKE

It is understood that a VESDA detection system with a sensitivity of 0.5% obscuration per meter will be installed throughout the development. A public address system with EWIS systems will be installed in accordance with AS2220[10]. In order to determine the likely activation of the VESDA system and visibility through the smoke for egress purposes, it is necessary to relate these aspects with properties calculated in the CFD model. The following sections describe the relationships.

9.1 Smoke Concentration Levels and Optical Density at the Fire Source

The Firecalc manual[11] gives values for optical density per metre at the fire source ranging between approximately 2 db/m and 10 db/m, depending on the likely fuel source. As a conservative estimate, a value of 10 db/m has been chosen for the purpose of determining visibility remote from the fire.

As optical density per metre is proportional to mass concentration of smoke particles[12], it follows that visibility is also proportional to the mass concentration. Thus, the concentration levels produced in PHOENICS at regions remote from the fire can be related back to the concentration at the fire source which is represented as unity concentration. The following equations describe these relationships:

$$\frac{D}{L} = D_0 \cdot \frac{W_L}{V} \qquad [1]$$

where D/L is Optical Density per metre in db/m
D_0 is termed Smoke Potential in ob.m^3/m (constant for a particular source)
W_L is the mass loss due to combustion in grams
V is the volume containing the smoke in m^3

$$Vis = \frac{10}{D/L} \qquad [2]$$

where Vis is Visibility in metres (for objects illuminated by scattered light)
D/L is Optical Density per metre in db/m

PHOENICS provides concentration levels remote from the fire which are related to the source concentration:

$$M_{SR} = C \cdot M_{S0} \qquad [3]$$

where M_{SR} is mass concentration at the source in g/m^3
M_{S0} is mass concentration remote from the source in g/m^3
C is the fraction of source concentration at the remote location

As shown above in [1], M_S (which is proportional to W_L/V) is proportional to D/L. Therefore:

$$\left(\frac{D}{L}\right)_R = C \cdot \left(\frac{D}{L}\right)_0 \qquad [4]$$

where $(D/L)_R$ is optical density per metre of smoke at a remote location
$(D/L)_0$ is optical density per metre of smoke at the source
C is the fraction of source concentration at the remote location

Thus, visibility can be determined at a remote location by referring back to the source optical density and combining equations [2] and [4]:

$$Vis_R = \frac{10}{C \cdot \left(\frac{D}{L}\right)_0} \qquad [5]$$

where Vis_R is the visibility through smoke at a remote location with smoke concentration level equal to C.

Rearranging [5] allows the concentration level (C) to be determined for a required visibility criterion. For the visibility criterion of 20 m, and 10 db/m optical density per metre at the source, the equivalent concentration level is as follows:

$$C = \frac{10}{Vis_R \cdot \left(\frac{D}{L}\right)_0} \Rightarrow \frac{10}{20*10} = \frac{1}{20} = 0.05$$

Thus, the 20 metre visibility criterion occurs at the 0.05 concentration levels indicated in PHOENICS graphs of smoke concentration.

20 metres visibility ≡ 0.05 smoke concentration level

9.2 Smoke Concentration for Detector Activation

In order to determine detector activation, the size of the fire is estimated which will cause the appropriate level of obscuration to a VESDA detection port assumed to located at roof level.

An obscuration of 0.5%/m is equivalent to an optical density of 0.002 db/m.

If a smoke concentration of 10 db/m at the source is assumed, as was done for the determination of the smoke concentration required for visibility, then using equation [4] the fraction of the source concentration required for activation of the VESDA system is

$$C = 0.002/10 = 0.0002$$

Thus activation occurs at the 0.0002 concentration levels indicated in PHOENICS graphs of smoke concentration.

Based on the results of the fire modelling it is estimated that the VESDA system will activate in approximately 45 seconds

Travel time for the smoke within the sampling tubing of the VESDA system was indicated to be 30 seconds. Verification and response time for the associated electronic systems would add a further 30 seconds(13) and thus the alarm time is predicted to be 105 seconds for all Hall 1.

The detection time for Halls 2, 3 and 4 (which have approximately half the ceiling height of Hall 1) is expected to be approximately 20 s plus the same 30 seconds for smoke travel time within the sampling tube and a further 30 seconds for verification and response. Thus, the detection delay in Halls 2, 3 and 4 is predicted to be approximately 80 seconds.

10. SPRINKLER ACTIVATION AND FIRE SUPPRESSION

The program SPRINKLER(14) was used to model sprinkler activation at various heights relevant to the halls. The model is based on a generally conservative approach of hot smoke flowing under an unconfined ceiling and heating the sprinkler up to its activation temperature. The model outputs are the time required to activate the sprinkler and the associated heat output of the fire. An ULTRAFAST fire was used as the basis for the fire scenario (refer Section 7). The sprinklers were assumed to have a standard Response Time Index of 214 $m^{½} s^{½}$, an activation temperature of 68°C and a spacing of 2.7 m (this allows for the possibility of the sprinkler directly overhead being shielded or ineffective for any reason). Ambient temperature was assumed to be approximately 20°C. The results are given in Table 1 and Figure 10.

Table 1: Variation of Activation Time and Fire Size with Sprinkler/Ceiling Height

SPRINKLER CEILING HEIGHT (m)	ACTIVATION TIME (s)	FIRE SIZE (MW)
10	193	6.6
13	215	8.2
20	292	15.2
23	333	19.7
30	427	32.4
45	669	79.6

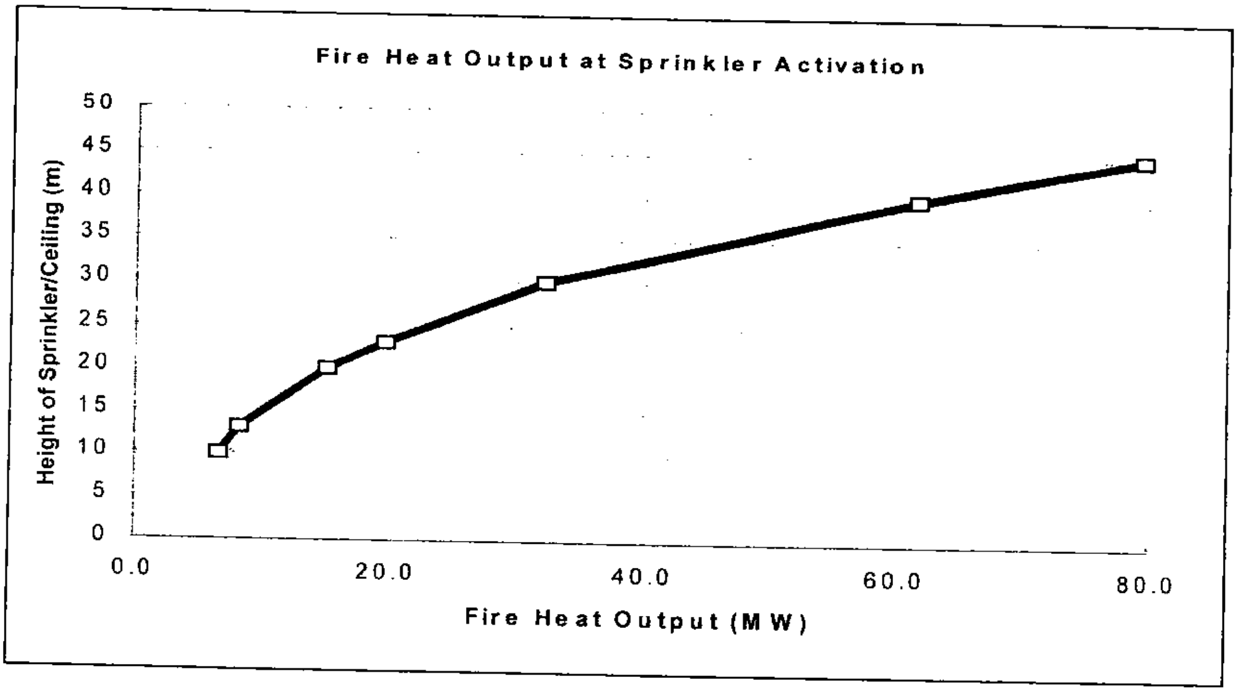


Figure 10. Variation of Fire Size with Sprinkler/Ceiling Height

As indicated above, the model assumes that the sprinklers are located essentially directly below a flat ceiling and hence the ceiling jet layer will spread across the ceiling to encompass the sprinkler head. In the present case, the ceilings are not flat and hence unless the sprinklers at lower levels are directly within the fire plume, ie essentially above the fire, they will not be exposed until the smoke layer descends to the their level. Given the large floor area of the halls it can not be assumed that in all cases the sprinklers on the side of the dome will be located within the plume. Accordingly, the time to activation and fire sizes may be greater, for sprinklers located at lower levels, than those shown in Table 1. In this situation, the maximum sprinkler activation times, of 669 seconds for Hall 1 and 333 seconds for Halls 2,3 and 4, should be used.

Generally, it is conservatively assumed in fire safety engineering assessments that sprinklers, once activated, will at least control the fire to a constant rate of heat release. This is represented in Figure 11 where that part of the curve parallel to the x-axis represents 'control' of the fire. Final extinguishment is generally assumed to occur once the fire brigade has arrived.

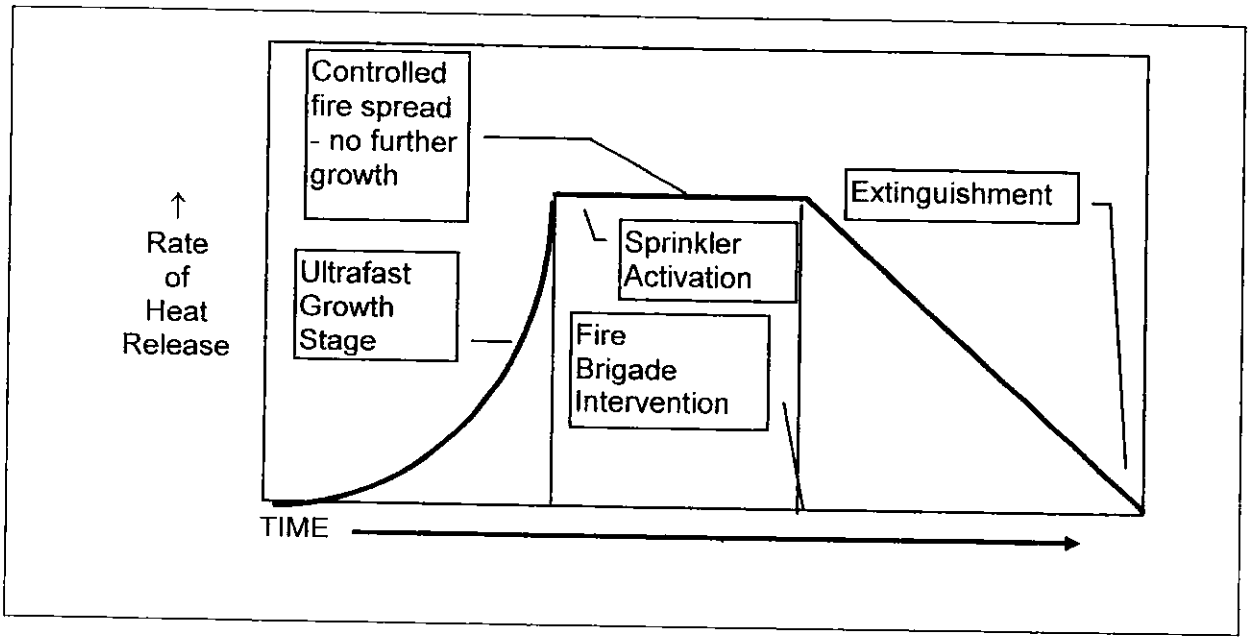


Figure 11. Typical Effect of Suppression activities on fire growth and extinguishment.

The complex being assessed does not, however, represent a typical situation where the above assumption can be made about the effectiveness of automatic sprinklers. This is due to a number of factors:

(a) The height of sprinklers above the fire decreases the effectiveness with water droplets finding difficulty in penetrating the fire plume and reaching the seat of the fire before being deflected or vaporised.

(b) The increased activation time allows the fire to grow to such a size that the effects described in (a) are magnified and the size and radiant heat of the fire hinders escape and directly endangers occupants.

(c) It must be assumed that the displays mounted in the exhibition halls will tend to shield any fire from the spray from the sprinklers.

An examination of the literature[15] indicates that sprinklers in such situations are effective to a limited degree but cannot be relied upon to control the fire, as shown in Figure 11.

Based on the indicated fire brigade arrival and set-up times (refer Section 3 of this report) the sprinklers within Hall 1 were predicted to activate (669 seconds) at approximately the same time as the brigade can begin fire fighting activities (105 + 540 = 645 seconds). With respect to Halls 2, 3, and 4, brigade attendance and fire fighting is predicted to occur after sprinkler activation (645 seconds vs. 333 seconds respectively).

Given all the above, it is recommended that sprinklers not be provided because of the time taken to respond and their limited effectiveness at the roof heights involved.

11. RESULTS OF MODELLING OF EVACUATION

As discussed in Section 5.2 the evacuation modelling was carried out in two stages viz calculation of pre-movement and movement times. The former calculation is based upon the characteristics of the occupants and the second on occupant numbers, the plan of the building, likely layout of exhibits and availability of exits (due to obstruction by fire etc).

11.1 Calculation of Pre-Movement Times According to the "Fire Engineering Design Guidelines"

11.1.1 Response Times

In order to estimate the delays occurring between the time occupants receive warnings regarding the presence of an emergency situation and the time they decide to take an action, it is necessary to identify the occupant capabilities.

The occupants of an exhibition centre may be classified in two major groups as public and staff. The characteristics of the occupants which would effect their response capability and a score allocation out of 5 (higher scores indicating better response capability) are given in Table 2.

Table 2. Response Efficiency Scores Allocation Table

Occupant type	*Alertness*	*Mobility*	Social Affiliation	Role	Position	Commit ment	Focal Point	*Familiarity*	W_{eff}	R_c
Public	5	5	4	4	4	4	4	3	4.25	1.75
Staff	5	5	5	5	4	5	4	5	4.9	1.1
									Avg:	1.43

To calculate response times the following equations are first used to calculate the response factor:

W_{eff} for R_c = (3 main factors x 2 + 5 secondary factors x 0.4) / Total no. of factors
and
$R_c = (6-W_{eff})$

where:

R_c response factor
W_{eff} weighted efficiency factor

The factors in italics (see Table 2) are the main factors.

For Public:

W_{eff} = ((5+5+3)*2 + (4+4+4+4+4)*0.4) / 8 = 4.25
and R_c = (6 - 4.25) = 1.75

For Staff:

W_{eff} = ((5+5+5) *2+ (5+5+4+5+4)*0.4) / 8 = 4.9
and R_c = (6 - 4.55) = 1.1

The presence of staff with higher response capability scores would have a positive effect on response capabilities of the public and would improve their response capability scores. To reflect this influence in the calculations one can average the two individual response factors and use a common score of 1.43.

Once the response factor is determined the response time is calculated according to the following equation:

Response time (t_r) = Baseline time estimate x R_c

The baseline time estimate (or the perfect response time expectancy) for an occupancy with advanced warning systems such as exhibition centres is 1 minute and thus:

Overall response time of exhibition centre occupants = 1 x 1.43 = 1.43 minutes .(84 seconds)

11.1.2 Coping Times

Once the presence of an emergency becomes obvious, prior to commencing movement the occupants will get or, in some cases, be forced to get involved in time consuming behaviour. As listed in the model in Figure 1, these behaviours would include looking for relatives or friends, completing a transaction or a conversation and confirming emergency situation.

To calculate the coping time delays it will be necessary to assign some coping capability scores to the occupants and the staff at the centre (see Table 3).

Table 3. Coping Efficiency Scores Allocation Table

Occupant Type										
	Commu nication	*Mobility*	Social Affiliation	Role	Position	Commit ment	Decisivenes s	*Familiarit y*	W_{eff}	C_c

Public	5	5	4	4	5	4	4	4	4.55	1.45
	Commu nication	Mobility	Social Affiliation	Role	*Position*	Commit ment	*Decisivenes s*	Familiarit y	W_{eff}	C_c
Staff	5	5	5	4	5	5	4	5	4.7	1.3
									Avg:	1.38

To calculate coping times the following equations are first used to calculate the coping factor::

W_{eff} for C_c = (3 main factors x 2 + 5 secondary factors x 0.4) / Total no. of factors

and

$C_c = (6-W_{eff})$

where:

C_c coping factor
W_{eff} weighted efficiency factor

The factors in italics in Table 3 are the main factors.

For Public:

$W_{eff} = ((5+5+4)*2 + (4+4+5+4+5)*0.4) / 8= 4.55$
and $C_c = (6 - 4.55) = 1.45$

For Staff:

$W_{eff} = ((5+5+4) *2+ (5+5+4+5+5)*0.4) / 8 = 4.7$
and $C_c = (6 - 4.7) = 1.3$

Again, the presence of staff with higher coping capability scores would have a positive effect and improve the coping capabilities and respective scores of the public. To reflect this influence in our calculations we can average the two coping factors and use a common score of 1.38 for all occupants.

To calculate response times the following equation is used:

Coping time (t_c) = Baseline time estimate x C_c

The baseline time estimate (or the perfect coping time expectancy) for an occupancy with advanced warning systems and highly mobile and alert occupants such as the exhibition centre is 1 minute.

Overall coping time of exhibition centre occupants = 1 x 1.38 = 1.38 minutes (83 seconds)

11.1.3 Total Pre-Movement Time

Total pre-movement time can be obtained by adding the response and coping times:

Pre-movement time = 1.43 + 1.38 = 2.81 minutes (Approximately 170 seconds)

11.2 Determination of Pre-Movement Time According to The Draft British Standard Guide to the Application of Fire Safety Engineering Principles to Fire Safety in Buildings

The draft British Standard Guide recommends delay times according to the type of alarm and information provided in the building. For public buildings which are fitted with EWIS systems with non-directive PA capabilities the draft British Standard suggests an overall pre-movement time of 3 minutes (180 seconds). This value is very compatible with the 170 seconds calculated using the Fire Engineering Design Guidelines method. (If the building is equipped with directive P.A. systems the British Draft Code recommends 120 seconds).

Given the multiple cue that the occupants may receive, such as seeing the fire and smoke, hearing the alarm, seeing other people evacuate and warnings from staff and other occupants, the pre-movement times could be considered to be conservative. However, the multiplying effect of all of the above cues in reducing a persons pre-movement time could be offset to a certain degree by the noise and activity within the halls leading to confusion of the meaning of the cues. Accordingly, the predicted pre-movement times are considered to be acceptable.

11.3 EVACNET+ Modelling of Sydney Exhibition Building

The Exhibition Building consists of a round hall (Hall 1) and three rectangular halls (Halls 2, 3 and 4) as illustrated in Figures 2 and 3. During an exhibition or function these halls may be utilised individually or in various combinations.

Hall 1 is surrounded by a large number exit doors. Halls 2 to 4 have two major exit doors, one at the Exhibition Court side and the other, through a kiosk area, at the Barnes Road side of the building.

Because of the uniform distribution of exits, for scenarios where Halls 2 to 4 are used individually or used in combination the building does not require separate evacuation models. However, due to the presence of a large number of exit doors around Hall 1 it was necessary to run a separate model for scenarios where Hall 1 would be used in conjunction with Hall 2.

Along with the exit sizes and occupant numbers, another factor which influences the evacuation of the building is the layout of different exhibitions. To reflect this influence various layouts and scenarios were modelled and evacuation times for these layouts were calculated. In addition, the effect of the blocking of an exit by a fire was considered (see Scenario/Model No.s 6 & 7). The Scenario/Models considered and the results obtained are set out below, together with the evacuations times:

SCENARIO / MODEL 1 - Standard Layout, Hall 2, 3 or 4 only, no fire obstructing exits, building general evacuation

Number of occupants = 1836
People movement time = 260 seconds.
Average travel time per occupant: 107 seconds
Pre-movement time = 170 seconds
Evacuation Time = 430 seconds (7 minutes 10 seconds)

Kiosk

SCENARIO / MODEL 2 - Longitudinal Layout, Hall 2, 3 or 4 only, no fire obstructing exits, building general evacuation

Number of occupants = 1434 (less number of occupants due to less free floor area)
People movement time = 210 seconds.
Average travel time per occupant: 86 seconds
Pre-movement time = 170 seconds
Evacuation Time = 380 seconds (6 minutes 20 seconds)

Kiosk

SCENARIO / MODEL 3 - The Herring Bone Layout, Hall 2, 3 or 4 only , no fire obstructing exits, building general evacuation

Number of occupants = 1844
People movement time = 190 seconds.
Average travel time per occupant: 102 seconds
Pre-movement time = 170 seconds
Evacuation Time = 360 seconds (6 minutes)

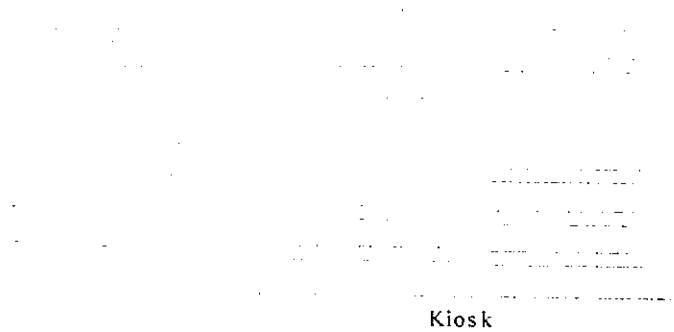
Kiosk

SCENARIO / MODEL 4 - Standard Layout (as Figure 1), Hall 1 only, no fire obstructing exits, building general evacuation

Number of occupants = 2240
People movement time = 140 seconds.
Average travel time per occupant: 43 seconds
Pre-movement time = 170 seconds
Evacuation Time = 310 seconds (5 minutes 10 seconds)

SCENARIO / MODEL 5 - Standard Layout (as Figure 1), Halls 1 and 2 combined, no fire obstructing exits, building general evacuation, movement allowed from Hall 2 to Hall 1.

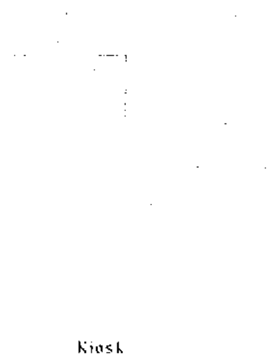
Number of occupants = 4076
People movement time = 190 seconds.
Average travel time per occupant: 65 seconds
Pre-movement time = 170 seconds
Evacuation Time = 360 seconds (6 minutes)



SCENARIO / MODEL 6 - Standard Layout, Hall 2, 3 or 4 only, fire near Kiosk, building general evacuation only through Exhibition Court Exit

Number of occupants = 1836
People movement time = 260 seconds.
Average travel time per occupant: 130 seconds
Pre-movement time = 170 seconds
Evacuation Time = 430 seconds (7 minutes 10 seconds)

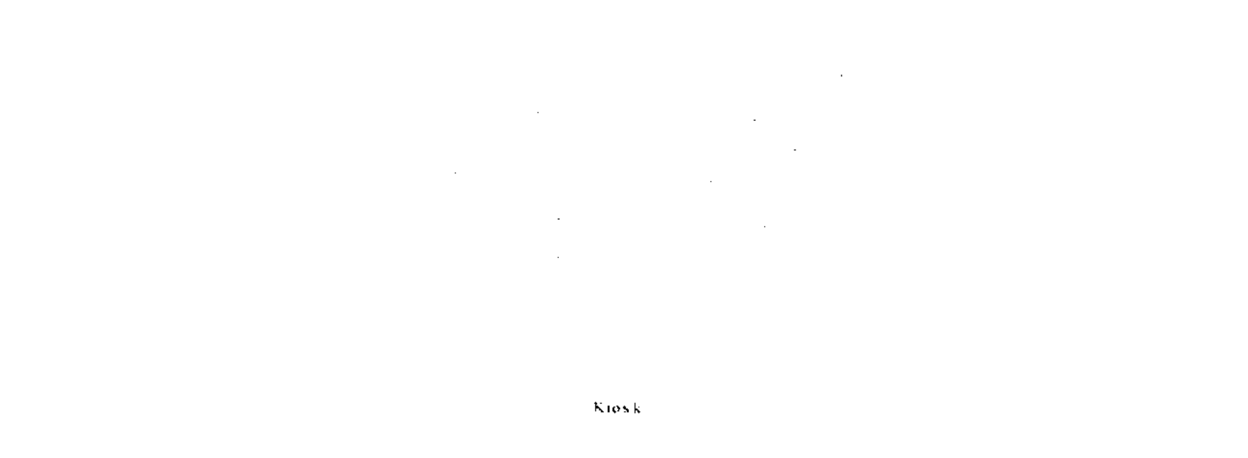
Comments: There is no travel and movement time difference between Models 1 and 6 due to the fact that the exits on the Exhibition court side are very wide and they do not cause any bottlenecks. The only major effect of the blocking of the exits near the Kiosk is the increased clearance times for the central areas shaded in the figure.



SCENARIO / MODEL 7 - Standard Layout, Hall 2, 3 or 4 only, fire near Exhibition Court Exit, building general evacuation only through exits near the Kiosk.

Number of occupants = 1836
People movement time = 670 seconds.
Average travel time per occupant: 343 seconds
Pre-movement time = 170 seconds
Evacuation Time = 840 seconds (14 minutes)

Comments: In this particular scenario the travel times increase drastically. This is caused by the smallness of the area near the Kiosk and the width of the exits which are much too narrow to cope with occupant numbers which may be as high as 1836 as assumed for this scenario.



11.4 Summary of Evacuation Modelling

Table 4 summarises the results of the model runs for all listed scenarios and includes the appropriate alarm times determined in Section 9 to give values for time required for evacuation.

Table 4. Evacuation Times for Different Models and Scenarios

SCENARIO AND MODEL	Number of Occupants	People Movement Time (secs.)	Average Travel Time per Occupant (secs.)	Pre-movement Time (secs.)	Evacuation Time (secs.)	Total Time Required for Evacuation including detection delay T_{RE} (secs.)
Standard Layout, Hall 2, 3 or 4 only, no fire obstructing exits, building general evacuation	1836	260	107	170	430	510
Longitudinal Layout, Hall 2, 3 or 4 only, no fire obstructing exits, building general evacuation	1434	210	86	170	380	460
The Herring Bone Layout, Hall 2, 3 or 4 only , no fire obstructing exits, building general evacuation	1844	190	102	170	380	440
Standard Layout (as Figure 1), Hall 1 only, no fire obstructing exits, building general evacuation	2240	140	43	170	310	415

(Table 4 Continued)

SCENARIO AND MODEL	Number of Occupants	People Movement Time (secs.)	Average Travel Time per Occupant (secs.)	Pre-movement Time (secs.)	Evacuation Time (secs.)	Total Time Required for Evacuation including detection delay T_{RE} (secs.)
Standard Layout (as Figure 1), Halls 1 and 2 combined, no fire obstructing exits, building general evacuation, movement allowed from Hall 2 to Hall 1.	4076	190	65	170	360	465
Standard Layout, Hall 2, 3 or 4 only, fire near Kiosk, building general evacuation only through Exhibition Court Exit	1836	260	130	170	430	510
Standard Layout, Hall 2, 3 or 4 only, fire near Exhibition Court Exit, building general evacuation only through exits near the Kiosk	1836	670	343	170	840	920

The evacuation times for different areas of the Sydney Exhibition Centre range between 310 and 840 seconds. For such high occupant levels the calculated total evacuation times are within realistic limits.

Most of the people movement times are half that of the case originating from a scenario (Scenario 7) where occupants are not able to use the exits near the Exhibition Court. This clearly indicates that, in such cases, whichever layout is adopted for an exhibition, clear access must always be maintained to the exits, and that, in such cases, additional exits would be beneficial. It is therefore recommended that the possibly of Scenario 7 occurring be dealt with by the designing architects and engineers by increasing the size of the available exits either through the use of extra exits or widening the existing exits.

12. RESULTS OF MODELLING OF SMOKE ACCUMULATION

The fire and smoke spread modelling was performed in association with various combinations and sections of the halls, with and without natural ventilation, using an Ultrafast fire without any active fire protection and reliant on the fire brigade intervention for fire control and extinguishment. For the natural ventilation case, it was assumed that only 50% of the effective free area was available because of adverse wind conditions (the 'effective free vent area' was said to be 50% of the vent dimensions).

The data obtained were:

(a) Size of fire versus time
(b) Height of hot smoke layer versus time
(c) Temperature profile of hot layer versus time
(d) Radiant heat output of fire versus time

These results were used to calculate the time for which tenable conditions were maintained, based on the criteria cited in Section 4.

The results of the modelling of smoke accumulation in terms of times for untenable conditions and time available for evacuation are summarised in Table 5.

Table 5. Results of Modelling Ultrafast Fire without Active Fire Protection

Building Section	Venting Available (%)	Time Available for Evacuation T_{AE} (sec)
1	0	420
1	50	660
1	50**	960
2 (half)	0	480
2 (half)	50	>720

* Based on the untenability criteria as described in Section 4 Some figures are interpolations between the time steps at which data was saved during the computer simulations

** With additional ventilation from Hall 2 opening.

12.1 Hall 1

For Hall 1, without natural venting, untenable conditions due to the smoke criterion were reached in approximately 420 seconds (see Figure 12).

For the case with natural ventilation (assumed to be 50% available) there was an increase in time of some 240 seconds before the Hall was untenable at 660 seconds. This increased yet again (960 seconds) if it was assumed that Hall 1 was open to Hall 2. The large volume of Hall 1 and the ventilation provided thus tends to mitigate against smoke logging of the Hall (compare Figures 12, 13 and 14).

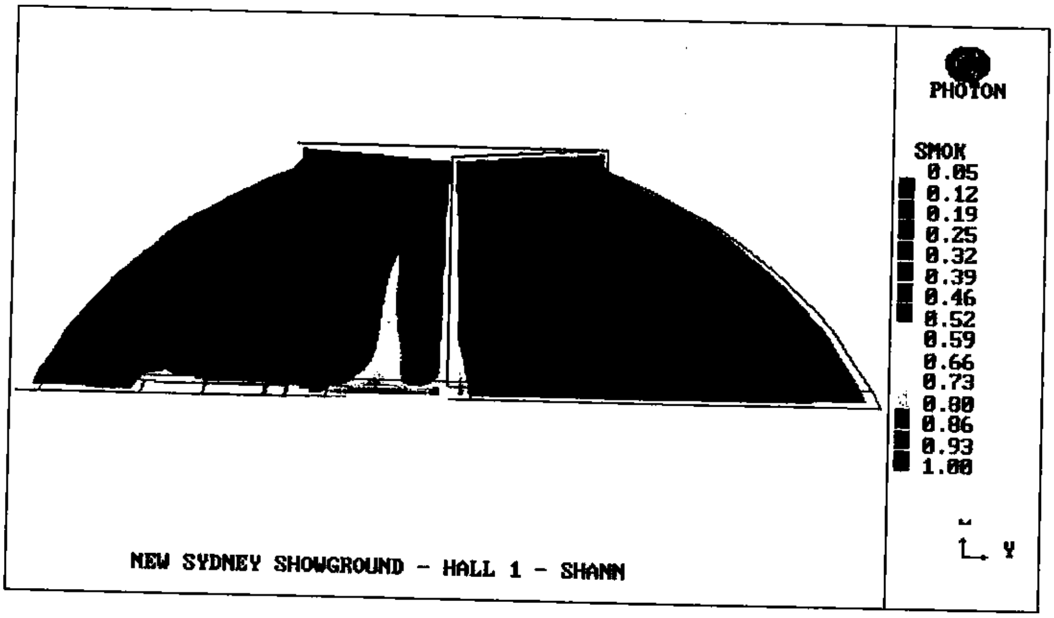


Figure 12. Smoke accumulation at 420 seconds for Hall 1 with 0% venting and no suppression.

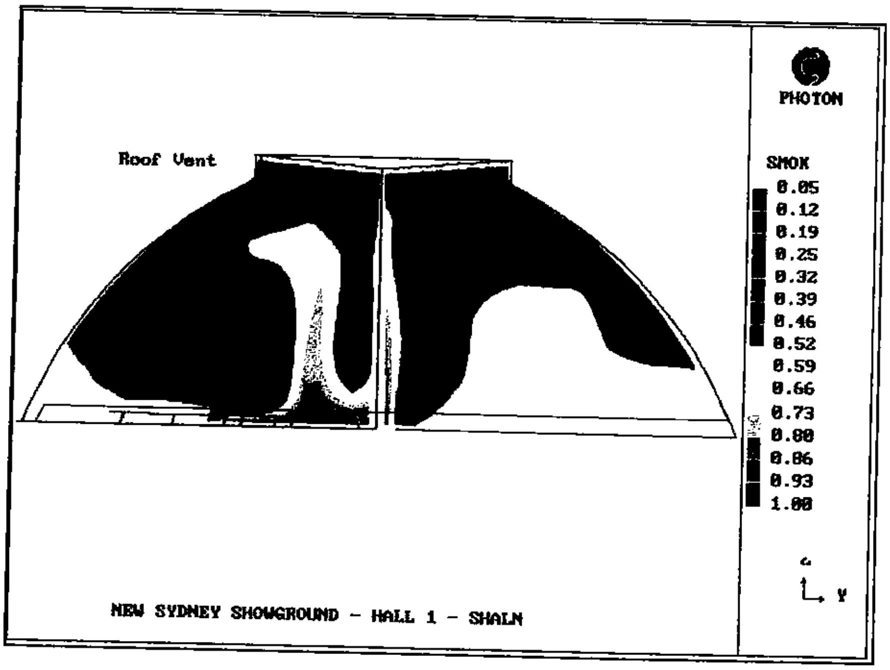


Figure 13. Smoke accumulation at 600 secs for Hall 1 with 50% venting and no suppression.

Assuming a fire brigade response time of 4.5 minutes, the fire brigade should arrive on the scene in approximately 375 seconds. This is less than the time taken for the occupants to evacuate the building and hence, the fire brigade will have to undertake rescue activities before fire fighting can begin. Assuming it takes 2 minutes for rescue and 2 minutes for setting up, fire fighting activities would begin after 645 seconds. At this stage the fire would be 74 MW which may cause a problem for fire fighters in terms of extinguishing the fire. Accordingly, even though the occupants are indicated to evacuate the hall without being exposed to untenable conditions, some form of fire control is considered desirable if the fire brigade are to be able to fight the fire effectively. One solution could be to use the trained staff within the hall to attempt fire fighting early in the fires development. Even if not successful in extinguishing the fire, their activities should reduce the rate of fire growth and provide the brigade with a better opportunity for fire fighting.

12.2 Hall 2, 3 & 4

For Halls 2, 3 and 4 (see Table 5) where the non-ventilated case for a half-hall configuration (the worst case configuration) produces untenable conditions after 480 seconds. Natural ventilation delays smoke logging (compare Figures 15 and 16) to greater than 720 seconds.

Evacuation modelling (Table 4) indicates that 510 seconds is required where the exits are unobstructed and 930 seconds if the exit to the exhibition court is obstructed. Accordingly, if the exits are unobstructed a safety margin for occupant evacuation of greater than 210 seconds (4 minutes) exists. Given the conservative assumptions for fire growth rate and vent area this is considered acceptable.

If the exits are blocked, occupants can be exposed to untenable conditions due to the extended time required to evacuate caused by the narrow exits adjacent to the kiosk. Accordingly, it is recommended that these exits be widened or other exits be made available such that the evacuation time is reduced, otherwise some for of active fire suppression system will have to be installed to provide an adequate level of life safety.

13. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the fire safety engineering assessment performed on the New Sydney Showgrounds and the assumptions described in Section 3 of this report, it is considered that:

1. An acceptable level of life safety can be achieved for all the halls, in the layouts modelled through the use of a natural roof venting system, provided that:

    a) The exits from the smaller halls, Halls 2,3 & 4, remain unobstructed and the width of the exits from the smaller halls adjacent to the kiosk area is increased to improve the time for occupant evacuation in case the fire obstructs other exits.

    b) From the point of view of fire brigade fire fighting activities, the trained staff within the halls are trained in fire fighting so that the rate of fire growth during the early stages of fire development can be limited using either the installed hydrants and hose reels or hand held extinguishers.

2. The analysis shows that a mechanical exhaust system is not required and that a sprinkler system will not be effective for the building roof heights involved.

The fire safety assessment included the following conservative assumptions;

1. Fire growth at an Ultrafast rate
2. 50 percent vent openings
3. No fire control due to staff

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FIRE ENGINEERING ASSESSMENT
NEW SYDNEY SHOWGROUND ZONE 2

Schedule of Drawings Examined

Architects: Anchor Mortlock & Woolley
Structural Engineers: Ove Arup & Partners
Project No. 9602

Drawing No.	Revision	Drawing No.	Revision
RA - A - 2- 000	C	RA - A - 2- 303	A
RA - A - 2- 001	A	RA - A - 2- 400	A
RA - A - 2- 100	B	RA - A - 2- 401	A
RA - A - 2- 101	B	RA - A - 2- 402	A
RA - A - 2- 102	C	RA - A - 2- 701	A
RA - A - 2- 103	C	RA - A - 2- 702	A
RA - A - 2- 104	A	RA - A - 2- 703	A
RA - A - 2- 105	A	RA - A - 2- 704	A
RA - A - 2- 106	A	RA - A - 2- 705	A
RA - A - 2- 107	A	RA - A - 2- 706	A
RA - A - 2- 108	B	RA - A - 2- 707	A
RA - A - 2- 109	B	RA - A - 2- 708	A
RA - A - 2- 200	A	RA - A - 2- 710	A
RA - A - 2- 201	A	RA - A - 2- 711	A
RA - A - 2- 202	A	RA - A - 2- 712	A
RA - A - 2- 203	A	RA - A - 2- 713	A
RA - A - 2- 204	A	RA - A - 2- 714	A
RA - A - 2- 300	A	RA - A - 2- 715	A
RA - A - 2- 301	A	RA - A - 2- 716	A
RA - A - 2- 302	A	RA - A - 2- 717	A

Drawings by Ove Arup & Partners / Project No. 9241

Drawing No.	Revision	Drawing No.	Revision	Drawing No.	Revision
RA - E - 2- 021 A	B	RA - M - 2- 010	A	RA - H - 2- 000	
RA - E - 2- 000 A	A	RA - M - 2- 011	A	RA - H - 2- 001	
RA - E - 2- 001 A	B	RA - M - 2- 012	A	RA - H - 2- 002	
RA - E - 2- 004 A	A	RA - M - 2- 000	A	RA - H - 2- 003	
RA - E - 2- 005 A	B	RA - M - 2- 001	A	RA - H - 2- 004	
RA - E - 2- 006 A	B	RA - M - 2- 002	A	RA - H - 2- 006	
RA - E - 2- 007 A	B	RA - M - 2- 007	A	RA - H - 2- 007	

RA - E - 2- 008	B	RA - M - 2- 004	A	RA - H - 2- 008
A				
RA - E - 2- 009	B	RA - M - 2- 006	A	RA - H - 2- 009
A				
RA - E - 2- 010	B	RA - M - 2- 013	A	RA - H - 2- 010
A				
RA - E - 2- 011	B	RA - M - 2- 014	A	RA - H - 2- 011
A				
RA - E - 2- 012	B			
RA - A - 2- 710	B			
RA - E - 2- 016	B			
RA - E - 2- 017	B			
RA - E - 2- 019	B			
RA - E - 2- 020	B			

Exhibition Layout 2
9602 SK 253