SYDNEY ADVENTIST HOSPITAL REDEVELOPMENT

STRUCTURAL ENGINEERING
PART 3A REPORT

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ISSUE: A

REVISION	DATE	ORIGINATOR	CHECKED	APPROVED	REMARKS
A	16 June 2010	PT	PT	PT	For Approval

1.0 EXECUTIVE SUMMARY

The project consists of a 10 level building with a concrete roof slab supporting mechanical plant equipment. Levels 1 to 5 house doctors suites, pre-operative use and theatres. Level 6 consists of a plantroom floor. Levels 7 to 10 consist of post operative care and wards.

All the floor slabs are proposed to be post-tensioned reinforced concrete, supported on reinforced concrete columns and lift cores.

The location of the concrete columns for the typical floors has been dictated by and co-ordinated with the internal layout of the functional spaces and the ancillary areas. Generally these columns suit the theatres below the Level 6 plantroom and the wards above Level 6. All column and stair wall transfer will occur at the Level 6 transition. The slab and beam sizes will be optimised to give structural efficiencies in the floor slab system.

The concrete floor slab and associated columns will support the building façade, with the building façade not intending to be loadbearing. The floor slabs will need to be independently checked for the effect of earthquake loads and floor vibrations.

The lateral stability of the building is to be provided by a combination of frame action between the floor slabs, the building columns and the concrete walls surrounding the stair and lift shafts.

A "flexible" building joint will be provided between the new and existing Clinical Services Building, to accommodate building movements during an earthquake event. The joint will be designed to support the day to day activities of the hospital and provide a fire barrier between the floors, however debond during an earthquake. The new concrete floor slabs will be constructed at a distance from the existing building to ensure the two structures do not pound against one another during an earthquake.

2.0 DESIGN STANDARDS

The structural design shall be in accordance with the latest issue of all relevant Australian Design Standards, Codes and other statutory requirements. As a minimum requirement, the design shall be based on, but not limited to

AS1170.0 (2002)	Structural Design Actions Part 0 General Principles
AS1170.1 (2002)	Structural Design Actions Part 1 Permanent, Imposed and Other Actions
AS1170.2 (2002)	Structural Design Actions Part 2 Wind Loads
AS1170.4 (2007)	Earthquake Loads
AS3600	Concrete Structures
AS3700	Masonry Code
AS4100	Steel Structures
AS4600	Cold-Formed Steel Structures

Building Code of Australia

BS 6472 : 1992	Evaluation to Human exposure to vibration in buildings
AS 2670.1 – 2001	Whole Body Vibration
AS 2670.2 – 1990	Continuous and shock induced vibration

A Design Guide for Footfall induced vibration of structures – M. Wilford and P. Young (2006)
Predicting footfall – Induced Vibrations – Ungar et al (2004)

3.0 DESIGN LIFE

The structure elements of the building shall be designed to provide adequate performance for a minimum period of 50 years.

The structural design shall take into consideration the possible changing building uses and the local environmental conditions during the proposed design life.

Material selection, specifications, and detailing of the structural elements shall be such as to provide optimum durability of the structure.

4.0 MATERIAL PROPERTIES FOR DESIGN

As a guide the following minimum material grades shall be used:

Concrete Strength Grades:	
Bored piers, footings	25 MPa
Reinforced floors, columns, walls	32 MPa, 40 MPa, 50 MPa, 65 MPa & 80MPa
Post-tensioned floors	32 MPa and 22 MPa at 5 days
Structural Steel Grades:	
Rolled sections	300 MPa
Plate and Connection Components	250 MPa
Hollow Sections	350 MPa

5.0 DESIGN DEAD LOAD

5.1 Unit Weights

Design dead load shall include all self-weight and dead loads of elements. Unit weights shall be in accordance with Appendix A of AS 1170.1 (2002)

5.2 Superimposed Dead Load

Due consideration shall be given to superimposed dead loads due to: partitions, floor finishes and toppings, ceilings and services, racking systems, plant and equipment, hobs and kerbing, perimeter screens and walling, escalators and stair flights, planters and landscaped areas, and any imposed dead loads from roof framing, glazing and linings. Reference shall be made to the architectural drawings for the extent and location of these loadings.

SCP will require equipment weights for all areas supporting heavy equipment such as operating rooms, laboratories, imaging and plantrooms. The weights will need to be submitted by the respective services consultants prior to structural design.

5.3 Roof Loads

If the roof is framed in structural steel, roof loads shall be evaluated in a systematic fashion as set out in the Pro-Forma at Appendix A of this Design Brief. Services and Acoustic Consultants are to be requested to supply the necessary loadings to allow completion of the Pro-Forma. A copy of the Pro-Forma shall be included in all calculations and shall be summarised on the roof-marking plan for each building.

Suspended ceilings, major service ducts and pipe work required to be supported by purlins shall be designed and specified to be attached to the webs of the purlins.

6.0 DESIGN LIVE LOAD

The floor slabs in the specifically designated areas shall be designed for the live loads nominated in Appendix B of this Design Brief.

Design loads shall be clearly designated on all structural floor plans.
Live Load reductions shall be applied in accordance with AS 1170.1.

SCP will require equipment weights for all areas supporting heavy equipment such as operating rooms, laboratories, imaging and plantrooms. The weights will need to be submitted by the respective services consultants prior to structural design.

7.0 DESIGN WIND LOAD

Design shall be in accordance with AS1170.2 – 2002 using the parameters set out in the Site Wind Analysis in Appendix C.

Design event for wind shall be 1/500 for ultimate wind and 1/25 for serviceability wind.

The design of façade elements and their connections to the structure shall make provision for all local peak wind pressures effects, calculated using AS 1170.2 local pressure factors.

Projecting canopies and awnings, particularly at street level shall be designed to resist the wind forces caused by deflected pressure flows from the surrounding buildings, using the method nominated in AS1170.2 (2002).

8.0 EARTHQUAKE

Design shall be in accordance with AS1170.4 – Part 4 "Earthquake Loads" (2007) using the following parameters:-

Structure Importance Level	:	3	
Earthquake Design Category	:	III (dynamic analysis)	
Annual Probability of Exceedance	:	1/500	
kp	:	1.0 (ultimate design) 1.0 (service design)	
Z	:	.08	
Site Sub-soil Class	:	A	
Structure Ductility Factor and Performance Factor	:	$\mu = 2$ Sp = .77	ordinary moment-resisting frames with limited ductile shear walls

- Design for lateral loads in accordance with Section 7
- Design for vertical loads in accordance with Section 7
- Accidental Tension in accordance Clause 6.6

- Design Load Cases

Case 1 DL+.3LL +1.0+Feqh(x)+.3Feqh(y)+1.0Feqv(x)+.3Feqv(y)+/-.1btorsion(x)+.3(+/-.lb torsion(y))

Case 2 DL+.3LL +.30Feqh(x)+1.0Feqh(y) +.30Feqv(x)+1.0 Feqv(y)+/-.3(.lb torsion(x))+/-.lb torsion(y)

Case 3 DL+.3LL +1.0 Feqh (x) +.30 Feqh(y)-1.0Feqv(x)-.3Feqv(y) +/- .lbtorsion(x) +.3(+/-.lbtorsion (y))

Case 4 DL+.3LL +.30Feqh(x) +1.0Feqh(y) - .30Feqv(y) -1.0 Feqv(y) +/-3(.lbtorsion(x)) +/- .lbtorsion(y)

Case 5 DL+.3LL +1.0 Feqh(x) +.30 Feqh(y) +/- .lbtorsion(x) +/- .3(.lbtorsion(y))

Case 6 DL.3LL +.30 Feqh(x) +_1.0Feqh(y) +/- .3(.lbtorsion (x)) +/- .lbtorsion (y)

Case 7 DL+.3LL +1.0+Feqh(x)-.3Feqh(y)+1.0Feqv(x)+.3Feqv(y)+/-.1btorsion(x)+.3(+/-.lb torsion(y))

Case 8 DL+.3LL +.30Feqh(x)-1.0Feqh(y) +.30Feqv(x)+1.0 Feqv(y)+/-.3(.lb torsion(x))+/-.lb torsion(y)

Case 9 DL+.3LL +1.0 Feqh (x) -.30 Feqh(y)-1.0Feqv(x)-.3Feqv(y) +/- .lbtorsion(x) +.3(+/-.lbtorsion (y))

Case 10 DL+.3LL +.30Feqh(x) -1.0Feqh(y) - .30Feqv(y) -1.0 Feqv(y) +/-3(.lbtorsion(x)) +/- .lbtorsion(y)

Case 11 DL+.3LL +1.0 Feqh(x) -.30 Feqh(y) +/- .lbtorsion(x) +/- .3(.lbtorsion(y))

Case 12 DL+.3LL +.30 Feqh(x) -1.0Feqh(y) +/- .3(.lbtorsion (x)) +/- .lbtorsion (y)

- Allowable interstorey drift : .015H
- Pounding to be calculated based on deflections determined in accordance with Clause 6.7.2
- Δ eq = Δ elastic x μ /Sp
- The structure will need to be designed for ultimate eg forces and elastic eg forces
- All walls and components shall be designed for Earthquake pressures and loads in accordance with Section 8
- Structure will need to be detailed as on intermediate moment resisting frame.

9.0 OTHER DESIGN LOADINGS

9.1 Minimum Lateral Loads to Interior Walls

Interior walls and permanent partitions and their fixings and supports, shall be designed to resist all loads to which they are subjected, but not less than a lateral force of 0.25 kPa (working), 0.40 kPa (ultimate) shall be applied perpendicular to the walls.

All walls should be designed for Earthquake forces as per AS 1170.4 – 2007.

9.2 Temporary and Construction Loads

The building structures shall be designed to resist all loads imposed during construction. In all instances, the building components in their temporary partly constructed state shall remain structurally stable.

A minimum construction live load of 2.0 kPa shall be adopted.

The selected contractor shall advise the extent of all areas which they require to be designed for additional loads from construction and material storage to suit construction arrangements.

9.3 Horizontal Loads to Handrails and Balustrades

All handrails and balustrades shall be designed in accordance with AS1170 Part 1. Where applicable, the design shall include for the effects of crowd loading or impact. Under maximum load conditions, these elements shall deform by following a plastic deformation mechanism.

Carpark walls and barriers shall be designed for low speed impact loads specified in AS 1170 Part 1.

10.0 SERVICEABILITY

10.1 Vibration Effects

Vibration due to plant should not be structurally critical or unacceptable to occupants. SCP assumes all plant to be base isolated on spring and damper mounts.

Floors shall be designed to ensure that they comply with the recommended acceleration and velocity limits in the relevant Standards. SCP will use the R factor method outlined in Annex A of AS 2670.2 and Appendix A of BS 6472.

SCP proposes to subdivide the Hospital floor usage into four (4) separate areas for dynamic assessment and design.

Zone 1 – Sensitive Equipment
Max accelerations and velocities to be supplied by the equipment specifier, nominal R factor = 1.0

Zone 2 – Operating Theatres
R factor = 1.0

Zone 3 – Night Wards
R factor = 1.4

Zone 4 – Normal office areas, public space, waiting areas, consultation rooms (without critical equipment)
R factor = 4 to 7

Generally, the vibration zoning can be described as follows:

Zone 1 – Areas for sensitive equipment, this should include any areas where there will be MRI's, CT scans etc that are usually affected by floor vibration.

Zone 2 – Areas such as operating theatres where important procedures are taking place and vibration is limited so that it cannot be senses by staff inside the theatre.

Zone 1 and 2 areas may be interchangeable subject to acoustic advice from an accredited acoustic consultant, as they have the same limits.

Zone 3 – Areas where vibration at night is to be limited so that patients lying horizontally cannot feel the bed shake as a result of staff walking near them.

When large groups are moving around the wards (usually during the daytime), some vibration may be felt, but this would be limited.

Zone 4 – Normal / General areas where admin, consultation, waiting room and any other normal activity takes place where some vibration can be felt and tolerated. These floors are to be designed like normal office type floors where vibration is not critical to everyday function. Most likely, vibration will not even be felt at all unless someone is sitting still and there is a large group of people walking nearby.

From a flexibility view point, Zone 1 and Zone 2 are interchangeable, and in most cases Zone 3 could be also used to support operating theatres, with further vibration analysis.

All dynamic assessment will be made based on 2 people walking moderately, each weighing 70 kg and walking out of phase.

Attached to this report is the floor plan showing the zones that have been adopted for the Stage 1 Expansion. These zones have been presented to and agreed by the Sydney Adventist Hospital user groups. The zones include the allowance for the hospitals future expansion / flexibility

10.2 Deflection Limits

The following floor deflection limits shall apply unless more stringent deflection limits are required for special conditions:

Car park Areas	
Total long term deflection	<span/250, or 25mm
General Floors	
Incremental deflection	<span/500
Total long term deflection	<span/250, or 25mm
Roof Structures (Concrete)	
Total long term deflection	<span/250, or 25mm
Compactus Areas (Concrete)	
Incremental long term deflection	<span/500

10.3 Lateral Drift

Serviceability levels shall be designed and constructed to limit inter-storey lateral drift of the storey height such that the integrity of all connected building elements are maintained.

In particular the effects of lateral drift needs to be addressed in the performance of the façade system.

Maximum allowable lateral and interstorey drift to be .015H.

10.4 Durability

The structure shall be designed giving due consideration to durability and the functionality of the building and its components. All concrete elements shall be designed for the following exposure classifications in accordance with AS3600.
Interior: A1
Exterior : B2

11.0 BUILDING JOINTS

Differential displacement and movements between building joints shall be evaluated and joint detailed shall be such as to accommodate the movement.

As a minimum calculations shall allow for combinations for the following:

- Axial shortening
- Concrete creep
- Concrete shrinkage
- Loading Differentials
- Thermal differentials and temperature gradients
- Building sway effects
- Seismic movements and pounding

Joints in tiling, terrazzo and granolithic topping floor finishes shall be coordinated with slab construction joint locations to be determined in consultation with project design team.

12.0 PENETRATIONS AND SERVICES RISERS

The design of the structure shall, as far as practicable, avoid the need for post construction penetrations. Known services and mechanical penetrations are to be coordinated with the relevant services consultants and the architect and clearly indicated on the structural drawings.

The post tensioned slab bands have been designed to incorporate known penetrations at the columns plus additional future 150 mm diameter max size penetrations. The location of permitted future penetrations are shown on the concrete outline plan and shall also be marked on the slab surface.

Where an existing penetration occurs at a column location, the allowable future 150 mm diameter penetration will be at the opposite column face only.

All future penetrations and fixings for surface mounted equipment in both the slab and the slab bands shall be approved by SCP Consulting before installation. (Note:- This is to avoid cutting tendons. No large penetrations are permitted in the slab bands. Large penetrations in post tensioned slabs will require strengthening as per conventionally reinforced slabs).

13.0 SPECIAL DESIGN CONSIDERATIONS

- 100% column stiffness shall be used when analysing floor slab systems.
- Where possible stage post-tensioning shall not be specified and tendons using 7 or less strands shall be used.
- Relevant live loads and structural member fire-ratings shall be shown on structural drawings.
- The building structures shall be designed with sufficient capacity to support building maintenance requirements, including roof harness fixing points where required.
- SCP will require a floor vibration assessment report for all sensitive areas such as operating theatres, imaging and plantrooms.

  The report shall be undertaken by an expert vibration consultant to determine the level of vibration velocity and accelerations as a result of structural vibrations arising from normal occupant use.
- SCP will require equipment weights for all areas supporting heavy equipment such as operating rooms, laboratories, imaging and plantrooms. The weights will need to be submitted by the respective services consultants prior to structural design.
- All earthing requirements for lightning protection to the building to be advised and detailed by the electrical consultant.

14 STRUCTURAL DRAWING REGISTER

14.1 DRAWING DELIVERABLES

Phase 1 – Concept Design

These drawings will be at scale 1:200 or 1:100, indicating the general foundation structural framing requirements and basic construction details. These drawings will contain firmer material rates and sizes in order for the cost planners to develop a Budget Price. The drawings will include:

- Slab on ground plans
- Foundation plans and details
- Suspended concrete framing plans
- Concrete strengths and reinforcement rates (conventional and post-tensioning)
- Typical sections
- Steel framing plans and elevations

Phase 2 – Design Development For Tender and For Construction

These drawings will be CAD generated at a scale of 1:100 for plans and 1:20 for details. They will consist of sufficient plans and details for Submission of Building Plans for authority approval, issue documents to contractors for tender and for construction. The drawings will include:

- Finalised framing plans
- Finalised foundation plans and details
- Column schedule and sizes
- Concrete outlines
- Reinforcement plans (where floors not post tensioned)
- Concrete sections
- Lift and Stair Details
- Structural steel framing plans
- Structural steel elevations
- Structural steel details
- Masonry details
- Façade support details

15 STRUCTURAL CERTIFICATION

15.1 The project shall be delivered according to the protocols and directions of the SCP Consulting "Operations Manual". This document outlines in detail the roles and responsibilities of all personnel involved with the delivery of the project.

15.2 The project can have a staged certification process. The initial Certificate of Design Compliance is sufficient for Construction certificate approval. The Certificate of Design and Construction Compliance is required before the building is occupied. The attached checklist indicated the Q. A. documentation required by SCP prior to issuing the certification. Refer to Appendix I.

APPENDIX A – ROOF LOADING

	ALLOWANCE		
ELEMENT DESCRIPTION	**UNIFORM (KG/SQ.M.)**	**CONCENTRATED (KGS)**	**LINE (KG/M)**
ROOF SHEETING	5		
PURLINS	5		
INSULATION	3		
NORMAL CEILING 2 Layers 13mm Gyprok and to suit acoustic requirements	20		
ELECTRICAL CABLING	TBA		TBA
LIGHTING	TBA	TBA	
AUDIO		TBA	
MONITORS		TBA	
A/C DUCTING	20 kg/m^2 Purlins 10 kg/m^2 Rafters		TBA
FAN COIL UNITS		TBA	
EXHAUST UNITS TO ROOF		TBA	
GAS PIPES (including AIR)			TBA
HYDRAULICS PIPES			TBA
SPRINKLERS	5		TBA
CATWALKS/WALKWAYS			TBA
ROOF ACCESS SYSTEM ANCHOR LOADS		TBA	
OTHER	TBA	TBA	TBA
ROOF LIVE LOAD (In accordance with AS1170.1)	25 MAX 50 kN	110	

TBA – TO BE ADVISED BY RELEVANT CONSULTANT

APPENDIX B -FLOOR LOADS

BUILDING COMPONENT	LIVE LOAD	SUPERIMPOSED DEAD LOADS
HOSPITAL WARDS	2 kPa min	1.5 kPa
OPERATING THEATRES *	3 kPa min	2.5 kPa
LABORATORIES *	3 kPa min	1.5 kPa
CAR PARKING	2.5 kPa min	0 kPa
LOADING DOCKS	15 kPa min	1.5 kPa
BACK OF HOUSE/WASTE AREAS	7.5.kPa min	1.5 kPa
STORAGE AREAS	7.5 kPa min	0 kPa
SUBSTATION/SWITCH ROOM	7.5 kPa min	5.0 kPa
AHU PLANT AREAS *	7.5 kPa min	2.5 kPa + B/W
AUDITORIUM	5.0 kPa min	2.5 kPa
BOILER PLANT AREAS *	7.5 kPa min	2.5 kPa + B/W
OFFICE SUITES	3 kPa min	1.5 kPa
PUBLIC SPACE	5.0 kPa min	1.5 kPa
IMAGING AREAS *	5.0 kPa min	1.5 kPa
CONCRETE ROOFS	3.0 kPa	1.5 kPa

Note:

- The design of the structure assumes Lightweight partitions throughout
- Services allowance = .5 kPa at underside of all slabs
- All toppings no greater than 50 mm thick

* Denotes all equipment loads shall be submitted to SCP for assessment.

An acoustic vibration assessment shall also be undertaken.

- Truck Loading Docks to be designed for unlimited repetitions of medium rigid trucks.

APPENDIX C – SITE WIND ANALYSIS

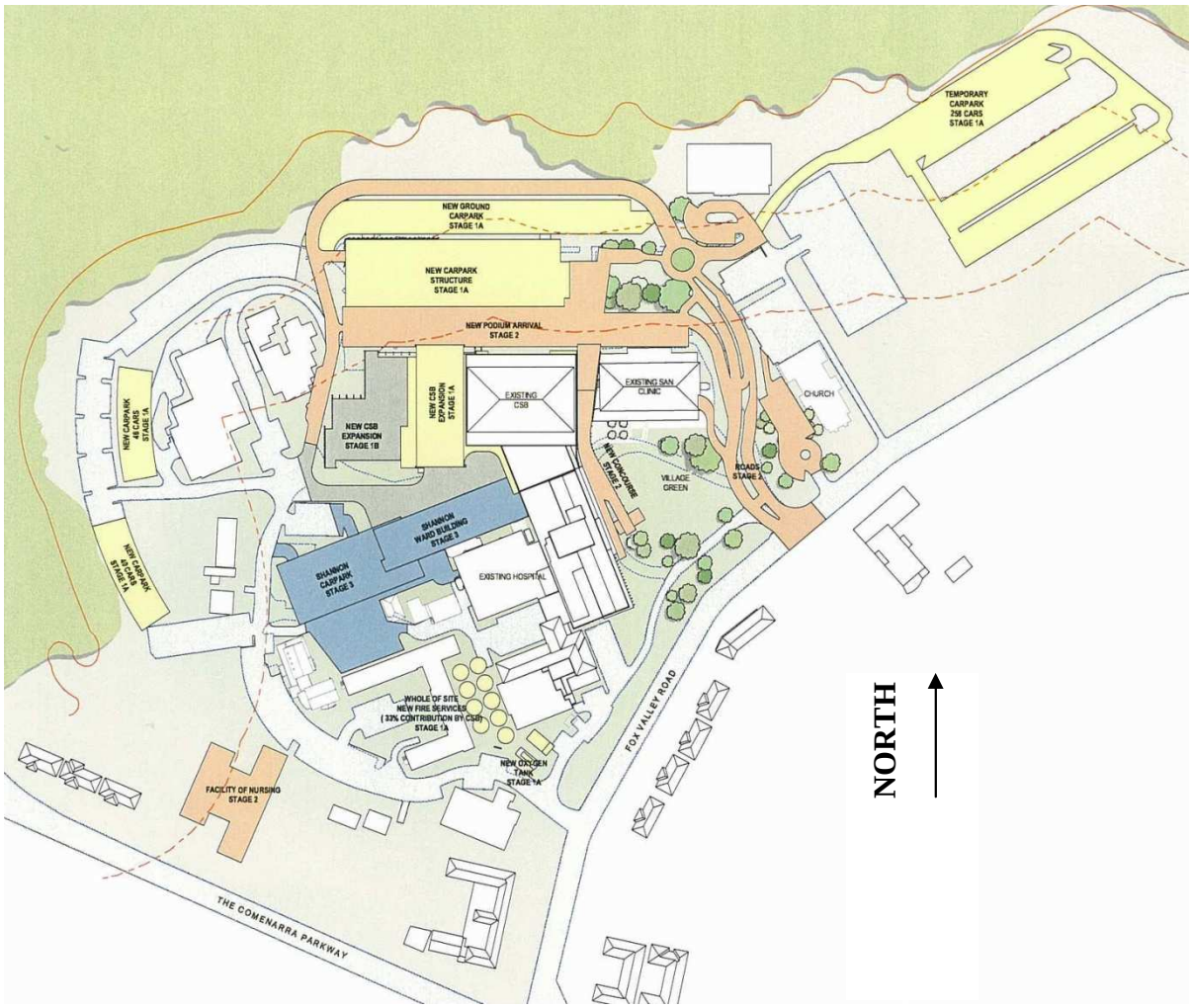
Importance Level = 3 (Buildings designed to contain large number of people)

Annual Probability Exceedence : 1 in 1000 – ultimate

Region : A2 1 in 25 – serviceability

V1000 – ultimate limit state = 46 m/s

V25 – serviceability limit state = 37 m/s



Wind Direction Multipliers		N NE E	0.95
		S SE	0.95
		SW W NW	1.00
Terrain Categories	faces of buildings		3
Shielding Multipliers	–	1.00	

APPENDIX D – FLOOR VIBRATION ZONES

Slab Vibration AS 2670

	Design Criteria for Slab Vibration AS 2670	Description
Sensitive Equipment Sensitive (Hospital Expansion) Operating Theatres	Multiplier 1.0 ✓ ✓	Areas for sensitive equipment and operating theatres where vibration is limited so it cannot affect equipment or be felt by occupants
Night Wards	Multiplier 1.4	Areas where vibration at night is limited so that patients lying horizontally cannot feel vibration as a result of staff walking near them When large groups are moving around a ward (usually during the day) minor vibration may be felt
General Areas	Multiplier 4.0 Normal office / retail buildings	General areas where some minor vibration can be felt and tolerated

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1st June 2009

Origin Properties
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Attention: *Mr John Ifield*

ACOUSTIC/VIBRATION BRIEF FOR SYDNEY ADVENTIST HOSPITAL REDEVELOPMENT – SCP JOB NO. 2899

SCP requires an Acoustic Report for Sydney Adventist Hospital Redevelopment Stage 1. The acoustic report by the acoustic consultant shall include, but not be limited to the following items:

1) Advise as the required R values, peak rms acceleration and velocity limits, (in accordance with AS 2670 / BS 6472) for four (4) Vibration Sensitive

   Zone 1 – Sensitive Medical Equipment Areas including MRI's

   Zone 2 – Operating Theatres

   Zone 3 – Night Wards

   Zone 4 – General Areas (offices, public space, consultation etc)

2) Minimum slab thickness above and below critical rooms / areas or zones and plantrooms.

3) Required slab construction to Level 6 and Roof Level plant rooms (are any topping slabs required?)

4) Comments on required structural vibration requirements for plantrooms adjacent to sensitive areas or zones.

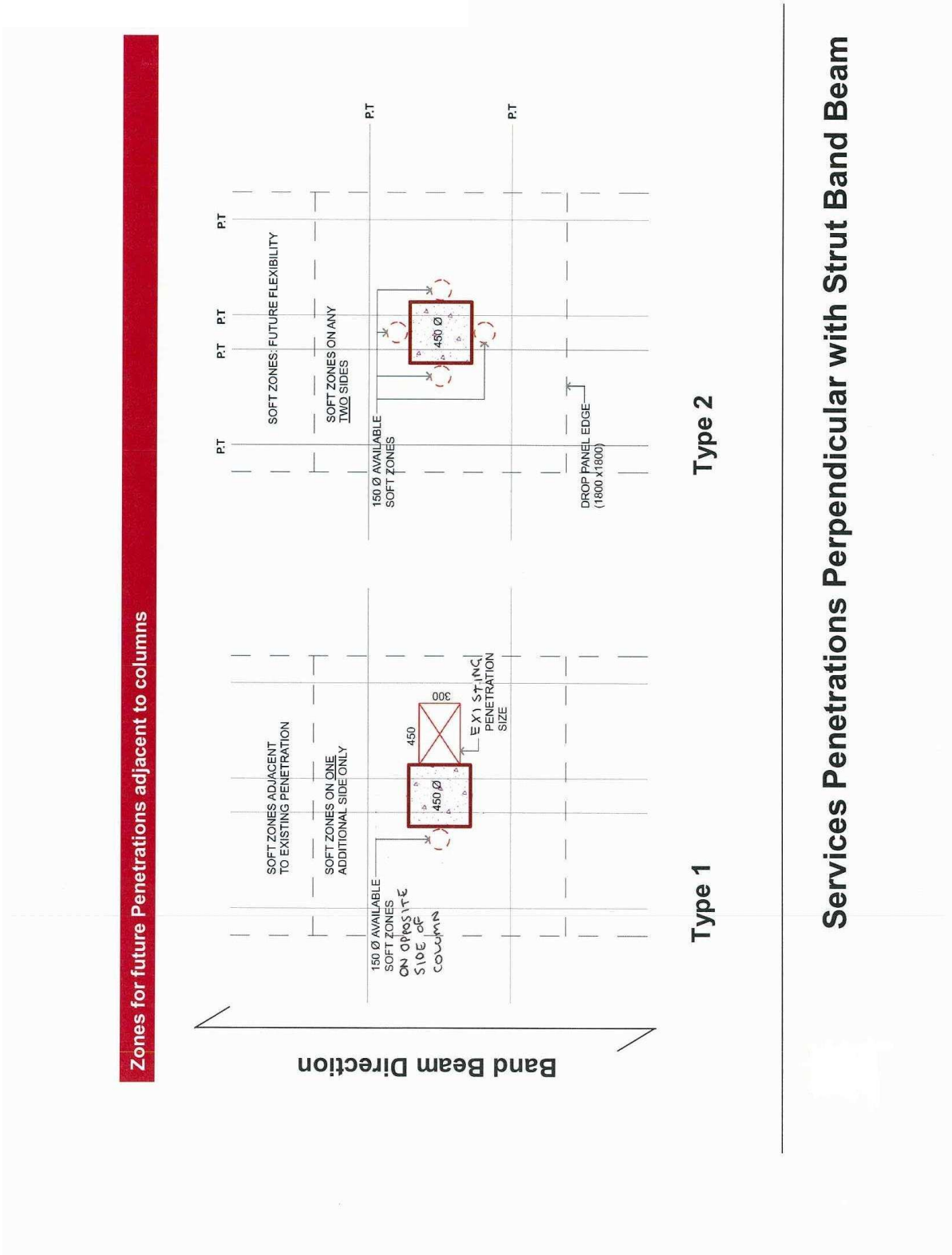
5) Minimum wall thickness for various lift shafts.

6) Any other which you feel are important to the structural design of the new building.

Yours faithfully
SCP CONSULTING PTY LTD

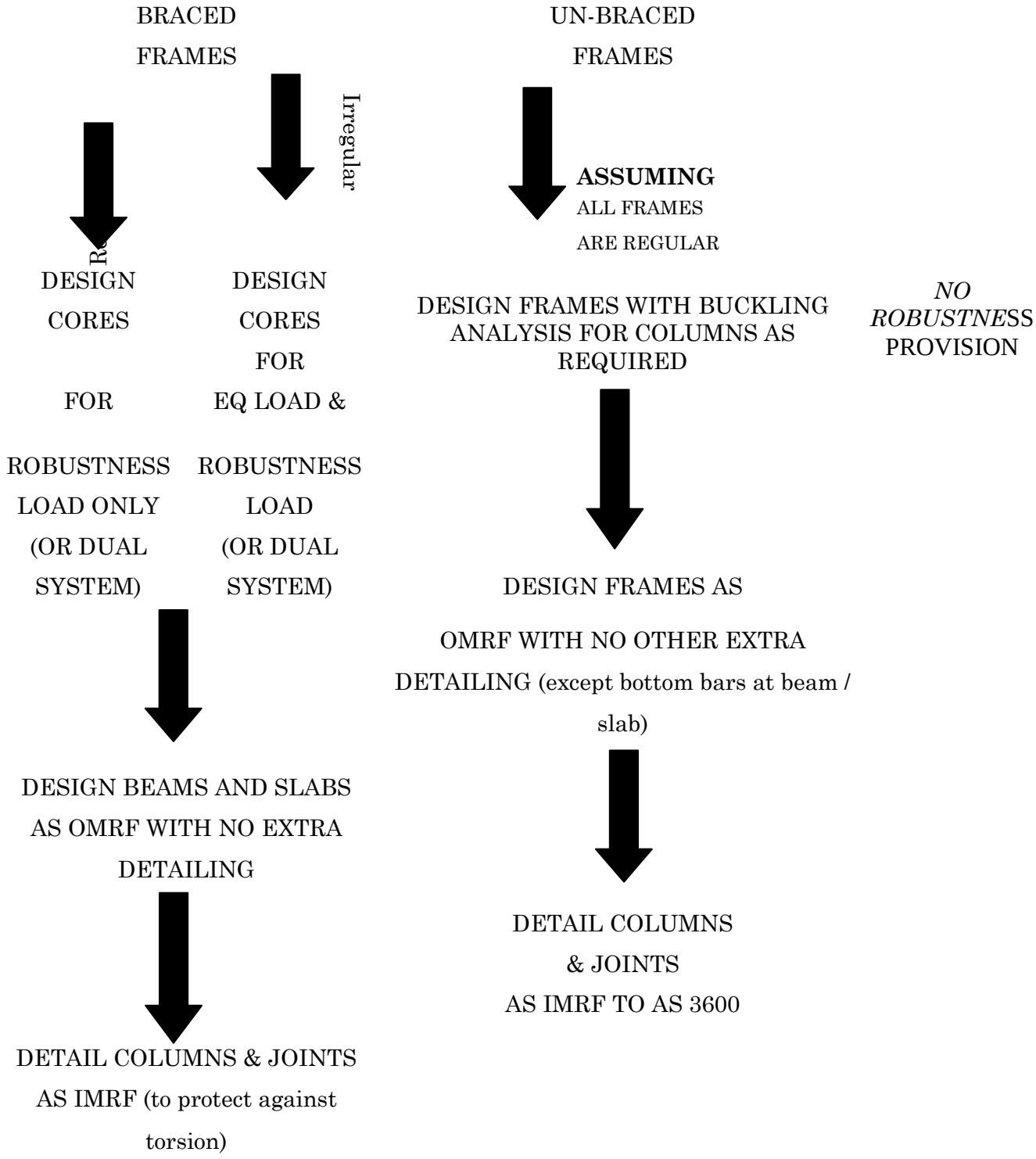
Peter Trickett
Director

APPENDIX E
DESIGN APPROACH FOR AS1170.4



APPENDIX E

DESIGN APPROACH FOR AS1170.4



SYDNEY ADVENTIST HOSPITAL REDEVELOPMENT

POST TENSIONED FLOOR SLABS

DESIGN BRIEF: 2899 DB1

PREPARED BY:

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1. Design Loads

The post-tensioned floors are to be designed for the following design loads:

i) Live Loads: As shown on drawings

ii) Dead Loads: As shown on drawings

iii) Earthquake Loads: The structure is a braced system.
All Earthquake loads are carried by the core and the shear walls.

2. Code Compliance

All floor slabs and beams are to be designed for strength and serviceability in accordance with the requirements of AS3600 – Concrete Structures.

All floors carrying masonry walls are to be designed to comply with the deflection and vibration criteria nominated on the drawings.

All frame analysis shall use 100% of the equivalent column stiffness.

3. Crack Control

Sufficient post-tensioning and reinforcement shall be provided in both directions so as to satisfy crack control provisions for moderate degree of cracking as per AS3600 Clause 9.4.3.4.

If post-tensioning alone is to provide crack control, a minimum level of 1.4MPa after final losses shall be maintained.

Where restraint by piers, core walls and other vertical elements is likely to reduce the level of prestress below the minimum level, adequate reinforcement is to be provided to properly control shrinkage cracking in the slabs and bands.

4. Concrete Strength

Project assessment is required for all concrete placed.

All concrete is to have a characteristic compressive strength F'c=32 MPa at 28 days, and f'cm = 22 MPa at 5 days.

Concrete in all post-tensioned slabs and beams to have a maximum drying shrinkage of 600 microstrain at 56 days.

Initial (25%) prestress is to be applied when the concrete compressive strength reaches 9 MPa.

Final (100%) prestress is to be applied after a minimum of 5 days, when the concrete has reached a compressive strength of at least 22 MPa.

5. Shop Drawings

The prestressing sub-contractor shall prepare shop drawings showing the cable layout, all cable profiles, jacking loads and theoretical extensions and details of all required anchorages and couplers, including all anti-burst anchorage reinforcement required additional to the flexural reinforcement shown on the structural drawings.

The two (2) copies of the Shop Drawings are to be submitted to the engineer for approval at least 10 working days prior to installation of cables on site.

6. Post Tension Specification

i) Workmanship, materials and stressing shall comply with the Australian Standard AS3600 – Concrete Structures.

ii) Design Assumptions are:

a) Minimum level of prestress in concrete slabs and slab bands after final losses shall be sufficient to satisfy Part 3.

b) Fire rating of floors - Refer to architects drawings.

c) All strands shall be 12.7 or 15.2 diameter 7 wire-super-grade, stress relieved, low relaxation strands to AS1311 with a minimum breaking load of 184 kN. Maximum tendon force prior to transfer (behind anchorage) – 156 kN per strand.

1. Co-efficient of friction in Duct u=0.2
   Estimated angular deviation B = .025 RAD/M
   Anchorage draw-in 6mm assumed

d) All concrete outlines have been based on 100% column stiffness. Final Post Tensioning Design shall use 100% column stiffness.

7. Tension ducts shall be fitted to smooth curves between positions shown. Ducts shall be semi-rigid steel sheeting (galvanised). The design assumes that 4 & 5 strand tendons are contained with 70 x 19 flat ducts. Duct profiles are measured from the soffit of the concrete slab or band to the underside of the duct. Except the anchorages where dimensions are to the centreline of the anchor.

8. Contractor shall submit calculations of assumed friction losses and total tendon elongations for approval of a minimum of 7 working days prior to commencement of stressing.

9. All ducts to be fully grouted within 5 days of stressing and after approval of elongations by the engineer.

10. Anchorages and splices shall be capable of developing the ultimate strength of tendons without excessive deformation. When required, satisfactory test data confirming the adequacy of the proposed devices shall be submitted.

11. Ducts, tendons and anchorages shall be firmly supported to prevent displacement during subsequent operations. They shall be placed with a tolerance of plus or minus 3 mm in concrete dimensions of 200 mm of less, plus or minus 5 mm in concrete dimensions between 200 mm and 600 mm, and plus or minus 15 mm in concrete dimensions over 600 mm.

12. Stressing

Calibrate stressing jacks to an accuracy of 2% pressure gauge readings shall be based on instruments having a calibrated accuracy of ± 0.5%. Calibration curves for the equipment to be used shall be made available to the engineer prior to stressing. The initial cable load between jack and anchorage shall not exceed 85% of the specified minimum ultimate cable load.

Stressing Sequence

Initial Stress: Jack each strand to 40 kN when concrete compressive strength reaches 9 MPa.

Final Stress: Apply full jacking load of 156 kN after a minimum of 5 days, when concrete has reached a compressive strength of at least 22 MPa.

All test cylinders used for early age strength determination are to be site cured under similar temperature and exposure conditions to the concrete floor slabs. Keep complete stressing record for each stressing operation for each cable as follows:

iii) Identification particulars of tendons.

iv) Initial force or pressure when tendons are marked for measurement of elongation.

v) Final force or pressures before anchoring tendons.

vi) Elongation at final force.

vii) Elongation remaining after anchoring tendon and release jacks.

Submit these records to the engineer for acceptance within 48 hours of completing each stressing operation.

13. Grouting

Grout shall consist of a mixture of cement and water.

Fly ash conforming to AS1129 and 1130, for use in concrete may be used. Fly ash shall not exceed 14kg per bag of cement.

Aluminium powder of the proper fines and quantity or other approved materials may be added to obtain a maximum of 10% expansion of the grout when measured unconfirmed.

Mix grout in a high-speed mechanical mixer and pass through a strainer into pluming equipment, which has provision for recirculation. Pumping of grout shall begin as soon as possible after mixing and may be continued as long as the grout retains the proper consistency.

APPENDIX G

SYDNEY ADVENTIST HOSPITAL REDEVELOPMENT

SCHEDULE OF CONCRETE MIXES

Mix Design	Location	Grade MPa	Cement Type	Fly Ash Allowable 25% Maximum	Silica Fume	Max. Shrinkage At 56 Days Micro Strain	Max. Aggregate Size (mm)	Super Plasticiser	F'cat 4 Days (MPa)	Max. Slump At Batching mm	Low Heat Character -istics	Water Proof Agent
1	• Mass Concrete (Pads) • Blinding Concrete	S15	GP	25%	Nil	750	20	Nil	N/A	80	N/A	N/A
2a	• Bored Piers	S32	GP	25%	Nil	750	20	Nil	N/A	80	N/A	N/A
2b	• Pad Footings • Strip Footings	S25	GP GP	25%	Nil	750	20	Nil	N/A	80	N/A	N/A
3	• Slab on Ground – Light Duty	S25	SL	25%	Nil	550	20	Yes	N/A	40	N/A	N/A
4	Post-tensioned Slabs Summer & Winter mixes to be Submitted Separately	4a S32 4b S40	SL	10%	Nil	650	20	Nil	22	80	N/A	N/A
5	• Reinforced Slabs / Stairs • Retaining Walls	S32	SL	25%	Nil	650	20	Nil	N/A	80	N/A	N/A
6	Core Walls / Lift Walls	S32	SL	25%	Nil	750	20	Yes	N/A	80	N/A	N/A
7	Slab on Ground – Heavy Duty	S32	SL	25%	Nil	550	20	Yes	N/A	40	N/A	N/A
8	Columns (Normal)	S40	GP	25%	Nil	750	20	Nil	N/A	80	N/A	N/A
9	Carpark Ramps/Pile Caps	S40	SL	25%	Nil	650	20	Nil	N/A	80	N/A	N/A
10a	Columns (High Strength)	S50	GP	25%	Nil	750	20	Nil	N/A	80	N/A	N/A
10b	Columns (High Strength)	S65	GP	20%	Nil	750	20	Nil	N/A	80	N/A	N/A
10c	Columns (High Strength)	S80	GP	20%	Nil	750	20	Nil	N/A	80	N/A	N/A
11	Blockwork Core Fill	S20	GP	25%	Nil	N/A	10	Nil	N/A	230	N/A	N/A
12	Shotcrete	S32	GP	25%	Yes	750	10	Nil	N/A	60	N/A	N/A
13	Lift Overrun Pit	S32	SL	25%	Nil	750	20	Nil	N/A	80	N/A	N/A
14	Roadway Slabs	S40	SL	10%	Nil	600	20	Nil	22	80	N/A	N/A
15	Loading Docks	S40	SL	10%	Nil	600	20	Nil	22	80	N/A	Xypex

APPENDIX H – FIRE RATINGS

SUMMARY OF BUILDING USE AND CLASSIFICATION

Building Use	Health-Care Building
Building Classification	Class 9a
Type of Construction required	A

FIRE RESISTANCE OF BUILDING ELEMENTS

- Fire Isolated Passageways discharging from fire isolated stairs or ramps : FRL 120/120/120
- Concrete slabs between all levels : FRL 120/120/120
- Stairs connecting all levels : FRL 120/120/120
- Lift and stair shafts : FRL 120/120/120
- Columns : FRL 120/120/120
- Plantroom Roof : FRL 120/120/120

Fire Resistance of Building Elements

FRL OF BUILDING ELEMENTS		
Building Element	Class of Building – FRL: (in minutes) Structural adequacy/integrity/insulation	
	5, 9 or 7 (carpark)	6
EXTERNAL WALL (including any column and other building element incorporated therein) or other external building element where the distance from any fire-source feature to which it is exposed is -		
For loadbearing parts-		
Less than 1.5m	120/120/120	120/120/120
1.5m to less than 3m	120/90/90	120/120/120
3m or more	120/60/30	120/120/90
For Non-loadbearing parts-		
Less than 1.5m	-/120/120	-/120/120
1.5m to less than 3m	-/90/90	-/120/120
3m or more	-/-/-	-/-/-
EXTERNAL COLUMN not incorporated in an external wall where the distance from any fire source feature to which it is exposed-		
Less than 3m	120/-/-	120/-/-
3m or more	-/-/-	-/-/-
COMMON WALLS and FIRE WALLS	120/120/120	120/120/120
INTERNAL WALLS		
Fire-resisting lift and stair shafts-		
Loadbearing	120/120/120	120/120/120
Non-loadbearing	-/120/120	-/120/120
Bounding public corridors, public lobbies and the like-		
Loadbearing	120/-/-	120/-/-
Non-loadbearing	-/-/-	-/-/-
Between or bounding sole-occupancy units-		
Loadbearing	120/-/-	120/-/-
Non-loadbearing	-/-/-	-/-/-
Ventilating, pipe, garbage, and the like shafts not used for the discharge of hot products of combustion-		
Loadbearing	120/90/90	120/120/120
Non-loadbearing	-/90/90	-/120/120
OTHER LOADBEARING INTERNAL WALLS, INTERNAL BEAMS, TRUSSES and COLUMNS	120/-/-	120/-/-
FLOORS	120/120/120	120/120/120
ROOFS	120/60/30	120/60/30

APPENDIX I

SCP CONSULTING
CHECKLIST OF DOCUMENTATION
REQUIRED BEFORE CERTIFICATION

PROJECT:_____ **DATE:** _____

BUILDING:_____

GENERAL **COMPLETED**

- Engineering Inspection Reports not signed off

Concrete Footings

- Copies of all inspection reports by geotechnical engineer _____
- Copies of certification of bearing pressures by geotechnical engineer _____
- Copy of concrete mix design _____
- Copies of all concrete cylinder test results _____
- Certificate for reinforcement stating grade _____

Concrete Slabs on Ground

- Copy of Sub-Base Compaction Tests and Reports _____
- Copy of Mix Design for Approval _____
- Copy of All Concrete Cylinder Test Results _____
- Copy of Shrinkage Test Results _____
- Details of Curing Compound applied including Compliance with Standards _____
- Details of Jointing Material used in Expansion Joints, Key Joints _____
- Copy of Results of Tolerance Check _____
- Certificate for any reinforcement stating grade _____
- Details of Post-Tensioning Extensions _____
- Details of grout used around tendons _____
- Grouting Records _____

Structural Steelwork

- Copies of Fabrication Inspection Reports including extent of NDE _____
- Copy of Paint Records and Testing/Galvanizing Records _____
- Copy of Applicators Warranty on Paint System/Galvanizing _____
- Copy of Inspection Reports of Paint System _____
- Copy of check on Fabrication and Erection Tolerances/Survey Certificate _____
- Copy of Certificates of steel grade and bolts _____
- Details of grout used _____

Suspended Concrete Work

- Copy of Mix Design for Approval _____
- Copy of all Concrete Cylinder Test Results _____
- Copy of any Shrinkage Test Results _____
- Details of Curing Compound used _____
- Certificate for any Reinforcement Stating Grade _____
- Details of Post-Tensioning Extensions _____
- Details of grout used around tendons _____
- Grouting Records _____

APPENDIX I

SCP CONSULTING
CHECKLIST OF DOCUMENTATION
REQUIRED BEFORE CERTIFICATION

PROJECT: _____ **DATE:** _____

BUILDING: _____

COMPLETED

Precast Concrete

- Copy of Certification from Practising Structural Engineer that Design and Construction Complies with Specification _____
- Copy of Certification as to Fire Rating and Copy of Supporting Documentation _____
- Copy of Construction Proposal Regarding
  - Concrete Mix Design
  - Curing Method
  - Joint Sealant _____
- Copy of Check of Tolerances after manufacture _____