

# Memorandum

ARUP

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To	Eugene White - Mulpha	Date	9 February 2018
Copies	Grant Bambach - Savilles George Cunha - Arup Glen Scott - Hassell	Reference number	252120
From	Peter Jameson - Arup	File reference	Memo_1_Existing_Rev3
Subject	Memo 1: Transport House – Additional Existing Building Assessment_Rev3		

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Please find below updated comments with respect to our assessment of the proposed ballroom extension the Transport House.

Our updated comments are highlighted in **green** (note that some minor changes in wording are also updated to add clarity; these are not highlighted). The unamended comments remain as part of our previous findings, as described in earlier revisions of this memo.

This update follows a more detailed assessment of the existing structure and proposed ballroom scheme by calculation and finite-element analysis. Since the previous revision (31/10/2017), we have conducted a number of site visits to review options for locations of seismic bracing; 12/12/2017 with Savilles; and 02/02/2015 with Savilles and Mulpha. The analysis and our comments have been informed by the discussions from these visits.

## 1. Existing Documentation

Arup received drawings of the existing 1936 structure. They included general arrangement plans for steel and concrete elements on all levels, a foundation layout plan, and column schedules. From these drawings, an analysis model of the existing structure was built in order to assess the implications of the proposed new ballroom scheme. A summary of these drawings is presented in *Appendix 1 – Summary of Information Received 20151210*.

In addition to the information from these drawings, a number of construction details must be investigated to confirm **the current condition of the materials** and that the as-built structure was constructed in accordance with the documentation. **This investigation will also provide additional detail on steel and concrete connection types not covered by the existing drawings at key locations.**

The investigation is required to uncover a sufficient representative sample of the building structure, including: -

- Column and beam elements;
- **Lift core masonry infill connections;**
- Beam-column connections; &
- Foundation elements.

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## 2. Confirmation of Assumptions from Review of Design Drawings

The existing drawings and documentation are discussed in detail in *Appendix 2 – Snapshots from the Building Analysis Model*. From these drawings, the following assumptions were made: -

- The original structure is of steel-framed construction with elements concrete-encased for fire protection. This was common practice at the time of construction in 1936;
- The framing layout suggests moment frames are used for stability with the majority of the columns and frame stiffness aligned in the short direction (North-South) of the building.

During the investigation, steel connections must be exposed to assess their condition, demonstrate the connection type, and confirm this assumption regarding stability. This aspect of the investigation is key for understanding the performance of the existing structure. The member connection fixity (pinned or fixed) directly influences the seismic performance of the structure. Examples of pinned and fixed connections are provided below.

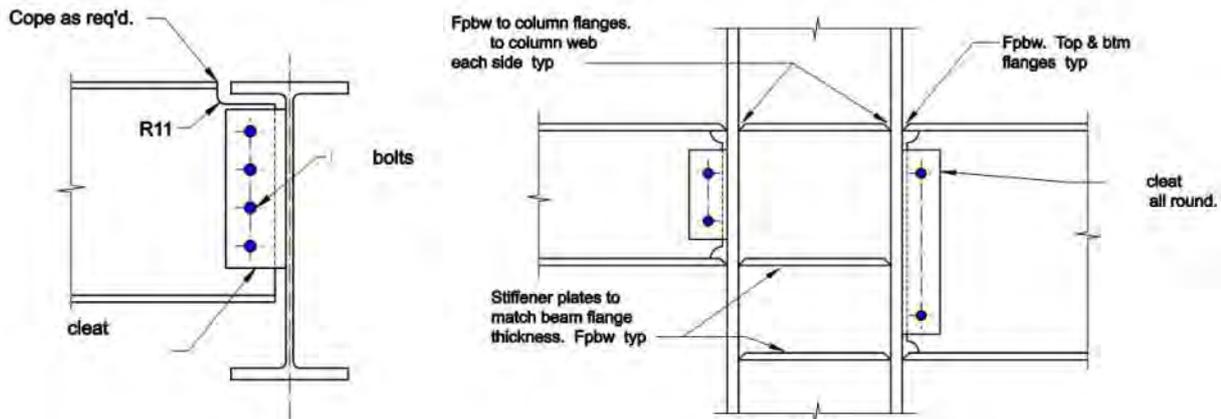


Figure 1 Examples of a simple pin-ended connection (left) and fixed connection (right)

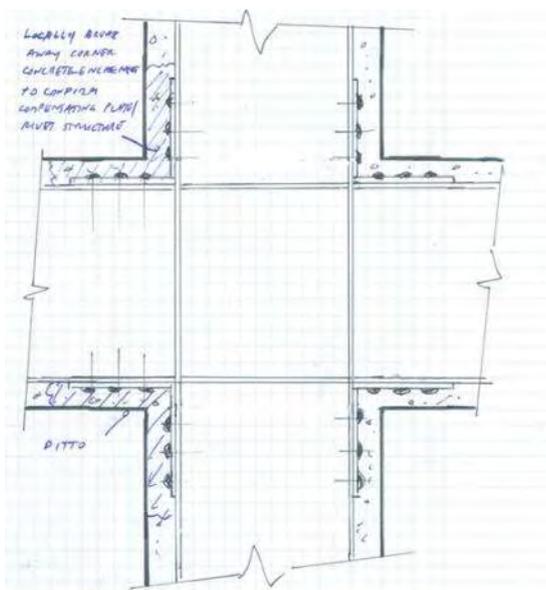


Figure 2 Configuration of existing column-beam connections if constructed as a fully-welded frame

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- It is also possible that the investigation will demonstrate that stability was provided through masonry in-fill between corner steel columns at the lift and stair cores. This was an alternative stability system also applied in the 1930s.
- Floor framing is provided by a series of two-way beams and concrete slabs. Typically, primary beams span in the North-South direction and secondary beams span East-West at 1/3 points along the primary beams. This is consistent with the assumption of frame action in the short direction for stability;
- Concrete slab thicknesses vary greatly across the floor plan and have been modelled to provide a representation of the self-weight of the structure and assessment of the existing loading. The type of reinforcement and connection (if any) to the steel beams should also be investigated; &
- The foundation drawings show pad footings of varying thicknesses. Footings thickness often varies with the uneven excavation of the foundation material. Consequently, an investigation into the as-built condition is required.

A detailed discussion of the scope and a proposed methodology for the investigation of the existing structure was provided in *Stage 1 – Preliminary Building Investigation Brief* issued 15/12/2017.

### 3. Analysis for Vertical Loads

We have carried out a finite-element analysis which includes the new loading from the proposed ballroom scheme. To assess the existing columns, an assumed value of steel yield stress was used to calculate their section capacity. This demonstrated that under the new loads the vertical load capacity is not exceeded based on a steel section check. In the detailed design, more thorough checks will be required that incorporate axial forces and bending moments from the lateral loading and any second-order effects. This level of analysis can only be conducted following confirmation of the column-beam connections and existing conditions.

For further discussion, refer to the analysis images in *Appendix 2*.

### 4. Building Stability (Seismic Analysis)

Seismic loads have been applied to the finite-element model with the following structural and material behaviour assumptions (refer *Appendix 2* for further discussion):

- Importance Level 3 (greater than 300 people can congregate) in accordance with AS1170.0;
- 50 year design life;
- Annual probability of exceedance: EQ ULS 1/1000 EQ SLS 1/25;
- Class IV sandstone provides for Site subsoil class B<sub>e</sub>;
- Modified structure with ballroom and seismic strengthening as braced-frame.  
Factors for equivalent static analysis to AS1170.4 –  $k_t=0.05$ ,  $\mu = 2$ , and  $S_p = 0.77$ ; &
- The proposed modifications to the building are deemed to be significant change to both the seismic mass distribution and the stability system. Consequently, a threshold load approach in accordance with AS3826-1998 is not applicable.

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The building should provide resistance to 100% of New Building Standard (NBS) - *AS1170.4: Earthquake Actions in Australia*.

For revision 2 of this memo, Arup undertook a high-level review of the implication of increasing the lateral loads on the basis of 100% NBS and the current ballroom configuration. The outcomes describe an increase in building utilisation up to 95%. This is increased from that achieved with the threshold loads described in the previous revision of this memo. Subsequent detailed modelling and analysis conducted to inform this revision confirmed this assessment.

This increase in utilisation further suggests that an alternative lateral load path should be allowed for and adopted in the event that a) it is found during investigation that the joints are not fixed but pinned and b) if building loads are increased due to scope creep of the new ballroom extension. Additionally, an upgrade to modern building standards should be considered best-practise when conducting a retrofit of an historic structure, especially one where the stability system is not well defined.

The extent of investigation works required to justify the existing structure without providing new bracing would be prohibitive. Given the high utilisation of the structure under a moment/sway frame configuration all column and beam junctions participating in the frame would need to be exposed and inspected to confirm fixity, condition assessment and confirm no latent conditions or defects are uncovered. This is important as the working of the system is premised on fixity. On-site strengthening may be required based on the inspection outcomes.

By providing seismic strengthening in the form of bracing (refer *Appendix 3* and *Appendix 4*), the extent of investigation works is greatly reduced. This approach provides a clear and robust load path and avoids reliance on the joint fixity to provide stability. The extent of on-site investigation and testing of the column to beam joint could reasonably be reduced from 100% to 20-25%. This extent will be confirmed following the results of the initial investigation and confirmation of the design direction adopted.

Given the difficulty in determining the seismic performance of the existing structure, any hybrid of the two approaches described above has not been considered. Such an approach would likely be the imposition of bracing in internal spaces with the more extensive investigation regime.

The option for providing full-height bracing to the building provides the most robust design that mitigates the risks associated with modifications to existing buildings. Options for bracing layouts and sizes are presented in *Appendix 3* and *Appendix 4*.

## 5. Foundations

Our calculations show that Class IV sandstone with an allowable bearing pressure of 2MPa or more is required in the base strata to support the increased loads from the ballroom scheme.

In addition to assessing the foundations for the increased vertical loads, special consideration must be given to the footings at the locations of the new bracing elements. Where the lateral loads were previously distributed amongst all the footings, bracing will concentrate load into a few specific locations. The investigation into the footing concrete and the foundation material will also inform this assessment.

The preliminary site visit and assessment of surrounding geotechnical strata indicated that the capacity of 2MPa can be achieved. A detailed investigation into the condition of the footing and the founding material will be required to confirm this capacity.

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## 6. Bracing

A number of bracing options were reviewed following on-site discussions with Mulpha and Savilles (12/12/17 and 02/02/18) regarding the suitability of locations and bracing types.

The analysis considered bracing as either steel circular hollow section (CHS) struts or steel rod cross-bracing. The typical size for the CHS would be a 219dia CHS and the typical rod diameter would range from 24mm to 50mm depending on the number of braced bay. The CHS and rod options are interchangeable and can be chose to suit the internal spaces or, in some instances, moved to the façade line. When substituting cross-bracing for CHS sections, multiple bays of bracing may be introduced to minimise the size of the rod section.

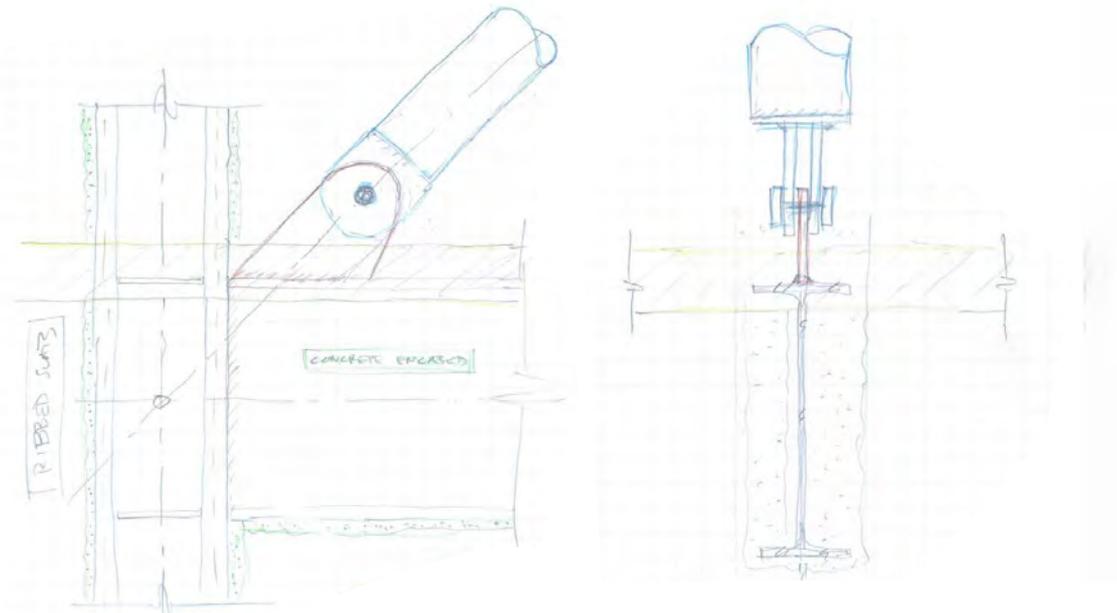


Figure 3 Option for connection detail of CHS strut (219CHS) at beam-column connection

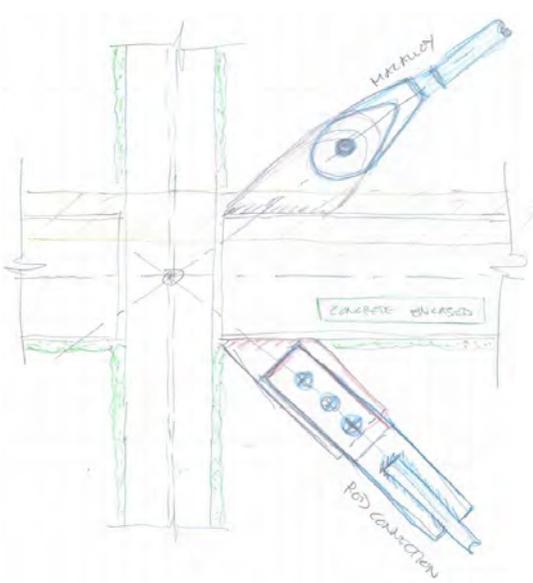


Figure 4 Option for connection of rod cross-bracing at beam-column connection

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Alternative locations were analysed to provide flexibility in planning of internal spaces. Figure 5 below presents one option for the bracing layout.

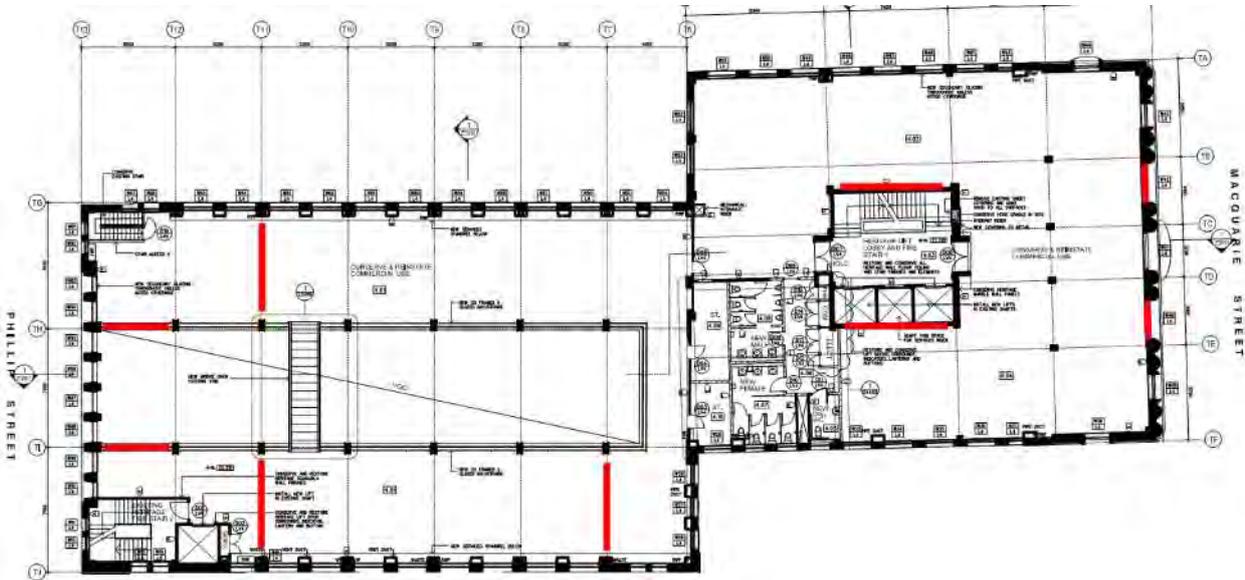


Figure 5 Option for locations of bracing shown on Mezzanine Level (L4) plan

A number of alternative locations are shown in Figure 6 below.

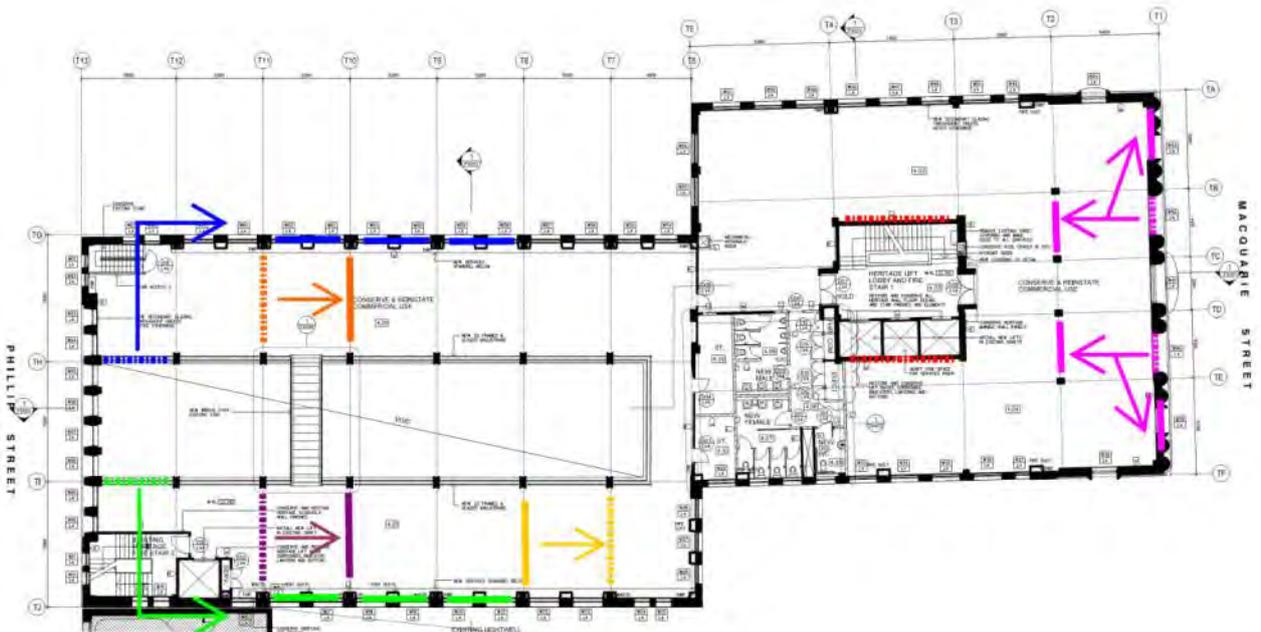


Figure 6 Options for alternative locations of bracing shown on Mezzanine (L4)

These locations were documented in more detail in the sketch *Conceptual Bracing Arrangement* (file ref 2017-12-15\_TH\_Bracing\_Options\_Update) issued on the 15/12/2017. This document is revised to include the recent discussions with Mulpha and Savilles (12/12/17 and 02/02/18) and presented in *Appendix 3*.

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When considering the location and type of bracing, some key items should be considered:

- The centreline of the bracing member must “node-out” with the centre-line of the beam and column members. Consequently, the angle of the bracing is limited to a single orientation. Figure 7 below shows some examples and a marked-up photo in *Appendix 3* shows one example of how this influences the interaction with the ceiling, and the non-structural façade columns.

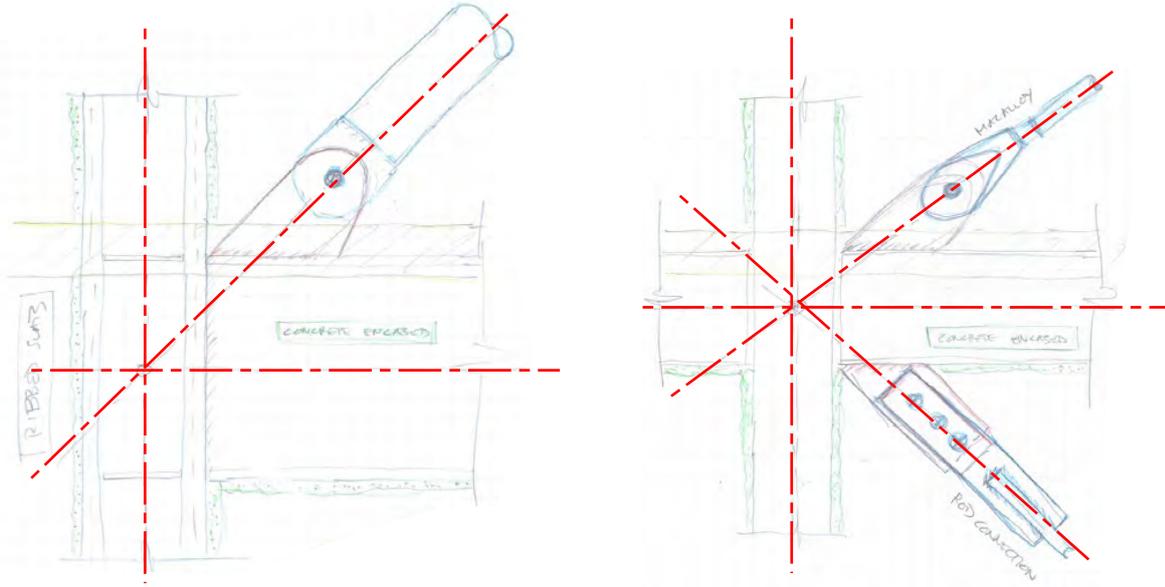


Figure 7 Examples of centrelines (red) of bracing, beam and column intersecting at a common node

- Braced bays may move level to level along the line of the bracing (parallel to the member) but not to a different gridline (perpendicular to the member). Figure 8 below highlights one braced location and provides an example of what is possible moving bracing along the same gridline (parallel).

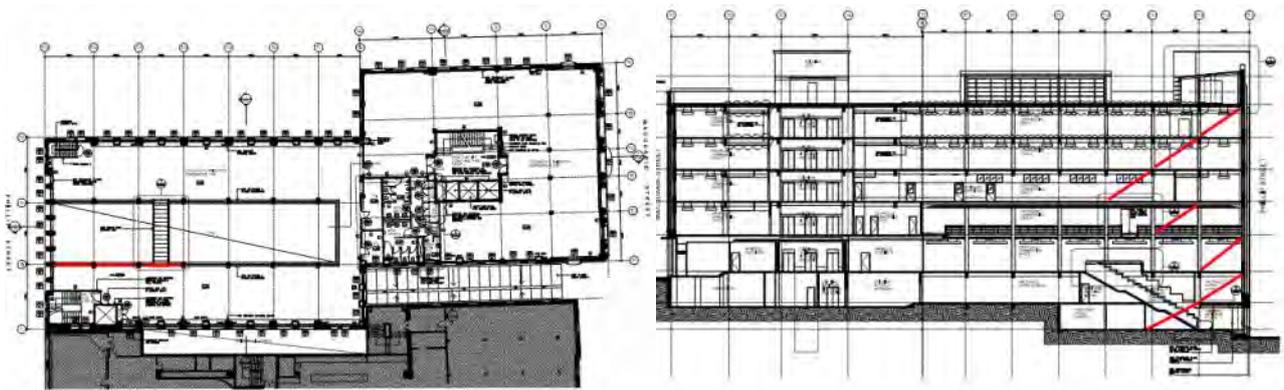


Figure 8 Plan (left) and section (right) showing options for moving bracing along a gridline level to level

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- Strut (CHS) 'A' frame bracing may also be inverted to form a 'V' frame. A single, longer diagonal strut may also be adopted, however this arrangement of bracing would result in a larger diameter member.

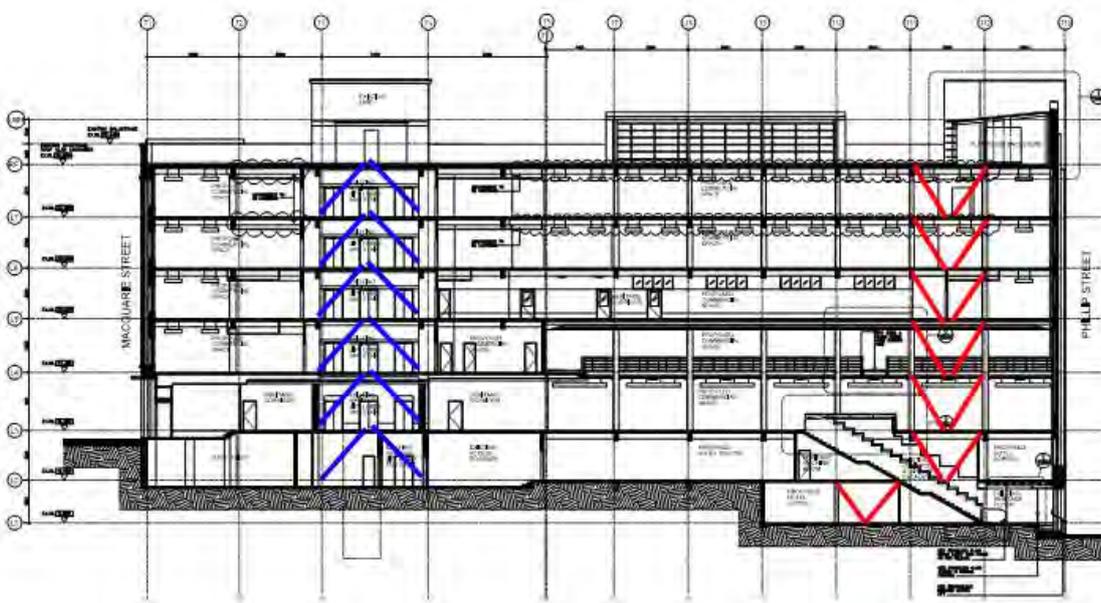


Figure 9 Example of 'A' frame bracing (blue) and inverted 'V' frame bracing (red)

- Visible bracing connections may be tastefully expressed with a pin cleated connection. An example of a rod bracing system with these connection is a [Macalloy Tension Rod](#) system (follow highlighted link to website). CHS connections may have a similar connection (refer Figure 3 above).  
Note that in many locations the connection will be made in the ceiling void and may need to extend through any raised floors.

## 7. Ballroom Scheme

The review of the existing structure for the addition load from the proposed ballroom scheme has been conducted per the drawings provided by Hassell on 10/11/2017. The following assumptions were adopted: -

- The pool structure has been omitted and the ballroom floor assumed a composite slab composed of concrete slab on Bondek or similar metal-deck sheeting, supported on a grid of primary and secondary beams that frame back onto the column grid of the existing building;
- The ballroom roof scheme is a lightweight long-span truss spanning North-South from the Northern edge of Transport House to façade line of the Intercontinental Hotel; &
- Lateral stability of the new structure is to be achieved by a series of braced bays which are located to prioritise unobstructed viewing to the North. **The braced bays should be on all four sides and ideally located in line with the bracing added to the base building.** They can be coordinated to be hidden in boundary or partition walls and is subject to further development of the new scheme.

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## 8. Summary and Next Steps

From our findings presented in this memo and the accompanying appendices, we consider that the existing structure has sufficient capacity to support the new loads with no supplementary strengthening to the steel columns. This conclusion must be validated by the investigation to assess the in-situ condition and the assumptions regarding member capacities and their connections. Regarding the stability system, it is our position that full-height bracing to the building provides the most robust solution that minimises the risks associated with the proposed extension work.

Inspection and testing of the existing structure shall be undertaken in two stages; a preliminary, limited investigation (Stage 1) and a detailed investigation (Stage 2).

The investigation and testing methodology for Stage 1 is detailed in the briefing document (refer *Stage 1 – Preliminary Building Investigation Brief*). This preliminary investigation will provide sufficient information to progress the current ballroom scheme. It will include the inspection and testing of the existing structure in easily accessible locations in order to provide a representative sample of materials and confirm typical connection details. This should include foundation materials, footing, masonry infill, and beam-column steel connections.

The results from the Stage 1 investigation and the design direction adopted for the stability framing/bracing will inform the scope and extent of the Stage 2 investigation.

# Memorandum

## A1 Summary of Information Received

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## Appendix 1 - Summary of Information Received

Drawing/Report No./Photo No	Type	Drawing/Report Name	Engineer/Author	Date	Date Received
496-2	Drawing	Structural Steel Layout - Basement Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-2C	Drawing	Reinforced Concrete Layout - Basement Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-3	Drawing	Structural Steel Layout - Ground Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-3A	Drawing (Photo)	Column Schedule Sheet 1	A.W. MORRISON CONSULTING	1936	27/11/2015
496-3B	Drawing (Photo)	Column Schedule Sheet 2	A.W. MORRISON CONSULTING	1936	27/11/2015
496-3C	Drawing	Reinforced Concrete Layout - Ground Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-4	Drawing	Structural Steel Layout - Mezzanine Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-4C	Drawing	Reinforced Concrete Layout - Mezzanine Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-5	Drawing	Structural Steel Layout - First Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-5C	Drawing	Reinforced Concrete Layout - First Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-6	Drawing	Structural Steel Layout - Second Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-6C	Drawing	Reinforced Concrete Layout - Second Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-7	Drawing	Structural Steel Layout - Third Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-7C	Drawing	Reinforced Concrete Layout - Third Floor	A.W. MORRISON CONSULTING	1936	10/12/2015
496-8	Drawing	Structural Steel Layout - Roof	A.W. MORRISON CONSULTING	1936	10/12/2015
496-8C	Drawing	Reinforced Concrete Layout - Roof	A.W. MORRISON CONSULTING	1936	10/12/2015
496-9C	Drawing (Photo)	Details & Schedule of Reinforced Concrete Beams	A.W. MORRISON CONSULTING	1936	27/11/2015
496-10	Drawing (Photo)	Amended Foundation Plan	A.W. MORRISON CONSULTING	1936	27/11/2015
496-11	Drawing (Photo)	Concrete Rib & Block Floor Details Macquarrie St End	A.W. MORRISON CONSULTING	1936	27/11/2015
P1030854	Specification	Structural Steelwork (Page 21)	H.E. BUDDEN & MACKEY ARCHITECTS	1936	27/11/2015
P1030855	Specification	Structural Steelwork (Page 22)	H.E. BUDDEN & MACKEY ARCHITECTS	1936	27/11/2015
P1030856	Specification	Structural Steelwork (Page 23)	H.E. BUDDEN & MACKEY ARCHITECTS	1936	27/11/2015
DOCINV 121115	Report	99 - 113 Macquarie Street Original Documentation Investigation Report	My Metals Pty Ltd	11/12/2015	27/11/2015
	Report	99 Macquarie Street, Sydney NSW 2000, Existing (Concrete) Column Schedule	My Metals Pty Ltd	10/2/2015	27/11/2015
	Report	99 Macquarie Street, Transport House - Mulpha Australia, Non Destructive Preliminary Structural Inspections	My Metals Pty Ltd	10/14/2015	27/11/2015
Ref:13753	Report	Re: Existing Structure Levels Property: 99 Macquarie Street, Sydney	CMS Surveyors Pty Limited	9/30/2015	27/11/2015
	Brochure	GSSI-Structure Scan Mini Series Brochure	Geophysical Survey Systems, Inc.		27/11/2015
852 20/120	Drawing	Basement 2. Floor Plan and Column Setout	G.M. - Michael Dysart & Partners	Oct-87	27/11/2015
852 20/121	Drawing	Basement 1.	G.M. - Michael Dysart & Partners	Feb-88	27/11/2015
		Dial Before You Dig (DBYD) Information Pack			27/11/2015

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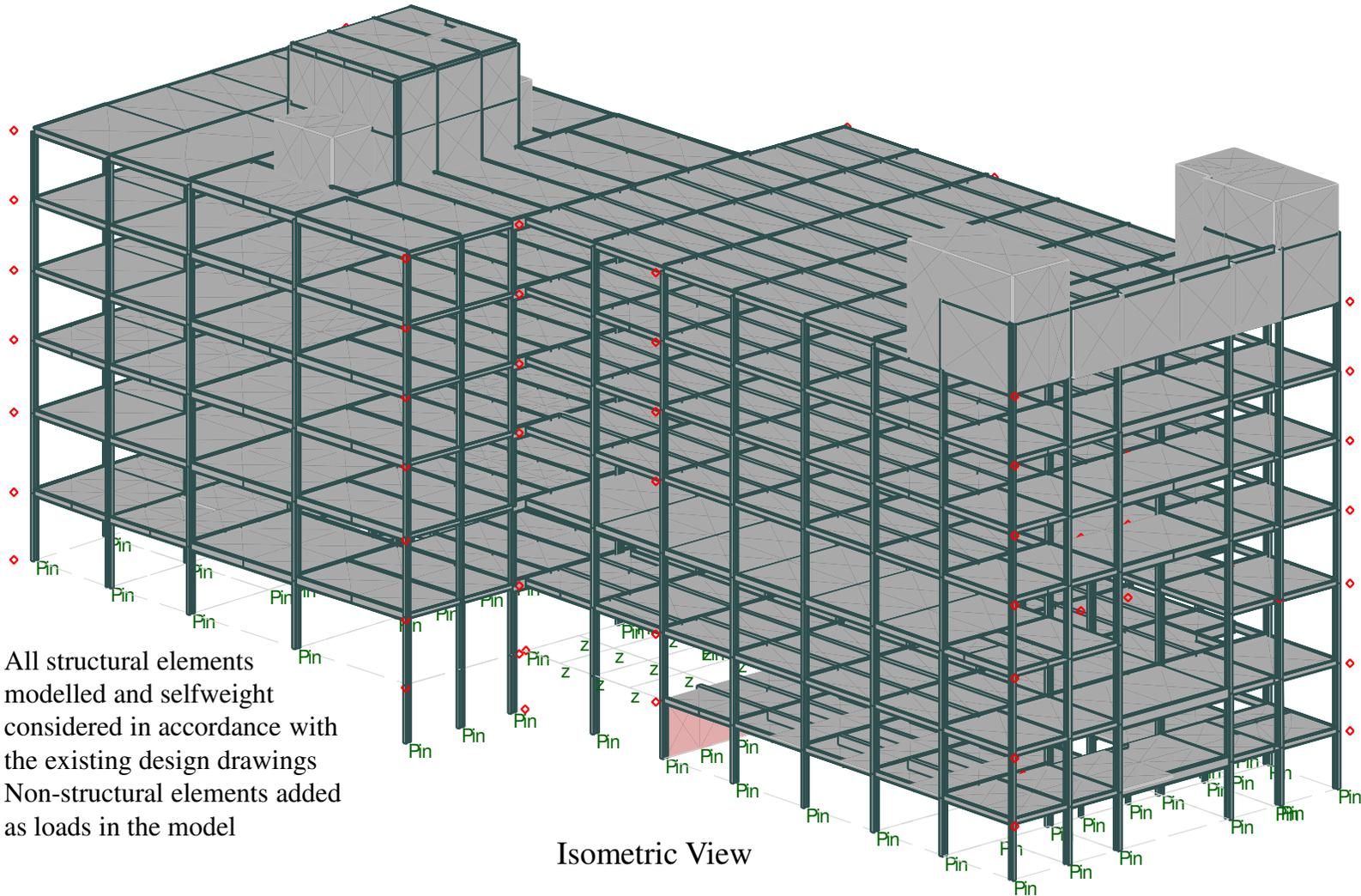
## A2 Snapshots from the Building Analysis Model

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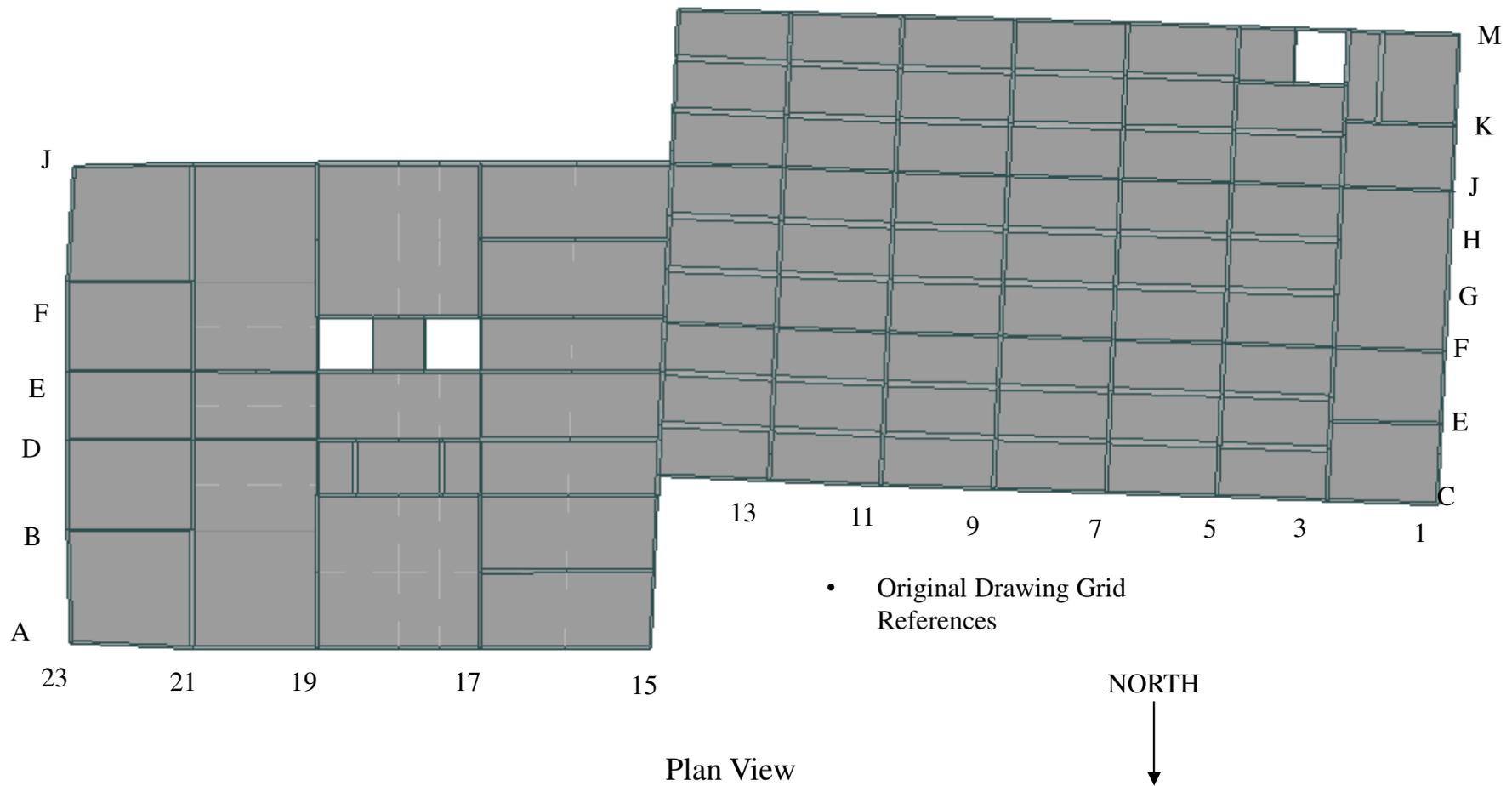
# Memorandum

## A2.1 Analysis images from previous memos

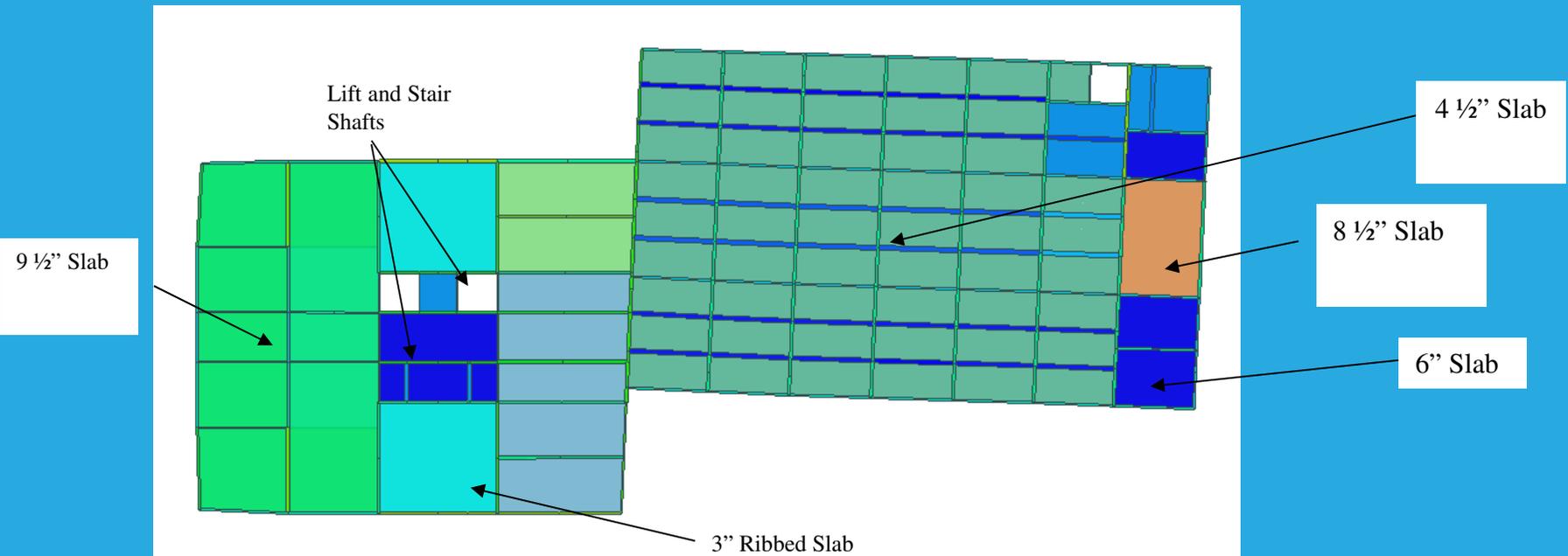
## Appendix 2 – Snapshots from the Building Analysis Model



# Typical Plan & Original Grids



# Typical Slab Thicknesses

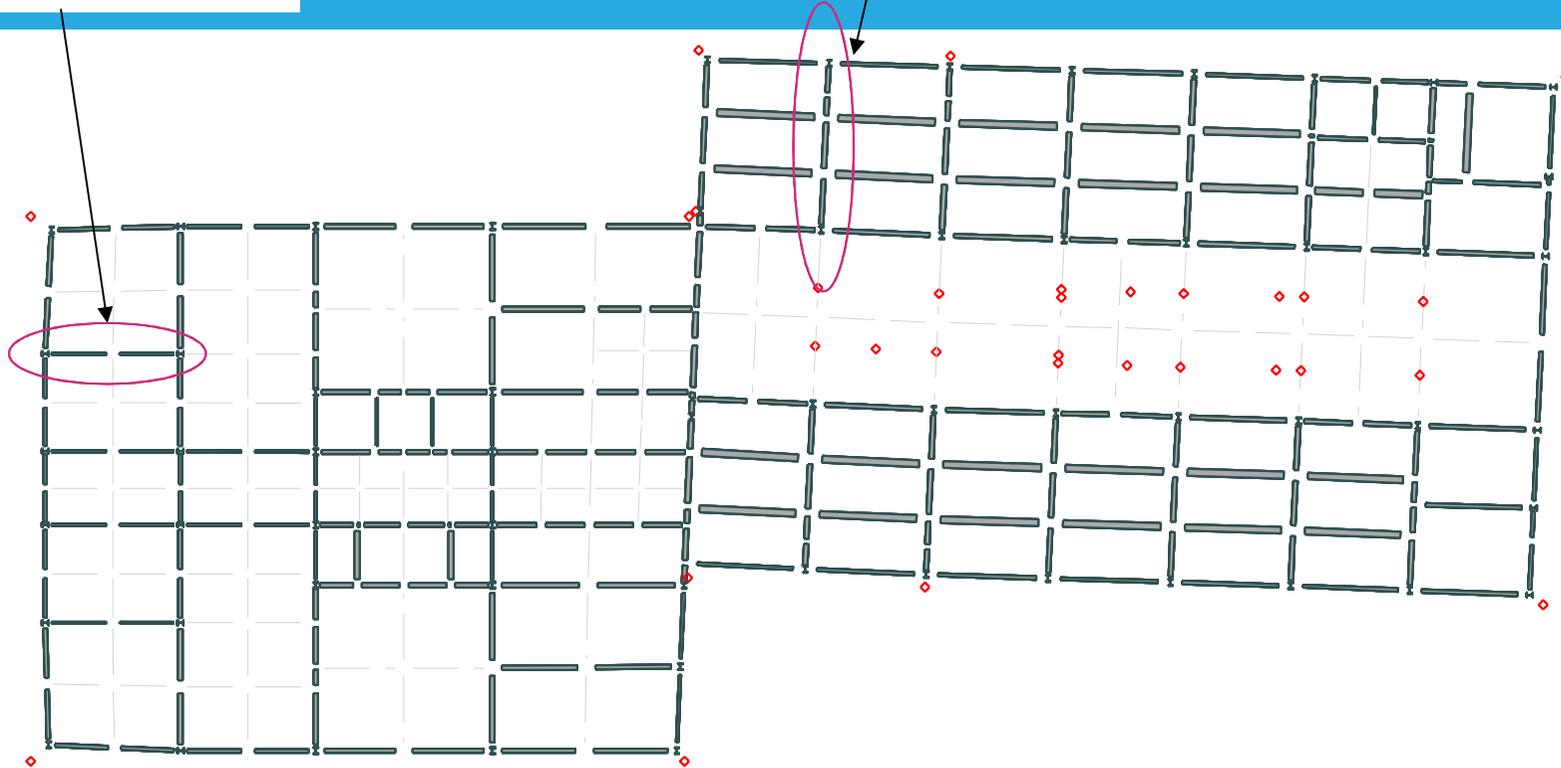
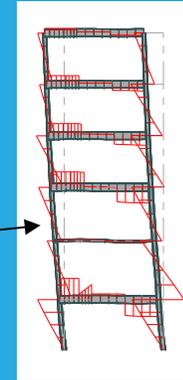


Slab thickness obtained from original reinforced concrete drawings.

# Lateral Stability by Frame Action

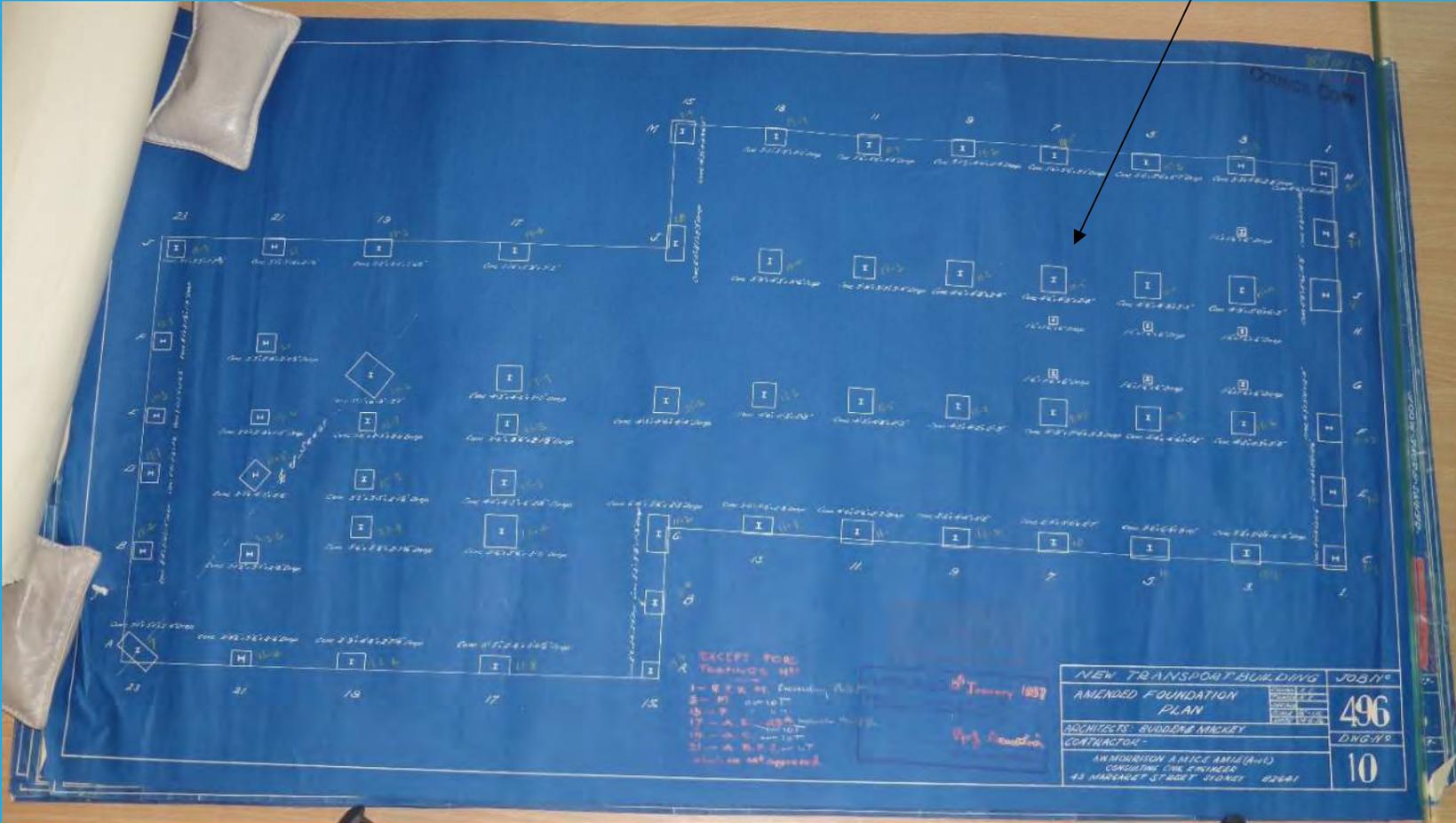
End bays typically aligned in orthogonal direction for long direction stability by frame action

Typical Column strong axis alignment (moment frame) is in short building direction



# Existing Foundations

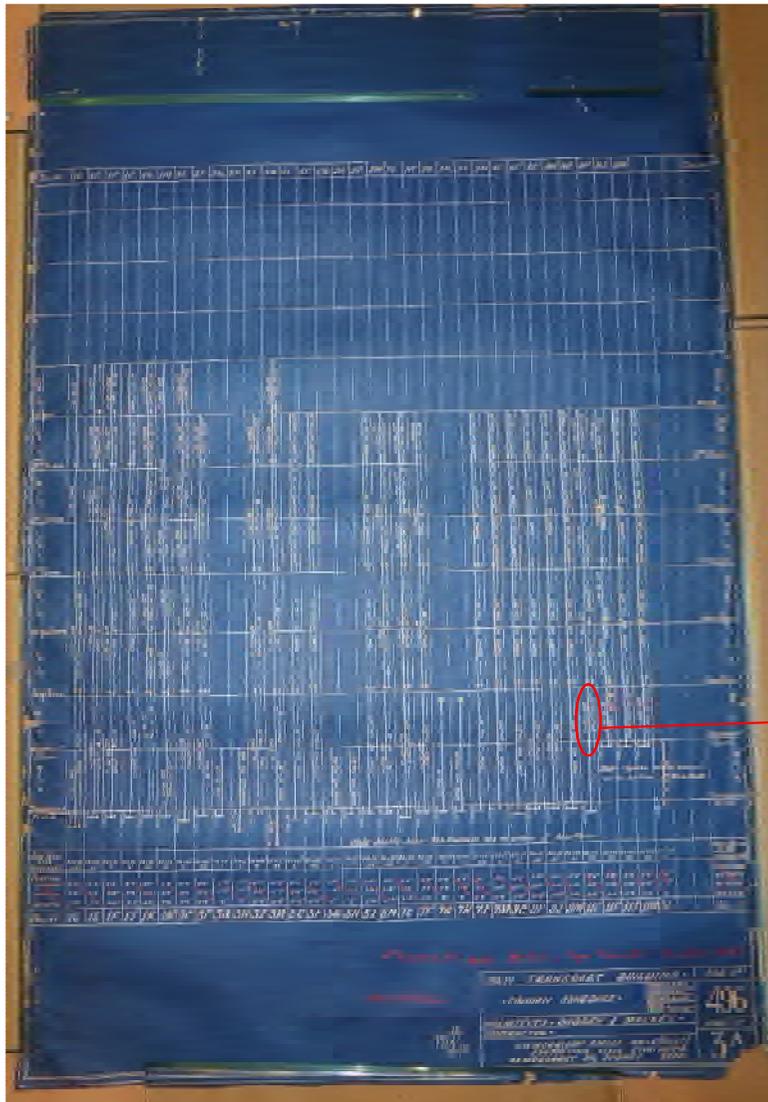
RC Pad Footings of varying plan area and depth on assumed Class IV sandstone or better



Original Foundation Plan

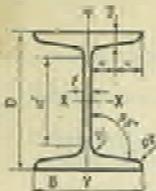


# Typical Column Details



Original Column Schedule

THE BROKEN HILL PROPRIETARY COMPANY LIMITED — AUSTRALIA



### ROLLED STEEL BEAMS

DIMENSIONS AND PROPERTIES

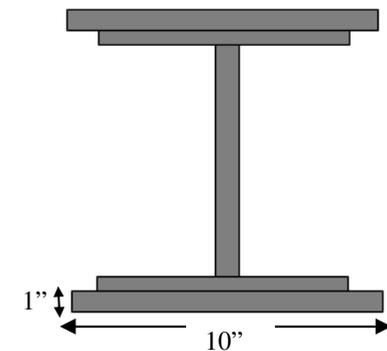
Reference Number	Size D x B Inches	Weight per Foot in Lbs.	Standard Thickness Inches		Radii Inches		Straight portion of Web Inches
			Web T <sub>w</sub>	Flange T	Root R <sub>1</sub>	Toe R <sub>2</sub>	
ASB 120	24 x 7½*	100	.04	.984	.73	.36	20.30
ASB 125	24 x 7½	95	.57	1.011	.73	.38	20.25
ASB 124	22 x 7	75	.50	.994	.69	.34	18.68
ASB 124	20 x 6½	65	.45	.920	.65	.32	16.80
ASB 123	18 x 6	55	.42	.757	.61	.30	15.01
ASB 121	16 x 6	50	.40	.729	.61	.30	13.09
ASB 120	15 x 6	45	.38	.655	.61	.30	12.25
ASB 119	14 x 5½	40	.37	.627	.57	.28	11.30
ASB 118	13 x 5	35	.35	.604	.53	.26	10.53
ASB 117	12 x 4	30	.33	.577	.49	.24	9.74
ASB 116	12 x 5	50	.33	.507	.53	.26	8.74
ASB 115	10 x 4	30	.30	.470	.50	.25	6.33
ASB 114	10 x 8	55	.40	.789	.77	.38	6.80
ASB 113	10 x 6	40	.36	.660	.61	.30	6.00

Historical Steelwork Handbook - BHP UB Sections

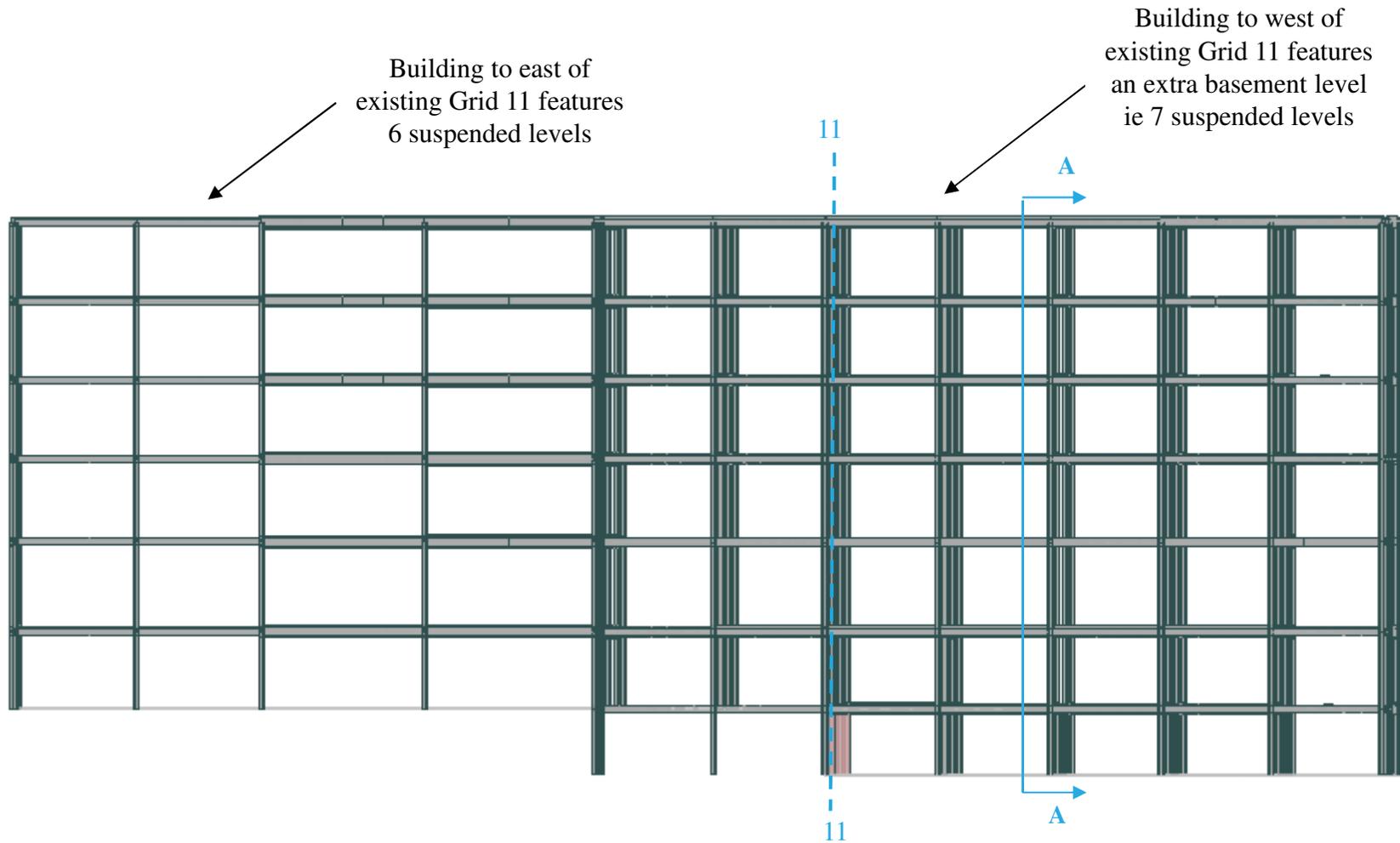
Details of column members were obtained from the original column schedule. Typical descriptions include the type of member and any additional flange plates, e.g. 10·8·55 2PLS – 10" x 1"

Sections were identified from the Historical Steelwork Handbook and additional flange plates were assumed riveted

Steel yield stress used,  $f_y = 190\text{MPa}$  (see page 12)

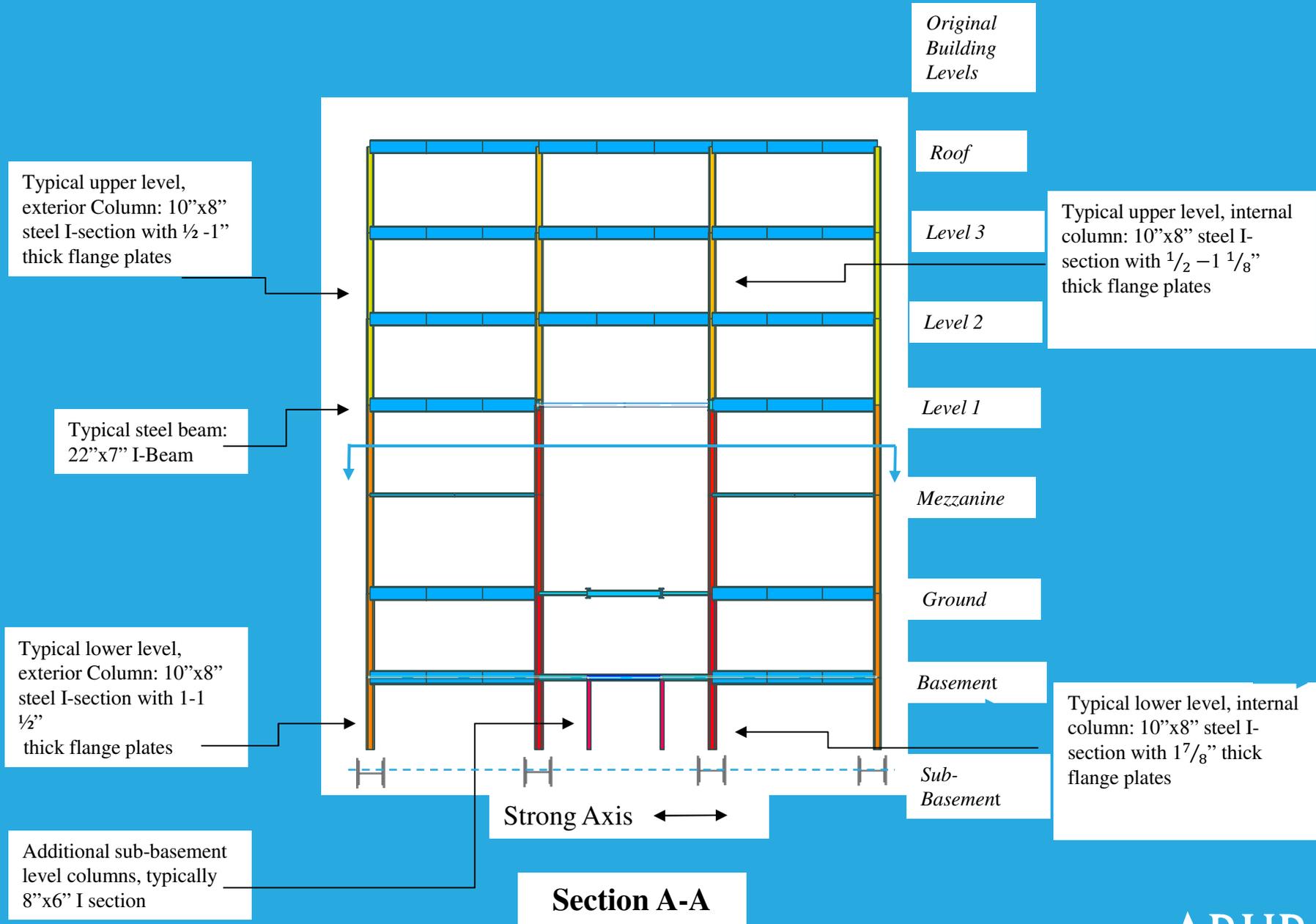


# Building Massing

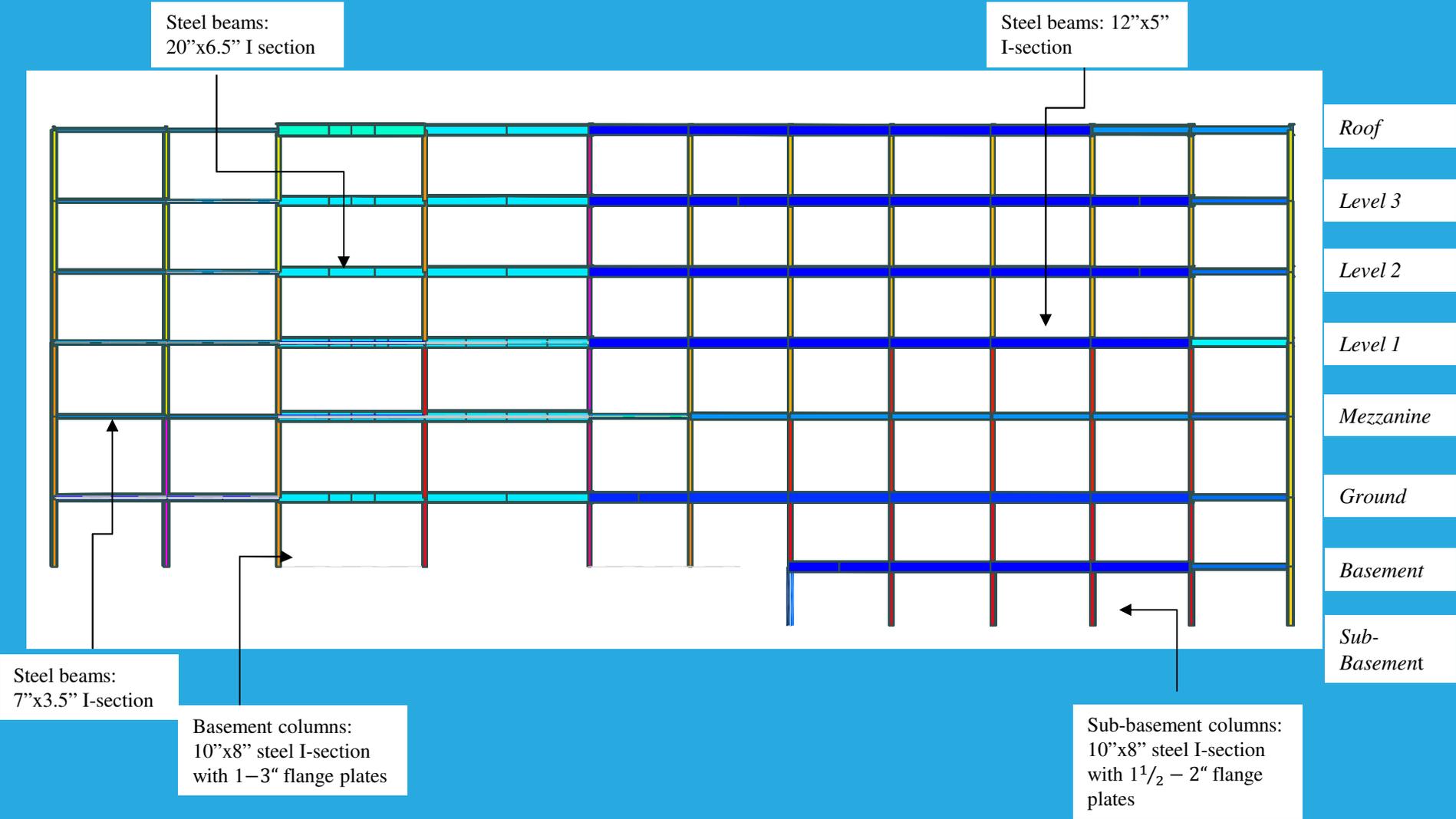


North Elevation

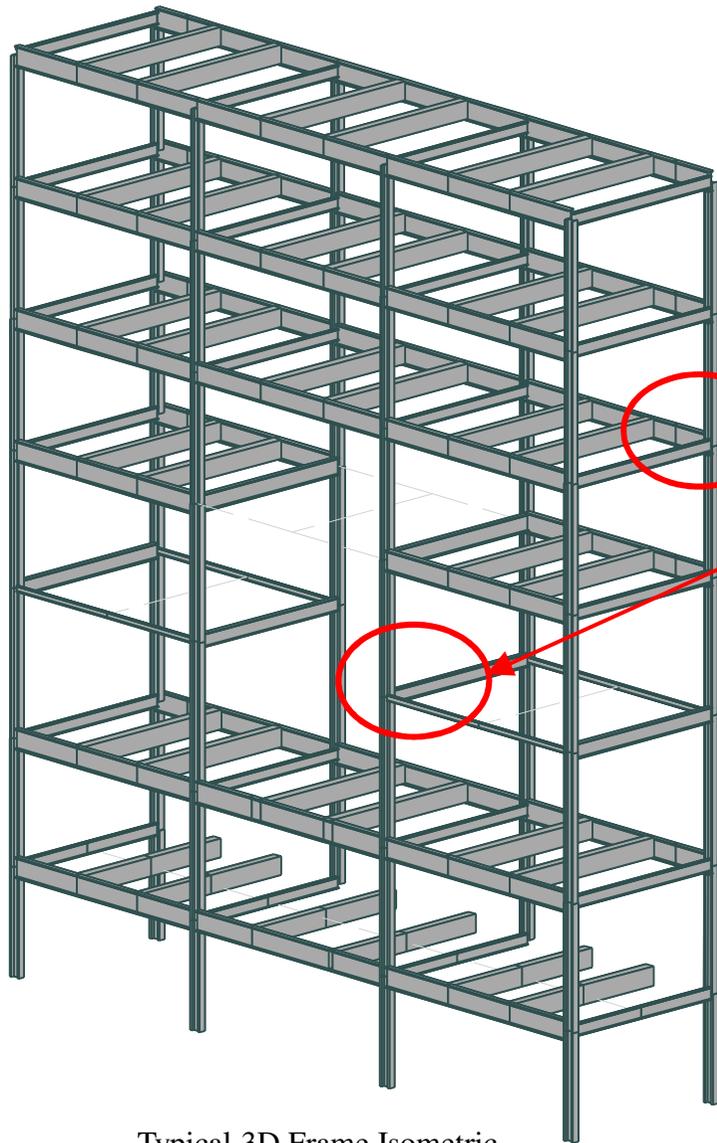
# Typical Short Section



# Typical Long Section







Typical 3D Frame Isometric

Beam-column connection assumed to be fully fixed for analysis purposes. Achieved by assumed fully riveted connections

This is a key design assumption that needs to be confirmed by investigation

Conservative lower bound values have been taken from Historical Steel Handbook which reference governing British Standard BS15

Up to and including  $\frac{3}{4}$  inch thick 16 tons/sq.in.  
Over  $\frac{3}{4}$ " up to  $1\frac{1}{2}$ " thick 15 tons/sq.in.  
Over  $1\frac{1}{2}$ " thick 14.75 tons/sq.in.  
Ultimate tensile strength 28 to 33 tons/sq.in.

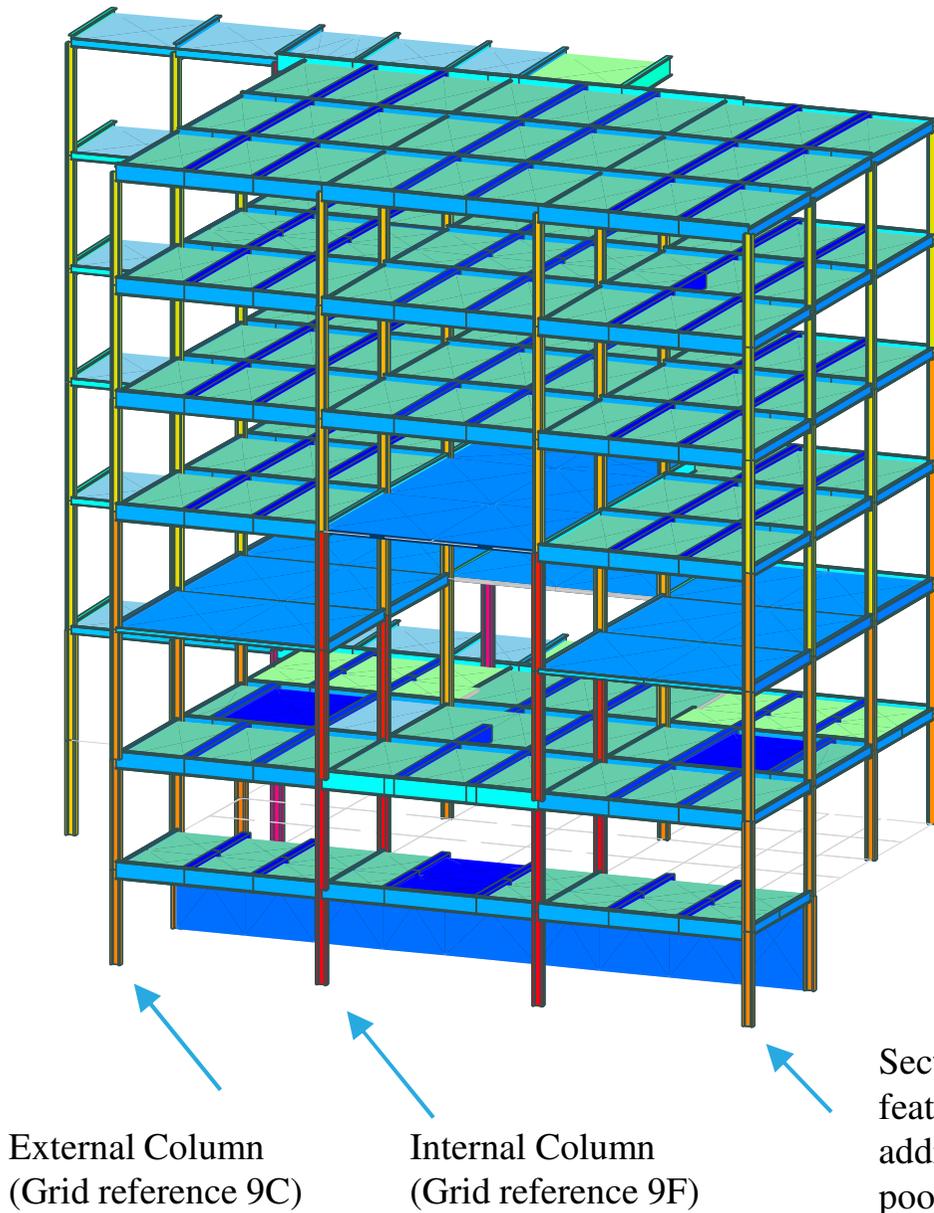
Lower bound Ultimate tensile strength,  $f_u$   
= 28 tsi  
= 425 MPa

Lower bound Yield Strength,  $f_y$   
= 14.75 tsi  
= 224 MPa

Further conservatism has been taken by adopting a lower yield strength which was based on testing carried out on similar historical project

**Adopted Yield Strength,  $f_y$**   
**= 12.5 tsi**  
**= 190 MPa**

Factored accordingly for ultimate limit state

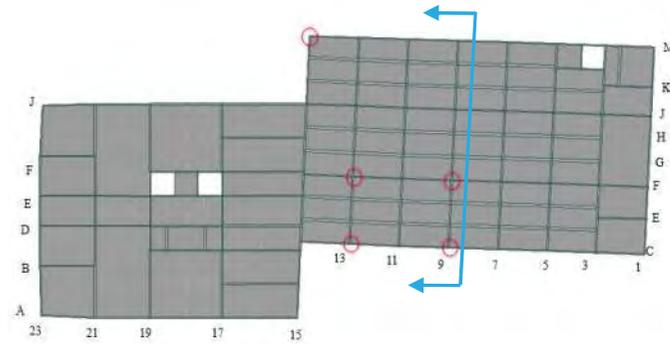


External Column  
(Grid reference 9C)

Internal Column  
(Grid reference 9F)

Section cut through grid 9  
features the area with the most  
additional load including the  
pool as well as the ballroom

Column capacity checks of all  
columns carried out assuming bare  
steel section only



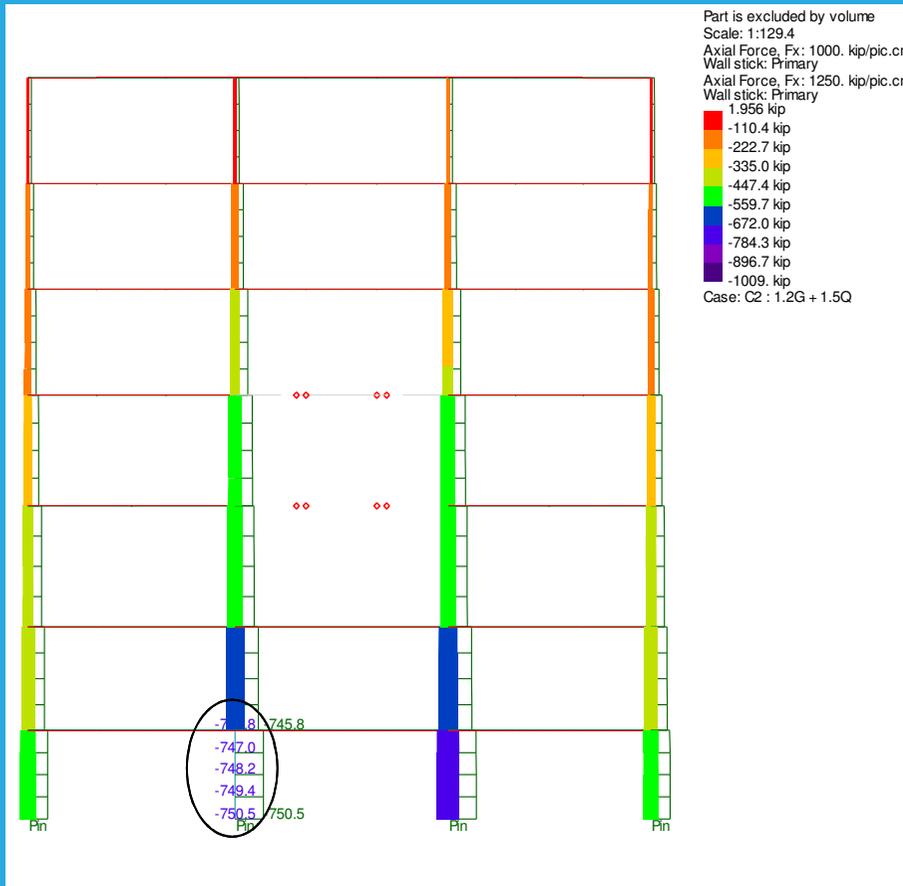
Key Plan for Critical Columns

Corner Column  
(Grid reference 15M)

# Gravity Load Analysis [Section @ Grid 9]

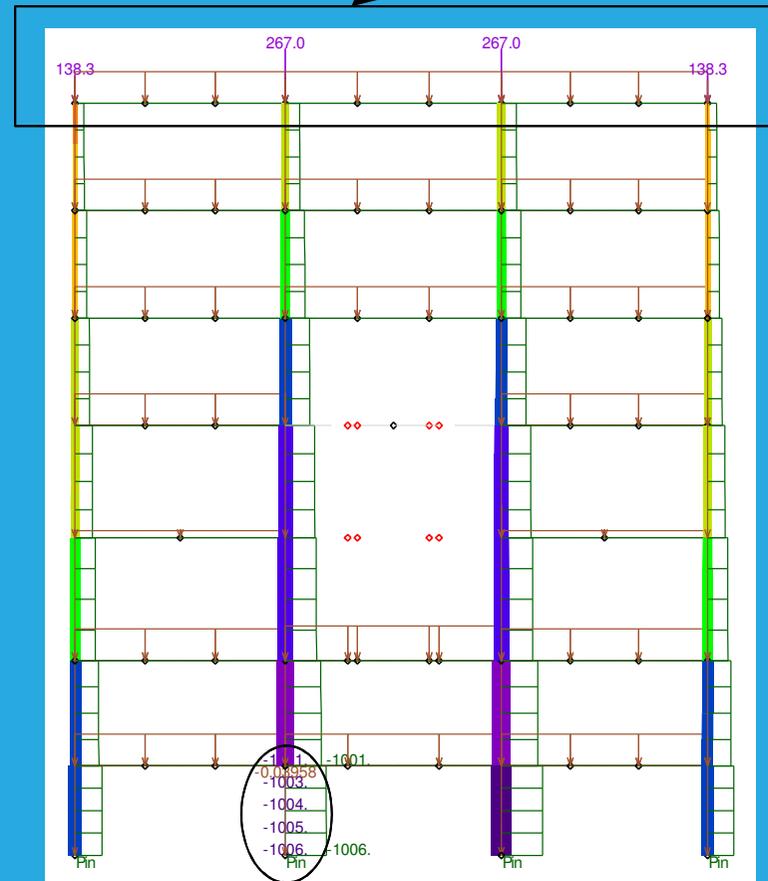
ULS gravity load case: 1.2G+1.5Q; Axial Force

Pool and Ballroom Scheme modelled as additional loads on top level of columns



## EXISTING LOADS

Max Load = 751 kip [=3340 kN]  
 Existing Utilization = 64% [OK]

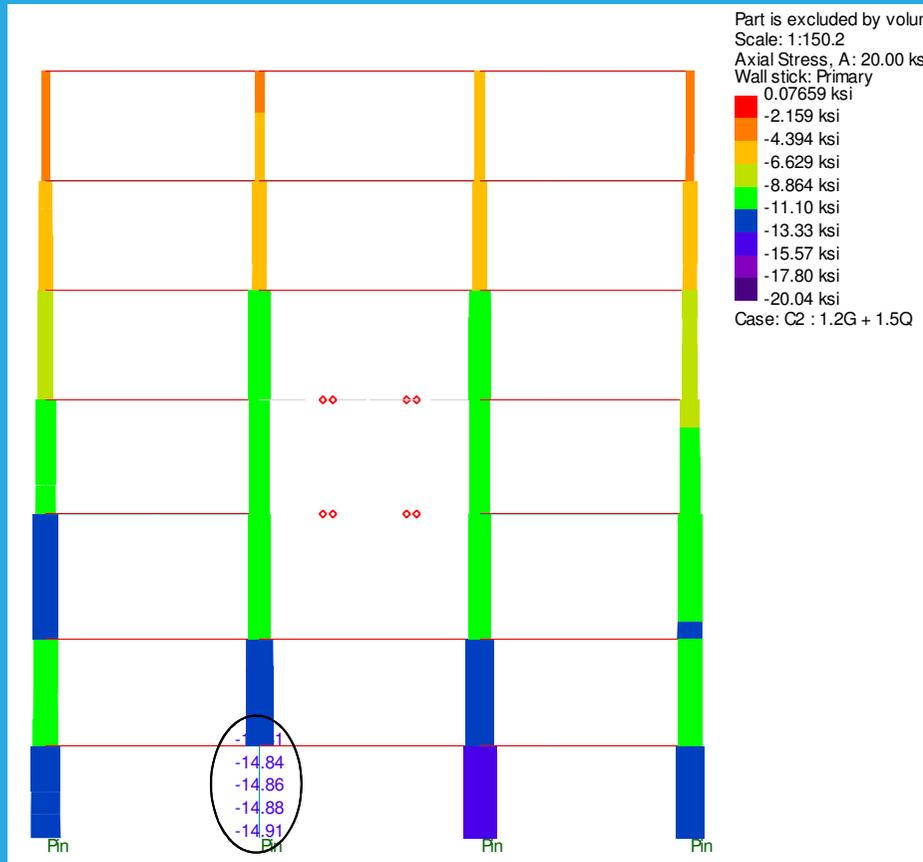


## FUTURE LOADS (POOL/BALLROOM SCHEME)

Max Load = 1006 kip [=4475kN]  
 Increase of 34% @ base  
 Existing Utilization = 85% [STILL OK]

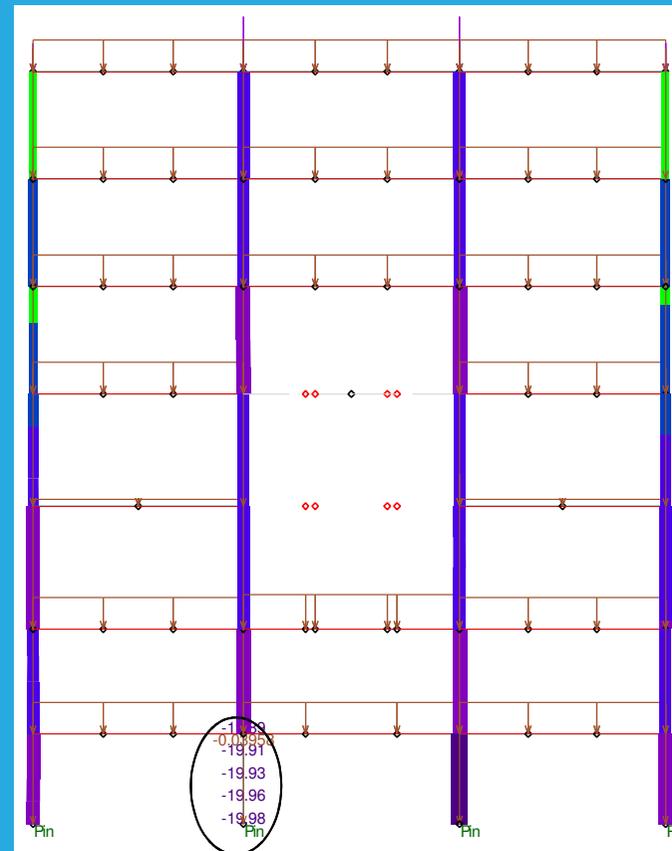
# Gravity Load Analysis [Section @ Grid 9]

ULS gravity load case: 1.2G+1.5Q; Axial Stress



## EXISTING LOADS

Max Stress = 15 ksi [= 103 MPa]  
 Factored Capacity incl. buckling [162MPa]  
**Existing Utilization = 64% [OK]**



## FUTURE LOADS (POOL/BALLROOM SCHEME)

Max Stress = 20 ksi [= 138 MPa]  
 Factored Capacity incl. buckling [162MPa]  
**Existing Utilization = 85% [STILL OK]**

# Memorandum

## A2.2 Updated images from latest analysis

# Memorandum

## Update to finite element model to include ballroom structure

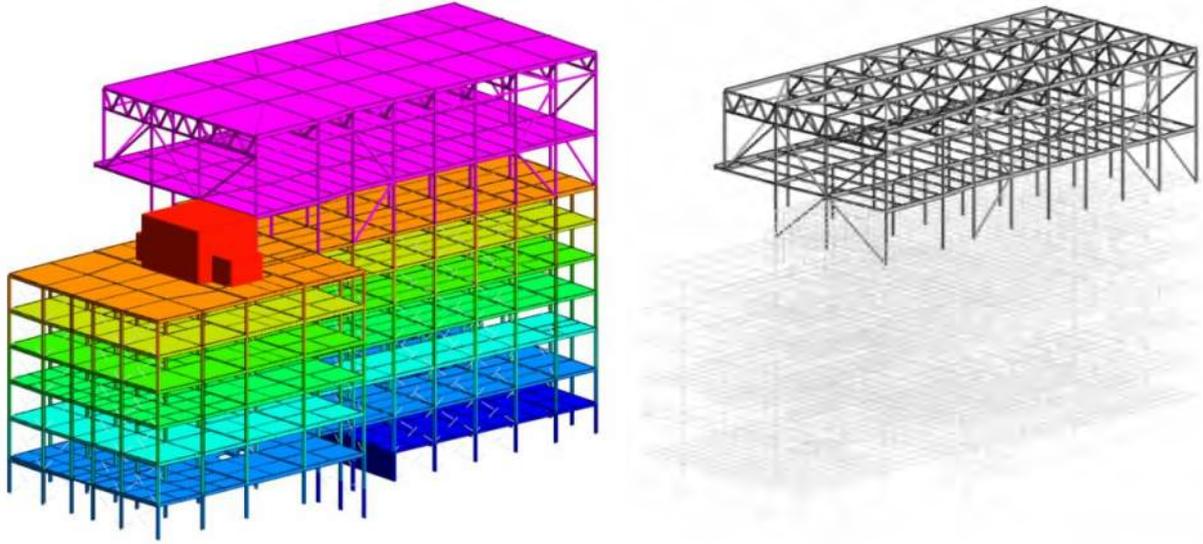


Figure 1 Finite element model including proposed ballroom addition

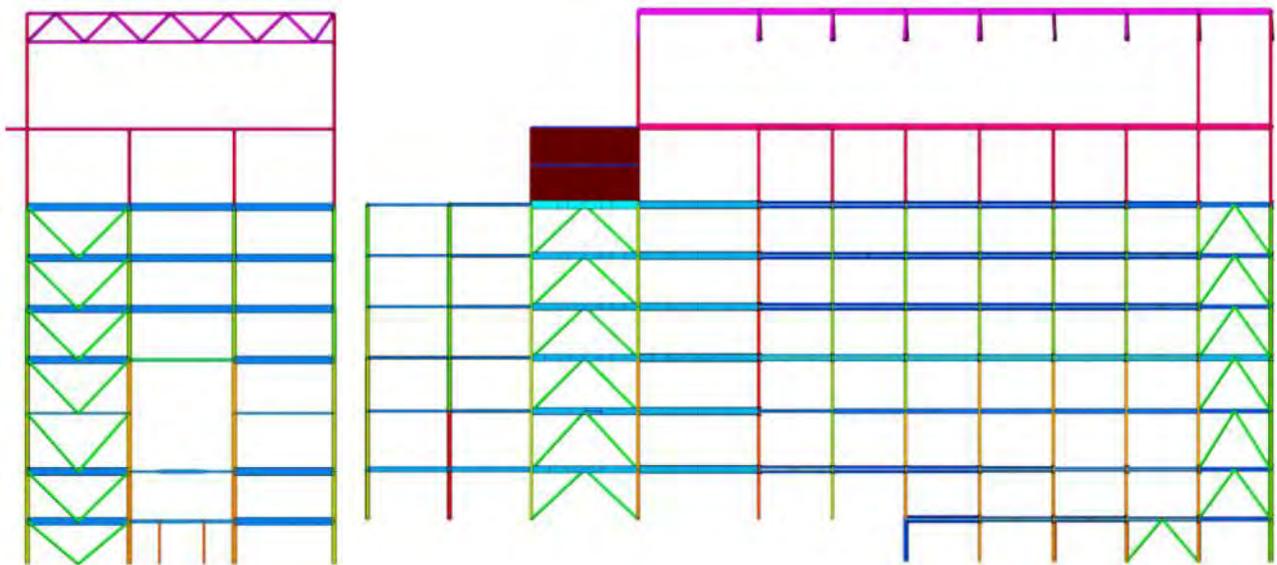


Figure 2 Sections through model

# Memorandum

## Update to finite element model with CHS strut seismic bracing

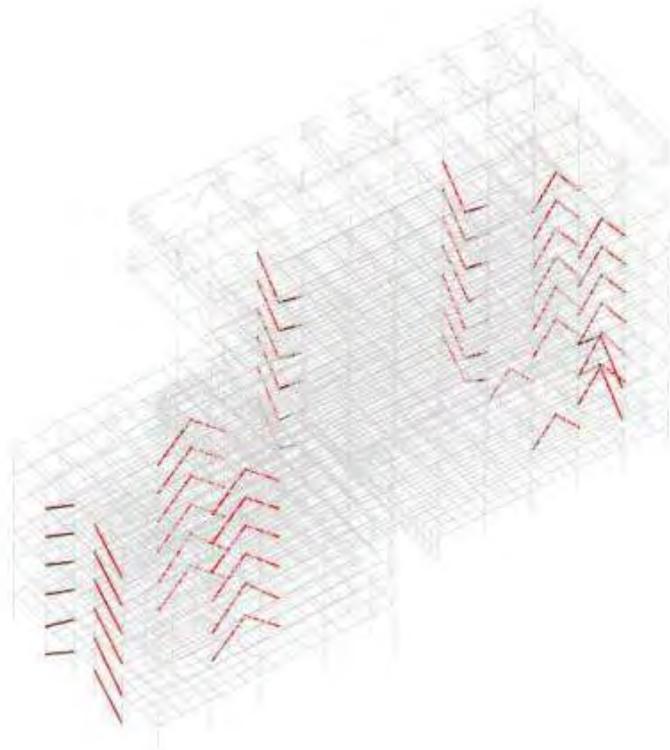


Figure 3 Isometric view of CHS strut bracing option

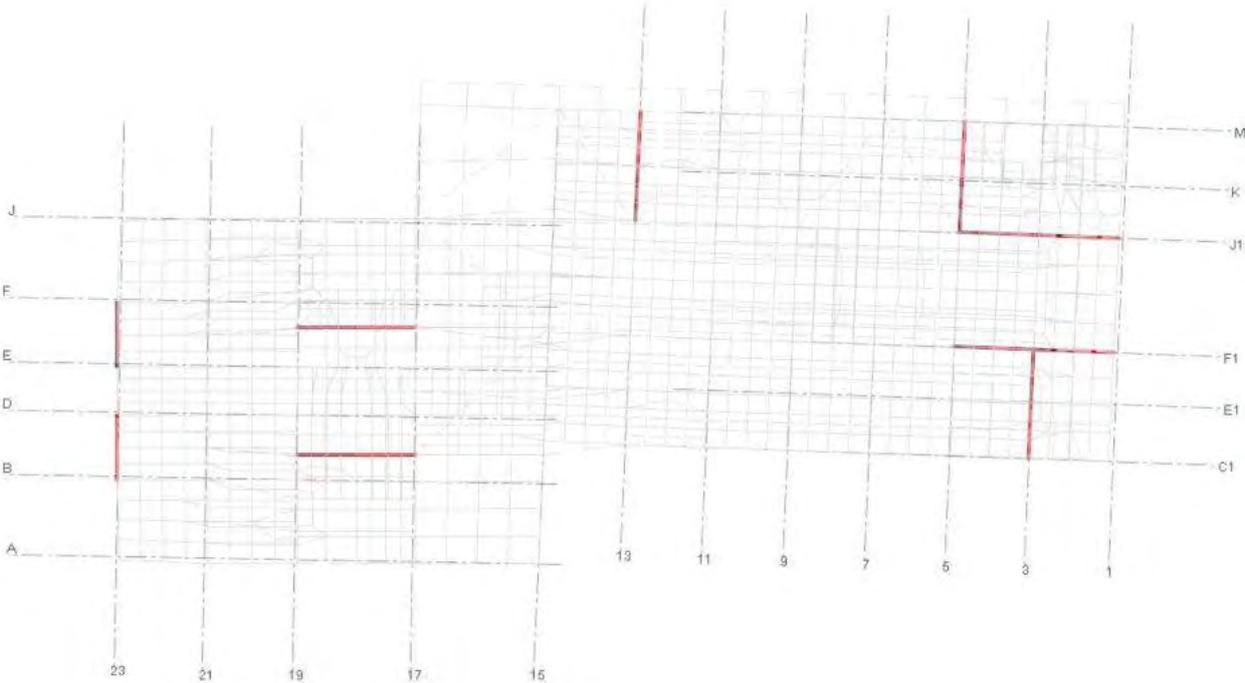


Figure 4 Plan view of CHS strut bracing option

# Memorandum

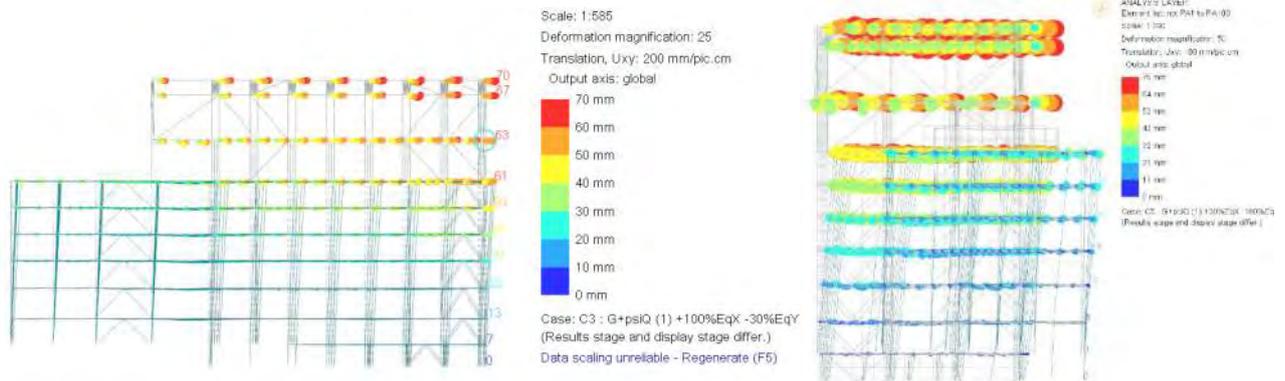


Figure 5 Analysis of CHS strut option showing earthquake drifts in X (left) and Y (right)

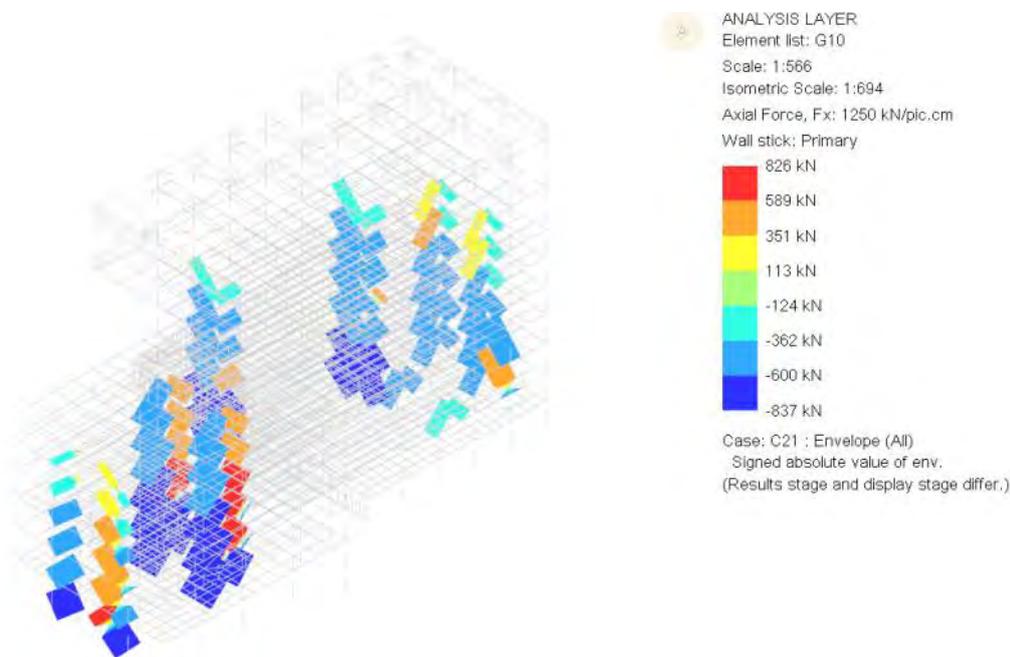


Figure 6 Analysis of CHS strut option showing earthquake axial forces in bracing

This analysis demonstrated that the typical size of CHS bracing will be a 219CHS. In the upper levels where the forces reduce, this may be reduced to a minimum of a 168CHS.

# Memorandum

## Update to finite element model with CHS strut and cross-bracing

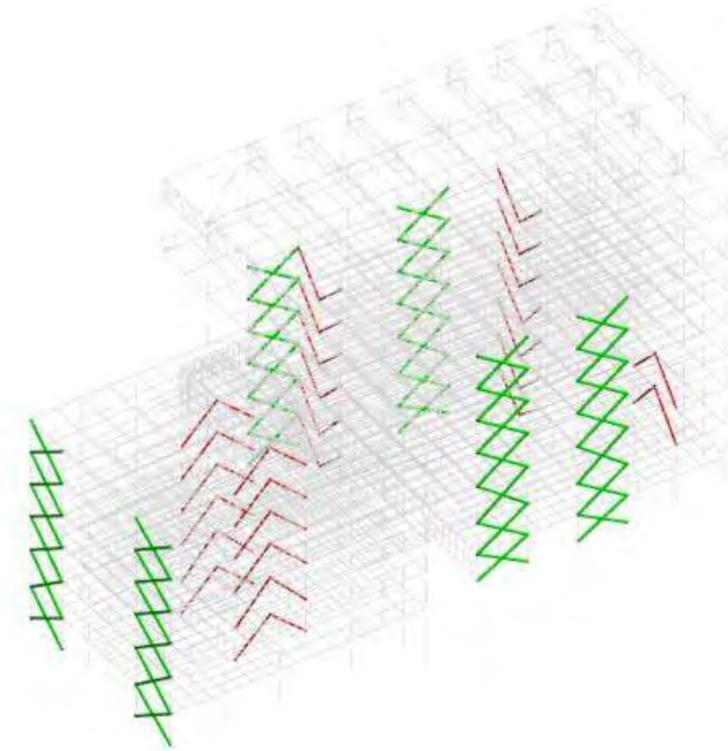


Figure 7 Isometric view of CHS strut and cross-bracing option

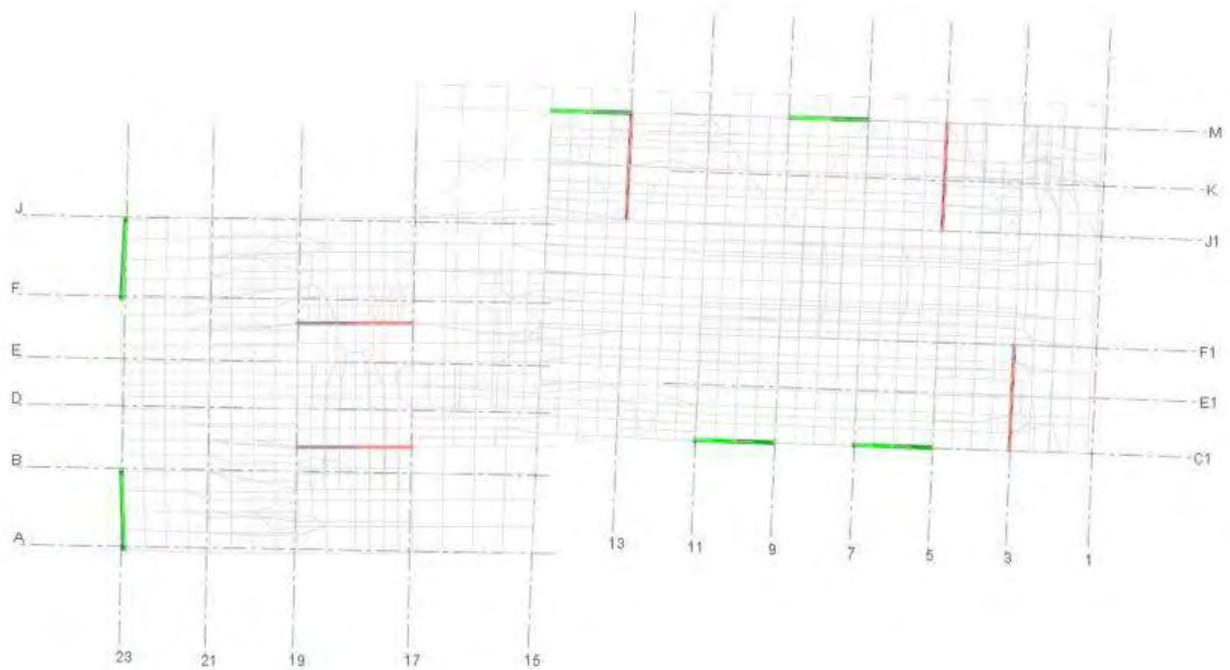


Figure 8 Plan view of CHS strut and cross-bracing option

# Memorandum

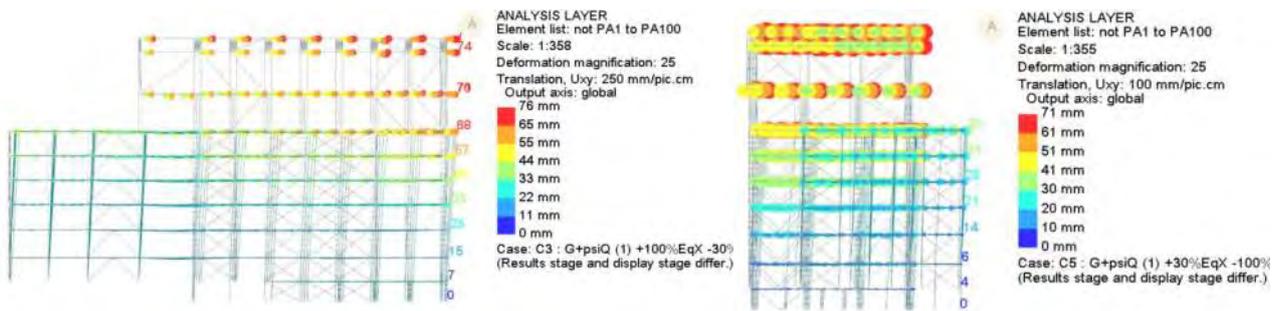


Figure 9 Analysis of CHS strut and cross-bracing option showing earthquake drifts in X (left) and Y (right)

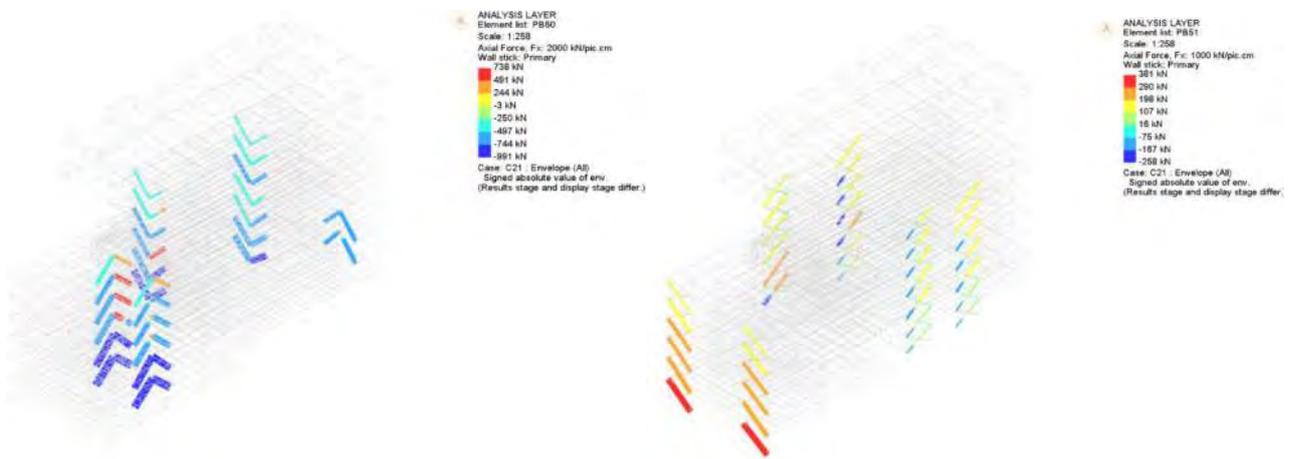
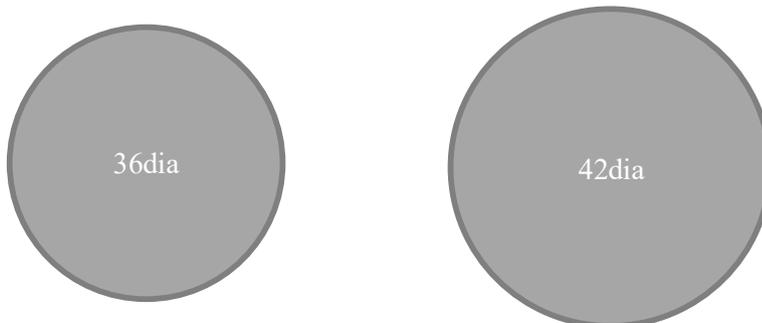


Figure 10 Analysis of CHS strut option showing earthquake axial forces in strut bracing (left) and cross-bracing (right)

This analysis demonstrated that the typical size of CHS bracing in this option can be a 219CHS. In the upper levels where the forces reduce, this may be reduced to a minimum of a 168CHS. For two bays of cross-bracing the diameter of the rod would be 40-50mm, for three bays it would be 30-40mm.

When printed at A4, typical size of rod cross-bracing sections are shown below.



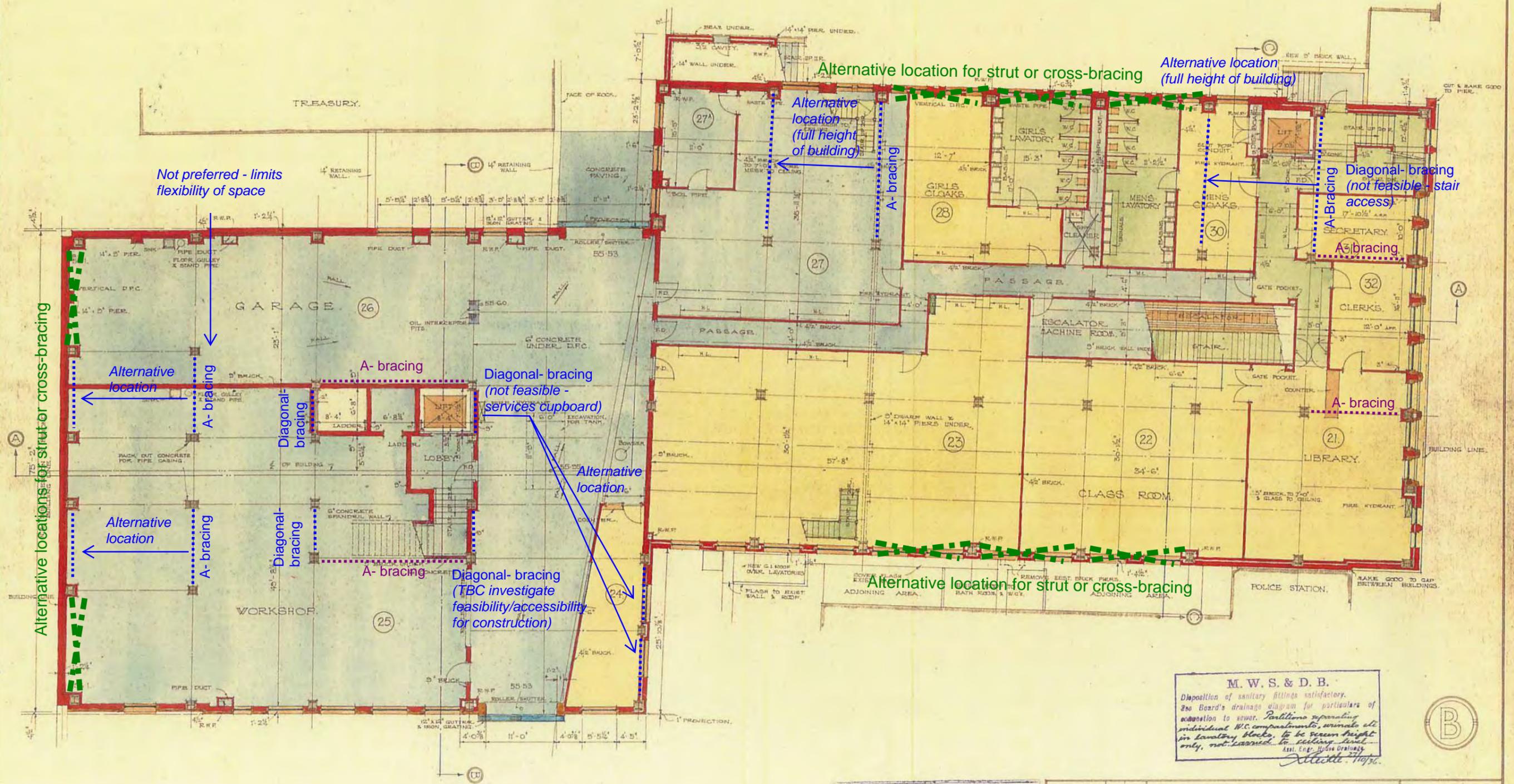
# Memorandum

## A3 Bracing Layout Options

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# Conceptual Bracing arrangement (08/02/2018)



M. W. S. & D. B.  
 Disposition of sanitary fittings satisfactory.  
 See Board's drainage diagram for particulars of  
 connection to sewer. Partitions separating  
 individual W.C. compartments, urinals etc  
 in lavatory blocks, to be screen height  
 only, not screened to ceiling level.  
 Arch. Eng. W.S. & D.B.  
 27/1/36

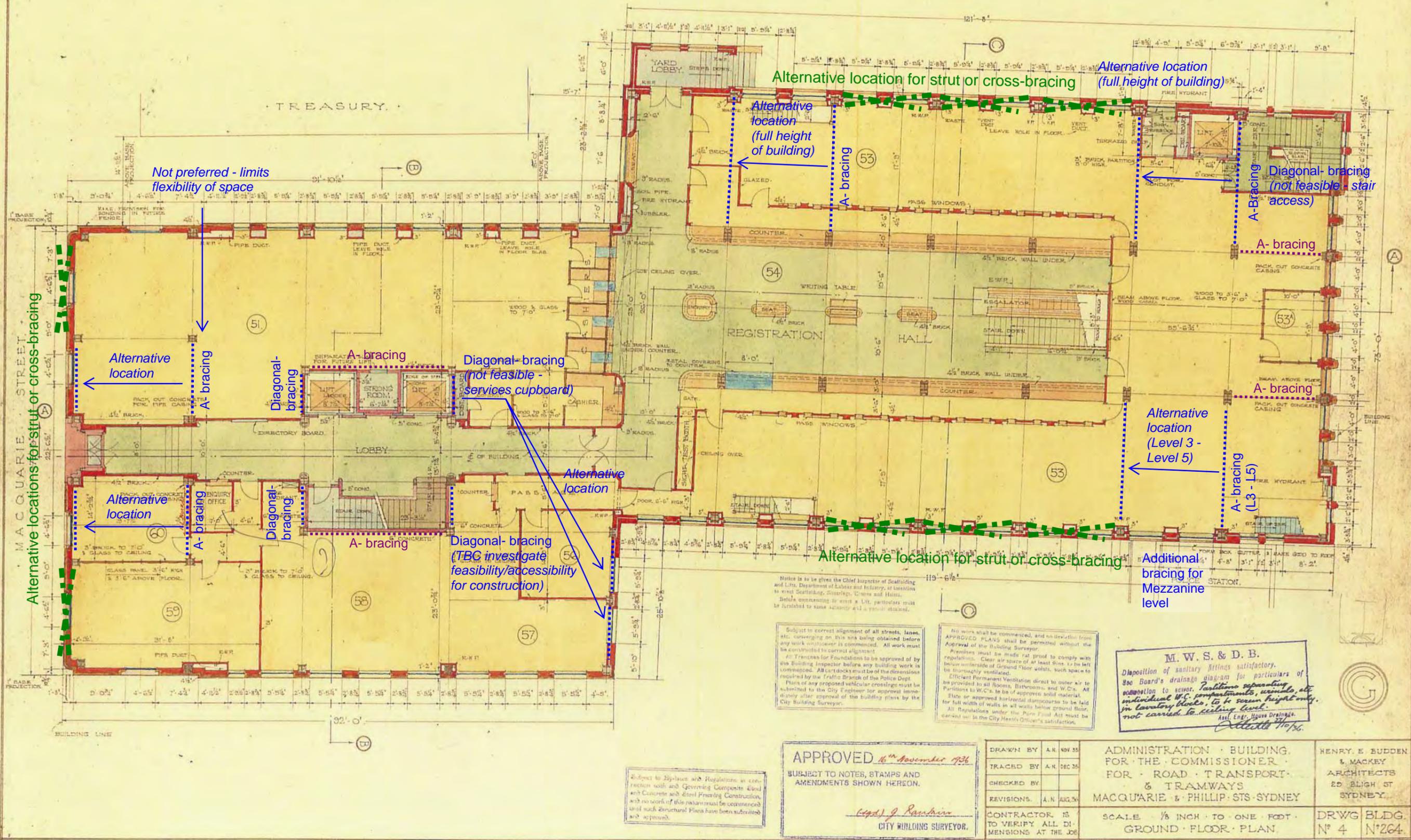
APPROVED 16<sup>th</sup> November 1936  
 SUBJECT TO NOTES, STAMPS AND  
 AMENDMENTS SHOWN HEREON.  
 (Sgd) J. Rankin  
 CITY BUILDING SURVEYOR.

DRAWN BY A.N. NOV. 35  
 TRACED BY A.N. DEC. 35  
 CHECKED BY  
 REVISIONS A.N. AUG. 36  
 CONTRACTOR IS  
 TO VERIFY ALL DI-  
 MENSIONS AT THE JOB

ADMINISTRATION BUILDING  
 FOR THE COMMISSIONER  
 FOR ROAD TRANSPORT  
 & TRAMWAYS  
 MACQUARIE & PHILLIP STS SYDNEY.  
 SCALE 1/8 INCH TO ONE FOOT  
 BASEMENT PLAN.

HENRY E. BUDDEN  
 & MACKAY  
 ARCHITECTS  
 29 BLIGH ST  
 SYDNEY.  
 DRWG BLDG  
 N<sup>o</sup> 3 N<sup>o</sup> 264.

Arup (08/02/2018)  
 Conceptual Bracing arrangement



Notice is to be given the Chief Inspector of Scolding and Lifts, Department of Labour and Industry, of intention to erect Scaffolding, Scaffolding, Cranes and Hoists. Before commencing to erect a Lift, particulars must be furnished to same authority and a permit obtained.

Subject to correct alignment of all streets, lanes, etc. superimposed on this site being obtained before any work whatsoever is commenced. All work must be constructed to correct alignment.  
 All Trenches for Foundations to be approved of by the Building Inspector before any building work is commenced. All cut docks must be of the dimensions required by the Traffic Branch of the Police Dept.  
 Plans of any proposed vehicular crossings must be submitted to the City Engineer for approval immediately after approval of the building plans by the City Building Surveyor.

No work shall be commenced, and no deviation from APPROVED PLANS shall be permitted without the Approval of the Building Surveyor.  
 Premises must be made rat proof to comply with regulations. Clear air space of at least 9ins. to be left below underside of Ground floor joists, such space to be thoroughly ventilated.  
 Efficient Permanent Ventilation direct to outer air to be provided to all Rooms, Bathrooms, and W.C.s. All Partitions to W.C.s. to be of appropriate solid material. Slate or approved horizontal dampcourse to be laid for full width of walls in all walls below ground floor. All Regulations under the Pure Food Act must be carried out to the City Health Officer's satisfaction.

M. W. S. & D. B.  
 Disposition of sanitary fittings satisfactory.  
 See Board's drainage diagram for particulars of connection to sewer. Partitions separating individual W.C. compartments, urinals, etc. in lavatory blocks, to a sewer height only, not carried to ceiling level.  
 Asst. Engr. House Drainage  
 Adelaide 11/1/16.

APPROVED 16<sup>th</sup> November 1936  
 SUBJECT TO NOTES, STAMPS AND AMENDMENTS SHOWN HEREON.  
 (Capt.) J. Rankin  
 CITY BUILDING SURVEYOR.

DRAWN BY	A.R. NOV 35
TRACED BY	A.R. DEC 35
CHECKED BY	
REVISIONS	A.N. AUG 36
CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB	

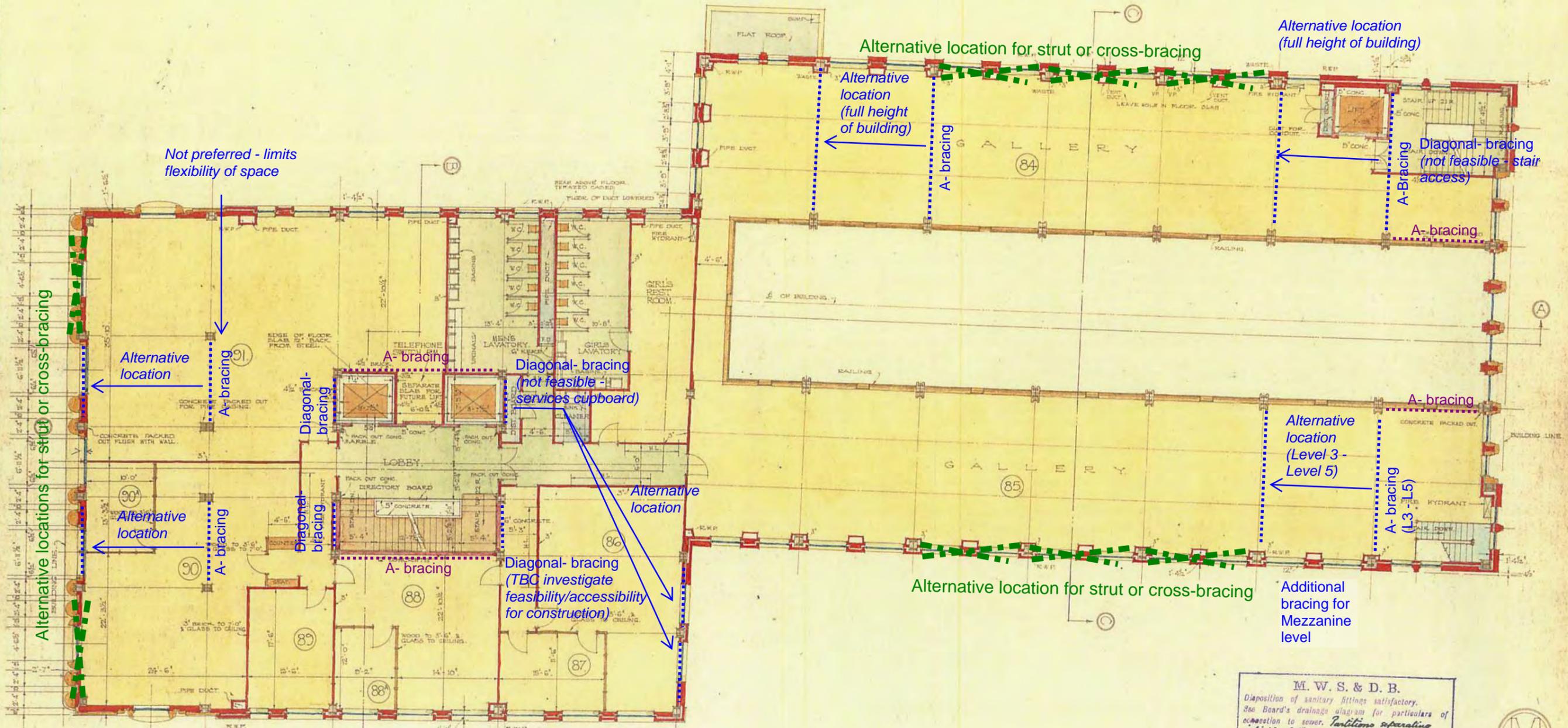
ADMINISTRATION BUILDING FOR THE COMMISSIONER FOR ROAD TRANSPORT & TRAMWAYS  
 MACQUARIE & PHILLIP STS SYDNEY  
 SCALE 1/8 INCH TO ONE FOOT  
 GROUND FLOOR PLAN.

HENRY E. SIDDEN & MACKAY ARCHITECTS 25 BLIGH ST SYDNEY  
 DRWG BLDG N<sup>o</sup> 4 N<sup>o</sup> 264.

Subject to By-laws and Regulations in connection with and Governing Concrete and Reinforced Concrete and Steel Framing Construction, and no work of this nature must be commenced until such Structural Plans have been submitted and approved.

Level 3

Arup (08/02/2018)  
 Conceptual Bracing arrangement



M. W. S. & D. B.  
 Disposition of sanitary fittings satisfactory.  
 See Board's drainage diagram for particulars of  
 connection to sewer. Partitions separating  
 individual W.C. compartments, urinals, etc.  
 in lavatory blocks, to be screen height only,  
 not covered to ceiling. *Assl. Engr. House Drainage.*  
*Attelle 11/1/36*

APPROVED 16<sup>th</sup> November 1936  
 SUBJECT TO NOTES, STAMPS AND  
 AMENDMENTS SHOWN HEREON.  
*(Sgd) J. Rankin*  
 CITY BUILDING SURVEYOR.

DRAWN BY	AN	NOV 25
TRACED BY	AN	DEC 25
CHECKED BY		
REVISIONS	AN	AUG 29
CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB		

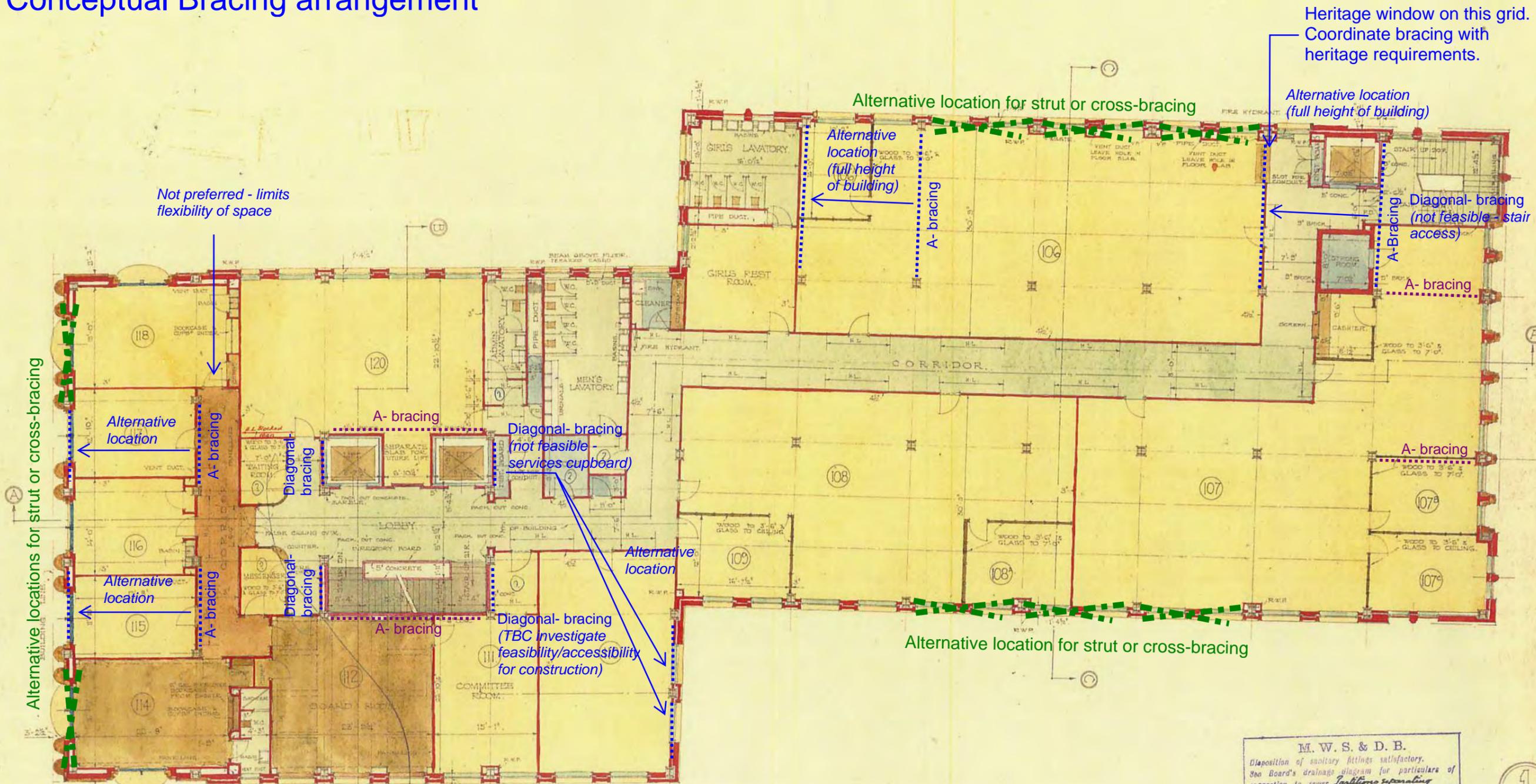
ADMINISTRATION - BUILDING  
 FOR THE COMMISSIONER  
 FOR ROAD TRANSPORT  
 & TRAMWAYS  
 MACQUARIE & PHILLIP STS SYDNEY

HENRY S. BUDDEN  
 & MACKAY  
 ARCHITECTS  
 25 BLIGH ST  
 SYDNEY

SCALE - 1/8 INCH TO ONE FOOT.  
 + MEZZANINE FLOOR PLAN +

DRWG BLDG  
 N° 5 N° 264

Arup (08/02/2018)  
 Conceptual Bracing arrangement



Heritage window on this grid.  
 Coordinate bracing with heritage requirements.

Alternative location (full height of building)

Alternative location (full height of building)

Diagonal-bracing (not feasible - stair access)

Not preferred - limits flexibility of space

Alternative locations for strut or cross-bracing

Alternative location

Alternative location

Diagonal-bracing (not feasible - services cupboard)

Alternative location

Diagonal-bracing (TBC investigate feasibility/accessibility for construction)

Alternative location for strut or cross-bracing

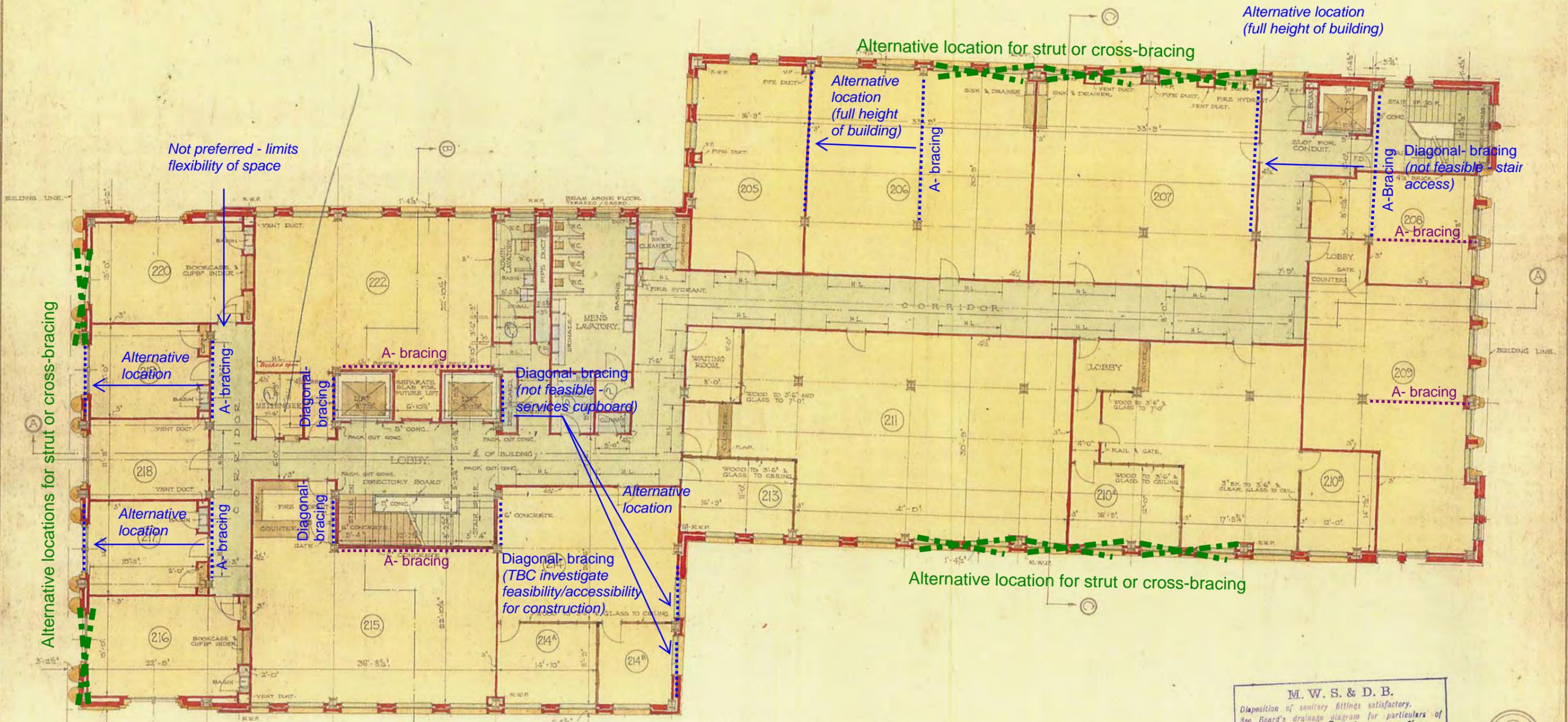
M. W. S. & D. B.  
 Disposition of sanitary fittings satisfactory. See Board's drainage diagram for particulars of connection to sewer. Partitions separating individual W.C. compartments, urinals, etc. in lavatory blocks, to be seven height only, not carried to ceiling level.  
 11/1/36



<b>APPROVED</b> 16 <sup>th</sup> November 1936. SUBJECT TO NOTES, STAMPS AND AMENDMENTS SHOWN HEREON.  <i>(Sd.) J. Rankin</i> CITY BUILDING SURVEYOR.	DRAWN BY: A.N. 10/1/36 TRACED BY: A.N. 12/1/36 CHECKED BY: REVISIONS: A.N. 10/1/36	ADMINISTRATION BUILDING FOR THE COMMISSIONER FOR ROAD TRANSPORT & TRAMWAYS MACQUARIE & PHILLIP STS SYDNEY.	HENRY E. BUDDEN & MACKAY ARCHITECTS 28 BLIGH ST SYDNEY.
	CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB	SCALE - 1/8" INCH TO ONE FOOT FIRST FLOOR PLAN	DRWG/BLDG N° 6 N° 254

Level 5

Arup (08/02/2018)  
 Conceptual Bracing arrangement



M. W. S. & D. B.  
 Disposition of sanitary fittings satisfactory.  
 See Board's drainage diagram for particulars of  
 connection to sewer. Partitions separating  
 individual W.C. compartments, urinals, etc.  
 in lavatory blocks, to be screen height only,  
 not carried to ceiling level.  
 Asst. Engr. House Drainage  
 Adelaide 11/1/56

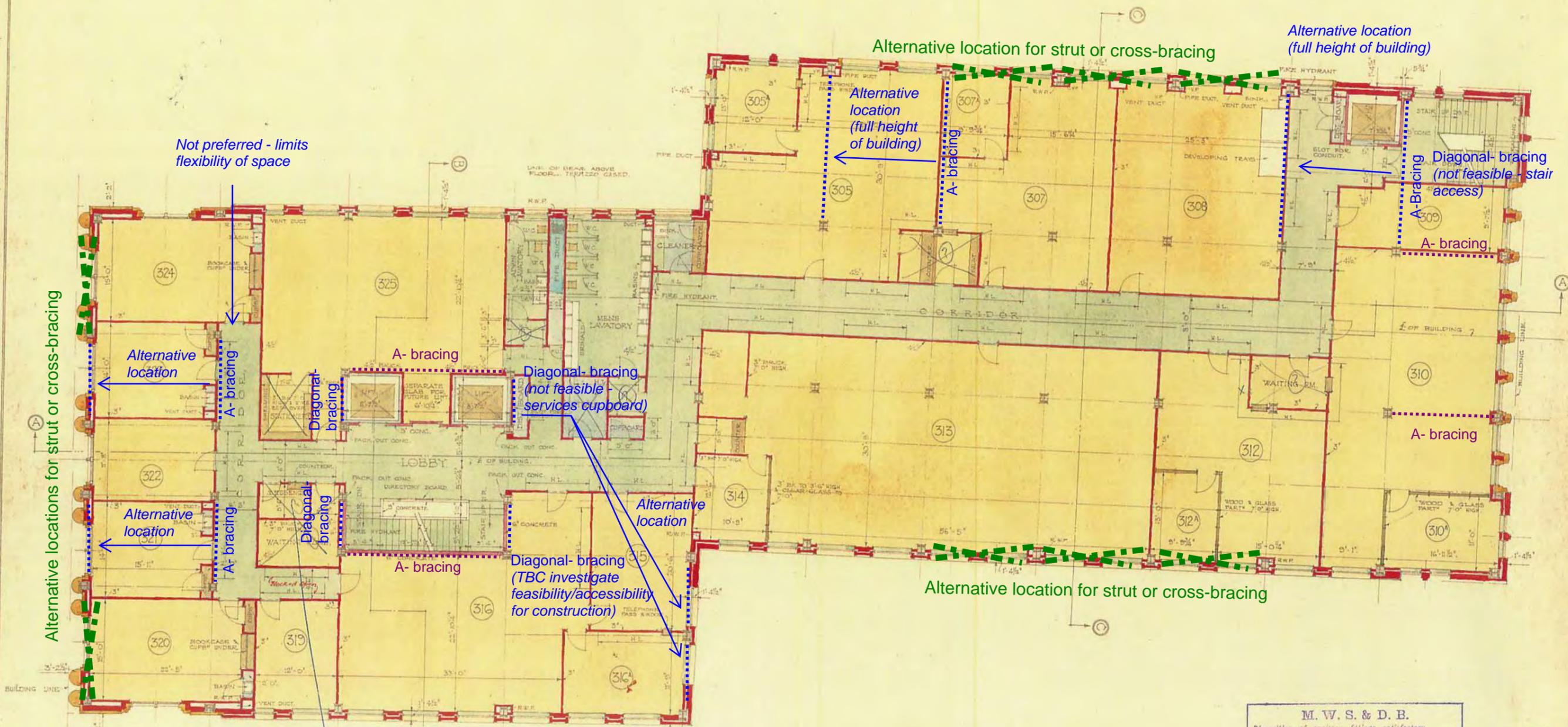
APPROVED 16<sup>th</sup> November 1916  
 SUBJECT TO NOTES, STAMPS AND  
 AMENDMENTS SHOWN HEREON.  
 (Sgd) J. Ransome  
 CITY BUILDING SURVEYOR.

DRAWN BY	A.N. NOV. 25
TRACED BY	A.N. DEC. 29
CHECKED BY	
REVISIONS	A.N. AUG. 26
CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB	

ADMINISTRATION BUILDING  
 FOR THE COMMISSIONER  
 FOR ROAD TRANSPORT  
 & TRAMWAYS  
 MACQUARIE & PHILLIP STS. SYDNEY.  
 SCALE - 1/8 INCH TO ONE FOOT.  
 SECOND FLOOR PLAN.

HENRY E. BUDDEN  
 & MACKAY  
 ARCHITECTS  
 25 BLIGH ST  
 SYDNEY.  
 DRWG BLDG  
 N° 7. N° 264.

Arup (08/02/2018)  
 Conceptual Bracing arrangement



M. W. S. & D. B.  
 Disposition of sanitary fittings satisfactory.  
 See Board's drainage diagram for particulars of  
 connection to sewer. Partitions separating  
 individual WC compartments, lavatories etc  
 in lavatory blocks, to be screen height only.  
 not carried to ceiling level.  
 Asst. Engr. House Drainage.  
 27/10/36

3

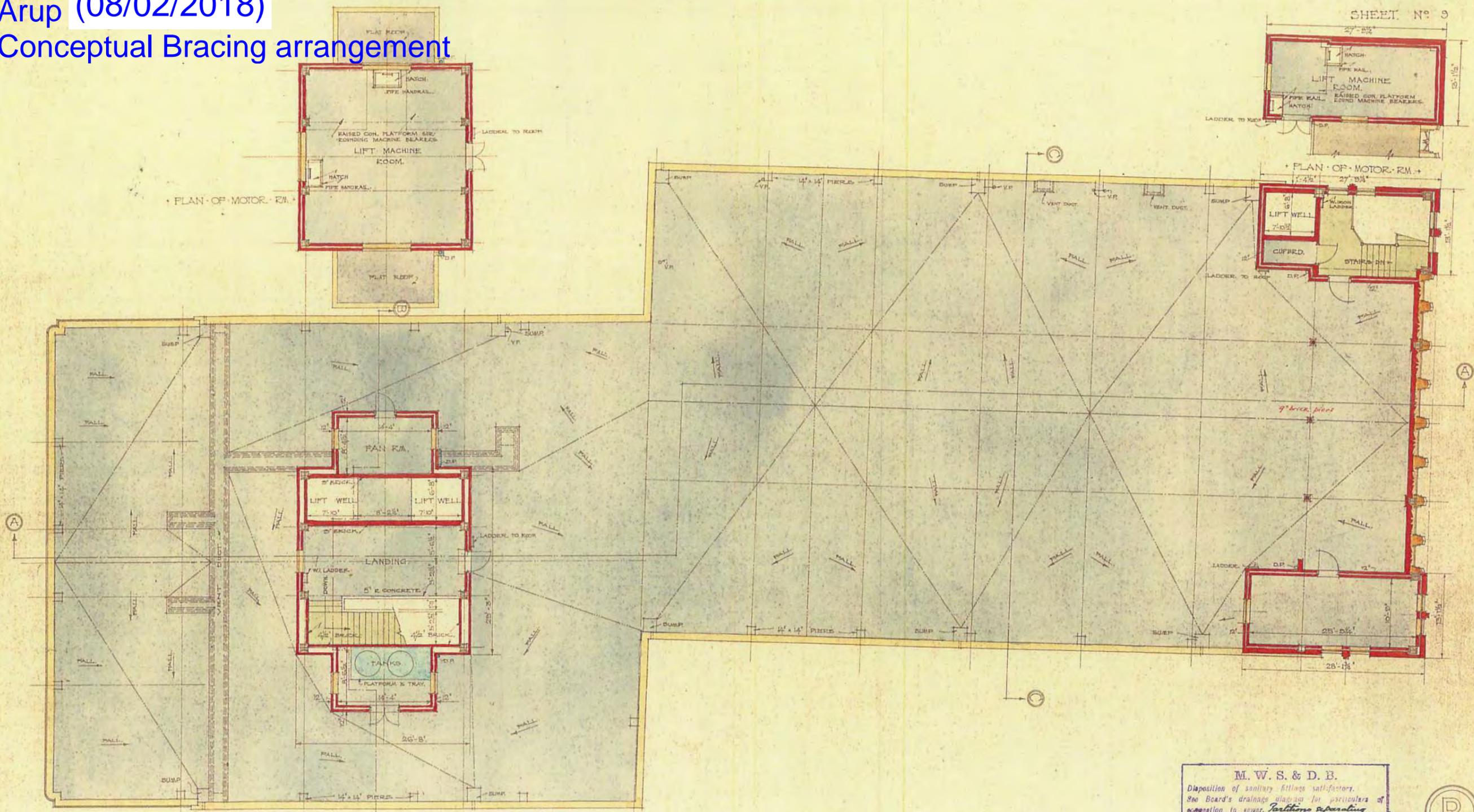
APPROVED 16<sup>th</sup> November 1936  
 SUBJECT TO NOTES, STAMPS AND  
 AMENDMENTS SHOWN HEREON.  
 (Sgd.) J. Rowland  
 CITY BUILDING SURVEYOR.

DRAWN BY AN 19V 25  
 TRACED BY AN DEC 25  
 CHECKED BY  
 REVISIONS AN 19V 25

ADMINISTRATION BUILDING  
 FOR THE COMMISSIONER  
 FOR ROAD TRANSPORT  
 & TRAMWAYS  
 MACQUARIE & PHILLIP STS SYDNEY  
 SCALE - 1/8 INCH TO ONE FOOT  
 THIRD FLOOR PLAN

HENRY E. BUDDEN  
 & MACKAY  
 ARCHITECTS  
 25 BIRCH ST.  
 SYDNEY.  
 DRWG BLDG  
 No 8. No 264

Arup (08/02/2018)  
 Conceptual Bracing arrangement



SHEET No 9

8

M. W. S. & D. B.  
 Disposition of sanitary fittings satisfactory.  
 See Board's drainage plan for particulars of  
 connection to sewer. Partitions separating  
 individual W.C. compartments, urinals, etc.  
 in sanitary blocks, to be seven feet only,  
 not carried to ceiling level.  
 Asst. Engr. - House Drainage  
 Attest 11/10/36



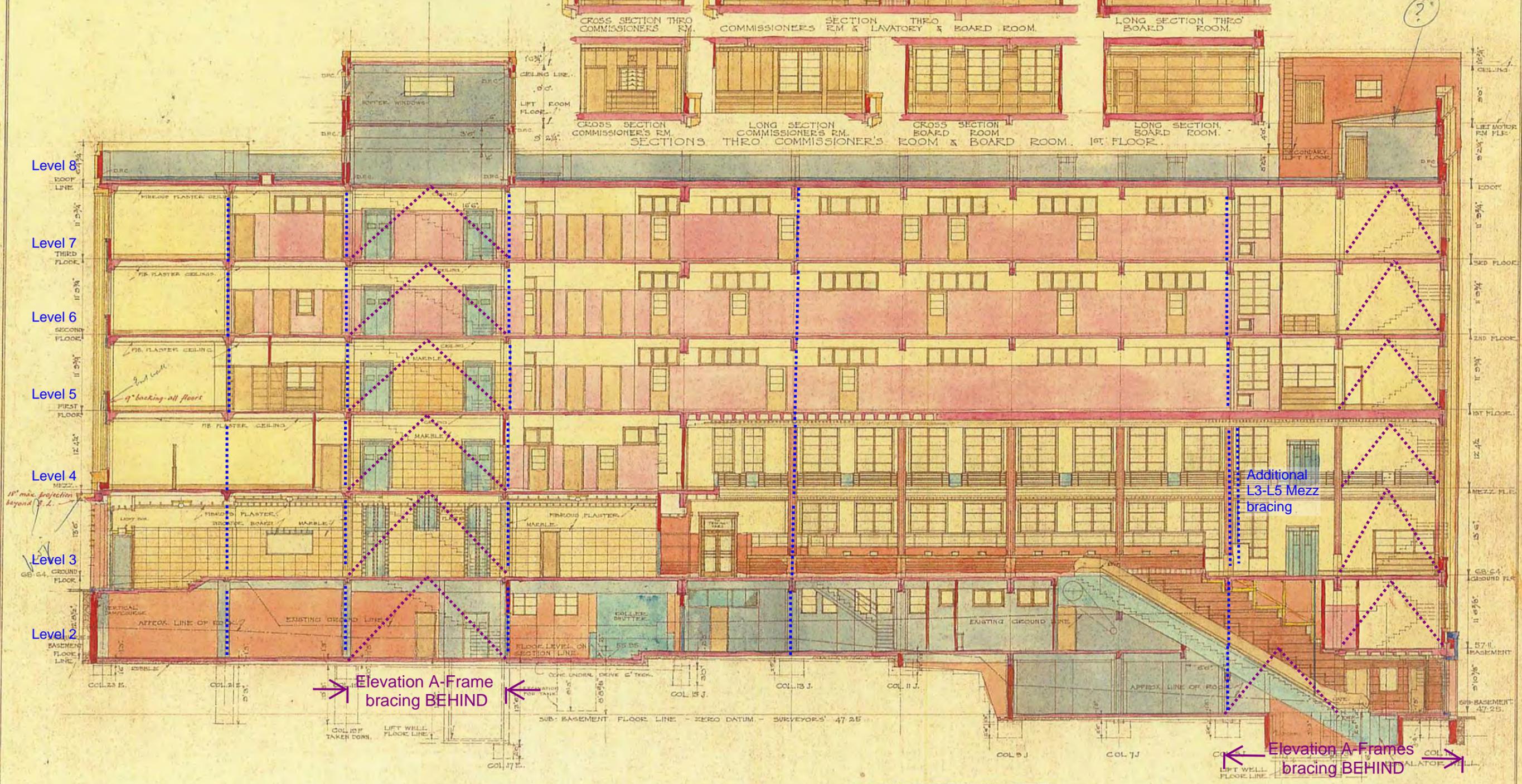
APPROVED 16<sup>th</sup> November 1936  
 SUBJECT TO NOTES, STAMPS AND  
 AMENDMENTS SHOWN HEREON.  
 (Sign) J. Rankin  
 CITY BUILDING SURVEYOR.

DRAWN BY H.W.A. DEC.36  
 TRACED BY H.W.A. DEC.36  
 CHECKED BY  
 REVISIONS A.N. AUG.36  
 CONTRACTOR IS  
 TO VERIFY ALL DIMENSIONS AT THE JOB

ADMINISTRATION BUILDING  
 FOR THE COMMISSIONER  
 FOR ROAD TRANSPORT  
 & TRAMWAYS  
 MACQUARIE & PHILLIP STS. SYDNEY  
 SCALE: 1/8 INCH TO ONE FOOT.  
 ROOF PLAN

HENRY E. BUDDEN  
 & MACKAY  
 ARCHITECTS.  
 25 BLIGH ST  
 SYDNEY  
 DRWG BLDG  
 N° 9. N° 264.

Arup (08/02/2018)  
 Conceptual Bracing arrangement



Alternative bracing locations not show for clarity (refer plans)

APPROVED <i>16<sup>th</sup> November 1936</i> SUBJECT TO NOTES, STAMPS AND AMENDMENTS SHOWN HEREON.  <i>(Sgd) J. Rankin</i> CITY BUILDING SURVEYOR.	DRAWN BY NWA 87/35 TRACED BY NWA 82/35 CHECKED BY REVISIONS AN 8/6/36	ADMINISTRATION BUILDING, FOR THE COMMISSIONER OF ROAD TRANSPORT & TRAMWAYS MACQUARIE & PHILLIP STS SYDNEY	HENRY E. BUDDEN & MACKAY ARCHITECTS 25 BLIGH ST SYDNEY.
	CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB	SCALE 1/8" INCH TO ONE FOOT LONG SECTION.	DRWG BLDG N° 10 N° 264.

Arup (08/02/2018)

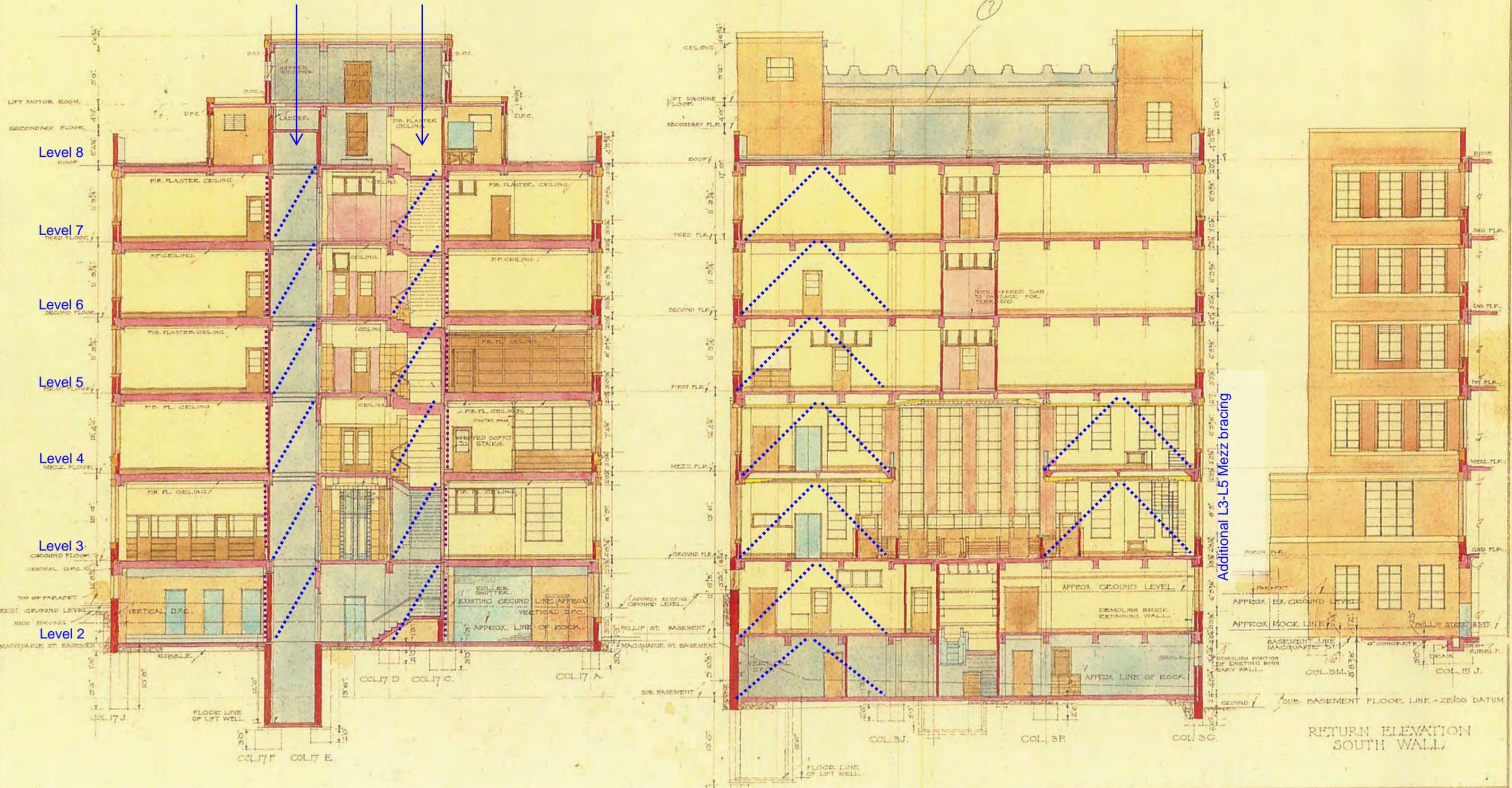
SHEET N° II.

8

# Conceptual Bracing arrangement

Diagonal-bracing  
South-West corner  
(not feasible -  
services cupboard)

Diagonal-bracing  
North-West corner  
(TBC investigate  
construction)



SECTION BB'

SECTION CC'

Additional L3-L5 Mezz bracing

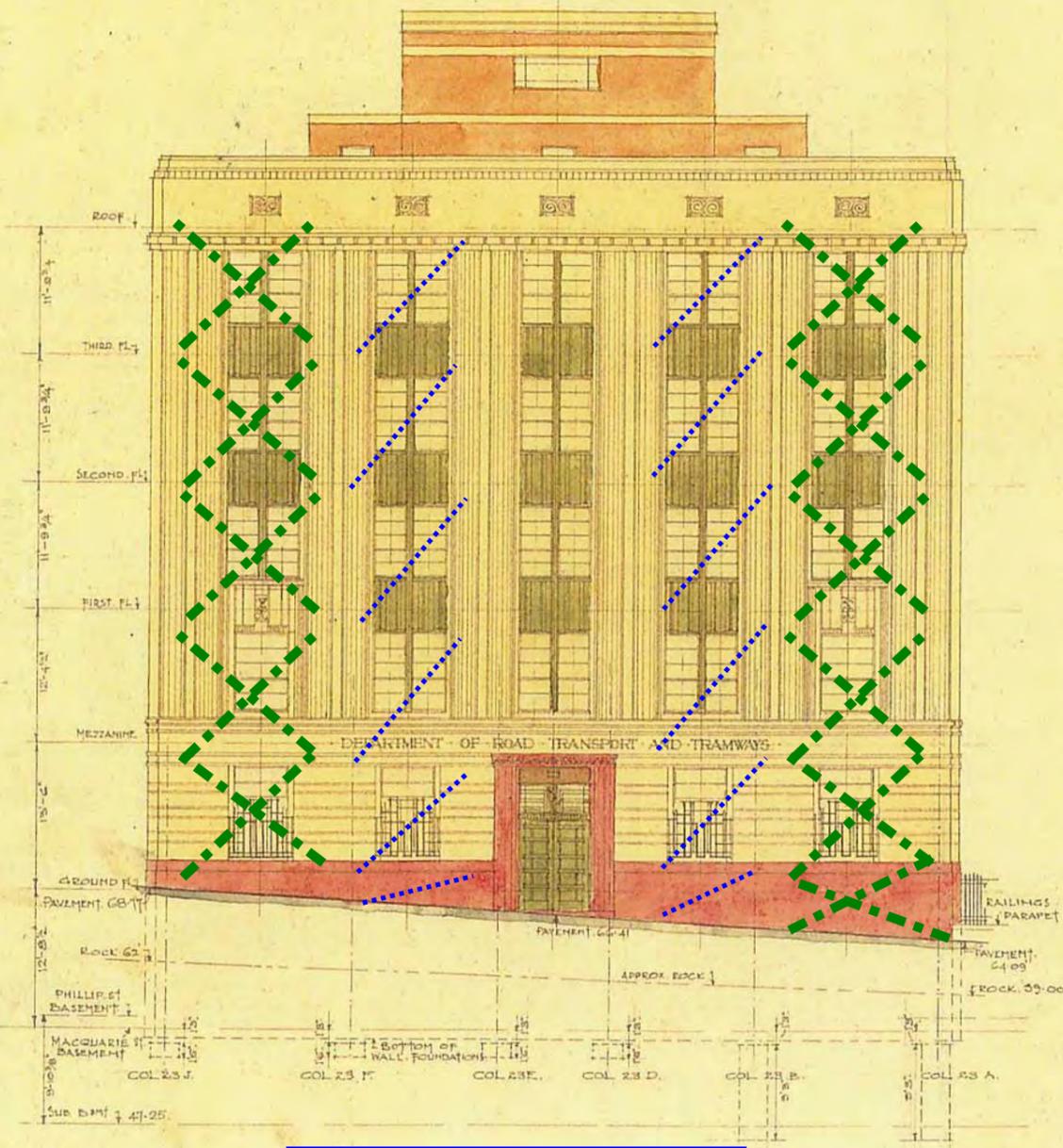
RETURN ELEVATION SOUTH WALL

Alternative bracing locations not show for clarity (refer plans)

**APPROVED** 16<sup>th</sup> November 1936  
 SUBJECT TO NOTES, STAMPS AND AMENDMENTS SHOWN HEREON.  
*(Signature)*  
 CITY BUILDING SURVEYOR.

DRAWN BY	ADMINISTRATION - BUILDING FOR THE COMMISSIONER FOR ROAD TRANSPORT & TRAMWAYS - MACQUARIE & PHILLIP STS SYDNEY	HENRY E. BUDDEN & MACKAY ARCHITECTS 25 BLIGH ST SYDNEY
TRACED BY		
CHECKED BY		
REVISIONS	AN AMEND	
CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB	SCALE - 1/8" INCH TO ONE FOOT - CROSS SECTIONS & ELEVATION	DRWG BLDG N° 11. N° 264.

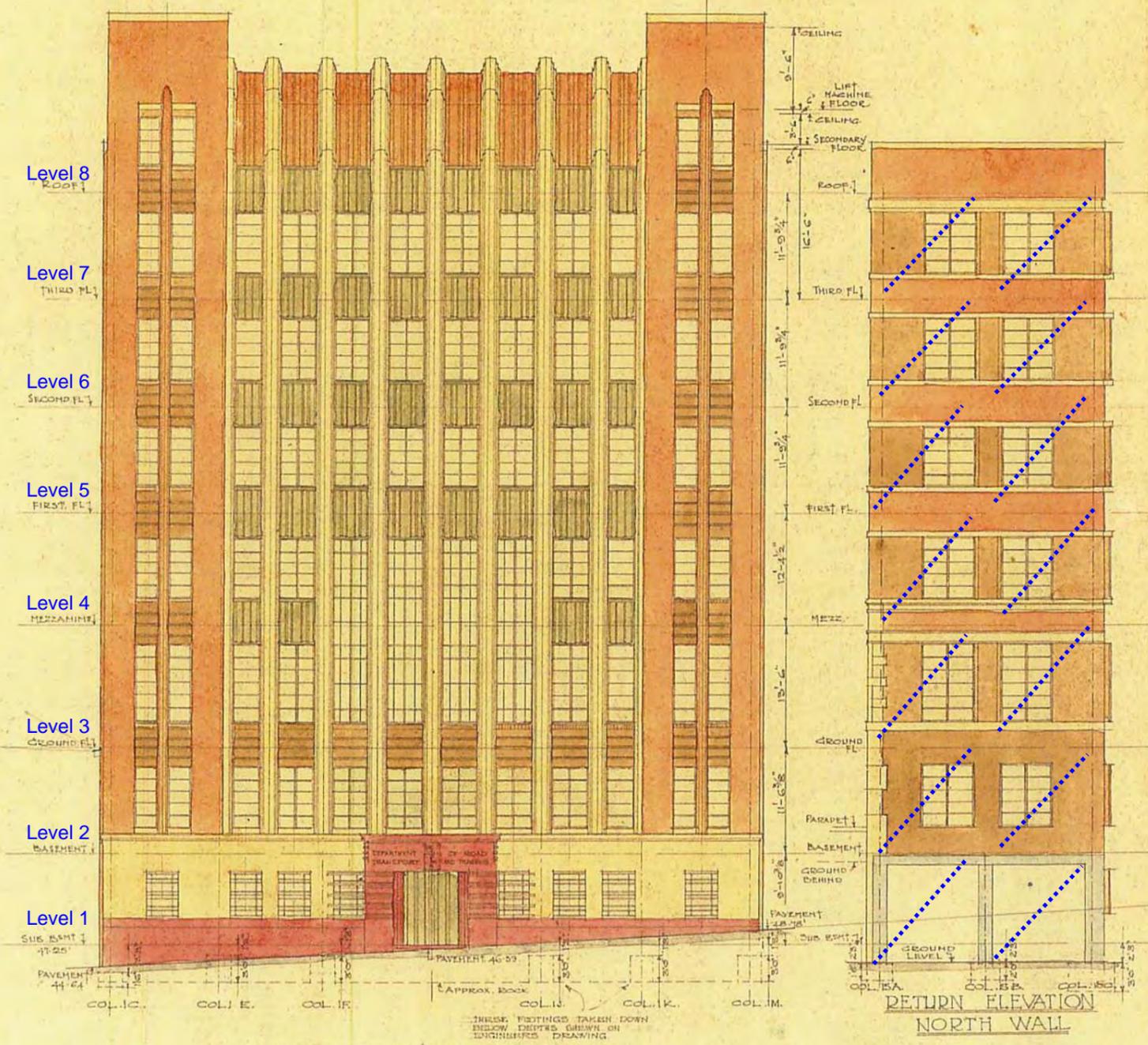
Arup (08/02/2018)  
 Conceptual Bracing arrangement



Alternative bracing location  
 behind facade (refer plans)

Alternative locations for strut or cross-bracing

ELEVATION TO MACQUARIE STREET.

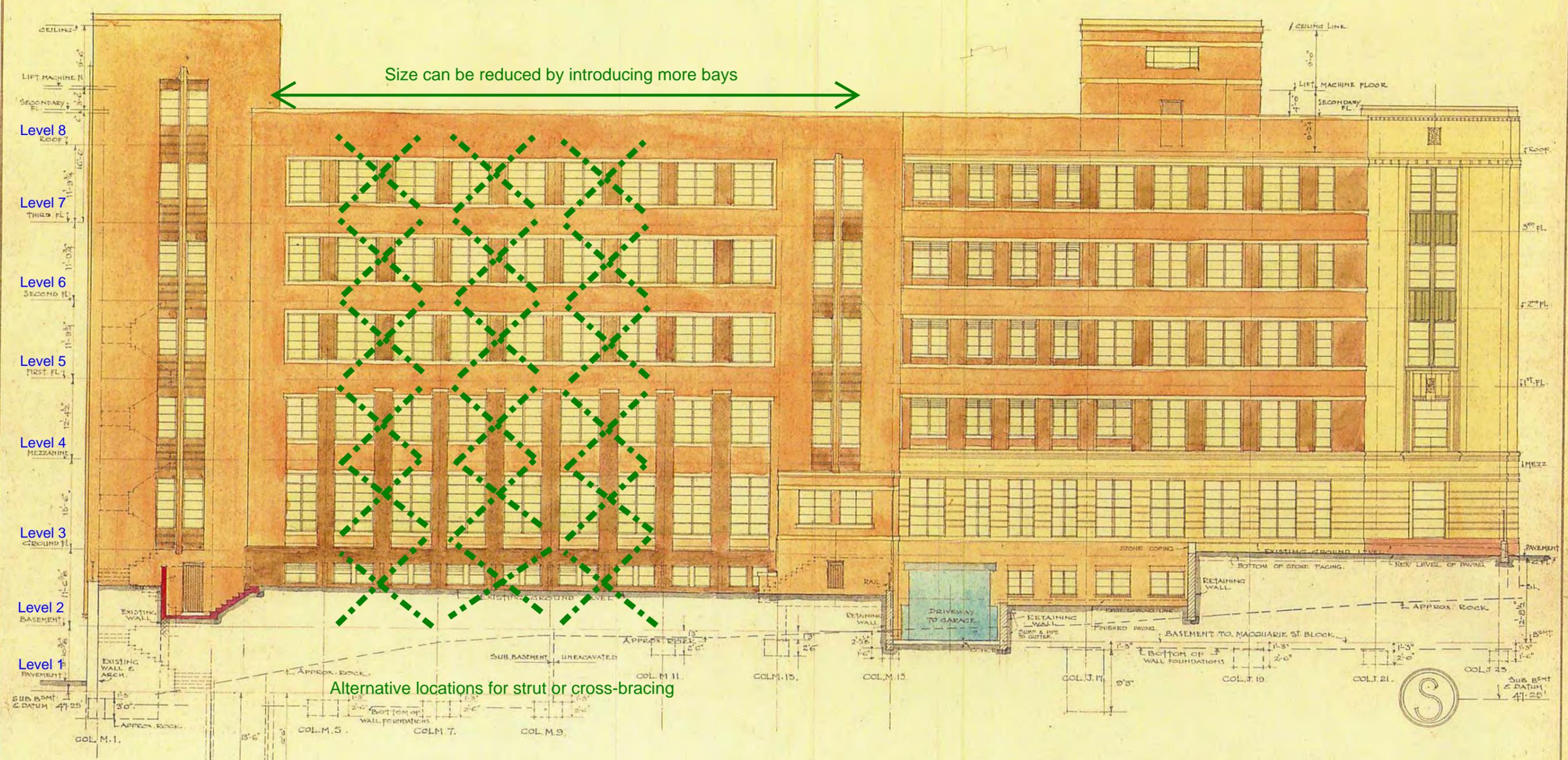


Alternative bracing location  
 behind facade (refer plans)

ELEVATION TO PHILLIP STREET

APPROVED 16 <sup>th</sup> November 1936 SUBJECT TO NOTES, STAMPS AND AMENDMENTS SHOWN HEREON.  <i>(Sd) J. Rankin</i> CITY BUILDING SURVEYOR.	DRAWN BY SEV. DR. 55	ADMINISTRATION BUILDING	HENRY B. BREDDEN
	TRACED BY SEV. DR. 35	FOR ROAD TRANSPORT & TRAMWAYS	ARCHITECTS
	CHECKED BY	MACQUARIE & PHILLIP STS SYDNEY.	25 BLIGH ST SYDNEY.
	REVISIONS. A.H. 10/36	CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB	SCALE 1/8 INCH TO ONE FOOT. ELEVATIONS.

Arup (08/02/2018)  
 Conceptual Bracing arrangement

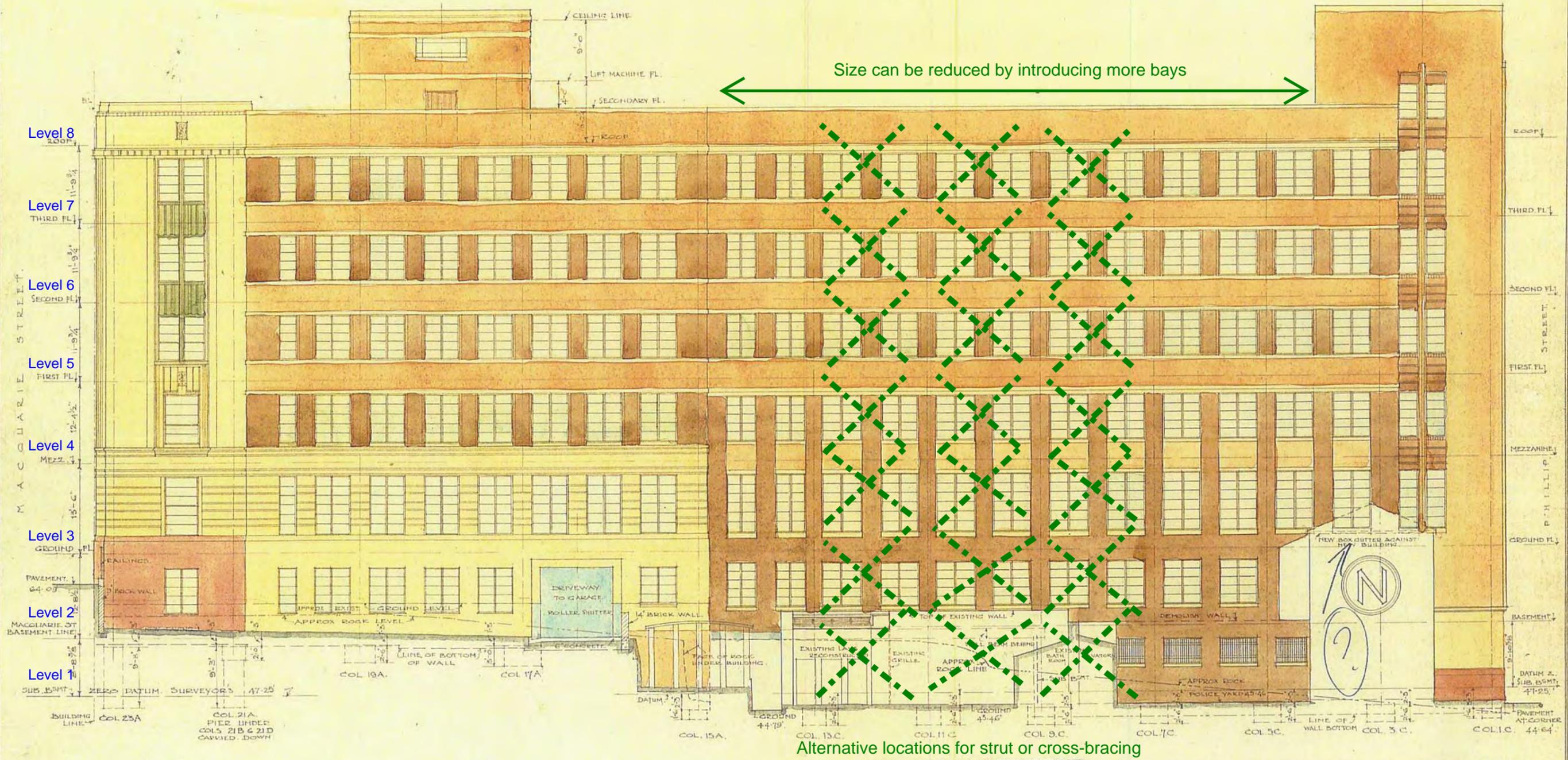


Alternative locations for strut or cross-bracing

ELEVATION OF SOUTH WALL

APPROVED 16 <sup>th</sup> November 1926 SUBJECT TO NOTES, STAMPS AND AMENDMENTS SHOWN HEREON. <i>(Sgd.) J. Rankin</i> CITY BUILDING SURVEYOR		DRAWN BY REV. DEC 50 TRACED BY REV. DEC 50 CHECKED BY REVISIONS. A.N. AUG 50 CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB	ADMINISTRATION BUILDING FOR THE COMMISSIONER FOR ROAD TRANSPORT & TRAMWAYS MACQUARIE & PHILLIP STS SYDNEY	HENRY E. BUDDEN & MACKEY ARCHITECTS 29 BLIGH ST SYDNEY. DRWG BLDG No 13 N° 264.
		SCALE 1/8 INCH TO ONE FOOT SOUTH ELEVATION		

Arup (08/02/2018)  
 Conceptual Bracing arrangement



Alternative locations for strut or cross-bracing

ELEVATION OF NORTH WALL

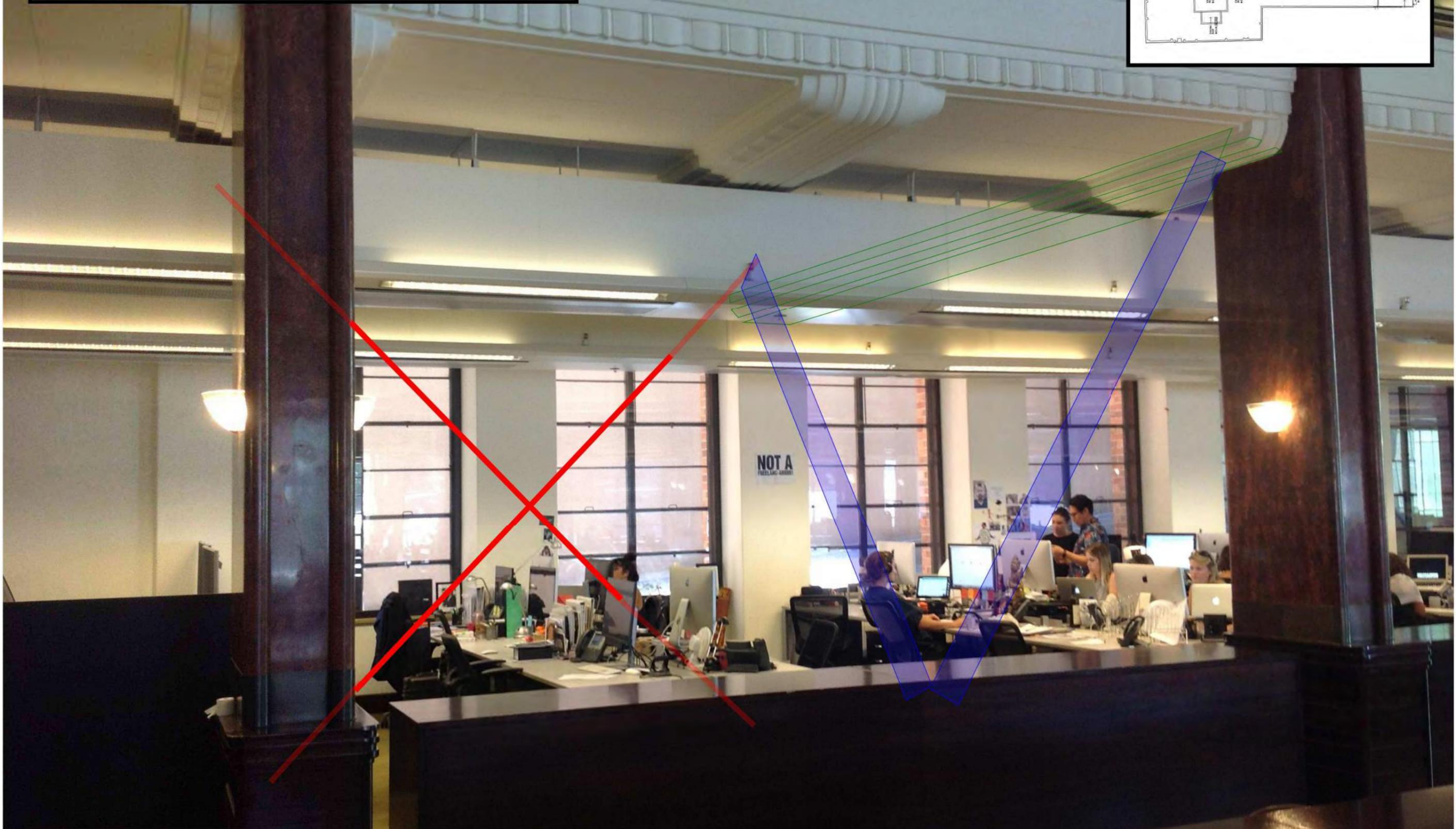
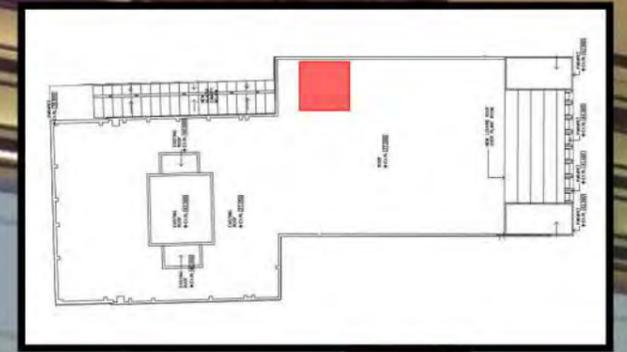
APPROVED 16<sup>th</sup> November 1936  
 SUBJECT TO NOTES, STAMPS AND AMENDMENTS SHOWN HEREON.  
*Wm. J. Rankin*  
 CITY BUILDING SURVEYOR.

DRAWN BY SEV DEC 20  
 TRACED BY SEV  
 CHECKED BY  
 REVISIONS A.H. AUG 20  
 CONTRACTOR IS TO VERIFY ALL DIMENSIONS AT THE JOB

ADMINISTRATION BUILDING FOR THE COMMISSIONER FOR ROAD TRANSPORT & TRAMWAYS - MACQUARIE & PHILLIP STS SYDNEY  
 SCALE 1/8 INCH TO ONE FOOT  
 NORTH ELEVATION

HENRY E. BUDDEN & MACKAY ARCHITECTS 29 BLIGH ST SYDNEY.  
 DRWG BLDG No 14 No 264.

Example of cross-bracing at facade and CHS  
'A' bracing internally at Grid 11-13/M-K at  
Ground (L3)



Note that the structural columns are every  
alternate facade vertical frame. Cross-bracing  
will be arranged as shown.

Bracing may be inverted to be  
an 'A' instead of a 'V'

# Memorandum

## A4 Example of Seismic Bracing

---

# Memorandum

A-frame SHS struts



<https://www.solutionsgc.com/wp-content/uploads/1605204.jpg>

CHS cross-bracing



<https://i.pinimg.com/originals/2f/52/d0/2f52d0f00d71f1eef0d0a38d14614b44.jpg>

# Memorandum

A-frame SHS struts



<https://www.nps.gov/tps/images/briefs/41-new-reinforcement-arrow.png>

A-frame UC struts



<https://media.licdn.com/mpr/mpr/AAEAAQAAAAAAAAAnnAAAAJDY4NzkyZWlwLWQ0OTYtNGY2ZS05Yzk3LWE0NDZIMDYzOTlmNQ.jpg>