8 PhillipStreet, Parramatta

ACSE 2022 Awards
Unusual Projects Category

1. Introduction

St Andrew's church and the adjacent church hall structure was erected in 1926 within the then small township of Parramatta. Fast forward almost 100 years and Parramatta city is now the commercial center of Sydney's West and home some of Sydney tallest skyscrapers. St Andrew's church and church hall has stood resolute throughout this rapid growth whilst holding significant cultural importance to the people of Parramatta. The development of 8 Phillip Street will tower over the existing church structure with a 55-Storey tower (200m) and 9-Storey basement (35m) plunging deep into the Parramatta ground below the existing hall structure. The integration of the existing church hall has required an innovative structural design that not only responds to the complex spatial constraints of the site but also facilitates a construction methodology and sequence that rises to meet the challenge of building both under and over a heritage listed masonry building.

2. Project Brief

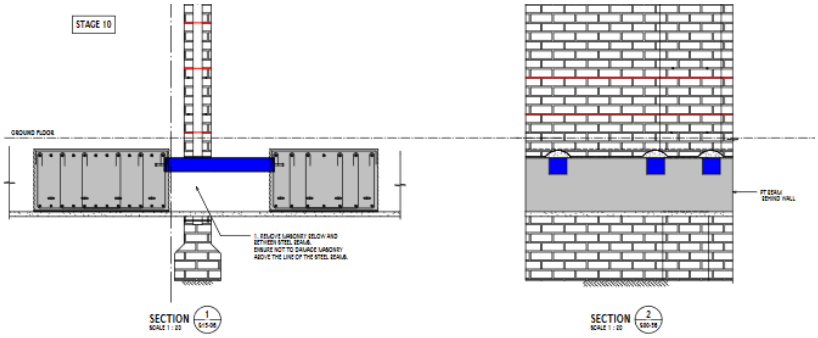
RBG's design brief was to develop an integrated construction methodology and sequence solution to transfer the existing church hall masonry structure onto the permanent suspended slab while allowing excavation of the 9-storey basement to occur below. Key challenges of the project brief included:

- Incorporation of the existing St Andrew's church hall structure into the top-down construction methodology
- Load transfer of the church hall structure onto the ground floor suspended slab
- Monitoring and assessment of church hall structure during load transfer
- Plunge column and steel bracing interface with excavation sequence & future construction

3. The Method and Construction Process

RBG took into consideration and project brief and constraints whilst also working closely with the contractor to develop an innovation structural solution that would ensure successful transition of the church hall structure onto the suspended slab. To complete the works the following construction sequence was adopted:

1. Cut and remove existing sections for the existing St Andrew's Church Hall
2. Individually number each brick then deconstruct a portion of the western church hall wall for future reinstatement
3. Installation of temporary raking props to provide stability to the retained portion of the existing church hall
4. Strengthen façade masonry wall as required
5. Installation of steel needle beams
6. Installation of plunge columns on a constrained site
7. Cut and remove strategic portions of church hall masonry to allow post tensioned concrete beams to be installed
8. Install reinforcement, post-tensioning strands and pour specific post tensioned concrete beams
9. Installation of monitoring points
10. "Jack" post tensioned concrete beams in predefined sequence
11. Remove existing church hall masonry below the level of the steel needle beams
12. Install reinforcement and pour remaining infill slabs and beams



4. Creativity and Innovation

One of the key challenges of the project was to develop a method to safely transfer the existing St Andrew's church hall from the existing strip foundation system to the suspended slab to allow excavation works to progress below.
As there is no original structural drawings RBG developed a full understanding of the building from onsite exploration, material testing and knowledge, reading of historical documentation and understanding previous projects of this vintage.

Working closely with the contractor, heritage architects and Parramatta city planning services the approach of a suspended slab using integrated steel needle beams and post tensioned concrete beams with supported on steel plunge columns was adopted. This top-down construction method minimised temporary works and allowed a working platform for which trucks could be loaded with excavated material within the small site boundary and off the busy streets of the Parramatta precinct.

Grout was injected beneath the church next door to stabilise its shallow foundations. The underpinning piles up against the church hall were selected over a D-Wall barrette due to manoeuvrability of heavy plant and equipment. The structural design and construction methodology was informed by preserving these heritage assets, including the deconstruction line, underpinning methodology, prop fixing details and temporary protection. For the plunge column integration, the width of the suspended slab was strategically selected to allow maximum retention of church hall and to allow the jump form to pass through unimpeded upwards. RBG de-risked the construction sequence by using our in-house digital capabilities, click on the QR code here to access a video.

5. Sustainability, Built Environment and Heritage

Sustainability:

All work required to enable the transfer of the St Andrew's church hall onto the suspended slab was completed to ensure the façade masonry fabric remained intact. Strategic locations for needle beams were chosen to ensure the church hall structure remained intact during the jacking of post-tensioning strands within the concrete beams whilst also eliminating the need for as much temporary works as possible.
Additionally, the plunge columns providing support to the suspended slab in the temporary condition has been incorporated into the permanent concrete column design, reducing the amount of steel reinforcement required.
Using an iterative approach RBG also designed the steel plunge columns and brace locations & installation sequence to minimise the amount of temporary works required.

Built environment and Heritage:

The 8 Phillip Street project combines the urbanisation of the Parramatta city and the rich heritage of the St Andrew's church as the hall is transformed into the showpiece gateway for an elegantly designed skyscraper.

St Andrew's Church and Hall is associated with a number of historical who made significant contributions to the ecclesiastical and cultural life of Parramatta. The integration of the chruch hall structure within the development required an innovative structural design that not only responded to the complex spatial constraints of the site but also facilitated a construction methodology that meets the challenge of building under and over a heritage listed masonry building.
The integration of the existing church hall into the new high-rise mixed use development will form an integral part of local community as it seeks to celebrate is past historic significance.

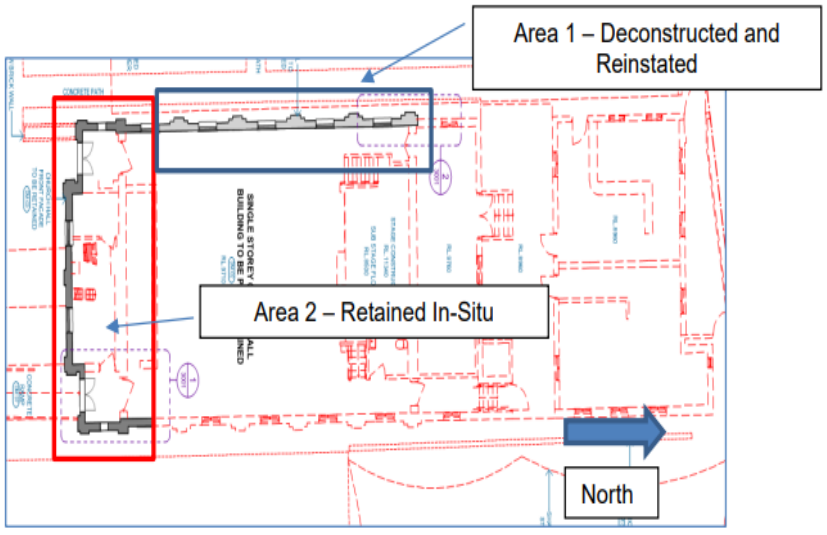
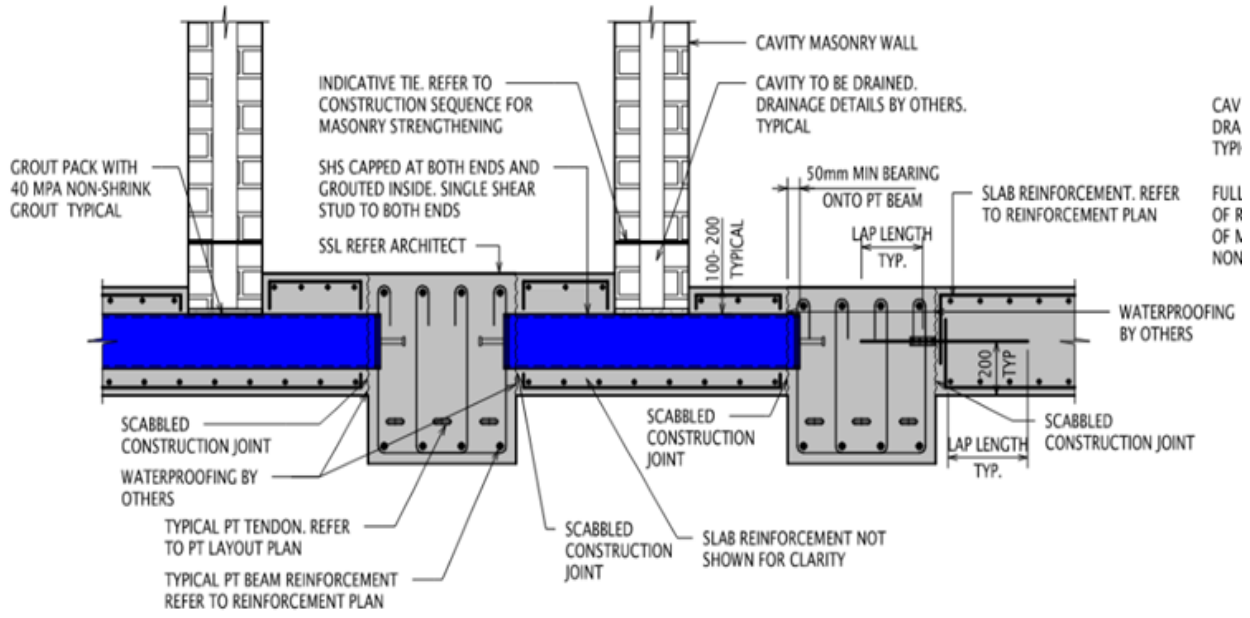


Figure 1 – Areas of Heritage Retention

6. The Challenges and Resolutions

1. Transfer of St Andrew's church hall structure onto the suspended slab:

One of the key challenges of the project was to safely transfer the existing St Andrew's church hall from its existing strip foundation system onto the permanent suspended slab. Working closely with multiply stakeholders a structural system comprising of steel needle beams and post-tensioned concrete beams was adopted. Various steel needle beams placed in specific locations around the remaining church hall structure, including the brick columns along its northern elevation. Post-tensioned concrete beams, once the jacking system had been complete, provided support to the steel needle beams and in-turn the remaining church hall structure. Due to the sensitive nature of the heritage listed masonry structure, RBG performed numerous sensitivity studies to develop an optimal stressing sequence for the jacking of the post-tensioned support structure to mitigate the potential differential movement. Live monitoring of the masonry church hall and the supporting post-tensioned support structure allowed trigger levels to ensure all movements remained within the safe limits. Additional strands were installed into all main main post-tensioned beams such that additional jacking forces could be applied if required to assist the transfer of load to the new foundation system. At not stage through the construction process were the monitoring alarms triggered or the need to utilise the additional post strand in each beam was was required. Once the redundant brickwork below the needle beams were removed, infill slabs were cast to create a monolithic suspended slab completing the transition of the St Andrew's church hall structure on the suspended slab supported by plunge columns.

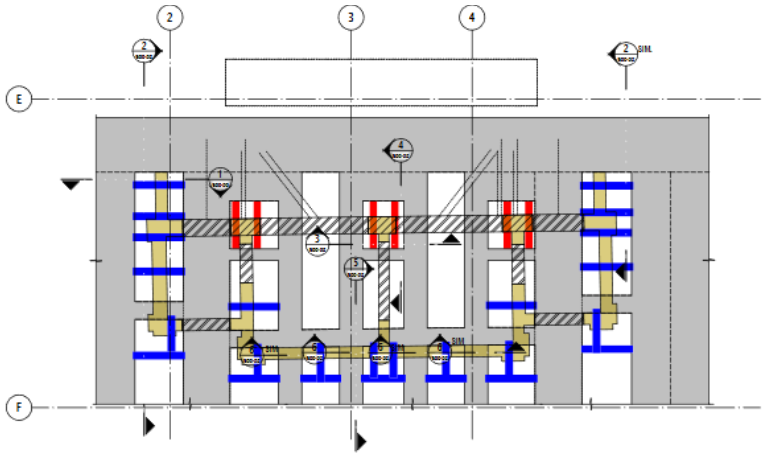


TYPICAL RC SLAB DETAIL SUPPORTING MASONRY WALL
SCALE 1:20

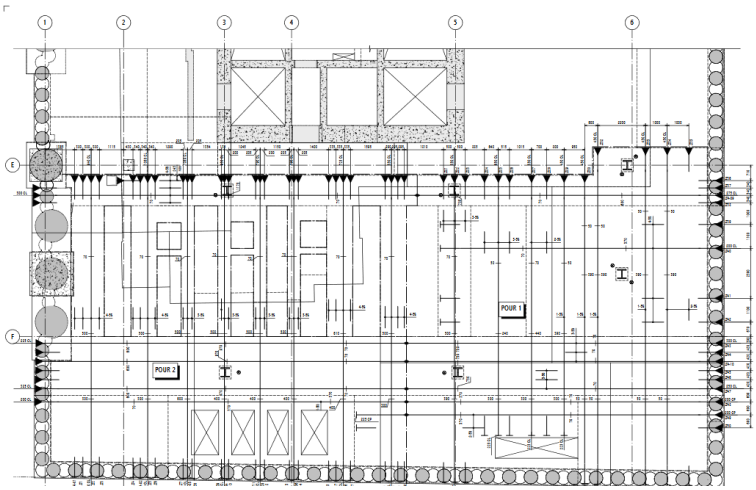
STRESSING CYCLE				
	TENDON #	AGE OF CONCRETE	MINIMUM CONCRETE STRENGTH (MPa)	STRESS PER STRAND
CYCLE 1	ALL EXCEPT 'A- SERIES' TENDONS.REFER NOTES.	REFER TO UNDERPINNING SECTIONS (MINIMUM 24 HOURS)	f 'cp=7	25% TOTAL
CYCLE 2	#21 TO 35, 39 TO 42, 48 TO 50	REFER TO UNDERPINNING SECTIONS (MINIMUM 5 DAYS)	f 'cp=22	REMAINDER
CYCLE 3	#19, 16, 14, 12, 10, 8, 5, 2	REFER TO UNDERPINNING SECTIONS (MINIMUM 5 DAYS)	f 'cp=22	REMAINDER
CYCLE 4	#37, 43, 47	REFER TO UNDERPINNING SECTIONS (MINIMUM 5 DAYS)	f 'cp=22	REMAINDER
CYCLE 5	#18, 15, 13, 11, 9, 7, 4, 1	REFER TO UNDERPINNING SECTIONS (MINIMUM 5 DAYS)	f 'cp=22	REMAINDER
CYCLE 6	#20, 17, 6, 3	REFER TO UNDERPINNING SECTIONS (MINIMUM 5 DAYS)	f 'cp=22	REMAINDER
CYCLE 7	#36, 38, 44, 45, 46	REFER TO UNDERPINNING SECTIONS (MINIMUM 5 DAYS)	f 'cp=22	REMAINDER

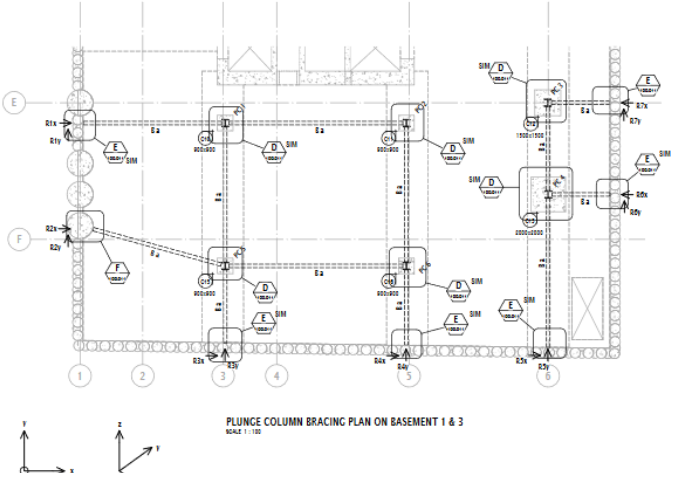
2. Providing a construction platform for a constrained site:

The project site, located within the busy Parramatta precinct, posed various challenges on how to excavate a 9-storey basement while supporting a heritage masonry structure. The amount of excavated material required to be removed led RBG to adopt a temporary construction platform within the site boundary that would later integrate and become the permanent ground floor suspended slab. To effectively support the church hall structure while also providing enough room to position excavators and haul trucks a "top-down" construction method was chosen. While this solved several temporary problems it also resulted in a number of significant challenges to the actual plunge column design and future integration & construction of the suspended slab and column elements. The plunge column design incorporated a specific construction sequence with tactical steel brace locations reducing the effective length of the column to support the axial load. The size of the column able to be used was limited with the tolerance for installation and size of the future columns with the carpark circulation zone. The chosen locations of the braces and construction sequence allows the room needed to place machinery to excavate the material while also enabling the future carpark slabs to be constructed without interference.



GROUND LEVEL UNDERPINNING SEQUENCE STAGE 10 PLAN





PLUNGE COLUMN BRACING PLAN ON BASEMENT 1 & 3