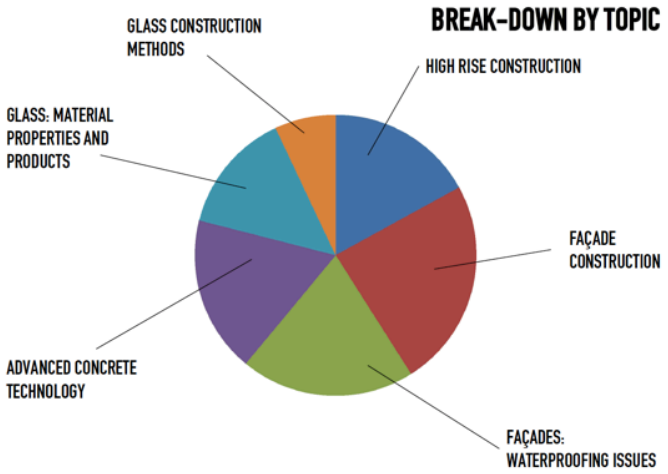
ADVANCED CONSTRUCTION TECHNOLOGY
EXAM REVISION



Multiple choice – 15%
Written note form (medium length) – 30%
Written answers to visual information – 30%
Answers by graphics (sketches, diagrams) – 25%

TOPIC 1 – HIGH-RISE CONSTRUCTION

Architectural Design and Construction Strategy:

- Resolving specific architectural design and details issues to their completion, incorporating performance based elements, converting design intent and standard details into the coordinated project for construction documentation
- Managing the demands and obligations of all stakeholders, subcontractors and personnel within a project including OH&S and IR.

Key Construction Challenges: changes over the years

1972 to 1993	1993 to 2010	2010 to 2015
Design	Cost	Risk
Detail	Design	Design
Sequence	Detail	Detail
Programme	Sequence	Sequence
Cost	Programme	Programme
	Cost	Cost

What is a tall building?

- High-rise buildings are usually more than 14 storeys tall or greater than 50m in height, however there are contextual considerations that may change such definition
- A free standing tall structure can be considered as a vertical cantilever fixed to the ground

Vertical Transportation

- Floor to floor height of a structure has an impact on lift requirements as it affects the travel distance

Mechanical Floors

- Preliminary height can typically be calculated as: Offices 2 x typical floor height & Residential 1.5 x typical floor height
- Mechanical floors should typically not serve more than 10 floors; therefore should not be more than 20 floors apart

Vertical Load Resistance

- For a multi-storey building, the distribution of gravity loads is not vertically uniform (i.e. the top floor columns only bear the weight of the roof)
- The more a vertical element is slender, the more susceptible it is to buckling

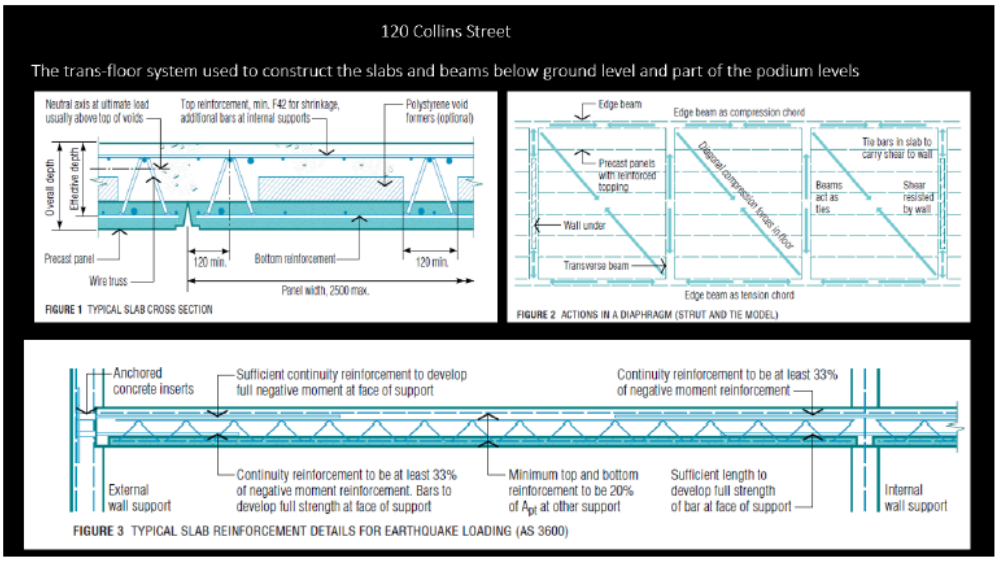
Lateral Load Resistance

- Need to ensure lateral resistance to multi-directional wind forces and earthquakes
- Wind forces are the governing design factor; they can have a higher impact on the building design than the already considerable gravity loads
- Due to the multi-directional loads, buildings need to have a 3D response
- The most efficient towers are those that compose of a square plan with four corners, as this achieves the maximum moment of inertia
- The three basic structural configurations to resist lateral forces are shear walls, braced frames and rigid frames (however these frames can impose heavy deformations on the structure, therefore they are more effective in combination).
- To limit the drift within acceptable limits a tall building must be stiff to resist bending; this could be done by increasing the weight of the structure or introducing a belt truss.
- Oscillation; the swing on the building, period remains the same under different wind conditions but becomes more noticeable when there is strong winds/gusts due to increased acceleration. Oscillation can be reduced by tuned mass dampers; these devices do not increase the weight substantially.

- Outrigger and belt trusses are generally located at 25% of height, 50% of height and at the top; they restrict the displacement of the core and redistribute loads to the columns on the perimeters.

Case Study: 120 Collins St

- Professional chambers building (part of church) formed part of the overall delivery strategy and permit conditions
- Sequence was driven by the Melbourne City Council's permit issues; as this caused the construction logic to change and challenged the access strategy initially planned for
- Floor systems connect into a reinforced concrete in-situ external edge beam



- Constructing the podium level required a re-design by 200mm, from level 6 to level 21, in order to allow for an access floor; the structure, façade and primary services were all required to be re-designed.
- Differential Settlement: the situation where a buildings foundation settles unequally in different areas after construction; this can lead to structural damage. It is usually caused by a change in soil structure or poor drainage conditions which can cause some areas to compact more than others.
- Delivery of the communication tower required re-engineering of core walls for the topmost levels, and re-design of the level 51 slab and beams in order to accommodate for the additional loads. In addition, the crane location and removal strategy had to be re-planned.
- The 4 tower cranes were removed by a recovery crane, which sat on a grillage; the recovery crane was then removed by setting up an air winch and stiff leg derrick.

01. PLATFORM-1
A working platform is mounted on a main grid work constructed from steel channels. This platform permits for high working loads and can also be used as a useful storage area.

02. MAIN GRID WORK
Upper level grid beams which support the platform level-1, external hanging platform and external hanging wall form shutters.

03. RAM SUPPORT COLUMN
The steel square hollow section installed between the shear key beam and main grid beam, to support the entire NFAC system's superstructure.

HYDRAULIC RAMS
Heavy-duty hydraulic rams are used to lift the entire system uniformly in one single operation.

04. SHEAR KEY BEAM
The system's superstructure is stabilised by the shear key beams. These beams support the entire system during raising & retracting of the jacking beams.

05. JACKING BEAM
The whole system is raised against to the jacking beam.

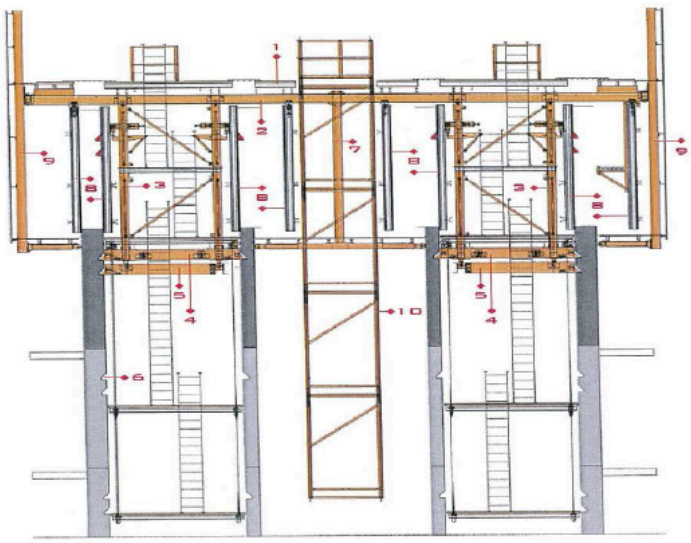


FIGURE 1: TYPICAL SECTION

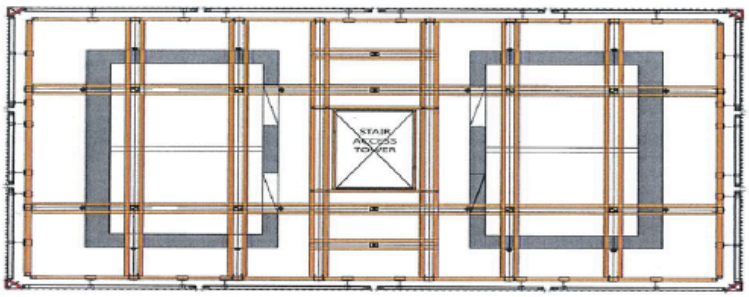


FIGURE 2: PLAN VIEW OF MAIN GRID WORK LAYOUT

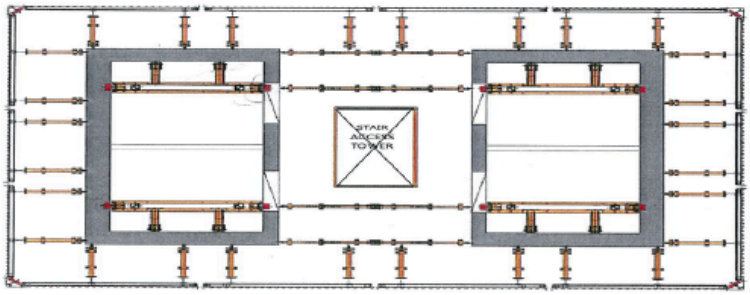


FIGURE 3: PLAN VIEW OF PATFORM-3 GRID WORK LAYOUT

06. SHEAR KEY AND JACKING BEAM POCKETS
The whole system is supported on pockets provided in the section of core it has already built. The special feature of the system is both jacking and shear key beams can be fitted in to common pockets in every lift.

07. LOBBY HANGER & BASE UNIT
Lobby hanger and base unit is hanging from the main grid beam and proving a safe working platform in between two cores.

08. WALL FORM SHUTTERS
Internal wall form shutters can be adjusted 3 directions using horizontal & lateral adjusting brackets attached to the supporting columns. The intermediate platform gives the access to do the required adjustments. External wallform shutters are attached to the main or secondary beams and can be rolled back by using 2 workers. NFAC wall form system can be quickly plumbed, easy stripped and easy set up.

09. EXTERNAL HANGING PLATFORM
This platform provides easy all-round access to worker and external wall form shutters can be handled using this platform. The external hanging platform is enclosed by cladding which is protected from wind and weather

10. STAIR ACCESS TOWER
Stair access tower assembles to the system and provides an access between system and construction floor.

Case Study: ANZ Building

- Essentially a curtain wall building with double structural glass, however there is zig zag tracery that project out and add enormous depth and complexity to the façade.
- Tender documents indicated a steel frame structure including the core; Grocon offered to re-engineer the primary structure to a reinforced concrete frame ensuring that cost, design, detail, sequence and programme were met.
- Due to the additional weight of the concrete frame and by having a side core design, they were required to create a design management strategy to address the differential settlement to the back or eastern façade.
- The structural frame changes had a direct impact on the façade and its cladding zones, as all grids centrelines were maintained (concrete columns became larger in plan area than the structural steel column section) which increased the complexity of all connections.
- The granite fixing failed due to the epoxy used as the epoxy was expanding under temperature causing cracking to the granite.
- The transfer trusses and gables (top of building) were constructed of structural steel with 80* of the granite pre-cladded off site and delivered into position, without the requirement to work on the external face of the building.

Case Study: 82 Flinders St

- Large restraint was the limited access to the site (lane behind, buildings either side, busy Flinders street)
- Formwork system was heavily considered in regards to programme planning; this was required due to the access restraints
- 'H' type shape of shear walls (apartment either side with the core in the middle); required due to the limited floor area as this reduced the requirement for columns.
- The foundation was staged in order to create lay down areas for the materials whilst also maintaining site access
- One of the biggest issues was generated around the façade system failing to achieve time, cost and quality

TOPIC 2 & 3 – FAÇADE CONSTRUCTION

Water Sources:

- Rain
- Snow
- Underground Humidity
- Water Vapour
- Building Services

Forces:

- Gravity
- Wind
- Surface Tension
- Capillary Action
- Hydrostatic Pressure