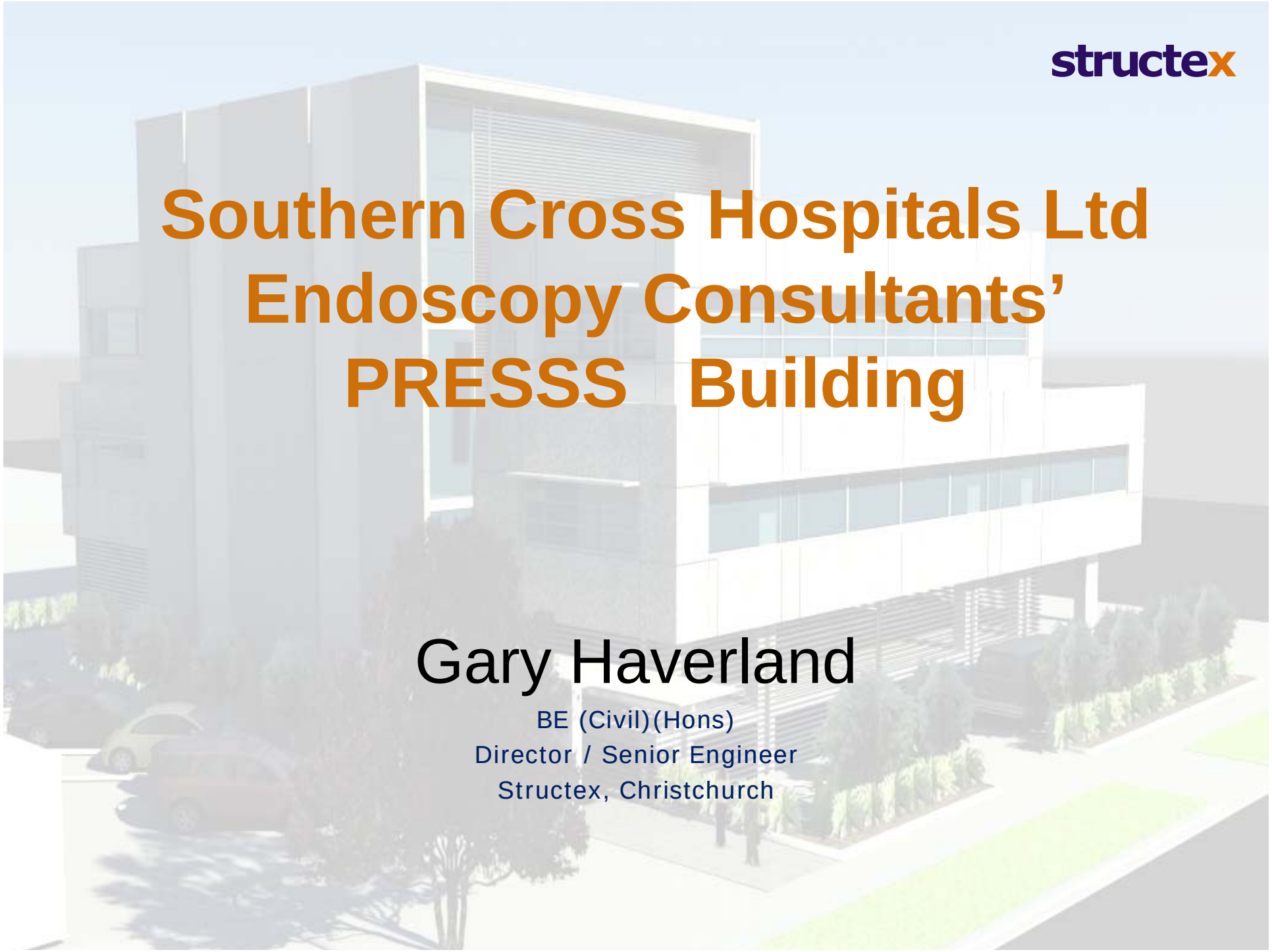

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Southern Cross Hospitals Ltd Endoscopy Consultants' PRESSS Building

Gary Haverland

BE (Civil)(Hons)

Director / Senior Engineer

Structex, Christchurch

structex

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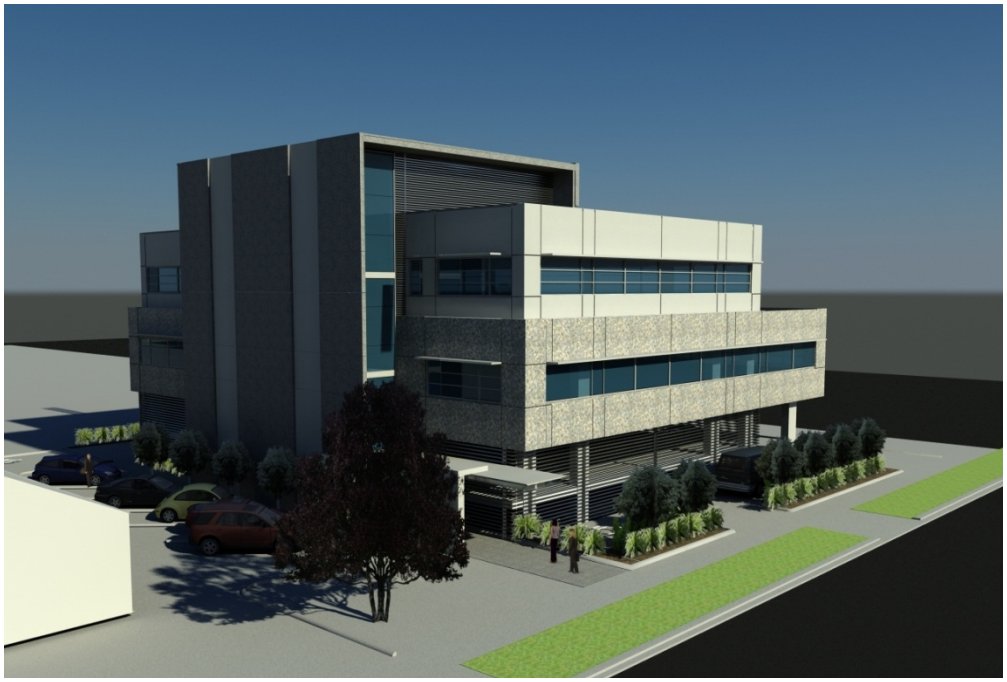

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ENT Building

- ENT Building designed in 2007
- 3-storey building, carpark on ground
- Building footprint 19m x 28m
- Lateral loads resisted by limited ductile frame in transverse direction, nominally ductile shear walls in longitudinal direction

ENT Building

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Precast frames ENT Construction

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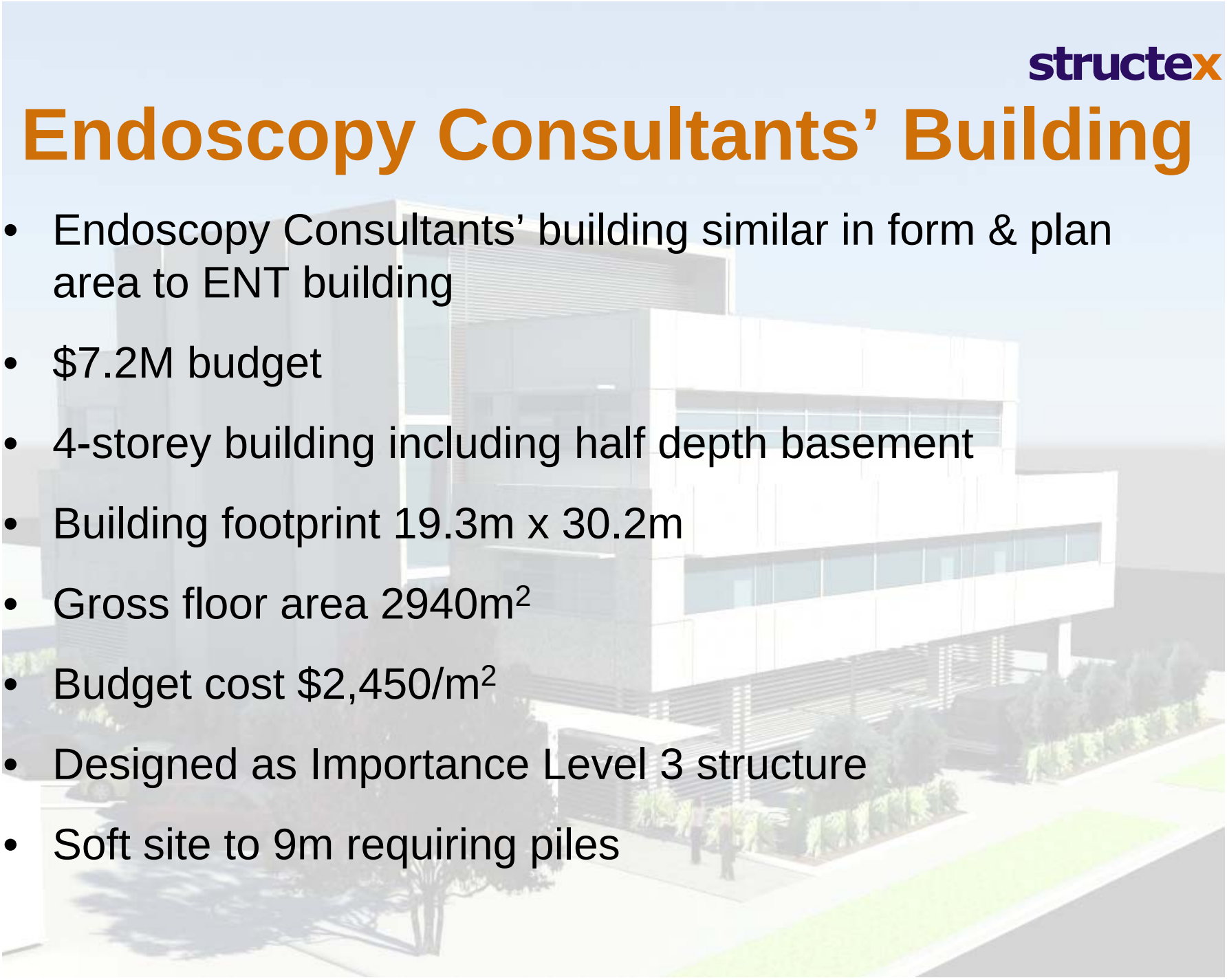
Endoscopy Consultants' Building

- Endoscopy Consultants' building similar in form & plan area to ENT building
- $7.2M budget
- 4-storey building including half depth basement
- Building footprint 19.3m x 30.2m
- Gross floor area 2940m^2
- Budget cost $2,450/m^2
- Designed as Importance Level 3 structure
- Soft site to 9m requiring piles



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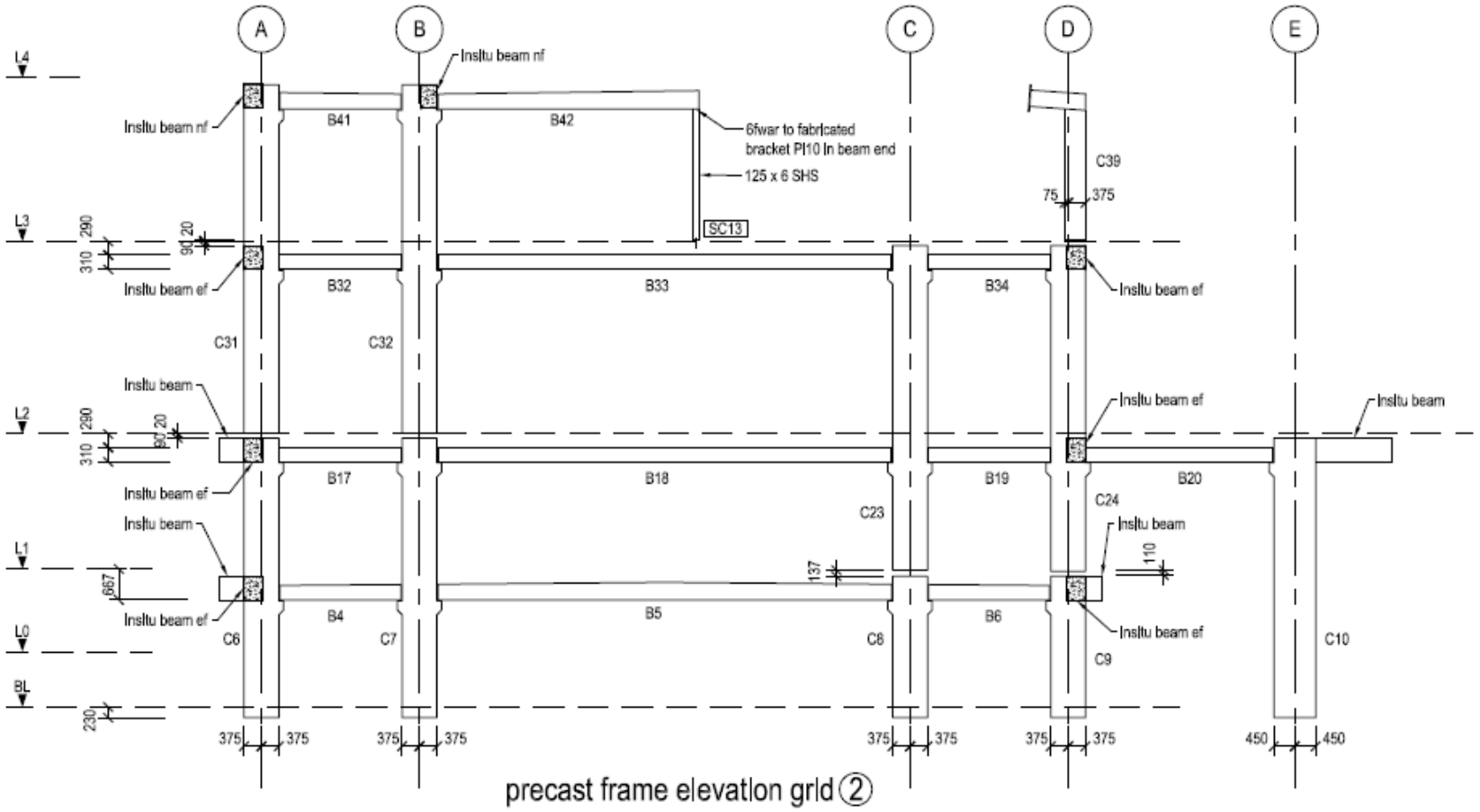
Typical cross section of central frame



precast frame elevation grid ②

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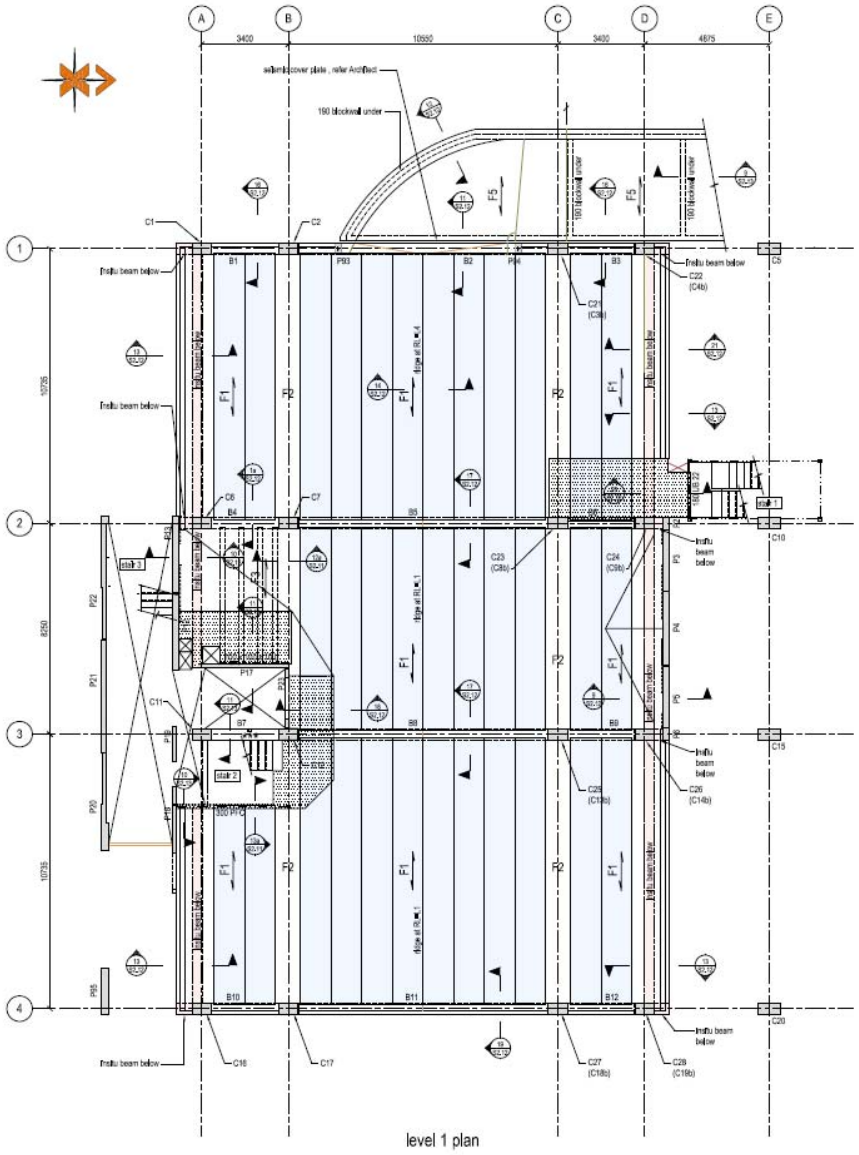
Level 1 Plan - Carpark



- Frames in transverse direction providing gravity support for floors & resisting lateral loads
- Column layout to suit carparks & span of flooring
- Shear walls resist loads in longitudinal direction & located each side of building
- Used wall adjacent to stair well as shear wall on south side
- Installed wall on north side to balance longitudinal lateral resistance

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Advantages

Proposed PRESSS structure with the following advantages:

- Full length precast beams could be used eliminating insitu beam joints
- No plastic hinges resulting in very little structural damage
- Building structure is self centering resulting in very little residual lean following an earthquake
- Building accelerations are lower than a RC frame or shear wall building resulting in less risk of damage to contents

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Advantages

- More rapid construction time as less insitu concrete on site
- Construction uses conventional building components such as precast beams, walls, drossbach ducts & starters
- Post-tensioning could be carried out by a number of contractors
- Lower foundation actions resulting in pile savings
- Screw piles required to minimise noise & avoid vibration
- Reduced wall reinforcing, tendon replacement

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Advantages

- Positive response from client, conditional upon demonstrating **price savings**
- Review with Fletcher Construction and complete construction and costing analysis resulting in $40,000 of structural savings including 45% reduction in some columns and two week time saving

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Process

- Pricing analysis confirmed savings were achieved
- Beam depth reduced from 700mm to 600mm allowing services to be accommodated without raising the building height
- Displacement based design procedures used to determine base shear
- Building drift 1.6% for walls, 1.8% for frames
- Code allows up to 2.5% drift

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General Building Construction

Aims:

- To keep construction components as conventional as possible
- To avoid structural components that may be perceived as adding cost
- To make all precast components a manageable size to allow transport and cranage
- To keep components simple and easy to construct

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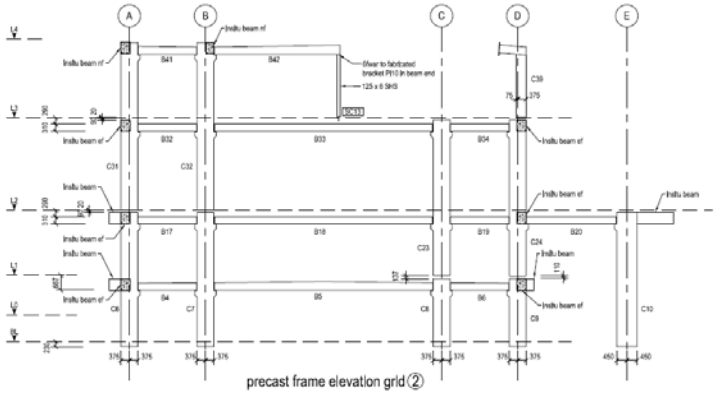
General Building Construction

General construction order:

- Sheet piling and excavation
- Screw piles
- Foundation beams
- Ground floor columns, install & grout
- Install beams & hollowcore floor with propping
- Install shear walls
- Cast topping slab
- Thread cable & tension beams & walls
- Complete insitu end beams, gutter etc



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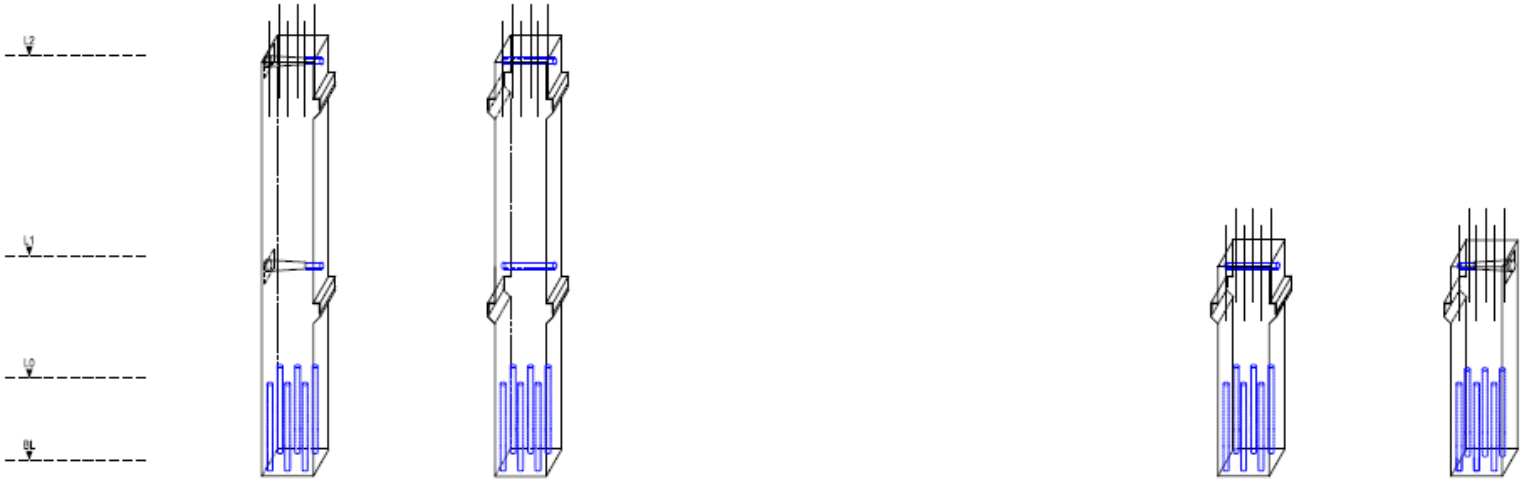
General Building Construction



Install columns

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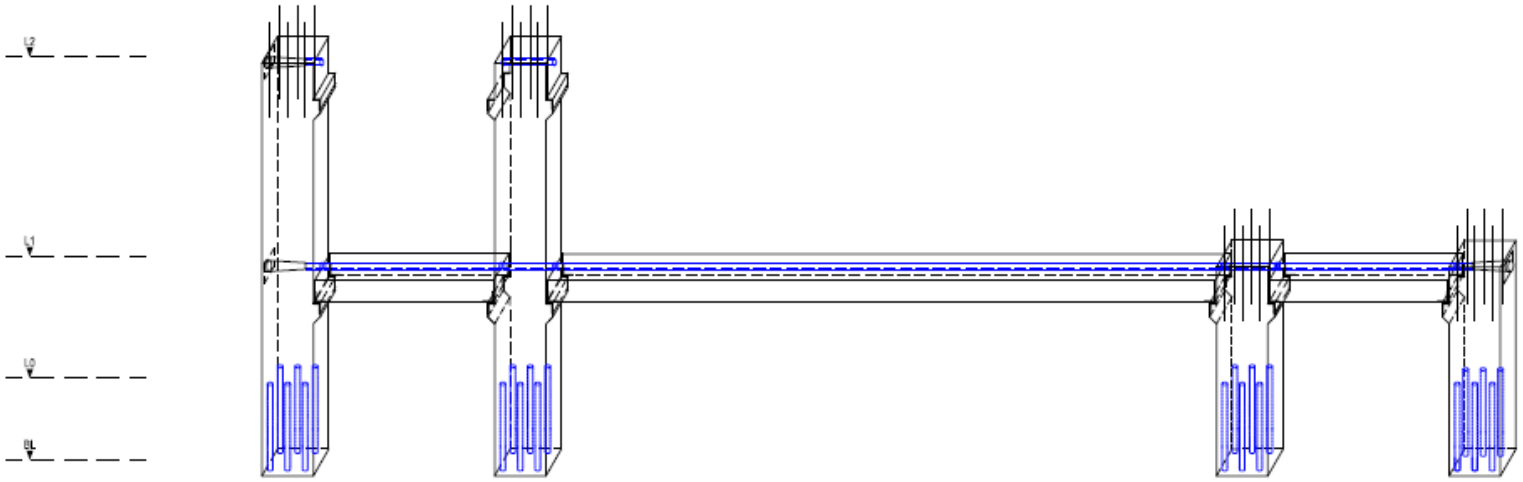
General Building Construction



Install beams

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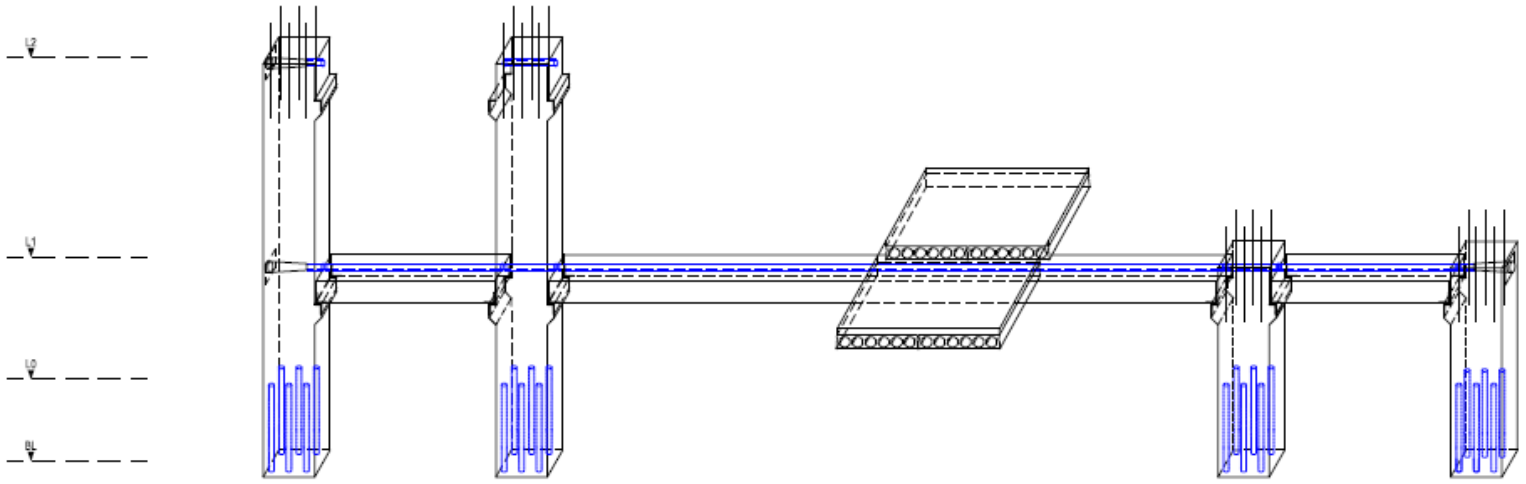
General Building Construction



Place floor and cast topping

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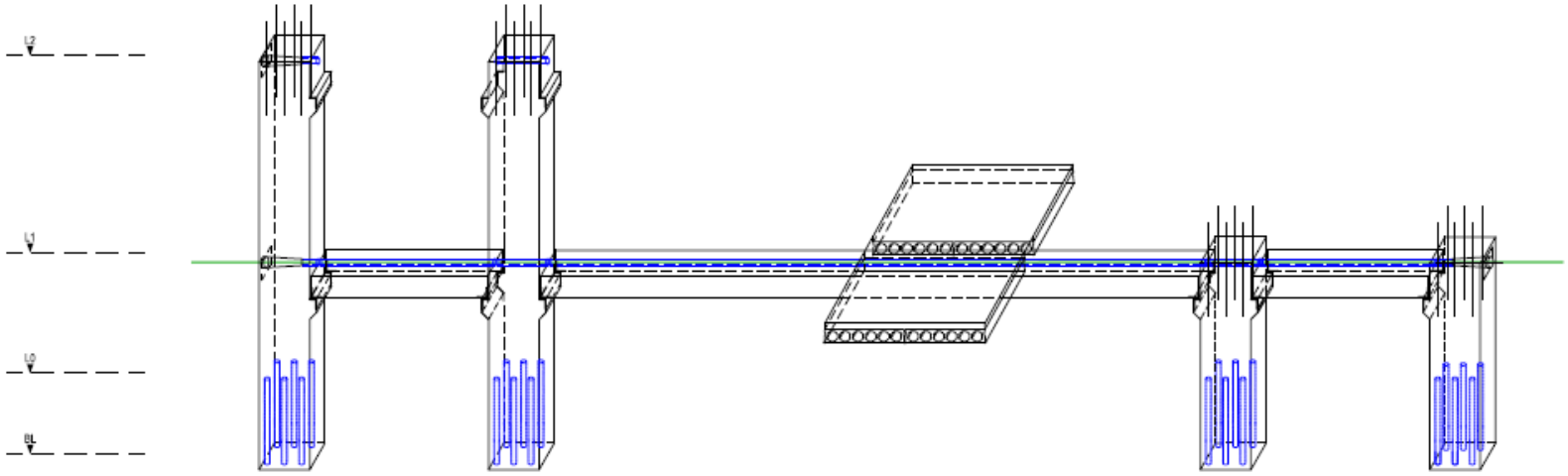
General Building Construction



Install tendon

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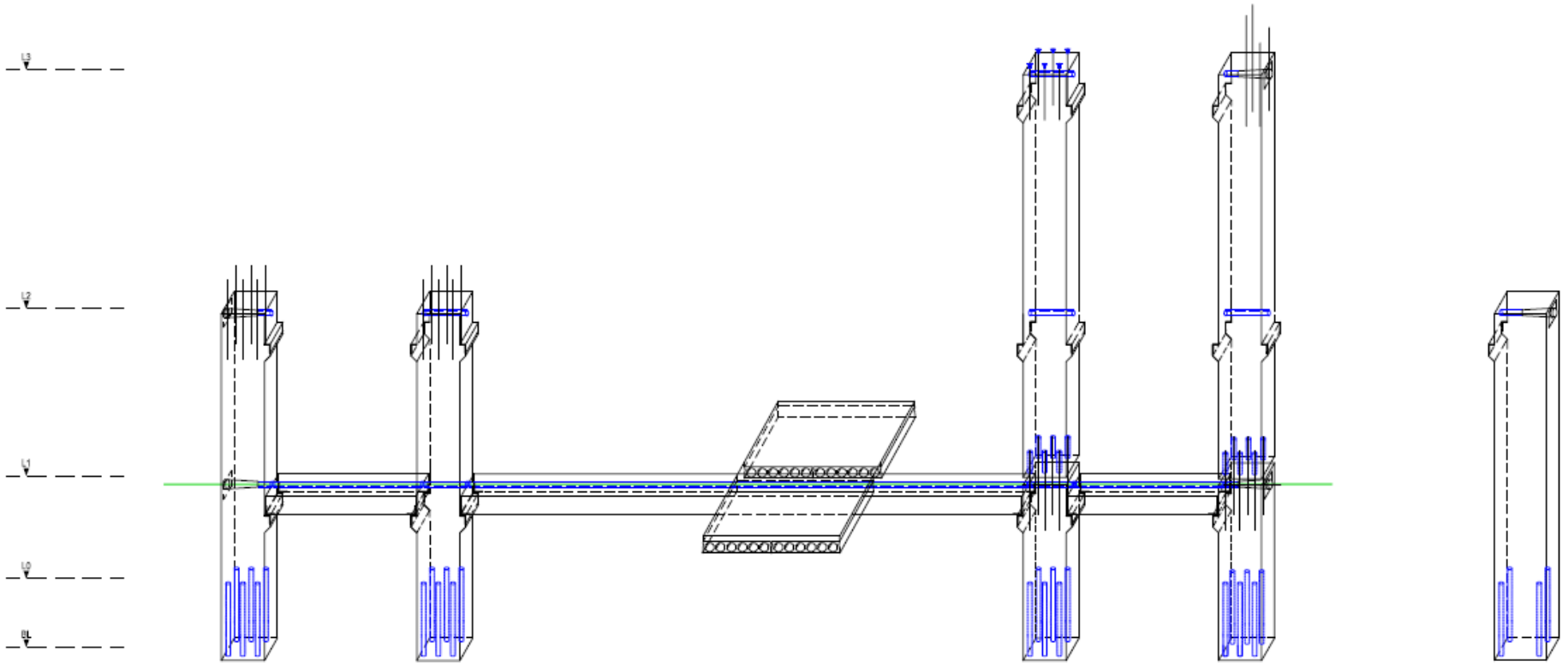
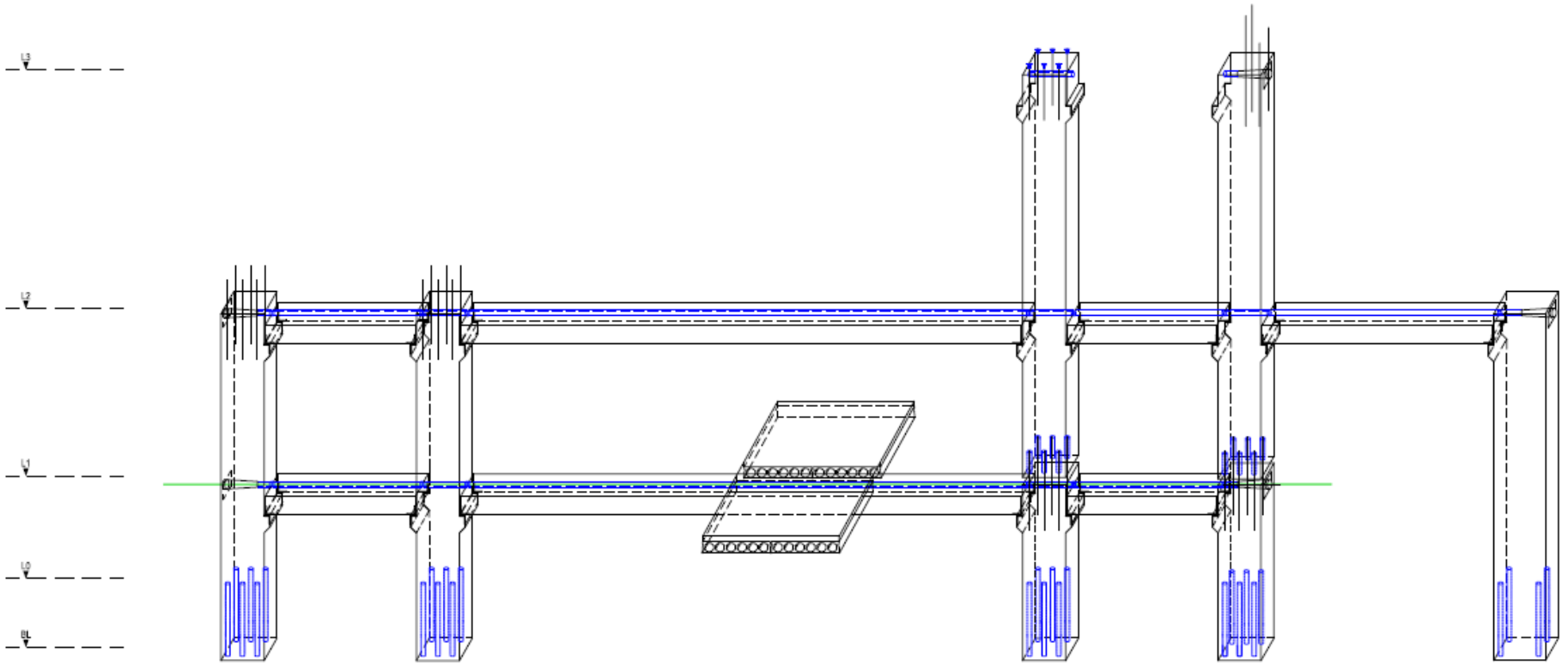
General Building Construction



Install columns

structex

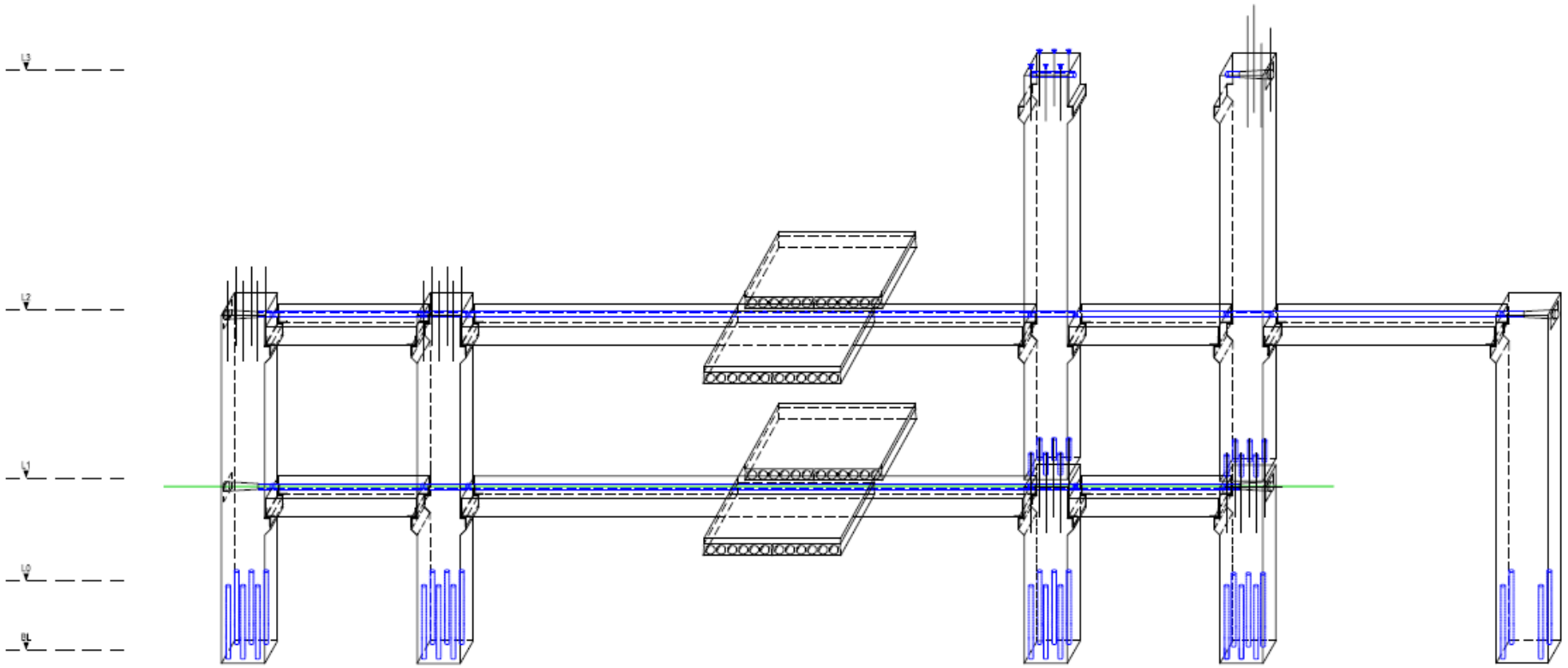
General Building Construction



Install beams

structex

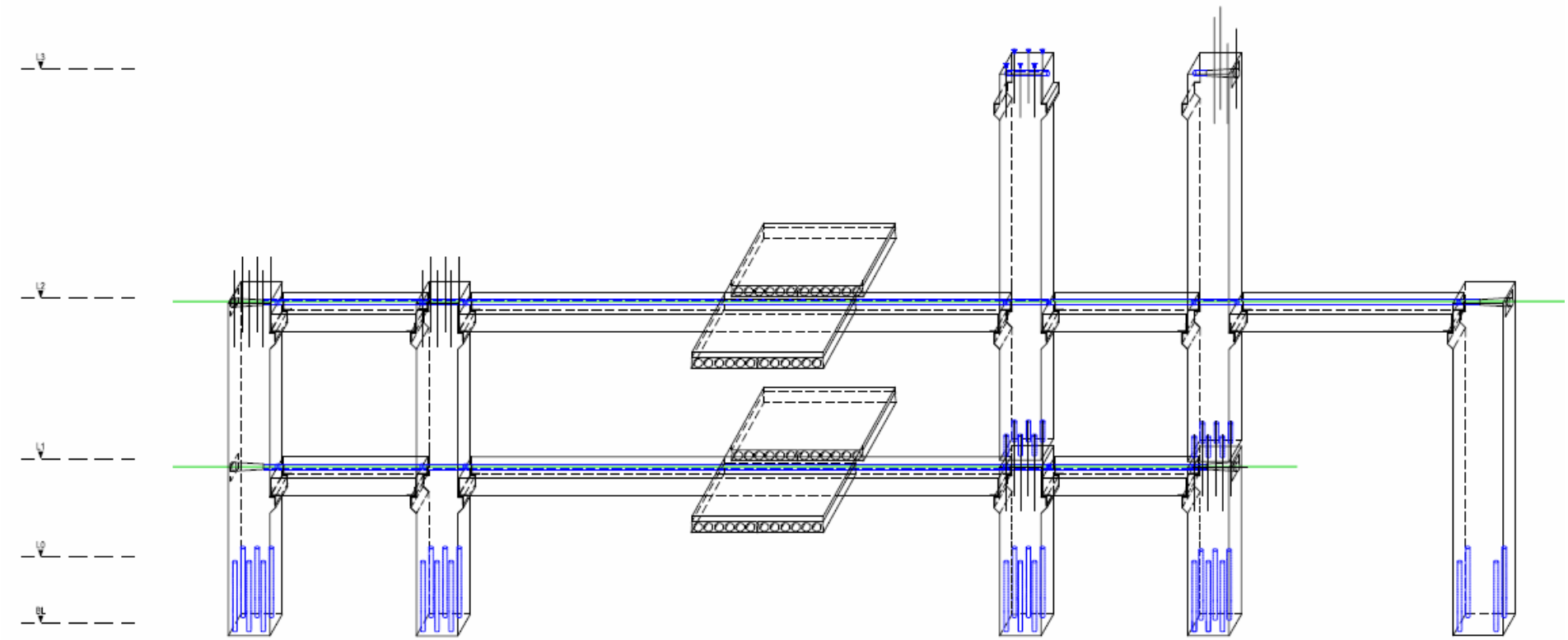
General Building Construction



Place floor & cast topping

structex

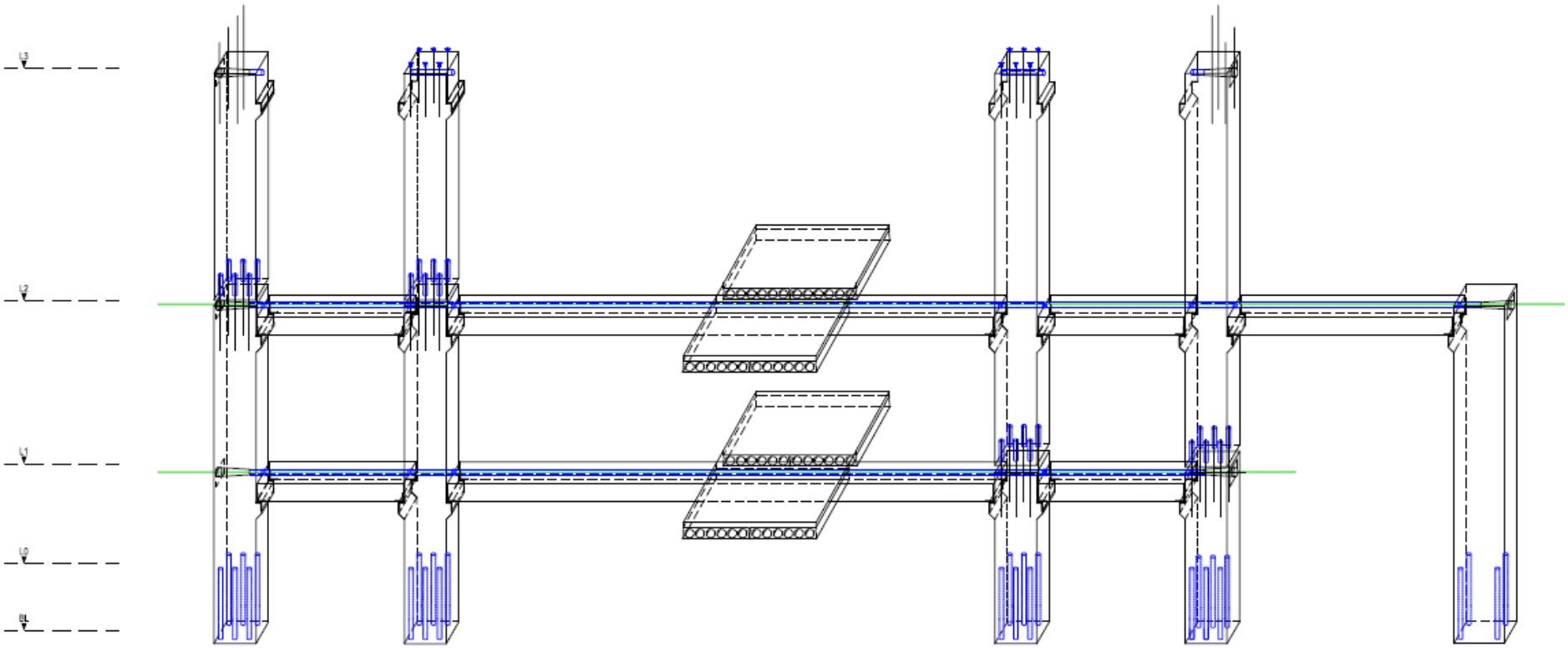
General Building Construction



Install tendon

structex

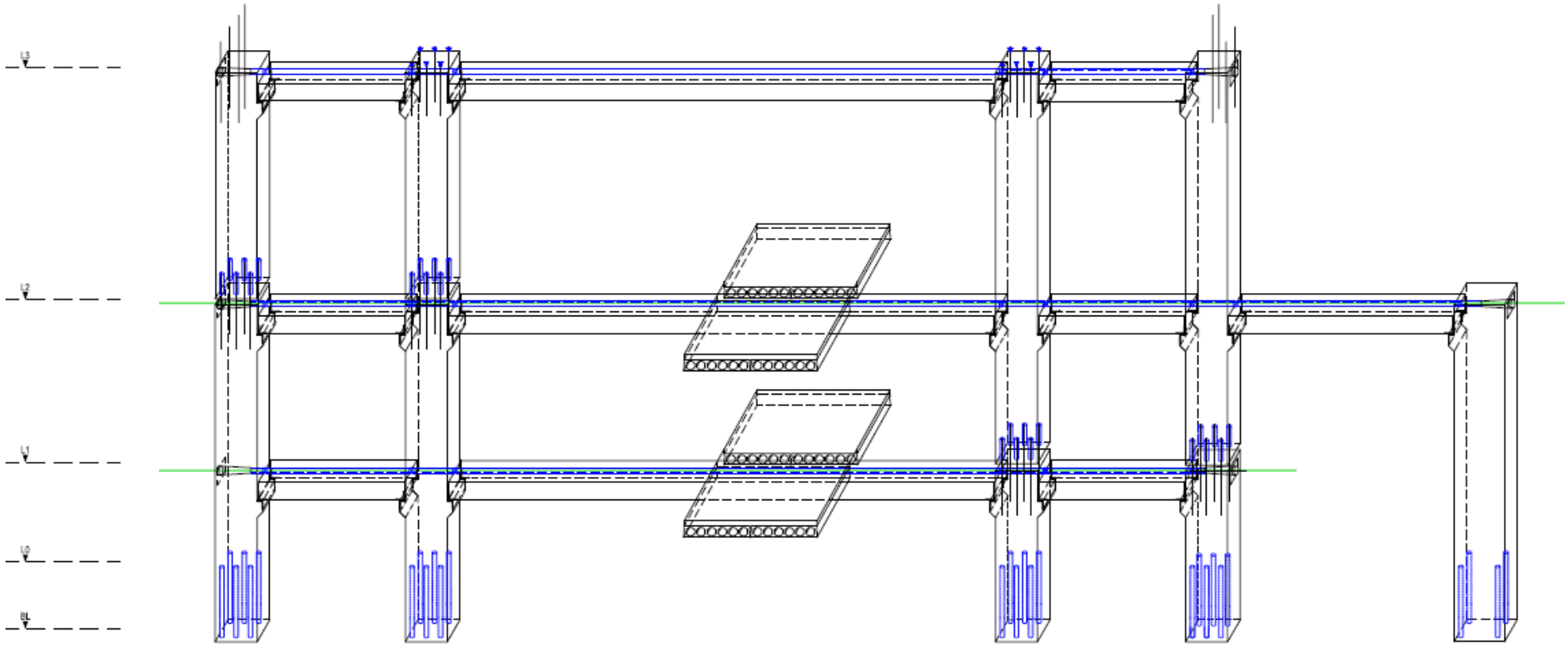
General Building Construction



Install columns

structex

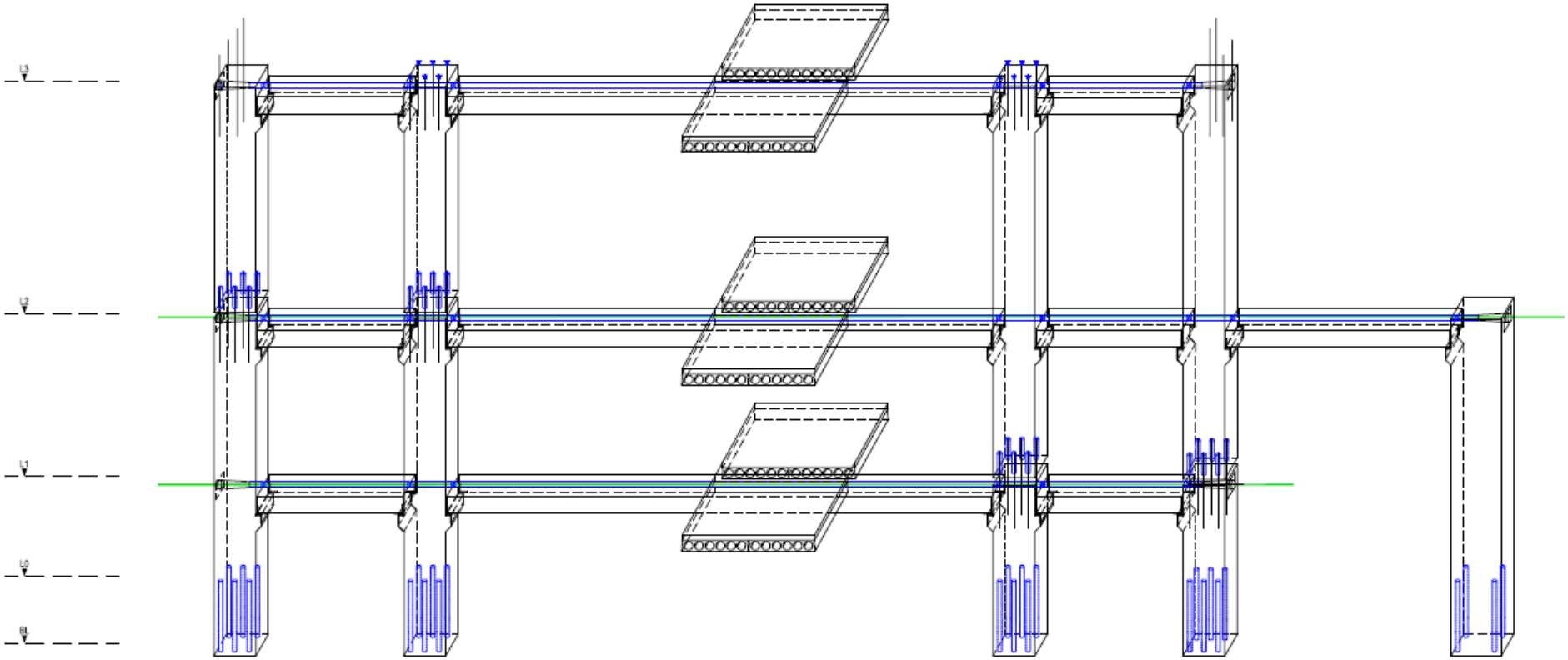
General Building Construction



Install beams

structex

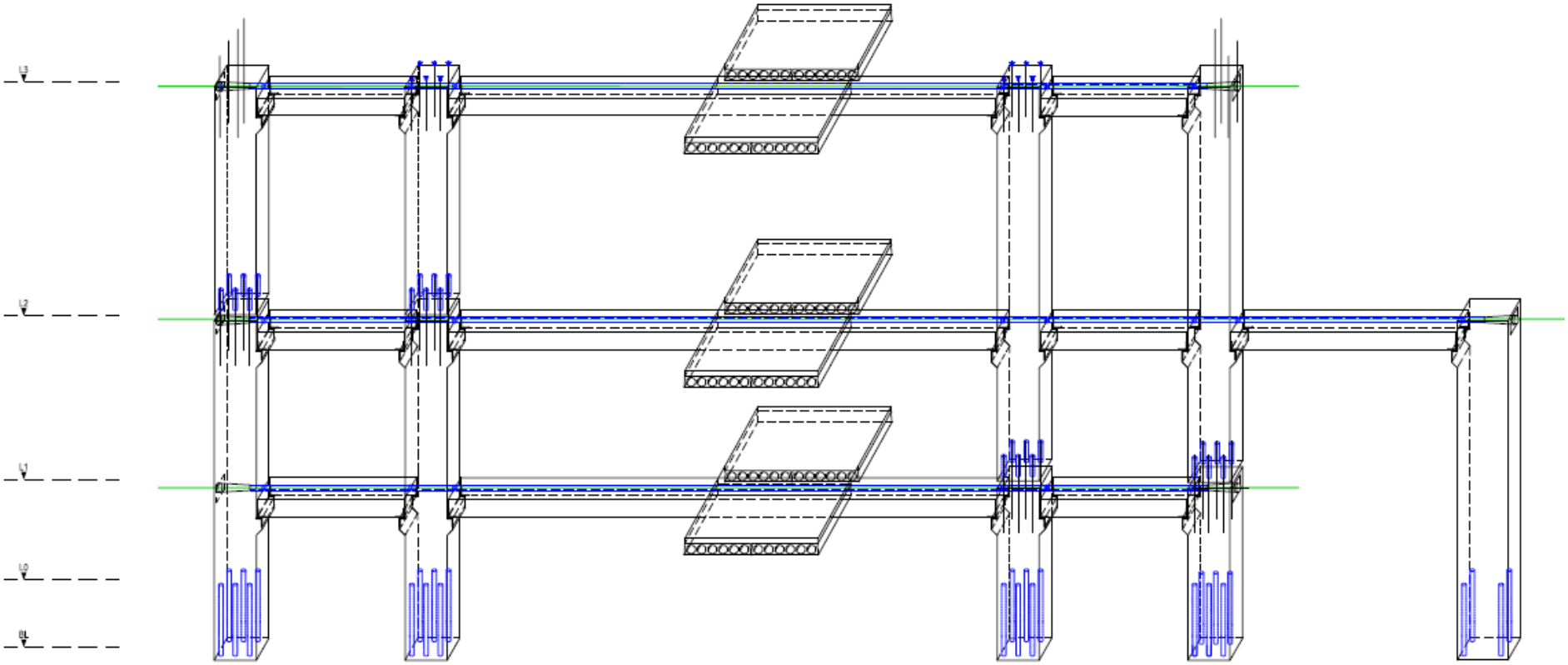
General Building Construction



Place floor & cast topping

structex

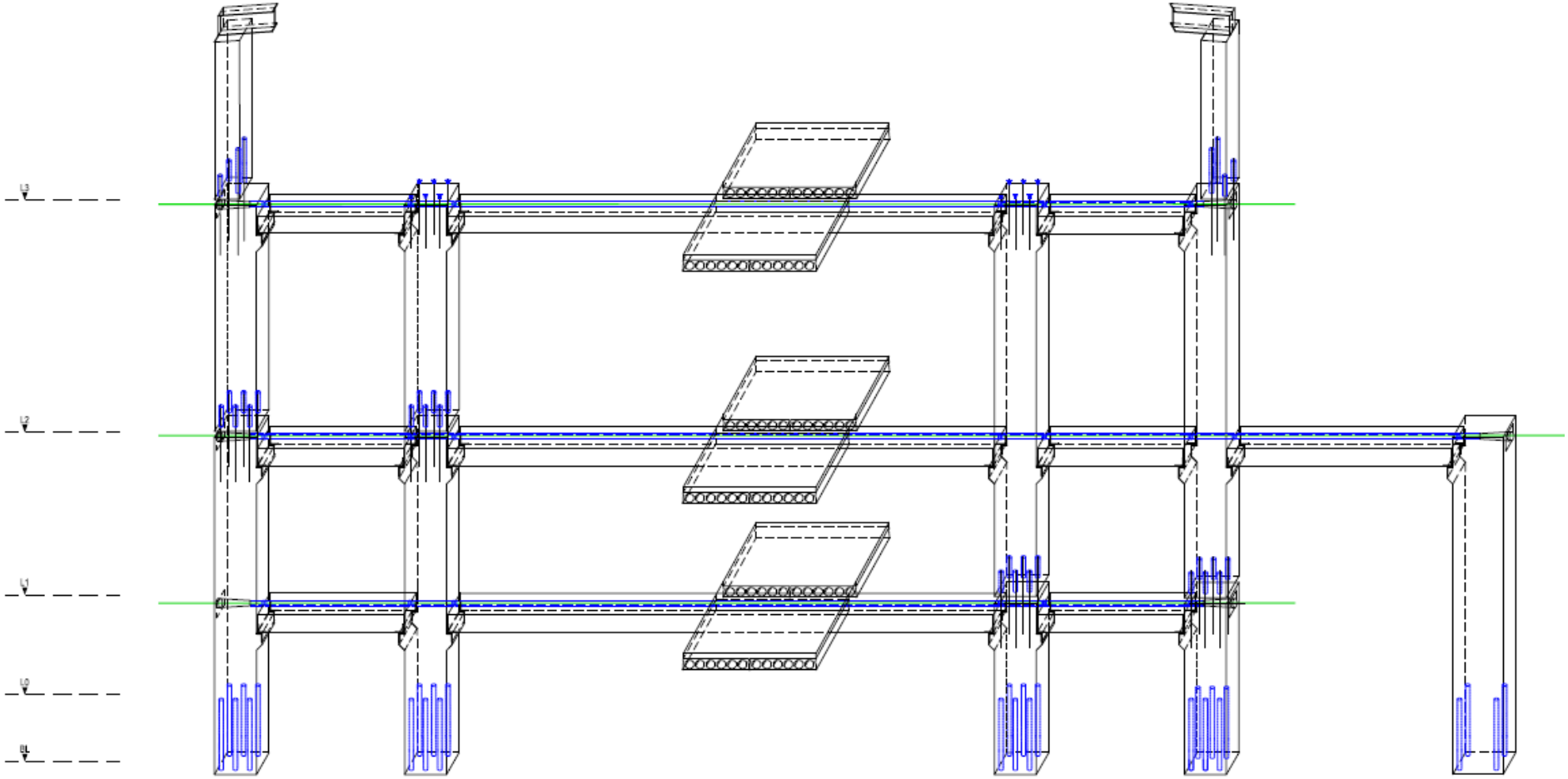
General Building Construction



Install tendon

structex

General Building Construction



Install columns

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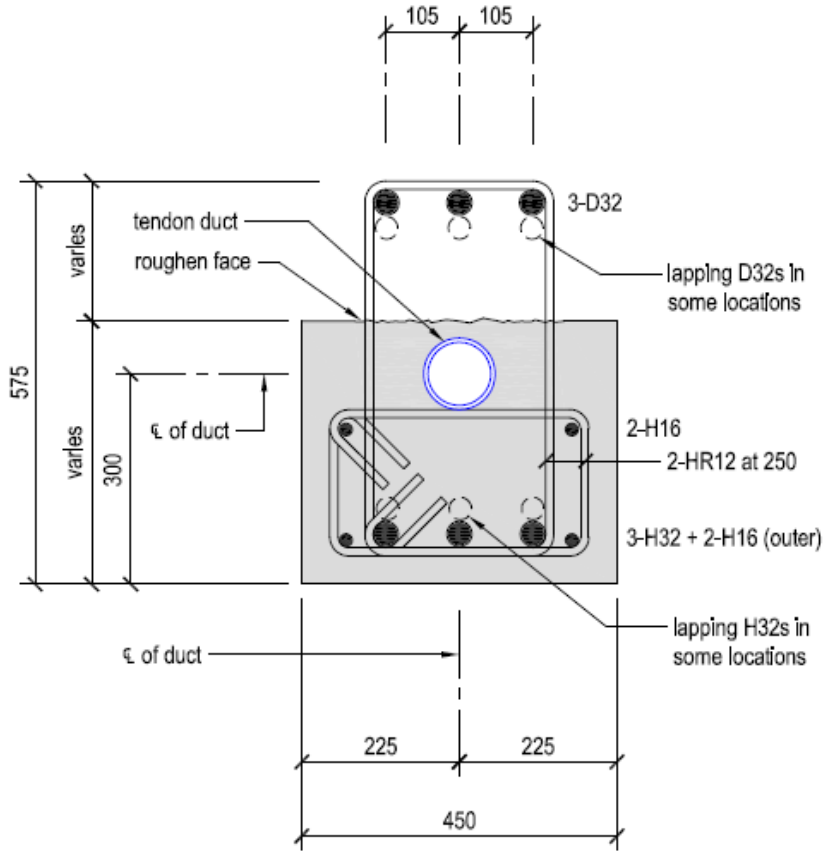
Components & Detailing

Precast beams,
& seating



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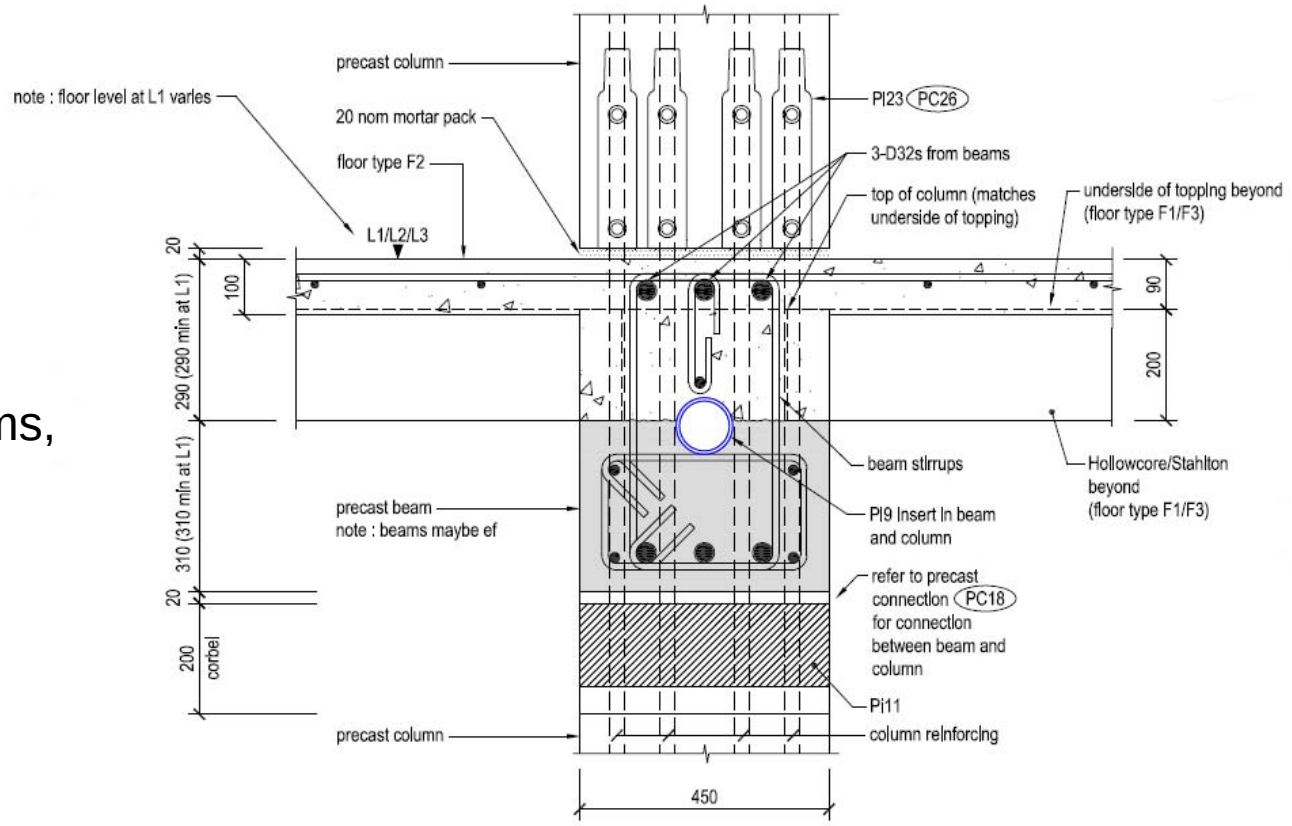
Components & Detailing

Precast beams,
& seating



note ; when column is on either grid A or D the 3-D32s run over the top of the column and have varying end details (either PC19 or PC20 or welded flat), refer to beam elevations

column joint
(insitu beams not shown)

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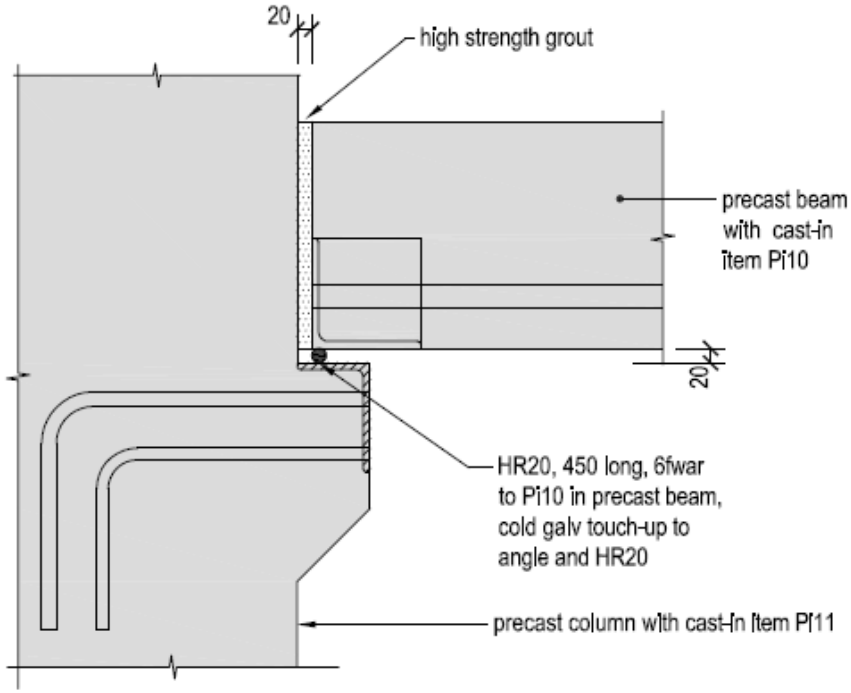
Components & Detailing

Precast beams,
& seating



PC18 (section)

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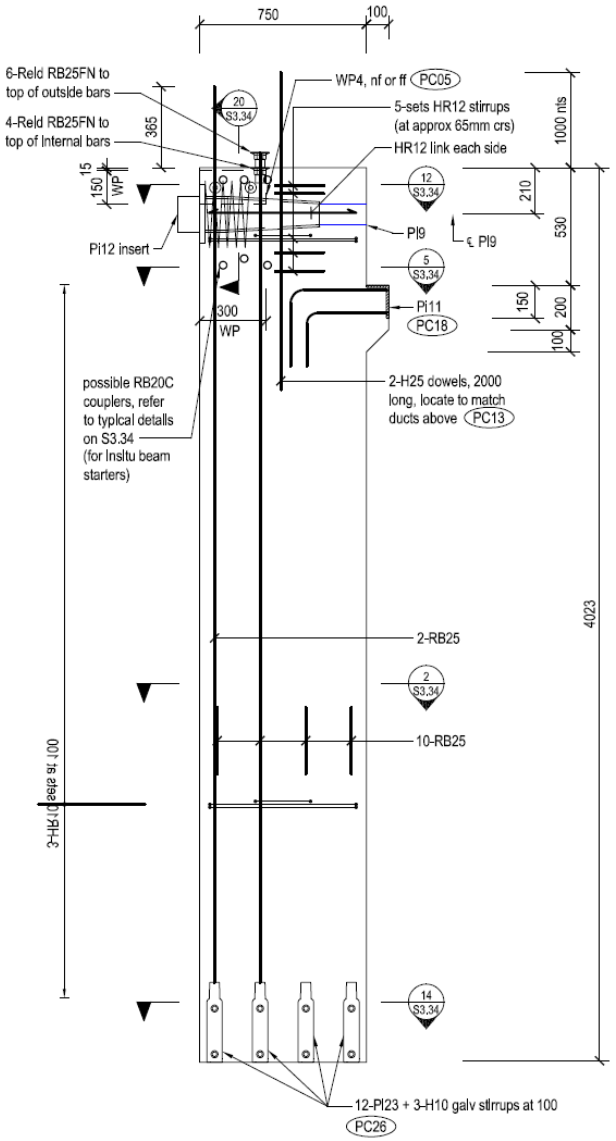
Components & Detailing

Precast beams, anchors & seating

Components & Detailing



column C29
similar column = C35

Precast columns & anchors

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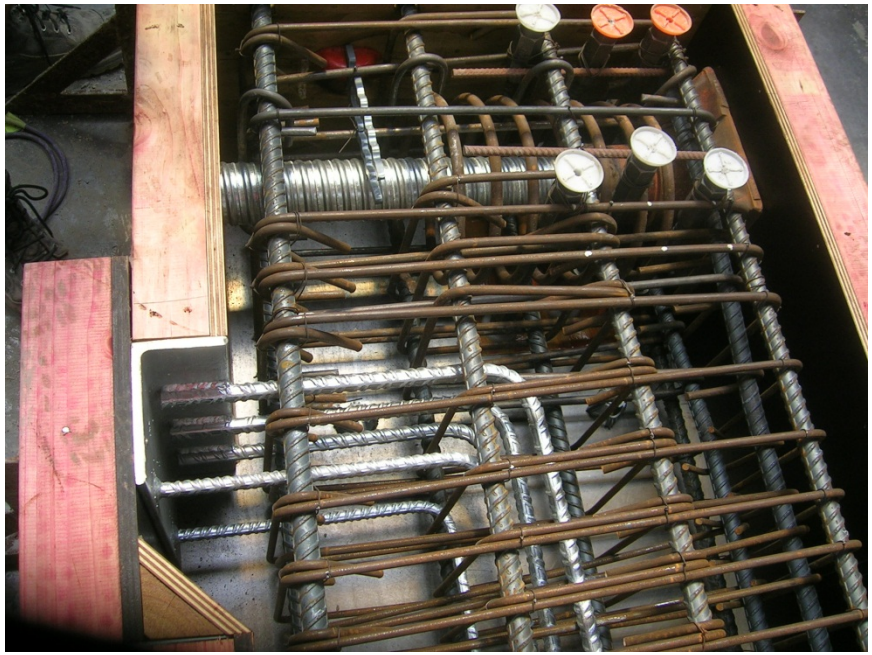
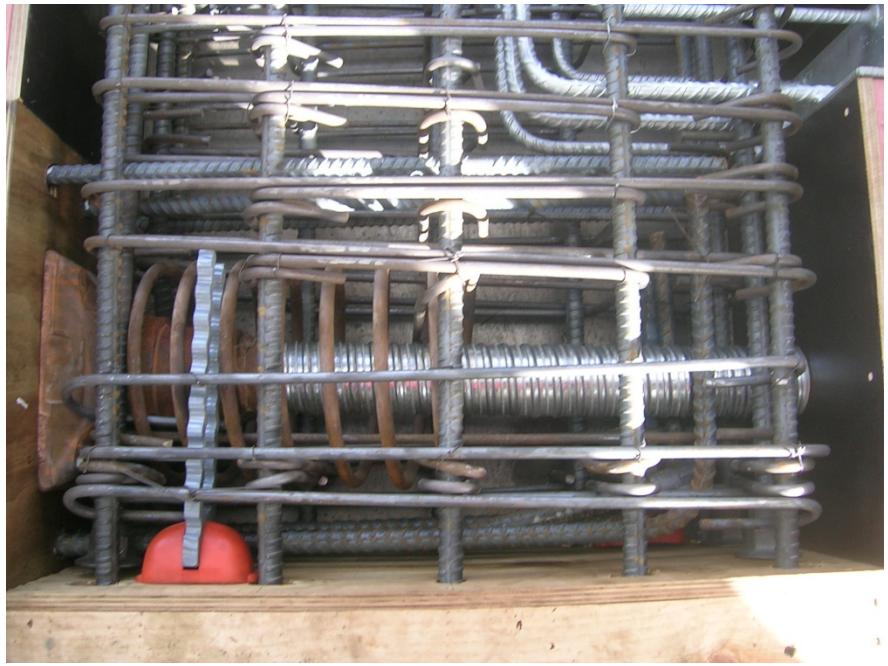
Components & Detailing

Precast columns & anchors





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Components & Detailing

Precast columns & anchors

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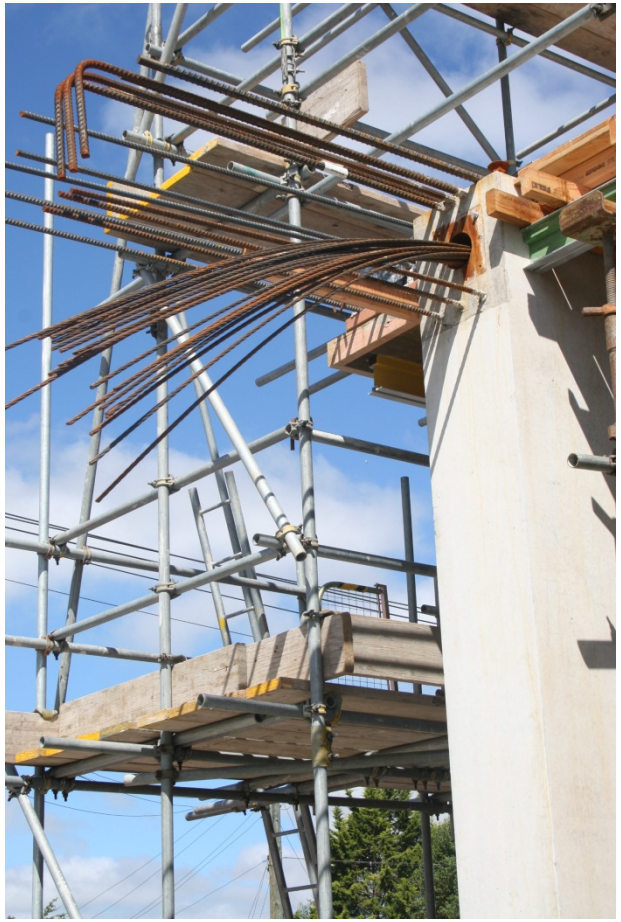
Components & Detailing

Precast columns & anchors



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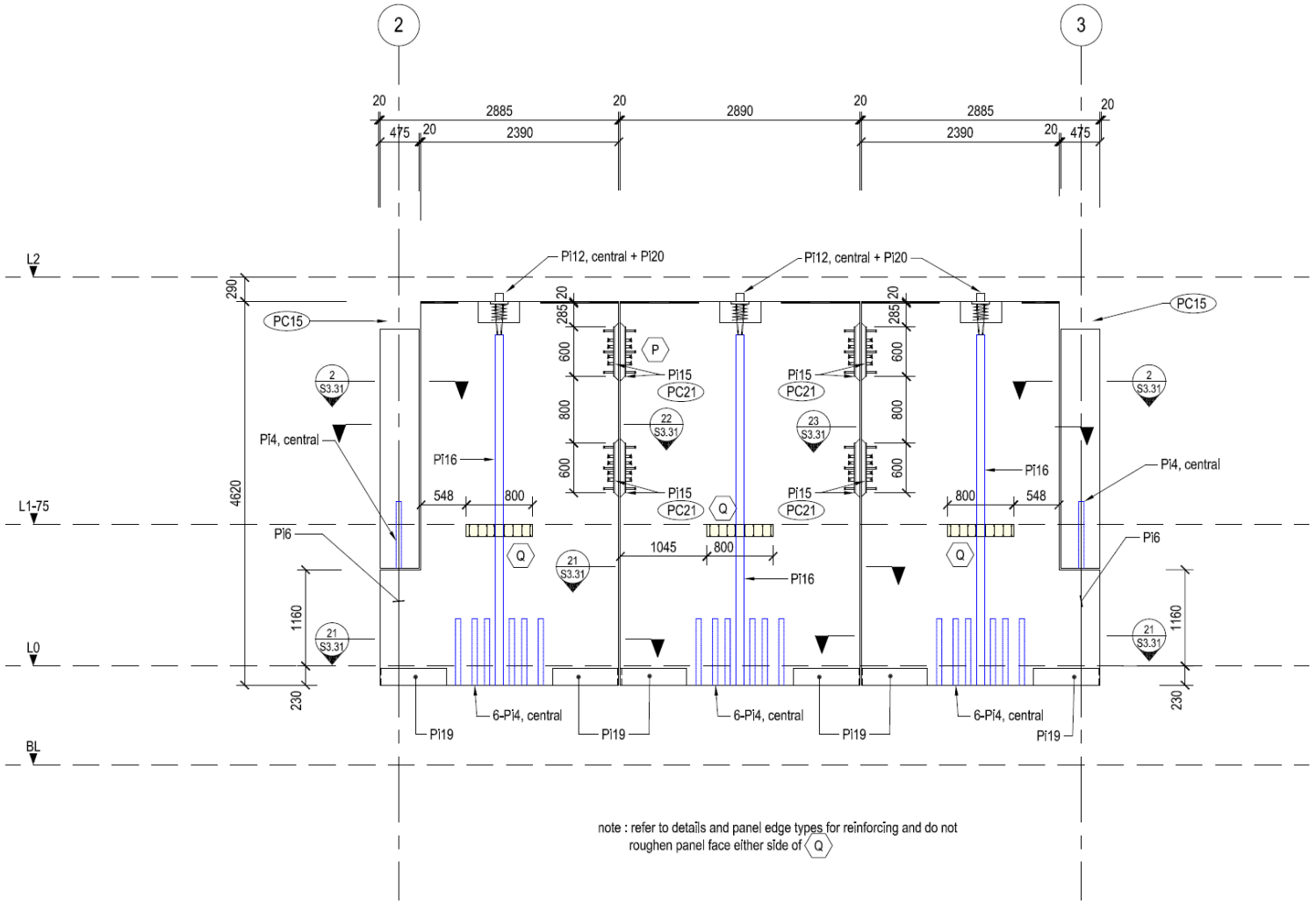
Components & Detailing

Shear Walls



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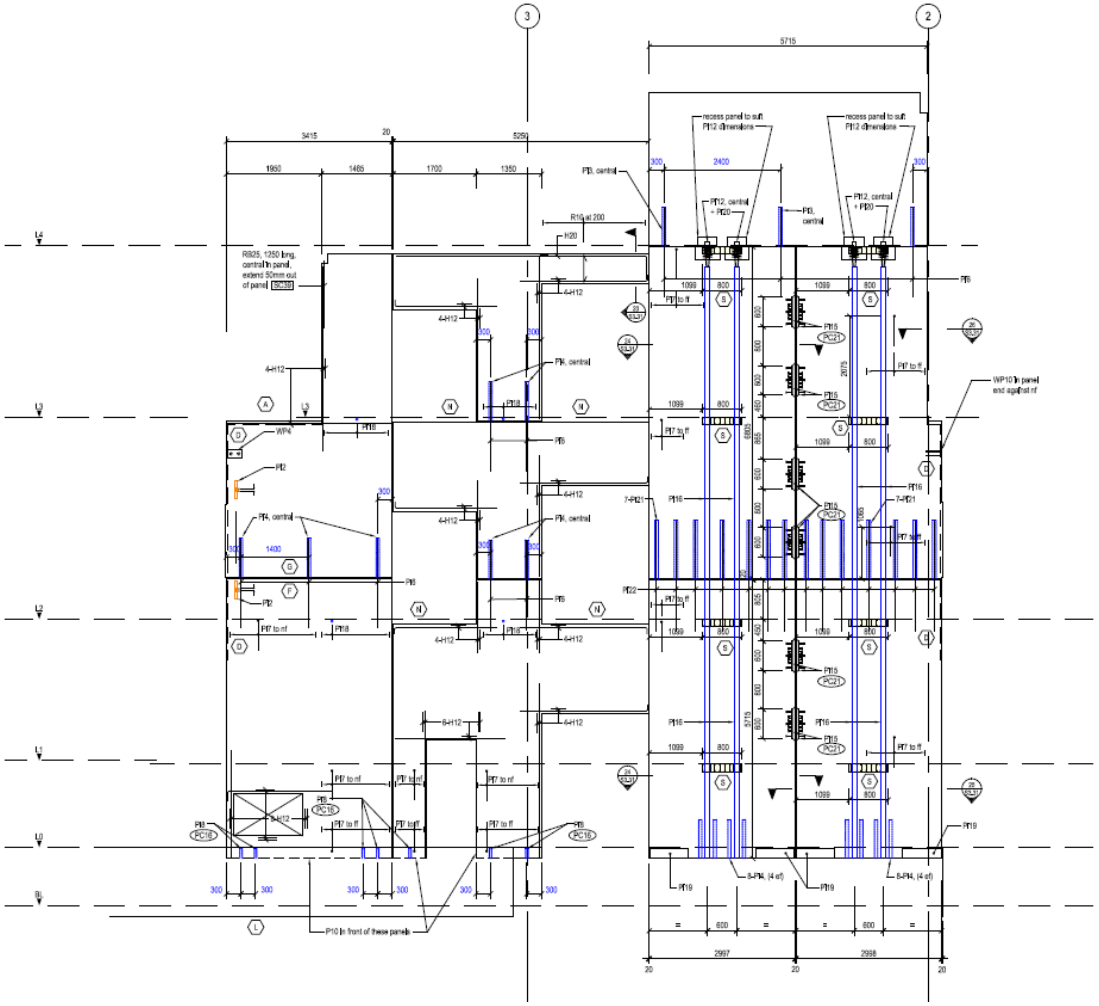
Components & Detailing

Shear Walls



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Components & Detailing

Shear Walls

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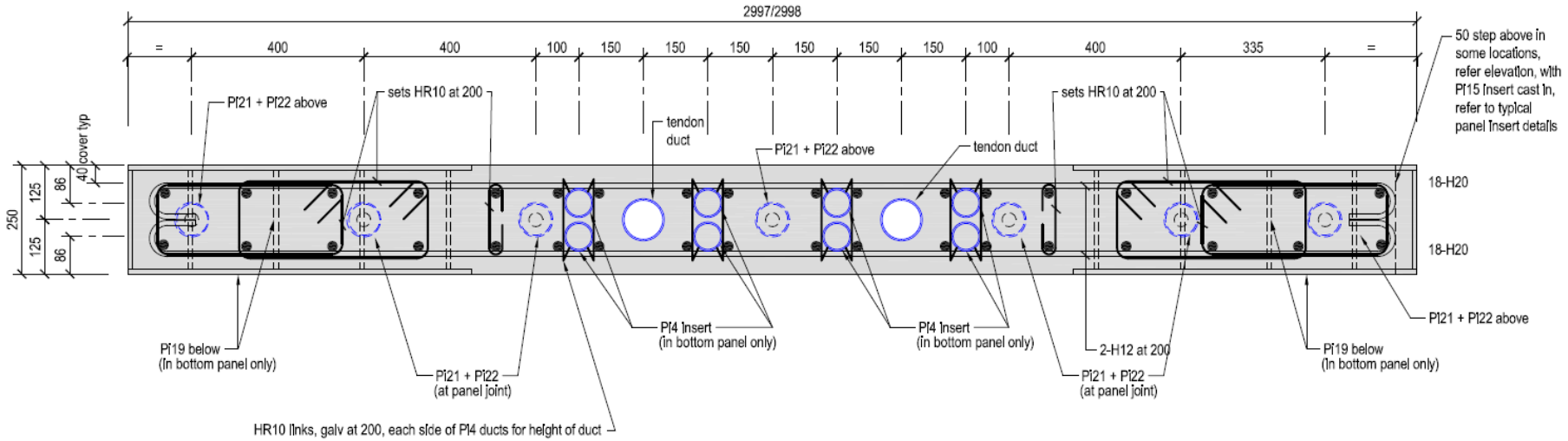
Components & Detailing



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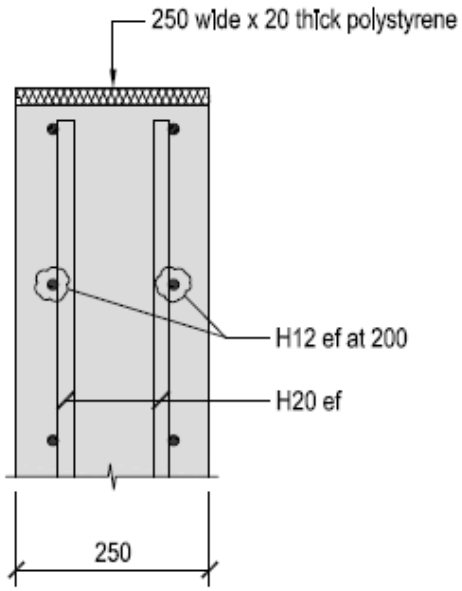
Components & Detailing

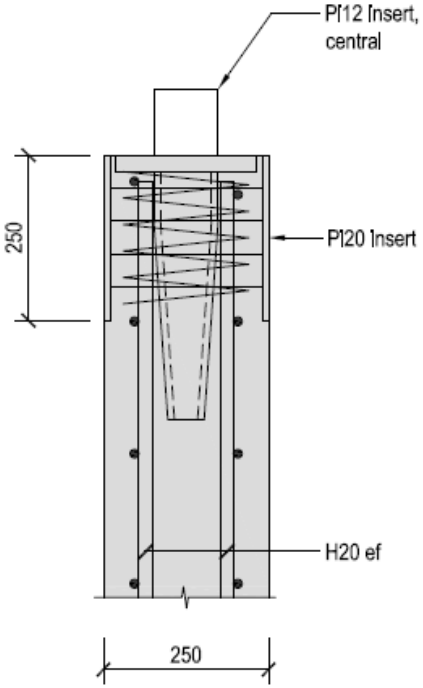
Shear Wall Detailing

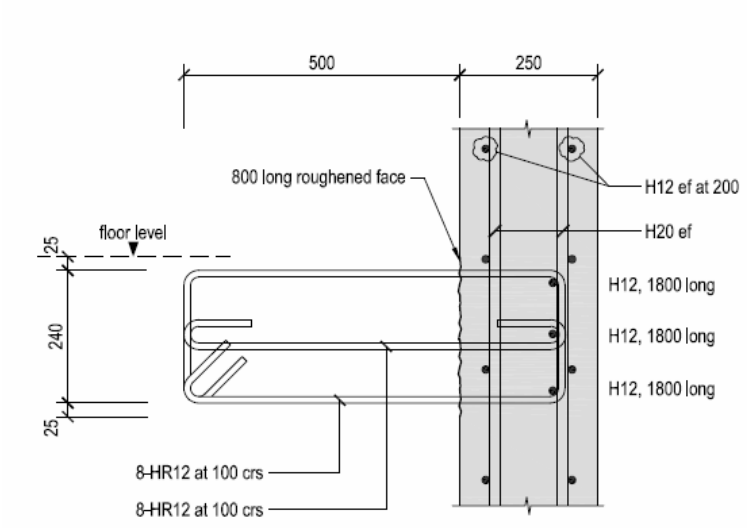
structex

Components & Detailing

Shear Wall Detailing







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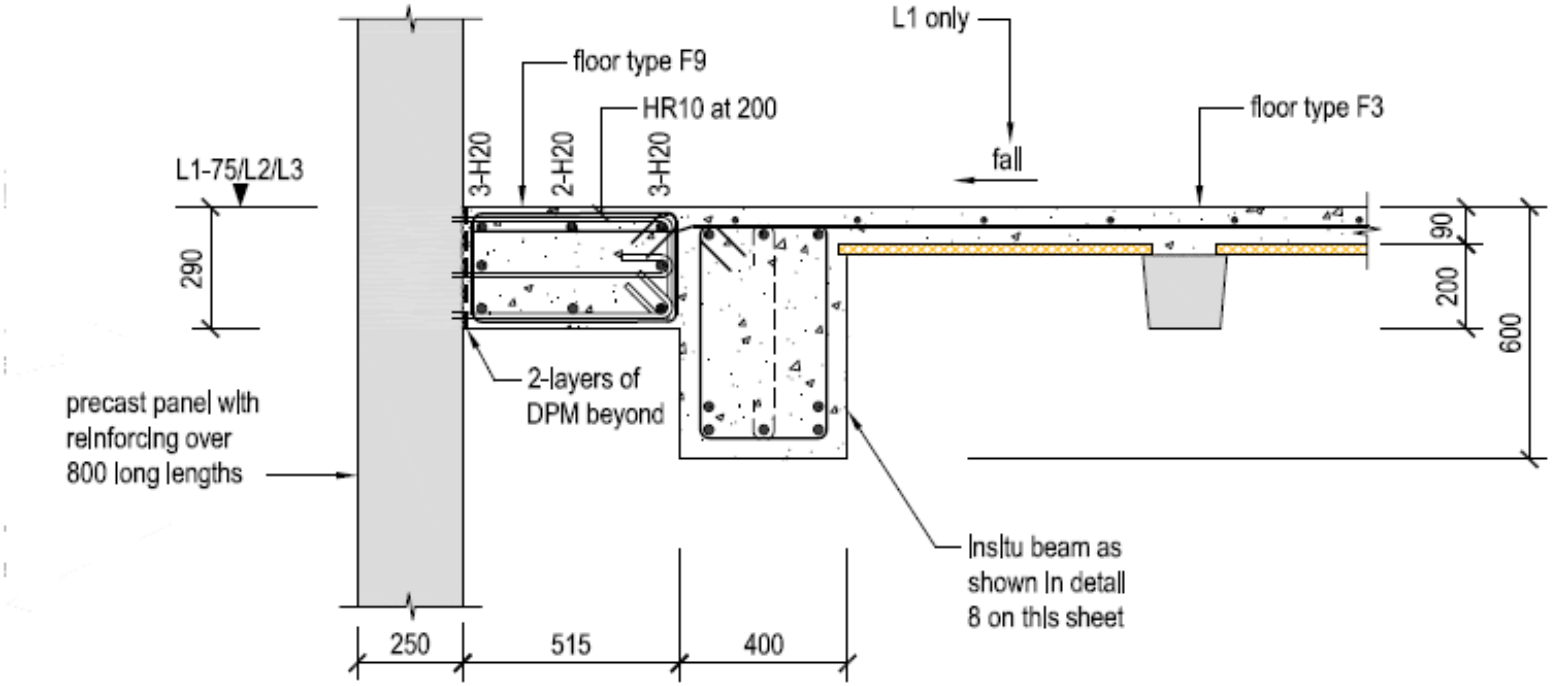
Components & Detailing



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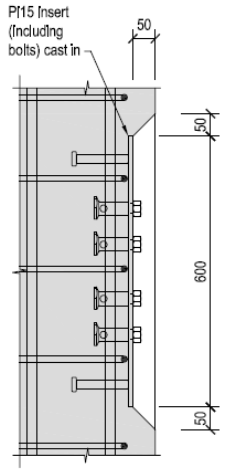
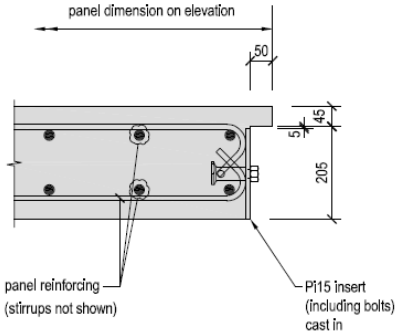
Components & Detailing

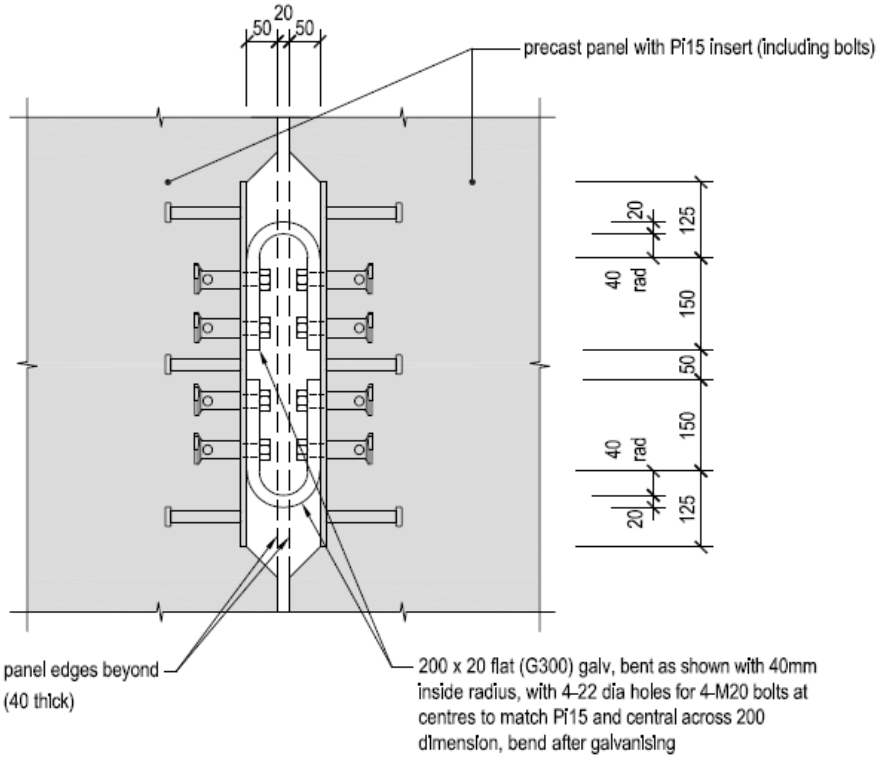
Shear Wall Detailing



(elevation)



(plan)



PC21 (section)

Pi15 insert

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Components & Detailing

Shear Wall Detailing

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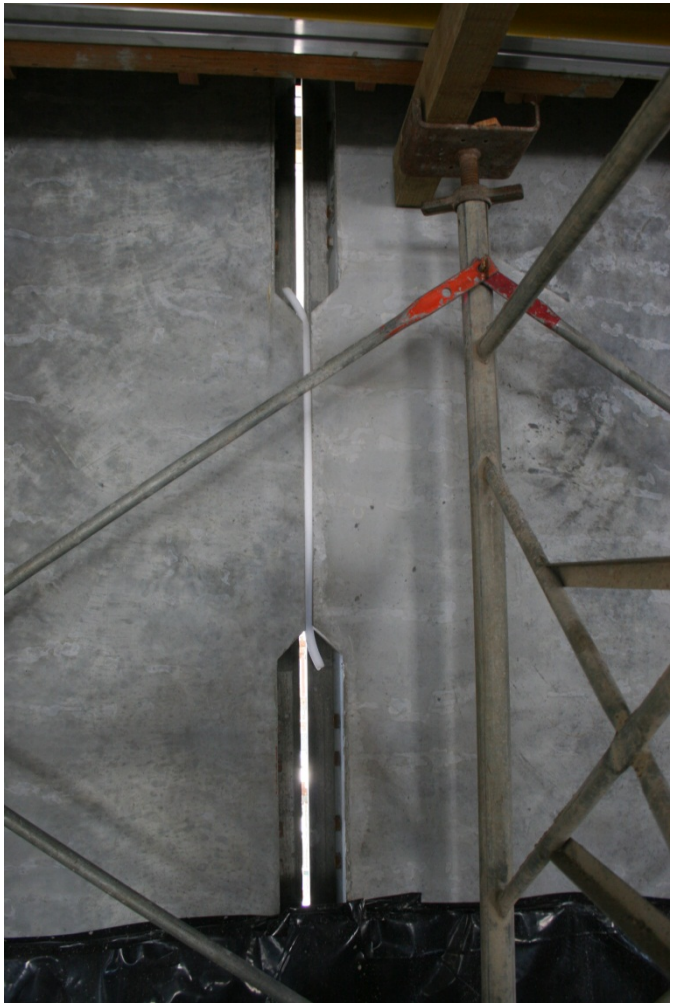
Components & Detailing



Shear Wall Detailing

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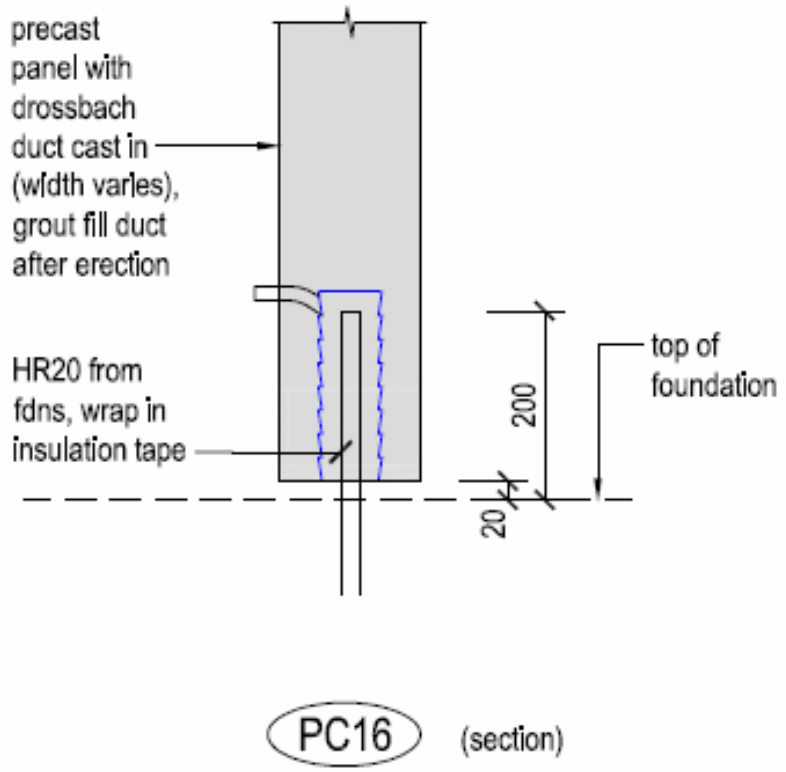
Components & Detailing



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Construction Photos

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Construction Photos

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Construction Photos

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Construction Photos

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Construction Photos

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Example of Damage to Plastic Hinge Beam

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Post Earthquake Photos

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Post Earthquake Photos

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Post Earthquake Photos

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How did the building perform...

- Building has experienced over 7500 earthquakes and aftershocks.
- 22 February 2011 earthquake exceeded the loadings that buildings are typically designed to.
- Seismic resisting system of the structure (PRESSS frames & walls) performed extremely well.
- Some cosmetic damage to non-structural components of the building.
- Some damage to services requiring repair.
- Armouring of joints at ends of beams & walls necessary and performed well with some spalling occurring.