Paddington Green Police Station

2 – 4 Harrow Road, London, W2 1XJ

Structures Chapter for DAS

WSP

March 2021

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Designed for life

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PADDINGTON GREEN POLICE STATION

PGPS-WSP-DDN-ST-0000 Structures Chapter for DAS rev P03

PADDINGTON GREEN POLICE STATION

PGPS-WSP-DDN-ST-0000 Structures Chapter for DAS rev P03

RIBA Stage 2 Planning Chapter for DAS

CONFIDENTIAL

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1.1 PROPOSED DEVELOPMENT

The proposed development consists of three buildings 18,15 and 32 storeys, respectively called blocks ''I'', ''J'' and ''K''.entire footprint of the site boundary is covered with a new single basement level at 28.15mAOD, with the exception of the middle portion to the north where an additional second level basement structure at 25.15mAOD is proposed to serve access from West End Gate loading bay. The entire basement is covered with a podium / ground floor slab at approximately 31.5mOAD.

Figure 2-1 - Proposed development isometric view

The buildings are predominately residential with the ground floors dedicated to main lobbies and retail, with first and second floor areas dedicated to office spaces. Refer to architectural documents for specific area schedule.

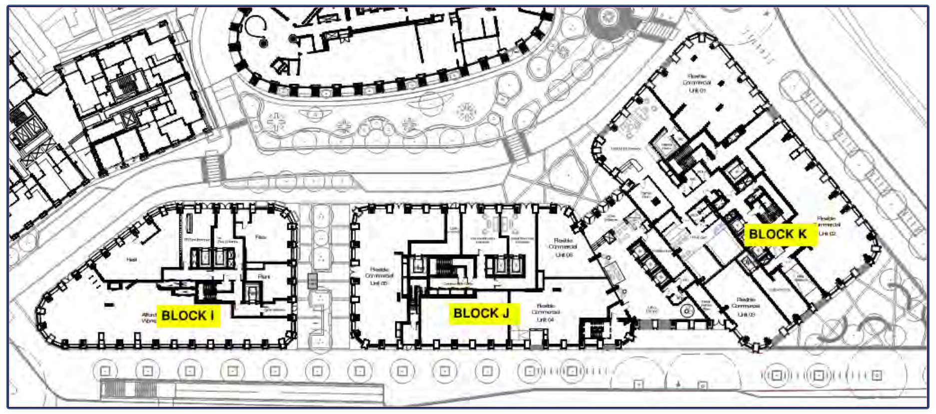


Figure 2-2 - Plan of proposed development

Block J and K are connected up to level 02 with a landscape roof on top, these areas are office space with green roofs. Blocks I and J sit over the car park ramp, access road and basement car parking.

The majority of the building superstructure falls within the existing basement footprint, except the south east corner of block K which over sails the existing basement footprint by 2-3 metres.

To the north of the site across Newcastle place are Blocks G & H which are yet to be constructed and Block A which has achieved practical completion and is in the process of being occupied.

1.2 KEY DEVELOPMENT CONSTRAINTS

The following constraints have been identified during the design development of this stage:

- L**ondon Underground Edgware Road underground station and running tunnels**:

The internal face of the existing tunnel is around 16-17m away from the proposed new basement with the crown of the tunnels circa 13.0m below the lowest new proposed foundation excavation level.

Further design and analysis will need to be carried out in the next design stage to obtain approvals for demolition and construction from LUL

- Live Roads- Harrow Rd, the flyover and Edgware Road effect site access and site welfare facilities. Again, further design and analysis will be required to seek all the necessary highways approvals prior to commencement of demolition.

- **Existing Building Foundations:**

The existing basement level is at approximate 29.7mAOD, the new proposed B1 level is at 28.15mAOD; the anticipated thickness of existing foundations is in the range of 2.0 to 3.0m.

- Existing **Diaphragm** Wall:

The information available regarding the existing Diaphragm Wall (D Wall) forming the existing basement is limited. The design to date has been based on an assumed D Wall length (toe level) based on the available historical information which should prove to be significantly different it could have an impact on the proposed new foundations and temporary works propping.

- **Below ground services and existing substation**
  Refer to MEP report for location and proposal

- **Substation incoming HV cables as part of Block H** (14-17PG);
  North West of the site, on Newcastle place there are a number of HV cables servicing the existing substation. The proposed basement requires an access ramp to be constructed under these cables.

- **Existing building demolition** asbestos materials are likely to be present due to the period of construction.

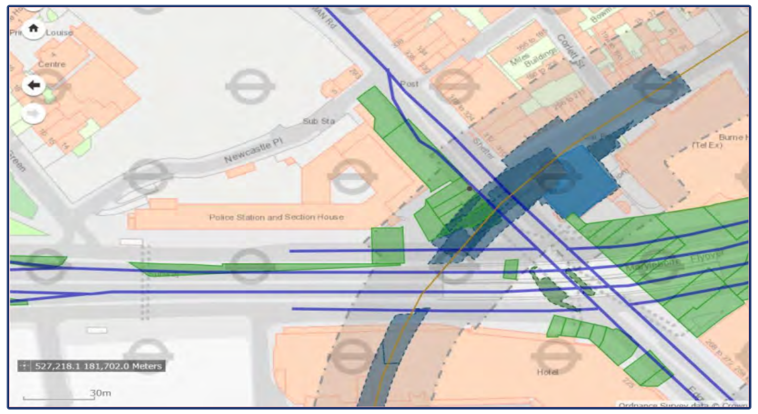


Figure 2-3 - Plan- LUL Tunnel Station box and running tunnels

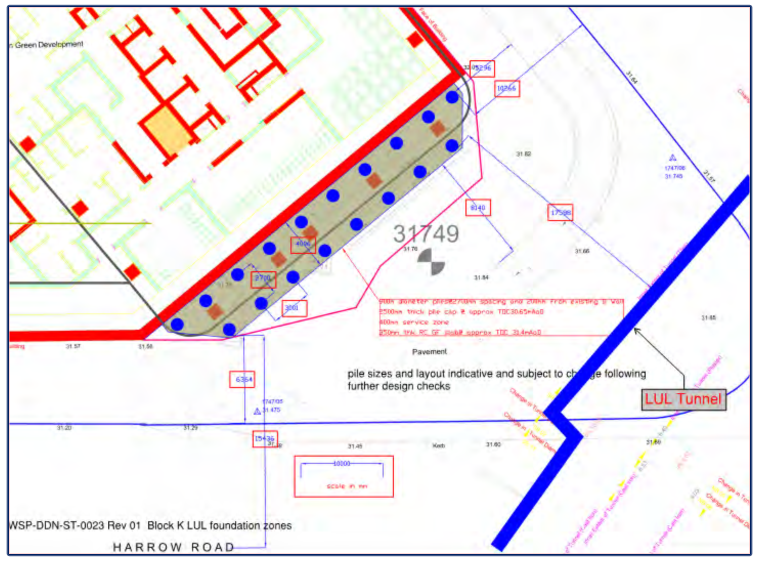


Figure 2-4 - Plan- LUL Tunnel and Proposed structure

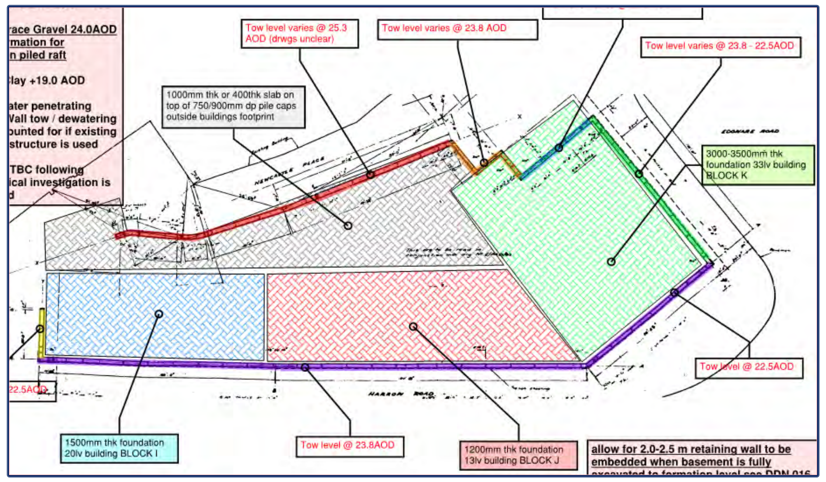


Figure 2-5 - Assumed Existing D Wall toe levels

1.3 EXISTING STRUCTURES AND DEMOLITION

The former police station comprises a 16 storey building with a low-level podium building that wraps around this to the west of the site is an eight-storey building.

There is an existing single storey basement at 29.7mAOD which is supported on piled foundations. From historical drawings it would suggest the basement was formed using diaphragm walls circa 20 inches thick (500mm) with a toe level at circa 22.6 to 23.8mAOD) and a reinforced concrete raft depth of circa 2.5 to 3.0m deep

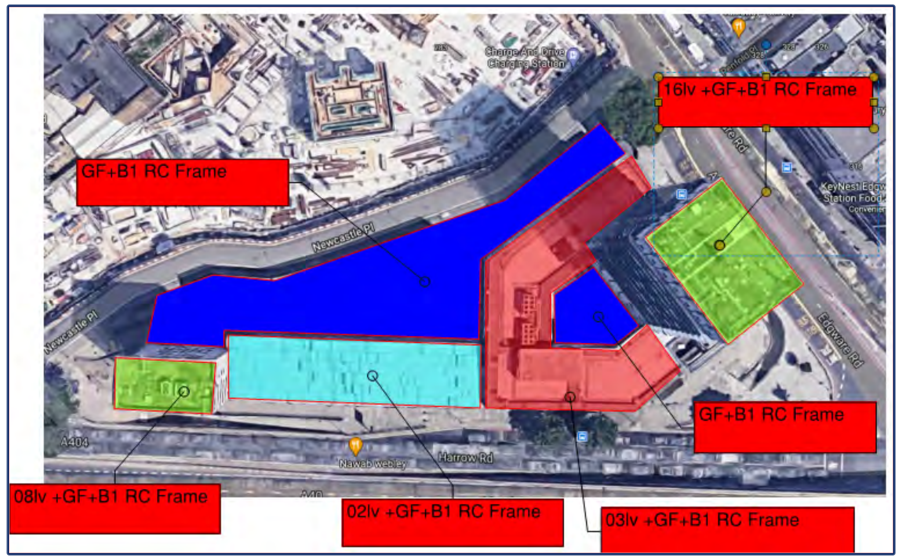


Figure 2-6 - Former Police station /existing building massing

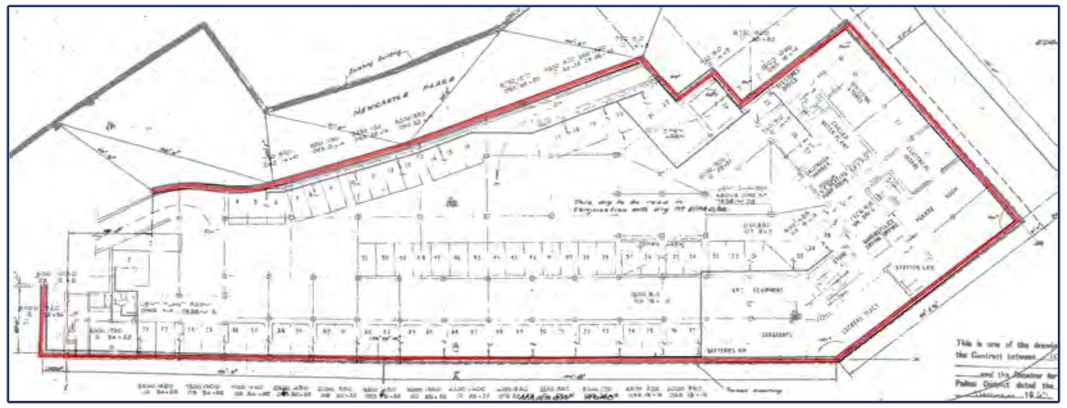


Figure 2-7 - Existing basement footprint - TOC at 29.7mAOD

1.4 GROUND CONDITIONS

Below hardstanding and substructure surfaces, the ground conditions are expected to comprise Made Ground over Langley Silt, River Terrace Deposits and the London Clay.

The Made Ground is expected to comprise heterogeneous slightly clayey sand and gravel whilst the Langley Silt a variable sequence of clays, silts and sands. The River Terrace Deposits are typically a slightly silty sand and the London Clay a stiff, closely fissured and locally very closely fissured, grey brown clay with rare silt partings.

Made Ground	29.7-28.0mAOD
Langley Silt	28.5-25.0mAOD
River Terrace Gravel	25.0-19.0mAOD
Clay	19.0 – at depth mAOD

Any foundations in form of raft shall be placed at River Terrace Gravel as Langley silt has inadequate bearing capacity.

GROUND WATER

Groundwater is expected as perched level in the Langley Silt at circa +30mOD increasing hydrostatically to circa +26mOD.

Groundwater in the London Clay is expected at +22mOD. The potential residual risks is associated with perched groundwater in the Langley Silt.

CONTAMINATION

TBC following Site Investigation, potential contamination from police station petrol tanks.

GROUND MOVEMENT

Ground movement assessment (GMA) to follow in next design stage.

2 STRUCTURAL FORM

2.1 GENERAL

Post tensioned concrete flat slabs are supported on concrete shear walls and columns which are supported / founded on either a pile raft or pile caps.

The majority of the layouts are single span floor from the central core to the perimeter columns.

The basement box generally comprises a single level and is formed with the reusing of the existing D wall in the temporary construction stages only, where the proposed basement footprint requires the installation of a new perimeter wall it's proposed a 750mm secant or contiguous piled wall is introduced. A 300 to 400mm thick reinforced concrete liner wall will be constructed inside the existing D wall and proposed secant / contiguous piled walls.

RC transfer beams are required at GF level under blocks I and J to allow for car park circulation.

2.2 ABOVE GROUND FRAMING

The structural frames consist of reinforced cores walls 300-400mm thick, concrete columns min 300mm thick and 225mm thick post-tensioned slabs, roof slabs are 350mm thick.

The lateral wind pressure on the facade is transferred horizontally to floor plates via cladding brackets. The floor slab acts as a diaphragm and are restrained laterally by lift and stair cores, these stiff vertical elements act as a cantilever and carry the wind forces down to the piled foundations. The piles transfer horizontal and vertical forces via friction and end bearing into the soils.

Perimeter columns are spaced on a 6.0m grid, allowing for cladding panels 3.0m wide to form the external envelope.

MEP services run in risers and underneath the soffit of the RC link beams (link beams 500mm deep) or slabs.

Block I

Block '' I'' is 18 levels with inset balconies; some slab edges are cantilevering up to 1.7m in the corners to reflect the curved shape of the building footprint.

The north east corner of the building is transferred at ground floor level to allow for larger open spaces within the basement car park areas.

Core Walls are 300-350mm thick and perimeter columns 1000x350mm positioned perpendicular to the slab edge to minimise deflections.

500mm deep RC beams linking shear and core walls are provided to increase lateral stiffness of the frame.

Both lift and stair cores are offset from the centre of rigidity/mass of the floor, as a result of this a rotation know as torsion is introduced. The twist of the building as a result of the wind forces applied is dealt with by the increased stiffness of the cores. The frame is analysed with 3D ETABS models considering reduced cracking factors of the link RC beams, maximum lateral deflection is in the range of 75-90mm with Natural Period of Tn= 2.2Hz

Floor plate design checks are performed with RAM Concept models and long-term deflection analysis undertaken indicates a maximum vertical deflection of 20.0mm.

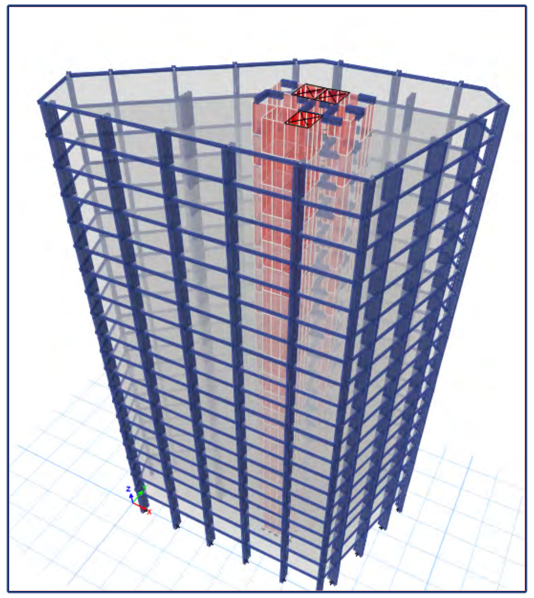


Figure 2-1 - Block I ETABS 3D analysis model

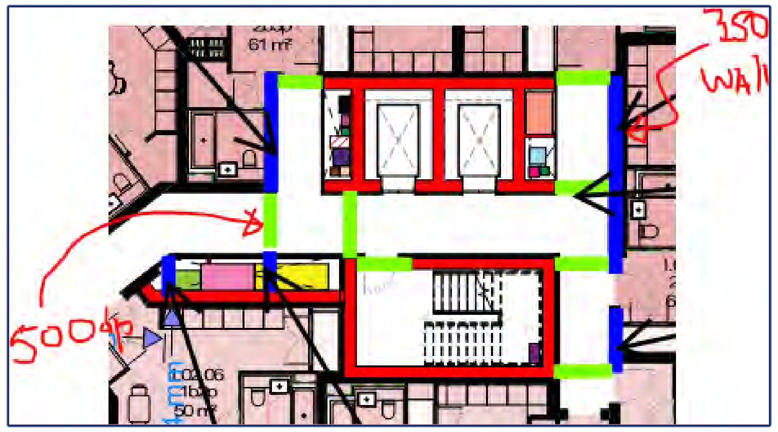


Figure 2-2 - Block 'I' core lateral stiffness elements - shear wall/link beams and stair/lift arrangement

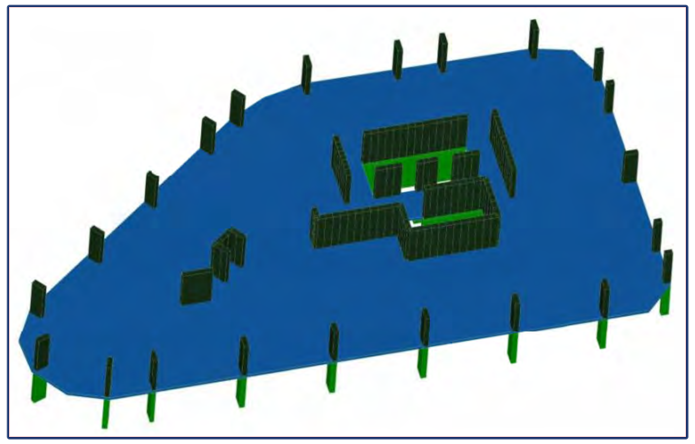


Figure 2-3 - Block I RAM Concept 3D analysis model

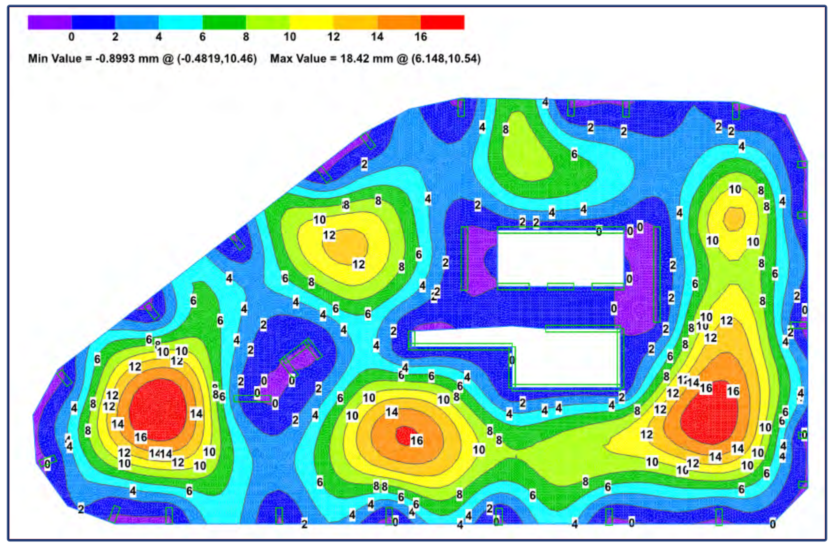


Figure 2-4 - Block I typical floor plate analysis model total deflection (20.0mm)

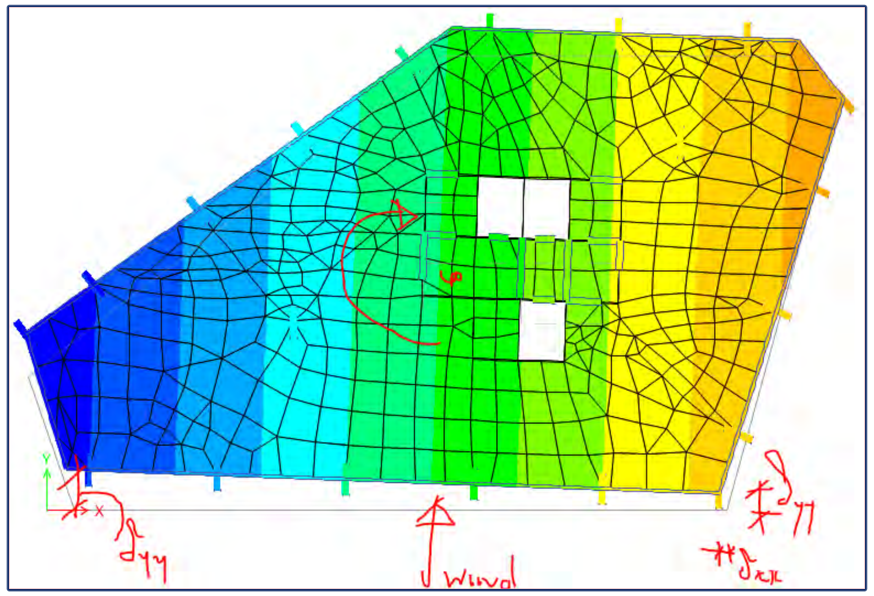


Figure 2-5 - Lateral stability deflection/twist roof level Block I wind XX direction deflection results : XX=75mm and YY=14.0mm

Block J

Block 'J' comprises 15 levels with cantilever corner slab edges; stair and two lift shafts with 300mm thick walls provide lateral stability resistance. Perimeter columns are 900x350mm oriented perpendicular to the slab edge.

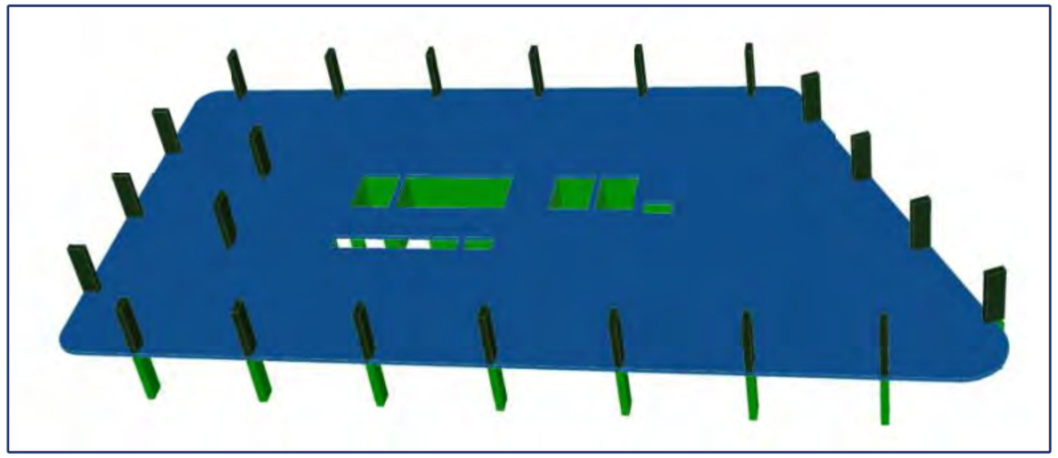


Figure 2-6 - Block J RAM Concept 3D analysis model

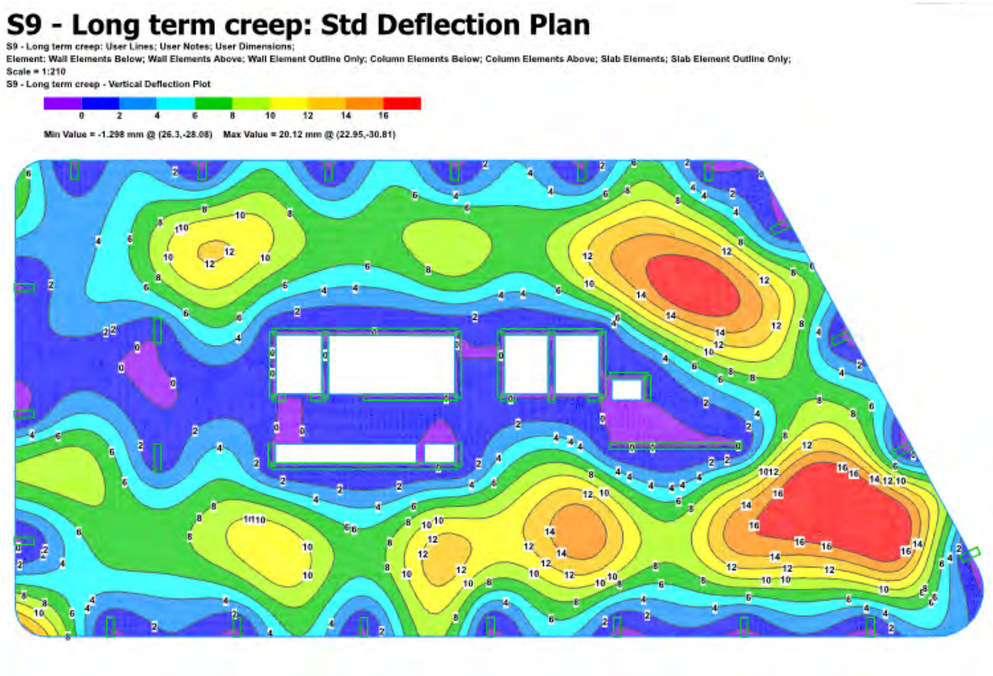


Figure 2-7 - Block J typical floor plate analysis model total deflection (20.0mm)

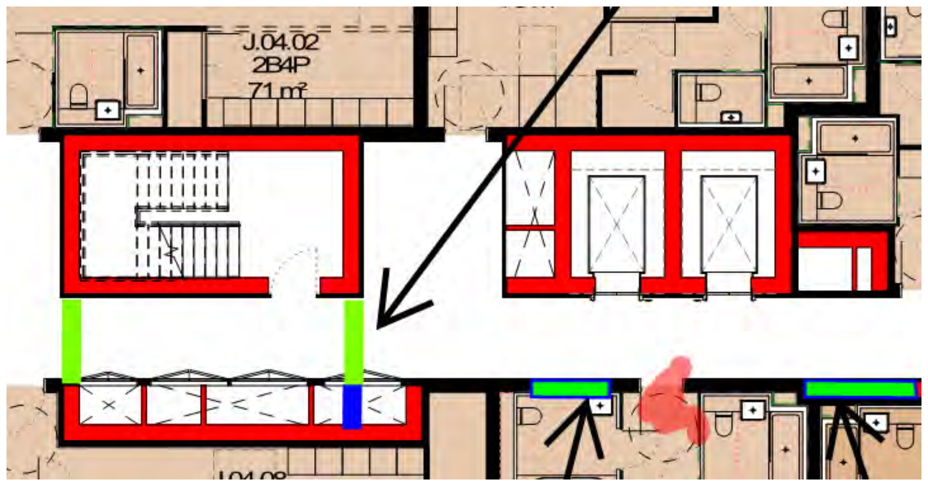


Figure 2-8 - Block I core lateral stiffness elements - shear wall/link beams and stair/lift shaft arrangement

Block K

Block K comprises 32 storeys with a lower level shoulder at 25 storeys to the north; the structural skeleton consists of a lift and stair core in the middle of the main tower and shear walls in the shoulder element, perimeter columns are spaced at 6.0m supporting 225mm thick PT slabs.

The majority of the perimeter columns are orientated perpendicular to the slab edge in order to minimise slab deflections, column sizes variy from 1650x400 to 1250x350 in size.

The main core walls are linked together with 500mm deep link beams for increased lateral stiffness. Walls are generally 400 mm thick, although there may be the opportunity to look at reducing the wall thickness up the height of the building in next stages of design to reduce the load on the foundations and embedded carbon.

Due to the main stability core being off set from the centre of the building floor a torsion effect is occurring when wind pressures are applied to the West or East elevations.

The building lateral stability is verified by ETABS 3D models, appropriate element stiffness / cracking factors are adopted and wind pressure in the region of 1.1-1.25kPa are applied.

Maximum movement at the level 32 is in the region of 150mm (limit 230mm) and at lv 25 is 140mm (limit 170mm); natural frequency period of the frame is 5.2Hz, it is on the high end but acceptable for residential comfort.

Floor plate PT detailed analysis has been carried out to verify the design for 9.5m single span areas, it satisfied the requirement by providing 4 strand per tendon, spaced at 1.2-1.4m. Edge internal slab deflections were found to be within acceptable limits due to the relative small spans of 6.0m. The building corner cantilever slab edges up to 3.3m were found to drive the design in relation to slab deflections.

Both roof slabs are 350mm thick reinforced concrete slabs.

Foundation pressures from the superstructure is in the region of 440-510kPa with anticipated pile loads in the region of 5000-7300kN with pile diameters ranging from 900-1200mm and a raft thickness of between 2.5m to 3.0m founding on the River Terrace Gravels. A foundation assessment will be undertaken in the next design stages to identify the optimum solution to be adopted eg larger pile diameter and shallower raft or vice versa.

South-East elevation lands on 2.5m deep pile cap with 900mm/1200mm diameter piles formed outside of existing basement. Further design will be carried out in next stages to ensure the deferential movement between the foundations is within acceptable limits.

Current design has allowance for either slip or jump- form core construction.

Figure 2-9 - Block K architectural CGI with lower shoulder at level 25

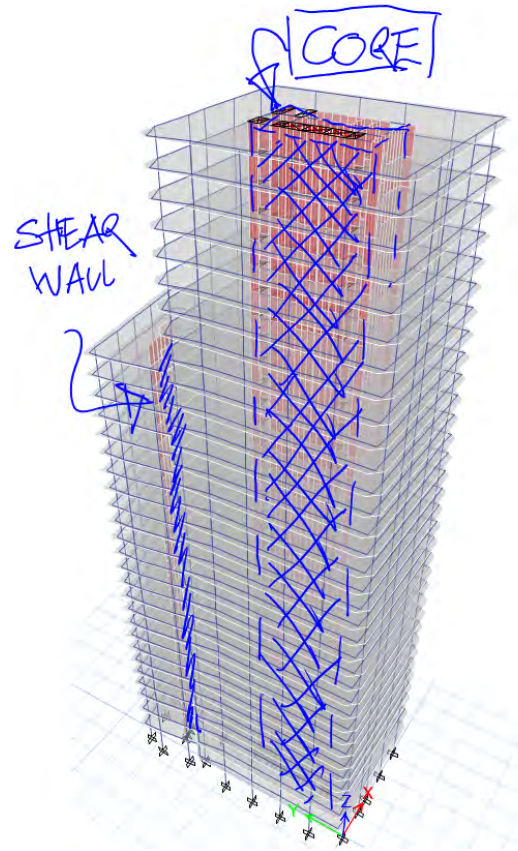


Figure 2-10 - Block K Plan of main lateral stability elements and wind horizontal distribution – cores and shear walls

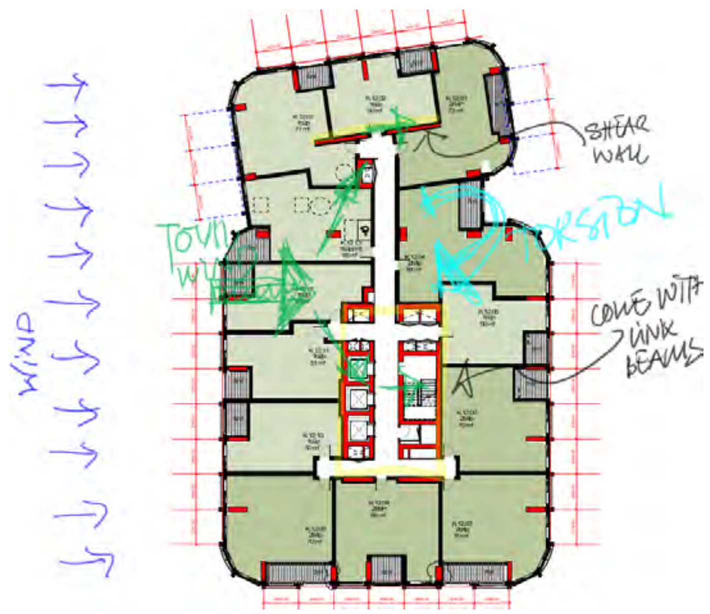
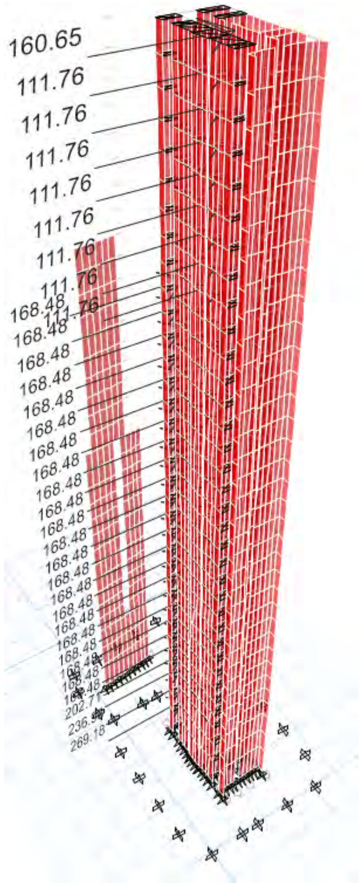


Figure 2-11 - Lateral wind load path through floor plate to vertical stiff elements



Etabs model wind load in XX direction West-East

Figure 2-12 - Block K lateral movement at level 26 due to wind West-East XX direction

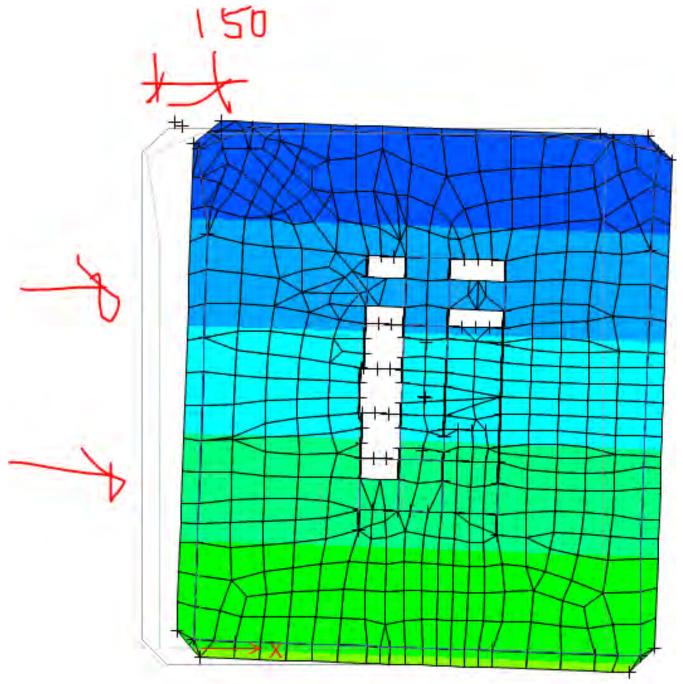


Figure 2-13 - Block K lateral movement at level 33 Roof due wind West-East XX direction

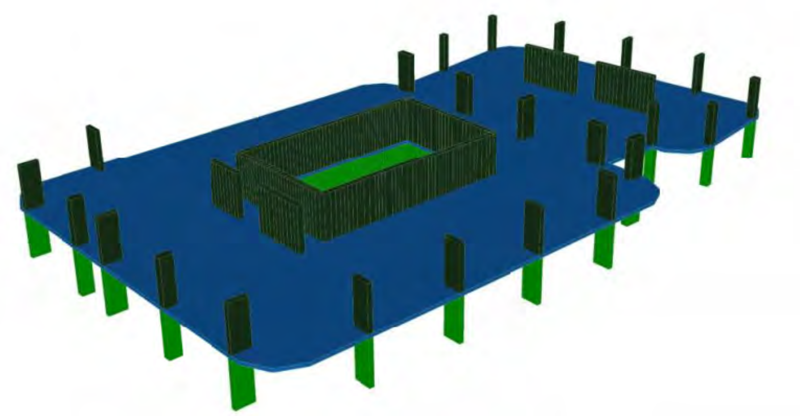


Figure 2-14 - Block K RAM Concept 3D analysis model

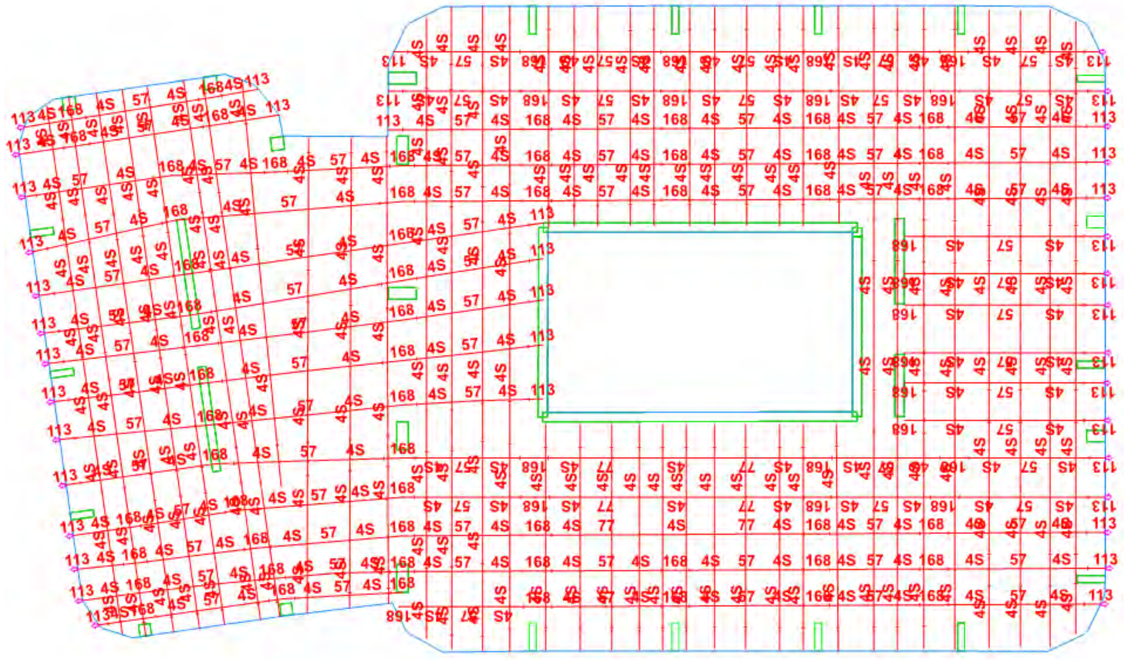


Figure 2-15 - Block K floor plate plan of post tension tendons and strands (PT)

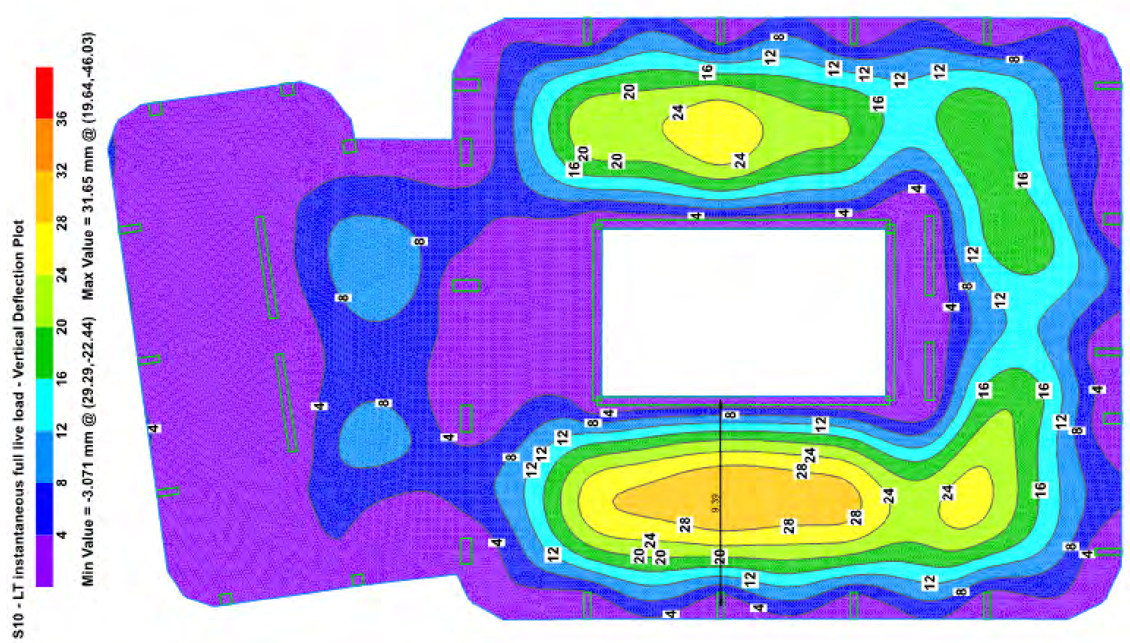


Figure 2-16 - Block K floor plate plan of long-term vertical total deflection 27-30mm at full load

2.3 SUBSTRUCTURE

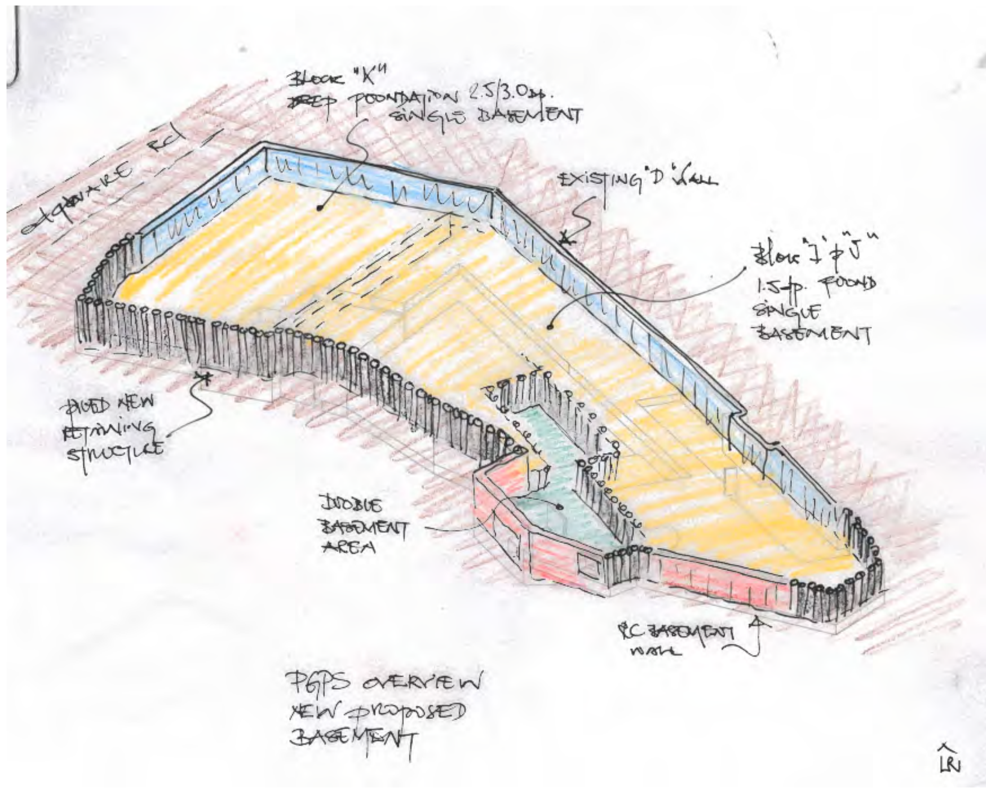


Figure 2-17 - Overview sketch of proposed new basement

Ground floor and transfer structural elements

A 450mm thick ground floor slab covers the entire footprint of the site with allowance for construction loading as well as road and finishes build up.

Some of perimeter columns for buildings I and J are required to be transferred to allow column free areas within the basement car parking areas. 1400mm deep transfer RC beams are required to transfer the columns. This shall be further optimised in the next design stages where possible once the layouts are fixed.

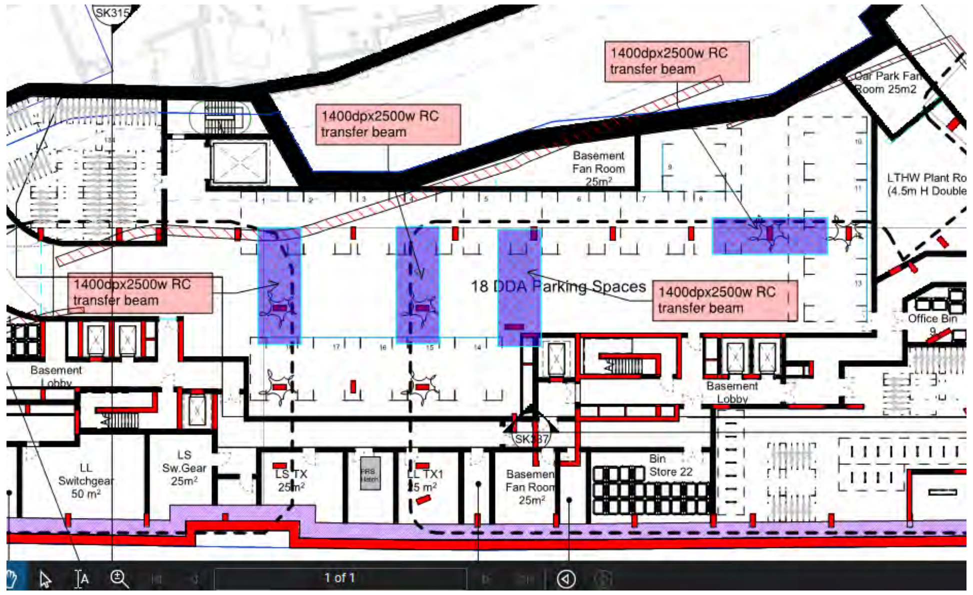


Figure 2-18 - GF plan of transfer beams blocks I and J

The ground floor slab provides lateral propping support to the perimeter retaining walls.

Foundations and basement slab

Expected foundation loading from Block I and J is in the region of 300-350kPa and 440-510kPa for block K. based on these values foundations will be required to be piled either a piled raft or a series of pile caps.

Basement B1 slab SSL is at 27.35 and 28.150mAOD, approximate expected depth of foundation of 1.5m for block I and J and 2.5 to 3.0m for block K gives formation levels of 25.85 mAOD (Block I and J) and 25.65m - 25.15mAOD (block K)

Referencing the assumed ground profile and that the River Terrace gravel is set at 25.0mAOD, the need of raft structurally is only for block K, where length of piles and depth of raft will drive the design ; for blocks I and J , piles with pile caps or thick slab forming a pile cap is most appropriate foundation choice.

Block K piles are expected to be 900-1200mm diameter with 6000-7300kN characteristic load, spaced at 2.7 - 3.6m throughout the raft. Blocks I and J piles are expected to be 600-750mm diameter, with loads in the region of 1500-2500kN.

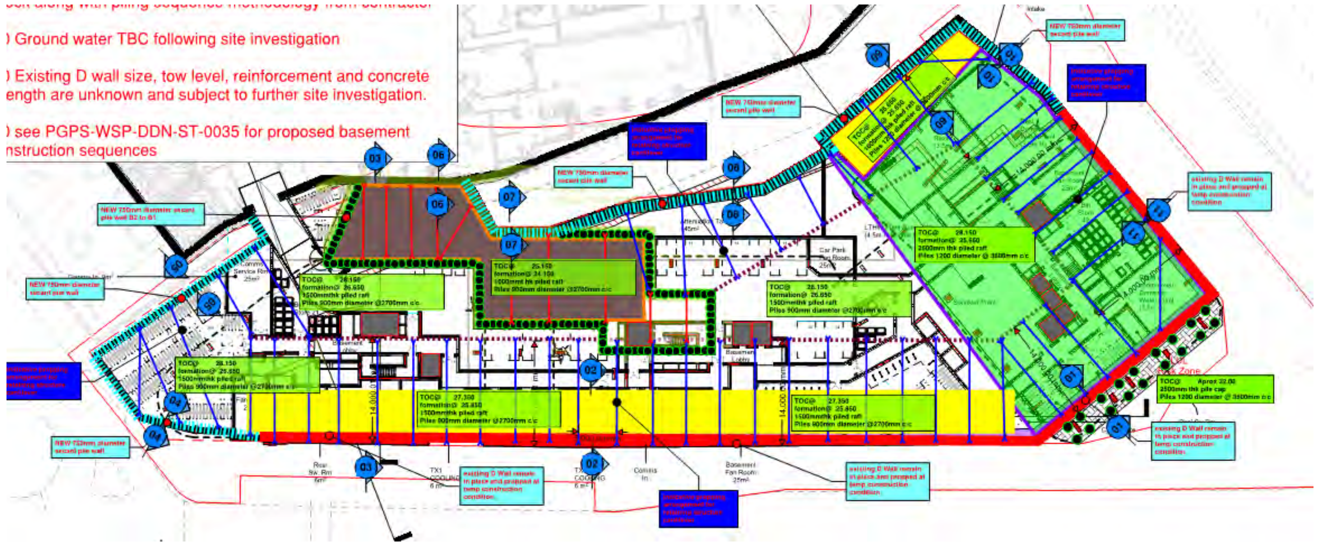


Figure 2-19 - Proposed Design Development Basement Layout and Foundation levels

Basement perimeter retaining structures

300-400mm thick perimeter liner walls are provided throughout the new basement. The existing D Wall is assumed to be reused at temporary construction stage only by the contractor to form the new basement. The existing D walls will require temporary propping at several levels to ensure required load path in the wall is provided.

In the absence of the existing D Wall, a 750mm contiguous piled wall for the single level basement areas could be constructed with a secant piled wall for the double basement level areas required.

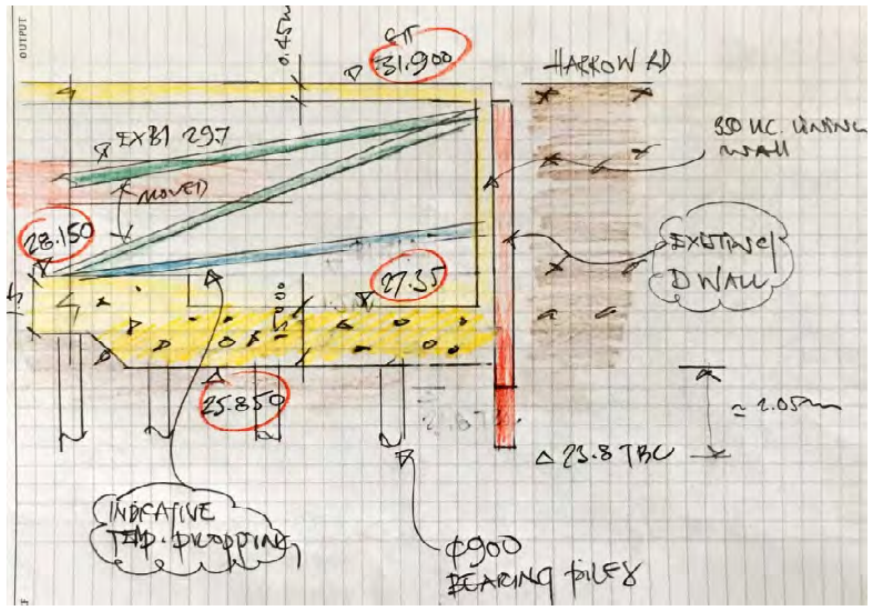


Figure 2-20 - Typical Section – Existing D Wall and Proposed Single level Basement

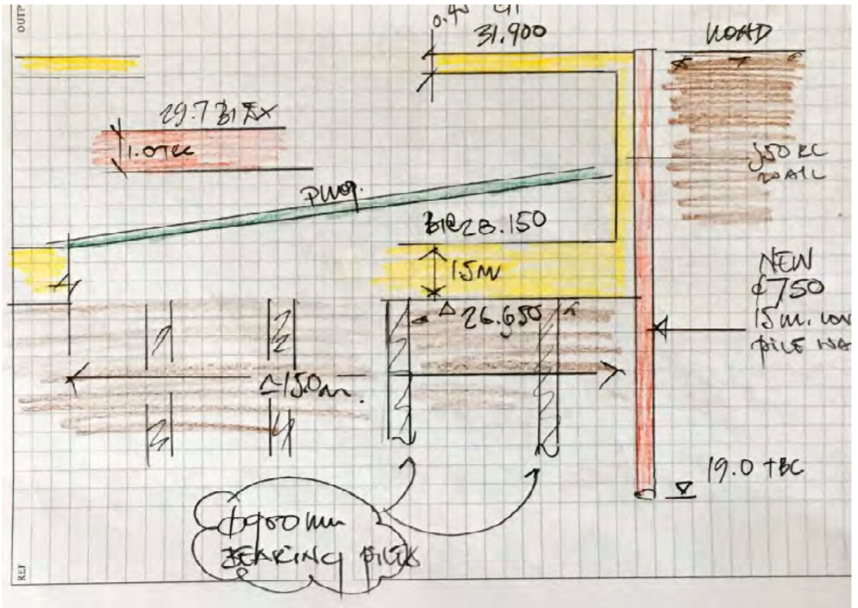


Figure 2-21 - Typical Section – NEW Pile wall and Proposed Single level Basement

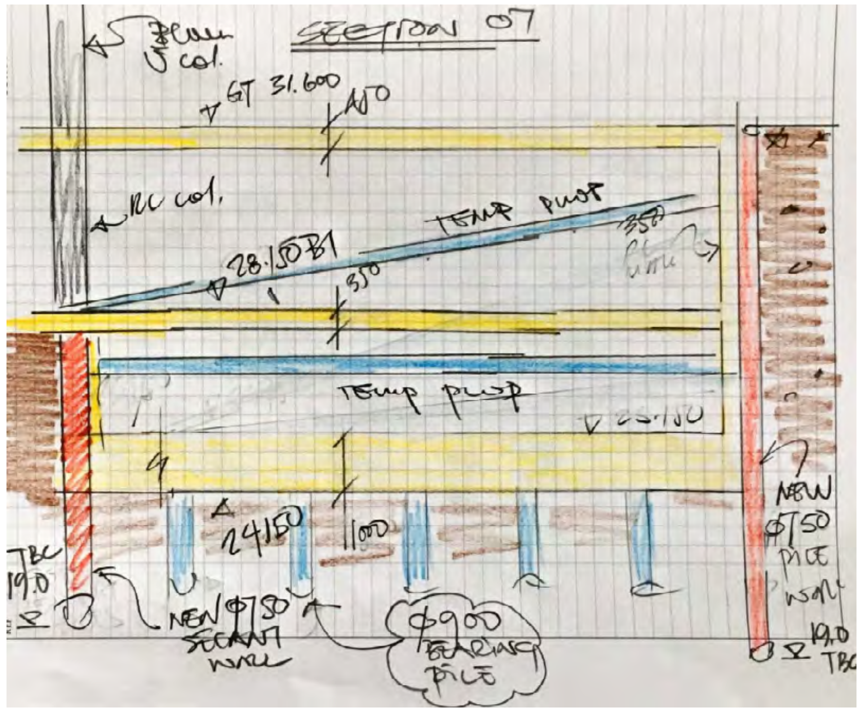


Figure 2-22 - Typical Section – double level Basement

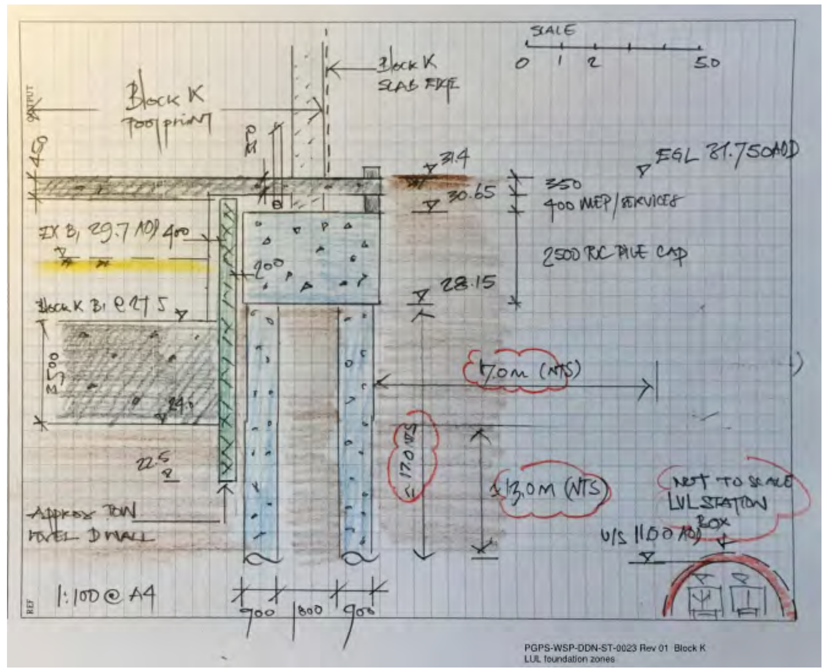


Figure 2-23 - Typical Section – LUL asset and Proposed Basement

3 DESIGN CRITERIA

3.1 DESIGN LIFE

The 'design working life' for the 'structure' (structural frame and main structural elements) is 60 years. This is in accordance with Eurocode 'Category 4' buildings – as recommended in Table NA.2.1 of the UK National Annex to BS EN 1990:2002.

3.2 FIRE RATING AND PROTECTION

The following BS 476 fire resistance periods are adopted in the design of the building, refer to fire consultant report for appropriate values:

▪ Superstructure Block K	**2** hours
▪ Superstructure Block I & J	**1.5** hours
▪ Substructure generally:	**2** hours
▪ Substations	**4** hours

All required periods of fire resistance for structural elements are to be confirmed by the Fire Engineering consultants.

Fire protection will be achieved by insitu concrete construction by the specification of member size and concrete cover to the main reinforcement to achieve compliance with BS EN 1992-1-2.

All applied fire protection measures to structural steelwork elements are to be specified by the Architect.

3.3 DISPROPORTIONATE COLLAPSE

The overriding principle of the building regulations is the concept of robustness. This is defined in EN 1991-1-7 as "the ability of a structure to withstand events like fire, explosions, impact or the consequences of human error without being damaged to an extent disproportionate to the original cause".

Blocks I and K classification to Approved Document A of the Building Regulations is defined as Class 3,systematic risk assessment will be carried out along with providing effective horizontal ties together with effective vertical ties in the structural system as per 2B; Blocks J classification is defined as a Class 2B, and for this classification effective robustness will be developed by providing effective horizontal ties together with effective vertical ties in the structural system.

The provision of vertical and horizontal ties will ensure that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause.

To satisfy the requirements for a Consequence Class 2B building, structural ties will be provided. These will include:

- Horizontal ties at each level to secure both internal and perimeter elements into the floor and roof level structures: beam-column and beam-beam connections will be detailed for the appropriate tensile forces and suitable reinforcement details will be provided around the perimeter of the building to ensure that beams are tied into the floorplates.
- Vertical ties to ensure that columns are continuous from foundation to roof level.

3.4 DESIGN LOADS

WIND LOADS

Wind loads acting on the main building frame and the various elements of cladding will be determined in accordance with the requirements of BS EN 1991-1-4 assuming the following:

▪ Basic wind speed	Vb = 21.5 m/s
▪ Altitude factor	Sa = 1.0
▪ Direction factor	Sd = 1.0
▪ Seasonal factor	Ss = 1.0
▪ Probability factor	Sp = 1.0
▪ Terrain and building factor	Sb = 1.0

SUPERIMPOSED PERMANENT LOADS

Typical Residential Floor

▪ Tiling (12.5mm Tile)	0.35kN/m2
▪ Additional finishes (tbc by client)	0.20kN/m2
▪ Chipboard (18mm)	0.12kN/m2
▪ Metal diffusion plate with U/F pipes	0.05kN/m2
▪ Floating Floor insulation panel (50mm)	0.04kN/m2
▪ Rigid Insulation (40mm)	0.05kN/m2
▪ Ceiling	0.17kN/m2
▪ Services and MEP	0.25kN/m2
Total	**1.20kN/m2**

Typical Office Floor (TBC with Client)

▪ Raised Floor TBC	1.00kN/m2
▪ Services, Ceiling and MEP	0.25kN/m2
Total	**1.25kN/m2**

General Ground Floor Paving

▪ 80mm Paver	1.76kN/m2
▪ 70mm Sand bedding	1.26kN/m2
▪ Screed / concrete to falls 125mm	2.50kN/m2
▪ Services	0.40kN/m2
Total	**5.92kN/m^2**

Green Roof Areas

▪ Screed / concrete to falls 125mm	2.50kN/m2
▪ Ceiling and services	0.40kN/m2
▪ Waterproofing, rigid insulation, vapour barrier	0.30kN/m2

- Green roof (extensive) 5.50kN/m2

Total	**8.70kN/m²**
Ground Floor Garden (Podium/Grassed Area)	
Screed / concrete to falls 125mm	2.50kN/m²
Ceiling and services	0.40kN/m²
Attenuation (500mm deep tank)	5.00kN/m²
Waterproofing, rigid insulation, vapour barrier	0.30kN/m²
Plantings / Soil Build-up 500mm	9.00kN/m²
Total	**17.20kN/m²**
Ground Floor Garden (Planted Area)	
Screed / concrete to falls 125mm	2.50kN/m²
Ceiling and services	0.40kN/m²
Waterproofing, rigid insulation, vapour barrier	0.30kN/m²
Soil Build-up 1000mm	18.00kN/m²
Trees	5.00kN/m²
Total	**26.20kN/m²**
Roadway	
Paving build-up	8.00kN/m²
Total	**8.00kN/m²**
Basement (B1, B2)	
Finishes (sealed/painted concrete assumed)	0.00kN/m²
MEP Services	1.50kN/m²
Total	**1.50kN/m²**

CLADDING LOADS

Single level panel glazing 3.0m wide & ½ column solid vertical panel	**7.5kN**
Slab edge horizontal belt	**5.0kN/m**
Curtain wall around balcony	**3.5kN/m**

VARIABLE LOADS

The following variable loads (live loads) have been adopted in the design:

Residential areas	1.5kN/m²
Partitions (see note #)	0.8kN/m²
Office Areas (tcb with Client) (including 1.0kNm2 partitions)	3.5kN/m²
Corridors and lift lobbies	3.0kN/m²
Staircases	4.0kN/m²
Balconies	2.5kN/m²
Roofs (access for maintenance only)	1.5kN/m²
Roof gardens	4.0kN/m²
Plant areas	7.5kN/m²
Ground floor (internal – C1 assumed throughout)	3.0kN/m²
Ground floor (external, except roadway)	5.0kN/m²
Roadway	10.0kN/m²
Basement - plant areas	7.5kN/m²
Basement – water tanks per metre height	10kN/m²
Basement – car parks	2.5kN/m²
Loading bay. Greater of:	15.0 kN/m²

 # NOTE # : Partition loads are adopted as live load but shall not be taken into account as part of live load reduction LTD

CONSTRUCTION LOADS

General construction activities i.e. loading out floors, use of scaffold towers and MEWPs etc. is to be undertaken in such a manner as not to exceed the imposed loadings indicated on the WSP loading plans. If higher loads are required options such as back propping should be discussed with WSP.

The ground floor slab structure will be designed for **20kN/m2** construction traffic.

NOTIONAL HORIZONTAL LOADS

The building will be designed to resist notional lateral loads applied at each floor simultaneously as stipulated in BS EN 1991-1. This load is applied in addition to wind loads.

LATERAL EARTH PRESSURES

Earth pressures will result from active pressures on the back face of any retaining structures. These will be assessed based on the parameters of the retained material.

Refer to loading plans for surcharge values on basement retaining structures.

HEAVE

Assumed **80kN/m²** heave combined with ground water, to be confirmed by site investigation.

3.5 GROUND WATER AND HEAVE

Groundwater level will be confirmed following the site investigation.

However, an extreme event load case is considered with the design water head at 1m below ground level. This can be a severe load case but could realistically arise in the short term from a broken water main or very heavy storm. However, as such it is considered reasonable to treat this as an accidental load case i.e. to use lower load factors and material factors for ultimate strength and to exclude it from serviceability checks.

Soil heave is considered at this stage since foundations are found in close proximity to London clay layer.

3.6 MOVEMENT AND TOLERANCE

3.6.1 GENERAL

The movement and tolerances will be described in detail in a movement and tolerance report to be produced in the next design stage (RIBA 3).

SWAY

Overall sway

The deflection of the building due to design wind loads is limited to H/500, where H is the building height.

Sway deflection of any one storey

The deflection of each storey, to be accommodated by the perimeter cladding, is limited to h/400 where h is the storey height.

DEFLECTION

Full details of deflection criteria, foundation movement and tolerances will be provided in the WSP Movement and Tolerances Specification in RIBA stage 3.

Computer models will be used to determine vertical and horizontal deflections and ensure that they are acceptable for the specified finishes, cladding and tolerances.

Slab edge deflections

Deflection of the edge beams (due to variable loads) is generally limited to the lesser of span / 600 or 10mm and due to superimposed permanent + variable loads is limited to 12mm.

Internal deflections

Deflection of the internal floor beams is considered in three stages:

- Permanent load deflection due to self-weight of structure
- Superimposed permanent loads due to permanent dead load (ceiling, floor and services)
- Variable load deflections due to live loads which may be transient.

The variable load deflection criteria for all internal beams not supporting cladding is span/360.

The total deflection criteria for all internal beams not supporting cladding is span/250.

Basement wall deflection

The maximum wall deflection will be in the limits of 10mm to 30mm. Limiting values to be confirmed following existing assets requirements during the approvals process in the next design stages.

AXIAL SHORTENING

It is not necessary to adjust the construction of the structure due to axial shortening of the core and columns for a building of this height.

- For cladding deflection, the values from axial shortening shall be considered.
- Refer to movement and tolerance specification: the anticipated vertical axial shortening of Block K is 1-3mm per level, values shall be considered for cladding deflection

CONSTRUCTION TOLERANCES

- The tolerances, to which the structure can be constructed, together with the deflection of the floor slabs, will affect the space available for building services in the floor and ceiling voids.
- The tolerances adopted are based on the principles described in BS5606: 'Guide to accuracy in building' and the preferred tolerances published by the specialist trade associations. These will be summarised in the movement and tolerances report / specification to be developed in the next design phases.

MOVEMENT JOINT BETWEEN BLOCK K AND J

Total vertical	**+/-10mm**
Total horizontal	**+/-25.0mm**
Construction tolerance	**+/-15mm**

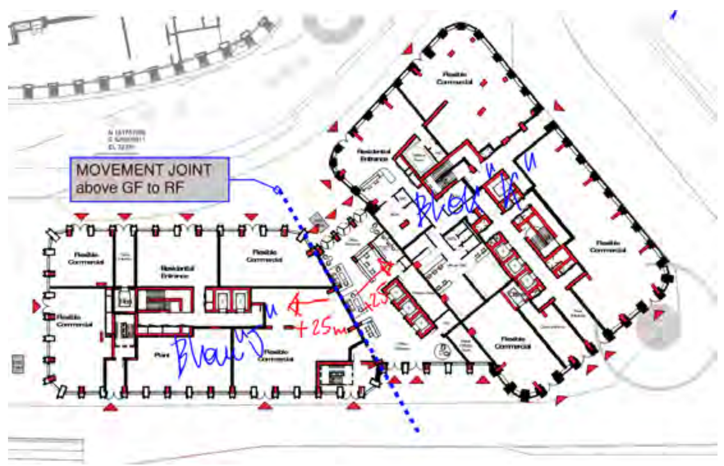


Figure 3-1 - Movement joint between Block J and K above G

3.6.2 TOLERANCES CONSIDERED FOR RIBA2 STAGE:

Superstructure:

Lifts internal dimension	+/-25mm
Elements position on plan	+/-10mm
Slab Levels	+/-10mm
Slab edge	+/-10mm
500mm deep RC Link Beams formed slip form and MEP under	Total 15.0mm soffit of link beams Total 10.0mm MEP tolerance under link beam

Basement:

Retaining structure pile walls on plan	+/-125mm
New RC Liner Wall on plan	+/-20mm
Existing D Wall on plan (not considered; survey to confirm existing)	+/-0.0mm
Slab Levels	+/-10mm
Raft Levels	+/-15.0mm
Lift pit levels	+/-20mm
Slab edge	+/-10mm

Foundation settlement

Core Block K	50.0mm
Core Block I&J	35.0mm
Perimeter Block K	40.0mm
Perimeter Block I&J	25.0mm

3.7 BASEMENT WATERPROOFING

- It's proposed the basement waterproofing system is similar to that on the constructed West End Gate basement.
- Grade 2 areas (carparking) waterproof concrete
- Grade 3 areas (habitable / plantrooms) requires 2 lines of defence a waterproof membrane and waterproof concrete

3.8 CRACK WIDTHS

- Superstructure & substructure crack width limit generally: 0.3mm

EARLY AGE CRACKING

- The concrete structure, particularly the slabs, will be subject to relatively large forces due to the expansion of the fresh concrete caused by the exothermic reaction of the cement hydration and then by the shrinkage as it cools and hardens. The amount of shrinkage is determined by the temperature drop which in turn is influenced by the cement content and type. The temperature drop is multiplied by the coefficient of thermal expansion of concrete (12 x 10-6) and the length of the element from the restraint to ascertain the contraction. This can be exacerbated by "locking" areas of slab between points of restraint and is mitigated by careful planning of the pour sequencing and the provision of additional reinforcement to control cracking where necessary.

3.9 MATERIAL PROPERTIES

SUPERSTRUCTURE

- Concrete columns C50/60
- Stair and lift cores C50/60
- PT slabs C35/45

BASEMENT

- RC Slab GF C32/40
- Liner Walls C32/40
- Raft C32/40
- Piles C32/40

TENDONS STRANDS

- 15.7mm diameter F_{py}=1580mPa and F_{se}=1200mPa

GROUT

- Grout for post-tensioning, around anchor bolts and under base plates is to be a non-shrink or expansive grout min 50mPa

REINFORCEMENT

- Reinforcement type 'H': grade 500, deformed type B conforming to BS4449.

4 PROPOSED CONSTRUCTIONS SEQUENCES

4.1 GENERAL

As advised by the Client the following construction phase is adapted at the time of writing this report:

- Demolish Existing Superstructure maintaining GF in place
- Start demolishing Existing basement from West to East (eg block I footprint towards block K)
- Start constructing NEW basement from West to East; including foundations and GF slabs
- Construct Block I –superstructure frame
- Construct Block K–superstructure frame
- Construct Block J–superstructure frame

4.2 EXISTING STRUCTURE DEMOLITION

Existing structure shall be demolished only to Ground Floor leaving the ground floor plate to act as a prop to the existing D Wall. This is important to maintain the integrity of the existing D Wall retaining structure.

Appropriate temporary works propping shall be provided for the existing D Wall prior demolition of the GF slab.

Existing foundation demolition and removals shall be approached with care to ensure existing D Wall toe is not undermined and cause excessive movement of the retaining structure.

4.3 BASEMENT CONSTRUCTION

The proposed construction technique is traditional: involving partial excavation while leaving soil berm around the perimeter of the existing D Wall, install propping prior to removal of the existing ground floor slab and basement to proposed excavation formation level.

Piling for the new foundations is suggested to be performed at or near the level of the existing building foundations approximately 1.0 to 3.0m below 29.7mAOD (TBC one existing footing form and level is confirmed).

It should be pointed out at this stage that due to racking props for perimeter walls, piling near the basement perimeter will require:

- Moving and adjusting of props to suit piling rig or spacing the props at such a distance that rig can access pile locations.
  Please note that columns are spaced at 6.0m and will required at least 4 piles at each location
- Horizontal wailer beams will also need to be adjusted/moved to allow for wall construction.

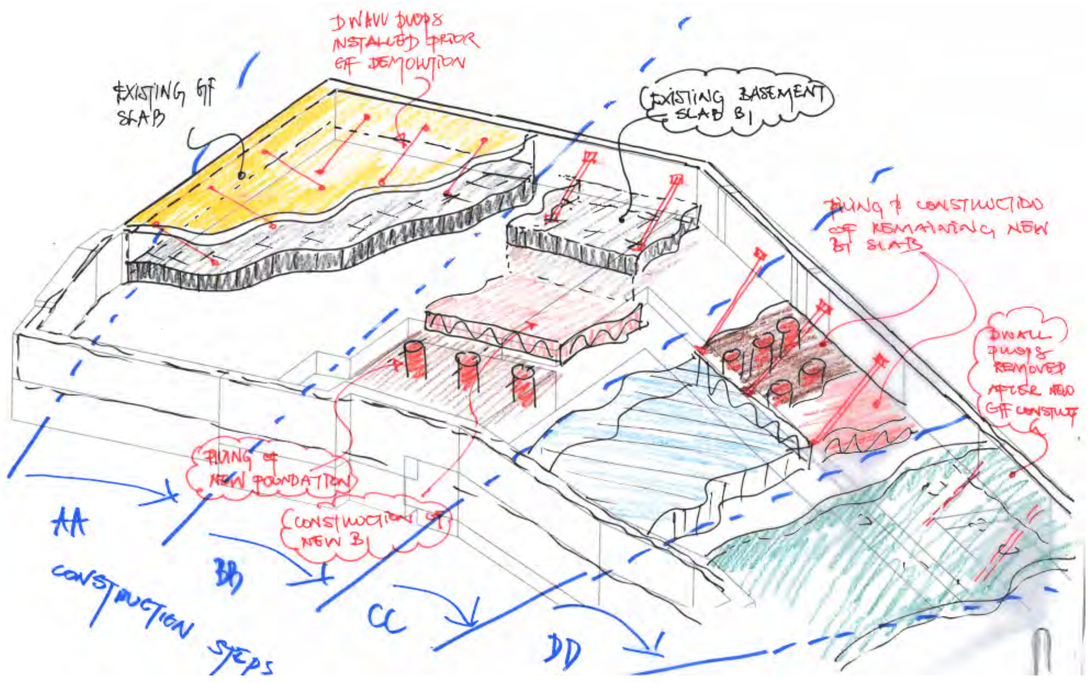


Figure 4-1 - Indicative sketch of new basement construction in 4 main work steps

Figure above summarizes the construction of new basement in 4 main steps:

AA: Propping of existing D wall while existing GF plate is in place;

BB: Demolition of GF and middle portion of existing B1 and foundations; piling and new foundation forming of basement slab

CC: Forming of remaining foundations near existing D Wall

DD: New GF plate construction following by wall propping removal

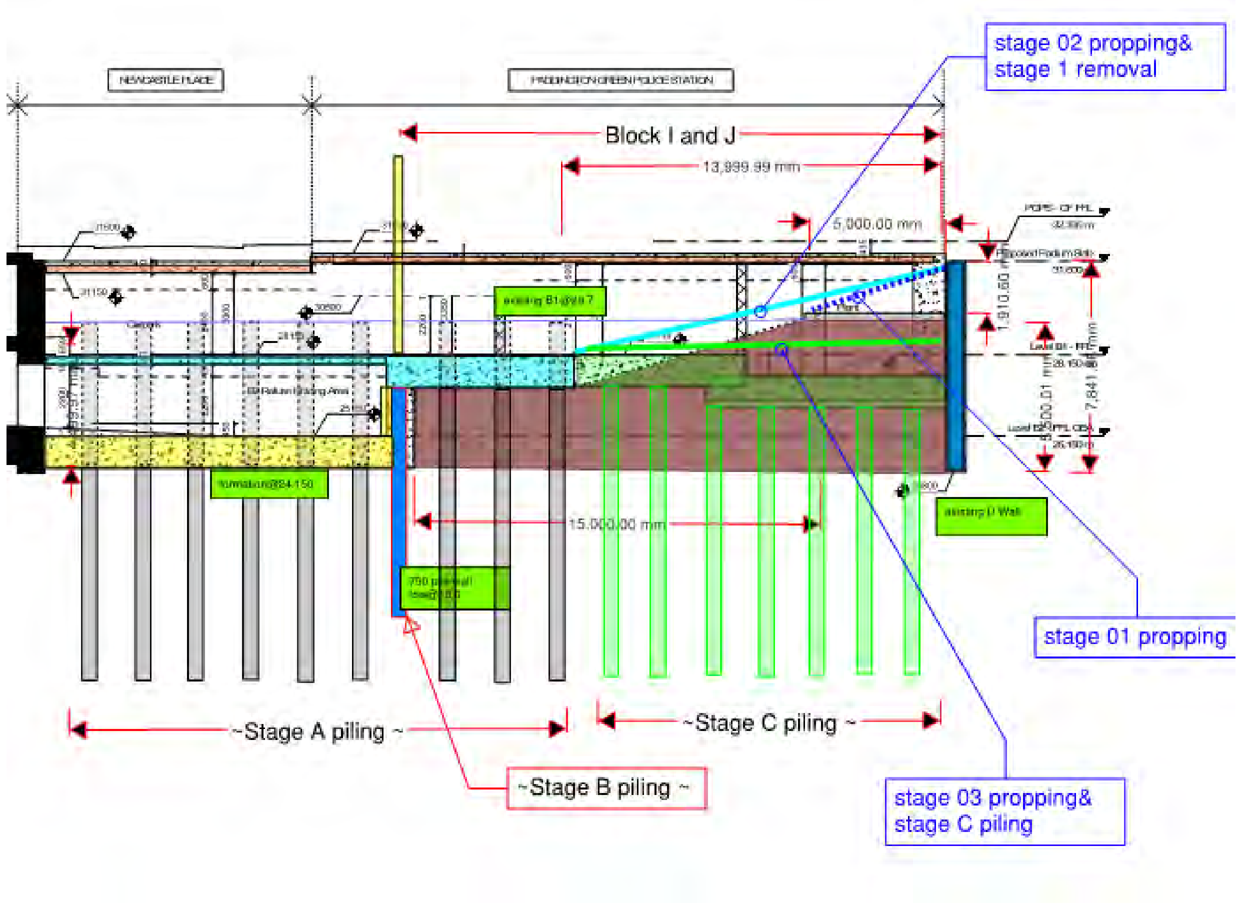


Figure 4-2 - Proposed construction sequence of New basement and existing D Wall

Construction methodology referencing figure above:

- Phase 1: Assuming existing basement is not demolished including GF slab, install inclined props stage 01
- Phase 2: Demolish existing GF slab
- Phase 3: Demolish part of existing B1 slab
- Phase 4A: Install bearing piles Stage A
- Phase 4B: Install secant wall Stage B piling
- Phase 5: Excavate to form B2 basement
- Phase 6: Construct part of new B1 slab/raft and install stage 02 propping/remove stage01 propping
- Phase 7: Partially Excavate remaining B1 and install stage 03 propping
- Phase 8: Fully Excavate remaining B1 and install stage C piling
- Phase 9: Construct remaining B1 and remove stage 03 propping
- Phase10: Construct the basement including GF slab
- Phase11: Remove stage 02 propping

NB: D Wall props will need to be removed and reinstalled/staggered more than once during the construction phases to allow for piling and liner wall construction. The proposed sequence is based on unknown D Wall reinforcement and concrete strength and assumed toe of 23.8AOD

4.4 SUPERSTRUCTURE CONSTRUCTION

The post-tensioned floor plates are constructed in traditional fashion with a 2 stage tensioning process with initial stage post tensioning at early stage of curing of concrete and then fully tensioned as per core and design requirements. The ducts will be fully grouted. The floor plates are not designed for load values larger than normal operational life purposes of the building.

Modular or precast form of construction could be looked into in further design stages for blocks I and J. Modular is unlikely to be a viable solution for Block K due to its size and layout.

5 CONSTRUCTION AND DESIGN RISKS

5.1 GROUND MOVEMENT

The toe of existing D Wall is situated above the subsoil clay layer and within the gravels, as a result of this water could be able to mitigate under the toe of the D wall; this water travel known as potential flow could cause ground movement. Potential cause of such flows is a burst water main. The current ground water level will only be determined once the SI is undertaken but based on the adjacent sites the main water table is lower than the existing basement level.

5.2 EXISTING DIAPHRAGM WALL

Temporary works engineer (TWE) is likely to require existing D Wall form and material properties in order to design the temporary works for the basement construction. This will establish the toe level, thickness of wall, concrete strength and reinforcement arrangement in order to ensure the wall behaves as per current loading profile on site.

The above described risk sits with main contractor.

5.3 OVER EXCAVATION AND UNDERMINING

The proposed foundation requires a formation level close to existing D wall toe level.

5.4 GROUND OBSTRUCTIONS

Demolition of existing foundation.

5.5 APPROVALS

- Building control – design calculations
- Insurance Provider - signing off the design
- London Underground Limited (LUL) – signing off Ground Movement Assessment & associated action plan
- Highways approvals re Flyover and Subways – signing off Ground Movement Assessment & associated action plan.
- Thames Water – GMA approval
- Electricity providers – substations and services diversion if any

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