CONQUIP ENGINEERING GROUP

Temporary Works Design

Project Number:	**ZP21-0103**
Project:	**247 Tottenham Court Rd**
Client:	**Deconstruct**
Calculations of Justification:	**Propping Design**
Date:	**16/05/22**

Document control

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Document Checking:

Revision	Date	Notes	Prepared by	Checked by	Approved by
T01	16/05/22	Tender Issue	GZ	NB	NB

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Figures

1 Introduction

Conquip have been asked by Deconstruct to design the propping system for the excavation at 247 Tottenham Court Rd as shown below. Level 1 props to be bolted directly onto concrete corbel above the capping beam and Level 2 props will be bolted onto a waling beam.
Two different pile wall designs have been provided by Deconstruct. Based on these two different pile wall designs provided, two options have been proposed by Conquip. See section 6.

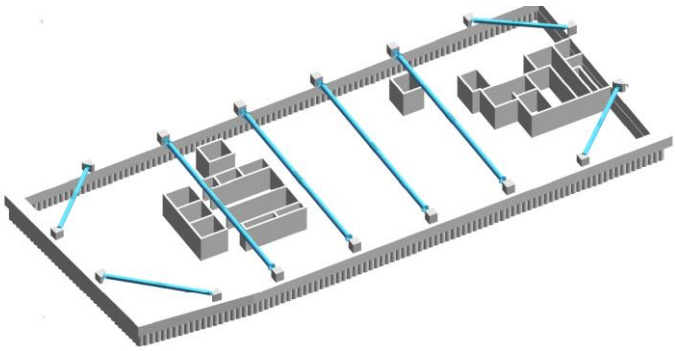

FIGURE 1: PROPPING LAYOUT - LEVEL 1

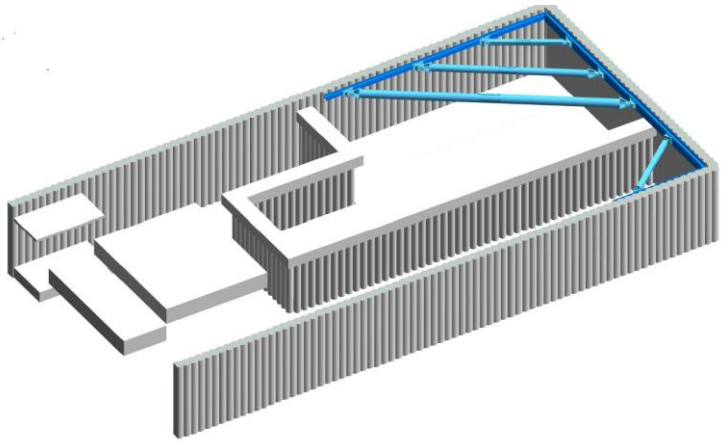

FIGURE 2 PROPPING LAYOUT - LEVEL 2

The retaining wall comprises of a Secant Piled Wall and capping beam designed by others. This design covers the following elements:

- Analysis of prop arrangement and prop specification
- Prop Connections

2 Standard

The structural design has been carried out in conformity with Eurocodes. The props will be designed in ultimate limit state (ULS) and the limit of the deflection to the criteria L/250 at serviceability limit state (SLS).

Standards

- BS EN 1991- Eurocode Actions on Structures
- BS EN 1992-1-1 2008 - Rules for buildings

- BS EN 1993-1-1 Design of Steel Structures to Eurocode
- BS EN 1993-1-8 2005 - Design of joints
- BS EN 1992-4:2018 – Design of fastenings for use in concrete

Guides

- Joints in steel construction: Moment-resisting joints to Eurocode 3
- C760 - Guidance on embedded retaining wall design

3 Information Received

This propping scheme has been designed based on the following documentation / information provided:

- 2176-A2S-XX-XX-CA-Y-0001-00 TCR Pile Wall Design
- 4190-AKT-ZZ-ZZ-M3-S-00001_sam
- 4190-AKT-XX-XX-DR-S-00012
- 4190-AKT-ZZ-00-DR-S-21000
- 4190-AKT-ZZ-00-DR-S-21001
- 4190-AKT-ZZ-B1-DR-S-20990
- 4190-AKT-ZZ-B2-DR-S-20950
- 4190-AKT-ZZ-B2-DR-S-20980
- 4190-AKT-ZZ-ZZ-DR-S-25100
- 4190-AKT-ZZ-ZZ-DR-S-25101
- 4190-AKT-ZZ-ZZ-DR-S-25200

4 Loading

4.1 Load Cases

CONQUIP have taken guidance from CIRIA C760 and have considered the following load cases for the temporary propping design:

- Load Case 1 – $\gamma_g G_k + \gamma_g G_{k,GEO} + \gamma_Q \Psi_0 Q_{k,temp}$
- Load Case 2 – $\gamma_g G_k \xi + \gamma_g G_{k,GEO} \xi + \gamma_Q Q_{k,temp}$
- Load Case 3 – $G_k + G_{k,GEO} + \Psi_0 Q_{k,temp} + Q_{k,accidental}$

From EC0, the following partial factors have been adopted:

- $\gamma_g = 1.35$
- $\gamma_Q = 1.50$
- $\Psi_0 = 0.60$
- $\xi = 0.925$

4.2 Design loadings

Deconstruct have provided design loading applied to the capping beam and waling beam. Two different Pile wall designs, i.e 750mm and 900mm pile diameter, have been provided by Deconstruct.

Design Section	SLS Temporary Prop Forces (kN/m)		SLS permanent Slab Forces (kN/m)		
	Temp Prop 1	Temp Prop 2	B2 Level	B1 Level	GF Level
SW01-A	109	-	-	125	107
SW02-A	123	-	179	197	116
SW03-A	103	172	298	417	84
SW04-A	103	172	298	417	84
SW01-B	138	-	-	140	115
SW03-B	122	455	588	474	98
SW05-B	122	455	588	474	98
Contiguous (B1-B2)	55	-	-	91	-

FIGURE 3: DESIGN LOADINGS – PILE WALL WITH 750MM PILE DIAMETER

Design Section	SLS Temporary Prop Forces (kN/m)		SLS permanent Slab Forces (kN/m)		
	Temp Prop 1	Temp Prop 2	B2 Level	B1 Level	GF Level
SW01-A	108	-	-	123	110
SW02-A	132	-	112	186	128
SW03-A	119	148	271	403	100
SW04-A	119	148	271	403	100
SW01-B	117	-	-	138	113
SW03-B	142	225	519	437	123
SW05-B	142	225	519	437	123
Contiguous (B1-B2)	55	-	-	91	-

FIGURE 4 DESIGN LOADINGS – PILE WALL WITH 900MM PILE DIAMETER

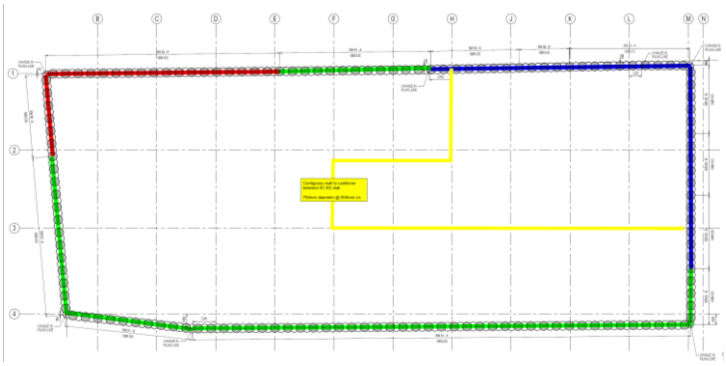

FIGURE 5 DESIGN SECTIONS

4.3 Thermal Loads

Thermal loading will be considered for the design of the props in accordance with CIRIA C760, whereby:

- $Q_{k,temp} = \alpha \Delta t E A \beta$
- $\alpha = 12x10^{-6}$ /°C
- $\Delta t = 15°C$ (assumed)
- $E = 210kN/mm^2$
- $A = 24301mm^2$ (400s), 29858 (600s), 37498 (800s)
- $\beta = 0.50$ (Stiff wall in stiff ground)

Based on the above thermal loads will be considered:

- Conquip 400S – 459.29 kN
- Conquip 600S – 564.32 kN
- Conquip 800S – 708.71 kN

4.4 Accidental Loads

An accidental load of 10kN at prop midspan is considered on all the props.

5 Construction Sequence

- Install secant piles from a platform
- Construct Capping beam and corbel
- Install temporary props level 1 at Corbel level
- Excavate to formal level B1
- Install secant piles and Construct Capping beam and corbel
- Install temporary props level 2 at Corbel level and waling beam
- Excavate to formal level B2
- Cast basement slab B2
- Cast liner wall and permanent structure from basement B2
- Cast basement slab B1
- Remove temporary props level 2
- Cast liner wall and permanent structure from basement B1
- Cast ground floor
- Remove temporary props level 1

Details to be confirmed by the contractor

6 Props Design Summary (Tender Stage)

6.1 Tender Stage Layout

The following figure shows the propping layout proposed by Conquip.

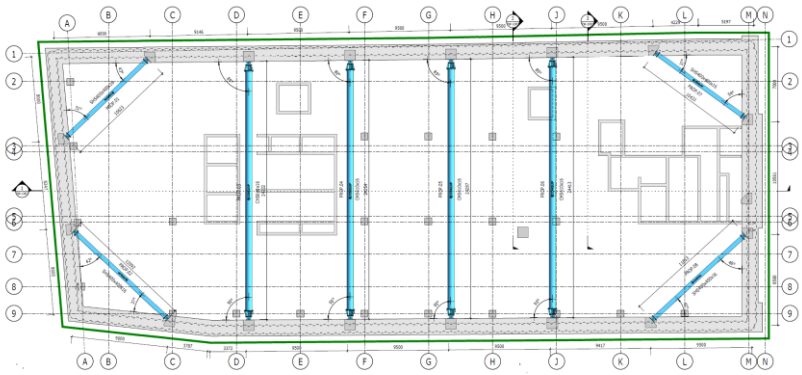

FIGURE 6 PROPPING LAYOUT - LEVEL 1

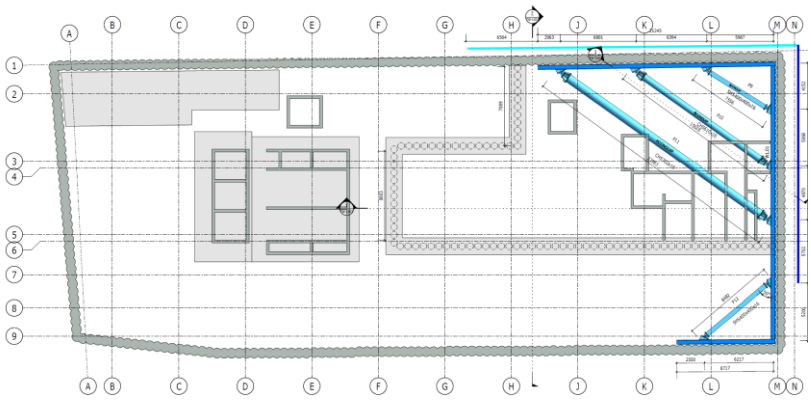

FIGURE 7: PROPPING LAYOUT - LEVEL 2

6.2 Ancillary Items

6.2.1 Option 1 – Pile wall with 750mm pile diameter

Level 1

P1 – P8 - Props to be bolted directly onto concrete corbel above the capping beam - **4No. M24 per connection**.

Level 2

Props to be bolted directly onto the waling beam. **4No. M24 per connection**.
Total length of 80m waling beam is required - **UC356x406x340**. On the east side of the wall, the waling beam will be double stacked to minimise the deflection.
Gallow brackets are required to support the waling beam. 25No. gallow brackets.

Shear stop – 6No. type 2 and 2No. Type 3

Shear keys are required to take the shear force on the north and south side of the wall. 9No. shear keys (UC356x368x202 250mm long). Based on 9No. shear keys, each secant pile that a shear key will be fixed into, is required to be capable of resisting a shear force of 1300kN. Pile wall designer to confirm suitability.

6.2.2 Option 2 – Pile wall with 900mm pile diameter

Level 1

P1 – P8 - Props to be bolted directly onto concrete corbel above the capping beam - **4No. M24 per connection**.

Level 2

Props to be bolted directly onto the waling beam. **4No. M24 per connection**.
Total length of 55m waling beam is required - **UC356x406x340**.
Gallow brackets are required to support the waling beam. **25No. gallow brackets**.

Shear stop – 6No. type 1 and 2No. Type 2

Shear keys are required to take the shear force on the north and south side of the wall. **5No. shear keys** (UC356x368x202 250mm long). Based on 5No. shear keys, each secant pile that a shear key will be fixed into, is required to be capable of resisting a shear force of 1300kN. Pile wall designer to confirm suitability.

6.3 Summary of Design details

Option 1

Average stiffness of propped wall
- Level 1= 55,000 kN/m/m.
- Level 2= 60,000 kN/m/m. Pile wall designer to confirm suitability.

Max deflection of capping beam = 6.6mm (Capping beam designer to confirm if there is a deflection limit requirement) and waling beam deflection= 19.7mm.

Option 2

Average stiffness of propped wall
- Level 1= 55,000 kN/m/m.
- Level 2= 60,000 kN/m/m. Pile wall designer to confirm suitability.

- Capping beam designer to confirm capping beam reinforcement is suitable to resist prop loading.
- Max deflection of capping beam = 6.6mm (Capping beam designer to confirm if there is a deflection limit requirement) and waling beam deflection= 13.7mm.

7 Residual Risk Assessment

The contractor should note the below risks relating to this scheme. A full risk assessment should be carried out by the contractor to determine further risks specific to the particular site.

- Overdig – exceeding dig levels stated in the pile wall design could lead to excessive loading of the piles/props that could lead to excessive deflection or even failure.
- Prop installation/removal – Props should be installed and removed at suitable stages as determined by the pile wall design – working at height should be avoided if possible. Prop installation/removal should be carried out by competent individuals using suitable lifting equipment and following installation guides provided by Conquip. The installation should be checked and signed off by a qualified engineer.
- Striking Props during excavation – Care should be taken to avoid striking props during the excavation of the basement and installation of the permanent structure. Any striking of props should be reported to Conquip to be assessed. An accidental loading of 10kN at prop centre is applied for design.
- Failure by sliding of waler beam: Waler beam to be welded to the shear keys that will be fixed into the pile wall.
- On site welding – for fixing the shear keys to the waling beam, on site welding is required. Contractor to ensure on site welding is carried out by a qualified welder.
- Packing behind waling beam – Contractor to ensure suitable concrete is used to pack any gaps behind the waling beam to ensure evenly load distribution from the piled wall to the waling beam.
- Grouting of secant pile – Contractor to ensure suitable concrete is used to grout gaps after fixing the shear keys into the secant pile to ensure the shear force can be evenly transferred from the waling beam to the piled wall.

Approval of Temporary Works Design

Our Client:	
Project Name:	
Principle Contractor:	

We trust the temporary works design meets all the requirements for this project. To confirm this and in order for us to proceed with the manufacturing and delivery phase, please read and put your signature to the statement below.

As the signatory below, I confirm that this temporary works design has been reviewed and has been approved as meeting all criteria and requirements set out for this project.

On behalf of: - Client Name

Name:	
Position in the company:	
Signed:	
Date:	

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