Work Procedures

For

Temporary support, Demolition, Underpinning, Piling, Excavation, Substructure, Superstructure

Project / Contract	42 Elsworthy Road
Contractor	Kutz Limited
Site Address	42 Elsworthy Road
Project Start Date	TBC
Expected Duration	TBC
Projected Completion Date	TBC

	Name	Title	Signature	Date
Document Author	Masoud Farahani	Director	M.F	27.07.2022
				21.11.2022
				20.12.2022
	Yiannis Babos	Site Manager	Y.B	12.01.2023
				17.01.2023

Emergency Contact Details			
Contact	Ali Poladi	Masoud Farahani	Yiannis Babos
Mobile	07973167545	07973256462	07805817742
E-mail	info@kutzlimited.com	info@kutzlimited.com	Yiannis.babos@kutzlimited.com

Contents Page

Date : 17.01.2023
Rev : 4

1. General Information Prior Commencing of Works

1.1 General Sequence of Works

1. Temporary Supports/Propping (Site Specific RAMS to be obtained from Nominated Contractor prior to commencement)

2. Demolition works (Site specific RAMS included from the main contractor KUTZ ltd)

3.Pilling (Site Specific RAMS to be obtained from Nominated Contractor prior to commencement)

4.Capping Beam Works (Site Specific RAMS to be obtained from Nominated Contractor prior to commencement)

5.Construction of stage 1 of Underpins and backfill (Site Specific RAMS to be obtained from Nominated Contractor prior to commencement)

6. Construction of new lower ground floor RC beams and RC slab (Site Specific RAMS to be obtained from Nominated Contractor prior to commencement)

7. Excavation of previous backfill, and progress with stage 2 of underpin construction, reaching level needed for basement (Site Specific RAMS to be obtained from Nominated Contractor prior to commencement)

8. Construction of basement RC ground beams , RC slab , RC lining walls and RC columns.

9. Superstructure works steelworks (Columns and beams) and re-arrangement of existing house as per Architect design.

1.2 Plant to be utilised

- 1 x 360 excavators
- Skip delivery lorries
- Dumper
- Concrete pump
- Compressor and breakers
- Spade gun and chisels
- Poker vibrator unit
- All plants will be operated by fully trained personnel holding CITB certificates of competence
- For other specific plant refer to subcontractors RAMS in Chapter 4.

1.3 Site Security

The main site access gate is located in 42 Elsworthy Road side and will be secured during the working day and locked and secured out of hours

At no time, will members of the public be permitted onto site in accordance with the Health and Safety Executive Guidance Note GS7.

1.4 Office and Welfare Facilities

Mobile site office will be erected to the proposed location **(Refer to Appendix A**), anybody wishing to gain access to the site will have to report at the site office and sign in.

Signage will be positioned to inform any visitors of the location of the site office

The site office will also act as the First Aid Point where a full site first aid kit will be maintained at all times

Temporary mess facilities with both hot and cold running water, drying facilities, table and chairs for use as site canteen and temporary W.C's will be installed on site. **(Refer to Appendix A)**

1.5 Site Induction

All foremen, including those working for subcontractors are to ensure that all their operatives have been issued with and have the read the contents of all our Contract Method Statements. It is imperative that they fully understand how the works are to be carried out safely and their role in achieving this aim.

Our company Health & Safety Policy and Procedures document explain all levels of staff and operative responsibilities. This document is brought to the attention of all staff and operatives at induction.

The method statements, Health & Safety Policy and Procedures and the contract Emergency Procedures form the basis of the site induction. All attendees will be asked to sign that not only have they attended but also understand all matters especially their role on the project.

Tool box talks will take place on a weekly basis on varied topics or more often when a specific matter needs to be covered relevant to the works. Attendees to these will be asked to sign to confirm their attendance and understanding of the topic.

1.6 Statutory Authorities

All services feeding site to be terminated, will be cut off outside of site boundaries prior to works.

1.7 Haul Routes

The access to the site in 42 Elsworthy Road will remain unobstructed at all times. 'Fire paths' for emergency vehicles will continue to be fully operational throughout the duration of the works.
In periods of dry weather, haul roads will be dampened down to prevent dust arising from moving vehicles.
In periods of wet weather a mobile steam cleaner and or road sweeper will be used as and when required to ensure the haul routes and surrounding roads are kept clean.

1.8 Site Hours

Site hours will be:

Monday to Friday 08:00am - 18:00pm
Saturday 08:00am - 13:00pm
Bank Holiday and Sunday working will not be permitted.

2. Hazards and Control Measures

2.1 General

Prior to any works commencing, all operatives will be site inducted and provided with both verbal and written information regarding site hazards. Only competent operatives will be allowed to work onsite, providing all relevant cards/qualification(CSCS e.t.c)

- Entering slew of machine – skilled labourer to attend machine at all time
- Deep excavations – Batter back sides of excavation and fence off all open excavations
- Using petrol skill saw – to be used by skilled labour only
- Handling concrete/cement – COSHH requirements to be adhered to
- Reversing vehicles – Attended always and high visibility jacked to be worn at all times
- Noise and Vibration – Ear defenders and goggles to be worn
- Movement of lorries – Banks man to direct all lorry movements
- Working on live drains (Weils disease) – Operatives to wear PPE
- Live services - Prior excavation works contractor to check and remove any services by the use of CAT scanner , visual inspections and services as built drawings of current property.
- Working at Heights - refer to risk assessment
- Manual handling - Avoid any heavy manual handling by the use of equipment or plant , manual handling training/instructions through tool box talks.

2.2 General Execution

All works will be executed in accordance with current Health and Safety Executive requirements, BS 6187 (2000) and HSE Guidance Notes GS29 1, 3 & 4 and more generally will comply with the following where relevant to works:

- Construction (Design & Management) Regulations 2007
- The Provision and Use of Work Equipment Regulations 1992/98 (as amended) (PUWER)
- The Lifting Operations and Lifting Equipment Regulations 1998 (as amended)(LOLER)
- The Construction (Health, Safety and Welfare) Regulations 1996
- The Heath and Safety at Work etc. Act 1974
- The Management of Health and Safety at Work Regulations 1999
- The Personal Protective Equipment at Work Regulations 2002
- Working at Heights Regulations 2005
- RIDDOR 1995
- COSHH Regulations 2002
- The Control of Pollution Act 1974
- Control of Pollution (Amendment) Act 1989
- The Environmental Protection Act 1990
- The Health and Safety (First Aid) Regulations (1981) (as amended)
- Manual Handling Operations Regulations 1992 (as amended)
- Control of Lead at Work Regulation 2002
- Protecting the Public – Your Next Move
- Control of Asbestos at Work Regulations 2006

2.3 Preventative Measures

Work Permits

All operations which involve work in confined spaces, work on or near live services, work on or near non-inert gases, work at heights in the proximity of moving plant/equipment, hot work in hazardous areas, maintenance of energised plant or systems or work involving specific hazards and requiring unusual control measures will be covered by a Permit to Work.

Each permit issued will cover precautions to be taken prior to commencement of work, during the work and on completion of work

Each permit will be issued by a competent, trained person. They will be knowledgeable in all aspect of the work and, particularly in the precautions required to prevent risks to all health and safety of personnel and damage to plant/equipment etc.

Each permit issued will be allotted a limitation of time. When this time expires, work will cease and, if uncompleted a new permit will be requested.

Work carried out under a permit will be executed by competent, trained personnel.

Each permit issued will be signed by the issuing authority and will state that all necessary precautions are in place. It will be countersigned by the person responsible for carrying out or supervising the work as an acknowledgement that he understands and will comply with the requirements of the permit.

Where necessary the issuing authority will visit the works area with the recipient of the permit to ensure that the necessary arrangements are made.

A copy of the permit will be retained in the work area. The original will be retained by the issuing authority.

On completion of the work or on expiry of the permit the person in charge of the work will sign a clearance statement at the bottom of the permit to confirm that work has closed and all personnel are withdrawn. The issuing authority will sign a statement stating that all copies of the permit are cancelled.

On termination of the work (or 1 hour later in the case of hot work) the issuing authority will visit the area of the work to ensure that the area has been left in a safe condition.

PPE

As with all site works, hard hats will be worn at all times together with hi vi's, steel toe footwear suitable for site work. Goggles and gloves are not mandatory at all times unless stated for specific work tasks. Protective equipment will be made available as required.

Smoking

At no time will smoking be permitted on site except within clearly defined areas.

Certificates - Training

All plant operative will hold a current CITB certificate for the type of plant they will be operating, General labourers will hold a current CSCS card and operatives for specific tasks(scaffold operatives e.t.c) will hold a current CITB certificate/qualification for the specific task. Our Company policy is to continuously upgrade and maintain high levels of training by providing toolbox talks. Copies of safety certificates will be available on site at all times.

First aid

First aid kit will be kept in the site office.

Dust

In common with all construction projects, dust control and suppression is given a high priority. All parties are aware of the 'sensitive' location of the site.
Throughout all demolition, excavation or other operations that have the potential to create dust, sufficient damping down will be carried out, should the need arise, by water cannons fed from a hydrant and our on site pumping equipment. This will minimise dust escape. Water being used for dust suppression will be delivered to the required location as a fine mist spray. This will reduce the need for vast amounts of water being used.

Diesel Storage

All diesel fuel required to operate machinery will be delivered to site either in suitable, locked 2005 litre barrel containers. Diesel will be stored in a suitable fuel tank(s), which is secure, lockable, bunded and with drip tray. The tank(s) will be kept on hard standing areas, away from any watercourses or open drainage systems. Vehicles will re-fuel by gravity feed from this point. The bund volume around the tank will be sufficient to take the full volume of the tank in the event of an emergency spillage. Any such emergency spillages or waste fuel/spillages into drip tray will be pumped into 205 litre barrels and removed from site to our operation yard where the waste fuel will be collected for disposal along with all our other company waste fuels and oils.

Fuel spillage emergency procedure

In the case of a spillage/leak of any fuels or oils, the following procedure should be adopted.

1. Immediately report incident to manager/supervisor. Manager/supervisor should contact a) fire bridge/police **999** the Environmental Agencies **0800-807060,** sewerage undertaker, Local Authority Environmental Health Dept etc.
2. Try to identify the source of pollution and stop the flow immediately. Switch off sources of ignition.
3. Avoid the spillage spreading
    - Check the site drainage plan – where will the spillage go
    - Stop the flow if possible
    - Dam the flow with earth/sand/polythene
    - Divert from drains/watercourses where possible
4. Gain access to spill kit within main site office. Use absorbent materials if appropriate. Place boom across watercourses as a precaution.
5. DO NOT wash spillage into drainage system. DO NOT use detergents. USE sand, absorbent material/mats to mop up.
6. Block off drains even if spill has already entered system.
7. Liquid spillages entering on site settlement tanks to be removed by specialist liquid disposal contractors.

Working at heights

A general risk assessment has been produced by the main contractor when working at heights. Operatives shall read and understand the risk assessment prior any work at height activity.

Manual handling

All members of staff have been instructed on the potential dangers of manual handling and will not lift items or equipment beyond their capabilities. Heavy or awkward items will be broken down into smaller units or dual lifted where this is not possible. It is the responsibility of the site foreman to assess every situation that requires manual handling and enforce control procedures where he/she deems necessary, where practical, mechanical aids should be available and used.

Contractor / Visitor Safety

Kutz Limited will liaise with other contractor's staff on a day to day basis and ensure they are aware of the risks present during the works. Staff and contractors will not leave any area of work in a dangerous condition or with risks to themselves, other contactors, tenants, or visitors. All tools and equipment will be cleared to secure storage at the completion of each shift. Scaffold, ladders and any other access to height will be made inaccessible.

Tools and Electrical Equipment

All items of tools and equipment will be visually inspected on a regular basis and , prior to use, defective or damaged equipment will be removed from service. Electrical tools will be 110V maximum, battery powered tools will be used where possible. Subcontractors will not be allowed to bring on to site any damaged or defective tools, the site foreman is responsible for ensuring all tools and equipment brought on the site are fit for purpose.

3. Method Statements

3.1 Generic Scope of Works

- Temporary Support
- Demolition works
- Foundation work for extension on west side and steelworks
- Underpinning
- Bulk excavation works
- Basement Concrete slab and wall/column works
- Lower Ground floor suspended RC slab
- Superstructure

3.1.1. Temporary Support

Temporary support will be installed in order to support the existing wall on grid line E and propping to underpinnings.

Please see Appendix B

3.2.2. Demolition works

Demolition will involve the complete removal of the roof.

All extensions on the west side of the house as well as the walls specified in drawings.

All demolition works will be carried out in accordance with the ICE demolition protocol 2008.

Fencing, barriers and signage will be placed around the perimeter of the site.

Existing brick boundary wall on the west side and part of north side of the site will be used as hoarding for the side. The rest of the north side will be hoarded with an access gate for site traffic and pedestrian access door. (Please see Appendix A for Site Logistic Plan).

All site operatives will be inducted and made aware of the site specific hazards.

The construction of the crossing will be done as per Site Logistic Plan. The existing footway will be removed and excavated to a depth of 225 and backfilled with concrete. The concrete will form a ramp up from the carriageway and will be laid flush with the adjoining footway, with a textured surface that is safe for pedestrians.

During construction of the temporary crossover, the works will be signed and guarded and will be carried out by a competent professional.

The permanent reinstatement of the crossover will be carried out by Camden Council.

Capping of all service supplies will be carried out. All such works shall only be undertaken with the prior agreement and approval of the relevant utility companies.

All soft stripping has already been carried out by others.

After the temporary support has been installed, secured, tested and signed off by competent operatives.

Demolition works will commence from the roof and working our way down.

Roof tiles manual handling removal using the perimeter scaffold as a safe access.

Protection scaffold edge will be installed on the perimeter of the roof. Roof tiles will be bagged and safely lowered to the ground floor level into the skip for site removal.

Roof timber frame manual handling removal by using hand tools. Access through scaffold, safely lowered on the ground floor into the skips for site removal.

Removal of walls as per Architects Demolition drawings and removed from site. This task will involve manual handling and all operatives will be instructed and informed (site induction, tool box talks) on how to safely undertake the task. Hard hats, steel toe shoes, hi-vis and gloves must be worn (P.P.E). Debris to be watered for dust control.

Protective barrier above boundary wall on the east side to protect adjoining property.

3.2.3. Foundation Work

Foundation work for patio retaining works will be done using a small digger.

Ready mix concrete will be pumped to form foundations for retaining walls.

3.3.3. Piling/ Capping Beam

All operatives will be site inducted and briefed about the nature of works , main contractors health and safety rules , welfare facilities , site access/egress.

PPE(hard hats, steel toe shoes, hi vi's,) must be worn at all times in the working zones Gloves and Eye protection when handling concrete. Leather gauntlet gloves and a welding mask to be worn whilst welding.

Segregate pilling area from other operators and make sure that there are no overhead or buried services.

Ensure that the ground is leveled for the rig machine.

Piling drilling sequence and location as per piling sub-contractor RAMS.

During drilling and concrete casting the area has to be clean and tidy.

Vehicles involved to the piling works have to jet washed while standing in the concrete ramp prior exit from the site.

Banks man to be present and guide access/egress of vehicles.

Hit and miss technique will be used during rig drilling to avoid any soil collapsing into the adjacent bore holes

Position the piling rig over the first pile position and check that the mast of the rig is vertical and adjust as necessary and insert auger bung.

Commence boring and ensure stability of rig throughout boring.

Mix the primer pump up in the concrete pump hopper and send down the concrete hose line to lubricate ready for the concrete.

Bore to designed length as will be indicated on piling sub-contractor drawing adding augers as necessary using the auxiliary winch and dolly. Record final depth on Pile Record Sheet.

Start concrete pump and begin to discharge concrete into hopper, ensuring that only sub-contractor personnel are within the work area.

Send concrete down the auger to knock out auger bung.

Commence pumping concrete whilst raising the auger, maintaining a steady pressure, stopping the pump to remove augers as necessary, using a tested and certified soft sling and shackle on the excavator with its digging bucket removed.

Repeat this process until the concrete has reached the top of the pile.

The excavator clears the pile spoil away carefully down to pile mat level, clear any spoil that may still be in the top of the concrete with a shovel. The reinforcement cage is then either manually lifted into position or lowered by the excavator or the rig service line into the wet concrete and pushed down by stepping on the helical binder. Should the reinforcement cage not enter the concrete by this means the excavator will be used to press it into the wet concrete. Banks man will ensure correct projection and cover spacers are in place.

The bars and helical will be assembled into cages using purpose made stands onto which bars are loaded to give stability. As each cage is completed it is removed from the assembly stands either by hand in the case of lightweight cages or by crane/excavator for heavier cages.

After fabrication, the cages are to be stored on timbers or clean hardcore to avoid contamination by soil.

Heavyweight cages need to have strengthened lifting points to enable them to be moved and lifted safely. This will normally consist of three turns of helical securely wired or welded to each main bar. Note: Heavy weight cages will generally be prefabricated and delivered to site.

Attendant excavator to be utilised to move cages to the piling rig.

Cage steel reinforcement to project over the end of the piles for capping beam anchoring.

Capping beam formwork and steel reinforcement.

Capping beam concrete pouring.

3.3.4. Underpinning

The underpins are constructed in 2 stages. The design presented here allows the basement excavation to the main basement level.

The first stage of underpin is constructed in a hit and miss sequence before the new lower ground slab and beams. Therefore, when these underpins are completed and the excavation under the top-down slab happens, the underpin will be propped at the top by the top-down slab.

After the top-down slab is constructed, the ground under will be excavated leaving 0.6m embedment for the 2.6m underpins cast in stage 1. Stage 2 will be constructed in a hit and miss sequence.

Stage one can reach 2.6 m depth. 0.6 m embedment must be maintained when excavated to ensure stability and bearing pressures is kept within a safe value. Back of the underpinning will be aligned with the back of the existing boundary wall face.

Stage two Stage 2 underpin is designed to achieve the excavation to the formation level of the basement B1 slab. An excavation of approx further 2.5 m is required.

Prior to works all operatives involved in this task will be site inducted and Informed/Instructed regarding all points in Chapter 1 and 2 of this document. Back of the underpinning will be aligned with the back of the existing boundary wall face.

3.3.4.1 Stage one underpinning

Set out underpins in max. 1.2 metre wide bays in hit and miss fashion numbered 1, 3, 5, 2, 4. Construct all No. 1 pins and dry pack, then move onto No. 2, then No. 3 etc.

Hand excavate to approximately 0.5m then install trench sheeting to face of excavation.

Once trench sheets are in place install trench prop and proceed with excavations to a maximum depth of 2.1m from reduced working platform level.

Remove existing mass concrete strip footing by the use of a diamond cut saw and cut back existing brick corbel by hand.

Clean up excavation by hand and clean underside of existing wall footing of any loose material.

The ground conditions provided in the soil report show the soil at the depth to be dry clay. Although relatively stable in nature care should be taken to remove any water that occurs due to run off that will soften the strata.

After installation of 125mm thick Cordek Filcore to the back of the underpin and reinforcement steel , fix timber shutter to the face of underpin. Brace back to trench sheets using props for support.

Concrete to be delivered to site in ready mix trucks and place using mini excavator up to 75mmn below existing footing. Vibrate concrete with electric vibrators to compact.

24-hrs after pouring underpin, strike the shutter and dry pack from the top of underpin to underside of existing footing.

Dry pack to consist of sharp sand, cement and anti-shrink additive rammed tight within the 75mm void.

Commence No. 3 underpins and repeat 4 steps above.

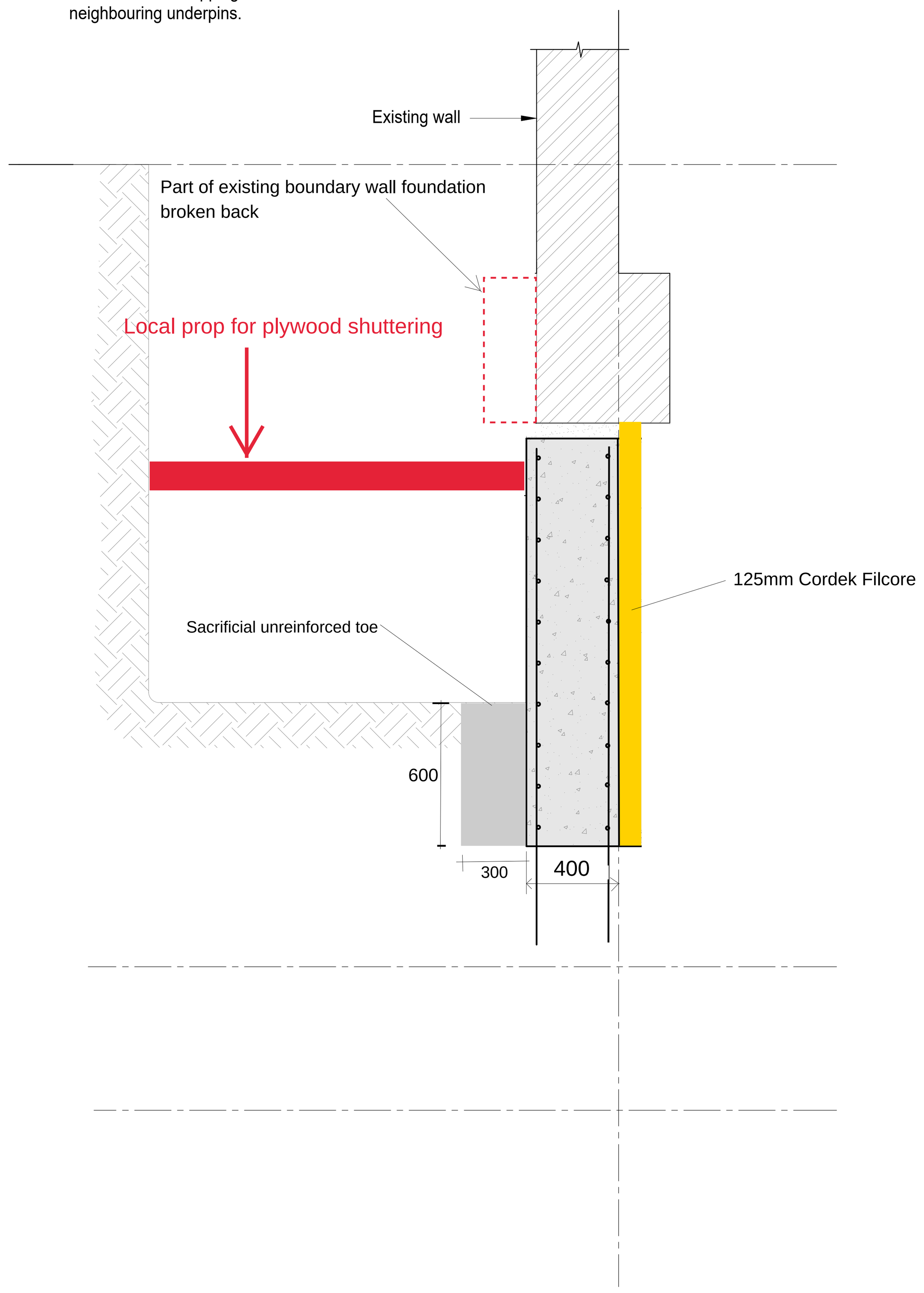
Follow procedure for all underpins ensuring adjacent pins have been dry packed and cured at least 48 hours before excavating next to them.

NOTE: The underpinning sections adjacent to the boundary wall in the rear and front lightwell only will need to be temporary supported @ high level with a waler beam UC 203X203X52 and braced with horizontal and corner steel struts with minimum SWL 150KN. These areas are open without a permanent slab to provide support as the majority of the rest underpinning inside the building footprint.

Stage 2 underpinning

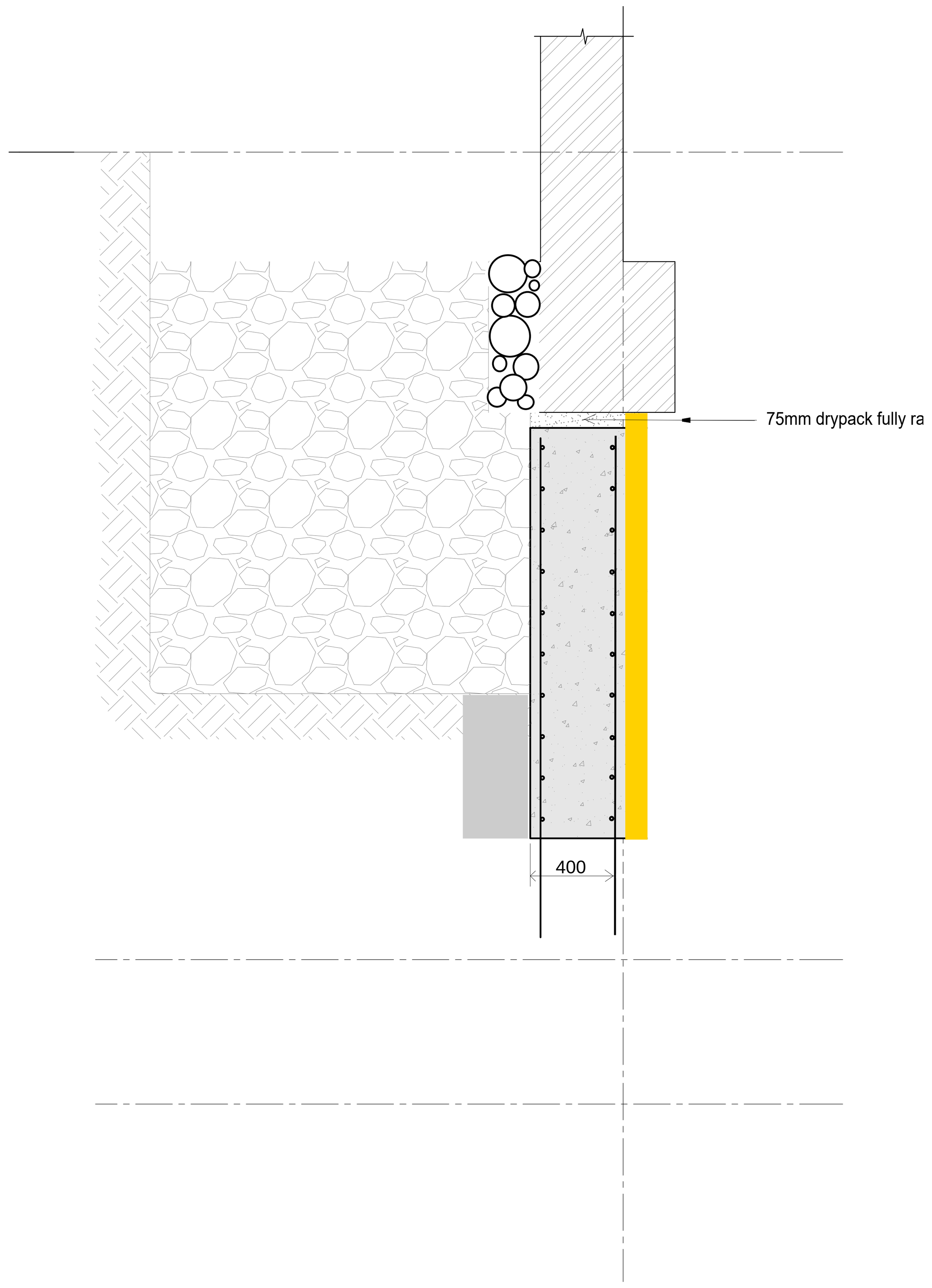
The methodology and sequence will be the same as underpinning stage 1 making sure reinforcement is overlapping to adjacent and 1st stage pins above.

1. Locally propped excavation. Cast first stage of underpin. Key the underpin by 600mm. Provide bars for lapping with the neighbouring underpins.



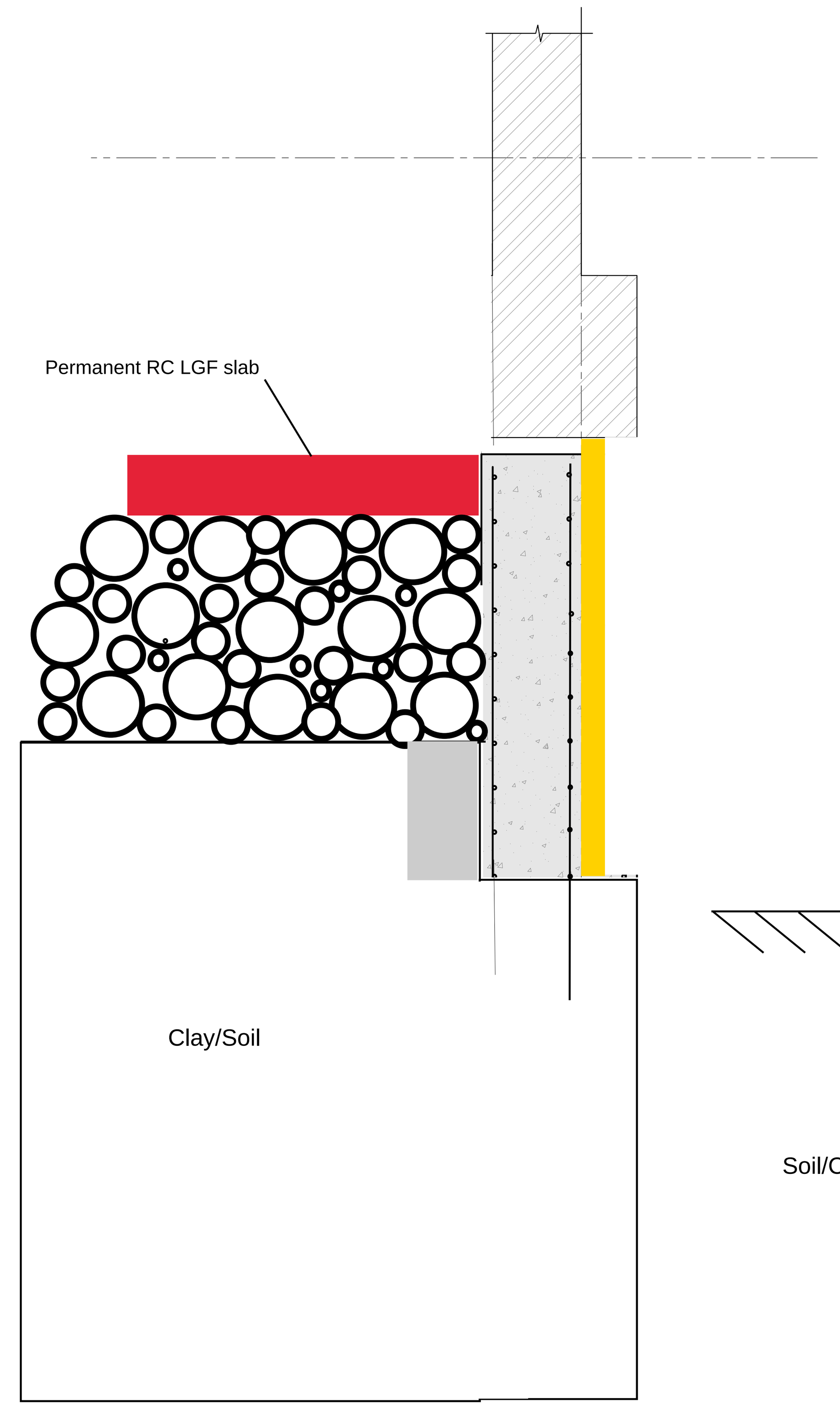
01 FIRST STAGE UNDERPIN
1:25

2. Backfill & continue to install first stage underpins in hit&miss sequence.



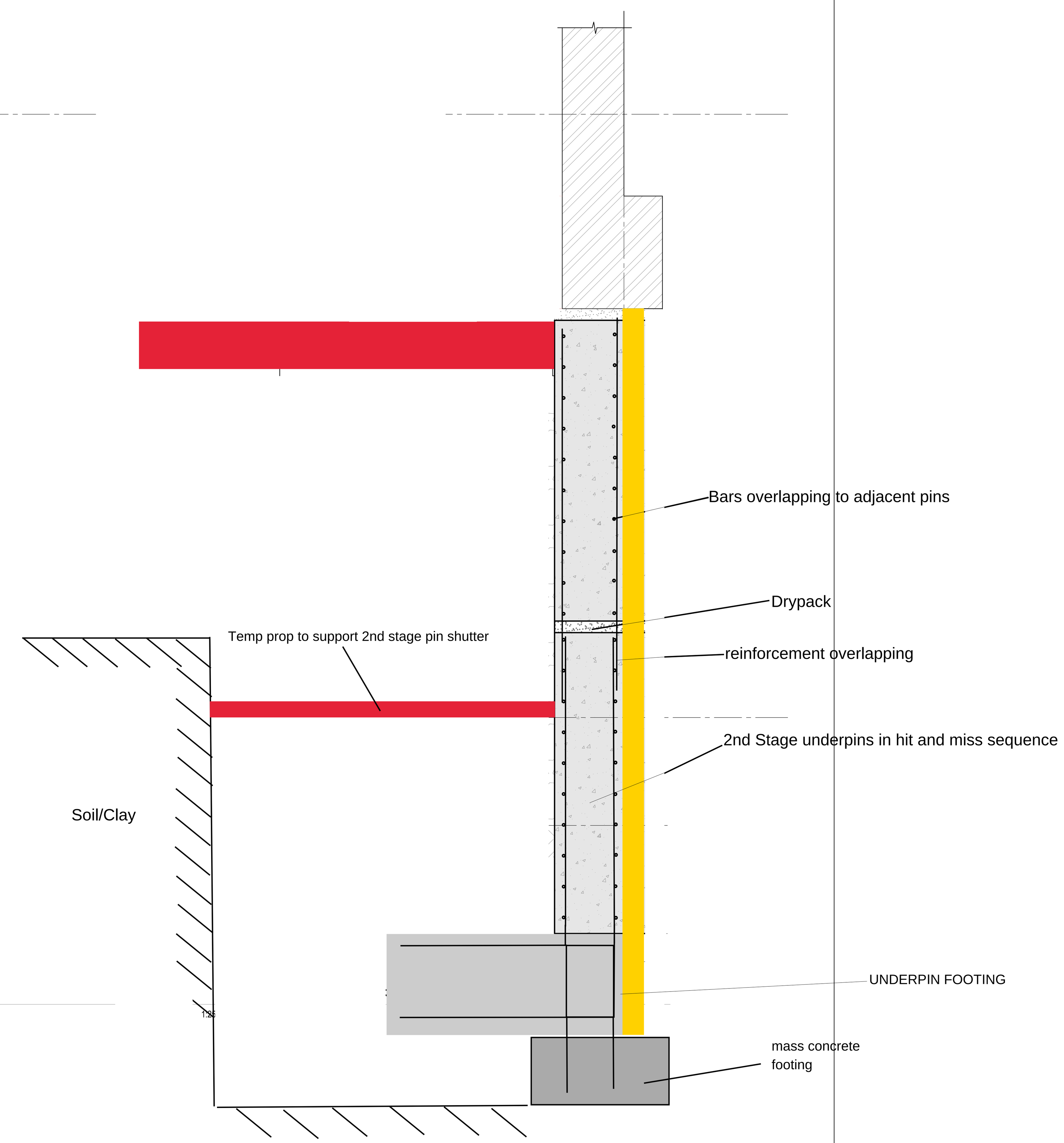
02 BACKFILL
1:25

3. Reduce backfill and construct permanent LGF Slab and beams



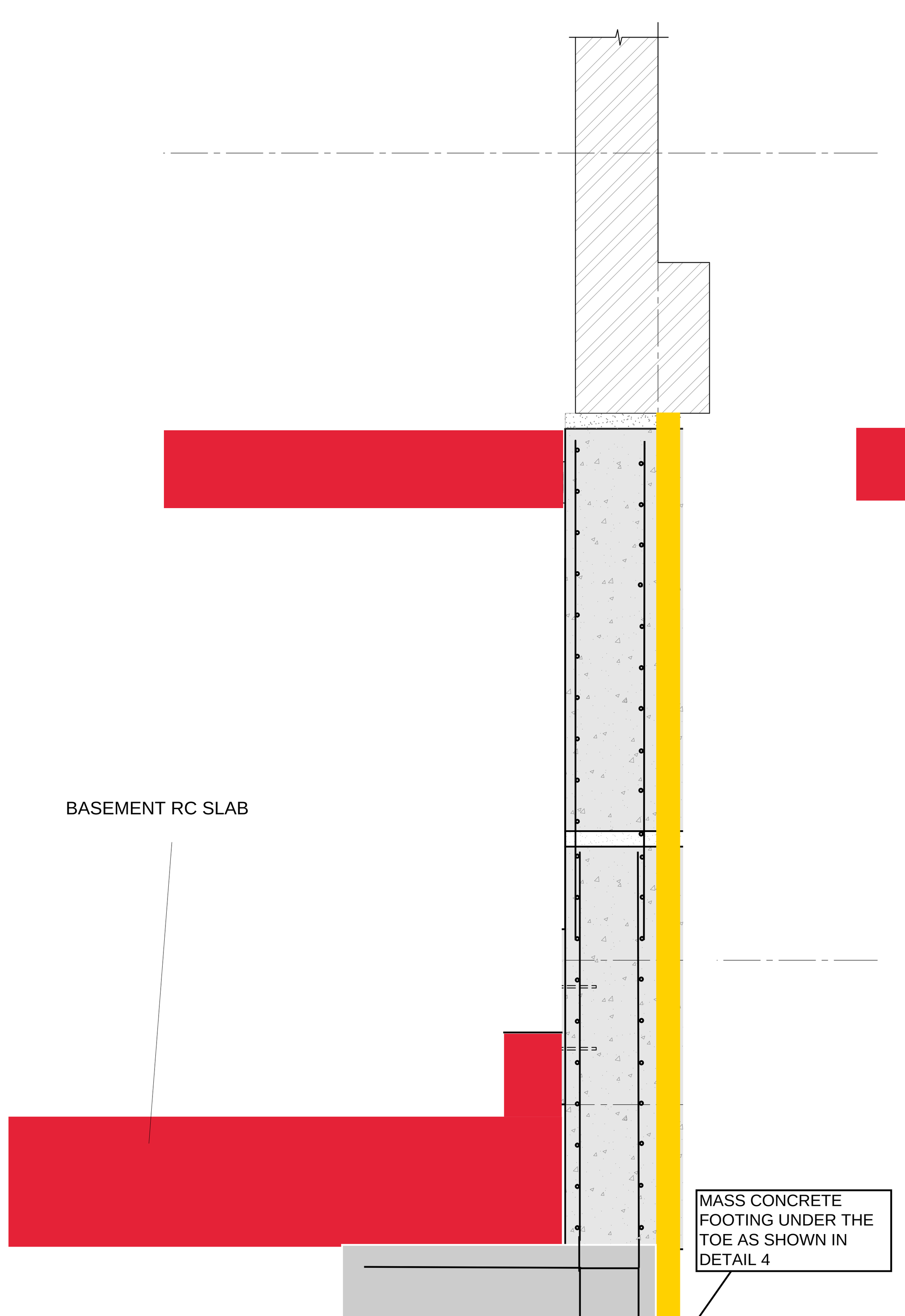
03 Permanent RC Slab
1:25

4. Basement excavation to desired level and 2nd stage underpinning



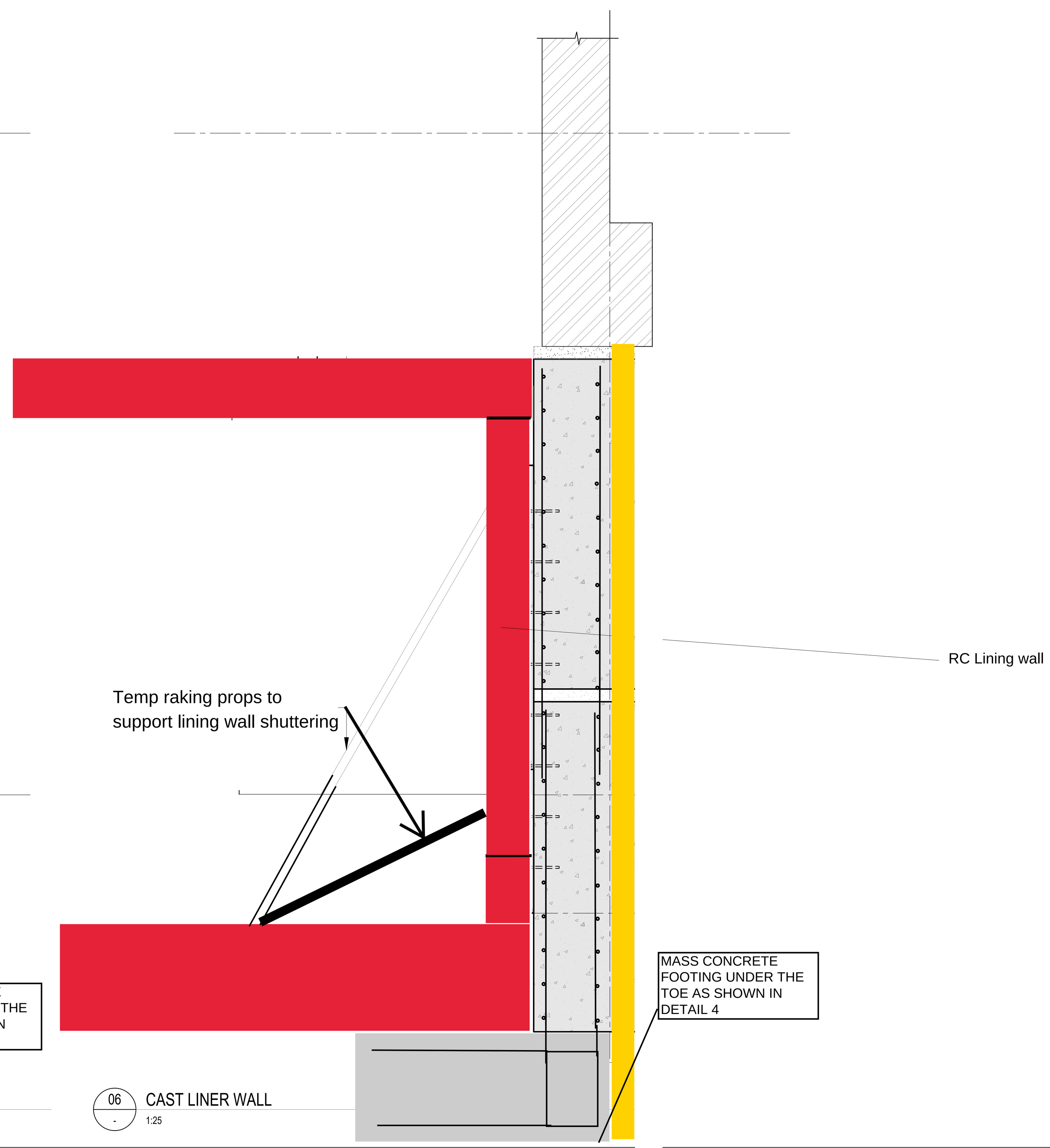
04.Excavation and 2nd stage underpins

5. Cast basement slab



05 CAST BASEMENT SLAB
1:25

6. Cast liner wall and install props



06 CAST LINER WALL
1:25

3.3.5 Bulk Excavation Works

In general the basement excavation will commence under the footprint of the existing building. The excavation will be undertaken by a competent and trained operator by means of a 360 degree excavator excavating to the reduced/basement level. The spoil piled within the front of the building and then loaded from the excavator into the dumper and removed from site.

At all times when the excavations are being undertaken the 360 degree excavator will be accompanied by a competent banks man. No personnel will be allowed to work nearby excavating works. The excavation working area and spoil unload route will be secured and segregated with edge barriers and signage. PPE must be worn a all times.

3.3.6 Basement Concrete Slab and Wall Works

Basement Concrete Slab

The concrete blinding level will be established by fixing level pins at appropriate locations and the concrete blinding will be placed via the bucket of the excavator. The concrete will be levelled by hand and protected when complete.
Traditional plywood formwork will be fixed insitu, levelled and checked for line and position. The bar reinforcement will be laid with spacer blocks fixed. The concrete slab will be offered for inspection to confirm the correct cleanliness bar content configuration and cover. The area will be blown clean and the finished concrete level marked on the edge formwork.
The concrete will be placed by one of the following methods, directly from the delivery truck or via a concrete pump. The concrete will be levelled and compacted using a 2” poker vibration unit. The concrete will be trowelled smooth using an easy float and protected when complete.
The formwork would generally be struck the following day but is subject to agreement and prevailing weather conditions
Concrete cube samples will be made on site and then will be sent away for testing.

Basement RC Liner Walls

All works will be carried out to the drawings and specifications by experienced operatives. The basement walls will be formed of 19mm shuttering plywood, nailed to 150 x 50mm timber bearers, spaced at (maximum) 400mm centres.
The plywood will be nailed to the timber bearers to form the wall shutter. This will then be oiled with a release agent.
The reinforcement will be fixed in situ. The wall shutter is then erected and is supported with tie bars. The carpenters will then nail the pre cut wall ends to the wall shutters.
All loose debris will be cleared from within the wall shutters prior to concreting.
The wall concrete will be poured by pump, thoroughly vibrated with a vibrating poker. Access will be by scaffold tower.

Formwork

Formworks should support the loads imposed on them by the fresh concrete together with additional stresses imposed by vibrating equipment and by construction traffic.

Formwork/shuttering will be installed as per approved drawings and secured against lateral force by concrete.

Form thus erected and installed will be rigid, water tight and dimensionally stable.

Formworks release agent material will be applied prior casting to ensure good surfaced finished of concrete.

Before placing concrete, all dirt, debris and other adjusting devices shall be secured against movement during concrete placing.

Before placing concrete all dirt, debris and other foreign matter shall be removed.

Before placing concrete, make sure all reinforcement is ready, cover block provided, all MEP installations completed (if any) and all necessary approvals have been taken.

Cover to reinforcement

Concrete cover to reinforcement as specified.

Construction Joints

The construction joints will be provided where required. Whenever concrete is to be bonded to other concrete that has hardened before deposition of further concrete, the contract surface shall be clean, hard and sound.

Concrete Placement Procedure

The concrete work shall confirm all requirements BS 8110, structural use of concrete.

No concrete shall be placed in the permanent works until materials have been approved.

No concrete shall be placed in any part of the permanent structure until consent has been given in writing.

The concrete shall be deposited as nearly as possible in its final position. It shall be placed so as to avoid segregation of concrete and displacement of the reinforcement, other embedded items or formwork.

Maximum free drop height shall be minimised to 1.5m to avoid segreation.

The layers shall not be placed so that they can form featheredges nor shall they be placed on a previous later that has taken its initial set. In order to comply with this requirement, a layer will be started before completion of the preceding layer.

The vibrators shall be operated at regular intervals to produce dense, compact and homogeneous concrete surface. The size of the vibrating pokers will be decided considering the layout of the reinforcements and will ensure consistent mass is obtained without segregation.

Testing

An independent testing laboratory will take the cubes for 7 and 28 days compressive strength and durability as specified.

Protection of Fresh Concrete

Freshly placed concrete shall be protect from rainfall and water running over the surface until it is sufficiently hard to resist damage.

No traffic shall be allowed on any concrete surface until it is sufficiently hard to resist damage by such traffic.
Freshly placed concrete shall not be subjected to any structural loading until it has attained at least its nominal strength as specified.

Curing

- Concrete shall be thoroughly wetted as soon as the forms are first loosened and shall be kept wet during the removal operation and until the curing media is applied.
- The curing process shall commence as soon as the concrete is hard enough to resist damage from the process.
- Curing shall be continued for as long as may be necessary to achieve its objectives but in any case for at least seven days or until the concrete is covered by the later construction, whichever is the shorter period.

Removal of Form work

- No formwork shall be removed until the concrete has gained sufficient strength as specified.
- Form work shall be carefully removed, without shock or disturbance to concrete.
- As soon as the form work has been removed, bolt holes in concrete faces, other than construction joints, which are not required for subsequent operations shall be filled.

3.3.7 Lower Ground Floor Concrete Slab Works

Please refer to Appendix B regarding the temporary work design.
Falsework tables will be set up and decked out with due consideration protection against falls from height.
A combisafe-style system will be used for edge protection. Where the formwork tables are incomplete a scaffold double tube ‘A’ – frame, 2m from the leading edge will be used.
The site supervisor will check the decked out area before steel fixing commences. The engineer will check the construction of the falsework, including the tightness of the screw jacks.
Traditional edge shutters will be fixed where required to the height of the top of the slab. Box outs will be set up as specified on the service and RC detail drawings. The bottom and top reinforcement bars will be placed using spacer chairs. Screed rails will be temporarily fixed to the reinforcement to control the level of the slab.
The engineer will make a pre pour inspection, including a final check on the position of the shuttering and offer for inspection to the client.
The concrete will be placed by means of concrete pumping and the concrete will be levelled, using a poker vibrator for compaction.
Compaction, sampling, finishing, protection and curing will be as previously described.
Shutters and falsework will be struck when it has been determined by the test cube analysis that the slab has gained sufficient strength to meet the structural engineer’s requirements, probably after a week. Back propping will be used as required. Immediately following the striking of tables all holes within the new formed slab will be covered with adequately strong ply boarding, fixed in position and marked up as a hole.

3.3.8 Superstructure Works

Structural works for superstructure will be carried out in the conventional way as per structural engineer and architect design.

Steel framework for new extension on the west side will be placed in position using a small mobile crane that sits on the loading platform. This work will be done by a nominated steelwork sub-contractor and site specific RAMS to be obtained prior to commencement on site.

Numbers of steel beams are placed in position for the support of ground floor 150mm thick composite concrete slab using comflor metal deck.

Edge shutters will be fixed where required to the height of the slab. A 383 mesh and H10 bars in each rib. The engineer will make a pre pour inspection.

The concrete will be placed by means of concrete pumping and the concrete will be levelled using a poker vibrator for compaction.

Compaction, sampling, finishing, protection and curing will be as previously described.

First floor works involve placing in position a few small steel beams on the east side and timber joists between the steel beams to form the roof structures with two glazed rooflights.

On the west side timber joints between the steel beams will form a flat roof over the new extension.

Roof coverings will be carried out by a nominated sub-contractor and RAMs to be obtained prior to commencement on site.

Second floor involves a number of small structural changes.

Third floor steel beams will be placed in position by a nominated sub-contractor as per structural engineer drawing. All lintels and padstones will be done prior to sub-contractor starting this task. Timber joists will be placed in position between the steel beams to form the floor and floorboards will provide a safe platform for placing in position the steel roof structure.

Scaffolding will provide a safe platform at roof level. Timber rafters and roof joists will be fitted to form the roof as per structural engineer and architect drawing.

Roof tiling leadwork etc will be carried out by a nominated sub-contractor and site specific RAMS to be obtained prior to commencement on site.

Scaffolding to Adjoining Property

Erecting scaffolding within the lightwell on the east side and across between no.40 and no.42 to extend boundary wall as per the new layout. 4no standards will be placed close to the walls on either side of the side access to provide maximum access width for the resident of no.40.

Scaffolding first lift on the neighbours side will be double boarded with 1200 gauge polystyrene plastic sheet between them and a layer of plywood on top to prevent any debris falling through, with netting on both sides of the scaffolding.

This work will be co-ordinated with the neighbours at no.40 before commencement in order to make sure that works can be carried out with minimum disturbance.

Access will be inspected on a daily basis during these works to make sure Health and Safety of residents.

The scaffolding will be alarmed.

14 days notice will be given prior to erection of scaffolding.

Scaffolding will be carried out by scaffolding sub-contractor and site specific RAMS will be obtained prior to commencement on site.

3.3.9 Movement Monitoring

Introduction

The surrounding party walls , buildings and the actual structure will be monitored during the works for movement. A specialist surveying company would set up a regime of monitoring. The company methodology will be added as soon as details are received.

Trigger Levels

Trigger levels and actions have been confirmed by the structural engineers as shown in below table

Status of Alert	**Max. vertical or horizontal Displacement**	**Action(s) in the event of a triggered level being exceeded**
Green	<5 mm	No action other than carry out work to original method statements and planned frequency for monitoring. Issue weekly or fortnightly reports to interested parties.
Amber	5 - 10 mm	Inform SEng & Temporary Works Engineer that green trigger exceeded. Continue work but with increased vigilance required monitoring at least once per day. Issue daily reports (where practical) to interested parties.
Red	+ 10 mm	Inform SEng, AO’s Eng & Temporary Works Engineer immediately. **Stop all works and await instruction**. Increase monitoring at critical zones to more than twice daily and continue twice daily elsewhere. Issue reports within 24 hours to interested parties.

Operatives are asked to sign below only when they have read and fully understand the Contract Method Statement and their part in it.

RECORD OF ATTENDANCE AT

42 Elsworthy Road, London NW3 3DL

INDUCTION TRAINING

NAME (Please Print)	COMPANY	SIGNATURE

RECORD OF TOOL BOX TALK ATTENDANCE AT

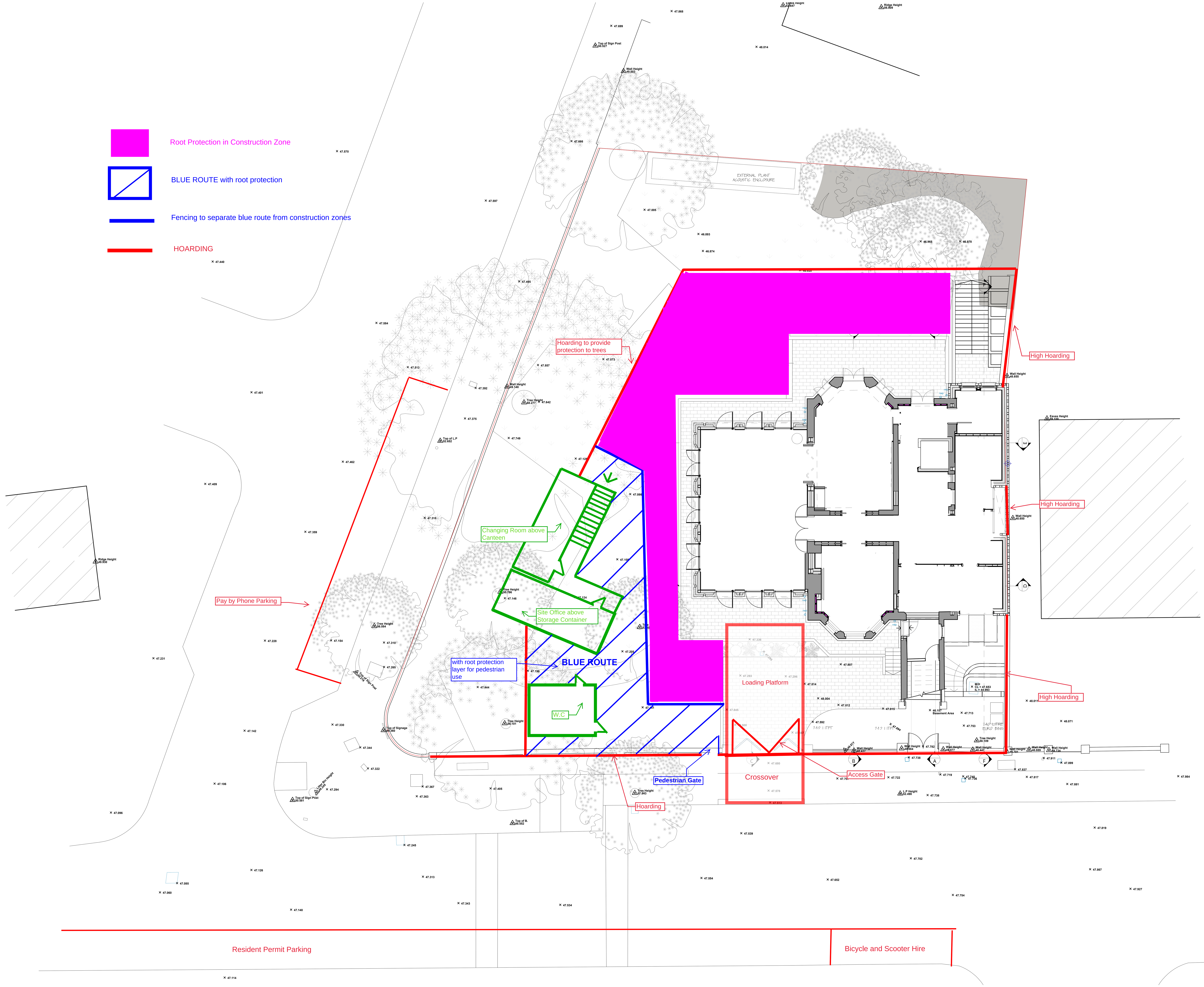
42 Elsworthy Road, NW3 3DL

TOOL BOX SUBJECT: ____

DATE: ____

NAME (Please Print)	COMPANY	SIGNATURE

Appendix A - Site Logistics Plan



WOLFF ARCHITECTS

London 16 Lambton Place Notting Hill
London W11 2SH
T +44 (0)20 7229 3125

Oxford Chandos Yard 83 Bicester Road
Long Crendon HP18 9EE
T +44 (0)1844 203310

W www.wolffarchitects.co.uk
E info@wolffarchitects.co.uk

KEY - Existing

- retained
- demolished

KEY - Proposed

- brickwork
- insulation - rigid
- blockwork
- concrete
- structure over
- stud wall (linings vary)
- planed timber

Read with architect's Fire Strategy plans

FFL	Finished Floor Level
FCL	Finished Ceiling Level
SOH	Structural Opening Height (AFFL)
SSH	Structural Sill Height (AFFL)

rwp	rainwater pipe	svp	soil vent pipe
g	gulley	sp	soil pipe
rwo	rainwater outlet	wp	waste pipe
MH	manhole	vp	vent pipe
IC	inspection chamber		

Rev.	Description	Date
0	First issue.	29.05.22

Project Title
42 Elsworthy Road
London NW3 3DL

Drawing Title
PROPOSED
Site Plan

Status
TENDER

Drawn by	Checked by	Scale
		1:100 @ A1

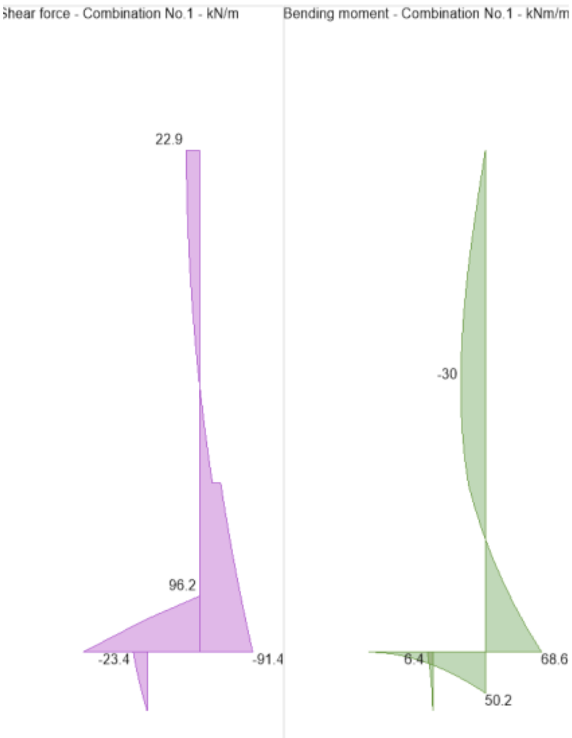
Project No.	Work Stage	Dwg. No.	Rev.
2164	TD	202	0

Appendix B - Temporary Works Design

11 Mass concrete Key to Party Wall Underpin

To satisfy party wall requirement and the temporary stability of the underpin, a mass concrete key is designed. This provides a base equal or greater than the existing wall foundation.

The key must be doweled into the underpin and poured at the same time as the rest of the stage 2 underpin. The underpins are designed to achieve the depths of 4.3m, required depth based on level of neighbouring pathway informed by Axiom.



The maximum bending moment in the key = 6.4kNm/m.

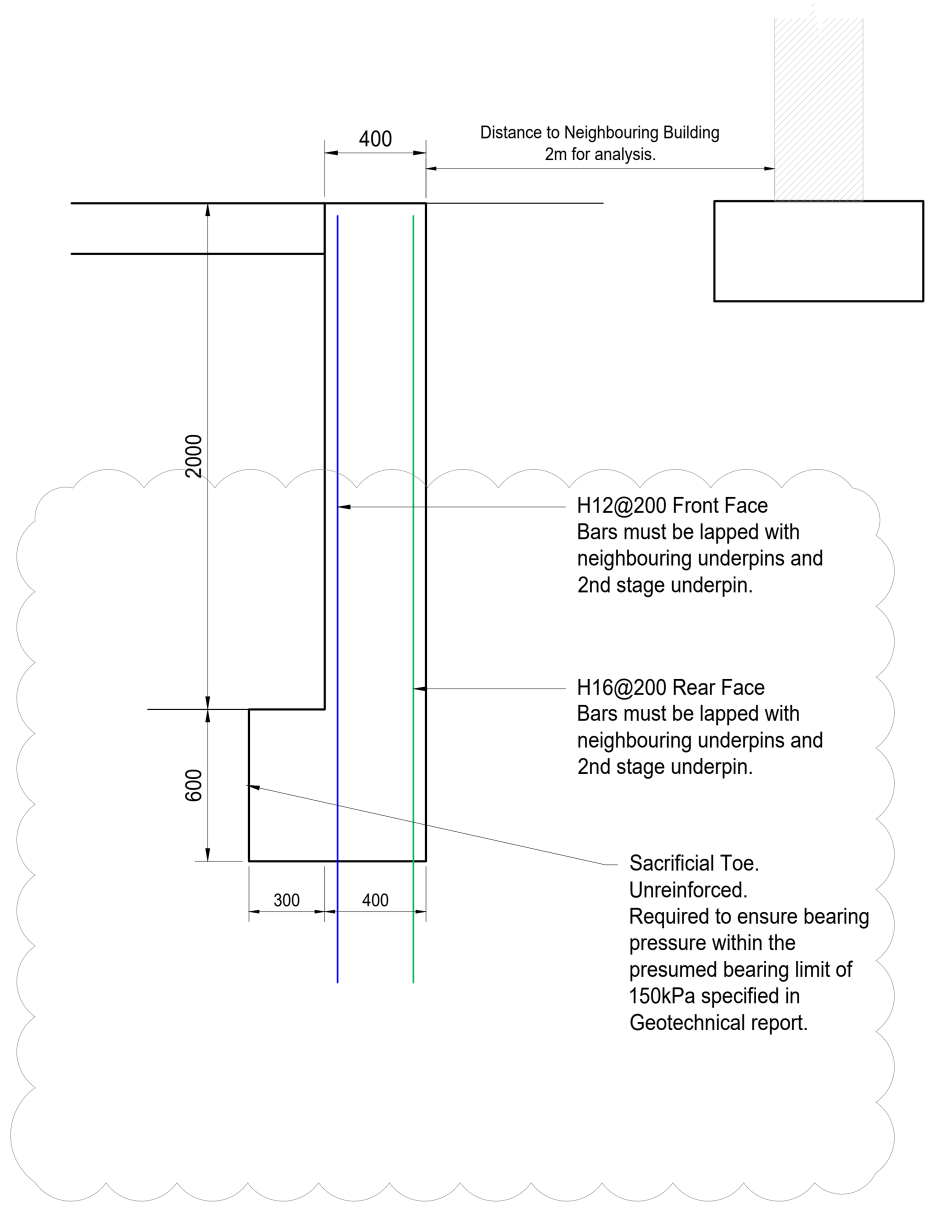
Bending moment in key, M	**6.40**	**kNm/m**	
Concrete section depth, D	850	mm	
Concrete section width (on average), B	1000	mm	
Bending stress, σ_b = M(D/2)/(B*D^3/12)	0.053	MPa	
Concrete Grade	30	MPa	
Mean tensile strength of concrete, f_{ctm} = 0.30f_{ck}^2/3.	**2.90**	**MPa**	**SATIS**

Therefore Mass Concrete Key is sufficient to withstand bending forces.

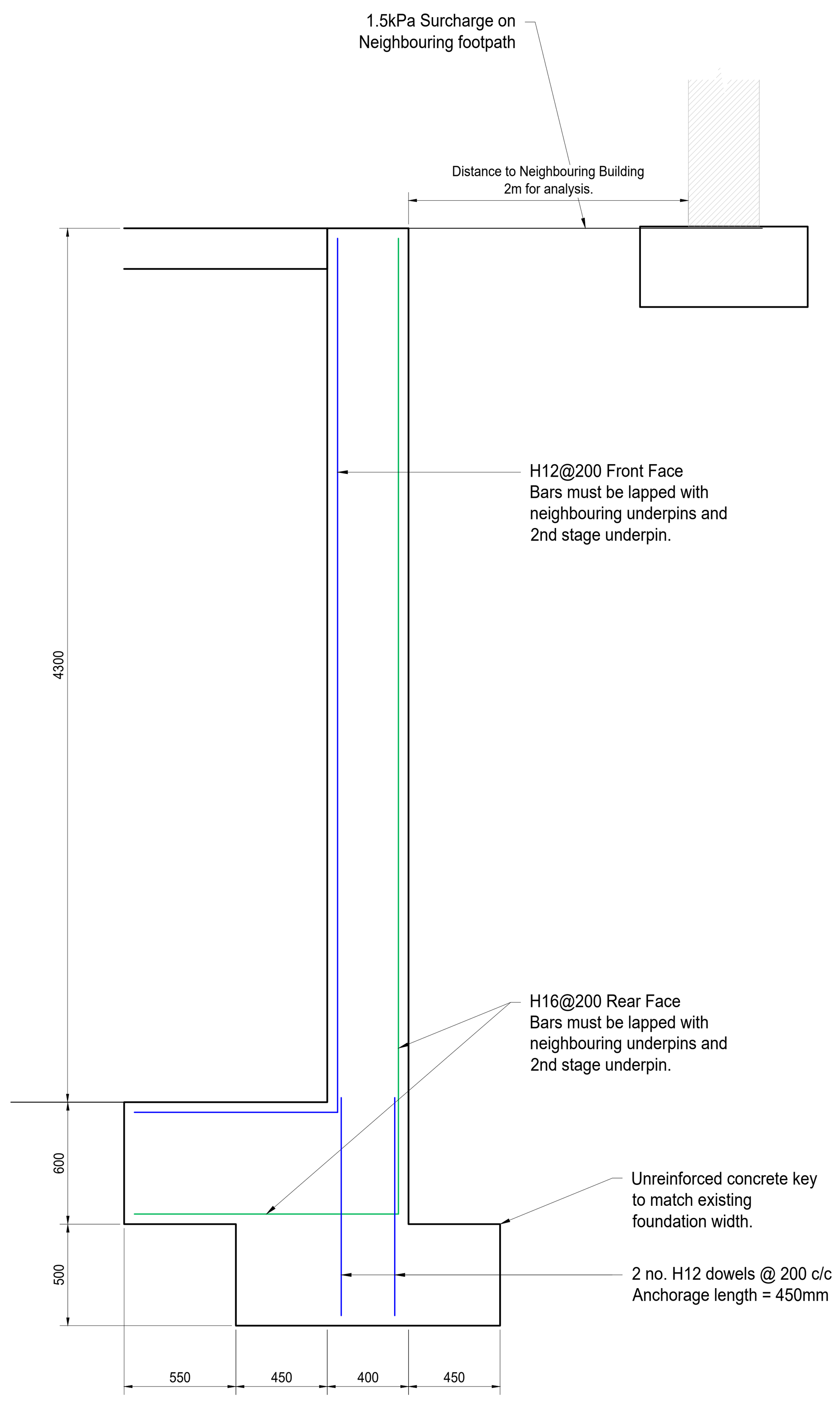
The maximum shear force in key = 23.4kN/m.

Shear stress on key/underpin plane = 23.4/(1*0.85) = 27.5kN/m^2 = 0.0275 MPa

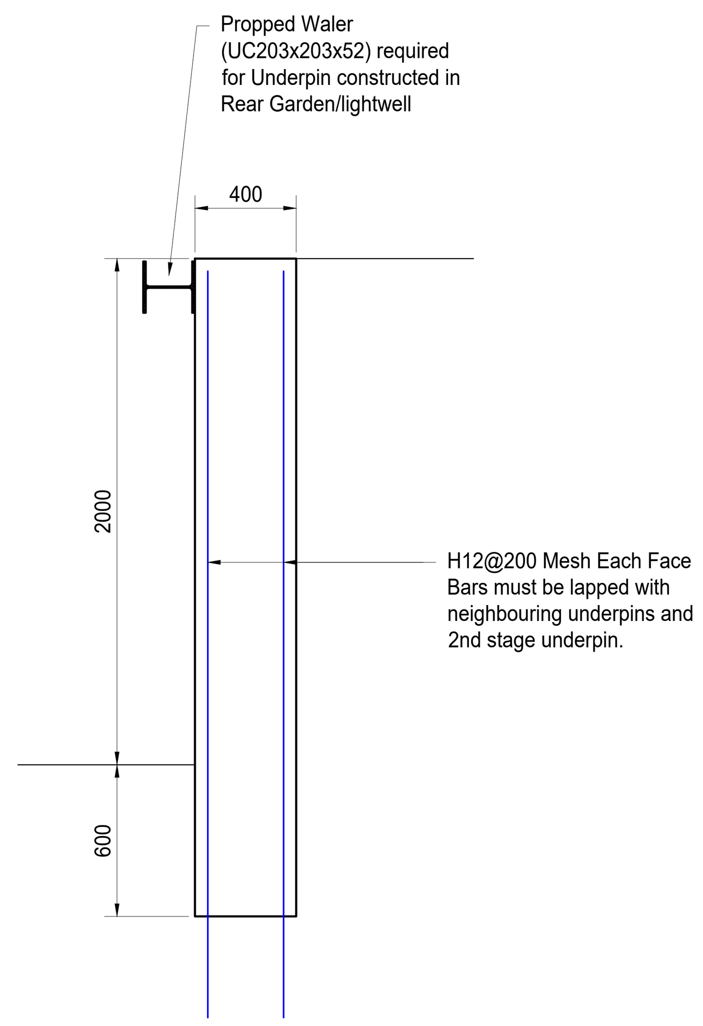
2no. H12 dowels @ 200c/c will ensure key can resist shear forces across the key/underpin plane.



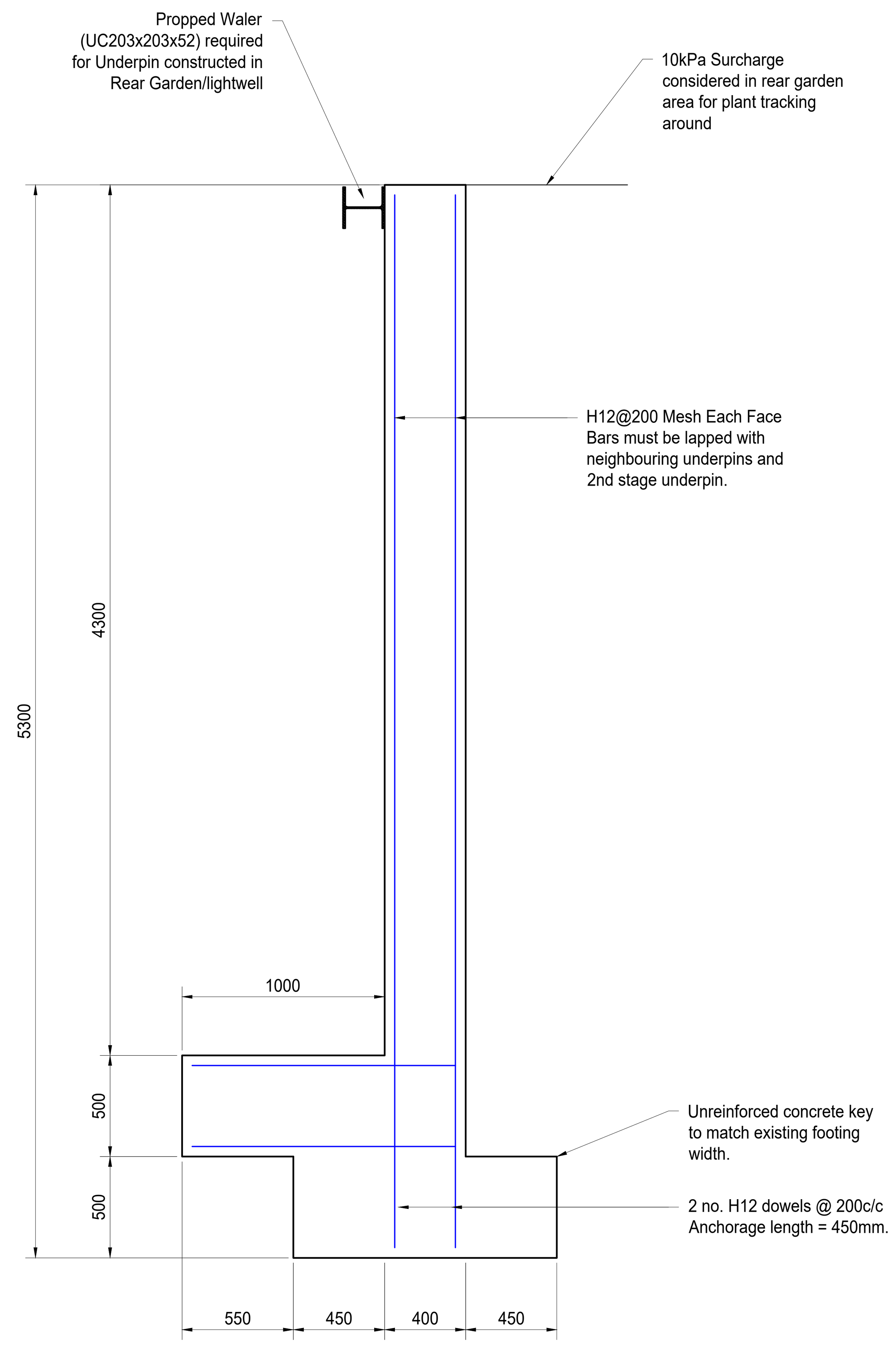
Party Wall Underpin
With Building Surcharge
Reaching B1 level
Stage 1
AXIOM ref B-02/03/07



Party Wall Underpin
With Building Surcharge
Reaching B1 level
Stage 2
AXIOM ref B-02/03/07



Party Wall Underpin
Without Building Surcharge
Reaching B1 level
Stage 1
AXIOM ref. B-01



Party Wall Underpin
Without Building Surcharge
Reaching B1 level
Stage 2
AXIOM ref. B-01

100mm long @A1 or 50mm long @A3

Notes:

1. This drawing to be read in conjunction with all relevant Architects & Engineers drawings & the Specifications.
2. The contractor is to be responsible for all dimensions & for the correct setting out of the work on site.
3. Do not scale from this drawing. To check drawing has been printed to the intended scale the above bar should be 100mm long @A1 or 50mm long @A3.
4. Temporary beams are as follows:

Legend	Description
TB1	500x500mm RC beam
TB2	UC203x203x60
TB3	UB356x117x57
TB4	UB 457x152x60
TB5	UC 254x254x73
TC1	UC203x203x46 Stub Column
TP	350mm dia. Temporary Pile

5. Cover to reinforcement:
   Temporary Beam All sides = 35mm
   Permanent beam cover as per structural engineer's specification.
6. Level 1 beams & padstone installed, Existing GF floor removed and middle wall removed before LGF beam and slab construction.
7. Infill existing doors and windows at LGF level.
8. Wall openings and new frames above LGF to be constructed **after** completion of basement foundations and columns.
9. Minimum reinforcement provided for the temporary requirements in beams.

Rev	Date	By	Amendments
P04	16.01.23	JN	Updated geometry to suit Party wall agreement
P03	12.01.22	JN	Updated geometry to suit Party wall agreement
P02	15.12.22	JN	Updated Sections
P01	02.11.22	JN	Preliminary Issue

Drawing Status
For Approval

WBD STRUCTURES

160 Fleet St. London EC4A 2DQ | +44 (0)2080650166 | www.wbdgroup.com

Project Title
Elsworthy Road

Drawing Title
Underpin Section
Sheet 1

Project Number
2022113

Scale	Date
As indicated	November 2022
Drawn by	Checked by
JN	LM

Drawing Number
2022113-DRW-001-007

Revision
P04

Appendix E: Party Wall Underpin Design

Appendix E1: Party Wall Underpin Design- B1 formation level with building surcharge

RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.14

Retaining wall details

Stem type	Propped cantilever
Stem height	h_{stem} = **2000** mm
Prop height	h_{prop} = **2000** mm
Stem thickness	t_{stem} = **400** mm
Angle to rear face of stem	α = **90** deg
Stem density	γ_{stem} = **25** kN/m^3
Toe length	l_{toe} = **200** mm
Base thickness	t_{base} = **600** mm
Base density	γ_{base} = **25** kN/m^3
Height of retained soil	h_{ret} = **2000** mm
Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm

Retained soil properties

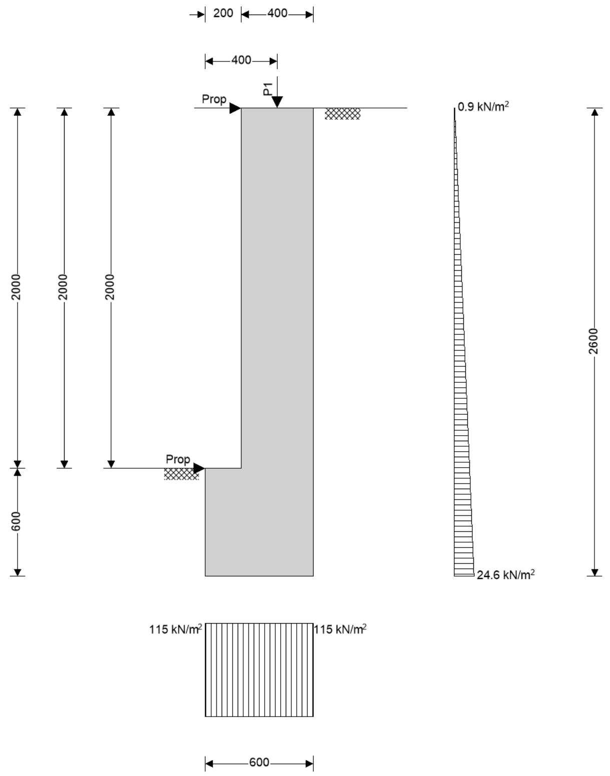
Soil type	Stiff silty clay
Moist density	γ_{mr} = **19** kN/m^3
Saturated density	γ_{sr} = **19** kN/m^3
Characteristic effective shear resistance angle	$\phi'_{r.k}$ = **22** deg
Characteristic wall friction angle	$\delta_{r.k}$ = **11** deg

Base soil properties

Soil type	Stiff silty clay
Soil density	γ_b = **19** kN/m^3
Characteristic cohesion	$c'_{b.k}$ = **120** kN/m^2
Characteristic effective shear resistance angle	$\phi'_{b.k}$ = **22** deg
Characteristic wall friction angle	$\delta_{b.k}$ = **11** deg
Characteristic base friction angle	$\delta_{bb.k}$ = **14.7** deg

Loading details

Variable surcharge load	$Surcharge_Q$ = **1.5** kN/m^2
Vertical line load at 400 mm	P_{G1} = **40** kN/m



General arrangement

Calculate retaining wall geometry

Base length	$l_{base} = l_{toe} + t_{stem} = \mathbf{600}$ mm
Moist soil height	$h_{moist} = h_{soil} = \mathbf{2000}$ mm
Length of surcharge load	$l_{sur} = l_{heel} = \mathbf{0}$ mm
- Distance to vertical component	$x_{sur\_v} = l_{base} - l_{heel} / 2 = \mathbf{600}$ mm
Effective height of wall	$h_{eff} = h_{base} + d_{cover} + h_{ret} = \mathbf{2600}$ mm
- Distance to horizontal component	$x_{sur\_h} = h_{eff} / 2 = \mathbf{1300}$ mm
Area of wall stem	$A_{stem} = h_{stem} \times t_{stem} = \mathbf{0.8}$ m^2
- Distance to vertical component	$x_{stem} = l_{toe} + t_{stem} / 2 = \mathbf{400}$ mm
Area of wall base	$A_{base} = l_{base} \times t_{base} = \mathbf{0.36}$ m^2
- Distance to vertical component	$x_{base} = l_{base} / 2 = \mathbf{300}$ mm

Design approach 1

Partial factors on actions - Table A.3 - Combination 1

Partial factor set	A1
Permanent unfavourable action	$\gamma_G = \mathbf{1.35}$
Permanent favourable action	$\gamma_{Gf} = \mathbf{1.00}$
Variable unfavourable action	$\gamma_Q = \mathbf{1.50}$
Variable favourable action	$\gamma_{Qf} = \mathbf{0.00}$

Partial factors for soil parameters – Table A.4 - Combination 1

Soil parameter set	M1

Angle of shearing resistance $\gamma_{\phi'}$ = **1.00**

Effective cohesion $\gamma_{c'}$ = **1.00**

Weight density γ_{γ} = **1.00**

Library item Partial factors output

Retained soil properties

Design moist density $\gamma_{mr}' = \gamma_{mr} / \gamma_{\gamma}$ = **19** kN/m³

Design saturated density $\gamma_{sr}' = \gamma_{sr} / \gamma_{\gamma}$ = **19** kN/m³

Design effective shear resistance angle $\phi'_{r.d} = atan(tan(\phi'_{r.k}) / \gamma_{\phi'})$ = **22** deg

Design wall friction angle $\delta_{r.d} = atan(tan(\delta_{r.k}) / \gamma_{\phi'})$ = **11** deg

Base soil properties

Design soil density $\gamma_b' = \gamma_b / \gamma_{\gamma}$ = **19** kN/m³

Design effective shear resistance angle $\phi'_{b.d} = atan(tan(\phi'_{b.k}) / \gamma_{\phi'})$ = **22** deg

Design wall friction angle $\delta_{b.d} = atan(tan(\delta_{b.k}) / \gamma_{\phi'})$ = **11** deg

Design base friction angle $\delta_{bb.d} = atan(tan(\delta_{bb.k}) / \gamma_{\phi'})$ = **14.7** deg

Design effective cohesion $c'_{b.d} = c'_{b.k} / \gamma_{c'}$ = **120** kN/m²

Using Coulomb theory

Active pressure coefficient $K_A = sin(\alpha + \phi'_{r.d})^2 / (sin(\alpha)^2 \times sin(\alpha - \delta_{r.d}) \times [1 + \sqrt{[}sin(\phi'_{r.d} + \delta_{r.d}) \times sin(\phi'_{r.d} - \beta) / (sin(\alpha - \delta_{r.d}) \times sin(\alpha + \beta))]]^2)$ = **0.413**

Passive pressure coefficient $K_P = sin(90 - \phi'_{b.d})^2 / (sin(90 + \delta_{b.d}) \times [1 - \sqrt{[}sin(\phi'_{b.d} + \delta_{b.d}) \times sin(\phi'_{b.d}) / (sin(90 + \delta_{b.d}))]]^2)$ = **2.958**

Bearing pressure check

Vertical forces on wall

Wall stem $F_{stem} = \gamma_G \times A_{stem} \times \gamma_{stem}$ = **27** kN/m

Wall base $F_{base} = \gamma_G \times A_{base} \times \gamma_{base}$ = **12.2** kN/m

Line loads $F_{P\_v} = \gamma_G \times P_{G1}$ = **54** kN/m

Total $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v}$ = **93.2** kN/m

Horizontal forces on wall

Surcharge load $F_{sur\_h} = K_A \times cos(\delta_{r.d}) \times \gamma_Q \times Surcharge_Q \times h_{eff}$ = **2.4** kN/m

Moist retained soil $F_{moist\_h} = \gamma_G \times K_A \times cos(\delta_{r.d}) \times \gamma_{mr}' \times h_{eff}^2 / 2$ = **35.2** kN/m

Base soil $F_{pass\_h} = -\gamma_{Gf} \times K_P \times cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2$ = **-9.9** kN/m

Total $F_{total\_h} = F_{sur\_h} + F_{moist\_h} + F_{pass\_h}$ = **27.6** kN/m

Moments on wall

Wall stem $M_{stem} = F_{stem} \times x_{stem}$ = **10.8** kNm/m

Wall base $M_{base} = F_{base} \times x_{base}$ = **3.6** kNm/m

Surcharge load $M_{sur} = -F_{sur\_h} \times x_{sur\_h}$ = **-3.1** kNm/m

Line loads $M_P = \gamma_G \times P_{G1} \times p_1$ = **21.6** kNm/m

Moist retained soil $M_{moist} = -F_{moist\_h} \times x_{moist\_h}$ = **-30.5** kNm/m

Total $M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{moist}$ = **2.5** kNm/m

Check bearing pressure

Propping force to stem $F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base})$ = **9.8** kN/m

Propping force to base $F_{prop\_base} = F_{total\_h} - F_{prop\_stem}$ = **17.8** kN/m

Moment from propping force $M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base})$ = **25.5** kNm/m

Distance to reaction $\bar{x} = (M_{total} + M_{prop}) / F_{total\_v}$ = **300** mm

Eccentricity of reaction $e = \bar{x} - l_{base} / 2 = \mathbf{0}$ mm

Loaded length of base $l_{load} = l_{base} = \mathbf{600}$ mm

Bearing pressure at toe $q_{toe} = F_{total\_v} / l_{base} = \mathbf{155.2}$ kN/m²

Bearing pressure at heel $q_{heel} = F_{total\_v} / l_{base} = \mathbf{155.2}$ kN/m²

Effective overburden pressure $q = (t_{base} + d_{cover}) \times \gamma_b' = \mathbf{11.4}$ kN/m²

Design effective overburden pressure $q' = q / \gamma_\gamma = \mathbf{11.4}$ kN/m²

Bearing resistance factors $N_q = Exp(\pi \times tan(\phi'_{b.d})) \times (tan(45 deg + \phi'_{b.d} / 2))^2 = \mathbf{7.821}$

$N_c = (N_q - 1) \times cot(\phi'_{b.d}) = \mathbf{16.883}$

$N_\gamma = 2 \times (N_q - 1) \times tan(\phi'_{b.d}) = \mathbf{5.512}$

Foundation shape factors $s_q = 1$

$s_\gamma = 1$

$s_c = 1$

Load inclination factors $H = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} - F_{prop\_stem} - F_{prop\_base} = \mathbf{0}$ kN/m

$V = F_{total\_v} = \mathbf{93.2}$ kN/m

$m = 2$

$i_q = [1 - H / (V + l_{load} \times c'_{b.d} \times cot(\phi'_{b.d}))]^m = \mathbf{1}$

$i_\gamma = [1 - H / (V + l_{load} \times c'_{b.d} \times cot(\phi'_{b.d}))]^{(m + 1)} = \mathbf{1}$

$i_c = i_q - (1 - i_q) / (N_c \times tan(\phi'_{b.d})) = \mathbf{1}$

Net ultimate bearing capacity

$n_f = c'_{b.d} \times N_c \times s_c \times i_c + q' \times N_q \times s_q \times i_q + 0.5 \times \gamma_b' \times l_{load} \times N_\gamma \times s_\gamma \times i_\gamma = \mathbf{2146.5}$ kN/m²

Factor of safety $FoS_{bp} = n_f / max(q_{toe}, q_{heel}) = \mathbf{13.826}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

Design approach 1

Partial factors on actions - Table A.3 - Combination 2

Partial factor set A2

Permanent unfavourable action $\gamma_G = \mathbf{1.00}$

Permanent favourable action $\gamma_{Gf} = \mathbf{1.00}$

Variable unfavourable action $\gamma_Q = \mathbf{1.30}$

Variable favourable action $\gamma_{Qf} = \mathbf{0.00}$

Partial factors for soil parameters – Table A.4 - Combination 2

Soil parameter set M2

Angle of shearing resistance $\gamma_{\phi'} = \mathbf{1.25}$

Effective cohesion $\gamma_{c'} = \mathbf{1.25}$

Weight density $\gamma_\gamma = \mathbf{1.00}$

Library item Partial factors output

Retained soil properties

Design moist density $\gamma_{mr}' = \gamma_{mr} / \gamma_\gamma = \mathbf{19}$ kN/m³

Design saturated density $\gamma_{sr}' = \gamma_{sr} / \gamma_\gamma = \mathbf{19}$ kN/m³

Design effective shear resistance angle $\phi'_{r.d} = atan(tan(\phi'_{r.k}) / \gamma_{\phi'}) = \mathbf{17.9}$ deg

Design wall friction angle $\delta_{r.d} = atan(tan(\delta_{r.k}) / \gamma_{\phi'}) = \mathbf{8.8}$ deg

Base soil properties

Design soil density $\gamma_b' = \gamma_b / \gamma_\gamma = \mathbf{19}$ kN/m³

Design effective shear resistance angle $\phi'_{b.d} = atan(tan(\phi'_{b.k}) / \gamma_{\phi'}) = \mathbf{17.9}$ deg

Design wall friction angle $\delta_{b.d} = atan(tan(\delta_{b.k}) / \gamma_{\phi'}) = \mathbf{8.8}$ deg

Design base friction angle $\delta_{bb.d} = atan(tan(\delta_{bb.k}) / \gamma_{\phi'})$ = **11.9** deg

Design effective cohesion $c'_{b.d} = c'_{b.k} / \gamma_{c'}$ = **96** kN/m^2

Using Coulomb theory

Active pressure coefficient $K_A = \sin(\alpha + \phi'_{r.d})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.d}) \times [1 + \surd[\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d} - \beta) / (\sin(\alpha - \delta_{r.d}) \times \sin(\alpha + \beta))]]^2)$ = **0.485**

Passive pressure coefficient $K_P = \sin(90 - \phi'_{b.d})^2 / (\sin(90 + \delta_{b.d}) \times [1 - \surd[\sin(\phi'_{b.d} + \delta_{b.d}) \times \sin(\phi'_{b.d}) / (\sin(90 + \delta_{b.d}))]]^2)$ = **2.340**

Bearing pressure check

Vertical forces on wall

Wall stem $F_{stem} = \gamma_G \times A_{stem} \times \gamma_{stem}$ = **20** kN/m

Wall base $F_{base} = \gamma_G \times A_{base} \times \gamma_{base}$ = **9** kN/m

Line loads $F_{P\_v} = \gamma_G \times P_{G1}$ = **40** kN/m

Total $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v}$ = **69** kN/m

Horizontal forces on wall

Surcharge load $F_{sur\_h} = K_A \times \cos(\delta_{r.d}) \times \gamma_Q \times Surcharge_Q \times h_{eff}$ = **2.4** kN/m

Moist retained soil $F_{moist\_h} = \gamma_G \times K_A \times \cos(\delta_{r.d}) \times \gamma_{mr}' \times h_{eff}^2 / 2$ = **30.8** kN/m

Base soil $F_{pass\_h} = -\gamma_{Gf} \times K_P \times \cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2$ = **-7.9** kN/m

Total $F_{total\_h} = F_{sur\_h} + F_{moist\_h} + F_{pass\_h}$ = **25.3** kN/m

Moments on wall

Wall stem $M_{stem} = F_{stem} \times x_{stem}$ = **8** kNm/m

Wall base $M_{base} = F_{base} \times x_{base}$ = **2.7** kNm/m

Surcharge load $M_{sur} = -F_{sur\_h} \times x_{sur\_h}$ = **-3.2** kNm/m

Line loads $M_P = \gamma_G \times P_{G1} \times p_1$ = **16** kNm/m

Moist retained soil $M_{moist} = -F_{moist\_h} \times x_{moist\_h}$ = **-26.7** kNm/m

Total $M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{moist}$ = **-3.1** kNm/m

Check bearing pressure

Propping force to stem $F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base})$ = **9.2** kN/m

Propping force to base $F_{prop\_base} = F_{total\_h} - F_{prop\_stem}$ = **16.1** kN/m

Moment from propping force $M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base})$ = **23.8** kNm/m

Distance to reaction $\bar{x} = (M_{total} + M_{prop}) / F_{total\_v}$ = **300** mm

Eccentricity of reaction $e = \bar{x} - l_{base} / 2$ = **0** mm

Loaded length of base $l_{load} = l_{base}$ = **600** mm

Bearing pressure at toe $q_{toe} = F_{total\_v} / l_{base}$ = **115** kN/m^2

Bearing pressure at heel $q_{heel} = F_{total\_v} / l_{base}$ = **115** kN/m^2

Effective overburden pressure $q = (t_{base} + d_{cover}) \times \gamma_b'$ = **11.4** kN/m^2

Design effective overburden pressure $q' = q / \gamma_\gamma$ = **11.4** kN/m^2

Bearing resistance factors $N_q = Exp(\pi \times \tan(\phi'_{b.d})) \times (\tan(45 deg + \phi'_{b.d} / 2))^2$ = **5.213**

$N_c = (N_q - 1) \times \cot(\phi'_{b.d})$ = **13.034**

$N_\gamma = 2 \times (N_q - 1) \times \tan(\phi'_{b.d})$ = **2.723**

Foundation shape factors $s_q = 1$

$s_\gamma = 1$

$s_c = 1$

Load inclination factors $H = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} - F_{prop\_stem} - F_{prop\_base}$ = **0** kN/m

$V = F_{total\_v}$ = **69** kN/m

$m = 2$

$i_q = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^m = \mathbf{1}$

$i_\gamma = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^{(m+1)} = \mathbf{1}$

$i_c = i_q - (1 - i_q) / (N_c \times \tan(\phi'_{b.d})) = \mathbf{1}$

Net ultimate bearing capacity

$n_f = c'_{b.d} \times N_c \times s_c \times i_c + q' \times N_q \times s_q \times i_q + 0.5 \times \gamma_b' \times l_{load} \times N_\gamma \times s_\gamma \times i_\gamma = \mathbf{1326.2}$ kN/m²

Factor of safety $FoS_{bp} = n_f / \max(q_{toe}, q_{heel}) = \mathbf{11.532}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.9.14

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

Concrete strength class: C32/40

Characteristic compressive cylinder strength: $f_{ck} = \mathbf{32}$ N/mm²

Characteristic compressive cube strength: $f_{ck,cube} = \mathbf{40}$ N/mm²

Mean value of compressive cylinder strength: $f_{cm} = f_{ck} + 8$ N/mm² $= \mathbf{40}$ N/mm²

Mean value of axial tensile strength: $f_{ctm} = 0.3$ N/mm² $\times (f_{ck} / 1$ N/mm²$)^{2/3} = \mathbf{3.0}$ N/mm²

5% fractile of axial tensile strength: $f_{ctk,0.05} = 0.7 \times f_{ctm} = \mathbf{2.1}$ N/mm²

Secant modulus of elasticity of concrete: $E_{cm} = 22$ kN/mm² $\times (f_{cm} / 10$ N/mm²$)^{0.3} = \mathbf{33346}$ N/mm²

Partial factor for concrete - Table 2.1N: $\gamma_C = \mathbf{1.50}$

Compressive strength coefficient - cl.3.1.6(1): $\alpha_{cc} = \mathbf{0.85}$

Design compressive concrete strength - exp.3.15: $f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_C = \mathbf{18.1}$ N/mm²

Maximum aggregate size: $h_{agg} = \mathbf{20}$ mm

Ultimate strain - Table 3.1: $\varepsilon_{cu2} = \mathbf{0.0035}$

Shortening strain - Table 3.1: $\varepsilon_{cu3} = \mathbf{0.0035}$

Effective compression zone height factor: $\lambda = \mathbf{0.80}$

Effective strength factor: $\eta = \mathbf{1.00}$

Bending coefficient k_1: $K_1 = \mathbf{0.40}$

Bending coefficient k_2: $K_2 = 1.00 \times (0.6 + 0.0014/\varepsilon_{cu2}) = \mathbf{1.00}$

Bending coefficient k_3: $K_3 = \mathbf{0.40}$

Bending coefficient k_4: $K_4 = 1.00 \times (0.6 + 0.0014/\varepsilon_{cu2}) = \mathbf{1.00}$

Reinforcement details

Characteristic yield strength of reinforcement: $f_{yk} = \mathbf{500}$ N/mm²

Modulus of elasticity of reinforcement: $E_s = \mathbf{200000}$ N/mm²

Partial factor for reinforcing steel - Table 2.1N: $\gamma_S = \mathbf{1.15}$

Design yield strength of reinforcement: $f_{yd} = f_{yk} / \gamma_S = \mathbf{435}$ N/mm²

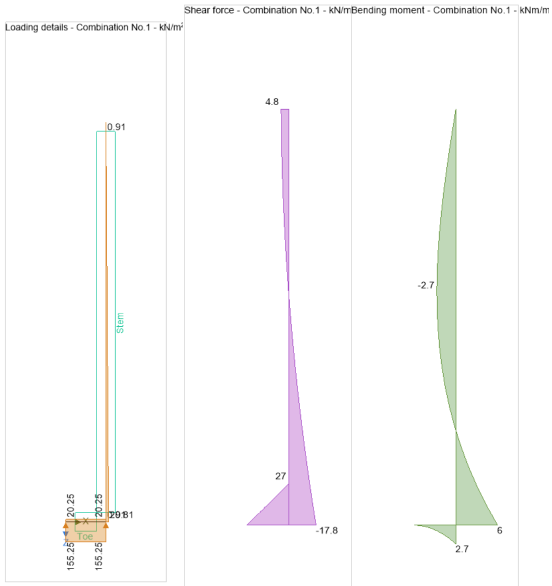
Cover to reinforcement

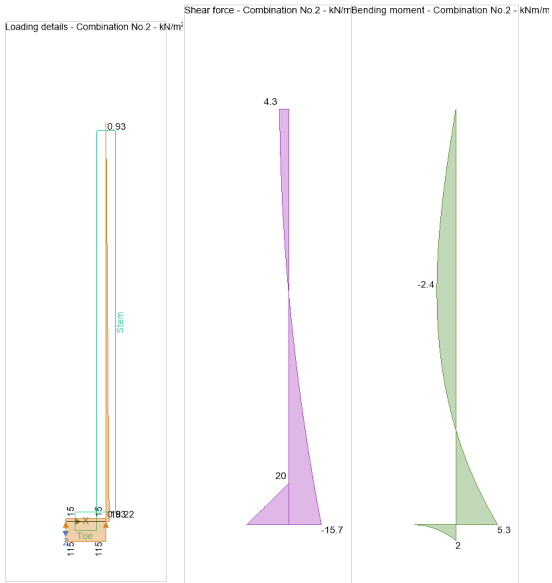
Front face of stem: $c_{sf} = \mathbf{40}$ mm

Rear face of stem: $c_{sr} = \mathbf{50}$ mm

Top face of base: $c_{bt} = \mathbf{50}$ mm

Bottom face of base: $c_{bb} = \mathbf{75}$ mm





Check stem design at 819 mm

Depth of section $h = \mathbf{400}$ mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 $M = \mathbf{2.7}$ kNm/m

Depth to tension reinforcement $d = h - c_{sf} - \phi_{sx} - \phi_{sfM} / 2 = \mathbf{345}$ mm

$K = M / (d^2 \times f_{ck}) = \mathbf{0.001}$

$K' = (2 \times \eta \times \alpha_{cc}/\gamma_C)\times(1 - \lambda \times (\delta - K_1)/(2 \times K_2))\times(\lambda \times (\delta - K_1)/(2 \times K_2))$

$K' = \mathbf{0.207}$

K' > K - No compression reinforcement is required

Lever arm $z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_C))^{0.5}, 0.95) \times d = \mathbf{328}$ mm

Depth of neutral axis $x = 2.5 \times (d - z) = \mathbf{43}$ mm

Area of tension reinforcement required $A_{sfM.req} = M / (f_{yd} \times z) = \mathbf{19}$ mm²/m

Tension reinforcement provided — 10 dia.bars @ 200 c/c

Area of tension reinforcement provided — $A_{sfM.prov} = \pi \times \phi_{sfM}^2 / (4 \times s_{sfM})$ = **393** mm²/m

Minimum area of reinforcement - exp.9.1N — $A_{sfM.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d$ = **542** mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) — $A_{sfM.max} = 0.04 \times h$ = **16000** mm²/m

$\max(A_{sfM.req}, A_{sfM.min}) / A_{sfM.prov}$ = **1.381**

FAIL - Area of reinforcement provided is less than minimum area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio — $\rho_0 = \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} / 1000$ = **0.006**

Required tension reinforcement ratio — $\rho = A_{sfM.req} / d$ = **0.000**

Required compression reinforcement ratio — $\rho' = A_{sfM.2.req} / d_2$ = **0.000**

Structural system factor - Table 7.4N — K_b = **1**

Reinforcement factor - exp.7.17 — $K_s = \min(500 \text{ N/mm}^2 / (f_{yk} \times A_{sfM.req} / A_{sfM.prov}), 1.5)$ = **1.5**

Limiting span to depth ratio - exp.7.16.a — $\min(K_s \times K_b \times [11 + 1.5 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times \rho_0 / \rho + 3.2 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times (\rho_0 / \rho - 1)^{3/2}], 40 \times K_b)$ = **40**

Actual span to depth ratio — h_{prop} / d = **5.8**

PASS - Span to depth ratio is less than deflection control limit

Check stem design at base of stem

Depth of section — h = **400** mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 — M = **6** kNm/m

Depth to tension reinforcement — $d = h - c_{sr} - \phi_{sr} / 2$ = **344** mm

$K = M / (d^2 \times f_{ck})$ = **0.002**

$K' = (2 \times \eta \times \alpha_{cc}/\gamma_C) \times (1 - \lambda \times (\delta - K_1)/(2 \times K_2)) \times (\lambda \times (\delta - K_1)/(2 \times K_2))$

K' = **0.207**

K' > K - No compression reinforcement is required

Lever arm — $z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_C))^{0.5}, 0.95) \times d$ = **327** mm

Depth of neutral axis — $x = 2.5 \times (d - z)$ = **43** mm

Area of tension reinforcement required — $A_{sr.req} = M / (f_{yd} \times z)$ = **42** mm²/m

Tension reinforcement provided — 12 dia.bars @ 200 c/c

Area of tension reinforcement provided — $A_{sr.prov} = \pi \times \phi_{sr}^2 / (4 \times s_{sr})$ = **565** mm²/m

Minimum area of reinforcement - exp.9.1N — $A_{sr.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d$ = **541** mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) — $A_{sr.max} = 0.04 \times h$ = **16000** mm²/m

$\max(A_{sr.req}, A_{sr.min}) / A_{sr.prov}$ = **0.957**

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio — $\rho_0 = \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} / 1000$ = **0.006**

Required tension reinforcement ratio — $\rho = A_{sr.req} / d$ = **0.000**

Required compression reinforcement ratio — $\rho' = A_{sr.2.req} / d_2$ = **0.000**

Structural system factor - Table 7.4N — K_b = **1**

Reinforcement factor - exp.7.17 — $K_s = \min(500 \text{ N/mm}^2 / (f_{yk} \times A_{sr.req} / A_{sr.prov}), 1.5)$ = **1.5**

Limiting span to depth ratio - exp.7.16.a — $\min(K_s \times K_b \times [11 + 1.5 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times \rho_0 / \rho + 3.2 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times (\rho_0 / \rho - 1)^{3/2}], 40 \times K_b)$ = **40**

Actual span to depth ratio — h_{prop} / d = **5.8**

PASS - Span to depth ratio is less than deflection control limit

Rectangular section in shear - Section 6.2

Design shear force V = **17.8** kN/m

$C_{Rd,c}$ = 0.18 / γ_C = **0.120**

k = min(1 + √(200 mm / d), 2) = **1.762**

Longitudinal reinforcement ratio ρ_l = min($A_{sr.prov}$ / d, 0.02) = **0.002**

v_{min} = 0.035 $N^{1/2}$/mm × $k^{3/2}$ × $f_{ck}^{0.5}$ = **0.463** N/mm²

Design shear resistance - exp.6.2a & 6.2b $V_{Rd.c}$ = max($C_{Rd.c}$ × k × (100 N²/mm⁴ × ρ_l × f_{ck})$^{1/3}$, v_{min}) × d

$V_{Rd.c}$ = **159.4** kN/m

V / $V_{Rd.c}$ = **0.112**

PASS - Design shear resistance exceeds design shear force

Check stem design at prop

Depth of section h = **400** mm

Rectangular section in shear - Section 6.2

Design shear force V = **4.8** kN/m

$C_{Rd,c}$ = 0.18 / γ_C = **0.120**

k = min(1 + √(200 mm / d), 2) = **1.762**

Longitudinal reinforcement ratio ρ_l = min($A_{sr1.prov}$ / d, 0.02) = **0.002**

v_{min} = 0.035 $N^{1/2}$/mm × $k^{3/2}$ × $f_{ck}^{0.5}$ = **0.463** N/mm²

Design shear resistance - exp.6.2a & 6.2b $V_{Rd.c}$ = max($C_{Rd.c}$ × k × (100 N²/mm⁴ × ρ_l × f_{ck})$^{1/3}$, v_{min}) × d

$V_{Rd.c}$ = **159.4** kN/m

V / $V_{Rd.c}$ = **0.030**

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Minimum area of reinforcement – cl.9.6.3(1) $A_{sx.req}$ = max(0.25 × $A_{sr.prov}$, 0.001 × t_{stem}) = **400** mm²/m

Maximum spacing of reinforcement – cl.9.6.3(2) s_{sx_max} = **400** mm

Transverse reinforcement provided 10 dia.bars @ 200 c/c

Area of transverse reinforcement provided $A_{sx.prov}$ = π × ϕ_{sx}^2 / (4 × s_{sx}) = **393** mm²/m

FAIL - Area of reinforcement provided is less than area of reinforcement required

Check base design at toe

Depth of section h = **600** mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 M = **2.7** kNm/m

Depth to tension reinforcement d = h - c_{bb} - ϕ_{bb} / 2 = **519** mm

K = M / (d² × f_{ck}) = **0.000**

K' = (2 × η × α_{cc}/γ_C)×(1 - λ × (δ - K_1)/(2 × K_2))×(λ × (δ - K_1)/(2 × K_2))

K' = **0.207**

K' > K - No compression reinforcement is required

Lever arm z = min(0.5 + 0.5 × (1 - 2 × K / (η × α_{cc} / γ_C))$^{0.5}$, 0.95) × d = **493** mm

Depth of neutral axis x = 2.5 × (d – z) = **65** mm

Area of tension reinforcement required $A_{bb.req}$ = M / (f_{yd} × z) = **13** mm²/m

Tension reinforcement provided 12 dia.bars @ 200 c/c

Area of tension reinforcement provided $A_{bb.prov}$ = π × ϕ_{bb}^2 / (4 × s_{bb}) = **565** mm²/m

Minimum area of reinforcement - exp.9.1N $A_{bb.min}$ = max(0.26 × f_{ctm} / f_{yk}, 0.0013) × d = **816** mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) $A_{bb.max}$ = 0.04 × h = **24000** mm²/m

$\max(A_{bb.req}, A_{bb.min}) / A_{bb.prov}$ = **1.443**

FAIL - Area of reinforcement provided is less than minimum area of reinforcement required

Library item: Rectangular single output

Rectangular section in shear - Section 6.2

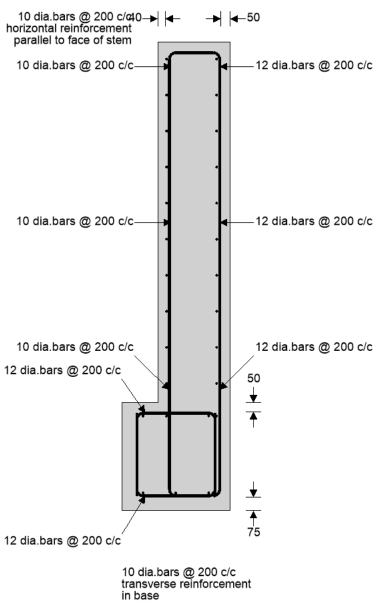
Design shear force	V = **27** kN/m
	$C_{Rd,c} = 0.18 / \gamma_C$ = **0.120**
	$k = \min(1 + \sqrt{(200 \text{ mm} / d)}, 2)$ = **1.621**
Longitudinal reinforcement ratio	$\rho_l = \min(A_{bb.prov} / d, 0.02)$ = **0.001**
	$v_{min} = 0.035 \text{ N}^{1/2}/\text{mm} \times k^{3/2} \times f_{ck}^{0.5}$ = **0.409** N/mm^2
Design shear resistance - exp.6.2a & 6.2b	$V_{Rd.c} = \max(C_{Rd.c} \times k \times (100 \text{ N}^2/\text{mm}^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$
	$V_{Rd.c}$ = **212** kN/m
	$V / V_{Rd.c}$ = **0.127**

PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Minimum area of reinforcement – cl.9.3.1.1(2)	$A_{bx.req} = 0.2 \times A_{bb.prov}$ = **113** mm^2/m
Maximum spacing of reinforcement – cl.9.3.1.1(3)	s_{bx_max} = **450** mm
Transverse reinforcement provided	10 dia.bars @ 200 c/c
Area of transverse reinforcement provided	$A_{bx.prov} = \pi \times \phi_{bx}^2 / (4 \times s_{bx})$ = **393** mm^2/m

PASS - Area of reinforcement provided is greater than area of reinforcement required



Reinforcement details

RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.14

Retaining wall details

Stem type	Propped cantilever
Stem height	h_{stem} = **4300** mm
Prop height	h_{prop} = **4300** mm
Stem thickness	t_{stem} = **400** mm
Angle to rear face of stem	α = **90** deg
Stem density	γ_{stem} = **25** kN/m^3
Toe length	l_{toe} = **1000** mm
Base thickness	t_{base} = **600** mm
Key position	p_{key} = **550** mm
Key depth	d_{key} = **500** mm
Key thickness	t_{key} = **850** mm
Base density	γ_{base} = **25** kN/m^3
Height of retained soil	h_{ret} = **4300** mm
Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm

Retained soil properties

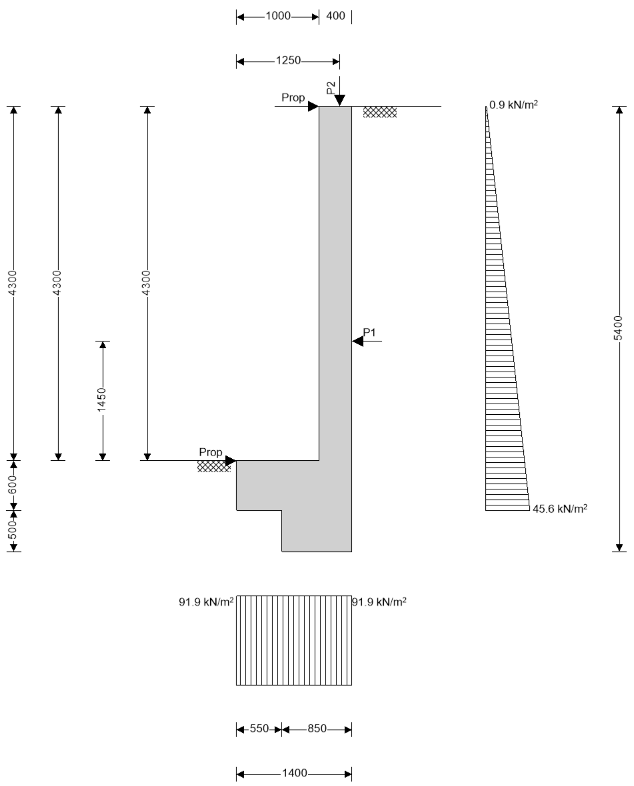
Soil type	Stiff silty clay
Moist density	γ_{mr} = **19** kN/m^3
Saturated density	γ_{sr} = **19** kN/m^3
Characteristic effective shear resistance angle	$\phi'_{r.k}$ = **22** deg
Characteristic wall friction angle	$\delta_{r.k}$ = **11** deg

Base soil properties

Soil type	Stiff silty clay
Soil density	γ_b = **19** kN/m^3
Characteristic cohesion	$c'_{b.k}$ = **120** kN/m^2
Characteristic effective shear resistance angle	$\phi'_{b.k}$ = **22** deg
Characteristic wall friction angle	$\delta_{b.k}$ = **11** deg
Characteristic base friction angle	$\delta_{bb.k}$ = **14.7** deg

Loading details

Variable surcharge load	$Surcharge_Q$ = **1.5** kN/m^2
Horizontal line load at 1450 mm	P_{G1} = **10.5** kN/m
Vertical line load at 1250 mm	P_{G2} = **54** kN/m



General arrangement

Calculate retaining wall geometry

Base length	$l_{base} = l_{toe} + t_{stem} =$ **1400** mm
Base height	$h_{base} = t_{base} + d_{key} =$ **1100** mm
Moist soil height	$h_{moist} = h_{soil} =$ **4300** mm
Length of surcharge load	$l_{sur} = l_{heel} =$ **0** mm
- Distance to vertical component	$x_{sur\_v} = l_{base} - l_{heel} / 2 =$ **1400** mm
Effective height of wall	$h_{eff} = h_{base} + d_{cover} + h_{ret} =$ **5400** mm
- Distance to horizontal component	$x_{sur\_h} = h_{eff} / 2 - d_{key} =$ **2200** mm
- Distance to horizontal component above key	$x_{sur\_h\_a} = (h_{eff} - d_{key}) / 2 =$ **2450** mm
Area of wall stem	$A_{stem} = h_{stem} \times t_{stem} =$ **1.72** m^2
- Distance to vertical component	$x_{stem} = l_{toe} + t_{stem} / 2 =$ **1200** mm
Area of wall base	$A_{base} = l_{base} \times t_{base} + d_{key} \times t_{key} =$ **1.265** m^2
- Distance to vertical component	$x_{base} = (l_{base}^2 \times t_{base} / 2 + d_{key} \times t_{key} \times (p_{key} + t_{key} / 2)) / A_{base} =$ **792** mm

Design approach 1

Partial factors on actions - Table A.3 - Combination 1

Partial factor set	A1
Permanent unfavourable action	$\gamma_G =$ **1.35**
Permanent favourable action	$\gamma_{Gf} =$ **1.00**
Variable unfavourable action	$\gamma_Q =$ **1.50**
Variable favourable action	$\gamma_{Qf} =$ **0.00**

Partial factors for soil parameters – Table A.4 - Combination 1

Soil parameter set — M1

Angle of shearing resistance — $\gamma_{\phi'}$ = **1.00**

Effective cohesion — $\gamma_{c'}$ = **1.00**

Weight density — γ_γ = **1.00**

Library item Partial factors output

Retained soil properties

Design moist density — $\gamma_{mr}' = \gamma_{mr} / \gamma_\gamma$ = **19** kN/m^3

Design saturated density — $\gamma_{sr}' = \gamma_{sr} / \gamma_\gamma$ = **19** kN/m^3

Design effective shear resistance angle — $\phi'_{r.d} = \text{atan}(\tan(\phi'_{r.k}) / \gamma_{\phi'})$ = **22** deg

Design wall friction angle — $\delta_{r.d} = \text{atan}(\tan(\delta_{r.k}) / \gamma_{\phi'})$ = **11** deg

Base soil properties

Design soil density — $\gamma_b' = \gamma_b / \gamma_\gamma$ = **19** kN/m^3

Design effective shear resistance angle — $\phi'_{b.d} = \text{atan}(\tan(\phi'_{b.k}) / \gamma_{\phi'})$ = **22** deg

Design wall friction angle — $\delta_{b.d} = \text{atan}(\tan(\delta_{b.k}) / \gamma_{\phi'})$ = **11** deg

Design base friction angle — $\delta_{bb.d} = \text{atan}(\tan(\delta_{bb.k}) / \gamma_{\phi'})$ = **14.7** deg

Design effective cohesion — $c'_{b.d} = c'_{b.k} / \gamma_{c'}$ = **120** kN/m^2

Using Coulomb theory

Active pressure coefficient — $K_A = \sin(\alpha + \phi'_{r.d})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.d}) \times [1 + \sqrt{[}\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d} - \beta) / (\sin(\alpha - \delta_{r.d}) \times \sin(\alpha + \beta))]]^2)$ = **0.413**

Passive pressure coefficient — $K_P = \sin(90 - \phi'_{b.d})^2 / (\sin(90 + \delta_{b.d}) \times [1 - \sqrt{[}\sin(\phi'_{b.d} + \delta_{b.d}) \times \sin(\phi'_{b.d}) / (\sin(90 + \delta_{b.d}))]]^2)$ = **2.958**

Bearing pressure check

Vertical forces on wall

Wall stem — $F_{stem} = \gamma_G \times A_{stem} \times \gamma_{stem}$ = **58.1** kN/m

Wall base — $F_{base} = \gamma_G \times A_{base} \times \gamma_{base}$ = **42.7** kN/m

Line loads — $F_{P\_v} = \gamma_G \times P_{G2}$ = **72.9** kN/m

Total — $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v}$ = **173.6** kN/m

Horizontal forces on wall

Surcharge load — $F_{sur\_h} = K_A \times \cos(\delta_{r.d}) \times \gamma_Q \times \text{Surcharge}_Q \times (h_{eff} - d_{key})$ = **4.5** kN/m

Line loads — $F_{P\_h} = \gamma_G \times P_{G1}$ = **14.2** kN/m

Moist retained soil — $F_{moist\_h} = \gamma_G \times K_A \times \cos(\delta_{r.d}) \times \gamma_{mr}' \times (h_{eff} - d_{key})^2 / 2$ = **124.9** kN/m

Base soil — $F_{pass\_h} = -\gamma_{Gf} \times K_P \times \cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2$ = **-33.4** kN/m

Total — $F_{total\_h} = F_{sur\_h} + F_{P\_h} + F_{moist\_h} + F_{pass\_h}$ = **110.2** kN/m

Moments on wall

Wall stem — $M_{stem} = F_{stem} \times x_{stem}$ = **69.7** kNm/m

Wall base — $M_{base} = F_{base} \times x_{base}$ = **33.8** kNm/m

Surcharge load — $M_{sur} = -F_{sur\_h} \times x_{sur\_h\_a}$ = **-11** kNm/m

Line loads — $M_P = \gamma_G \times P_{G2} \times p_2 - (\gamma_G \times P_{G1} \times (p_1 + t_{base}))$ = **62.1** kNm/m

Moist retained soil — $M_{moist} = -F_{moist\_h} \times x_{moist\_h\_a}$ = **-204** kNm/m

Total — $M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{moist}$ = **-49.4** kNm/m

Check bearing pressure

Propping force to stem — $F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base})$ = **34.9** kN/m

Propping force to base $F_{prop\_base} = F_{total\_h} - F_{prop\_stem}$ = **75.3** kN/m

Moment from propping force $M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base})$ = **170.9** kNm/m

Distance to reaction $\bar{x} = (M_{total} + M_{prop}) / F_{total\_v}$ = **700** mm

Eccentricity of reaction $e = \bar{x} - l_{base} / 2$ = **0** mm

Loaded length of base $l_{load} = l_{base}$ = **1400** mm

Bearing pressure at toe $q_{toe} = F_{total\_v} / l_{base}$ = **124** kN/m^2

Bearing pressure at heel $q_{heel} = F_{total\_v} / l_{base}$ = **124** kN/m^2

Effective overburden pressure $q = (t_{base} + d_{cover}) \times \gamma_b'$ = **11.4** kN/m^2

Design effective overburden pressure $q' = q / \gamma_\gamma$ = **11.4** kN/m^2

Bearing resistance factors $N_q = Exp(\pi \times \tan(\phi'_{b.d})) \times (\tan(45 deg + \phi'_{b.d} / 2))^2$ = **7.821**

$N_c = (N_q - 1) \times \cot(\phi'_{b.d})$ = **16.883**

$N_\gamma = 2 \times (N_q - 1) \times \tan(\phi'_{b.d})$ = **5.512**

Foundation shape factors $s_q = 1$

$s_\gamma = 1$

$s_c = 1$

Load inclination factors $H = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} + F_{P\_h} - F_{prop\_stem} - F_{prop\_base}$ = **0** kN/m

$V = F_{total\_v}$ = **173.6** kN/m

$m = 2$

$i_q = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^m$ = **1**

$i_\gamma = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^{(m + 1)}$ = **1**

$i_c = i_q - (1 - i_q) / (N_c \times \tan(\phi'_{b.d}))$ = **1**

Net ultimate bearing capacity

$n_f = c'_{b.d} \times N_c \times s_c \times i_c + q' \times N_q \times s_q \times i_q + 0.5 \times \gamma_b' \times l_{load} \times N_\gamma \times s_\gamma \times i_\gamma$ = **2188.4** kN/m^2

Factor of safety $FoS_{bp} = n_f / \max(q_{toe}, q_{heel})$ = **17.644**

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

Design approach 1

Partial factors on actions - Table A.3 - Combination 2

Partial factor set A2

Permanent unfavourable action γ_G = **1.00**

Permanent favourable action γ_{Gf} = **1.00**

Variable unfavourable action γ_Q = **1.30**

Variable favourable action γ_{Qf} = **0.00**

Partial factors for soil parameters – Table A.4 - Combination 2

Soil parameter set M2

Angle of shearing resistance $\gamma_{\phi'}$ = **1.25**

Effective cohesion $\gamma_{c'}$ = **1.25**

Weight density γ_γ = **1.00**

Library item Partial factors output

Retained soil properties

Design moist density $\gamma_{mr}' = \gamma_{mr} / \gamma_\gamma$ = **19** kN/m^3

Design saturated density $\gamma_{sr}' = \gamma_{sr} / \gamma_\gamma$ = **19** kN/m^3

Design effective shear resistance angle $\phi'_{r.d} = atan(\tan(\phi'_{r.k}) / \gamma_{\phi'})$ = **17.9** deg

Design wall friction angle $\delta_{r.d} = atan(\tan(\delta_{r.k}) / \gamma_{\phi'})$ = **8.8** deg

Base soil properties

Design soil density — $\gamma_b' = \gamma_b / \gamma_\gamma$ = **19** kN/m³

Design effective shear resistance angle — $\phi'_{b.d} = \text{atan}(\tan(\phi'_{b.k}) / \gamma_{\phi'})$ = **17.9** deg

Design wall friction angle — $\delta_{b.d} = \text{atan}(\tan(\delta_{b.k}) / \gamma_{\phi'})$ = **8.8** deg

Design base friction angle — $\delta_{bb.d} = \text{atan}(\tan(\delta_{bb.k}) / \gamma_{\phi'})$ = **11.9** deg

Design effective cohesion — $c'_{b.d} = c'_{b.k} / \gamma_{c'}$ = **96** kN/m²

Using Coulomb theory

Active pressure coefficient — $K_A = \sin(\alpha + \phi'_{r.d})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.d}) \times [1 + \sqrt{[\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d} - \beta) / (\sin(\alpha - \delta_{r.d}) \times \sin(\alpha + \beta))]}]^2)$ = **0.485**

Passive pressure coefficient — $K_P = \sin(90 - \phi'_{b.d})^2 / (\sin(90 + \delta_{b.d}) \times [1 - \sqrt{[\sin(\phi'_{b.d} + \delta_{b.d}) \times \sin(\phi'_{b.d}) / (\sin(90 + \delta_{b.d}))]}]^2)$ = **2.340**

Bearing pressure check

Vertical forces on wall

Wall stem — $F_{stem} = \gamma_G \times A_{stem} \times \gamma_{stem}$ = **43** kN/m

Wall base — $F_{base} = \gamma_G \times A_{base} \times \gamma_{base}$ = **31.6** kN/m

Line loads — $F_{P\_v} = \gamma_G \times P_{G2}$ = **54** kN/m

Total — $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v}$ = **128.6** kN/m

Horizontal forces on wall

Surcharge load — $F_{sur\_h} = K_A \times \cos(\delta_{r.d}) \times \gamma_Q \times Surcharge_Q \times (h_{eff} - d_{key})$ = **4.6** kN/m

Line loads — $F_{P\_h} = \gamma_G \times P_{G1}$ = **10.5** kN/m

Moist retained soil — $F_{moist\_h} = \gamma_G \times K_A \times \cos(\delta_{r.d}) \times \gamma_{mr}' \times (h_{eff} - d_{key})^2 / 2$ = **109.3** kN/m

Base soil — $F_{pass\_h} = -\gamma_{Gf} \times K_P \times \cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2$ = **-26.6** kN/m

Total — $F_{total\_h} = F_{sur\_h} + F_{P\_h} + F_{moist\_h} + F_{pass\_h}$ = **97.8** kN/m

Moments on wall

Wall stem — $M_{stem} = F_{stem} \times x_{stem}$ = **51.6** kNm/m

Wall base — $M_{base} = F_{base} \times x_{base}$ = **25.1** kNm/m

Surcharge load — $M_{sur} = -F_{sur\_h} \times x_{sur\_h\_a}$ = **-11.2** kNm/m

Line loads — $M_P = \gamma_G \times P_{G2} \times p_2 - (\gamma_G \times P_{G1} \times (p_1 + t_{base}))$ = **46** kNm/m

Moist retained soil — $M_{moist} = -F_{moist\_h} \times x_{moist\_h\_a}$ = **-178.6** kNm/m

Total — $M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{moist}$ = **-67.2** kNm/m

Check bearing pressure

Propping force to stem — $F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base})$ = **32.1** kN/m

Propping force to base — $F_{prop\_base} = F_{total\_h} - F_{prop\_stem}$ = **65.8** kN/m

Moment from propping force — $M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base})$ = **157.2** kNm/m

Distance to reaction — $\bar{x} = (M_{total} + M_{prop}) / F_{total\_v}$ = **700** mm

Eccentricity of reaction — $e = \bar{x} - l_{base} / 2$ = **0** mm

Loaded length of base — $l_{load} = l_{base}$ = **1400** mm

Bearing pressure at toe — $q_{toe} = F_{total\_v} / l_{base}$ = **91.9** kN/m²

Bearing pressure at heel — $q_{heel} = F_{total\_v} / l_{base}$ = **91.9** kN/m²

Effective overburden pressure — $q = (t_{base} + d_{cover}) \times \gamma_b'$ = **11.4** kN/m²

Design effective overburden pressure — $q' = q / \gamma_\gamma$ = **11.4** kN/m²

Bearing resistance factors — $N_q = \text{Exp}(\pi \times \tan(\phi'_{b.d})) \times (\tan(45 \text{ deg} + \phi'_{b.d} / 2))^2$ = **5.213**

$N_c = (N_q - 1) \times \cot(\phi'_{b.d})$ = **13.034**

$N_\gamma = 2 \times (N_q - 1) \times \tan(\phi'_{b.d}) = \mathbf{2.723}$

Foundation shape factors

$s_q = 1$

$s_\gamma = 1$

$s_c = 1$

Load inclination factors

$H = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} + F_{P\_h} - F_{prop\_stem} - F_{prop\_base} = \mathbf{0}$ kN/m

$V = F_{total\_v} = \mathbf{128.6}$ kN/m

$m = 2$

$i_q = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^m = \mathbf{1}$

$i_\gamma = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^{(m + 1)} = \mathbf{1}$

$i_c = i_q - (1 - i_q) / (N_c \times \tan(\phi'_{b.d})) = \mathbf{1}$

Net ultimate bearing capacity

$n_f = c'_{b.d} \times N_c \times s_c \times i_c + q' \times N_q \times s_q \times i_q + 0.5 \times \gamma_b' \times l_{load} \times N_\gamma \times s_\gamma \times i_\gamma = \mathbf{1346.9}$ kN/m^2

Factor of safety

$FoS_{bp} = n_f / \max(q_{toe}, q_{heel}) = \mathbf{14.66}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

Appendix E2: Party Wall Underpin Design- B1 formation level without building surcharge

RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.14

Retaining wall details

Stem type	Propped cantilever
Stem height	h_{stem} = **2000** mm
Prop height	h_{prop} = **2000** mm
Stem thickness	t_{stem} = **400** mm
Angle to rear face of stem	α = **90** deg
Stem density	γ_{stem} = **25** kN/m^3
Toe length	l_{toe} = **1** mm
Base thickness	t_{base} = **600** mm
Base density	γ_{base} = **25** kN/m^3
Height of retained soil	h_{ret} = **2000** mm
Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm

Retained soil properties

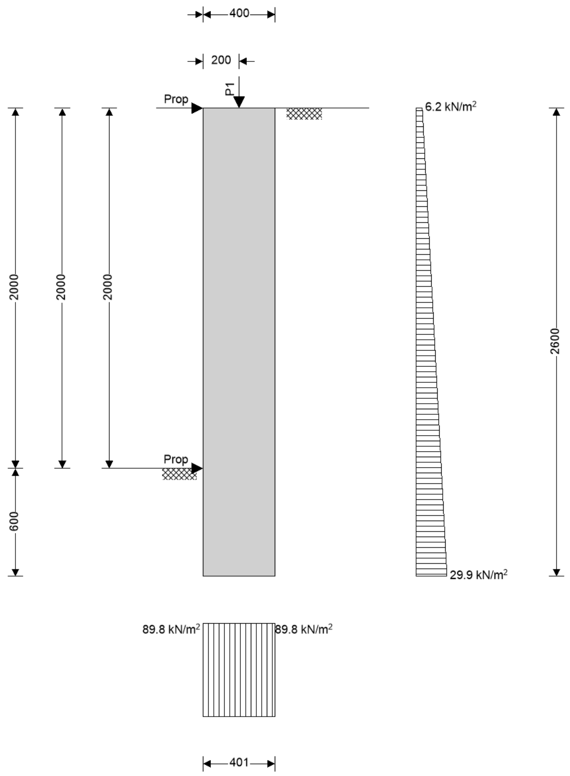
Soil type	Stiff silty clay
Moist density	γ_{mr} = **19** kN/m^3
Saturated density	γ_{sr} = **19** kN/m^3
Characteristic effective shear resistance angle	$\phi'_{r.k}$ = **22** deg
Characteristic wall friction angle	$\delta_{r.k}$ = **11** deg

Base soil properties

Soil type	Stiff silty clay
Soil density	γ_b = **19** kN/m^3
Characteristic cohesion	$c'_{b.k}$ = **120** kN/m^2
Characteristic effective shear resistance angle	$\phi'_{b.k}$ = **22** deg
Characteristic wall friction angle	$\delta_{b.k}$ = **11** deg
Characteristic base friction angle	$\delta_{bb.k}$ = **14.7** deg

Loading details

Variable surcharge load	$Surcharge_Q$ = **10** kN/m^2
Vertical line load at 200 mm	P_{G1} = **10** kN/m



General arrangement

Calculate retaining wall geometry

Base length	$l_{base} = l_{toe} + t_{stem} = \mathbf{401}$ mm
Moist soil height	$h_{moist} = h_{soil} = \mathbf{2000}$ mm
Length of surcharge load	$l_{sur} = l_{heel} = \mathbf{0}$ mm
- Distance to vertical component	$x_{sur\_v} = l_{base} - l_{heel} / 2 = \mathbf{401}$ mm
Effective height of wall	$h_{eff} = h_{base} + d_{cover} + h_{ret} = \mathbf{2600}$ mm
- Distance to horizontal component	$x_{sur\_h} = h_{eff} / 2 = \mathbf{1300}$ mm
Area of wall stem	$A_{stem} = h_{stem} \times t_{stem} = \mathbf{0.8}$ m^2
- Distance to vertical component	$x_{stem} = l_{toe} + t_{stem} / 2 = \mathbf{201}$ mm
Area of wall base	$A_{base} = l_{base} \times t_{base} = \mathbf{0.241}$ m^2
- Distance to vertical component	$x_{base} = l_{base} / 2 = \mathbf{201}$ mm

Design approach 1

Partial factors on actions - Table A.3 - Combination 1

Partial factor set	A1
Permanent unfavourable action	$\gamma_G = \mathbf{1.35}$
Permanent favourable action	$\gamma_{Gf} = \mathbf{1.00}$
Variable unfavourable action	$\gamma_Q = \mathbf{1.50}$
Variable favourable action	$\gamma_{Qf} = \mathbf{0.00}$

Partial factors for soil parameters – Table A.4 - Combination 1

Soil parameter set	M1

Angle of shearing resistance $\gamma_{\phi'}$ = **1.00**

Effective cohesion $\gamma_{c'}$ = **1.00**

Weight density γ_{γ} = **1.00**

Library item Partial factors output

Retained soil properties

Design moist density $\gamma_{mr}' = \gamma_{mr} / \gamma_{\gamma}$ = **19** kN/m³

Design saturated density $\gamma_{sr}' = \gamma_{sr} / \gamma_{\gamma}$ = **19** kN/m³

Design effective shear resistance angle $\phi'_{r.d} = atan(tan(\phi'_{r.k}) / \gamma_{\phi'})$ = **22** deg

Design wall friction angle $\delta_{r.d} = atan(tan(\delta_{r.k}) / \gamma_{\phi'})$ = **11** deg

Base soil properties

Design soil density $\gamma_b' = \gamma_b / \gamma_{\gamma}$ = **19** kN/m³

Design effective shear resistance angle $\phi'_{b.d} = atan(tan(\phi'_{b.k}) / \gamma_{\phi'})$ = **22** deg

Design wall friction angle $\delta_{b.d} = atan(tan(\delta_{b.k}) / \gamma_{\phi'})$ = **11** deg

Design base friction angle $\delta_{bb.d} = atan(tan(\delta_{bb.k}) / \gamma_{\phi'})$ = **14.7** deg

Design effective cohesion $c'_{b.d} = c'_{b.k} / \gamma_{c'}$ = **120** kN/m²

Using Coulomb theory

Active pressure coefficient $K_A = sin(\alpha + \phi'_{r.d})^2 / (sin(\alpha)^2 \times sin(\alpha - \delta_{r.d}) \times [1 + \sqrt{[}sin(\phi'_{r.d} + \delta_{r.d}) \times sin(\phi'_{r.d} - \beta) / (sin(\alpha - \delta_{r.d}) \times sin(\alpha + \beta))]]^2)$ = **0.413**

Passive pressure coefficient $K_P = sin(90 - \phi'_{b.d})^2 / (sin(90 + \delta_{b.d}) \times [1 - \sqrt{[}sin(\phi'_{b.d} + \delta_{b.d}) \times sin(\phi'_{b.d}) / (sin(90 + \delta_{b.d}))]]^2)$ = **2.958**

Bearing pressure check

Vertical forces on wall

Wall stem $F_{stem} = \gamma_G \times A_{stem} \times \gamma_{stem}$ = **27** kN/m

Wall base $F_{base} = \gamma_G \times A_{base} \times \gamma_{base}$ = **8.1** kN/m

Line loads $F_{P\_v} = \gamma_G \times P_{G1}$ = **13.5** kN/m

Total $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v}$ = **48.6** kN/m

Horizontal forces on wall

Surcharge load $F_{sur\_h} = K_A \times cos(\delta_{r.d}) \times \gamma_Q \times Surcharge_Q \times h_{eff}$ = **15.8** kN/m

Moist retained soil $F_{moist\_h} = \gamma_G \times K_A \times cos(\delta_{r.d}) \times \gamma_{mr}' \times h_{eff}^2 / 2$ = **35.2** kN/m

Base soil $F_{pass\_h} = -\gamma_{Gf} \times K_P \times cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2$ = **-9.9** kN/m

Total $F_{total\_h} = F_{sur\_h} + F_{moist\_h} + F_{pass\_h}$ = **41** kN/m

Moments on wall

Wall stem $M_{stem} = F_{stem} \times x_{stem}$ = **5.4** kNm/m

Wall base $M_{base} = F_{base} \times x_{base}$ = **1.6** kNm/m

Surcharge load $M_{sur} = -F_{sur\_h} \times x_{sur\_h}$ = **-20.6** kNm/m

Line loads $M_P = \gamma_G \times P_{G1} \times p_1$ = **2.7** kNm/m

Moist retained soil $M_{moist} = -F_{moist\_h} \times x_{moist\_h}$ = **-30.5** kNm/m

Total $M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{moist}$ = **-41.3** kNm/m

Check bearing pressure

Propping force to stem $F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base})$ = **19.6** kN/m

Propping force to base $F_{prop\_base} = F_{total\_h} - F_{prop\_stem}$ = **21.4** kN/m

Moment from propping force $M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base})$ = **51** kNm/m

Distance to reaction $\bar{x} = (M_{total} + M_{prop}) / F_{total\_v}$ = **201** mm

Eccentricity of reaction $e = \bar{x} - l_{base} / 2 = \mathbf{0}$ mm

Loaded length of base $l_{load} = l_{base} = \mathbf{401}$ mm

Bearing pressure at toe $q_{toe} = F_{total\_v} / l_{base} = \mathbf{121.2}$ kN/m²

Bearing pressure at heel $q_{heel} = F_{total\_v} / l_{base} = \mathbf{121.2}$ kN/m²

Effective overburden pressure $q = (t_{base} + d_{cover}) \times \gamma_b' = \mathbf{11.4}$ kN/m²

Design effective overburden pressure $q' = q / \gamma_\gamma = \mathbf{11.4}$ kN/m²

Bearing resistance factors $N_q = Exp(\pi \times tan(\phi'_{b.d})) \times (tan(45 deg + \phi'_{b.d} / 2))^2 = \mathbf{7.821}$

$N_c = (N_q - 1) \times cot(\phi'_{b.d}) = \mathbf{16.883}$

$N_\gamma = 2 \times (N_q - 1) \times tan(\phi'_{b.d}) = \mathbf{5.512}$

Foundation shape factors $s_q = 1$

$s_\gamma = 1$

$s_c = 1$

Load inclination factors $H = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} - F_{prop\_stem} - F_{prop\_base} = \mathbf{0}$ kN/m

$V = F_{total\_v} = \mathbf{48.6}$ kN/m

$m = 2$

$i_q = [1 - H / (V + l_{load} \times c'_{b.d} \times cot(\phi'_{b.d}))]^m = \mathbf{1}$

$i_\gamma = [1 - H / (V + l_{load} \times c'_{b.d} \times cot(\phi'_{b.d}))]^{(m + 1)} = \mathbf{1}$

$i_c = i_q - (1 - i_q) / (N_c \times tan(\phi'_{b.d})) = \mathbf{1}$

Net ultimate bearing capacity

$n_f = c'_{b.d} \times N_c \times s_c \times i_c + q' \times N_q \times s_q \times i_q + 0.5 \times \gamma_b' \times l_{load} \times N_\gamma \times s_\gamma \times i_\gamma = \mathbf{2136.1}$ kN/m²

Factor of safety $FoS_{bp} = n_f / max(q_{toe}, q_{heel}) = \mathbf{17.618}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

Design approach 1

Partial factors on actions - Table A.3 - Combination 2

Partial factor set A2

Permanent unfavourable action $\gamma_G = \mathbf{1.00}$

Permanent favourable action $\gamma_{Gf} = \mathbf{1.00}$

Variable unfavourable action $\gamma_Q = \mathbf{1.30}$

Variable favourable action $\gamma_{Qf} = \mathbf{0.00}$

Partial factors for soil parameters – Table A.4 - Combination 2

Soil parameter set M2

Angle of shearing resistance $\gamma_{\phi'} = \mathbf{1.25}$

Effective cohesion $\gamma_{c'} = \mathbf{1.25}$

Weight density $\gamma_\gamma = \mathbf{1.00}$

Library item Partial factors output

Retained soil properties

Design moist density $\gamma_{mr}' = \gamma_{mr} / \gamma_\gamma = \mathbf{19}$ kN/m³

Design saturated density $\gamma_{sr}' = \gamma_{sr} / \gamma_\gamma = \mathbf{19}$ kN/m³

Design effective shear resistance angle $\phi'_{r.d} = atan(tan(\phi'_{r.k}) / \gamma_{\phi'}) = \mathbf{17.9}$ deg

Design wall friction angle $\delta_{r.d} = atan(tan(\delta_{r.k}) / \gamma_{\phi'}) = \mathbf{8.8}$ deg

Base soil properties

Design soil density $\gamma_b' = \gamma_b / \gamma_\gamma = \mathbf{19}$ kN/m³

Design effective shear resistance angle $\phi'_{b.d} = atan(tan(\phi'_{b.k}) / \gamma_{\phi'}) = \mathbf{17.9}$ deg

Design wall friction angle $\delta_{b.d} = atan(tan(\delta_{b.k}) / \gamma_{\phi'}) = \mathbf{8.8}$ deg

Design base friction angle $\delta_{bb.d} = \mathrm{atan}(\tan(\delta_{bb.k}) / \gamma_{\phi'}) = \mathbf{11.9}$ deg

Design effective cohesion $c'_{b.d} = c'_{b.k} / \gamma_{c'} = \mathbf{96}$ kN/m²

Using Coulomb theory

Active pressure coefficient $K_A = \sin(\alpha + \phi'_{r.d})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.d}) \times [1 + \sqrt{[\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d} - \beta) / (\sin(\alpha - \delta_{r.d}) \times \sin(\alpha + \beta))]}]^2) = \mathbf{0.485}$

Passive pressure coefficient $K_P = \sin(90 - \phi'_{b.d})^2 / (\sin(90 + \delta_{b.d}) \times [1 - \sqrt{[\sin(\phi'_{b.d} + \delta_{b.d}) \times \sin(\phi'_{b.d}) / (\sin(90 + \delta_{b.d}))]}]^2) = \mathbf{2.340}$

Bearing pressure check

Vertical forces on wall

Wall stem $F_{stem} = \gamma_G \times A_{stem} \times \gamma_{stem} = \mathbf{20}$ kN/m

Wall base $F_{base} = \gamma_G \times A_{base} \times \gamma_{base} = \mathbf{6}$ kN/m

Line loads $F_{P\_v} = \gamma_G \times P_{G1} = \mathbf{10}$ kN/m

Total $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v} = \mathbf{36}$ kN/m

Horizontal forces on wall

Surcharge load $F_{sur\_h} = K_A \times \cos(\delta_{r.d}) \times \gamma_Q \times Surcharge_Q \times h_{eff} = \mathbf{16.2}$ kN/m

Moist retained soil $F_{moist\_h} = \gamma_G \times K_A \times \cos(\delta_{r.d}) \times \gamma_{mr}' \times h_{eff}^2 / 2 = \mathbf{30.8}$ kN/m

Base soil $F_{pass\_h} = -\gamma_{Gf} \times K_P \times \cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2 = \mathbf{-7.9}$ kN/m

Total $F_{total\_h} = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} = \mathbf{39.1}$ kN/m

Moments on wall

Wall stem $M_{stem} = F_{stem} \times x_{stem} = \mathbf{4}$ kNm/m

Wall base $M_{base} = F_{base} \times x_{base} = \mathbf{1.2}$ kNm/m

Surcharge load $M_{sur} = -F_{sur\_h} \times x_{sur\_h} = \mathbf{-21.1}$ kNm/m

Line loads $M_P = \gamma_G \times P_{G1} \times p_1 = \mathbf{2}$ kNm/m

Moist retained soil $M_{moist} = -F_{moist\_h} \times x_{moist\_h} = \mathbf{-26.7}$ kNm/m

Total $M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{moist} = \mathbf{-40.5}$ kNm/m

Check bearing pressure

Propping force to stem $F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base}) = \mathbf{18.4}$ kN/m

Propping force to base $F_{prop\_base} = F_{total\_h} - F_{prop\_stem} = \mathbf{20.7}$ kN/m

Moment from propping force $M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base}) = \mathbf{47.7}$ kNm/m

Distance to reaction $\bar{x} = (M_{total} + M_{prop}) / F_{total\_v} = \mathbf{201}$ mm

Eccentricity of reaction $e = \bar{x} - l_{base} / 2 = \mathbf{0}$ mm

Loaded length of base $l_{load} = l_{base} = \mathbf{401}$ mm

Bearing pressure at toe $q_{toe} = F_{total\_v} / l_{base} = \mathbf{89.8}$ kN/m²

Bearing pressure at heel $q_{heel} = F_{total\_v} / l_{base} = \mathbf{89.8}$ kN/m²

Effective overburden pressure $q = (t_{base} + d_{cover}) \times \gamma_b' = \mathbf{11.4}$ kN/m²

Design effective overburden pressure $q' = q / \gamma_\gamma = \mathbf{11.4}$ kN/m²

Bearing resistance factors $N_q = \mathrm{Exp}(\pi \times \tan(\phi'_{b.d})) \times (\tan(45\ \mathrm{deg} + \phi'_{b.d} / 2))^2 = \mathbf{5.213}$

$N_c = (N_q - 1) \times \cot(\phi'_{b.d}) = \mathbf{13.034}$

$N_\gamma = 2 \times (N_q - 1) \times \tan(\phi'_{b.d}) = \mathbf{2.723}$

Foundation shape factors $s_q = 1$

$s_\gamma = 1$

$s_c = 1$

Load inclination factors $H = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} - F_{prop\_stem} - F_{prop\_base} = \mathbf{0}$ kN/m

$V = F_{total\_v} = \mathbf{36}$ kN/m

$m = 2$

$i_q = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^m = \mathbf{1}$

$i_\gamma = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^{(m + 1)} = \mathbf{1}$

$i_c = i_q - (1 - i_q) / (N_c \times \tan(\phi'_{b.d})) = \mathbf{1}$

Net ultimate bearing capacity

$n_f = c'_{b.d} \times N_c \times s_c \times i_c + q' \times N_q \times s_q \times i_q + 0.5 \times \gamma_b' \times l_{load} \times N_\gamma \times s_\gamma \times i_\gamma = \mathbf{1321}$ kN/m²

Factor of safety $FoS_{bp} = n_f / \max(q_{toe}, q_{heel}) = \mathbf{14.709}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.9.14

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

Concrete strength class C30/37

Characteristic compressive cylinder strength $f_{ck} = \mathbf{30}$ N/mm²

Characteristic compressive cube strength $f_{ck,cube} = \mathbf{37}$ N/mm²

Mean value of compressive cylinder strength $f_{cm} = f_{ck} + 8$ N/mm² $= \mathbf{38}$ N/mm²

Mean value of axial tensile strength $f_{ctm} = 0.3$ N/mm² $\times (f_{ck} / 1$ N/mm²$)^{2/3} = \mathbf{2.9}$ N/mm²

5% fractile of axial tensile strength $f_{ctk,0.05} = 0.7 \times f_{ctm} = \mathbf{2.0}$ N/mm²

Secant modulus of elasticity of concrete $E_{cm} = 22$ kN/mm² $\times (f_{cm} / 10$ N/mm²$)^{0.3} = \mathbf{32837}$ N/mm²

Partial factor for concrete - Table 2.1N $\gamma_C = \mathbf{1.50}$

Compressive strength coefficient - cl.3.1.6(1) $\alpha_{cc} = \mathbf{0.85}$

Design compressive concrete strength - exp.3.15 $f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_C = \mathbf{17.0}$ N/mm²

Maximum aggregate size $h_{agg} = \mathbf{20}$ mm

Ultimate strain - Table 3.1 $\varepsilon_{cu2} = \mathbf{0.0035}$

Shortening strain - Table 3.1 $\varepsilon_{cu3} = \mathbf{0.0035}$

Effective compression zone height factor $\lambda = \mathbf{0.80}$

Effective strength factor $\eta = \mathbf{1.00}$

Bending coefficient k_1 $K_1 = \mathbf{0.40}$

Bending coefficient k_2 $K_2 = 1.00 \times (0.6 + 0.0014/\varepsilon_{cu2}) = \mathbf{1.00}$

Bending coefficient k_3 $K_3 = \mathbf{0.40}$

Bending coefficient k_4 $K_4 = 1.00 \times (0.6 + 0.0014/\varepsilon_{cu2}) = \mathbf{1.00}$

Reinforcement details

Characteristic yield strength of reinforcement $f_{yk} = \mathbf{500}$ N/mm²

Modulus of elasticity of reinforcement $E_s = \mathbf{200000}$ N/mm²

Partial factor for reinforcing steel - Table 2.1N $\gamma_S = \mathbf{1.15}$

Design yield strength of reinforcement $f_{yd} = f_{yk} / \gamma_S = \mathbf{435}$ N/mm²

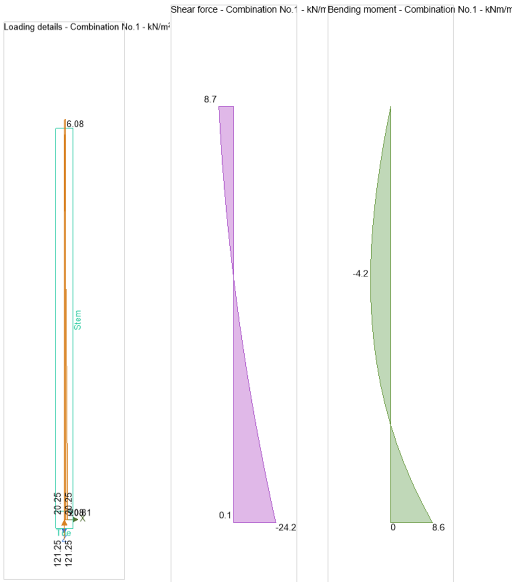
Cover to reinforcement

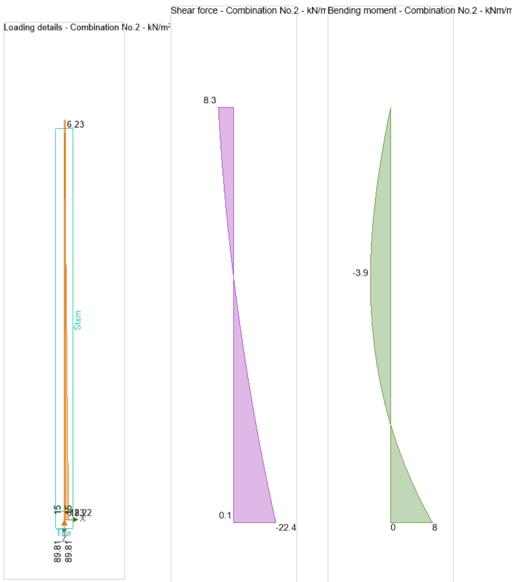
Front face of stem $c_{sf} = \mathbf{40}$ mm

Rear face of stem $c_{sr} = \mathbf{50}$ mm

Top face of base $c_{bt} = \mathbf{50}$ mm

Bottom face of base $c_{bb} = \mathbf{75}$ mm





Check stem design at 864 mm

Depth of section $h = \mathbf{400}$ mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 $M = \mathbf{4.2}$ kNm/m

Depth to tension reinforcement $d = h - c_{sf} - \phi_{sx} - \phi_{sfM} / 2 = \mathbf{344}$ mm

$K = M / (d^2 \times f_{ck}) = \mathbf{0.001}$

$K' = (2 \times \eta \times \alpha_{cc}/\gamma_C)\times(1 - \lambda \times (\delta - K_1)/(2 \times K_2))\times(\lambda \times (\delta - K_1)/(2 \times K_2))$

$K' = \mathbf{0.207}$

K' > K - No compression reinforcement is required

Lever arm $z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_C))^{0.5}, 0.95) \times d = \mathbf{327}$ mm

Depth of neutral axis $x = 2.5 \times (d - z) = \mathbf{43}$ mm

Area of tension reinforcement required $A_{sfM.req} = M / (f_{yd} \times z) = \mathbf{29}$ mm²/m

Tension reinforcement provided 12 dia.bars @ 200 c/c

Area of tension reinforcement provided $A_{sfM.prov} = \pi \times \phi_{sfM}^2 / (4 \times s_{sfM})$ = **565** mm²/m

Minimum area of reinforcement - exp.9.1N $A_{sfM.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d$ = **518** mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) $A_{sfM.max} = 0.04 \times h$ = **16000** mm²/m

$\max(A_{sfM.req}, A_{sfM.min}) / A_{sfM.prov}$ = **0.916**

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio $\rho_0 = \sqrt{(f_{ck} / 1\ N/mm^2)} / 1000$ = **0.005**

Required tension reinforcement ratio $\rho = A_{sfM.req} / d$ = **0.000**

Required compression reinforcement ratio $\rho' = A_{sfM.2.req} / d_2$ = **0.000**

Structural system factor - Table 7.4N K_b = **1**

Reinforcement factor - exp.7.17 $K_s = \min(500\ N/mm^2 / (f_{yk} \times A_{sfM.req} / A_{sfM.prov}), 1.5)$ = **1.5**

Limiting span to depth ratio - exp.7.16.a $\min(K_s \times K_b \times [11 + 1.5 \times \sqrt{(f_{ck} / 1\ N/mm^2)} \times \rho_0 / \rho + 3.2 \times \sqrt{(f_{ck} / 1\ N/mm^2)} \times (\rho_0 / \rho - 1)^{3/2}], 40 \times K_b)$ = **40**

Actual span to depth ratio h_{prop} / d = **5.8**

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm

Variable load factor - EN1990 – Table A1.1 ψ_2 = **0.6**

Serviceability bending moment M_{sls} = **2.5** kNm/m

Tensile stress in reinforcement $\sigma_s = M_{sls} / (A_{sfM.prov} \times z)$ = **13.5** N/mm²

Load duration Long term

Load duration factor k_t = **0.4**

Effective area of concrete in tension $A_{c.eff} = \min(2.5 \times (h - d), (h - x) / 3, h / 2)$

$A_{c.eff}$ = **119000** mm²/m

Mean value of concrete tensile strength $f_{ct.eff} = f_{ctm}$ = **2.9** N/mm²

Reinforcement ratio $\rho_{p.eff} = A_{sfM.prov} / A_{c.eff}$ = **0.005**

Modular ratio $\alpha_e = E_s / E_{cm}$ = **6.091**

Bond property coefficient k_1 = **0.8**

Strain distribution coefficient k_2 = **0.5**

k_3 = **3.4**

k_4 = **0.425**

Maximum crack spacing - exp.7.11 $s_{r.max} = k_3 \times c_{sf} + k_1 \times k_2 \times k_4 \times \phi_{sfM} / \rho_{p.eff}$ = **565** mm

Maximum crack width - exp.7.8 $w_k = s_{r.max} \times \max(\sigma_s - k_t \times (f_{ct.eff} / \rho_{p.eff}) \times (1 + \alpha_e \times \rho_{p.eff}), 0.6 \times \sigma_s) / E_s$

w_k = **0.023** mm

w_k / w_{max} = **0.077**

PASS - Maximum crack width is less than limiting crack width

Check stem design at base of stem

Depth of section h = **400** mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 M = **8.6** kNm/m

Depth to tension reinforcement $d = h - c_{sr} - \phi_{sr} / 2$ = **344** mm

$K = M / (d^2 \times f_{ck})$ = **0.002**

$K' = (2 \times \eta \times \alpha_{cc}/\gamma_C) \times (1 - \lambda \times (\delta - K_1)/(2 \times K_2)) \times (\lambda \times (\delta - K_1)/(2 \times K_2))$

K' = **0.207**

K' > K - No compression reinforcement is required

Lever arm $z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_C))^{0.5}, 0.95) \times d$ = **327** mm

Depth of neutral axis $x = 2.5 \times (d – z)$ = **43** mm

Area of tension reinforcement required $A_{sr.req} = M / (f_{yd} \times z)$ = **60** mm²/m

Tension reinforcement provided 12 dia.bars @ 200 c/c

Area of tension reinforcement provided $A_{sr.prov} = \pi \times \phi_{sr}^2 / (4 \times s_{sr})$ = **565** mm²/m

Minimum area of reinforcement - exp.9.1N $A_{sr.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d$ = **518** mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) $A_{sr.max} = 0.04 \times h$ = **16000** mm²/m

$\max(A_{sr.req}, A_{sr.min}) / A_{sr.prov}$ = **0.916**

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio $\rho_0 = \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} / 1000$ = **0.005**

Required tension reinforcement ratio $\rho = A_{sr.req} / d$ = **0.000**

Required compression reinforcement ratio $\rho' = A_{sr.2.req} / d_2$ = **0.000**

Structural system factor - Table 7.4N K_b = **1**

Reinforcement factor - exp.7.17 $K_s = \min(500 \text{ N/mm}^2 / (f_{yk} \times A_{sr.req} / A_{sr.prov}), 1.5)$ = **1.5**

Limiting span to depth ratio - exp.7.16.a $\min(K_s \times K_b \times [11 + 1.5 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times \rho_0 / \rho + 3.2 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times (\rho_0 / \rho - 1)^{3/2}], 40 \times K_b)$ = **40**

Actual span to depth ratio h_{prop} / d = **5.8**

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm

Variable load factor - EN1990 – Table A1.1 ψ_2 = **0.6**

Serviceability bending moment M_{sls} = **5.3** kNm/m

Tensile stress in reinforcement $\sigma_s = M_{sls} / (A_{sr.prov} \times z)$ = **28.8** N/mm²

Load duration Long term

Load duration factor k_t = **0.4**

Effective area of concrete in tension $A_{c.eff} = \min(2.5 \times (h - d), (h - x) / 3, h / 2)$

$A_{c.eff}$ = **119000** mm²/m

Mean value of concrete tensile strength $f_{ct.eff} = f_{ctm}$ = **2.9** N/mm²

Reinforcement ratio $\rho_{p.eff} = A_{sr.prov} / A_{c.eff}$ = **0.005**

Modular ratio $\alpha_e = E_s / E_{cm}$ = **6.091**

Bond property coefficient k_1 = **0.8**

Strain distribution coefficient k_2 = **0.5**

k_3 = **3.4**

k_4 = **0.425**

Maximum crack spacing - exp.7.11 $s_{r.max} = k_3 \times c_{sr} + k_1 \times k_2 \times k_4 \times \phi_{sr} / \rho_{p.eff}$ = **599** mm

Maximum crack width - exp.7.8 $w_k = s_{r.max} \times \max(\sigma_s – k_t \times (f_{ct.eff} / \rho_{p.eff}) \times (1 + \alpha_e \times \rho_{p.eff}), 0.6 \times \sigma_s) / E_s$

w_k = **0.052** mm

w_k / w_{max} = **0.173**

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **24.2** kN/m

$C_{Rd,c} = 0.18 / \gamma_C$ = **0.120**

$k = \min(1 + \sqrt{(200 \text{ mm} / d)}, 2)$ = **1.762**

Longitudinal reinforcement ratio — $\rho_l = \min(A_{sr.prov} / d, 0.02) = \mathbf{0.002}$

$v_{min} = 0.035 N^{1/2}/mm \times k^{3/2} \times f_{ck}^{0.5} = \mathbf{0.449}$ N/mm²

Design shear resistance - exp.6.2a & 6.2b — $V_{Rd.c} = \max(C_{Rd.c} \times k \times (100 N^2/mm^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$

$V_{Rd.c} = \mathbf{154.3}$ kN/m

$V / V_{Rd.c} = \mathbf{0.157}$

PASS - Design shear resistance exceeds design shear force

Check stem design at prop

Depth of section — h = **400** mm

Rectangular section in shear - Section 6.2

Design shear force — V = **8.7** kN/m

$C_{Rd,c} = 0.18 / \gamma_C = \mathbf{0.120}$

$k = \min(1 + \sqrt{(200 mm / d)}, 2) = \mathbf{1.762}$

Longitudinal reinforcement ratio — $\rho_l = \min(A_{sr1.prov} / d, 0.02) = \mathbf{0.002}$

$v_{min} = 0.035 N^{1/2}/mm \times k^{3/2} \times f_{ck}^{0.5} = \mathbf{0.449}$ N/mm²

Design shear resistance - exp.6.2a & 6.2b — $V_{Rd.c} = \max(C_{Rd.c} \times k \times (100 N^2/mm^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$

$V_{Rd.c} = \mathbf{154.3}$ kN/m

$V / V_{Rd.c} = \mathbf{0.057}$

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Minimum area of reinforcement – cl.9.6.3(1) — $A_{sx.req} = \max(0.25 \times A_{sr.prov}, 0.001 \times t_{stem}) = \mathbf{400}$ mm²/m

Maximum spacing of reinforcement – cl.9.6.3(2) — $s_{sx\_max} = \mathbf{400}$ mm

Transverse reinforcement provided — 10 dia.bars @ 200 c/c

Area of transverse reinforcement provided — $A_{sx.prov} = \pi \times \phi_{sx}^2 / (4 \times s_{sx}) = \mathbf{393}$ mm²/m

FAIL - Area of reinforcement provided is less than area of reinforcement required

Rectangular section in shear - Section 6.2

Design shear force — V = **0.1** kN/m

$C_{Rd,c} = 0.18 / \gamma_C = \mathbf{0.120}$

$k = \min(1 + \sqrt{(200 mm / d)}, 2) = \mathbf{1.762}$

Longitudinal reinforcement ratio — $\rho_l = \min(A_{bb.prov} / d, 0.02) = \mathbf{0.002}$

$v_{min} = 0.035 N^{1/2}/mm \times k^{3/2} \times f_{ck}^{0.5} = \mathbf{0.449}$ N/mm²

Design shear resistance - exp.6.2a & 6.2b — $V_{Rd.c} = \max(C_{Rd.c} \times k \times (100 N^2/mm^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$

$V_{Rd.c} = \mathbf{154.3}$ kN/m

$V / V_{Rd.c} = \mathbf{0.001}$

PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

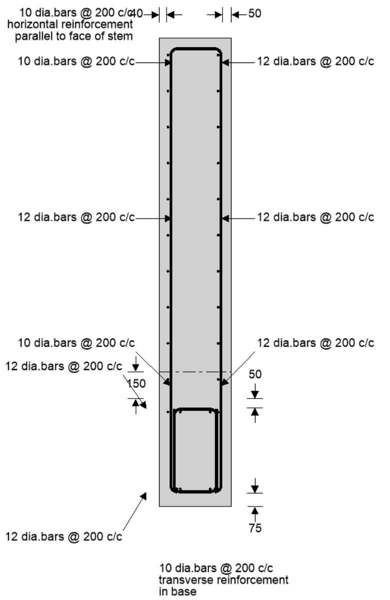
Minimum area of reinforcement – cl.9.3.1.1(2) — $A_{bx.req} = 0.2 \times A_{bb.prov} = \mathbf{113}$ mm²/m

Maximum spacing of reinforcement – cl.9.3.1.1(3) — $s_{bx\_max} = \mathbf{450}$ mm

Transverse reinforcement provided — 10 dia.bars @ 200 c/c

Area of transverse reinforcement provided — $A_{bx.prov} = \pi \times \phi_{bx}^2 / (4 \times s_{bx}) = \mathbf{393}$ mm²/m

PASS - Area of reinforcement provided is greater than area of reinforcement required



Reinforcement details

Project				Job no.	
42 Elsworthy Rd				2022113	
Calcs for				Start page no./Revision	
Underpin Stage 2 Party Wall No Surcharge				1 2	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
JN	13/01/2023	MU			

RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.14

Retaining wall details

Stem type	Propped cantilever
Stem height	h_{stem} = **4300** mm
Prop height	h_{prop} = **4300** mm
Stem thickness	t_{stem} = **400** mm
Angle to rear face of stem	α = **90** deg
Stem density	γ_{stem} = **25** kN/m^3
Toe length	l_{toe} = **1000** mm
Base thickness	t_{base} = **500** mm
Key position	p_{key} = **550** mm
Key depth	d_{key} = **500** mm
Key thickness	t_{key} = **850** mm
Base density	γ_{base} = **25** kN/m^3
Height of retained soil	h_{ret} = **4300** mm
Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm

Retained soil properties

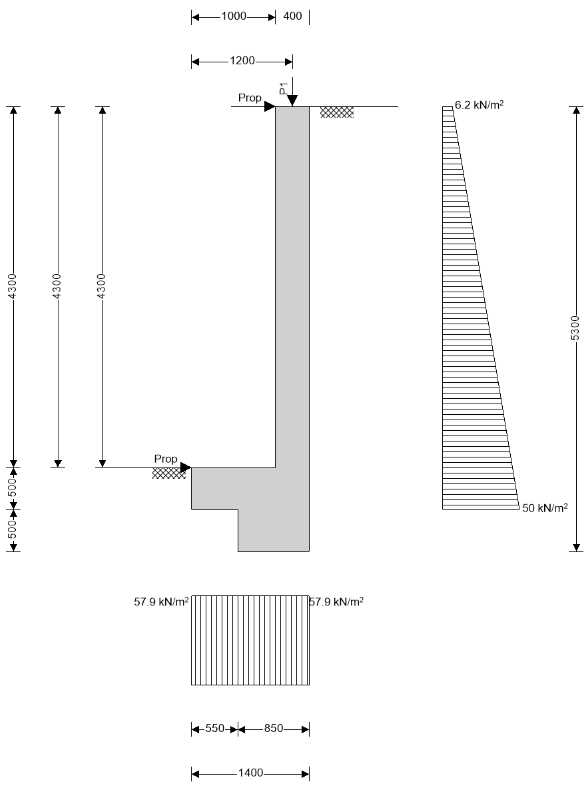
Soil type	Stiff silty clay
Moist density	γ_{mr} = **19** kN/m^3
Saturated density	γ_{sr} = **19** kN/m^3
Characteristic effective shear resistance angle	$\phi'_{r.k}$ = **22** deg
Characteristic wall friction angle	$\delta_{r.k}$ = **11** deg

Base soil properties

Soil type	Stiff silty clay
Soil density	γ_b = **19** kN/m^3
Characteristic cohesion	$c'_{b.k}$ = **120** kN/m^2
Characteristic effective shear resistance angle	$\phi'_{b.k}$ = **22** deg
Characteristic wall friction angle	$\delta_{b.k}$ = **11** deg
Characteristic base friction angle	$\delta_{bb.k}$ = **14.7** deg

Loading details

Variable surcharge load	$Surcharge_Q$ = **10** kN/m^2
Vertical line load at 1200 mm	P_{G1} = **10** kN/m



General arrangement

Calculate retaining wall geometry

Base length	$l_{base} = l_{toe} + t_{stem} =$ **1400** mm
Base height	$h_{base} = t_{base} + d_{key} =$ **1000** mm
Moist soil height	$h_{moist} = h_{soil} =$ **4300** mm
Length of surcharge load	$l_{sur} = l_{heel} =$ **0** mm
- Distance to vertical component	$x_{sur\_v} = l_{base} - l_{heel} / 2 =$ **1400** mm
Effective height of wall	$h_{eff} = h_{base} + d_{cover} + h_{ret} =$ **5300** mm
- Distance to horizontal component	$x_{sur\_h} = h_{eff} / 2 - d_{key} =$ **2150** mm
- Distance to horizontal component above key	$x_{sur\_h\_a} = (h_{eff} - d_{key}) / 2 =$ **2400** mm
Area of wall stem	$A_{stem} = h_{stem} \times t_{stem} =$ **1.72** m^2
- Distance to vertical component	$x_{stem} = l_{toe} + t_{stem} / 2 =$ **1200** mm
Area of wall base	$A_{base} = l_{base} \times t_{base} + d_{key} \times t_{key} =$ **1.125** m^2
- Distance to vertical component	$x_{base} = (l_{base}^2 \times t_{base} / 2 + d_{key} \times t_{key} \times (p_{key} + t_{key} / 2)) / A_{base} =$ **804** mm

Design approach 1

Partial factors on actions - Table A.3 - Combination 1

Partial factor set	A1
Permanent unfavourable action	$\gamma_G =$ **1.35**
Permanent favourable action	$\gamma_{Gf} =$ **1.00**
Variable unfavourable action	$\gamma_Q =$ **1.50**
Variable favourable action	$\gamma_{Qf} =$ **0.00**

Partial factors for soil parameters – Table A.4 - Combination 1

Soil parameter set: M1

Angle of shearing resistance: $\gamma_{\phi'}$ = **1.00**

Effective cohesion: $\gamma_{c'}$ = **1.00**

Weight density: γ_{γ} = **1.00**

Library item Partial factors output

Retained soil properties

Design moist density: $\gamma_{mr}' = \gamma_{mr} / \gamma_{\gamma}$ = **19** kN/m^3

Design saturated density: $\gamma_{sr}' = \gamma_{sr} / \gamma_{\gamma}$ = **19** kN/m^3

Design effective shear resistance angle: $\phi'_{r.d} = \text{atan}(\tan(\phi'_{r.k}) / \gamma_{\phi'})$ = **22** deg

Design wall friction angle: $\delta_{r.d} = \text{atan}(\tan(\delta_{r.k}) / \gamma_{\phi'})$ = **11** deg

Base soil properties

Design soil density: $\gamma_b' = \gamma_b / \gamma_{\gamma}$ = **19** kN/m^3

Design effective shear resistance angle: $\phi'_{b.d} = \text{atan}(\tan(\phi'_{b.k}) / \gamma_{\phi'})$ = **22** deg

Design wall friction angle: $\delta_{b.d} = \text{atan}(\tan(\delta_{b.k}) / \gamma_{\phi'})$ = **11** deg

Design base friction angle: $\delta_{bb.d} = \text{atan}(\tan(\delta_{bb.k}) / \gamma_{\phi'})$ = **14.7** deg

Design effective cohesion: $c'_{b.d} = c'_{b.k} / \gamma_{c'}$ = **120** kN/m^2

Using Coulomb theory

Active pressure coefficient: $K_A = \sin(\alpha + \phi'_{r.d})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.d}) \times [1 + \sqrt{[\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d} - \beta) / (\sin(\alpha - \delta_{r.d}) \times \sin(\alpha + \beta))]}]^2)$ = **0.413**

Passive pressure coefficient: $K_P = \sin(90 - \phi'_{b.d})^2 / (\sin(90 + \delta_{b.d}) \times [1 - \sqrt{[\sin(\phi'_{b.d} + \delta_{b.d}) \times \sin(\phi'_{b.d}) / (\sin(90 + \delta_{b.d}))]}]^2)$ = **2.958**

Bearing pressure check

Vertical forces on wall

Wall stem: $F_{stem} = \gamma_G \times A_{stem} \times \gamma_{stem}$ = **58.1** kN/m

Wall base: $F_{base} = \gamma_G \times A_{base} \times \gamma_{base}$ = **38** kN/m

Line loads: $F_{P\_v} = \gamma_G \times P_{G1}$ = **13.5** kN/m

Total: $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v}$ = **109.5** kN/m

Horizontal forces on wall

Surcharge load: $F_{sur\_h} = K_A \times \cos(\delta_{r.d}) \times \gamma_Q \times \text{Surcharge}_Q \times (h_{eff} - d_{key})$ = **29.2** kN/m

Moist retained soil: $F_{moist\_h} = \gamma_G \times K_A \times \cos(\delta_{r.d}) \times \gamma_{mr}' \times (h_{eff} - d_{key})^2 / 2$ = **119.8** kN/m

Base soil: $F_{pass\_h} = -\gamma_{Gf} \times K_P \times \cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2$ = **-27.6** kN/m

Total: $F_{total\_h} = F_{sur\_h} + F_{moist\_h} + F_{pass\_h}$ = **121.5** kN/m

Moments on wall

Wall stem: $M_{stem} = F_{stem} \times x_{stem}$ = **69.7** kNm/m

Wall base: $M_{base} = F_{base} \times x_{base}$ = **30.5** kNm/m

Surcharge load: $M_{sur} = -F_{sur\_h} \times x_{sur\_h\_a}$ = **-70.1** kNm/m

Line loads: $M_P = \gamma_G \times P_{G1} \times p_1$ = **16.2** kNm/m

Moist retained soil: $M_{moist} = -F_{moist\_h} \times x_{moist\_h\_a}$ = **-191.7** kNm/m

Total: $M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{moist}$ = **-145.4** kNm/m

Check bearing pressure

Propping force to stem: $F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base})$ = **46.3** kN/m

Propping force to base: $F_{prop\_base} = F_{total\_h} - F_{prop\_stem}$ = **75.2** kN/m

Moment from propping force	$M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base})$ = **222.1** kNm/m
Distance to reaction	$\bar{x} = (M_{total} + M_{prop}) / F_{total\_v}$ = **700** mm
Eccentricity of reaction	$e = \bar{x} - l_{base} / 2$ = **0** mm
Loaded length of base	$l_{load} = l_{base}$ = **1400** mm
Bearing pressure at toe	$q_{toe} = F_{total\_v} / l_{base}$ = **78.2** kN/m^2
Bearing pressure at heel	$q_{heel} = F_{total\_v} / l_{base}$ = **78.2** kN/m^2
Effective overburden pressure	$q = (t_{base} + d_{cover}) \times \gamma_b'$ = **9.5** kN/m^2
Design effective overburden pressure	$q' = q / \gamma_\gamma$ = **9.5** kN/m^2
Bearing resistance factors	$N_q = Exp(\pi \times \tan(\phi'_{b.d})) \times (\tan(45 deg + \phi'_{b.d} / 2))^2$ = **7.821**
	$N_c = (N_q - 1) \times \cot(\phi'_{b.d})$ = **16.883**
	$N_\gamma = 2 \times (N_q - 1) \times \tan(\phi'_{b.d})$ = **5.512**
Foundation shape factors	$s_q = 1$
	$s_\gamma = 1$
	$s_c = 1$
Load inclination factors	$H = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} - F_{prop\_stem} - F_{prop\_base}$ = **0** kN/m
	$V = F_{total\_v}$ = **109.5** kN/m
	$m = 2$
	$i_q = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^m$ = **1**
	$i_\gamma = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^{(m+1)}$ = **1**
	$i_c = i_q - (1 - i_q) / (N_c \times \tan(\phi'_{b.d}))$ = **1**

Net ultimate bearing capacity

$n_f = c'_{b.d} \times N_c \times s_c \times i_c + q' \times N_q \times s_q \times i_q + 0.5 \times \gamma_b' \times l_{load} \times N_\gamma \times s_\gamma \times i_\gamma$ = **2173.6** kN/m^2

Factor of safety $FoS_{bp} = n_f / \max(q_{toe}, q_{heel})$ = **27.785**

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

Design approach 1

Partial factors on actions - Table A.3 - Combination 2

Partial factor set	A2
Permanent unfavourable action	γ_G = **1.00**
Permanent favourable action	γ_{Gf} = **1.00**
Variable unfavourable action	γ_Q = **1.30**
Variable favourable action	γ_{Qf} = **0.00**

Partial factors for soil parameters – Table A.4 - Combination 2

Soil parameter set	M2
Angle of shearing resistance	$\gamma_{\phi'}$ = **1.25**
Effective cohesion	$\gamma_{c'}$ = **1.25**
Weight density	γ_γ = **1.00**

Library item Partial factors output

Retained soil properties

Design moist density	$\gamma_{mr}' = \gamma_{mr} / \gamma_\gamma$ = **19** kN/m^3
Design saturated density	$\gamma_{sr}' = \gamma_{sr} / \gamma_\gamma$ = **19** kN/m^3
Design effective shear resistance angle	$\phi'_{r.d} = atan(\tan(\phi'_{r.k}) / \gamma_{\phi'})$ = **17.9** deg
Design wall friction angle	$\delta_{r.d} = atan(\tan(\delta_{r.k}) / \gamma_{\phi'})$ = **8.8** deg

Base soil properties

Design soil density	$\gamma_b' = \gamma_b / \gamma_\gamma$ = **19** kN/m^3

Design effective shear resistance angle $\phi'_{b.d} = \text{atan}(\tan(\phi'_{b.k}) / \gamma_{\phi'}) =$ **17.9** deg

Design wall friction angle $\delta_{b.d} = \text{atan}(\tan(\delta_{b.k}) / \gamma_{\phi'}) =$ **8.8** deg

Design base friction angle $\delta_{bb.d} = \text{atan}(\tan(\delta_{bb.k}) / \gamma_{\phi'}) =$ **11.9** deg

Design effective cohesion $c'_{b.d} = c'_{b.k} / \gamma_{c'} =$ **96** kN/m²

Using Coulomb theory

Active pressure coefficient $K_A = \sin(\alpha + \phi'_{r.d})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.d}) \times [1 + \sqrt{[\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d} - \beta) / (\sin(\alpha - \delta_{r.d}) \times \sin(\alpha + \beta))]}]^2) =$ **0.485**

Passive pressure coefficient $K_P = \sin(90 - \phi'_{b.d})^2 / (\sin(90 + \delta_{b.d}) \times [1 - \sqrt{[\sin(\phi'_{b.d} + \delta_{b.d}) \times \sin(\phi'_{b.d}) / (\sin(90 + \delta_{b.d}))]}]^2) =$ **2.340**

Bearing pressure check

Vertical forces on wall

Wall stem $F_{stem} = \gamma_G \times A_{stem} \times \gamma_{stem} =$ **43** kN/m

Wall base $F_{base} = \gamma_G \times A_{base} \times \gamma_{base} =$ **28.1** kN/m

Line loads $F_{P\_v} = \gamma_G \times P_{G1} =$ **10** kN/m

Total $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v} =$ **81.1** kN/m

Horizontal forces on wall

Surcharge load $F_{sur\_h} = K_A \times \cos(\delta_{r.d}) \times \gamma_Q \times Surcharge_Q \times (h_{eff} - d_{key}) =$ **29.9** kN/m

Moist retained soil $F_{moist\_h} = \gamma_G \times K_A \times \cos(\delta_{r.d}) \times \gamma_{mr}' \times (h_{eff} - d_{key})^2 / 2 =$ **104.9** kN/m

Base soil $F_{pass\_h} = -\gamma_{Gf} \times K_P \times \cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2 =$ **-22** kN/m

Total $F_{total\_h} = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} =$ **112.9** kN/m

Moments on wall

Wall stem $M_{stem} = F_{stem} \times x_{stem} =$ **51.6** kNm/m

Wall base $M_{base} = F_{base} \times x_{base} =$ **22.6** kNm/m

Surcharge load $M_{sur} = -F_{sur\_h} \times x_{sur\_h\_a} =$ **-71.8** kNm/m

Line loads $M_P = \gamma_G \times P_{G1} \times p_1 =$ **12** kNm/m

Moist retained soil $M_{moist} = -F_{moist\_h} \times x_{moist\_h\_a} =$ **-167.9** kNm/m

Total $M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{moist} =$ **-153.5** kNm/m

Check bearing pressure

Propping force to stem $F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base}) =$ **43.8** kN/m

Propping force to base $F_{prop\_base} = F_{total\_h} - F_{prop\_stem} =$ **69.1** kN/m

Moment from propping force $M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base}) =$ **210.3** kNm/m

Distance to reaction $\bar{x} = (M_{total} + M_{prop}) / F_{total\_v} =$ **700** mm

Eccentricity of reaction $e = \bar{x} - l_{base} / 2 =$ **0** mm

Loaded length of base $l_{load} = l_{base} =$ **1400** mm

Bearing pressure at toe $q_{toe} = F_{total\_v} / l_{base} =$ **57.9** kN/m²

Bearing pressure at heel $q_{heel} = F_{total\_v} / l_{base} =$ **57.9** kN/m²

Effective overburden pressure $q = (t_{base} + d_{cover}) \times \gamma_b' =$ **9.5** kN/m²

Design effective overburden pressure $q' = q / \gamma_\gamma =$ **9.5** kN/m²

Bearing resistance factors $N_q = \text{Exp}(\pi \times \tan(\phi'_{b.d})) \times (\tan(45 \text{ deg} + \phi'_{b.d} / 2))^2 =$ **5.213**

$N_c = (N_q - 1) \times \cot(\phi'_{b.d}) =$ **13.034**

$N_\gamma = 2 \times (N_q - 1) \times \tan(\phi'_{b.d}) =$ **2.723**

Foundation shape factors $s_q = 1$

$s_\gamma = 1$

$s_c = 1$

Load inclination factors $H = F_{sur\_h} + F_{moist\_h} + F_{pass\_h} - F_{prop\_stem} - F_{prop\_base} = \mathbf{0}$ kN/m

$V = F_{total\_v} = \mathbf{81.1}$ kN/m

$m = 2$

$i_q = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^m = \mathbf{1}$

$i_\gamma = [1 - H / (V + l_{load} \times c'_{b.d} \times \cot(\phi'_{b.d}))]^{(m + 1)} = \mathbf{1}$

$i_c = i_q - (1 - i_q) / (N_c \times \tan(\phi'_{b.d})) = \mathbf{1}$

Net ultimate bearing capacity

$n_f = c'_{b.d} \times N_c \times s_c \times i_c + q' \times N_q \times s_q \times i_q + 0.5 \times \gamma_b' \times l_{load} \times N_\gamma \times s_\gamma \times i_\gamma = \mathbf{1337}$ kN/m²

Factor of safety $FoS_{bp} = n_f / \max(q_{toe}, q_{heel}) = \mathbf{23.073}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.9.14

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

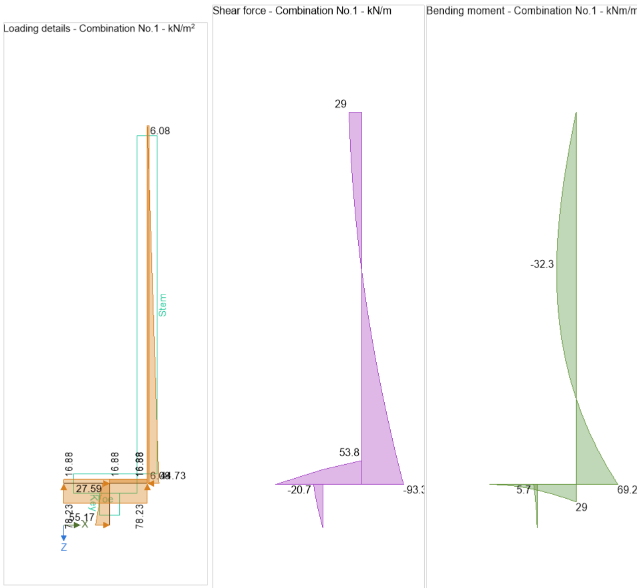
Concrete strength class	C32/40
Characteristic compressive cylinder strength	$f_{ck} = \mathbf{32}$ N/mm²
Characteristic compressive cube strength	$f_{ck,cube} = \mathbf{40}$ N/mm²
Mean value of compressive cylinder strength	$f_{cm} = f_{ck} + 8$ N/mm² $= \mathbf{40}$ N/mm²
Mean value of axial tensile strength	$f_{ctm} = 0.3$ N/mm² $\times (f_{ck} / 1$ N/mm²$)^{2/3} = \mathbf{3.0}$ N/mm²
5% fractile of axial tensile strength	$f_{ctk,0.05} = 0.7 \times f_{ctm} = \mathbf{2.1}$ N/mm²
Secant modulus of elasticity of concrete	$E_{cm} = 22$ kN/mm² $\times (f_{cm} / 10$ N/mm²$)^{0.3} = \mathbf{33346}$ N/mm²
Partial factor for concrete - Table 2.1N	$\gamma_C = \mathbf{1.50}$
Compressive strength coefficient - cl.3.1.6(1)	$\alpha_{cc} = \mathbf{0.85}$
Design compressive concrete strength - exp.3.15	$f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_C = \mathbf{18.1}$ N/mm²
Maximum aggregate size	$h_{agg} = \mathbf{20}$ mm
Ultimate strain - Table 3.1	$\varepsilon_{cu2} = \mathbf{0.0035}$
Shortening strain - Table 3.1	$\varepsilon_{cu3} = \mathbf{0.0035}$
Effective compression zone height factor	$\lambda = \mathbf{0.80}$
Effective strength factor	$\eta = \mathbf{1.00}$
Bending coefficient k_1	$K_1 = \mathbf{0.40}$
Bending coefficient k_2	$K_2 = 1.00 \times (0.6 + 0.0014/\varepsilon_{cu2}) = \mathbf{1.00}$
Bending coefficient k_3	$K_3 = \mathbf{0.40}$
Bending coefficient k_4	$K_4 = 1.00 \times (0.6 + 0.0014/\varepsilon_{cu2}) = \mathbf{1.00}$

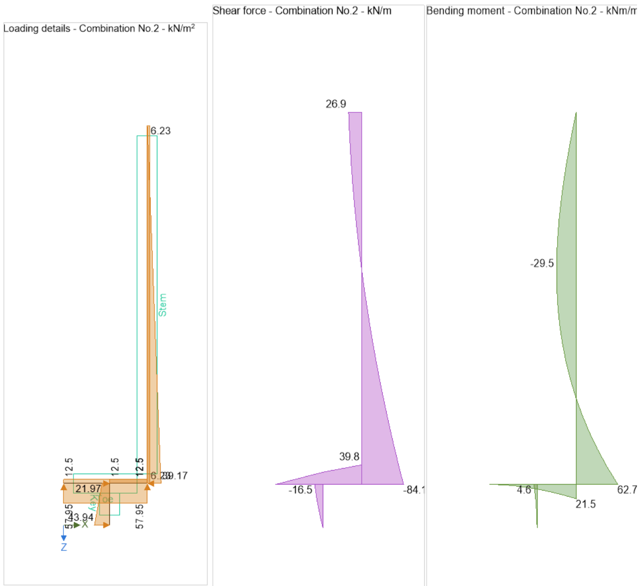
Reinforcement details

Characteristic yield strength of reinforcement	$f_{yk} = \mathbf{500}$ N/mm²
Modulus of elasticity of reinforcement	$E_s = \mathbf{200000}$ N/mm²
Partial factor for reinforcing steel - Table 2.1N	$\gamma_S = \mathbf{1.15}$
Design yield strength of reinforcement	$f_{yd} = f_{yk} / \gamma_S = \mathbf{435}$ N/mm²

Cover to reinforcement

Front face of stem	$c_{sf} = \mathbf{40}$ mm
Rear face of stem	$c_{sr} = \mathbf{50}$ mm
Top face of base	$c_{bt} = \mathbf{50}$ mm
Bottom face of base	$c_{bb} = \mathbf{75}$ mm





Check stem design at 2200 mm

Depth of section h = **400** mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 M = **32.3** kNm/m

Depth to tension reinforcement $d = h - c_{sf} - \phi_{sx} - \phi_{sfM} / 2 =$ **344** mm

$K = M / (d^2 \times f_{ck}) =$ **0.009**

$K' = (2 \times \eta \times \alpha_{cc}/\gamma_C)\times(1 - \lambda \times (\delta - K_1)/(2 \times K_2))\times(\lambda \times (\delta - K_1)/(2 \times K_2))$

$K' =$ **0.207**

K' > K - No compression reinforcement is required

Lever arm $z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_C))^{0.5}, 0.95) \times d =$ **327** mm

Depth of neutral axis $x = 2.5 \times (d - z) =$ **43** mm

Area of tension reinforcement required $A_{sfM.req} = M / (f_{yd} \times z) =$ **228** mm^2/m

Tension reinforcement provided — 12 dia.bars @ 200 c/c

Area of tension reinforcement provided — $A_{sfM.prov} = \pi \times \phi_{sfM}^2 / (4 \times s_{sfM})$ = **565** mm²/m

Minimum area of reinforcement - exp.9.1N — $A_{sfM.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d$ = **541** mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) — $A_{sfM.max} = 0.04 \times h$ = **16000** mm²/m

$\max(A_{sfM.req}, A_{sfM.min}) / A_{sfM.prov}$ = **0.957**

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio — $\rho_0 = \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} / 1000$ = **0.006**

Required tension reinforcement ratio — $\rho = A_{sfM.req} / d$ = **0.001**

Required compression reinforcement ratio — $\rho' = A_{sfM.2.req} / d_2$ = **0.000**

Structural system factor - Table 7.4N — K_b = **1**

Reinforcement factor - exp.7.17 — $K_s = \min(500 \text{ N/mm}^2 / (f_{yk} \times A_{sfM.req} / A_{sfM.prov}), 1.5)$ = **1.5**

Limiting span to depth ratio - exp.7.16.a — $\min(K_s \times K_b \times [11 + 1.5 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times \rho_0 / \rho + 3.2 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times (\rho_0 / \rho - 1)^{3/2}], 40 \times K_b)$ = **40**

Actual span to depth ratio — h_{prop} / d = **12.5**

PASS - Span to depth ratio is less than deflection control limit

Check stem design at base of stem

Depth of section — h = **400** mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 — M = **69.2** kNm/m

Depth to tension reinforcement — $d = h - c_{sr} - \phi_{sr} / 2$ = **344** mm

$K = M / (d^2 \times f_{ck})$ = **0.018**

$K' = (2 \times \eta \times \alpha_{cc}/\gamma_C)\times(1 - \lambda \times (\delta - K_1)/(2 \times K_2))\times(\lambda \times (\delta - K_1)/(2 \times K_2))$

K' = **0.207**

K' > K - No compression reinforcement is required

Lever arm — $z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_C))^{0.5}, 0.95) \times d$ = **327** mm

Depth of neutral axis — $x = 2.5 \times (d - z)$ = **43** mm

Area of tension reinforcement required — $A_{sr.req} = M / (f_{yd} \times z)$ = **487** mm²/m

Tension reinforcement provided — 12 dia.bars @ 200 c/c

Area of tension reinforcement provided — $A_{sr.prov} = \pi \times \phi_{sr}^2 / (4 \times s_{sr})$ = **565** mm²/m

Minimum area of reinforcement - exp.9.1N — $A_{sr.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d$ = **541** mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) — $A_{sr.max} = 0.04 \times h$ = **16000** mm²/m

$\max(A_{sr.req}, A_{sr.min}) / A_{sr.prov}$ = **0.957**

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio — $\rho_0 = \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} / 1000$ = **0.006**

Required tension reinforcement ratio — $\rho = A_{sr.req} / d$ = **0.001**

Required compression reinforcement ratio — $\rho' = A_{sr.2.req} / d_2$ = **0.000**

Structural system factor - Table 7.4N — K_b = **1**

Reinforcement factor - exp.7.17 — $K_s = \min(500 \text{ N/mm}^2 / (f_{yk} \times A_{sr.req} / A_{sr.prov}), 1.5)$ = **1.161**

Limiting span to depth ratio - exp.7.16.a — $\min(K_s \times K_b \times [11 + 1.5 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times \rho_0 / \rho + 3.2 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times (\rho_0 / \rho - 1)^{3/2}], 40 \times K_b)$ = **40**

Actual span to depth ratio — h_{prop} / d = **12.5**

PASS - Span to depth ratio is less than deflection control limit

Rectangular section in shear - Section 6.2

Design shear force — $V = \mathbf{93.3}$ kN/m

$C_{Rd,c} = 0.18 / \gamma_C = \mathbf{0.120}$

$k = \min(1 + \sqrt{(200\ mm / d)}, 2) = \mathbf{1.762}$

Longitudinal reinforcement ratio — $\rho_l = \min(A_{sr.prov} / d, 0.02) = \mathbf{0.002}$

$v_{min} = 0.035\ N^{1/2}/mm \times k^{3/2} \times f_{ck}^{0.5} = \mathbf{0.463}\ N/mm^2$

Design shear resistance - exp.6.2a & 6.2b — $V_{Rd.c} = \max(C_{Rd.c} \times k \times (100\ N^2/mm^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$

$V_{Rd.c} = \mathbf{159.4}$ kN/m

$V / V_{Rd.c} = \mathbf{0.585}$

PASS - Design shear resistance exceeds design shear force

Check stem design at prop

Depth of section — $h = \mathbf{400}$ mm

Rectangular section in shear - Section 6.2

Design shear force — $V = \mathbf{29}$ kN/m

$C_{Rd,c} = 0.18 / \gamma_C = \mathbf{0.120}$

$k = \min(1 + \sqrt{(200\ mm / d)}, 2) = \mathbf{1.762}$

Longitudinal reinforcement ratio — $\rho_l = \min(A_{sr1.prov} / d, 0.02) = \mathbf{0.002}$

$v_{min} = 0.035\ N^{1/2}/mm \times k^{3/2} \times f_{ck}^{0.5} = \mathbf{0.463}\ N/mm^2$

Design shear resistance - exp.6.2a & 6.2b — $V_{Rd.c} = \max(C_{Rd.c} \times k \times (100\ N^2/mm^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$

$V_{Rd.c} = \mathbf{159.4}$ kN/m

$V / V_{Rd.c} = \mathbf{0.182}$

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Minimum area of reinforcement – cl.9.6.3(1) — $A_{sx.req} = \max(0.25 \times A_{sr.prov}, 0.001 \times t_{stem}) = \mathbf{400}\ mm^2/m$

Maximum spacing of reinforcement – cl.9.6.3(2) — $s_{sx\_max} = \mathbf{400}$ mm

Transverse reinforcement provided — 10 dia.bars @ 200 c/c

Area of transverse reinforcement provided — $A_{sx.prov} = \pi \times \phi_{sx}^2 / (4 \times s_{sx}) = \mathbf{393}\ mm^2/m$

FAIL - Area of reinforcement provided is less than area of reinforcement required

Check base design at toe

Depth of section — $h = \mathbf{500}$ mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 — $M = \mathbf{29}$ kNm/m

Depth to tension reinforcement — $d = h - c_{bb} - \phi_{bb} / 2 = \mathbf{419}$ mm

$K = M / (d^2 \times f_{ck}) = \mathbf{0.005}$

$K' = (2 \times \eta \times \alpha_{cc}/\gamma_C)\times(1 - \lambda \times (\delta - K_1)/(2 \times K_2))\times(\lambda \times (\delta - K_1)/(2 \times K_2))$

$K' = \mathbf{0.207}$

K' > K - No compression reinforcement is required

Lever arm — $z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_C))^{0.5}, 0.95) \times d = \mathbf{398}$ mm

Depth of neutral axis — $x = 2.5 \times (d – z) = \mathbf{52}$ mm

Area of tension reinforcement required — $A_{bb.req} = M / (f_{yd} \times z) = \mathbf{167}\ mm^2/m$

Tension reinforcement provided — 12 dia.bars @ 200 c/c

Area of tension reinforcement provided — $A_{bb.prov} = \pi \times \phi_{bb}^2 / (4 \times s_{bb}) = \mathbf{565}\ mm^2/m$

Minimum area of reinforcement - exp.9.1N — $A_{bb.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d = \mathbf{659}\ mm^2/m$

Maximum area of reinforcement - cl.9.2.1.1(3) — $A_{bb.max} = 0.04 \times h = \mathbf{20000}\ mm^2/m$

$\max(A_{bb.req}, A_{bb.min}) / A_{bb.prov}$ = **1.165**

FAIL - Area of reinforcement provided is less than minimum area of reinforcement required

Library item: Rectangular single output

Rectangular section in shear - Section 6.2

Design shear force — V = **53.8** kN/m

$C_{Rd,c} = 0.18 / \gamma_C$ = **0.120**

$k = \min(1 + \sqrt{(200 \text{ mm} / d)}, 2)$ = **1.691**

Longitudinal reinforcement ratio — $\rho_l = \min(A_{bb.prov} / d, 0.02)$ = **0.001**

$v_{min} = 0.035 \text{ N}^{1/2}/\text{mm} \times k^{3/2} \times f_{ck}^{0.5}$ = **0.435** N/mm^2

Design shear resistance - exp.6.2a & 6.2b — $V_{Rd.c} = \max(C_{Rd.c} \times k \times (100 \text{ N}^2/\text{mm}^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$

$V_{Rd.c}$ = **182.4** kN/m

$V / V_{Rd.c}$ = **0.295**

PASS - Design shear resistance exceeds design shear force

Check key design

Depth of section — h = **850** mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 — M = **5.7** kNm/m

Depth to tension reinforcement — $d = h - c_{bb} - \phi_k / 2$ = **769** mm

$K = M / (d^2 \times f_{ck})$ = **0.000**

$K' = (2 \times \eta \times \alpha_{cc}/\gamma_C)\times(1 - \lambda \times (\delta - K_1)/(2 \times K_2))\times(\lambda \times (\delta - K_1)/(2 \times K_2))$

K' = **0.207**

K' > K - No compression reinforcement is required

Lever arm — $z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_C))^{0.5}, 0.95) \times d$ = **731** mm

Depth of neutral axis — $x = 2.5 \times (d – z)$ = **96** mm

Area of tension reinforcement required — $A_{k.req} = M / (f_{yd} \times z)$ = **18** mm^2/m

Tension reinforcement provided — 12 dia.bars @ 200 c/c

Area of tension reinforcement provided — $A_{k.prov} = \pi \times \phi_k^2 / (4 \times s_k)$ = **565** mm^2/m

Minimum area of reinforcement - exp.9.1N — $A_{k.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d$ = **1209** mm^2/m

Maximum area of reinforcement - cl.9.2.1.1(3) — $A_{k.max} = 0.04 \times h$ = **34000** mm^2/m

$\max(A_{k.req}, A_{k.min}) / A_{k.prov}$ = **2.138**

FAIL - Area of reinforcement provided is less than minimum area of reinforcement required

Library item: Rectangular single output

Rectangular section in shear - Section 6.2

Design shear force — V = **20.7** kN/m

$C_{Rd,c} = 0.18 / \gamma_C$ = **0.120**

$k = \min(1 + \sqrt{(200 \text{ mm} / d)}, 2)$ = **1.510**

Longitudinal reinforcement ratio — $\rho_l = \min(A_{k.prov} / d, 0.02)$ = **0.001**

$v_{min} = 0.035 \text{ N}^{1/2}/\text{mm} \times k^{3/2} \times f_{ck}^{0.5}$ = **0.367** N/mm^2

Design shear resistance - exp.6.2a & 6.2b — $V_{Rd.c} = \max(C_{Rd.c} \times k \times (100 \text{ N}^2/\text{mm}^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$

$V_{Rd.c}$ = **282.5** kN/m

$V / V_{Rd.c}$ = **0.073**

PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

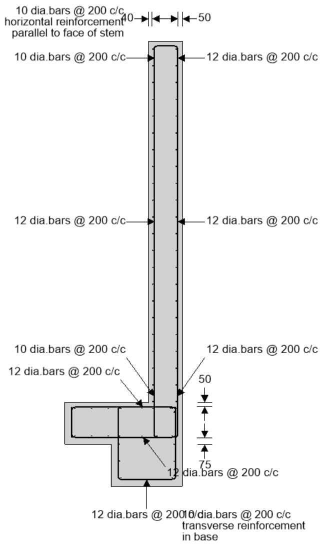
Minimum area of reinforcement – cl.9.3.1.1(2) — $A_{bx.req} = 0.2 \times A_{bb.prov}$ = **113** mm^2/m

Maximum spacing of reinforcement – cl.9.3.1.1(3) — s_{bx_max} = **450** mm

Transverse reinforcement provided — 10 dia.bars @ 200 c/c

Area of transverse reinforcement provided $A_{bx.prov} = \pi \times \phi_{bx}^2 / (4 \times s_{bx})$ = **393** mm²/m

PASS - Area of reinforcement provided is greater than area of reinforcement required



Reinforcement details

Appendix F: External Wall Panel Check

MASONRY WALL PANEL DESIGN

In accordance with EN1996-1-1:2005 + A1:2012 incorporating Corrigenda February 2006 and July 2009 and the UK national annex

Tedds calculation version 1.2.19

Summary table

	Allowable	Actual	Utilisation	
Slenderness ratio	27;	18.0;	0.667;	PASS
Vertical loading on wall	672.191 kN/m;	206.130 kN/m;	0.307;	PASS
Design moment to wall	11.360 kNm/m;	8.262 kNm/m;	0.727;	PASS

Masonry panel details

Single-leaf wall example - Unreinforced masonry wall without openings

Panel length L = **1000** mm

Panel height h = **7200** mm

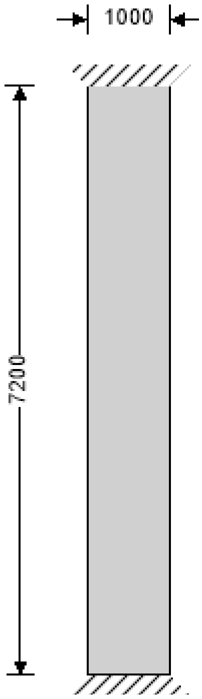
Panel support conditions

Top and bottom supported

Effective height of masonry walls - Section 5.5.1.2

Reduction factor ρ_2 = **1.000**

Effective height of wall - eq 5.2 $h_{ef} = \rho_2 \times h$ = **7200** mm

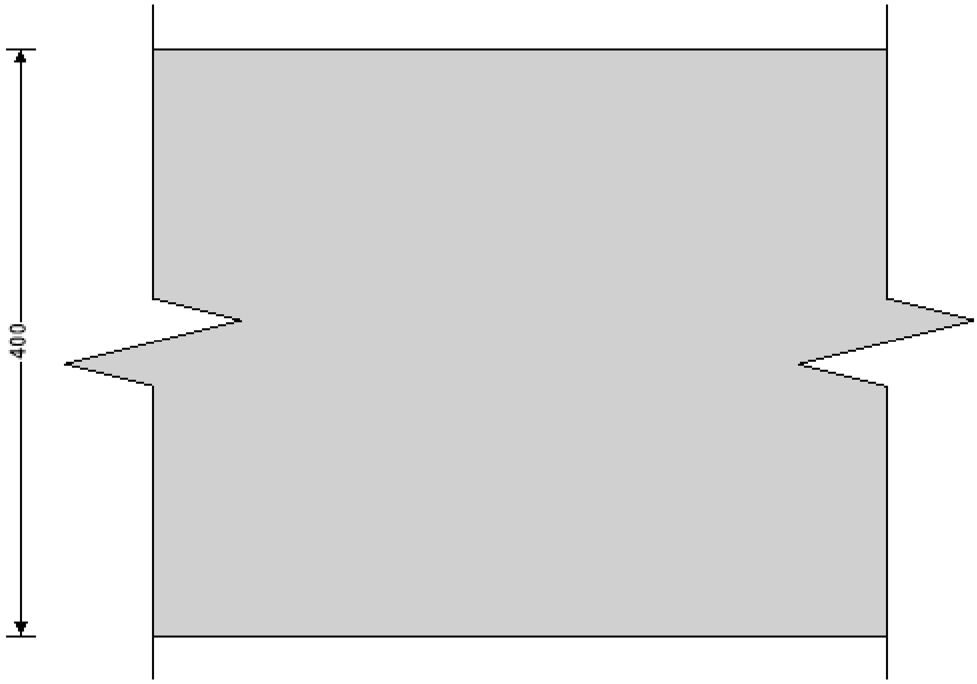


Single-leaf wall construction details

Wall thickness t = **400** mm

Effective thickness of masonry walls - Section 5.5.1.3

Effective thickness $t_{ef} = t$ = **400** mm



Masonry details

Masonry type **Clay with water absorption between 7% and 12% - Group 1**

Compressive strength of masonry f_c = **20** N/mm^2

Height of unit h_u = **215** mm

Width of unit w_u = **400** mm

Conditioning factor k = **1.0**

- Conditioning to the air dry condition in accordance with cl.7.3.2

Shape factor - Table A.1 d_{sf} = **1.115**

Norm. mean compressive strength of masonry $f_b = f_c \times k \times d_{sf}$ = **22.3** N/mm^2

Density of masonry γ = **20** kN/m^3

Mortar type **M4 - General purpose mortar**

Compressive strength of masonry mortar f_m = **4** N/mm^2

Compressive strength factor - Table NA.4 K = **0.50**

Characteristic compressive strength of masonry - eq 3.1

$f_k = K \times f_b^{0.7} \times f_m^{0.3}$ = **6.659** N/mm^2

Characteristic flexural strength of masonry having a plane of failure parallel to the bed joints - Table NA.6

f_{xk1} = **0.4** N/mm^2

Characteristic flexural strength of masonry having a plane of failure perpendicular to the bed joints - Table NA.6

f_{xk2} = **1.1** N/mm^2

Lateral loading details

Characteristic wind load on panel W_k = **0.850** kN/m^2

Vertical loading details

Permanent load on top of wall G_k = **110** kN/m

Variable load on top of wall Q_k = **12.5** kN/m at an eccentricity of 20 mm

Partial factors for material strength

Category of manufacturing control **Category I**

Class of execution control **Class 1**

Partial factor for masonry in compressive flexure γ_{Mc} = **2.30**

Partial factor for masonry in tensile flexure γ_{Mt} = **2.30**

Partial factor for masonry in shear γ_{Mv} = **2.50**

Slenderness ratio of masonry walls - Section 5.5.1.4

Allowable slenderness ratio SR_{all} = **27**

Slenderness ratio $SR = h_{ef} / t_{ef}$ = **18.0**

PASS - Slenderness ratio is less than maximum allowable

Unreinforced masonry walls subjected to mainly vertical loading - Section 6.1

Partial safety factors for design loads

Partial safety factor for permanent load γ_{fG} = **1.35**

Partial safety factor for variable imposed load γ_{fQ} = **1.5**

Partial safety factor for variable wind load γ_{fW} = **0.75**

Check vertical loads

Reduction factor for slenderness and eccentricity - Section 6.1.2.2

Vertical load at top of wall $N_{id} = \gamma_{fG} \times G_k + \gamma_{fQ} \times Q_k$ = **167.25** kN/m

Moment at top of wall due to vertical load $M_{id} = \gamma_{fG} \times G_k \times e_G + \gamma_{fQ} \times Q_k \times e_Q$ = **0.375** kNm/m

Initial eccentricity - cl.5.5.1.1 $e_{init} = h_{ef} / 450$ = **16** mm

Moment at top of wall due to horizontal load M_{Eid} = **0** kNm/m

Eccentricity at top of wall due to horizontal load e_h = **0** mm

Eccentricity at top of wall - eq.6.5 $e_i = \max(M_{id} / N_{id} + e_h + e_{init}, 0.05 \times t)$ = **20** mm

Reduction factor at top of wall - eq.6.4 $\Phi_i = \max(1 - 2 \times e_i / t, 0)$ = **0.9**

Vertical load at middle of wall $N_{md} = \gamma_{fG} \times (G_k + \gamma \times t \times h / 2) + \gamma_{fQ} \times Q_k$ = **206.13** kN/m

Moment at middle of wall due to vertical load $M_{md} = \gamma_{fG} \times G_k \times e_G + \gamma_{fQ} \times Q_k \times e_Q$ = **0.375** kNm/m

Moment at middle of wall due to horizontal load M_{Emd} = **4.131** kNm/m

Eccentricity at middle of wall due to horizontal load $e_{hm} = M_{Emd} / N_{md}$ = **20** mm

Eccentricity at middle of wall due to loads - eq.6.7 $e_m = M_{md} / N_{md} + e_{hm} + e_{init}$ = **37.9** mm

Eccentricity at middle of wall due to creep e_k = **0** mm

Eccentricity at middle of wall - eq.6.6 $e_{mk} = \max(e_m + e_k, 0.05 \times t)$ = **37.9** mm

From eq.G.2 $A_1 = 1 - 2 \times e_{mk} / t$ = **0.811**

Short term secant modulus of elasticity factor K_E = **1000**

Modulus of elasticity - cl.3.7.2 $E = K_E \times f_k$ = **6659** N/mm^2

Slenderness - eq.G.4 $\lambda = (h_{ef} / t_{ef}) \times \sqrt{(f_k / E)}$ = **0.569**

From eq.G.3 $u = (\lambda - 0.063) / (0.73 - 1.17 \times e_{mk} / t)$ = **0.817**

Reduction factor at middle of wall - eq.G.1 $\Phi_m = \max(A_1 \times e^{-(u \times u)/2}, 0)$ = **0.58**

Reduction factor for slenderness and eccentricity $\Phi = \min(\Phi_i, \Phi_m)$ = **0.58**

Verification of unreinforced masonry walls subjected to mainly vertical loading - Section 6.1.2

Design value of the vertical load $N_{Ed} = \max(N_{id}, N_{md})$ = **206.130** kN/m

Design compressive strength of masonry $f_d = f_k / \gamma_{Mc}$ = **2.895** N/mm^2

Vertical resistance of wall - eq.6.2 $N_{Rd} = \Phi \times t \times f_d$ = **672.191** kN/m

PASS - Design vertical resistance exceeds applied design vertical load

Unreinforced masonry walls subjected to lateral loading - Section 6.3

Partial safety factors for design loads

Partial safety factor for permanent load γ_{fG} = **1**

Partial safety factor for variable imposed load γ_{fQ} = **0**

Partial safety factor for variable wind load γ_{fW} = **1.5**

WARNING - Limiting height and length to thickness ratios for walls under the serviceability limit state were not checked as the design is beyond the scope of Annex F, these limits should be checked independently.

Design moments of resistance in panels

Self weight at middle of wall $S_{wt} = 0.5 \times h \times t \times \gamma$ = **28.8** kN/m

Design compressive strength of masonry $f_d = f_k / \gamma_{Mc}$ = **2.895** N/mm²

Design vertical compressive stress $\sigma_d = \min(\gamma_{fG} \times (G_k + S_{wt}) / t, 0.15 \times \Phi \times f_d)$ = **0.252** N/mm²

Design flexural strength of masonry parallel to bed joints

$f_{xd1} = f_{xk1} / \gamma_{Mt}$ = **0.174** N/mm²

Apparent design flexural strength of masonry parallel to bed joints

$f_{xd1,app} = f_{xd1} + \sigma_d$ = **0.426** N/mm²

Design flexural strength of masonry perpendicular to bed joints

$f_{xd2} = f_{xk2} / \gamma_{Mt}$ = **0.478** N/mm²

Elastic section modulus of wall $Z = t^2 / 6$ = **26666667** mm³/m

Moment of resistance parallel to bed joints - eq.6.15

$M_{Rd1} = f_{xd1,app} \times Z$ = **11.36** kNm/m

Moment of resistance perpendicular to bed joints - eq.6.15

$M_{Rd2} = f_{xd2} \times Z$ = **12.754** kNm/m

Design moment in panels

Using elastic analysis to determine bending moment coefficients for a vertically spanning panel

Bending moment coefficient α = **0.125**

Design moment in wall $M_{Ed} = \gamma_{fW} \times \alpha \times W_k \times h^2$ = **8.262** kNm/m

PASS - Resistance moment exceeds design moment

Appendix G: Underpin/Retaining Wall Embedment Check – WALLAP analysis

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Soil types Right side
1	46.33	1 Made Ground	1 Made Ground
2	45.60	3 London Clay	3 London Clay

SOIL PROPERTIES

-- Soil type -- No. Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1 Made Ground	18.00	26000	1.500	OC	1.000	1.000	65.00d
(46.30)		(1000)		(0.200)	(2.570)	(2.571)	
2 Not defined							
3 London Clay	20.00	42000	1.000	OC	1.000	1.000	70.00u
(45.60)		(4200)		(0.490)	(2.570)	(2.571)	(7.000)

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No. Description	Ka: Soil friction angle	Ka: Wall adhesion coeff.	Ka: Back-fill angle	Kp: Soil friction angle	Kp: Wall adhesion coeff.	Kp: Back-fill angle
1 Made Ground	0.00	0.991	0.00	0.00	0.995	0.00
2 Not defined						
3 London Clay	0.00	0.991	0.00	0.00	0.995	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3
Initial water pressure profile = Profile number 1

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Left: Point no.	Left: Elev. m	Left: Piezo elev. m	Left: Water press. kN/m2	Right: Point no.	Right: Elev. m	Right: Piezo elev. m	Right: Water press. kN/m2
1	1	36.00	36.00	0.0	1	36.00	36.00	0.0

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 43.70
Maximum finite element length = 0.16 m
Youngs modulus of wall E = 3.0000E+07 kN/m2
Moment of inertia of wall I = 5.3333E-03 m4/m run
E.I = 159999 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Prop no.	Elev.	Prop spacing m	Cross-section area sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /prop kN	Strut or Anchor	Allow tension ?	L/R
1	46.00	1.00	0.200000	3.000E+07	10.00	0.00	0	Strut	No	R

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	46.33	2.00(L)	100.00	1.00	100.00	=	N/A	1.00 -
2	46.33	0.00(L)	100.00	100.00	10.00	=	N/A	1.00 -

Note: L = Left side, R = Right side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.2 at elevation 46.33
2	Apply surcharge no.1 at elevation 46.33
3	Excavate to elevation 45.90 on RIGHT side
4	Install strut or anchor no.1 at elevation 46.00
5	Excavate to elevation 44.30 on RIGHT side

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: Serviceability Limit State
All loads and soil strengths are unfactored

Stability analysis:
Method of analysis - Burland-Potts
Factor on passive for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 0.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 10.30 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 25.00 m

Width of excavation on Left side of wall = 25.00 m
Width of excavation on Right side of wall = 25.00 m

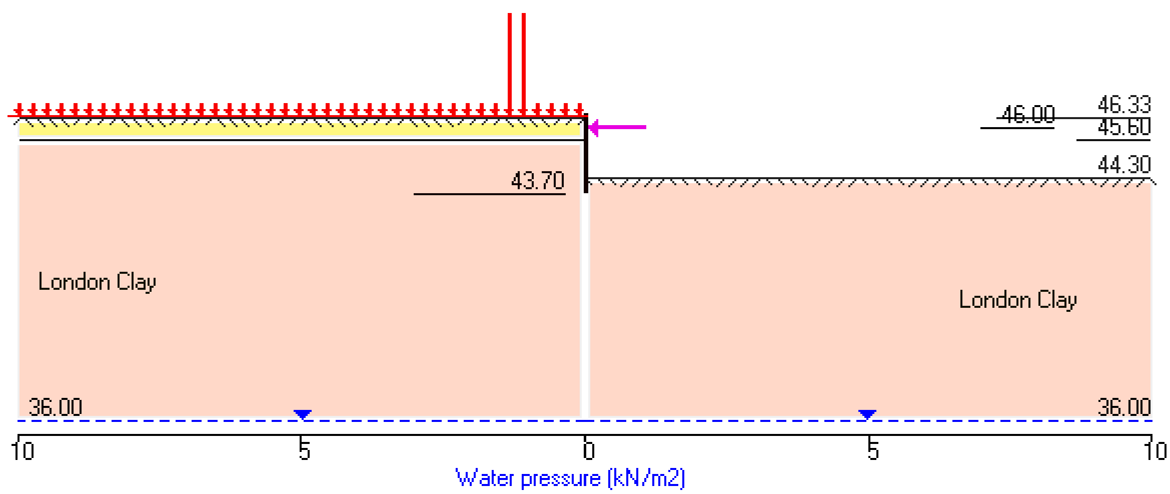
Distance to rigid boundary on Left side = 25.00 m
Distance to rigid boundary on Right side = 25.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.2 at elev. 46.33	No	No	No
2	Apply surcharge no.1 at elev. 46.33	No	No	No
3	Excav. to elev. 45.90 on RIGHT side	No	No	No
4	Install prop no.1 at elev. 46.00	No	No	No
5	Excav. to elev. 44.30 on RIGHT side	Yes	Yes	Yes
*	Summary output	Yes	-	No

```
WBD GROUP                                                      | Sheet No.
Program: WALLAP  Version 6.07  Revision A55.B74.R58           | Job No. 2022113
                              Licensed from GEOSOLVE          | Made by :     JN
Data filename/Run ID: Retaining_wall_Stage_1 embedment_SLS    |
42 Elsworthy Road                                              | Date:13-01-2023
Stage 1 Embedment Check Party Wall                             | Checked :
------------------------------------------------------------------------------
                                                        Units: kN,m
```

Stage No.5   Excav. to elev. 44.30 on RIGHT side



Units: kN,m

Stage No. 5 Excavate to elevation 44.30 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method

Factor of safety on nett available passive

				FoS for toe elev. = 43.70		Toe elev. for FoS = 1.500		
Stage No.	Ground level Act.	Pass.	Prop Elev.	Factor of Safety	Moment equilib. at elev.	Toe elev.	Wall Penetr -ation	Direction of failure
5	46.33	44.30	46.00	4.621	n/a	***	***	L to R

Legend: *** Result not found

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 25.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 25.00 from wall
Right side 25.00 from wall

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	46.33	5.98	0.000	-3.77E-04	0.0	0.0	
2	46.25	5.41	0.000	-3.77E-04	0.5	0.0	
3	46.17	5.31	0.000	-3.77E-04	0.9	0.1	
4	46.08	5.19	0.001	-3.77E-04	1.3	0.2	
5	46.00	6.82	0.001	-3.77E-04	1.8	0.3	-16.5
		6.82	0.001	-3.77E-04	-14.7	0.3	
6	45.90	9.07	0.001	-3.77E-04	-13.9	-1.1	
7	45.75	12.47	0.001	-3.75E-04	-12.2	-3.1	
8	45.60	15.92	0.001	-3.71E-04	-10.1	-4.8	
		9.32	0.001	-3.71E-04	-10.1	-4.8	
9	45.44	11.40	0.001	-3.66E-04	-8.5	-6.2	
10	45.28	13.64	0.001	-3.59E-04	-6.5	-7.4	
11	45.12	15.98	0.001	-3.51E-04	-4.1	-8.3	
12	44.96	18.41	0.001	-3.43E-04	-1.3	-8.7	
13	44.80	20.85	0.001	-3.34E-04	1.8	-8.6	
14	44.64	23.29	0.001	-3.26E-04	5.3	-8.1	
15	44.48	25.67	0.001	-3.18E-04	9.3	-6.9	
16	44.39	26.98	0.001	-3.15E-04	11.6	-6.0	
17	44.30	28.26	0.001	-3.12E-04	14.1	-4.8	
		-15.56	0.001	-3.12E-04	14.1	-4.8	
18	44.15	-19.40	0.001	-3.08E-04	11.5	-2.9	
19	44.00	-23.39	0.001	-3.06E-04	8.3	-1.3	
20	43.85	-27.56	0.001	-3.05E-04	4.5	-0.4	
21	43.70	-31.90	0.001	-3.05E-04	-0.0	-0.0	

At elev. 46.00 Prop force = 16.5 kN/m run

(continued)

Stage No.5 Excavate to elevation 44.30 on RIGHT side

LEFT side

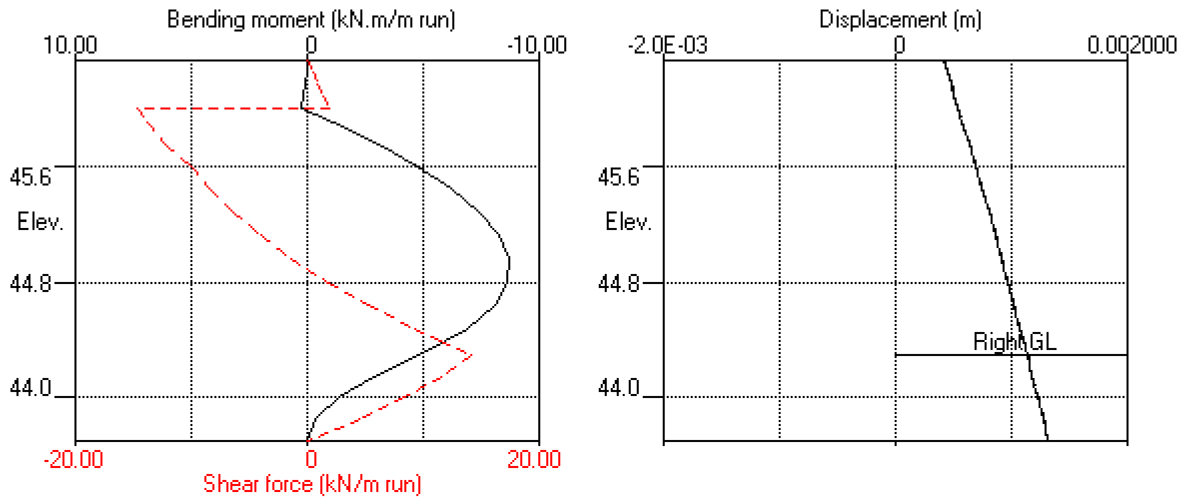
Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	46.33	0.00	10.00	0.00	177.11	5.98	5.98	66085
2	46.25	0.00	11.49	0.00	178.60	5.41	5.41	66295
3	46.17	0.00	12.99	0.00	180.10	5.31	5.31	66505
4	46.08	0.00	14.51	0.00	181.62	5.19	5.19	66715
5	46.00	0.00	16.07	0.00	183.18	6.82	6.82	11892
6	45.90	0.00	18.02	0.00	185.13	9.07	9.07	11937
7	45.75	0.00	21.09	0.00	188.20	12.47	12.47	12005
8	45.60	0.00	24.34	0.00	191.46	15.92	15.92	12072
		Total>	24.34	0.00	204.31	9.32	9.32	26391
9	45.44	Total>	28.35	0.00	211.20	11.40	11.40	26813
10	45.28	Total>	32.53	0.00	218.26	13.64	13.64	27235
11	45.12	Total>	36.86	0.00	225.47	15.98	15.98	27657
12	44.96	Total>	41.28	0.00	232.76	18.41	18.41	28080
13	44.80	Total>	45.73	0.00	240.10	20.85	20.85	28502
14	44.64	Total>	50.18	0.00	247.43	23.29	23.29	28924
15	44.48	Total>	54.59	0.00	254.72	25.67	25.67	29346
16	44.39	Total>	57.04	0.00	258.79	26.98	26.98	29584
17	44.30	Total>	59.46	0.00	262.83	28.26	28.26	29821
18	44.15	Total>	63.44	0.00	269.50	30.31	30.31	30217
19	44.00	Total>	67.32	0.00	276.09	32.25	32.25	30613
20	43.85	Total>	71.11	0.00	282.58	34.06	34.06	31009
21	43.70	Total>	74.81	0.00	288.97	35.75	35.75	31405

RIGHT side

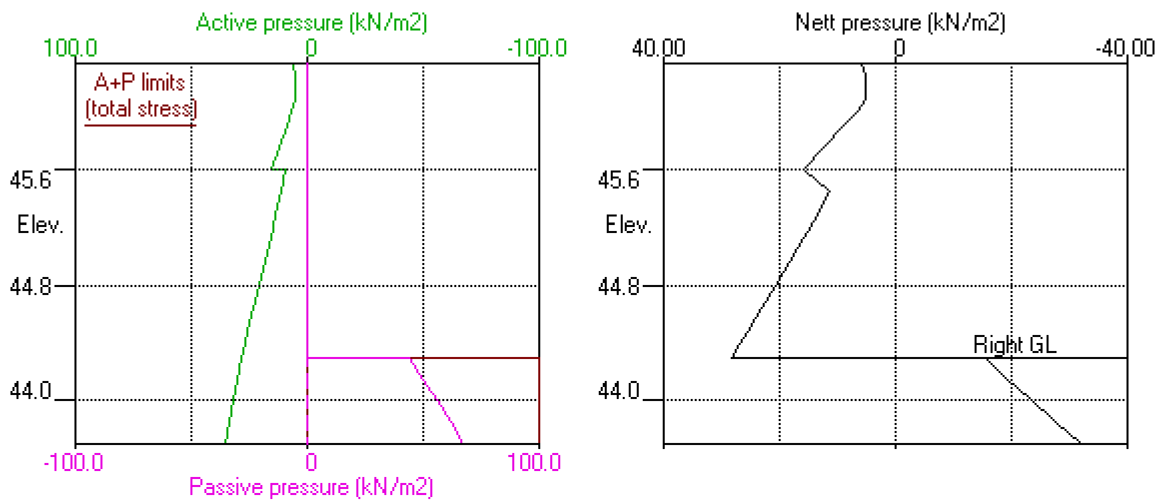
Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	46.33	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	46.25	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	46.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	46.08	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	46.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	45.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	45.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	45.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	45.28	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	45.12	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	44.96	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	44.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	44.64	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	44.48	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	44.39	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	44.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	203.37	43.82	43.82	49785
18	44.15	Total>	3.00	0.00	209.07	49.71	49.71	50445
19	44.00	Total>	6.00	0.00	214.77	55.64	55.64	51106
20	43.85	Total>	9.00	0.00	220.46	61.62	61.62	51767
21	43.70	Total>	12.00	0.00	226.16	67.65	67.65	52428

```
WBD GROUP                                                          | Sheet No.
Program: WALLAP  Version 6.07  Revision A55.B74.R58                | Job No. 2022113
                           Licensed from GEOSOLVE                  | Made by :     JN
Data filename/Run ID: Retaining_wall_Stage_1 embedment_SLS         |
42 Elsworthy Road                                                  | Date:13-01-2023
Stage 1 Embedment Check Party Wall                                 | Checked :
-------------------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.5 Excav. to elev. 44.30 on RIGHT side



Stage No.5 Excav. to elev. 44.30 on RIGHT side



Units: kN,m

Summary of results

LIMIT STATE PARAMETERS
Limit State: Serviceability Limit State
All loads and soil strengths are unfactored

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method
Factor of safety on nett available passive

				FoS for toe elev. = 43.70		**Toe elev. for FoS = 1.500**		
Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	Factor of Safety	Moment equilib. at elev.	Toe elev.	Wall Penetr -ation	Direction of failure
1	46.33	46.33	Cant.	20.419	43.85	***	***	L to R
2	46.33	46.33	Cant.	20.427	43.85	***	***	L to R
3	46.33	45.90	Cant.	11.984	43.81	***	***	L to R
4	46.33	45.90		No analysis at this stage				
5	46.33	44.30	46.00	4.621	n/a	***	***	L to R

Legend: *** Result not found

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 25.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 25.00 from wall
Right side 25.00 from wall

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement max.	Displacement min.	Bending moment Calculated max.	Bending moment Calculated min.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	Shear force Calculated min.	Shear force Factored max.	Shear force Factored min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	46.33	0.000	0.000	0	-0	0	-0	0	0	0	0
2	46.25	0.001	0.000	0	-0	0	-0	0	-0	1	-0
3	46.17	0.001	0.000	0	-0	0	-0	1	-0	1	-0
4	46.08	0.001	0.000	0	-0	0	-0	1	-0	2	-0
5	46.00	0.001	0.000	0	-0	0	-0	2	-15	2	-20
6	45.90	0.001	0.000	0	-1	0	-2	2	-14	3	-19
7	45.75	0.001	0.000	1	-3	1	-4	1	-12	2	-17
8	45.60	0.001	0.000	1	-5	1	-6	1	-10	1	-14
9	45.44	0.001	0.000	1	-6	1	-8	0	-8	0	-11
10	45.28	0.001	0.000	1	-7	1	-10	0	-6	0	-9
11	45.12	0.001	0.000	1	-8	1	-11	0	-4	0	-6
12	44.96	0.001	0.000	1	-9	1	-12	0	-1	0	-2
13	44.80	0.001	0.000	1	-9	1	-12	2	-1	2	-1
14	44.64	0.001	0.000	0	-8	1	-11	5	-1	7	-1
15	44.48	0.001	0.000	0	-7	0	-9	9	-1	12	-1
16	44.39	0.001	0.000	0	-6	0	-8	12	-1	16	-1
17	44.30	0.001	0.000	0	-5	0	-6	14	-1	19	-1
18	44.15	0.001	0.000	0	-3	0	-4	11	-0	16	-1
19	44.00	0.001	0.000	0	-1	0	-2	8	-0	11	-0
20	43.85	0.001	0.000	0	-0	0	-0	4	-0	6	-0
21	43.70	0.001	0.000	0	-0	0	-0	0	-0	0	-0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment Calculated max.	elev.	min.	elev.	Bending moment Factored max.	min.	Shear force Calculated max.	elev.	min.	elev.	Shear force Factored max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	0	43.70	-0	45.12	0	-0	0	44.39	-1	45.60	0	-1
2	0	45.90	-0	44.80	0	-0	0	44.15	-0	45.60	0	-1
3	1	45.28	-0	43.70	1	-0	2	45.90	-1	44.64	3	-1
4	No calculation at this stage											
5	0	46.00	-9	44.96	0	-12	14	44.30	-15	46.00	19	-20

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum (m)	elev.	Displacement minimum (m)	elev.	Stage description
1	0.000	43.70	0.000	46.33	Apply surcharge no.2 at elev. 46.33
2	0.000	43.70	0.000	46.33	Apply surcharge no.1 at elev. 46.33
3	0.001	43.70	0.000	46.33	Excav. to elev. 45.90 on RIGHT side
4	No calculation at this stage				Install prop no.1 at elev. 46.00
5	0.001	43.70	0.000	46.33	Excav. to elev. 44.30 on RIGHT side

Prop forces at each stage (horizontal components)

Stage no.	Prop no. 1 at elev. 46.00 --Calculated-- kN per m run	kN per prop	Factored kN per prop
5	16	16	22

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Soil types Right side
1	46.33	1 Made Ground	1 Made Ground
2	45.60	3 London Clay	3 London Clay

SOIL PROPERTIES

-- Soil type -- No. Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1 Made Ground	18.00	26000	1.500	OC	1.000	1.000	65.00d
(46.30)		(1000)		(0.200)	(2.570)	(2.571)	
2 Not defined							
3 London Clay	20.00	42000	1.000	OC	1.000	1.000	70.00u
(45.60)		(4200)		(0.490)	(2.570)	(2.571)	(7.000)

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No. Description	Ka: Soil friction angle	Ka: Wall adhesion coeff.	Ka: Back-fill angle	Kp: Soil friction angle	Kp: Wall adhesion coeff.	Kp: Back-fill angle
1 Made Ground	0.00	0.991	0.00	0.00	0.995	0.00
2 Not defined						
3 London Clay	0.00	0.991	0.00	0.00	0.995	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3
Initial water pressure profile = Profile number 1

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Left: Point no.	Left: Elev. m	Left: Piezo elev. m	Left: Water press. kN/m2	Right: Point no.	Right: Elev. m	Right: Piezo elev. m	Right: Water press. kN/m2
1	1	36.00	36.00	0.0	1	36.00	36.00	0.0

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 41.00
Maximum finite element length = 0.30 m
Youngs modulus of wall E = 3.0000E+07 kN/m2
Moment of inertia of wall I = 5.3333E-03 m4/m run
E.I = 159999 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Prop no.	Elev.	Prop spacing m	Cross-section area sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /prop kN	Strut or Anchor	Allow tension ?	L/R
1	46.00	1.00	0.200000	3.000E+07	10.00	0.00	0	Strut	No	R

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	46.33	2.00(L)	100.00	1.00	100.00	=	N/A	1.00 -
2	46.33	0.00(L)	100.00	100.00	10.00	=	N/A	1.00 -

Note: L = Left side, R = Right side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.2 at elevation 46.33
2	Apply surcharge no.1 at elevation 46.33
3	Excavate to elevation 45.90 on RIGHT side
4	Install strut or anchor no.1 at elevation 46.00
5	Excavate to elevation 42.00 on RIGHT side

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: Serviceability Limit State
All loads and soil strengths are unfactored

Stability analysis:
Method of analysis - Burland-Potts
Factor on passive for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 0.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 10.30 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 25.00 m

Width of excavation on Left side of wall = 25.00 m
Width of excavation on Right side of wall = 25.00 m

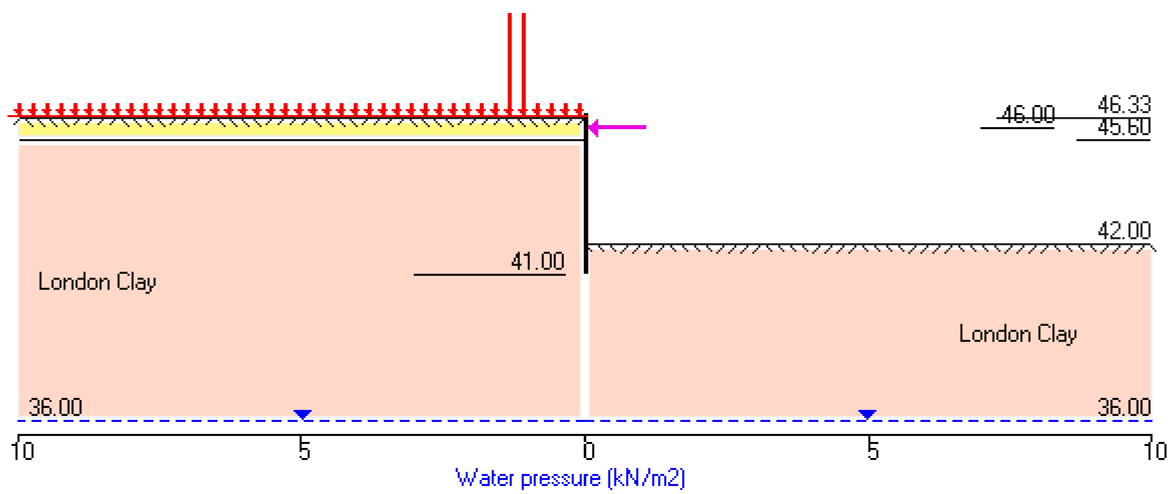
Distance to rigid boundary on Left side = 25.00 m
Distance to rigid boundary on Right side = 25.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement Bending mom. Shear force	Output options: Active, Passive pressures	Output options: Graph. output
1	Apply surcharge no.2 at elev. 46.33	No	No	No
2	Apply surcharge no.1 at elev. 46.33	No	No	No
3	Excav. to elev. 45.90 on RIGHT side	No	No	No
4	Install prop no.1 at elev. 46.00	No	No	No
5	Excav. to elev. 42.00 on RIGHT side	Yes	Yes	Yes
*	Summary output	Yes	-	No

Units: kN,m

Stage No.5 Excav. to elev. 42.00 on RIGHT side



Units: kN,m

Stage No. 5 Excavate to elevation 42.00 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method

Factor of safety on nett available passive

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = 41.00 Factor of Safety	FoS for toe elev. = 41.00 Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Toe elev. for FoS = 1.500 Wall Penetr -ation	Direction of failure
5	46.33	42.00	46.00	3.367	n/a	***	***	L to R

Legend: *** Result not found

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 25.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 25.00 from wall
Right side 25.00 from wall

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	46.33	16.86	0.001	-1.03E-03	0.0	-0.0	
2	46.17	8.28	0.001	-1.03E-03	2.1	0.3	
3	46.00	6.32	0.001	-1.03E-03	3.3	0.7	-46.4
		6.32	0.001	-1.03E-03	-43.1	0.7	
4	45.90	8.41	0.001	-1.03E-03	-42.4	-3.5	
5	45.60	14.77	0.001	-1.01E-03	-38.9	-15.8	
		6.15	0.001	-1.01E-03	-38.9	-15.8	
6	45.30	8.85	0.002	-9.73E-04	-36.7	-27.0	
7	45.00	12.01	0.002	-9.13E-04	-33.5	-37.5	
8	44.70	15.43	0.002	-8.34E-04	-29.4	-46.9	
9	44.40	18.95	0.002	-7.38E-04	-24.3	-54.9	
10	44.10	22.50	0.003	-6.29E-04	-18.0	-61.2	
11	43.80	26.10	0.003	-5.10E-04	-10.8	-65.5	
12	43.50	29.82	0.003	-3.86E-04	-2.4	-67.4	
13	43.20	33.76	0.003	-2.60E-04	7.2	-66.7	
14	42.90	38.01	0.003	-1.39E-04	17.9	-62.9	
15	42.60	42.62	0.003	-2.78E-05	30.0	-55.7	
16	42.30	47.60	0.003	6.62E-05	43.6	-44.7	
17	42.00	52.92	0.003	1.35E-04	58.6	-29.4	
		-57.87	0.003	1.35E-04	58.6	-29.4	
18	41.70	-58.66	0.003	1.76E-04	41.2	-14.4	
19	41.40	-58.87	0.003	1.94E-04	23.5	-4.7	
20	41.20	-58.83	0.003	1.98E-04	11.8	-1.2	
21	41.00	-58.72	0.003	1.99E-04	0.0	-0.0	

At elev. 46.00 Prop force = 46.4 kN/m run

(continued)

Stage No.5 Excavate to elevation 42.00 on RIGHT side

LEFT side

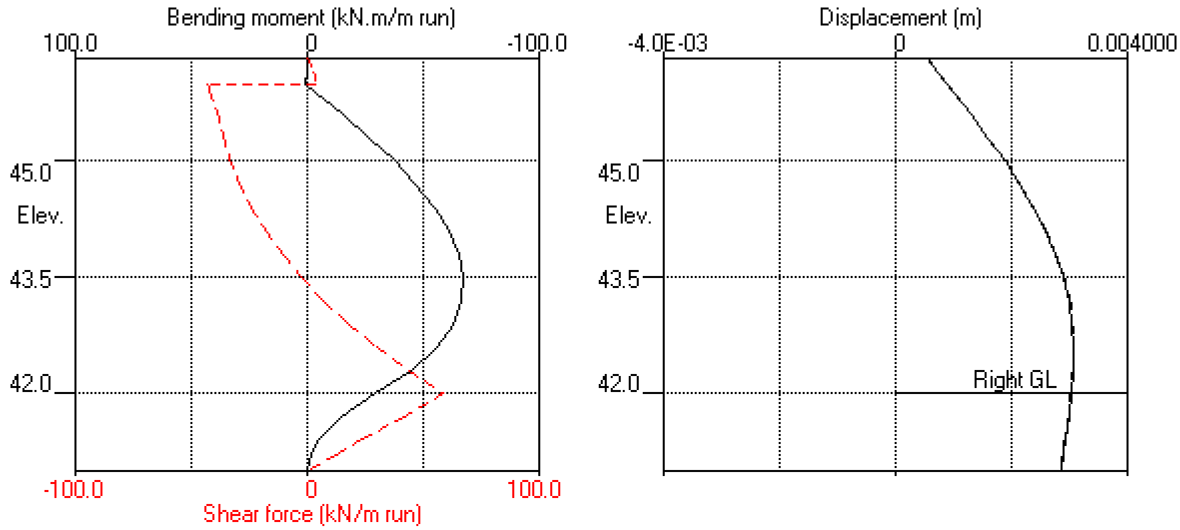
Node no.	Y coord	Water press. kN/m2	Vertic-al kN/m2	Effective stresses: Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	46.33	0.00	10.00	0.00	177.11	16.86	16.86	66049
2	46.17	0.00	12.99	0.00	180.10	8.28	8.28	66469
3	46.00	0.00	16.07	0.00	183.18	6.32	6.32	6074
4	45.90	0.00	18.02	0.00	185.13	8.41	8.41	6097
5	45.60	0.00	24.34	0.00	191.46	14.77	14.77	6166
		Total>	24.34	0.00	204.31	6.15	6.15	14092
6	45.30	Total>	32.00	0.00	217.37	8.85	8.85	14514
7	45.00	Total>	40.17	0.00	230.94	12.01	12.01	14937
8	44.70	Total>	48.52	0.00	244.68	15.43	15.43	15360
9	44.40	Total>	56.77	0.00	258.33	18.95	18.95	15782
10	44.10	Total>	64.74	0.00	271.71	22.50	22.50	16205
11	43.80	Total>	72.35	0.00	284.72	26.10	26.10	16628
12	43.50	Total>	79.60	0.00	297.36	29.82	29.82	17051
13	43.20	Total>	86.51	0.00	309.67	33.76	33.76	17473
14	42.90	Total>	93.13	0.00	321.69	38.01	38.01	17896
15	42.60	Total>	99.50	0.00	333.46	42.62	42.62	18319
16	42.30	Total>	105.69	0.00	345.05	47.60	47.60	18742
17	42.00	Total>	111.73	0.00	356.49	52.92	52.92	19164
18	41.70	Total>	117.66	0.00	367.81	58.48	58.48	19587
19	41.40	Total>	123.50	0.00	379.05	64.17	64.17	20010
20	41.20	Total>	127.35	0.00	386.51	68.00	68.00	20292
21	41.00	Total>	131.19	0.00	393.94	71.83	71.83	20574

RIGHT side

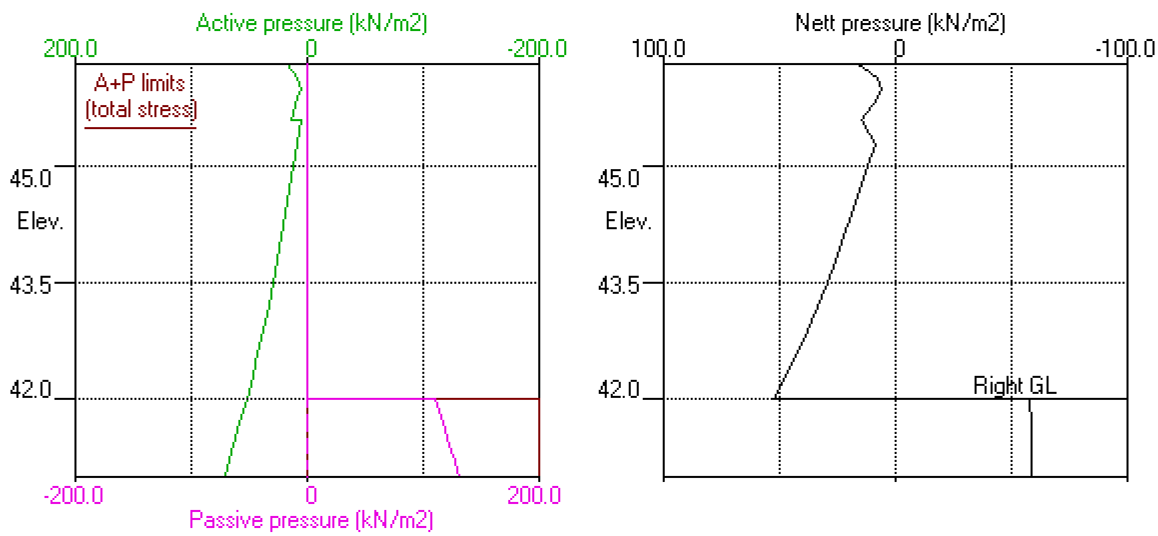
Node no.	Y coord	Water press. kN/m2	Vertic-al kN/m2	Effective stresses: Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	46.33	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	46.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	46.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	45.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	45.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	44.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	44.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	44.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	43.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	43.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	43.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	42.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	42.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	42.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	244.76	110.79	110.79	42253
18	41.70	Total>	6.00	0.00	256.16	117.14	117.14	43185
19	41.40	Total>	12.00	0.00	267.56	123.04	123.04	44118
20	41.20	Total>	16.00	0.00	275.16	126.83	126.83	44739
21	41.00	Total>	20.00	0.00	282.76	130.55	130.55	45360

```
WBD GROUP                                                            | Sheet No.
Program: WALLAP  Version 6.07  Revision A55.B74.R58                  | Job No. 2022113
                             Licensed from GEOSOLVE                  | Made by :     JN
Data filename/Run ID: Retaining_wall_SLS                             |
42 Elsworthy Road                                                    | Date:13-01-2023
Retaining wall_Stage_2_Embedment_Check                               | Checked :
------------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.5 Excav. to elev. 42.00 on RIGHT side



Stage No.5 Excav. to elev. 42.00 on RIGHT side



```
WBD GROUP                                                           | Sheet No.
Program: WALLAP  Version 6.07  Revision A55.B74.R58                 | Job No. 2022113
                              Licensed from GEOSOLVE                | Made by :    JN
Data filename/Run ID: Retaining_wall_SLS                            |
42 Elsworthy Road                                                   | Date:13-01-2023
Retaining wall_Stage_2_Embedment_Check                              | Checked :
------------------------------------------------------------------------------
                                                          Units: kN,m
```

Summary of results

LIMIT STATE PARAMETERS

Limit State: Serviceability Limit State

All loads and soil strengths are unfactored

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method

Factor of safety on nett available passive

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = 41.00: Factor of Safety	FoS for toe elev. = 41.00: Moment equilib. at elev.	Toe elev. for FoS = 1.500: Toe elev.	Toe elev. for FoS = 1.500: Wall Penetr -ation	Direction of failure
1	46.33	46.33	Cant.	23.607	41.42	***	***	L to R
2	46.33	46.33	Cant.	23.627	41.41	***	***	L to R
3	46.33	45.90	Cant.	13.788	41.35	***	***	L to R
4	46.33	45.90		No analysis at this stage				
5	46.33	42.00	46.00	3.367	n/a	***	***	L to R

Legend: *** Result not found

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 25.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 25.00 from wall
Right side 25.00 from wall

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Bending moment, shear force and displacement envelopes

Node	Y	Displacement		Bending moment				Shear force			
no.	coord			Calculated		Factored		Calculated		Factored	
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	46.33	0.001	0.000	0	-0	0	-0	0	0	0	0
2	46.17	0.001	0.000	0	-0	0	-0	2	-0	3	-0
3	46.00	0.001	0.000	1	-0	1	-0	3	-43	4	-58
4	45.90	0.001	0.000	0	-4	0	-5	2	-42	2	-57
5	45.60	0.001	0.000	1	-16	1	-21	0	-39	0	-53
6	45.30	0.002	0.000	1	-27	1	-37	0	-37	0	-50
7	45.00	0.002	0.000	0	-38	0	-51	0	-34	0	-45
8	44.70	0.002	0.000	0	-47	0	-63	0	-29	0	-40
9	44.40	0.002	0.000	0	-55	0	-74	0	-24	0	-33
10	44.10	0.003	0.000	0	-61	0	-83	0	-18	0	-24
11	43.80	0.003	0.000	0	-65	0	-88	0	-11	0	-15
12	43.50	0.003	0.000	0	-67	0	-91	0	-2	0	-3
13	43.20	0.003	0.000	0	-67	0	-90	7	0	10	0
14	42.90	0.003	0.000	0	-63	0	-85	18	0	24	0
15	42.60	0.003	0.000	0	-56	0	-75	30	0	41	0
16	42.30	0.003	0.000	0	-45	0	-60	44	0	59	0
17	42.00	0.003	0.000	0	-29	0	-40	59	0	79	0
18	41.70	0.003	0.000	0	-14	0	-19	41	0	56	0
19	41.40	0.003	0.000	0	-5	0	-6	24	0	32	0
20	41.20	0.003	0.000	0	-1	0	-2	12	0	16	0
21	41.00	0.003	0.000	0	-0	0	-0	0	-0	0	-0

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment						Shear force					
no.	Calculated				Factored		Calculated				Factored	
	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	0	46.33	-1	44.40	0	-1	0	43.20	-1	45.60	0	-1
2	0	46.33	-4	43.50	0	-5	2	42.30	-2	45.00	3	-3
3	1	45.60	-2	43.20	1	-3	2	45.90	-2	44.40	2	-3
4	No calculation at this stage											
5	1	46.00	-67	43.50	1	-91	59	42.00	-43	46.00	79	-58

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum (m)	elev.	Displacement minimum (m)	elev.	Stage description
1	0.000	46.33	0.000	46.33	Apply surcharge no.2 at elev. 46.33
2	0.001	41.00	0.000	46.33	Apply surcharge no.1 at elev. 46.33
3	0.001	42.00	0.000	46.33	Excav. to elev. 45.90 on RIGHT side
4	No calculation at this stage				Install prop no.1 at elev. 46.00
5	0.003	42.60	0.000	46.33	Excav. to elev. 42.00 on RIGHT side

Prop forces at each stage (horizontal components)

Stage no.	Prop no. 1 at elev. 46.00 --Calculated-- kN per m run	kN per prop	Factored kN per prop
5	46	46	63

Appendix C - Main Contractor Risk Assessment

5. Main Contractor's Risk Assessments

5.1 Noise and Vibration Risk Assessment

Who might be exposed to the hazards :

• - Adjoining properties residents
• - General public
• - Site Staff / Site Visitors

How might they be harmed :

• - Noise induced hearing lost from long term noise exposure
• - Temporary noise affects such as tinnitus
• - Develop Stress related symptoms as noise is a stressor
• - Inability to hear other warnings
• - Lack of concentration
• - Vibration could cause disturbance to nearby residents/occupants as well as nuisance to the general public.
• - Vibration could compromise the structure and adjoining buildings stability

Control Measures / Mitigation :

• Site Induction.
• - Training , Information , Instruction and Supervision. e.g training on how to use, store, and maintain the hearing protection.
• - The site boundaries(brick walls ,hoardings, hedges, trees)will act as a natural noise barrier.
• - Fixed items of construction plant will be electrically powered in preference to diesel or petrol driven.
• - Try to avoid the use of mechanical tools or plant and undertake the task manually if practically reasonable e.g cutting , breaking with the use of hand tools.
• - All cutting, grinding and sawing should be minimized on-site and pre-fabricated material and modules should be brought in where possible.
• - Staff reminded on the need to wear Ear defenders correctly, to maintain and clean and to report loss, defect to their line manager.
• - Isolating noisy procedures and restricting access to noisy areas. Cutting near adjoining properties should be avoided.
• - noisy plant will be kept as far away as possible from sensitive areas.
• - PPE, ie ear defenders worn.
• - Limited work times in vicinity of high noise exposure.
• - Specification for work plant and equipment to achieve lowest noise and vibration emission.
• - Vehicle and plant maintenance regime to be implemented so that eg loose panels and unbalanced rotating parts are attended to. Ensure that engineering means of reducing noise, eg anti vibration mounts, silencers, dampeners are implemented

whenever possible.
• Follow manufacturer's guidance and measures to operate plant and equipment and use it in a manner which minimizes noise.
• Avoid metal on metal impacts.
• Plant which is considered to introduce the risk of potential noise effects to be limited to working between 08:00 – 18:00 hrs Monday to Friday only, for high impact work this is limited to 09:00 – 12:00 hrs & 14:00 – 17:00 hrs Monday to Friday only.
20

• Control of site deliveries between 09:00 - 13:00 and 14:00 - 17:00 Monday to Friday.
• breaker usage to be limited to only where absolutely necessary.
• where possible rebar will be cut to the required lengths prior to site delivery to minimise any necessary site trimming.
• hydraulic or pneumatic shears will be used in preference to angle grinders when trimming rebar where practicable .
• All HGV movements associated with the worksite will only take place during normal working hours, unless otherwise agreed and approved by KUTZ ltd.
• Use all plant and equipment only for tasks for which it has been designed for.
• Shut down all plant and equipment in intermittent use in the intervening periods between works or throttle it down to a minimum.
• Carry out attended noise monitoring at the start of any new phase of works, to check source sound emission data from plant on-site and following any complaints.
• Send regular updates at appropriate intervals to all identified affected neighbours via newsletter and posting information on the site hoarding. Also make information available via email when requested.
• Advise neighbours about reasons for and duration of any permitted works outside of normal working hours.
• Arrange meetings and communicate on a regular basis with the local authority to monitor the progress of the works and to consider any concerns or complaints raised by the local community.

Actions taken from who :

• Site Staff
• Site Management

5.2 Using and handling vibrating tools and equipment/plant Risk Assessment

Who might be exposed to the hazards:
• Site Staff

How might they be harmed :

• Excessive vibration levels when operating mechanical tools , plant and equipment could cause vascular, neurological or musculoskeletal HANS symptoms or whole -body vibration.

Control Measures / Mitigation :

• - Change the task process by avoiding the use of vibrating hand held equipment if reasonably practicable
• - Compliance with Control of Vibration at Work Regulations 2005
• - Purchase or rent the equipment with lowest vibration levels and with reduced vibration design
• - Equipment used must be in a good repair and properly maintained
• - Use the correct bit , disk or attachment for the work , keep them sharpened. Replace sanding discs when worn
• - Use the equipment/plant in accordance with manufacturer's instructions well within safe limits.
• - Trained and authorized operatives only to use equipment/plant
• - Particular operations causing excessive vibration risk advised at induction training
• - Ensure operatives have regular short breaks
• - Tool box talks
• - Suitable gloves provided and worn
• - Encourage operatives to warm up before starting work
• - Massaging and exercising fingers during work breaks
• - Regular breaks from working with vibrating equipment/plant and task sharing
• - Monitor the use of equipment/plant causing vibration
• - Operatives advised/trained to be able to detect any early signs and symptoms of Hand Arm Vibration

Actions taken from who :

• Site Staff
• Site Management

5.3 Dust and Emissions Control Risk Assessment

Who might be exposed to the hazards :

• Adjoining properties residents
• General public
• Site Staff / Site Visitors

How might they be harmed :

• Pre-site Preparation – Failure to plan site activities with specific pollution problems (dust and emissions)

Control Measures / Mitigation :

• - Follow best practice and prevent dust and other pollutant emissions from being carried out outside the boundary.
• - Compile method statements and risk assessments
• - Machinery, fuel and chemical storage and dust generating activities will not be located close to boundaries and sensitive receptors if at all possible.
• - Erect effective barriers around dusty activities
• - Notify the Local Authority Building Control Team.
• I- nventory and timetables of all dust generating activities
• - Erection of solid barriers to site boundary
• - All site personnel to be fully trained
• I- dentify responsible person in charge

How might they be harmed :

• Haul Routes – Generation of dust and emissions. Failure to maintain Haul and access routes.

Control Measures / Mitigation :

• Use consolidated surfaces on all haul roads to reduce dust emissions
• Regularly inspect all access and repair if required
• Daily sweeping and cleaning
• Impose speed limits

How might they be harmed :

• Damping down haul routes both within and outside the site – Forming wet areas, causing splashing, generating puddles.

Control Measures / Mitigation :

• Approved wet methods or mechanical road sweepers on all roads during periods of dry weather
• Clean road edges and pavement using wet method
• Use approved wet methods or mechanical road sweepers on all roads at least once a

day
• - Provide hard standing areas for vehicles and regularly inspect and clean these areas.
• - Where possible use sustainable sources of water
• - Contact the Environmental Agency to recycle any collected materials or run off water according to legal requirements

How might they be harmed :

• Vehicles – Dust and emissions created by vehicles.

Control Measures / Mitigation :

• - We will carry out the following controls to reduce dust and particulates associated with vehicles – such as that from exhaust emissions, the contact of tyres on the road surface or dust blowing from material being carried.
• - All vehicles must switch off engines – no idling
• - Set speed limits
• - Cover and secure all loads entirely with clean sheets that are entering and leaving the site
• - Wash vehicle wheels when leaving site
• - Reduce the number of vehicle movements where possible

How might they be harmed :

• Site monitoring protocols – Managing the generation of dust and emissions. Dust and emissions from work activities and dust and emissions from vehicles.

Control Measures / Mitigation :

• - Employ best practice at all times
• - Take into account the impact of dust and particulates on occupational exposure standards to minimize worker exposure and breaches of air quality objectives that may occur outside of the site boundary such as by visual assessment
• - Keep an accurate log of complaints from the public
• - Determine the prevailing wind direction across the site and plan site activities to suit
• - Monitor dust deposition and spoiling rates as these can be used to indicate nuisance
• - We will carry out a visual inspection of site activities, dust controls and site conditions and record in a daily dust log.
• - We will appoint a designated person to regularly monitor air quality on a daily basis on this site using a hand held monitor and check against a site set limits

How might they be harmed :

• Site Entrances/ Exits – Dust and emissions escaping through site entrance. Build u of dust and emissions at site entrance. Mud and dust on the road.

Control Measures / Mitigation :

• We will employ the following dust control measures to help prevent dust being spread outside the site boundary by site vehicles at entrances and exits.

• - All vehicles to be inspected prior to leaving site
• - Full time traffic marshal to be in place during all working hours
• - Wheel wash all vehicles entering and leaving the site
• - Traffic marshal controlling the site entrance
• - Put in place procedures for effective cleaning of vehicles and inspection which should include full inspection of underside and wheels of vehicle
• - Ensure the loading of materials is done with the lowest drop height
• - Vehicles carrying dusty materials should be securely covered before leaving site
• - Enter all information of all vehicles entering/ leaving site in a log book

How might they be harmed :

• - Excavations and Earthworks – Dust and emissions by works activity
- Control Measures / Mitigation :
• - All dusty activities should be damped down, especially during dry weather
• - Temporarily cover earthworks where possible
• - Re-vegetate exposed areas to stabilize surface
• - Spoils from Earthworks emoved from site as soon as possible
- How might they be harmed :
• - Stockpiles and storage mounds – Dust and emissions generated from stockpiles. Loose materials blowing across site and into public areas.
- Control Measures / Mitigation :
• - Do not maintain long term stockpiles on site
• - Minimise drop heights to control the fall of materials (dust)
• - Keep stock piles away from the site boundary
• - Cover stock piles if possible
• - Take into account the predominant wind direction when siting the position of stockpiles
• - Reuse hard-core where possible to avoid unnecessary vehicle movements
• - Erect fences or similar height and size to the stockpile to act as wind barriers and keep these clean using wet methods
• - Keep stockpiles damped down
- How might they be harmed :
• - Cutting, grinding and sawing – Dust and emissions generated from cutting, grinding and sawing work activities

Control Measures / Mitigation :

• All equipment should be fitted with water suppressant systems
• Use dust extraction techniques where possible
• Do not carry out cutting activities where dust is driven directly into public areas
• Use precut materials where possible
• Use local exhaust ventilation

How might they be harmed :

• Chutes and Skips – Dust and emissions generated from the loading of skips and the using of chutes.

Control Measures / Mitigation :

• Securely cover skips
• Minimise drop heights
• Regularly damp down surfaces with water
• Completely enclose skips where possible
• Do not carry out works in windy conditions

How might they be harmed :

• Demolition – Dust and emissions generated from demolition works and other activities.

Control Measures / Mitigation :

• - All dusty activities should be damped down, especially during dry weather.
• - Strip and screen the building with suitable material and strip the inside of the building before demolition begins
• - Notify the Health and Safety Executive of the works to take place
• - Only licensed and competent operatives will be used
• - Clearly identify the location of asbestos containing materials before starting work
• - Procedures put in place to sample and analyse suspect materials
• - Independent air sampling will be carried out to ensure standards are met
• - Disposal of asbestos containing materials to licensed waste sites according to HSE guidelines before the demolition works commence
• - Materials will be removed from site as soon as possible to reduce stock piling

How might they be harmed :

• Waste Disposal/ Burning – Dust and emissions generated from waste disposal and burning activities.

Control Measures / Mitigation :

• - There will be no burning allowed on site at any time.
• - All excess materials will be used elsewhere on site, sent to other sites to be used, sent to transfer stations for recycling, sent back to the supplier for restacking or at the very last resort sent to landfill
• - All skips to be labelled and sorted where possible
• - Materials to be stored away from sensitive locations
• - We will employ a just in time delivery system to reduce the amount of time materials are stored on site

How might they be harmed :

• - Dealing with spillages – Emissions and contaminations from spillages. Control Measures / Mitigation :
• - The following measures will be implemented on this project.
• - Bunded areas will be used wherever practicable.
• - Regular site inspections will be carried out looking for spillages

• - Spill kids will be placed around the site and operatives trained in their use
• - Certain spillages will be cleaned using agreed wet handling methods
• - Vacuum and sweep activities will be regularly carried out to prevent the buildup of fine waste dust material, which is spilled on the site, and is designated as waste and will be removed from site.
• - The Environment Agency, London Fire and Emergency Planning Authority will be informed if harmful substances are spilled.

Actions taken from who :

- Site Staff
- Site Management

5.4 Working at Height Risk Assessment

Risk assessment for General Work at Height

Contents **Page**

Date : 17.01.2023
Rev : 4

1.0 Introduction

Working at height is always a high-risk activity. Falls are the largest cause of accidental death in the construction industry and need to be avoided by provision of suitable access equipment being properly used.

High safety standards are essential for all working at height and the nature of the precautions required must be assessed for each individual job. This procedural guidance sets out responsibilities, precautions and provides general guidance for good practice relevant to all working at height.

2.0 Scope

This procedural guidance applies to all working at height on 2 Elm Tree project

3.0 Purpose

The purpose of this procedural guidance is to ensure:

- working at height is avoided where possible;
- when working at height is unavoidable, all hazards are considered and sufficient safe systems of work are in operation that will actively reduce the risk of injury to all persons involved;
- compliance with relevant legislative requirements;
- best practice is adopted.

4.0 Definitions

4.1 Working at height

All falls from any height need to be prevented. Work at height means work in any place, including a place at or below ground level or when a person is accessing or exiting from such a place (except via a staircase in a permanent workplace) where if regulatory measures are not taken, a person could fall a distance likely to cause personal injury.

4.2 Short duration work

Short duration work is measured in minutes rather than hours. It includes jobs such as replacing a few tiles, making minor adjustments to equipment, inspections and access to other areas/locations. Work at height is still dangerous even if it lasts for a short time and appropriate safety measures are essential.

4.3 Safe systems of work

A safe system of work is a method of completing a job which eliminates identified hazards and controls risks. Good planning can significantly reduce the risks involved in working at height and a safe system of work achieves the controlled completion of the work with the minimum of risk for the individuals involved. Specific types of working at height must be done under a safe system of work, guidance for which is detailed in section 7.0.

4.4 Ladders

Ladders refers to fixed ladders, all portable ladders, section ladders, extending ladders, combination ladders and stepladders.

4.5 Working platform

A working platform constitutes any platform used as a place of work or as a means of access or egress from/to a place of work (e.g. scaffolding, trestle, mobile platform, etc).

5.0 Legal Requirements

5.1 The Work at Height Regulations 2005

The overriding principle of these regulations is that employers must do all that is reasonably practicable to prevent anyone falling. The hierarchy for managing work at height is as follows:

- Avoid work at height where possible;
- Use work equipment or other measures to prevent falls where working at height cannot be avoided;
- Where the risk of falling cannot be eliminated, use work equipment or other measures to minimise the distance and consequences of any fall.

All work at height must be properly planned and organised

- Ensure that no work at height is carried out if it is safe and reasonably practicable to do it other than at height;
- Ensure that the work at height is properly planned, supervised and carried out as safely as is reasonably practicable;
- Ensure that emergencies and rescue procedures are planned for;
- Take account of the risk assessment findings carried out under Regulation 3 of the Management of Health and Safety at Work Regulations.

All work at height must take account of weather conditions that could pose a risk to the health and safety of any person working at height

- Ensure that any work is postponed until the weather improves sufficiently.

Anyone involved in working at height must be competent and appropriately trained

- If a person is being trained they must be supervised by a competent person;
- Competency and training refers to anyone involved in organisation, planning, supervision and the supply/maintenance of equipment in respect of working at height;
- Where a risk of falling remains, ensure that those persons working at height are trained in how to avoid falling and how to avoid or minimise any injuries should they fall.

The place where work at height is undertaken must be safe

- The place of work and the means of access must have features to prevent falls from height.

Equipment used for working at height must be appropriately inspected

- If it is not reasonably practicable to include features to prevent a fall and they would not allow the worker to carry out the work safely, equipment must be provided to prevent a fall occurring (as far as reasonably practicable);
- If the risk of falling cannot be entirely eliminated, the potential distance and effect of the fall must be minimised;
- Equipment provided for work at height must be the most suitable available, provide collective measures (e.g. guard rails) with priority over personal protection (e.g. safety harnesses), and take account of the working conditions

and risks to the safety of all persons at the place where the equipment is to be used;

- Equipment, temporary structures and safety features must comply with the requirements laid out in Schedules 2 to 6 of the Regulations;
- Ensure that each location where work at height is to be undertaken is checked on every occasion before that place is used. This must take account of checking the surface of every parapet, permanent rail, etc;
- Ensure that any equipment included within Schedules 2 to 6 of the Regulations is inspected after assembly or installation and as often as is necessary thereafter to ensure safety;
- Any equipment from another business must be accompanied with a clear indication that the last inspections have been carried out. Likewise for any equipment leaving the employers business;
- Any work platform where a person could fall more than 2m must be inspected in-situ prior to use (but not more than 7 days before). Any mobile platform must be inspected at the site of use rather than each time it is moved within the site boundary. The person inspecting the platform must prepare a report before going off duty providing the details laid out in Schedule 7 of the Regulations and provide a copy within 24 hours to the person who requested the inspection. Reports should be available at the construction site until the work is completed and then at the employers main office for another 3 months;
- General inspection records should be kept until the next inspection has been completed.

The risks posed by fragile materials must be properly controlled

- Ensure that employees do not go onto or near to a fragile surface unless it is the only reasonably practicable way for the work to be completed safely taking into account the demands of the task, equipment and working environment;
- Any person working on or near to a fragile surface must be provided with suitable work platforms, coverings, guard rails, etc. to minimise any risks and employers must do all that is reasonably practicable to minimise the distance and effect of a fall.

Ensure that the risks from falling objects are properly controlled

- In order to prevent any potential injuries employers must do all that is reasonably practicable to prevent anything falling;
- Alternatively, ensure that no-one is injured by anything falling;
- Ensure that nothing is thrown or tipped from height if it is likely to injure a person or be stored by such a method that its movement is likely to injure anyone;
- Any workplace where there is a risk of personal injury by a falling object or person, ensure that the area is clearly indicated and that authorised people are excluded and unable to reach it.

5.2 Management of Health and Safety at Work Regulations 1999

A suitable and sufficient assessment of the risks for all working at height activities is required for the purpose of deciding what control measures are required to ensure the safety of all persons. All working at height must be risk assessed with significant risks recorded using KUTZ Ltd risk assessment documentation.

5.3 The Workplace (Health Safety & Welfare) Regulations 1992
These regulations make the following requirements:

- fixed ladders should be of sound construction, properly maintained and securely fixed. Rungs should be horizontal, provide adequate foothold with stiles extending at least 1100mm above the landing;
- precautions which may include fall-arrest devices, crawling boards, etc. should be taken where there is a risk of falling off or through a roof;
- working at height should be limited to trained persons and in high risk situations a written permit to work system should be adopted as part of a safe system of work for authorised persons.

5.4 The Construction (Health, Safety & Welfare) Regulations 1996
These regulations make the following requirements:

- every place of work to be made and kept safe, including safe access and egress.

-

5.5 The Provision and Use of Work Equipment (PUWER) Regulations 1998
These regulations make the following requirements in respect to all equipment provided for use at work. All work equipment must be:

- suitable for the intended purpose;
- safe for use;
- maintained in a safe state of repair and regularly checked;
- provided for use to persons who have received adequate information, instruction and training in the equipments safe operation/use;
- fitted with all necessary suitable safety measures or protective devices e.g. warnings and guards;
- used with correct safe working load specifications.

5.6 British and European Standards
HSE and BERR (The Department for Business, Enterprise and Regulatory Reform) recommend Class 1[2,3] 'Industrial' or EN 1314 ladders or stepladders for use at work. Domestic (Class 3[2,3]) ones are not normally suitable for use at work. All equipment used within the project must meet the relevant British and/or European Standards. For example:

- wooden ladders – BS 1129:1990;
- aluminium ladders, steps, trestles and lightweight staging – BS 2037:1994;
- step stools – BS EN 14183:2003
- pre-fabricated mobile access and working towers – BS 11392.2 Part 4.

6.0 Hazards
A hazard means anything that can cause harm. Falls during working at height can occur from ladders, through gaps or holes in working platforms, through fragile materials and whilst accessing areas. In addition, serious injury can result from material falling or being thrown from height. Accidents occur to people working at height during maintenance, cleaning, demolishing, access and inspection type activities.

7.0 Procedural Guidance
(Please refer to section 5.1 for specific requirements under the Work at Height Regulations 2005)

Date : 17.01.2023
Rev : 4

7.1 Necessity of working at height

The best way to avoid a fall from height is to make sure that nobody ever undertakes working at height. Therefore working at height should always be avoided where possible by asking 'do we need to do the work?' If the work needs to be done can it be completed in a controlled manner from a safe place? For example, if a gutter needs to be inspected, can it be done from a powered access platform?

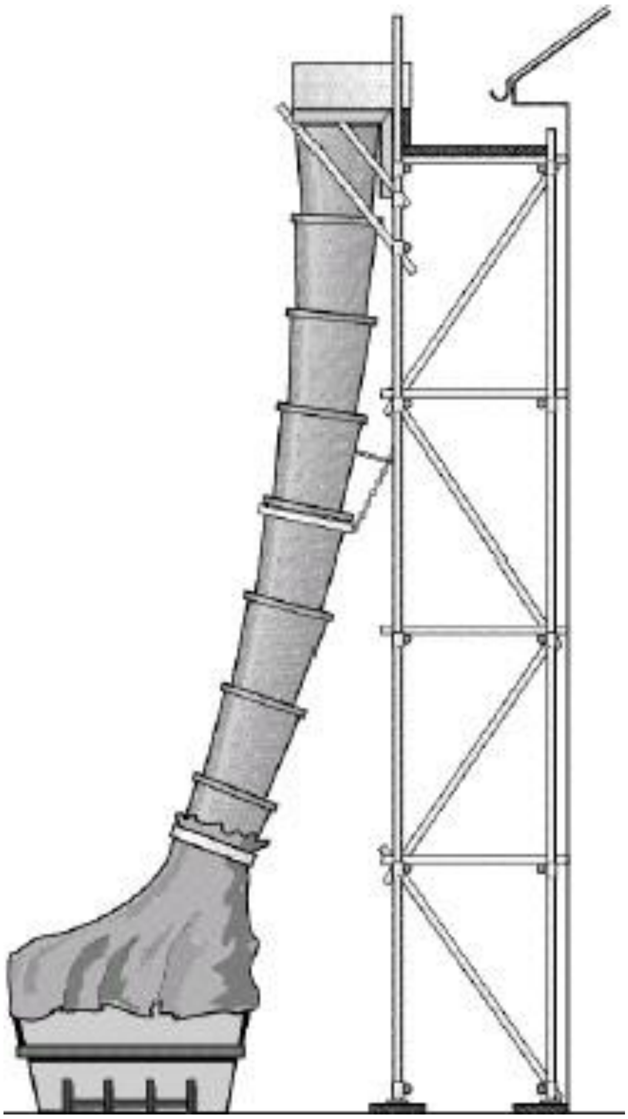
7.2 Precautions for all working at height

The following precautions are required for all working at height. It is the responsibility of KUTZ Ltd management team, duly authorised person or relevant manager to ensure all aspects of this section have been carried out prior to work commencing and to ensure that a safe system of work to include a working at height permit (as required) is fully implemented.

7.2.1 Risk assessment, method statements and working at height permits

Prior to working at height commencing a risk assessment must be undertaken by a competent person and be recorded in line with KUTZ Ltd risk assessment procedure. Any person requested by the site management to assist in the risk assessment process will be competent and trained in the risk assessment process. It is the responsibility of KUTZ ltd site management to ensure that such persons receive appropriate information, instruction and training in risk assessment as required. The risk assessment must identify a safe system of work detailed in a safety method statement being specific and relevant to the work to be undertaken. The risk assessment and method statement must be signed by the competent person and communicated to all those involved in the working at height activity. A risk assessment, safe working procedure/method statement and permit to work covering all work where it is possible to fall 2m or more, must be authorised and in operation for the duration of the task. A permit to work system is a formal written system used to control certain types of work that are potentially hazardous. A permit to work is a document which specifies the work to be done and the precautions to be taken. They form an essential part of safe systems of work for many maintenance activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered.

APPENDIX 1 – ENCLOSED RUBBISH CHUTE



Rubbish chute and skip positioned to take waste materials.

APPENDIX 2 – Ladder/Stepladder Inspection Checklist

Inspection date:	
Ladder description:	
Identification reference:	
Name:	
Signature:	

Aluminium Ladders	OK?
Check for distortion along the stiles.	
Check for tightness of rungs.	
Check extension fittings for security and serviceability.	
Check all rivets and fastenings.	
Check for corrosion.	
Check for and remove any sharp edges on stiles and rungs.	
Check anti-slip end pieces are in good condition and are not loose.	
Check visually for flaws and cracks.	
Check non-slip bases for damage or wear.	
Aluminium ladders must be clearly marked: **'AVOID ELECTRICAL HAZARDS'**	
Anything else to note: Standard BS2037 Class 1 or BSEN131	
Wooden Ladders	**OK?**
Check rungs or treads are not decaying, missing, loose or short-grained?	
Check rungs or treads do not solely rely for support upon nails, spikes or similar fixings.	
Check tie-rods are secure.	
Check stiles are free from defect (e.g. cracks and splits).	
Check that wooden ladders are not painted as this may hide defects (clear varnish is OK).	
Check ladder is free from any signs of warping.	
Check non-slip bases are not be damaged or worn.	
Anything else to note: Standard BS1129 Class 1	
Stepladders	**OK?**
Check stepladders are not wobbly when positioned as this demonstrates side strain.	
Check hinge brackets/spreaders are not loose or bent.	
Check stop on the hinge bracket/spreaders is not broken and is fully effective.	
Check hinges are not loose.	

Risk assessment for Working at Height

Company name: KUTZ Ltd **Date of risk:**

What are the hazards?	Who might be harmed and how?	What are you already doing?	Do you need to do anything else to control this risk?	Action by who?	Action by when?	Done

Working platforms at113 height	Serious or even fatal injury could occur if an operator or an object (e.g materials , tools) falls from height. Others working or passing below are also at risk such as visitors and public.	- **DO NOT** work at height unless it is essential. - **USE** of an existing structure as a safe working platform. - Ensure that there is available space – to fit them in. - Must be designed/erected/altered/dismantled by appropriately trained and competent persons only and directed by a competent supervisor. - Ensure that the working platform is secure and footed on stable ground/support or structure. - Ensure that the working platform will support the weight of those persons using it and any materials. - Ensure that there is adequate working space to undertake the work. - Ensure that all open edges are protected by use of strong and rigid guard rails strongly secured on the platform. - Guard rail at least 910mm above edge - Toe boards at least 150mm high - Intermediate guard rail so there is no gap greater than 470mm. - Ensure that is free from openings /trapping points by using guardrails , covers, toe boards and signage. - Ensure that is free from tripping/slipping hazards(cables , tools, materials, debris). - **DO NOT** stack materials close to the edges - Use enclosed rubbish chutes or lower material to the ground in containers. - Good housekeeping to be checked by KUTZ ltd staff and management team on a daily basis. - Ensure safe access/egress by using fixed ladders or fixed steps, guardrails might be used for extra safety - Unauthorized access not allowed around high level workplace and/or below it by using barriers and appropriate signs. - Ensure weather conditions allow to work on external platforms. - **-DO NOT** work at height in icy, wet or windy conditions. Avoid excessive exposure to sunlight by wearing appropriate clothing, using sun-creams and wearing sun glasses to avoid excessive reflective glare.		All staff, Site Management		

What are the hazards?	Who might be harmed and how?	What are you already doing?	Do you need to do anything else to control this risk?	Action by who?	Action by when?	Done
Working platforms at height		- Work platforms should always be inspected prior to work at height commencing to determine whether conditions have changed and to enable safe working - PPE(safety hats , steel toe shoes , gloves, HiVi's). - Information , Instruction , Training by providing Toolbox talks.		All staff, Site Management		
Working near open edges(excavations, open ground holes, staircases, concrete slabs)	Serious or even fatal injury could occur if an operator or an object (e.g materials , tools) falls from height. Others working or passing below are also at risk such as visitors and public.	- Ensure edge protection is strong and rigid by using bolted timber frame (4''x 2'')or steel tubular guardrails anchored and clamped. - Must be fixed to a structure for adequate support. - Guard rail at least 910mm above edge. - Toe boards at least 150mm high. - Intermediate guard rail so there is no gap greater than 470mm. - Must be designed/installed/altered/dismantled by appropriately trained and competent persons only and directed by a competent supervisor. - **DO NOT** stack materials close to the edges. - Waste material should either be lowered to the ground in a controlled manner or by the use of safe access/egress route(fixed stairs). - Good housekeeping to be checked by KUTZ ltd staff and management team on a daily basis. - Ensure safe access/egress by using fixed ladders or fixed steps, guardrails might be used for extra safety. - **DO NOT** work near open edges in icy, wet or windy conditions. - Open holes will be securely covered with materials suitable to take all required loadings. - **DO NOT** remove or modify hole coverings without the approval of KUTZ Ltd management team. - Edge protection should always be inspected prior to work at height commencing to determine whether conditions have changed and to enable safe working. - PPE(safety hats , steel toe shoes , gloves, HiVi's). - Ensure that Instruction, Information and Supervision is communicated(Site induction, Toolbox talks) to all those involved in the working at height activity		All staff, Site Management		

What are the hazards?	Who might be harmed and how?	What are you already doing?	Do you need to do anything else to control this risk?	Action by who?	Action by when?	Done
Safety Restraint Harnesses	Serious or even fatal injury could occur if an operator wearing a harness falls from height. Others working or passing below are also at risk such as visitors and public.	- Will be only accepted if all other options not reasonably practicable. - All users have to be trained in safe use and Inspection(Qualification certificate) - Visually inspected by the competent/trained user before use and examined at least every three months with a record of examination(**Refer to harness pre-use inspection checklist** KL_OHSAS 68) - Harness anchor needs to be kept as high possible to minimise the free fall distance. - Installation of fixing points for harnesses must be supervised by a suitably qualified person. - When a fall happens, another worker (who has been previously trained in rescue procedures and rescue equipment handling) needs to **assess the situation and make contact with the fallen worker**, determining his status. In the meantime, the emergency services 999 will need to be contacted and the company alerted about the accident.**(**Refer to health and Safety emergency response plan **KL_OHSAS6)**		All staff, Site Management		
Ladders and Stepladders	Serious or even fatal injury could occur if an operator or an object (e.g materials , tools) falls from height. Others working or passing below are also at risk such as visitors and public.	- management by providing a stepladder/ladder permit.(Refer to **KL_OHSAS 38 Rev 0)** - Permits will not be issued by KUTZ ltd if it is reasonably practicable to use access equipment that presents less risk of falling. - Ensure they have no visible defects and have had a pre-use check completed for that working day. - Should only be used for a maximum of 30 minutes in one position. - Ensure that they are used for light work only and not include tasks that involve the worker carrying more than 10Kg. - Ensure to maintain three points of contact(hands and feet)whilst in the working position. - Operators should not overreach or overstretch whilst on the ladder. - Always keep both feet on the same rung and centre of the body within the styles.		All staff, Site Management		

What are the hazards?	Who might be harmed and how?	What are you already doing?	Do you need to do anything else to control this risk?	Action by who?	Action by when?	Done
Ladders and Stepladders	Serious or even fatal injury could occur if an operator or an object (e.g materials , tools) falls from height. Others working or passing below are also at risk such as visitors and public.	- Side loading should be avoided and steps should be face-on to the work. If this is not feasible , steps should be tied at a suitable point - Tool belts should be used for carrying items whilst ascending/ descending. - Ensure to read manufacturer's information. - Class 1[2,3] ' Industrial' or EN 131[4] ladders or step ladders for use in the work environment. - Ensure that only be used on firm and level ground or where the load can be spread via use of a board. - Ensure that they are placed on clean and solid surfaces that are free from loose material to ensure that the feet can grip adequately. - Ensure that they have been appropriately secured. - Ensure that ladders used for access to another level should be tied and extend at least 1m above the landing point to provide a secure handhold. As a general rule, stepladders should not be used in this manner unless they have been specifically designed for this purpose. - Ensure that they are protected by suitable barriers and cones to prevent pedestrians or vehicles to come close. - Ensure that any live electrical work is undertaken from a non-conductive ladder or steps. - Ensure to be inspected on first receipt, before use, before use by the user, on return to store and on a three monthly recorded inspection regime. - Ensure any person using the ladder/stepladder is wearing appropriate PPE(robust non slip steel toe shoes , safety hat, HiV). - Ensure any person using the L/S are physically fir and competent to undertake works at height. - Ensure to provide Information, Instruction, Training and Supervision. - Ensure weather conditions are suitable for external works. - **DO NOT** use home-made or makeshift ladders/stepladders! - **DO NOT** carry out repairs to damaged ladders/stepladders! - **DO NOT** use painted ladders/stepladders as the paint may cover defects and damage! - **DO NOT** use DIY type ladders/stepladders for site work – they may not be strong enough!		All staff, Site Management		

What are the hazards?	Who might be harmed and how?	What are you already doing?	Do you need to do anything else to control this risk?	Action by who?	Action by when?	Done
Ladders and Stepladders	Serious or even fatal injury could occur if an operator or an object (e.g materials , tools) falls from height. Others working or passing below are also at risk such as visitors and public.	**-DO NOT** move ladders/stepladders while standing on the rungs/steps! **-DO NOT** support ladders/stepladders by the rungs or steps during storage! **-DO NOT** place ladders/stepladders on movable objects! **-DO NOT** extend a ladder whilst stood on the rungs!		All staff, Site Management		
General access Scaffolds / Tower Scaffolds	Serious or even fatal injury could occur if an operator or an object (e.g materials , tools) falls from height. Others working or passing below are also at risk such as visitors and public.	-Must be designed/erected/altered/dismantled by appropriately trained and competent persons only (using the NASC approved methods set out in the guidance SG4:05 Apendix A) and directed by a competent supervisor. -Ensure that scaffold handover cert is issued to the KUTZ ltd management team when scaffold complete. -**DO NOT** use unless it is complete, inspected and identified as safe to use by a scaftag. -Ensure that statutory inspections are completed prior to use, at periods not exceeding 7 days, after adaption/alteration, and any conditions that may have affected the safe use/stability. - Unauthorized access not allowed around high level workplace and/or below it by using barriers and appropriate signs. -Use of barriers / designated safe routes to avoid any personnel / visitors from passing below or nearby. -Hirer should provide adequate instruction manual detailing erection sequence and bracing requirements for **Hired tower scaffolds .** - Ensure are placed on a firm and level foundation that is capable of supporting the weight of the scaffold and any other potential loading. - Ensure to be braced and tied into a permanent structure or otherwise suitably stabilised as per any manufacturer's instructions - Ensure only to be sheeted after informing and obtaining guidance from the supplier - Ensure to have platforms that are fully boarded and of adequate width for the intended work and access. - Ensure to consist of scaffold boards that are adequately supported and do not overhang excessively. - Ensure that all open edges are protected by use of strong and rigid guard rails strongly secured on the platform. - Guard rail at least 910mm above edge		All staff, Site Management		

What are the hazards	Who might be harmed and how?	What are you already doing?	Do you need to do anything else to control this risk?	Action by who?	Action by when?	Done
General access Scaffolds / Tower Scaffolds	Serious or even fatal injury could occur if an operator or an object (e.g materials , tools) falls from height. Others working or passing below are also at risk such as visitors and public.	- Toe boards at least 150mm high - Intermediate guard rail so there is no gap greater than 470mm. - Ensure that is free from openings /trapping points by using guardrails , covers, toe boards, brick boards and signage. - Ensure that is free from tripping/slipping hazards(cables , tools, materials, debris). - Ensure to minimise materials and equipment storage on the scaffold / tower scaffold. - **DO NOT** stack materials close to the edges - Use enclosed rubbish chutes or lower material to the ground in containers. - Good housekeeping to be checked by KUTZ ltd staff and management team on a daily basis. - Ensure safe access/egress by the use of internal ladders with secure handholds at all landing places. - Ensure weather conditions allow to work. - **DO NOT** work at height in icy, wet or windy conditions. Avoid excessive exposure to sunlight by wearing appropriate clothing, using sun-creams and wearing sun glasses to avoid excessive reflective glare. - PPE(safety hats , steel toe shoes , gloves, HiVi's). - Ensure that Instruction, Information, Training and Supervision is communicated(Site induction, Toolbox talks) to all those involved in the working at height activity.		All staff, Site Management		
Band stands / Trestles	Serious injury could occur if an operator falls from height.	- Kutz ltd do not promote the use of band stands and trestles as a work platform. - Use only proprietary platform systems e.g safe stands are used if they are positioned on flat. compact and level surfaces. - Use only for short height activities max 1m. and short duration of works. - Ensure to use/install according to manufacturer/supplier instructions - Ensure use of guardrails. - Good housekeeping - Instruction , Information , Training and Supervision - PPE(HiVi's , Safety hat, anti slip steel toe shoes, gloves)		All staff, Site Management		

What are the hazards	. Who might be harmed and how?	What are you already doing?	Do you need to do anything else to control this risk?	Action by who?	Action by when?	Done
Step - up	Minor injury could occur if an operator falls	- Only proprietary step - ups are to be used. - Ensure to check for any damages prior work commencement. - Any domestic or damaged are not used. - PPE(HiVi's , Safety hat, anti slip steel toe shoes, gloves)				

Assessment review date :

HEALTH AND SAFETY EMERGENCY RESPONSE PLAN

42 Elsworthy Road

Contract No:

KUTZ LIMITED

A health and safety emergency is an occurrence that requires an immediate and prioritised response to provide assistance, first aid, medical attention, rescue and/or evacuation to reduce risks to life and increase the likelihood of recovery.

The following emergency response procedures have been specifically developed for this project.

1 FIRST AID AND MEDICAL ATTENTION (Insert the specific emergency procedures for providing first aid and ensuring medical attention)

If someone is injured in an accident **stay calm** and:

- first check that you and the casualty are not in any danger. If you are, make the situation safe.
- when it's safe to do so, dial 999 or 112 for an ambulance, if necessary.

If a person is not breathing normally after an incident, call for an ambulance and then, if you can, start CPR straight away. Use hands-only CPR if you are not trained to perform rescue breaths

Who is in control?	Names of competent persons involved	Means of communication	Method & Equipment
Yiannis Babos	Yiannis Babos	Mobile phone	First aid Kit Recovery position CPR

2 FIRE FIGHTING AND RESCUE (Insert the specific emergency procedures for fighting fires and evacuating the site.)

- Evacuate the site and move to the fire assembly point
- Raise the fire alarm
- Use fire extinguishers
- Call fire brigade

Who is in control?	Names of competent persons involved	Means of communication	Method & Equipment
		Mobile phone	Fire extinguisher Fire alarm

3 RESCUE FROM A TOWER CRANE (Insert the specific emergency procedures for rescuing persons from the top or on the steps of a tower crane, including any provision of first aid.)

N/A

Who is in control?	Names of competent persons involved	Means of communication	Method & Equipment
		Mobile phone	

4 RESCUE OF PERSON SUSPENDED IN A HARNESS (Insert the specific emergency procedures for rescuing persons suspended in a harness, including any provision of first aid and specific measures required until medical attention arrives. Note: ensure any person suspended from a harness receives medical attention.)

When a fall happens, another worker (who has been previously trained in rescue procedures and rescue equipment

Who is in control?	Names of competent persons involved	Means of communication	Method & Equipment
N/A	N/A		

5 RESCUE OF PERSON(S) FROM SAFETY NETS (Insert the specific emergency procedures for rescuing persons from safety nets.)

N/A

Who is in control?	Names of competent persons involved	Means of communication	Method & Equipment

6 RESCUE FROM CONFINED SPACES (Insert the specific emergency procedures (who, what, how, when) for rescuing persons from confined spaces.)

- Identify the spaces
- Develop a plan
- Identify and eliminate all hazard
- Call fire brigade if necessary

Who is in control?	Names of competent persons involved	Means of communication	Method & Equipment

7 RESCUE FROM AN EXCAVATION (Insert the specific emergency procedures for rescuing persons from an excavation.)

- Identify the danger/space
- Evacuate the area from any other personnel and stop anyone trying to get there.
- Develop a plan
- Identify and eliminate all hazard
- Call relevant authorities
- Keep monitoring the casualties untill help arrives

Who is in control?	Names of competent persons involved	Means of communication	Method & Equipment

8 RESCUE FROM AN INCOMPLETE SCAFFOLD(*Insert the specific emergency procedures for rescuing persons from an incomplete scaffold (e.g. a scaffolder).*			
Who is in control?	**Names of competent persons involved**	**Means of communication**	**Method & Equipment**

9 RESCUE FROM A SEGREGATED ASBESTOS AREA (*Insert the specific emergency procedures for rescuing persons from a segregated asbestos area (e.g. asbestos removal personnel).*			
N/A			
Who is in control?	**Names of competent persons involved**	**Means of communication**	**Method & Equipment**

10 RESCUE AND EVACUATION FROM A SERVICE STRIKE (Gas / Electricity) (*Insert the specific emergency procedures for rescuing and evacuating persons from a service strike.)*			
Who is in control?	**Names of competent persons involved**	**Means of communication**	**Method & Equipment**

11 RESCUE FROM WATER (*Insert the specific emergency procedures for rescuing persons from water.)*			
N/A			
Who is in control?	**Names of competent persons involved**	**Means of communication**	**Method & Equipment**

12 SITE EVACUATION (*Insert the specific emergency procedures for evacuating the site.)*			
- Follow evacuation plan - Stay calm and in order when evacuating the site - Assembly point			
Who is in control?	**Names of competent persons involved**	**Means of communication**	**Method & Equipment**

KUTZ LIMITED

42 Elsworthy Road

Contract No:

Section:		**Scheme ref. no.**		**Design Brief No:**	

Request & Approval for TWC Design			
Action	**Name**	**Sign/Date**	
Originator			
Approved TWC			
Approved PM			

TW Company	
TW Designer	
TW Telephone No	

Scope of Design Required		
Deliverable	**Y/N**	**Date Required**
Outline sketches		
Full working drawings		
Calculations		
Design checks		
Design check certificates		
Outline method statements		
Erection checklist		

Description of TW required, including reference to location, spec clause, constraints, etc…

Preferred/non preferred methods, systems or types of equipment

Ground conditions, ground water level, soil types, include bore hole logs

Design limitations, site imposed, contract imposed, include extracts from contract documents

Particular loading conditions

Access limitations

Existing services – overhead/underground

Other information provided to the temporary works designer

KUTZ LIMITED

TEMPORARY WORKS DESIGN CHECK CERTIFICATE

Site/Office Address	Project No.	Design Brief.
Unit 3, Second Floor Hawthorn Business Centre 165 Granville Road London, NW2 2AZ		
	Certificate No.	**Revision**
		0

SECTION OF WORKS

INFORMATION CHECKED (Drg. No. or Document Reference us accurately describe the works)	DESCRIPTION OF CHECK (e.g. Concept, Structural, Dimensional)

DESIGN CRITERIA & REFERENCES (Specifications, Codes, British Standards, Standard Data, Guidance Notes, Computer Programmes, etc.)

NOTES, OBSERVATIONS or RESTRICTIONS (Which may be applicable to the proposed Temporary Works)

CHECK CARRIED OUT BY	DISTRIBUTION
I certify that I have independently checked the above design and drawings, that reasonable professional skill and care have been used in the design of the Temporary Works identified within this certificate.	
Name …………………………………………………	**Project File** …………………………………………
Job …………………………………………………	**Site** ……………………………………………
Signature ………………………………	
Date ………. / ………. / ……….	

KUTZ LIMITED

TEMPORARY WORKS
PERMIT TO LOAD / USE / UNLOAD / DISMANTLE

42 Elsworthy Road

Contract No:

Section:		**Permit No:**	

PART 1 **PERMIT TO LOAD / USE**

A - The following item of temporary works:
B - has been inspected for compliance with the following approved design information, (reference documents)
C - and is approved for use/loading as per the design information and manufacturer's instructions for a period of:
additional
D – The above described works may be LOAD/UNLOADED (below) subject to the following conditions, restrictions or works listed.
E – Alterations to Designed Scheme
Declaration: I verify that such works and additional works have been completed prior to **LOADING** of Temporary are completed as required.

NAME:		SIGNED:		DATE:	

Copy to TWC / Supervisor

KUTZ LIMITED

TEMPORARY WORKS
PERMIT TO LOAD / USE / UNLOAD / DISMANTLE

42 Elsworthy Road

Contract No:

PART 2	PERMIT TO UNLOAD / DISMANTLE

A - The following item of permanent works:
B – has achieved the following design criteria (as required by permanent works designs):
Insert details of verifying documents, (cube results, engineering design parameter, etc)
C – the temporary works detailed in part 1A is now approved for unloading/dismantling subject to the following:
1. Unloading/dismantling sequence in compliance with the approved design details, method statement and manufacturers instructions. 2. *Detail areas of TW to be retained (where applicable) or additional TW to be installed prior to or after unloading/dismantling.*
Declaration: The above described works may be **UNLOADED** subject to the conditions listed & **ONLY** after an inspection by the **APPOINTED PERSON,** with all details, signature and date completed. I verify that such works and additional works have been completed prior to **UNLOADING** of Temporary Works and are completed as required.

NAME:		SIGNED:		DATE:	

Copy to TWC / Supervisor

TEMPORARY WORKS
PERMIT TO LOAD / USE / UNLOAD / DISMANTLE

42 Elsworthy Road

Contract No:

GUIDANCE NOTE

PERMIT TO LOAD

The first section, of this form is the template to be completed when requesting consent by the 'User' and granting consent by 'KUTZ ltd' to **LOAD** completed temporary works as detailed in the completed Temporary Works Register and in accordance with the supplied temporary works drawings and accompanying calculations agreed with 'KUTZ ltd' representatives.

NOTE:

NO works that involves **LOADING** is permitted until;

- The Temporary Works design and calculations are approved and signed off by 'Kutz Ltd'
- The conditions listed within **PART 1** of the permit are fully completed and inspected
- The Temporary Works are inspected and documented by the 'Appointed Person'
- All other necessary H&S documentation is in place and signed off by 'Kutz Ltd'

PERMIT TO UNLOAD

The second section of this form is the template permit document to be completed by the Permit 'User' and 'Kutz Ltd' when requesting and/or granting consent to **'UNLOAD'** Temporary Works as detailed in Part 1 of the Permit.

NOTE:

NO works that involves **UNLOADING** is permitted until:

- The conditions listed within **PART 1** of the permit are fully completed and inspected
- The Temporary Works are inspected and documented by the 'Appointed Person'
- All other necessary H&S documentation is in place and signed off by 'Kutz Ltd'
- When propping (support carriage) for RC Works is required to remain below RC floors (normally at least 2 floors). Transfer that propping/carriage to the next permit, then sign off the original permit and carry out an inspection for the transferred propping or carriage.

TEMPORARY WORKS CLASSIFICATION CHART

Classification and Requirements	Examples
CATEGORY 1	
TW that are very low risk with no design input will be subject to the same standard safe working practices as all other site operations. • do not need to be recorded on the temporary works management chart	• Slab edge shutters less than 300mm deep • Excavations that are shallow and low risk
CATEGORY 2	
TW used in low risk situations and where there is no interface with the public, incorporating standard equipment constructed in accordance with relevant British Standards or Manufacturers recommendations. • must be recorded on the TW management chart	• Access scaffolds with no special features and low enough to be untied • Excavations that are low risk, e.g. < 1.2m deep, no adjacent services/foundations
CATEGORY 3	
TW that are considered to be medium/high risk and/or have an interface with the public. • must be recorded on the TW management chart • must have a Design Brief prepared if temporary works item is direct to Kutz Ltd • must be designed and checked by competent site staff or external organisation • must have Drawings issued including notes detailing what the TW are designed for • must have a Permit To Load/Dismantle issued by the TWC where appropriate	• Access scaffolding (un-sheeted, independent, tied) less than 25m high • Non-basic scaffolds • Excavations greater than 1.2m deep • Formwork for walls and columns • Falsework systems • Foundations for mobile cranes rated at over 100 tonnes
CATEGORY 4	
One off schemes of major temporary works that may involve the fabrication of materials and equipment to produce a non-standard solution. Schemes that could have a major impact on public safety. • must be recorded on the TW management chart • must have a Design Brief prepared if temporary works item is direct to Kutz Ltd • must be designed by competent site staff or external organisation. TWC to check suitability of designer with senior engineer / technical manager in the business unit. • must have a Design Check carried out by independent engineer who was not involved in the original design and have a Design Check Certificate issued • must have drawings issued including notes detailing what the TW have been designed for, including any restrictions on the construction or use of the TW. • must have a Permit To Load/Dismantle issued by the TWC where appropriate	• Access scaffolding (un-sheeted, tied) more than 25m high • Sheeted scaffold more than 10m high. • Excavations that are high risk • Tower crane bases • Foundations for mobile cranes rated at over 500 tonnes • Façade retention schemes • Temporary roofs • All Cofferdams

Scaffold DESIGN BRIEF
Name of Project: ***42 Elsworthy Road***
Contract No:

KUTZ LIMITED

Site Location:		**Scheme ref. no.**		**Design Brief No:**	

DUTY of Scaffold including anticipated usage, loads to be carried (including plant). Indicate designation (load class-boards-inside boards)	
HEIGHT and **LENGTH** of scaffold, including maximum bay length and Lift heights	
DATE scaffold is required to be in place	**PERIOD** scaffold is to remain in place
SUPPORTING GROUND / STRUCTURE (Safe bearing capacity) include any hidden hazards (drainage, ducts etc)	
LOADING TOWER requirement for strengthened scaffold to receive loads placed by mechanical handling equipment	
EDGE PROTECTION & CLADDING (Brick guards, Debris netting, Monarflex, Signage, additional/internal guard rails, etc)	**TIE TYPE** (drilled in anchors, through tie, raker, reveal etc.)
BOARDED lift requirement (ie: overlain with plywood, anti slip requirement, gaps covered, boards secured, etc)	
LOCATION & TYPE OF ACCESS (Emergency escape) (Proprietary stair tower, ladder tower, ladder through platform, etc...)	

Request & Approval for TWC Design

Action	Name	Sign/Date	
Originator			
Approved TWC			
Approved PM			

TW Company	
TW Designer	
TW Telephone No	

Scope of Design Required

Deliverable	Y/N	Date Required
Outline sketches		
Full working drawings		
Calculations		
Design checks		
Design check certificates		
Outline method statements		
Erection checklist		

LADDER / STEPLADDER PERMIT

KUTZ LIMITED

PROJECT:	42 Elsworthy Road	CONTRACT No:		PERMIT No:	

SECTION 1

Precise location of work task to be undertaken : (attach plan or sketch as necessary on reverse of permit)

Description of the work task:

Is it reasonably practicable to use any of the following access equipment for the work task?

	Y/N		Y/N		Y/N	Other (please detail)
Existing place of work:		Podium steps:		MEWP: Folding		
Scaffold / mobile tower:		Pop-up platform:		platform:		

If yes to any of the above, this permit must not be issued and the identified access equipment used.

If no to all of the above, ladders/steps are permitted for use subject to the requirements of this permit and the following:	Y/N
1. Has a risk assessment and method statement, specific for the task and work location been submitted for approval?	
2. Has the risk assessment and method statement been appraised and approved?	

SECTION 2

REQUIRMENTS RELATING TO THE PERMIT:	YES	NO
All items must be checked and in place prior to issue of this Permit. **HAVE you read the approved risk assessment and method statement for the task, specifically the control measures for the use of ladders/stepladders in the locations identified above?** 1. Ground conditions firm, level, free from holes/ruts and free from materials and obstacles? 2. Ladders / stepladders Class 1 and fit for purpose. 3. Ladders / stepladders free from defects and inspected prior to use. 4. Use of ladders / stepladders restricted to the work location detailed in Section 1 of this permit. 5. This permit is for short duration works only. 6. This permit is to be returned on completion of works. 7. Copy of permit to be carried at all times.		
Other : (Please specify)		

SECTION 3

PERMIT AUTHORISATION (Kutz Limited)

The above location has been examined and any precautions detailed within Section 2 above have been checked and are in place. This permit is valid only for the date and times detailed below:

Date:		Start Time:		Expiry Time:	
Signed (for and on behalf of Bay Construct):				Print:	

SECTION 4

CONTRACTOR PERMIT RECEIPT and WITHDRAWAL

I agree to work in compliance with the approved risk assessment and method statement and will supervise to ensure the ladders / stepladders are being used correctly under this Permit. I will stop work if the work process strays outside the approved safe system of work or the requirements of this Permit. When work is completed, or the Permit has expired, I will return it to the Issuer. This Permit will be available if requested during the works.

Start Time:		Signed:		Print:	
On behalf of (Contractor):					
This Permit is withdrawn at:(time)		on the date shown in Section 3 above and the ladder / stepladders have been removed to secure storage to prevent unauthorised use.			
Signed (for and on behalf of Bay Construct):				Print:	

KUTZ LIMITED

Inspection and reports

1.0 Introduction

This information sheet sets out the specific requirements for:

- the inspection of:
  - excavations of any depth;
  - cofferdams and caissons;
  - existing places of work (which prevent falls without the addition or use of other equipment e.g. permanent guard rails on a flat roof);
  - work platforms (eg scaffolds, mobile platforms);
  - collective fall arrest systems (eg nets, airbags, soft landing systems);
  - personal fall protection systems (eg work positioning, rope access, work restraint and fall arrest systems);
  - ladders and stepladders;

2.0 Inspections

The information in **Table 1** outlines what must be checked, inspected or examined under the Construction (Health, Safety and Welfare) Regulations 1996, the Lifting Operations and Lifting Equipment Regulations 1998 and the Work at Height Regulations 2005. It includes the timing and frequency of those inspections.

Inspections should only be carried out by a competent person. This is someone with the experience, knowledge and appropriate qualifications necessary to enable them to identify any risks that are present and decide upon the measures required to control those risks.

Stop work if the inspection shows it is not safe to continue.

3.0 Reports

The result of an inspection must be recorded and retained.

If an inspection is of:

- an excavation, cofferdam or caisson; or
- a working platform which is 2 metres or above in height **and** is undertaken after installation or assembly or to comply with the seven day inspection regime;

The competent person must:

- complete the inspection report before the end of the working period; and
- provide a copy of the report to the person for whom the inspection was carried out within 24 hours.

The person receiving the report **MUST**:

- keep it at the site where the inspection was carried out until construction work is completed; and
- keep it at an office for a further period as specified within the company Integrated Management System/ Appendix D/Document Records List.

'Insert Type (e.g Scaffold')

INSPECTION REPORT

1. Name and address of person for whom inspection was carried out.

2. Site address.

3. Date and time of inspection.

4. Location and description of place of work or work equipment inspected.

5. Matters which give rise to any health and safety risks.

6. Can work be carried out safely? Y / N

7. If not, name of person informed.

8. Details of any other action taken as a result of matters identified in 5 above.

9. Details of any further action considered necessary.

10. Name and position of person making the report.

11. Date and time report handed over.

12. Name and position of person receiving report.

Table 1 Timing and frequency of checks, inspections and examinations

Place of work or work equipment	*Timing and frequency of checks, inspections and examinations*								
	Inspect before work at the start of every shift (see note 1)	Inspect after any event likely to have affected its strength or stability	Inspect after accidental fall of rock, earth or other material	Inspect after installation or assembly in any position (see notes 2 and 3)	Inspect at suitable intervals	Inspect after exceptional circumstances which are liable to jeopardise the safety of work equipment	Inspect at intervals not exceeding 7 days (see note 3)	Check on each occasion before use (REPORT NOT REQUIRED)	LOLER Thorough Examination (if work equipment subject to LOLER) (see note 4)
Excavations which are supported to prevent any person being buried or trapped by an accidental collapse or a fall or dislodgement of material	✓	✓	✓				✓		
Cofferdams and caissons	✓	✓					✓		
The surface and every parapet or permanent rail of every existing place of work at height								✓	
Guard rails, toe boards, barriers and similar collective means of fall protection				✓	✓	✓	✓		
Scaffolds and other working platforms (including tower scaffolds and MEWPs) used for construction work		✓		✓		✓	✓		✓
All other working platforms		✓		✓	✓	✓	✓		✓
Collective safeguards for arresting falls (eg nets, airbags, soft landing systems)		✓		✓	✓	✓	✓		
Personal fall protection systems (including work positioning, rope access, work restraint and fall arrest systems)				✓	✓	✓	✓		✓
Ladders and stepladders					✓	✓	✓	✓	

Notes

1 Although an excavation must be inspected at the start of every shift, only one report is needed in any seven-day period. However, if something happens to affect its strength or stability, and/or an additional inspection is carried out, a report must then be completed. A record of this inspection must be processed as outlined on page 1.

2 'Installation' means putting into position and 'assembly' means putting together. You are not required to inspect and provide a report every time a ladder, tower scaffold or mobile elevated work platform (MEWP) is moved on site or a personal fall protection system is clipped to a new location.

3 An inspection and a report is required for a tower scaffold or MEWP after installation or assembly and every seven days thereafter, providing the equipment is being used on the same site. A record of this inspection must be processed as outlined on page 1. If a tower scaffold is reassembled rather than simply moved, then an additional, pre-use inspection and report is required. It is acceptable for this inspection to be carried out by the person responsible for erecting the tower scaffold, providing they are trained and competent. A visible tag system, which supplements inspection records as it is updated following each pre-use inspection, is a way of recording and keeping the results until the next inspection.

4 All work equipment subject to LOLER regulation 9, thorough examination and inspection requirements, will continue to be subject to LOLER regulation 9 requirem

HARNESS PRE-USE INSPECTION CHECKLIST

KUTZ LIMITED

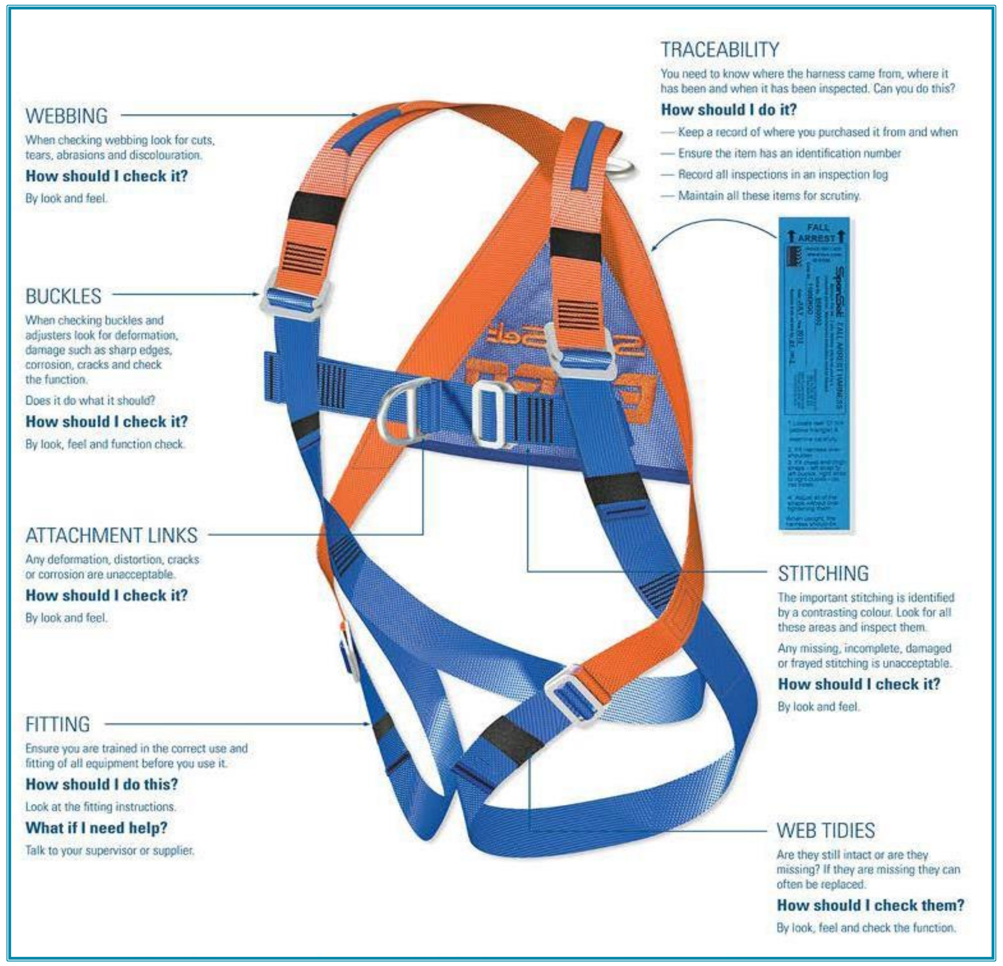
All checks should be conducted **DAILY** in accordance with the manufacturer's manual

ALL FAULTS AND DEFECTS TO BE REPORTED IMMEDIATELY TO YOUR SUPERVISOR

Only persons who are trained and authorised by their employer should operate this equipment.

Name of User:	
Model/Type:	
Serial No:	
Date of Manufacture:	
Name of Competent Inspector :	
Date of Last 6 Monthly Thourough Examination:	
Date of Next 6 Monthly Thourough Examination:	
Inspection Date (week commencing):	

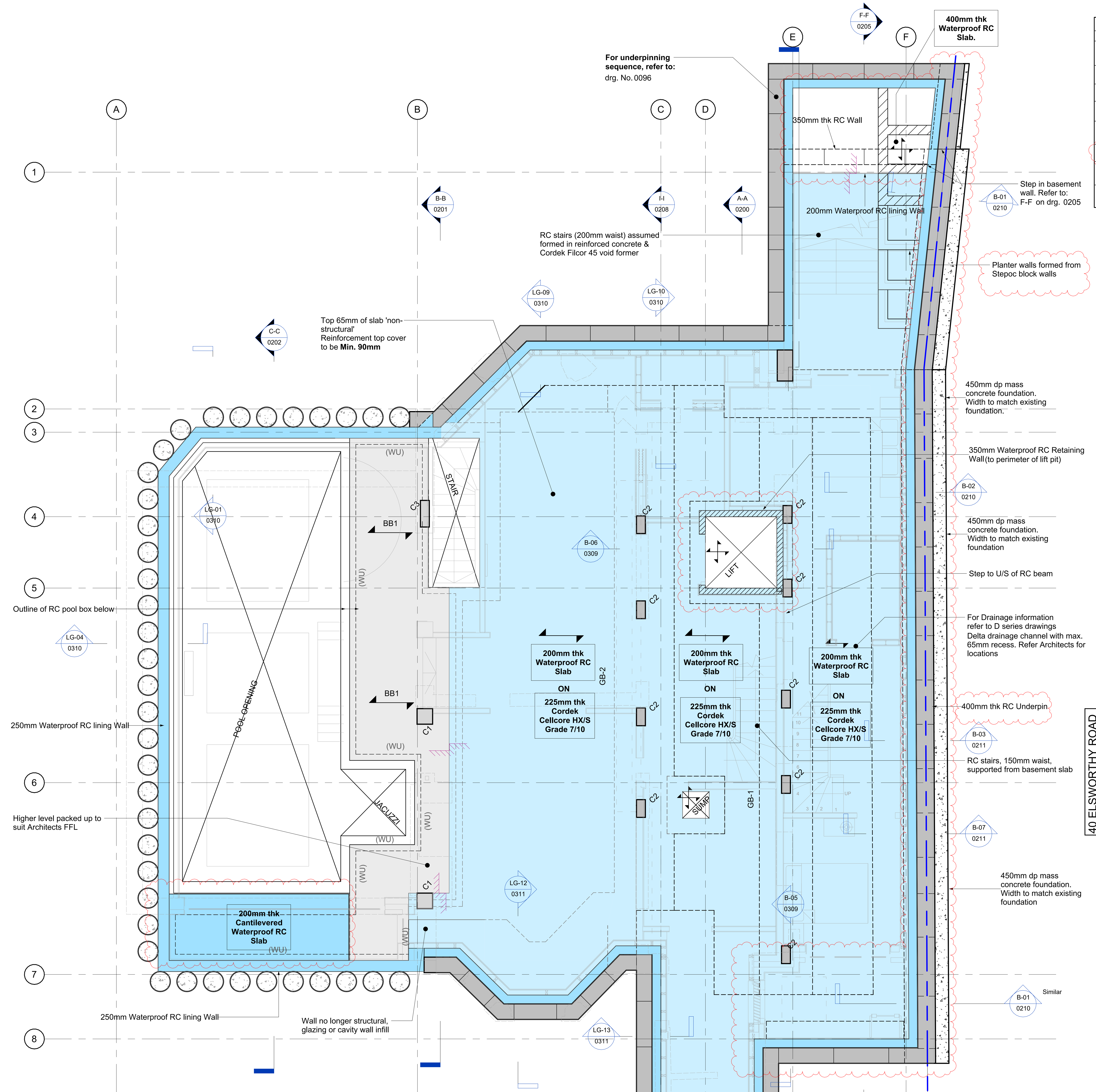
Component/Part:		Possible Defect (check for),(list not exhaustive)	Serviceability			Defect Report (description)	Remarks/Actions	Daily (User Initials)	
			O.K.	N/A	Faulty				
Webbing/Stitching	Shoulder Straps	Cuts/Abrasions						M	
	Chest & Back straps	Worn Threads							
	Waist Straps	Burns						T	
	Leg Straps	Discolour							
D-Rings	Back D-Ring	Incomplete (missing parts)						W	
	Waist D-ring	Contamination (oil, dirt, other)							
	Sternum D-Ring	Cracks						T	
Buckles	Shoulder Adjustment	Corrosion							
	Chest & Back Buckle	Deformation						F	
	Chest Carabiner	Excessive Wear							
	Leg straps	Poor Function						S	
Labels & Markings	Appropriate Safety Markings	Punctures/Holes				**Reported to:**			
Inpection Tag	Legible	Physical Damage/ Sharp Edges						S	
	Date of First Use	Unauthorised Repairs or Alterations				**Date Reported:**			



If you don't understand what is an acceptable of damage. Refer to INDG 367-'Inspecting Fall Arrest Equipment' & Manufacturers Instructions

Appendix D - Planning Structural Engineer Drawings

Date : 17.01.2023
Rev : 4



BASEMENT LEVEL -1 PLAN

1 : 50

LINTEL SCHEDULE (OVER)	
REF.	SIZE
L1	Naylor R6 100x140mm deep lintel to replace existing timber internal lintels
L2	Catnic CG110/125
L3	2no.50x200 C24
L4	2no.50x200 C24 + 1no. 8x195 Flitch Plate
L5	Catnic CN71A + 140dp Precast Lintel (Inside Leaf)
L6	Naylor R9 140(w) x100mm (dp) lintel
L7	Naylor R6 100x140mm deep lintel (1No. per 10mm brickwork)
New timber lintels to be supported on 3No. 50x100 cripple studs	

FLOOR SCHEDULE (SUBSTRUCTURE)	
REF.	SIZE
	RC Slab or Raft. Refer to plan for thickness
	Waterproof RC Slab or Raft. Refer to plan for thickness
BB1	225thk Beam and Block flooring Superdead: 4.1kN/m Live: 1.5kN/m
BB2	225thk Beam and Block flooring Superdead: 4.1kN/m Live: 5.0kN/m

STRUCTURAL FRAMING SCHEDULE		
REF	SIZE	COMMENTS
B-1	300x400mm dp RC	
B-2	500x300mm dp RC	
B-3	500x300mm dp RC .	
B-4	400x300mm dp RC	
B-6	175xMin.400mm dp RC Waterproof	Depth to suit opening
B-7	1000x500mm dp RC	
B-8	1000x350mm dp RC	
B-9	500x650mm dp RC	
B-10	750x550mm dp RC	
B-11	790x300mm dp RC	
B-12	1000x300mm dp Rc	
B-13	850x650mm dp RC	
B-14	400x400mm dp RC	
B-15	1000x350mm dp RC.	
ExSB	Existing Beam	
FB1	Flitch beam	Flitch beam - 2No 150x50 C24 Joists, bolted at 800 crs with M16 bolt
GB-1	1200x425mm dp RC	
GB-2	1500x425mm dp RC	
GB-3	2100x575mm dp RC	
SB-1	UC203x203x46	S355
SB-2	UC254x254x132	S355
SB-4	UC254x254x73	S355
SB-5	UB203x102x23	S355
SB-7	UC305x305x158	S355
SB-8	PFC150x90x24	S355
SB-9	UC152x152x37	S355
SB-10	152SFB79	S355
SB-11	152SFB93	S355
SB-12	UC203x203x71	S355
SB-13	UC203x203x86	S355
SB-14	UC203x203x60	S355
SB-15	UC152x152x23	S355
SB-16	UB203x133x25	S355
SB-17	UB254x146x43	S355
SB-18	UC254x254x89	S355
SB-20	RHS150x100x8	S355
SB-21	UB254x102x28	S355
VB1	12x150mm thk Steel Plate Vertical Bracing	

STRUCTURAL COLUMN SCHEDULE		
REF	SIZE	COMMENTS
C1	350mm x 350mm RC	
C2	200mm x 400mm RC	
C3	600mm x 200mm RC	
C4	700mm x 350mm RC	
ExC	Existing Steel Column	
SC-2	SHS150x150x8	S355
SC-3	UC254x254x107	S355
SC-4	SHS100x100x8	S355
SC-7	UC152x152x37	S355
SC-8	UC152x152x23	S355
SC-9	SHS150x150x12.5	S355
SC-10	UC203x203x46	S355
SC-12	SHS150x150x10	S355
SC-13	UC203x203x60	S355
WP-2	AnconWP2_140x70x4mm	

STRUCTURAL PADSTONE SCHEDULE	
REF	DEPTH x WIDTH x LENGTH [mm]
PS-1	215 (dp) x 215 (w) x 440mm (l)
PS-2	215 (dp) x 215 (w) x 600mm (l)
PS-3	215 (dp) x 102 (w) x 440mm (l)
PS-6	215 (dp) x 215 (w) x 215mm (l)
PS-10	215 (dp) x 330 (w) x 500mm (l)
PS-11	300 (dp) x 102 (w) x 660mm (l)
PS-14	215 (dp) x 215 (w) x 2x440mm (l)
PS-15	140 (dp) x215 (w) x 330mm (l)
PS-16	140 (dp) x102 (w) x 330mm (l)
PS-17	215 (dp) x 102 (w) x 600mm (l)

LIFT SHAFT NOTES

Lift pit:
- Lift pit with bottom slab. **In waterproof concrete.** Depth TBC with Architect and lift manufacturer

Lift overrun:
- TBC with Architect
- Blockwork walls to continue to form lift overrun at higher level.

Front wall:
Allow for 140mm blockwork wall with PC lintel for opening.

Lift Walls:
Allow for 20mm compressible filler and Ancon LHR to restrain the top of lift walls. Lift shaft walls to be built in 140mm 7N dense blockwork

NOTES:
1. If in doubt, please ask.
2. Do not scale this drawing. Any discrepancies are to be reported to the engineer immediately.
3. All dimensions in millimetres, unless noted otherwise.
4. All dimensions and levels are to be checked on site by the contractor prior to preparing any working drawings or commencing on site.
5. The contractor must ensure and will be held responsible for the overall stability of the building/structure/excavation at all stages of the work.
6. All work by the contractor must be carried out in such a way that all requirements under the health and safety at work act are satisfied.
7. All work is to be carried out in compliance with the requirements of the relevant statutory authorities and regulations.
8. **To be read in conjunction with General Notes Drg.No.** 21142-ASL-ZZ-XX-DR-S-0001.

LEGEND (SUBSTRUCTURE)

- GA Section (A / 0100)
- Site Boundary
- Detail Section (1-01 / 0100)
- Existing structure
- Existing structure to be demolished
- Structure under
- Structure above
- New Mass Concrete
- New Reinforced Concrete
- New waterproof RC structure
- New waterproof RC floor
- C — New Steel Column
- (CU) — New Steel Column Under
- C(NCB) — New Steel Column with no continuation below
- PS — Insitu concrete padstone. Refer schedule for sizes.
- New loadbearing blockwork with a min. compressive strength of xxN/mm² in type (xxx) mortar.

IMPORTANT CDM/H&S NOTE

The designers highlight the significant Residual Health and Safety risks that have not been eliminated from the designs. These significant Residual Risks are identified below. This note refers to significant residual risks as defined in CDM legislation. Other health and safety risks associated with construction activities may be present.

- Soil investigation found lead in soil, landscape to provde clean cover system
- Trimming steel installation /cutting of existing beams & slab
- Contractor to ensure adequate temporary works.
- Maximum loading out of existing floor slab to be 150kg/m²
- Temporary prop to existing stair for lift cut out and installation
- Temporary works to boundary to be agreed

HORIZONTAL AND VERTICAL CONSTRUCTION JOINTS OF ALL WATERPROOF CONCRETE IN THE BASEMENT TO BE FITTED WITH HYDROPHILIC STRIPS TO CONTRACTORS WATERPROOFING DESIGN AND DETAILS.

AWAITING DETAILS FROM ARCHITECT - TO BE COORDINATED

PARTY WALL ISSUE - NOT FOR CONSTRUCTION

Rev	Date	Amendments	By	Chkd
PW 4	04.01.23	RC Underping thickness increased, notes updated, schedules updated	JA	PG
PW 3	20.10.22	Party Wall Issue	JA	PG
PW 2	12.10.22	Party Wall Issue	JA	PG

PARTY WALL ISSUE

AXIOM STRUCTURES
+44 (0)20 3637 2751
office@axiom-structures.co.uk
www.axiom-structures.co.uk

Client:
PRIVATE

Project:
42 ELSWORTHY ROAD, NW3 3DL

Drawing title:
PW - BASEMENT PLAN

Date:	Scale at A1:	Scale at A3:
03/2022	As indicated	
Drawn by: JA	Designed by: PG	Chk'd by: AB

PROJECT	ORIGINATOR	ZONE	LEVEL	TYPE	ROLE	NUMBER	REVISION
21142	- ASL -	ZZ	- B1 -	DR -	S -	0098. -	PW4

PADSTONE NOTES

(*) - denotes beam to be strapped down to the solid masonry wall with min. 2No. heavy duty vertical straps, refer typical detail

C20/25 concrete typical.

We allowed for existing brickwork as 5N bricks in type (iv) mortar.

Refer to plans for further notes and other padstones.

Bear on solid and sound masonry wall. Consult SE if flues are found, prestressed concrete padstone/ lintels may be required

LIFT SHAFT NOTES

Lift pit:
- Lift pit with bottom slab. **In waterproof concrete.** Depth TBC with Architect and lift manufacturer

Lift overrun:
- TBC with Architect
- Blockwork walls to continue to form lift overrun at higher level.

Front wall:
Allow for 140mm blockwork wall with PC lintel for opening.

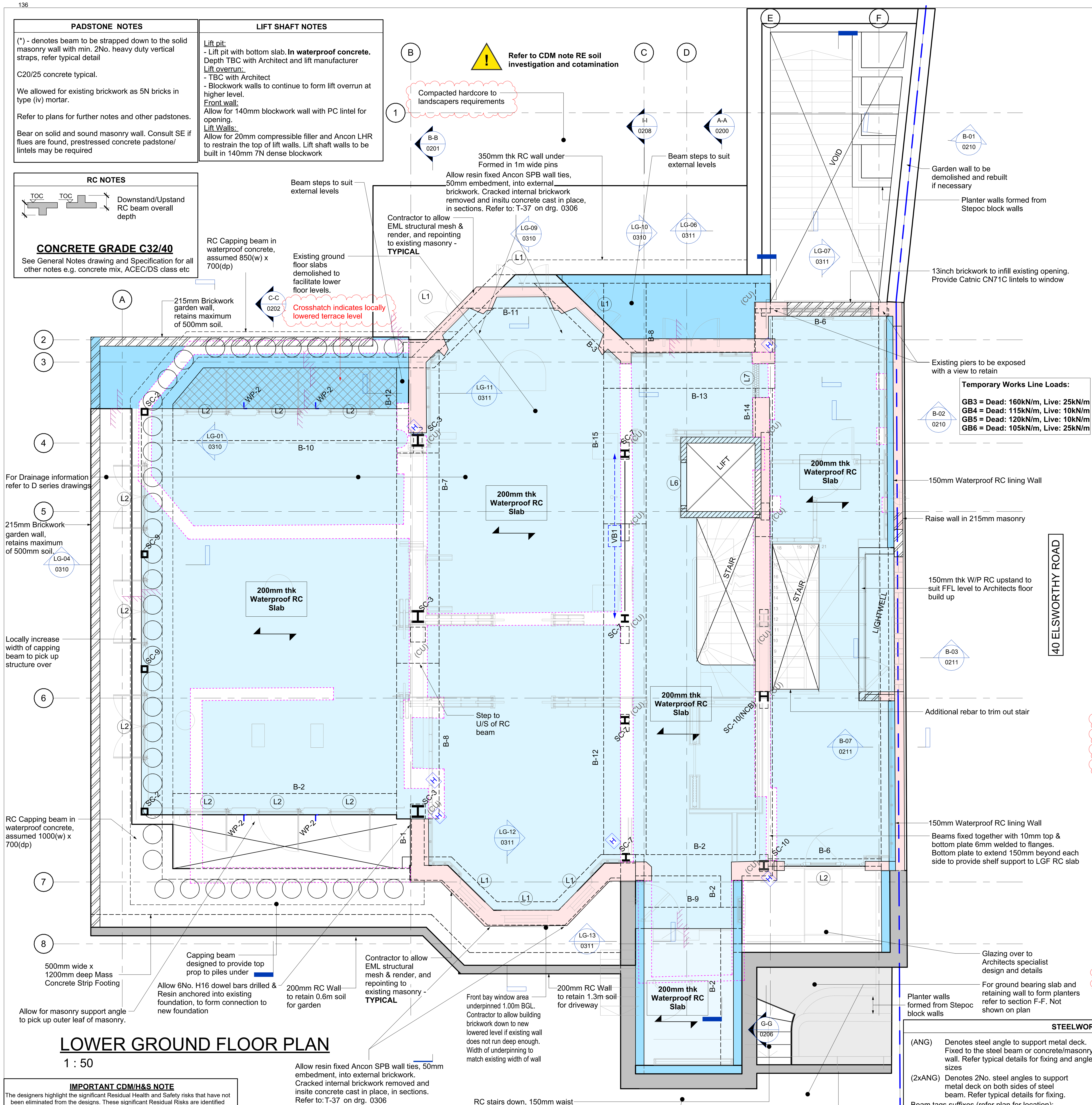
Lift Walls:
Allow for 20mm compressible filler and Ancon LHR to restrain the top of lift walls. Lift shaft walls to be built in 140mm 7N dense blockwork

RC NOTES

TOC TOC Downstand/Upstand RC beam overall depth

CONCRETE GRADE C32/40

See General Notes drawing and Specification for all other notes e.g. concrete mix, ACEC/DS class etc



LOWER GROUND FLOOR PLAN

1 : 50

Allow resin fixed Ancon SPB wall ties, 50mm embedment, into external brickwork. Cracked internal brickwork removed and insite concrete cast in place, in sections. Refer to: T-37 on drg. 0306

RC stairs down, 150mm waist

Stair landing build up TBC by Architect

IMPORTANT CDM/H&S NOTE

The designers highlight the significant Residual Health and Safety risks that have not been eliminated from the designs. These significant Residual Risks are identified below. This note refers to significant residual risks as defined in CDM legislation. Other health and safety risks associated with construction activities may be present.

- Soil investigation found lead in soil, landscape to provde clean cover system
- Trimming steel installation /cutting of existing beams & slab
- Contractor to ensure adequate temporary works.
- Maximum loading out of existing floor slab to be 150kg/m²
- Temporary prop to existing stair for lift cut out and installation
- Temporary works to boundary to be agreed

HORIZONTAL AND VERTICAL CONSTRUCTION JOINTS OF ALL WATERPROOF CONCRETE IN THE BASEMENT TO BE FITTED WITH HYDROPHILIC STRIPS TO CONTRACTORS WATERPROOFING DESIGN AND DETAILS.

AWAITING DETAILS FROM ARCHITECT - TO BE COORDINATED

STRUCTURAL FRAMING SCHEDULE

REF	SIZE	COMMENTS
B-1	300x400mm dp RC	
B-2	500x300mm dp RC	
B-3	500x300mm dp RC .	
B-4	400x300mm dp RC	
B-6	175xMin.400mm dp RC Waterproof	Depth to suit opening
B-7	1000x500mm dp RC	
B-8	1000x350mm dp RC	
B-9	500x650mm dp RC	
B-10	750x550mm dp RC	
B-11	790x300mm dp RC	
B-12	1000x300mm dp Rc	
B-13	850x650mm dp RC	
B-14	400x400mm dp RC	
B-15	1000x350mm dp RC.	
ExSB	Existing Beam	
FB1	Flitch beam	Flitch beam - 2No 150x50 C24 Joists, bolted at 800 crs with M16 bolt
GB-1	1200x425mm dp RC	
GB-2	1500x425mm dp RC	
GB-3	2100x575mm dp RC	
SB-1	UC203x203x46	S355
SB-2	UC254x254x132	S355
SB-4	UC254x254x73	S355
SB-5	UB203x102x23	S355
SB-7	UC305x305x158	S355
SB-8	PFC150x90x24	S355
SB-9	UC152x152x37	S355
SB-10	152SFB79	S355
SB-11	152SFB93	S355
SB-12	UC203x203x71	S355
SB-13	UC203x203x86	S355
SB-14	UC203x203x60	S355
SB-15	UC152x152x23	S355
SB-16	UB203x133x25	S355
SB-17	UB254x146x43	S355
SB-18	UC254x254x89	S355
SB-20	RHS150x100x8	S355
SB-21	UB254x102x28	S355
VB1	12x150mm thk Steel Plate Vertical Bracing	

STRUCTURAL COLUMN SCHEDULE

REF	SIZE	COMMENTS
C1	350mm x 350mm RC	
C2	200mm x 400mm RC	
C3	600mm x 200mm RC	
C4	700mm x 350mm RC	
ExC	Existing Steel Column	
SC-2	SHS150x150x8	S355
SC-3	UC254x254x107	S355
SC-4	SHS100x100x8	S355
SC-7	UC152x152x37	S355
SC-8	UC152x152x23	S355
SC-9	SHS150x150x12.5	S355
SC-10	UC203x203x46	S355
SC-12	SHS150x150x10	S355
SC-13	UC203x203x60	S355
WP-2	AnconWP2_140x70x4mm	

STRUCTURAL PADSTONE SCHEDULE

REF	DEPTH x WIDTH x LENGTH [mm]
PS-1	215 (dp) x 215 (w) x 440mm (l)
PS-2	215 (dp) x 215 (w) x 600mm (l)
PS-3	215 (dp) x 102 (w) x 440mm (l)
PS-6	215 (dp) x 215 (w) x 215mm (l)
PS-10	215 (dp) x 330 (w) x 500mm (l)
PS-11	300 (dp) x 102 (w) x 660mm (l)
PS-14	215 (dp) x 215 (w) x 2x440mm (l)
PS-15	140 (dp) x215 (w) x 330mm (l)
PS-16	140 (dp) x102 (w) x 330mm (l)
PS-17	215 (dp) x 102 (w) x 600mm (l)

STRUCTURAL FOUNDATION SCHEDULE

REF	SIZE	COMMENTS
SF-1	500mm wide x 1200mm deep Mass Concrete Strip Footing	

LINTEL SCHEDULE (OVER)

REF.	SIZE
L1	Naylor R6 100x140mm deep lintel to replace existing timber internal lintels
L2	Catnic CG110/125
L3	2no.50x200 C24
L4	2no.50x200 C24 + 1no. 8x195 Flitch Plate
L5	Catnic CN71A + 140dp Precast Lintel (Inside Leaf)
L6	Naylor R9 140(w) x100mm (dp) lintel
L7	Naylor R6 100x140mm deep lintel (1No. per 10mm brickwork)

New timber lintels to be supported on 3No. 50x100 cripple studs

STEELWORK NOTES

(ANG) Denotes steel angle to support metal deck. Fixed to the steel beam or concrete/masonry wall. Refer typical details for fixing and angle sizes

(2xANG) Denotes 2No. steel angles to support metal deck on both sides of steel beam. Refer typical details for fixing.

Beam tags suffixes (refer plan for location):

(*) Suffix denotes allowance for 10mm thk steel bottom plate to support masonry /Comflor over refer to Architect details for plate width

(#) Suffix denotes allowance for 10mm thk top steel plate to support masonry wall over refer to Architect details for plate width. See Typical details

Secondary steelwork tags:

P1 Windpost / parapet post, refer schedule for size

MS1 Masonry support, refer schedule for size

Notes:
- For setting out and levels refer to architectural drawings
- **All external steelwork to be galvanised. Allow thermal breaks at the end of every external steel member**
- Refer to plans and schedule for mass concrete padstones locations and sizes.
- Use minimum 4M16 8.8 bolts, 12thk end plate to 12mm toe plate connection between beams. Toe plate to be welded to both flanges , and with web stiffener behind. 6mm fillet welds to any steelwork connection. All subject to design.UNO
- For tubular section connections use M16 Hollo bolts as per details
- Refer to General Notes drawing for further notes
- All baseplates to be concealed within the walls thickness

Beam/Column tags suffixes (refer plan for location):

H Denotes existing wall to be laterally restrained via fixing to proposed beam or column. Refer typical detail on drg No.T-24 on drg. 0303

ALL STEELWORK S355

FLOOR SCHEDULE

REF.	SIZE
FJ1	Proposed span direction of timber floor joists 50x200mm dp C24 at 400 crs
FJ2	Proposed span direction of timber floor joists 50x200mm dp C24 at 300 crs
FR1	Proposed span direction of timber flat roof joists 50x150mm dp C24 at 400 crs
RR1	Proposed span direction of timber roof joists 50x150mm dp C24 at 400 crs
C1	Proposed span direction of timber ceiling joists 50x150mm dp C24 at 400 crs.
CS1	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =4.5 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 1.5 kN/m2
CS2	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =4.5 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 5.0 kN/m2
CS3	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =6.0 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 0.75 kN/m2
	Proposed RC slab. With A393 mesh top. For type and thickness refer to plan
	Direction of span of existing floor.
	Existing timber joists. All existing timbers to be checked for condition and replaced as necessary.

Note: all loads given above are unfactored

TIMBER & METSEC FLOORS NOTES:

LATERAL STABILITY
Ply assumed to act as diaphragm and provide lateral stability to the roof & timber/lightweight steel joist floors structure. To be **glued and screwed** refer to general notes for detailed information regarding ply type and fixing

DECKING INFORMATION:
Min. 18mm thk ply decking to floors
Min. 12mm thk ply decking to roofs (no access)
All ply to be marine plywood (external grade plywood)
All ply joints to be staggered. Decking to be glued and screwed. Fixed with min 3mm dia annular ringed gavanised 60mm long round wire nails at 150mm centres along all edges and 300mm centres along intermediate supports. Refer to specs and General Notes drawing for further notes.

OTHER
Timber joists to be doubled-up under non load-bearing partitions walls & where running parallel to bathtubs.

COMPOSITE SLAB NOTES:

Allow for composite deck support at all 4 edges.
a) For all beams supporting comflor deck positioned within beam depth, allow for support steel angles 150x150x12, fully welded (or bolted as typical detail) to provide support at all 4 edges.
b) Where composite deck abuts masonry wall - allow for steel angle resin anchored to the wall. See typical details

REINFORCEMENT ESTIMATES (FOR PRICING ONLY)

Raft Slab	150 kg/m³	LGF slabs	150 kg/m³
Basement slab	150 kg/m³	Beams	120 kg/m³
Retaining walls	180 kg/m³	Additional Waterproof thickness	70 kg/m³
Ground Bearing slabs	65 kg/m³		

Also refer to notes on drawings and schedules for reinforcement allowance information

LINTEL NOTES

- Allow replacing existing external wall, internal face timber lintels with L1 (typical detail).
- 150mm end bearing either end UNO.
- Lintels to be propped during construction of slabs above to TWC / TWD specification.
- Allow Naylor R9 precast lintel (L6) to suit width of wall, for all internal doors where door height is adjusted.

NOTES:

1. If in doubt, please ask.
2. Do not scale this drawing. Any discrepancies are to be reported to the engineer immediately.
3. All dimensions in millimetres, unless noted otherwise.
4. All dimensions and levels are to be checked on site by the contractor prior to preparing any working drawings or commencing on site.
5. The contractor must ensure and will be held responsible for the overall stability of the building/structure/excavation at all stages of the work.
6. All work by the contractor must be carried out in such a way that all requirements under the health and safety at work act are satisfied.
7. All work is to be carried out in compliance with the requirements of the relevant statutory authorities and regulations.
8. **To be read in conjunction with General Notes Drg.No.** 21142-ASL-ZZ-XX-DR-S-0001.

LEGEND

- Site Boundary
- A 0100 GA Section
- 1-01 0100 Detail Section
- Existing structure
- Existing structure to be demolished
- Structure under
- Structure above
- New Mass Concrete
- New Reinforced Concrete
- New waterproof RC structure
- New waterproof RC floor
- (WU) New Wall Under
- C New Steel Column
- (CU) New Steel Column Under
- C(NCB) New Steel Column with no continuation below
- B1 New Steel Beam & reference.
- (F) Furfix wall ties
- (TJ) Triple up existing floor joists
- Moment connection
- Continuous beam (spanning over the column)
- Proposed beam splice location
- Location of crank in beam with full strength butt welded connection, refer plan for details.
- LRS Lateral Restraint Strap. Heavy duty (30x5 galvanised mild steel), at max 1.2m crs. See General notes for fixing.
- PS Insitu concrete padstone. Refer schedule for sizes.
- 140mm thk 7N dense blockwork wall
- New two way spanning RC slab of normal weight concrete slab. Refer to schedule for details.

PARTY WALL ISSUE - NOT FOR CONSTRUCTION

Rev	Date	Amendments	By	Chkd
PW 3	04.01.23	Notes, added, schedules updated	JA	PG
C2	23.11.22	Party Wall updated	JA	PG
PW 2	12.10.22	Party Wall Issue	JA	PG
PW 1	30.09.22	Party Wall Issue	JA	PG

PARTY WALL ISSUE

AXIOM STRUCTURES
+44 (0)20 3637 2751
office@axiom-structures.co.uk
www.axiom-structures.co.uk

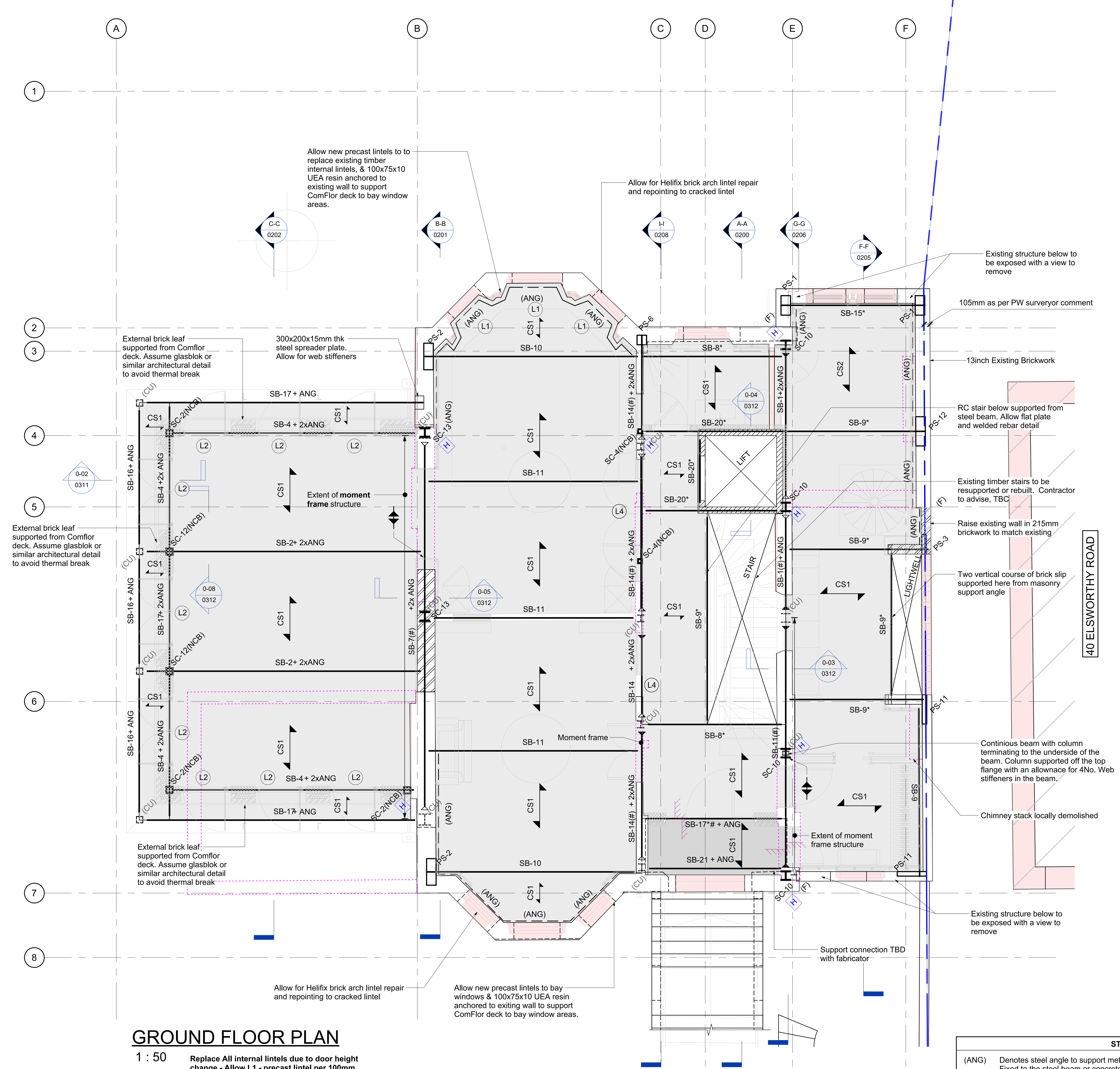
Client:
PRIVATE

Project:
42 ELSWORTHY ROAD, NW3 3DL

Drawing title:
PW - LOWER GROUND FLOOR PLAN

Date:	Scale at A1:	Scale at A3:
03/2022	As indicated	
Drawn by: JA	Designed by: PG	Chk'd by: AB

PROJECT	ORIGINATOR	ZONE	LEVEL	TYPE	ROLE	NUMBER	REVISION
21142	ASL	ZZ	LGF	DR	S	0099.	PW3



GROUND FLOOR PLAN

1 : 50

Replace All internal lintels due to door height change - Allow L1 - precast lintel per 100mm, UNLESS NOTED OTHERWISE

STRUCTURAL FRAMING SCHEDULE

REF	SIZE	COMMENTS
B-1	300x400mm dp RC	
B-2	500x300mm dp RC	
B-3	500x300mm dp RC .	
B-4	400x300mm dp RC	
B-6	175xMin.800mm dp RC Waterproof	Depth to suit opening
B-7	1000x500mm dp RC	
B-8	1000x350mm dp RC	
B-9	500x650mm dp RC	
B-10	750x550mm dp RC	
B-11	790x300mm dp RC	
B-12	1000x300mm dp Rc	
B-13	850x650mm dp RC	
B-14	400x400mm dp RC	
B-15	1000x350mm dp RC.	
ExSB	Existing Beam	
FB1	Flitch beam	Flitch beam - 2No 150x50 C24 Joists, bolted at 800 crs with M16 bolt
GB-1	1200x400mm dp RC	
SB-1	UC203x203x46	S355
SB-2	UC254x254x132	S355
SB-3	UC254x254x73	S355
SB-5	UB203x102x23	S355
SB-7	UC305x305x158	S355
SB-8	PFC150x90x24	S355
SB-9	UC152x152x37	S355
SB-10	152SFB79	S355
SB-11	152SFB93	S355
SB-12	UC203x203x71	S355
SB-13	UC203x203x86	S355
SB-14	UC203x203x60	S355
SB-15	UB203x133x25	S355
SB-16	UB203x133x25	S355
SB-17	UB254x146x43	S355
SB-18	UC254x254x89	S355
SB-20	RHS150x100x8	S355
SB-21	UB254x102x28	S355
VB1	12x150mm thk Steel Plate Vertical Bracing	

STRUCTURAL COLUMN SCHEDULE

REF	SIZE	COMMENTS
C1	350mm x 350mm RC	
C2	200 x 400mm RC	
ExC	Existing Steel Column	
SC-2	SHS150x150x8	S355
SC-3	UC254x254x107	S355
SC-4	SHS100x100x8	S355
SC-7	UC152x152x37	S355
SC-9	SHS150x150x12.5	S355
SC-10	UC203x203x46	S355
SC-11	RHS150x100x12.5	S355
SC-12	SHS150x150x10	S355
SC-13	UC203x203x60	S355
WP-2	AnconWP2_140x70x4mm	

STRUCTURAL PADSTONE SCHEDULE

REF	DEPTH x WIDTH x LENGTH [mm]	COMMENTS
PS-1	215 (dp) x 215 (w) x 440mm (l)	
PS-2	215 (dp) x 215 (w) x 600mm (l)	
PS-3	215 (dp) x 102 (w) x 440mm (l)	
PS-6	215 (dp) x 215 (w) x 215mm (l)	
PS-11	300 (dp) x 102 (w) x 660mm (l)	
PS-12	300 (dp) x 215 (w) x 660mm (l)	
PS-13	215 (dp) x 215 (w) x 880mm (l)	

LINTEL SCHEDULE (OVER)

REF.	SIZE
L1	Naylor R6 100x140mm deep lintel to replace existing timber internal lintels
L2	Catnic CG110/125
L3	2no.50x200 C24
L4	2no.50x200 C24 + 1no. 8x195 Flitch Plate
L5	Catnic CN71A + 140dp Precast Lintel (Inside Leaf)
L6	Naylor R9 100x140mm deep lintel

New timber lintels to be supported on 3No. 50x100 cripple studs

FLOOR SCHEDULE

REF.	SIZE
FJ1	Proposed span direction of timber floor joists 50x200mm dp C24 at 400 crs
FJ2	Proposed span direction of timber floor joists 50x200mm dp C24 at 300 crs
FR1	Proposed span direction of timber flat roof joists 50x150mm dp C24 at 400 crs
RR1	Proposed span direction of timber roof joists 50x150mm dp C24 at 400 crs
C1	Proposed span direction of timber ceiling joists 50x150mm dp C24 at 400 crs.
CS1	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =4.5 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 1.5 kN/m2
CS2	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =4.5 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 5.0 kN/m2
CS3	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =6.0 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 0.75 kN/m2
	Proposed RC slab. With A393 mesh top. For type and thickness refer to plan
	Direction of span of existing floor.
	Existing timber joists. All existing timbers to be checked for condition and replaced as necessary.

Note: all loads given above are unfactored

TIMBER & METSEC FLOORS NOTES:

LATERAL STABILITY
Ply assumed to act as diaphragm and provide lateral stability to the roof & timber/lightweight steel joist floors structure. To be **glued and screwed** refer to general notes for detailed information regarding ply type and fixing

DECKING INFORMATION:
Min. 18mm thk ply decking to floors
Min. 12mm thk ply decking to roofs (no access)
All ply to be marine plywood (external grade plywood)
All ply joints to be staggered. Decking to be glued and screwed. Fixed with min 3mm dia annular ringed galvanised 60mm long round wire nails at 150mm centres along all edges and 300mm centres along intermediate supports. Refer to specs and General Notes drawing for further notes.

OTHER
Timber joists to be doubled-up under non load-bearing partitions walls & where running parallel to bathtubs.

COMPOSITE SLAB NOTES:

Allow for composite deck support at all 4 edges.
a) For all beams supporting comflor deck positioned within beam depth, allow for support steel angles 150x150x12, fully welded (or bolted as typical detail) to provide support at all 4 edges.
b) Where composite deck abuts masonry wall - allow for steel angle resin anchored to the wall. See typical details

NOTES:

1. If in doubt, please ask.
2. Do not scale this drawing. Any discrepancies are to be reported to the engineer immediately.
3. All dimensions in millimetres, unless noted otherwise.
4. All dimensions and levels are to be checked on site by the contractor prior to preparing any working drawings or commencing on site.
5. The contractor must ensure and will be held responsible for the overall stability of the building/structure/excavation at all stages of the work.
6. All work by the contractor must be carried out in such a way that all requirements under the health and safety at work act are satisfied.
7. All work is to be carried out in compliance with the requirements of the relevant statutory authorities and regulations.
8. **To be read in conjunction with General Notes Drg.No.** 21142-ASL-ZZ-XX-DR-S-0001.

LEGEND

- Site Boundary
- GA Section (A / 0100)
- Detail Section (1-01 / 0100)
- Existing structure
- Existing structure to be demolished
- Structure under
- Structure above
- New Mass Concrete
- New Reinforced Concrete
- New waterproof RC structure
- New waterproof RC floor
- New Wall Under (WU)
- New Steel Column (C)
- New Steel Column Under (CU)
- New Steel Column with no continuation below (C(NCB))
- New Steel Beam & reference. (B1)
- Furfix wall ties (F)
- Triple up existing floor joists (TJ)
- Moment connection
- Continuous beam (spanning over the column)
- Proposed beam splice location
- Location of crank in beam with full strength butt welded connection, refer plan for details.
- LRS — Lateral Restraint Strap. Heavy duty (30x5 galvanised mild steel), at max 1.2m crs. See General notes for fixing.
- PS — Insitu concrete padstone. Refer schedule for sizes.
- 140mm thk 7N dense blockwork wall
- New two way spanning RC slab of normal weight concrete slab. Refer to schedule for details.

PARTY WALL ISSUE - NOT FOR CONSTRUCTION

Rev	Date	Amendments	By	Chkd
PW 2	12.10.22	Party Wall Issue	JA	PG
PW 1	30.09.22	Party Wall Issue	JA	PG
C2	10.08.22	Dim added	JA	PG
C1	01.08.22	Construction Issue	JA	PG

PARTY WALL ISSUE

AXIOM STRUCTURES
+44 (0)20 3637 2751
office@axiom-structures.co.uk
www.axiom-structures.co.uk

Client:
PRIVATE

Project:
42 ELSWORTHY ROAD, NW3 3DL

Drawing title:
PW - GROUND FLOOR PLAN

Date:	Scale at A1:	Scale at A3:
03/2022	As indicated	
Drawn by: JA	Designed by: PG	Chk'd by: AB

PROJECT	ORIGINATOR	ZONE	LEVEL	TYPE	ROLE	NUMBER	REVISION
21142	ASL	ZZ	00	DR	S	0100.	PW2

IMPORTANT CDM/H&S NOTE

The designers highlight the significant Residual Health and Safety risks that have not been eliminated from the designs. These significant Residual Risks are identified below. This note refers to significant residual risks as defined in CDM legislation. Other health and safety risks associated with construction activities may be present.

- Soil investigation found lead in soil, landscape to provde clean cover system
- Trimming steel installation /cutting of existing beams & slab
- Contractor to ensure adequate temporary works.
- Maximum loading out of existing floor slab to be 150kg/m²
- Temporary prop to existing stair for lift cut out and installation
- Temporary works to boundary to be agreed

AWAITING DETAILS FROM ARCHITECT - TO BE COORDINATED

PADSTONE NOTES

(*) - denotes beam to be strapped down to the solid masonry wall with min. 2No. heavy duty vertical straps, refer typical detail

C20/25 concrete typical.

We allowed for existing brickwork as 5N bricks in type (iv) mortar.

Refer to plans for further notes and other padstones.

Bear on solid and sound masonry wall. Consult SE if flues are found, prestressed concrete padstone/ lintels may be required

RC NOTES

TOC TOC — Downstand/Upstand RC beam overall depth

CONCRETE GRADE C32/40

See General Notes drawing and Specification for all other notes e.g. concrete mix, ACEC/DS class etc

STEELWORK NOTES

(ANG) Denotes steel angle to support metal deck. Fixed to the steel beam or concrete/masonry wall. Refer typical details for fixing and angle sizes

(2xANG) Denotes 2No. steel angles to support metal deck on both sides of steel beam. Refer typical details for fixing.

Beam tags suffixes (refer plan for location):

(*) Suffix denotes allowance for 10mm thk steel bottom plate to support masonry /Comflor over refer to Architect details for plate width

(#) Suffix denotes allowance for 10mm thk top steel plate to support masonry wall over refer to Architect details for plate width. See Typical details

Secondary steelwork tags:

P1 Windpost / parapet post, refer schedule for size

MS1 Masonry support, refer schedule for size

Notes:
- For setting out and levels refer to architectural drawings
- **All external steelwork to be galvanised. Allow thermal breaks at the end of every external steel member**
- Refer to plans and schedule for mass concrete padstones locations and sizes.
- Use minimum 4M16 8.8 bolts, 12thk end plate to 12mm toe plate connection between beams. Toe plate to be welded to both flanges , and with web stiffener behind. 6mm fillet welds to any steelwork connection. All subject to design. UNO
- For tubular section connections use M16 Hollo bolts as per details
- Refer to General Notes drawing for further notes
- All baseplates to be concealed within the walls thickness

Beam/Column tags suffixes (refer plan for location):

(H) Denotes existing wall to be laterally restrained via fixing to proposed beam or column. Refer typical detail on drg No.T-24 on drg. 0303

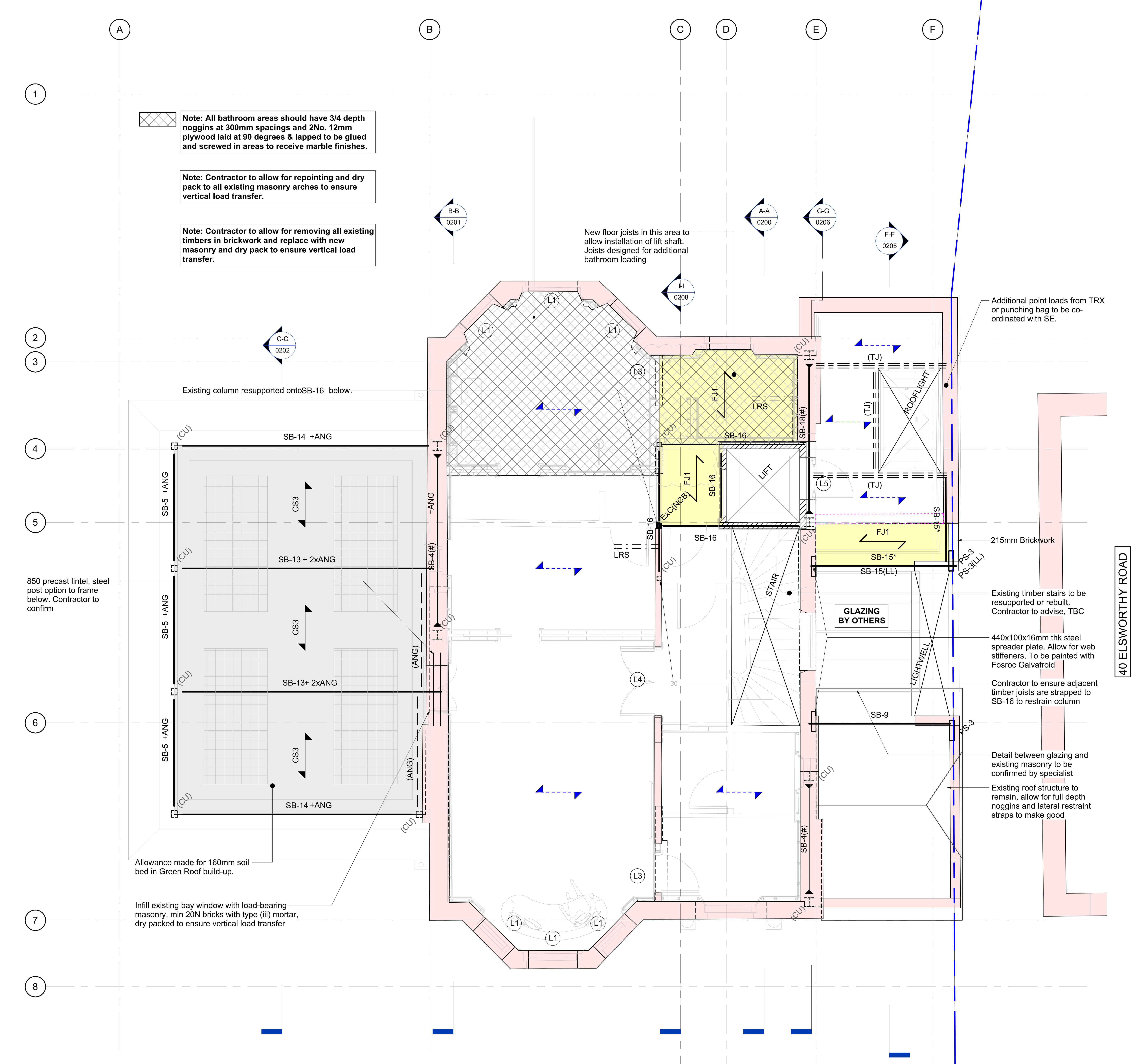
ALL STEELWORK S355

LINTEL NOTES

- Allow replacing existing external wall, internal face timber lintels with L1 (typical detail).
- 150mm end bearing either end UNO.
- Lintels to be propped during construction of slabs above to TWC / TWD specification.
- Allow Naylor R9 precast lintel (L6) to suit width of wall, for all internal doors where door height is adjusted.

LIFT SHAFT NOTES

Lift pit:
- Lift pit with bottom slab. **In waterproof concrete.** Depth TBC with Architect and lift manufacturer
Lift overrun:
- TBC with Architect
- Blockwork walls to continue to form lift overrun at higher level.
Front wall:
Allow for 140mm blockwork wall with PC lintel for opening.
Lift Walls:
Allow for 20mm compressible filler and Ancon LHR to restrain the top of lift walls. Lift shaft walls to be built in 140mm 7N dense blockwork



FIRST FLOOR PLAN

1 : 50

Replace All internal lintels due to door height change - Allow L1 - precast lintel per 100mm, UNLESS NOTED OTHERWISE

AWAITING DETAILS FROM ARCHITECT - TO BE COORDINATED

IMPORTANT CDM/H&S NOTE

The designers highlight the significant Residual Health and Safety risks that have not been eliminated from the designs. These significant Residual Risks are identified below. This note refers to significant residual risks as defined in CDM legislation. Other health and safety risks associated with construction activities may be present.

- Soil investigation found lead in soil, landscape to provde clean cover system
- Trimming steel installation /cutting of existing beams & slab
- Contractor to ensure adequate temporary works.
- Maximum loading out of existing floor slab to be 150kg/m²
- Temporary prop to existing stair for lift cut out and installation
- Temporary works to boundary to be agreed

REINFORCEMENT ESTIMATES (FOR PRICING ONLY)

Raft Slab	150 kg/m³	LGF slabs	150 kg/m³
Basement slab	150 kg/m³	Beams	120 kg/m³
Retaining walls	180 kg/m³	Additional Waterproof thickness	70 kg/m³
Ground Bearing slabs	65 kg/m³		

Also refer to notes on drawings and schedules for reinforcement allowance information

PADSTONE NOTES

(*) - denotes beam to be strapped down to the solid masonry wall with min. 2No. heavy duty vertical straps, refer typical detail

C20/25 concrete typical.

We allowed for existing brickwork as 5N bricks in type (iv) mortar.

Refer to plans for further notes and other padstones.

Bear on solid and sound masonry wall. Consult SE if flues are found, prestressed concrete padstone/ lintels may be required

RC NOTES

TOC TOC

Downstand/Upstand RC beam overall depth

CONCRETE GRADE C32/40

See General Notes drawing and Specification for all other notes e.g. concrete mix, ACEC/DS class etc

STEELWORK NOTES

(ANG) Denotes steel angle to support metal deck. Fixed to the steel beam or concrete/masonry wall. Refer typical details for fixing and angle sizes

(2xANG) Denotes 2No. steel angles to support metal deck on both sides of steel beam. Refer typical details for fixing.

Beam tags suffixes (refer plan for location):

(*) Suffix denotes allowance for 10mm thk steel bottom plate to support masonry /Comflor over refer to Architect details for plate width

(#) Suffix denotes allowance for 10mm thk top steel plate to support masonry wall over refer to Architect details for plate width. See Typical details

Secondary steelwork tags:

P1 Windpost / parapet post, refer schedule for size

MS1 Masonry support, refer schedule for size

Notes:

- For setting out and levels refer to architectural drawings
- **All external steelwork to be galvanised. Allow thermal breaks at the end of every external steel member**
- Refer to plans and schedule for mass concrete padstones locations and sizes.
- Use minimum 4M16 8.8 bolts, 12thk end plate to 12mm toe plate connection between beams. Toe plate to be welded to both flanges , and with web stiffener behind. 6mm fillet welds to any steelwork connection. All subject to design.UNO
- For tubular section connections use M16 Hollo bolts as per details
- Refer to General Notes drawing for further notes
- All baseplates to be concealed within the walls thickness

Beam/Column tags suffixes (refer plan for location):

H Denotes existing wall to be laterally restrained via fixing to proposed beam or column. Refer typical detail on drg No.T-24 on drg. 0303

ALL STEELWORK S355

STRUCTURAL FRAMING SCHEDULE

REF	SIZE	COMMENTS
B-1	300x400mm dp RC	
B-2	500x300mm dp RC	
B-3	500x300mm dp RC .	
B-4	400x300mm dp RC	
B-6	175xMin.800mm dp RC Waterproof	Depth to suit opening
B-7	1000x500mm dp RC	
B-8	1000x350mm dp RC	
B-9	500x650mm dp RC	
B-10	750x550mm dp RC	
B-11	790x300mm dp RC	
B-12	1000x300mm dp Rc	
B-13	850x650mm dp RC	
B-14	400x400mm dp RC	
B-15	1000x350mm dp RC.	
ExSB	Existing Beam	
FB1	Flitch beam	Flitch beam - 2No 150x50 C24 Joists, bolted at 800 crs with M16 bolt
GB-1	1200x400mm dp RC	
SB-1	UC203x203x46	S355
SB-2	UC254x254x132	S355
SB-4	UC254x254x73	S355
SB-5	UB203x102x23	S355
SB-7	UC305x305x158	S355
SB-8	PFC150x90x24	S355
SB-9	UC152x152x37	S355
SB-10	152SFB79	S355
SB-11	152SFB93	S355
SB-12	UC203x203x71	S355
SB-13	UC203x203x86	S355
SB-14	UC203x203x60	S355
SB-15	UC152x152x23	S355
SB-16	UB203x133x25	S355
SB-17	UB254x146x43	S355
SB-18	UC254x254x89	S355
SB-20	RHS150x100x8	S355
SB-21	UB254x102x28	S355
VB1	12x150mm thk Steel Plate Vertical Bracing	

STRUCTURAL COLUMN SCHEDULE

REF	SIZE	COMMENTS
C1	350mm x 350mm RC	
C2	200 x 400mm RC	
ExC	Existing Steel Column	
SC-2	SHS150x150x8	S355
SC-3	UC254x254x107	S355
SC-4	SHS100x100x8	S355
SC-7	UC152x152x37	S355
SC-9	SHS150x150x12.5	S355
SC-10	UC203x203x46	S355
SC-11	RHS150x100x12.5	S355
SC-12	SHS150x150x10	S355
SC-13	UC203x203x60	S355
WP-2	AnconWP2_140x70x4mm	

STRUCTURAL PADSTONE SCHEDULE

REF	DEPTH x WIDTH x LENGTH [mm]	COMMENTS
PS-1	215 (dp) x 215 (w) x 440mm (l)	
PS-2	215 (dp) x 215 (w) x 600mm (l)	
PS-3	215 (dp) x 102 (w) x 440mm (l)	
PS-6	215 (dp) x 215 (w) x 215mm (l)	
PS-11	300 (dp) x 102 (w) x 660mm (l)	
PS-12	300 (dp) x 215 (w) x 660mm (l)	
PS-13	215 (dp) x 215 (w) x 880mm (l)	

LINTEL SCHEDULE (OVER)

REF.	SIZE
L1	Naylor R6 100x140mm deep lintel to replace existing timber internal lintels
L2	Catnic CG110/125
L3	2no.50x200 C24
L4	2no.50x200 C24 + 1no. 8x195 Flitch Plate
L5	Catnic CN71A + 140dp Precast Lintel (Inside Leaf)
L6	Naylor R9 100x140mm deep lintel

New timber lintels to be supported on 3No. 50x100 cripple studs

FLOOR SCHEDULE

REF.	SIZE
FJ1	Proposed span direction of timber floor joists 50x200mm dp C24 at 400 crs
FJ2	Proposed span direction of timber floor joists 50x200mm dp C24 at 300 crs
FR1	Proposed span direction of timber flat roof joists 50x150mm dp C24 at 400 crs
RR1	Proposed span direction of timber roof joists 50x150mm dp C24 at 400 crs
C1	Proposed span direction of timber ceiling joists 50x150mm dp C24 at 400 crs.
CS1	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =4.5 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 1.5 kN/m2
CS2	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =4.5 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 5.0 kN/m2
CS3	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =6.0 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 0.75 kN/m2
	Proposed RC slab. With A393 mesh top. For type and thickness refer to plan
	Direction of span of existing floor.
	Existing timber joists. All existing timbers to be checked for condition and replaced as necessary.

Note: all loads given above are unfactured

TIMBER & METSEC FLOORS NOTES:

LATERAL STABILITY

Ply assumed to act as diaphragm and provide lateral stability to the roof & timber/lightweight steel joist floors structure. To be **glued and screwed** refer to general notes for detailed information regarding ply type and fixing

DECKING INFORMATION:

Min. 18mm thk ply decking to floors
Min. 12mm thk ply decking to roofs (no access)
All ply to be marine plywood (external grade plywood)
All ply joints to be staggered. Decking to be glued and screwed. Fixed with min 3mm dia annular ringed galvanised 60mm long round wire nails at 150mm centres along all edges and 300mm centres along intermediate supports. Refer to specs and General Notes drawing for further notes.

OTHER

Timber joists to be doubled-up under non load-bearing partitions walls & where running parallel to bathtubs.

COMPOSITE SLAB NOTES:

Allow for composite deck support at all 4 edges.
a) For all beams supporting comflor deck positioned within beam depth, allow for support steel angles 150x150x12, fully welded (or bolted as typical detail) to provide support at all 4 edges.
b) Where composite deck abuts masonry wall - allow for steel angle resin anchored to the wall. See typical details

LINTEL NOTES

- Allow replacing existing external wall, internal face timber lintels with L1 (typical detail).
- 150mm end bearing either end UNO.
- Lintels to be propped during construction of slabs above to TWC / TWD specification.
- Allow Naylor R9 precast lintel (L6) to suit width of wall, for all internal doors where door height is adjusted.

LIFT SHAFT NOTES

Lift pit:
- Lift pit with bottom slab. **In waterproof concrete.** Depth TBC with Architect and lift manufacturer

Lift overrun:
- TBC with Architect
- Blockwork walls to continue to form lift overrun at higher level.

Front wall:
Allow for 140mm blockwork wall with PC lintel for opening.

Lift Walls:
Allow for 20mm compressible filler and Ancon LHR to restrain the top of lift walls. Lift shaft walls to be built in 140mm 7N dense blockwork

NOTES:

1. If in doubt, please ask.
2. Do not scale this drawing. Any discrepancies are to be reported to the engineer immediately.
3. All dimensions in millimetres, unless noted otherwise.
4. All dimensions and levels are to be checked on site by the contractor prior to preparing any working drawings or commencing on site.
5. The contractor must ensure and will be held responsible for the overall stability of the building/structure/excavation at all stages of the work.
6. All work by the contractor must be carried out in such a way that all requirements under the health and safety at work act are satisfied.
7. All work is to be carried out in compliance with the requirements of the relevant statutory authorities and regulations.
8. **To be read in conjunction with General Notes Drg.No.** 21142-ASL-ZZ-XX-DR-S-0001.

LEGEND

- Site Boundary
- GA Section (A / 0100)
- Detail Section (1-01 / 0100)
- Existing structure
- Existing structure to be demolished
- Structure under
- Structure above
- New Mass Concrete
- New Reinforced Concrete
- New waterproof RC structure
- New waterproof RC floor
- New Wall Under (WU)
- New Steel Column (C)
- New Steel Column Under (CU)
- New Steel Column with no continuation below (C(NCB))
- New Steel Beam & reference. (B1)
- Furfix wall ties (F)
- Triple up existing floor joists (TJ)
- Moment connection
- Continuous beam (spanning over the column)
- Proposed beam splice location
- Location of crank in beam with full strength butt welded connection, refer plan for details.
- LRS Lateral Restraint Strap. Heavy duty (30x5 galvanised mild steel), at max 1.2m crs. See General notes for fixing.
- PS Insitu concrete padstone. Refer schedule for sizes.
- 140mm thk 7N dense blockwork wall
- New two way spanning RC slab of normal weight concrete slab. Refer to schedule for details.

PARTY WALL ISSUE - NOT FOR CONSTRUCTION

Rev	Date	Amendments	By	Chkd
PW 2	12.10.22	Party Wall Issue	JA	PG
PW 1	30.09.22	Party Wall Issue	JA	PG
C1	01.08.22	Construction Issue	JA	PG

PARTY WALL ISSUE

AXIOM STRUCTURES
+44 (0)20 3637 2751
office@axiom-structures.co.uk
www.axiom-structures.co.uk

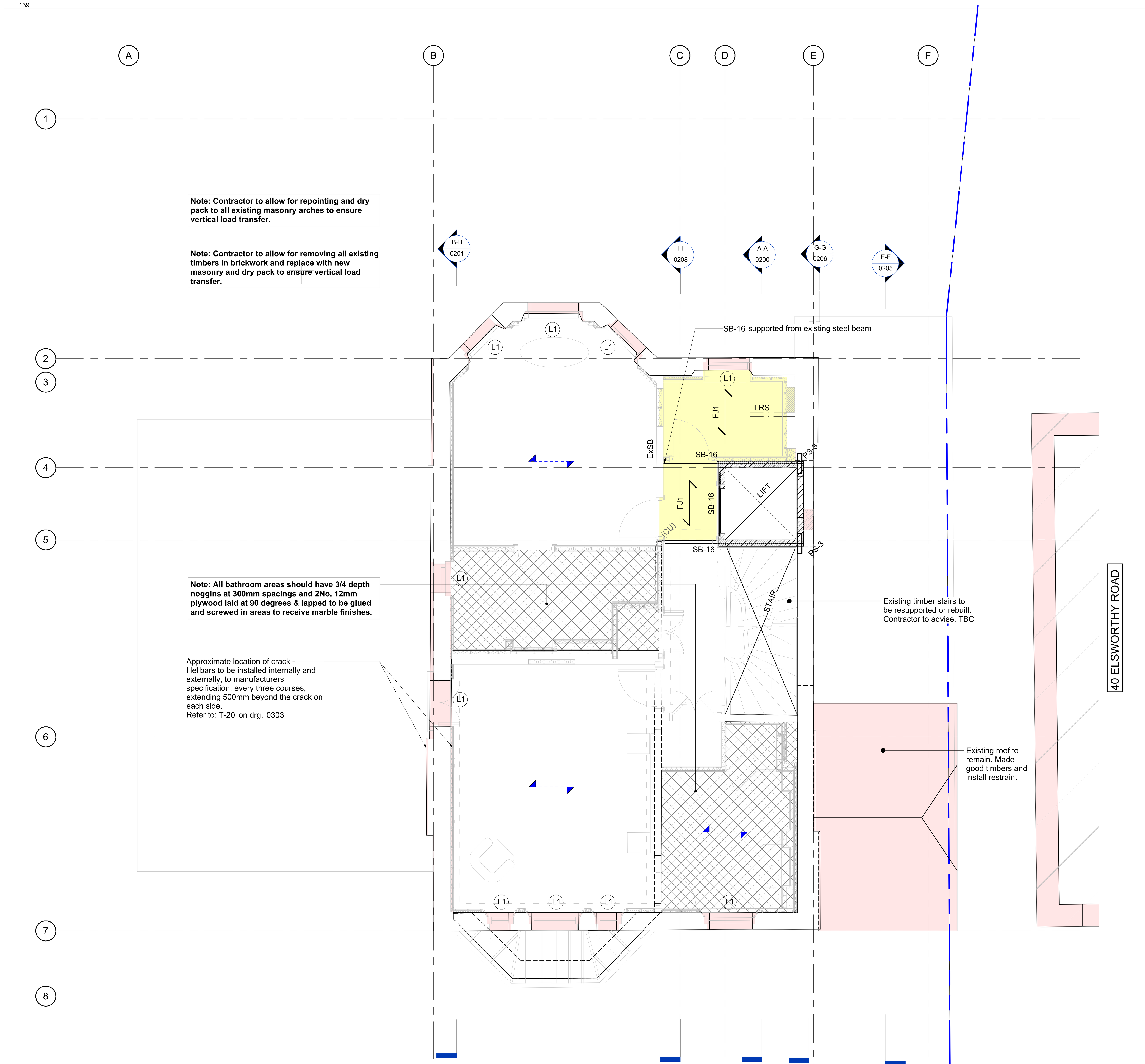
Client:
PRIVATE

Project:
42 ELSWORTHY ROAD, NW3 3DL

Drawing title:
PW - FIRST FLOOR PLAN

Date: 03/2022	Scale at A1: As indicated	Scale at A3:
Drawn by: JA	Designed by:PG	Chk'd by: AB

PROJECT	ORIGINATOR	ZONE	LEVEL	TYPE	ROLE	NUMBER	REVISION
21142	ASL	ZZ	01	DR	S	0101.	PW2



SECOND FLOOR PLAN

1 : 50

AWAITING DETAILS FROM ARCHITECT - TO BE COORDINATED

STRUCTURAL FRAMING SCHEDULE

REF	SIZE	COMMENTS
B-1	300x400mm dp RC	
B-2	500x300mm dp RC	
B-3	500x300mm dp RC .	
B-4	400x300mm dp RC	
B-6	175xMin.800mm dp RC Waterproof	Depth to suit opening
B-7	1000x500mm dp RC	
B-8	1000x350mm dp RC	
B-9	500x650mm dp RC	
B-10	750x550mm dp RC	
B-11	790x300mm dp RC	
B-12	1000x300mm dp Rc	
B-13	850x650mm dp RC	
B-14	400x400mm dp RC	
B-15	1000x350mm dp RC.	
ExSB	Existing Beam	
FB1	Flitch beam	Flitch beam - 2No 150x50 C24 Joists, bolted at 800 crs with M16 bolt
GB-1	1200x400mm dp RC	
SB-1	UC203x203x46	S355
SB-2	UC254x254x132	S355
SB-4	UC254x254x73	S355
SB-5	UB203x102x23	S355
SB-7	UC305x305x158	S355
SB-8	PFC150x90x24	S355
SB-9	UC152x152x37	S355
SB-10	152SFB79	S355
SB-11	152SFB93	S355
SB-12	UC203x203x71	S355
SB-13	UC203x203x86	S355
SB-14	UC203x203x60	S355
SB-15	UC152x152x23	S355
SB-16	UB203x133x25	S355
SB-17	UB254x146x43	S355
SB-18	UC254x254x89	S355
SB-20	RHS150x100x8	S355
SB-21	UB254x102x28	S355
VB1	12x150mm thk Steel Plate Vertical Bracing	

STRUCTURAL COLUMN SCHEDULE

REF	SIZE	COMMENTS
C1	350mm x 350mm RC	
C2	200 x 400mm RC	
ExC	Existing Steel Column	
SC-2	SHS150x150x8	S355
SC-3	UC254x254x107	S355
SC-4	SHS100x100x8	S355
SC-7	UC152x152x37	S355
SC-9	SHS150x150x12.5	S355
SC-10	UC203x203x46	S355
SC-11	RHS150x100x12.5	S355
SC-12	SHS150x150x10	S355
SC-13	UC203x203x60	S355
WP-2	AnconWP2_140x70x4mm	

STRUCTURAL PADSTONE SCHEDULE

REF	DEPTH x WIDTH x LENGTH [mm]	COMMENTS
PS-1	215 (dp) x 215 (w) x 440mm (l)	
PS-2	215 (dp) x 215 (w) x 600mm (l)	
PS-3	215 (dp) x 102 (w) x 440mm (l)	
PS-6	215 (dp) x 215 (w) x 215mm (l)	
PS-11	300 (dp) x 102 (w) x 660mm (l)	
PS-12	300 (dp) x 215 (w) x 660mm (l)	
PS-13	215 (dp) x 215 (w) x 880mm (l)	

FLOOR SCHEDULE

REF.	SIZE
FJ1	Proposed span direction of timber floor joists 50x200mm dp C24 at 400 crs
FJ2	Proposed span direction of timber floor joists 50x200mm dp C24 at 300 crs
FR1	Proposed span direction of timber flat roof joists 50x150mm dp C24 at 400 crs
RR1	Proposed span direction of timber roof joists 50x150mm dp C24 at 400 crs
C1	Proposed span direction of timber ceiling joists 50x150mm dp C24 at 400 crs.
CS1	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =4.5 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 1.5 kN/m2
CS2	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =4.5 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 5.0 kN/m2
CS3	Proposed span direction of 150mm thk composite slab, with metal deck. Preliminary size: Comflor 60/0.9mm with A393 mesh and H10 bars in each rib. To contractor's specialist design and detail, for the following loads SDL =6.0 kN/m2 (superdead load, excluding self-weight of metal deck) LL = 0.75 kN/m2
	Proposed RC slab. With A393 mesh top. For type and thickness refer to plan
	Direction of span of existing floor.
	Existing timber joists. All existing timbers to be checked for condition and replaced as necessary.

Note: all loads given above are unfactored

TIMBER & METSEC FLOORS NOTES:

LATERAL STABILITY
Ply assumed to act as diaphragm and provide lateral stability to the roof & timber/lightweight steel joist floors structure. To be **glued and screwed** refer to general notes for detailed information regarding ply type and fixing

DECKING INFORMATION:
Min. 18mm thk ply decking to floors
Min. 12mm thk ply decking to roofs (no access)
All ply to be marine plywood (external grade plywood)
All ply joints to be staggered. Decking to be glued and screwed. Fixed with min 3mm dia annular ringed galvanised 60mm long round wire nails at 150mm centres along all edges and 300mm centres along intermediate supports. Refer to specs and General Notes drawing for further notes.

OTHER
Timber joists to be doubled-up under non load-bearing partitions walls & where running parallel to bathtubs.

COMPOSITE SLAB NOTES:

Allow for composite deck support at all 4 edges.
a) For all beams supporting comflor deck positioned within beam depth, allow for support steel angles 150x150x12, fully welded (or bolted as typical detail) to provide support at all 4 edges.
b) Where composite deck abuts masonry wall - allow for steel angle resin anchored to the wall. See typical details

NOTES:
1. If in doubt, please ask.
2. Do not scale this drawing. Any discrepancies are to be reported to the engineer immediately.
3. All dimensions in millimetres, unless noted otherwise.
4. All dimensions and levels are to be checked on site by the contractor prior to preparing any working drawings or commencing on site.
5. The contractor must ensure and will be held responsible for the overall stability of the building/structure/excavation at all stages of the work.
6. All work by the contractor must be carried out in such a way that all requirements under the health and safety at work act are satisfied.
7. All work is to be carried out in compliance with the requirements of the relevant statutory authorities and regulations.
8. **To be read in conjunction with General Notes Drg.No.** 21142-ASL-ZZ-XX-DR-S-0001.

LEGEND

A / 0100	GA Section	1-01 / 0100	Detail Section
	Existing structure		Site Boundary
	Structure under		Existing structure to be demolished
	New Mass Concrete		Structure above
	New waterproof RC structure		New Reinforced Concrete
(WU)	New Wall Under		New waterproof RC floor
C	New Steel Column	(CU)	New Steel Column Under
C(NCB)	New Steel Column with no continuation below		
B1	New Steel Beam & reference.	(F)	Furfix wall ties
		(TJ)	Triple up existing floor joists
	Moment connection		
	Continuous beam (spanning over the column)		
	Proposed beam splice location		
	Location of crank in beam with full strength butt welded connection, refer plan for details.		
LRS	Lateral Restraint Strap. Heavy duty (30x5 galvanised mild steel), at max 1.2m crs. See General notes for fixing.		
PS	Insitu concrete padstone. Refer schedule for sizes.		
	140mm thk 7N dense blockwork wall		
	New two way spanning RC slab of normal weight concrete slab. Refer to schedule for details.		

PARTY WALL ISSUE - NOT FOR CONSTRUCTION

Rev	Date	Amendments	By	Chkd
PW 2	12.10.22	Party Wall Issue	JA	PG
PW 1	30.09.22	Party Wall Issue	JA	PG
C1	01.08.22	Construction Issue	JA	PG

PARTY WALL ISSUE

AXIOM STRUCTURES
+44 (0)20 3637 2751
office@axiom-structures.co.uk
www.axiom-structures.co.uk

Client:
PRIVATE

Project:
42 ELSWORTHY ROAD, NW3 3DL

Drawing title:
PW - SECOND FLOOR PLAN

Date: 03/2022	Scale at A1: As indicated	Scale at A3:
Drawn by: JA	Designed by: PG	Chk'd by: AB

PROJECT	ORIGINATOR	ZONE	LEVEL	TYPE	ROLE	NUMBER	REVISION
21142	ASL	ZZ	02	DR	S	0102	PW2

LINTEL NOTES

- Allow replacing existing external wall, internal face timber lintels with L1 (typical detail).
- 150mm end bearing either end UNO.
- Lintels to be propped during construction of slabs above to TWC / TWD specification.
- Allow Naylor R9 precast lintel (L6) to suit width of wall, for all internal doors where door height is adjusted.

LIFT SHAFT NOTES

Lift pit:
- Lift pit with bottom slab. **In waterproof concrete.** Depth TBC with Architect and lift manufacturer

Lift overrun:
- TBC with Architect
- Blockwork walls to continue to form lift overrun at higher level.

Front wall:
Allow for 140mm blockwork wall with PC lintel for opening.

Lift Walls:
Allow for 20mm compressible filler and Ancon LHR to restrain the top of lift walls. Lift shaft walls to be built in 140mm 7N dense blockwork

STEELWORK NOTES

(ANG) Denotes steel angle to support metal deck. Fixed to the steel beam or concrete/masonry wall. Refer typical details for fixing and angle sizes

(2xANG) Denotes 2No. steel angles to support metal deck on both sides of steel beam. Refer typical details for fixing.

Beam tags suffixes (refer plan for location):

(*) Suffix denotes allowance for 10mm thk steel bottom plate to support masonry /Comflor over refer to Architect details for plate width

(#) Suffix denotes allowance for 10mm thk top steel plate to support masonry wall over refer to Architect details for plate width. See Typical details

Secondary steelwork tags:

P1 Windpost / parapet post, refer schedule for size

MS1 Masonry support, refer schedule for size

Notes:
- For setting out and levels refer to architectural drawings
- **All external steelwork to be galvanised. Allow thermal breaks at the end of every external steel member**
- Refer to plans and schedule for mass concrete padstones locations and sizes.
- Use minimum 4M16 8.8 bolts, 12thk end plate to 12mm toe plate connection between beams. Toe plate to be welded to both flanges , and with web stiffener behind. 6mm fillet welds to any steelwork connection. All subject to design.UNO
- For tubular section connections use M16 Hollo bolts as per details
- Refer to General Notes drawing for further notes
- All baseplates to be concealed within the walls thickness

Beam/Column tags suffixes (refer plan for location):

H Denotes existing wall to be laterally restrained via fixing to proposed beam or column. Refer typical detail on drg No.T-24 on drg. 0303

ALL STEELWORK S355

RC NOTES

TOC TOC Downstand/Upstand RC beam overall depth

CONCRETE GRADE C32/40

See General Notes drawing and Specification for all other notes e.g. concrete mix, ACEC/DS class etc

PADSTONE NOTES

(*) - denotes beam to be strapped down to the solid masonry wall with min. 2No. heavy duty vertical straps, refer typical detail

C20/25 concrete typical.

We allowed for existing brickwork as 5N bricks in type (iv) mortar.

Refer to plans for further notes and other padstones.

Bear on solid and sound masonry wall. Consult SE if flues are found, prestressed concrete padstone/ lintels may be required

REINFORCEMENT ESTIMATES (FOR PRICING ONLY)

Raft Slab	150 kg/m³	LGF slabs	150 kg/m³
Basement slab	150 kg/m³	Beams	120 kg/m³
Retaining walls	180 kg/m³	Additional Waterproof thickness	70 kg/m³
Ground Bearing slabs	65 kg/m³		

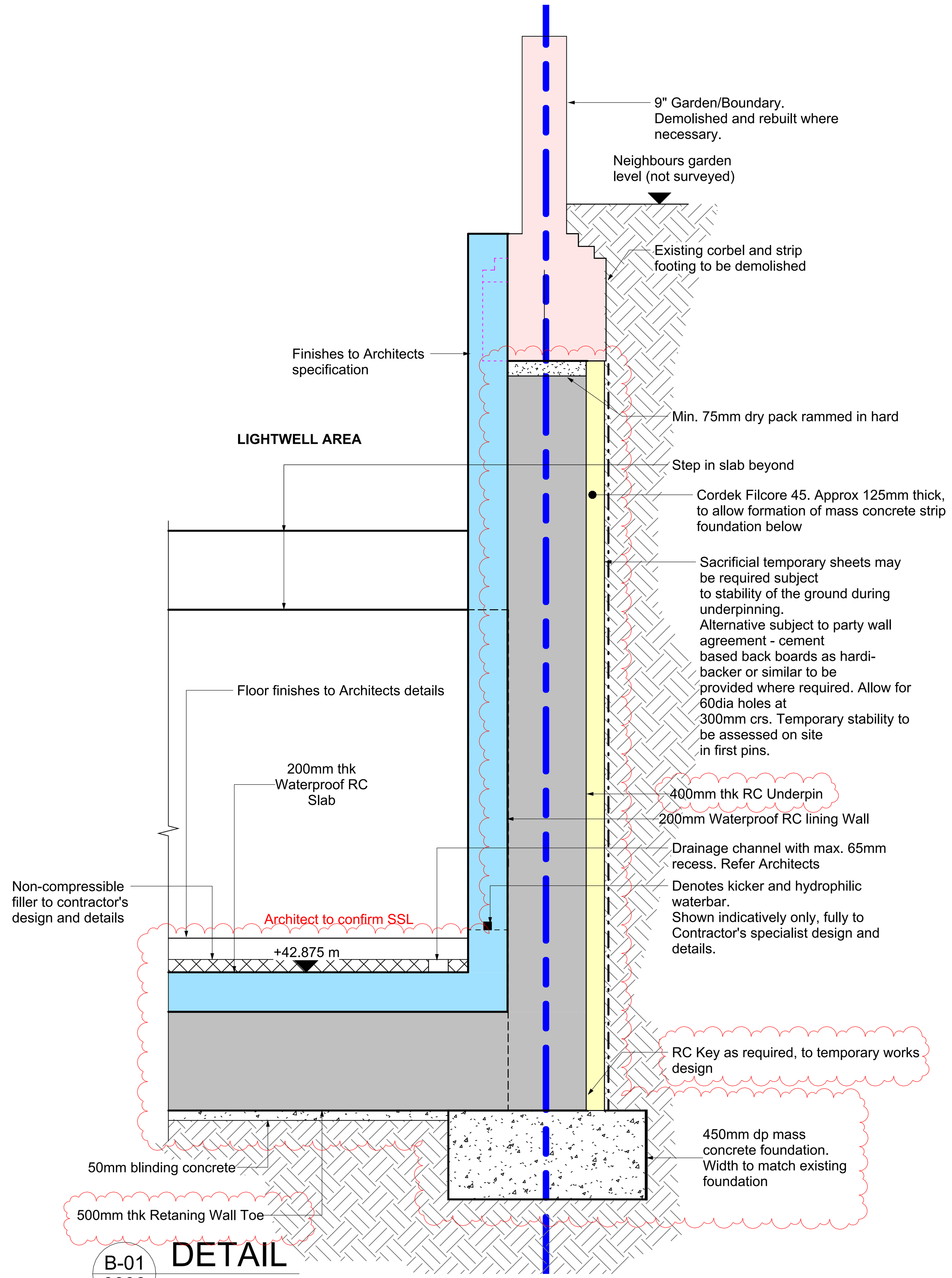
Also refer to notes on drawings and schedules for reinforcement allowance information

IMPORTANT CDM/H&S NOTE

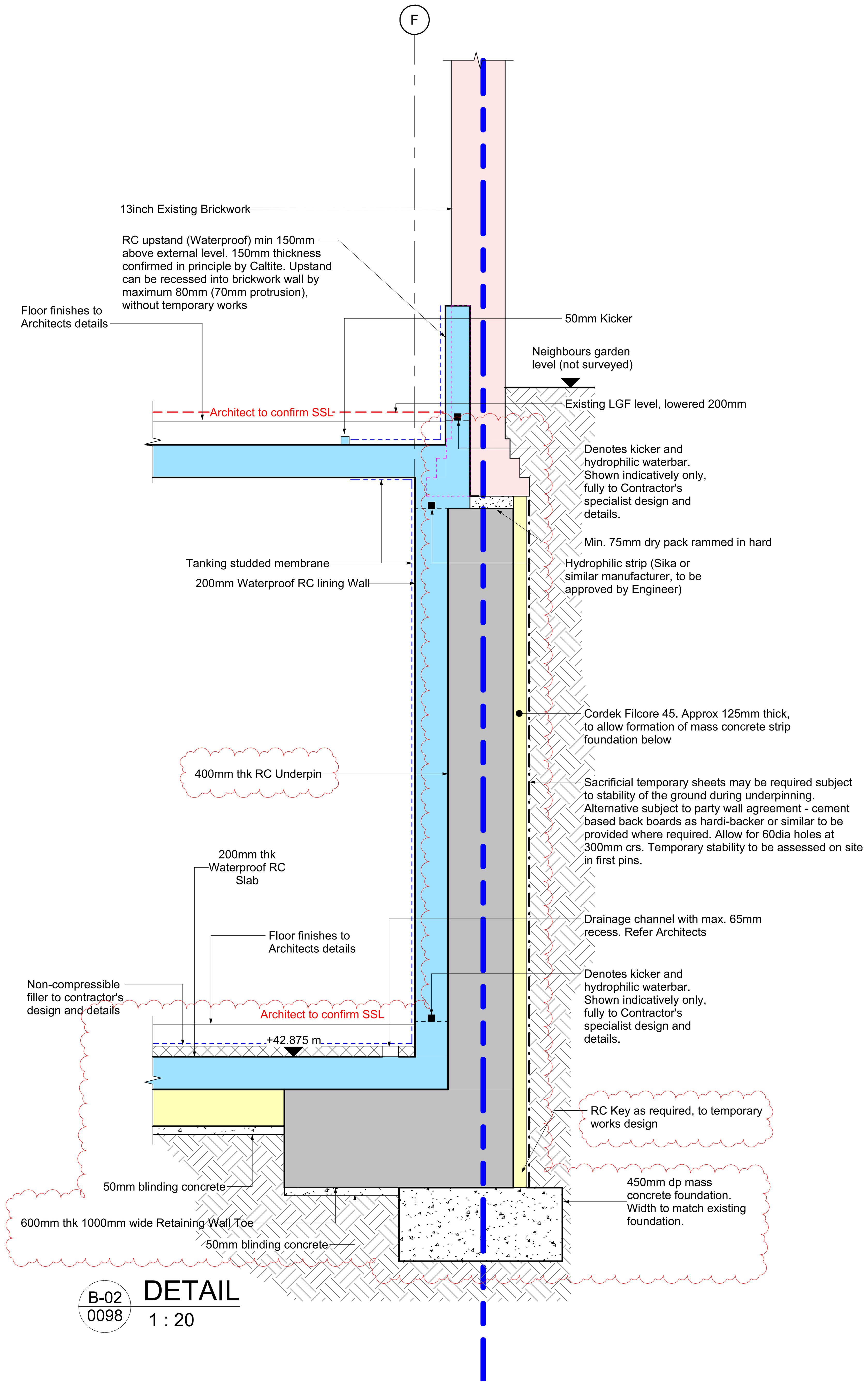
The designers highlight the significant Residual Health and Safety risks that have not been eliminated from the designs. These significant Residual Risks are identified below. This note refers to significant residual risks as defined in CDM legislation. Other health and safety risks associated with construction activities may be present.

- Soil investigation found lead in soil, landscape to provde clean cover system
- Trimming steel installation /cutting of existing beams & slab
- Contractor to ensure adequate temporary works.
- Maximum loading out of existing floor slab to be 150kg/m²
- Temporary prop to existing stair for lift cut out and installation
- Temporary works to boundary to be agreed

NOTES:
1. If in doubt, please ask.
2. Do not scale this drawing. Any discrepancies are to be reported to the engineer immediately.
3. All dimensions in millimetres, unless noted otherwise.
4. All dimensions and levels are to be checked on site by the contractor prior to preparing any working drawings or commencing on site.
5. The contractor must ensure and will be held responsible for the overall stability of the building/structure/excavation at all stages of the work.
6. All work by the contractor must be carried out in such a way that all requirements under the health and safety at work act are satisfied.
7. All work is to be carried out in compliance with the requirements of the relevant statutory authorities and regulations.
8. **To be read in conjunction with General Notes Drg.No.** 21142-ASL-ZZ-XX-DR-S-0001.



B-01 0098 **DETAIL** 1 : 20



B-02 0098 **DETAIL** 1 : 20

HORIZONTAL AND VERTICAL CONSTRUCTION JOINTS OF ALL WATERPROOF CONCRETE IN THE BASEMENT TO BE FITTED WITH HYDROPHILIC STRIPS TO CONTRACTORS WATERPROOFING DESIGN AND DETAILS.

Rev	Date	Amendments	By	Chkd
C4	04.01.23	0210 - RC underpin thickness increased	JA	PG
C3	23.11.22	Slab thickness increased, Party wall updates	JA	PG
C2	10.08.22	Detail updated	JA	PG
C1	01.08.22	Construction Issue	JA	PG

FOR CONSTRUCTION

AXIOM STRUCTURES
+44 (0)20 3637 2751
office@axiom-structures.co.uk
www.axiom-structures.co.uk

Client:
PRIVATE

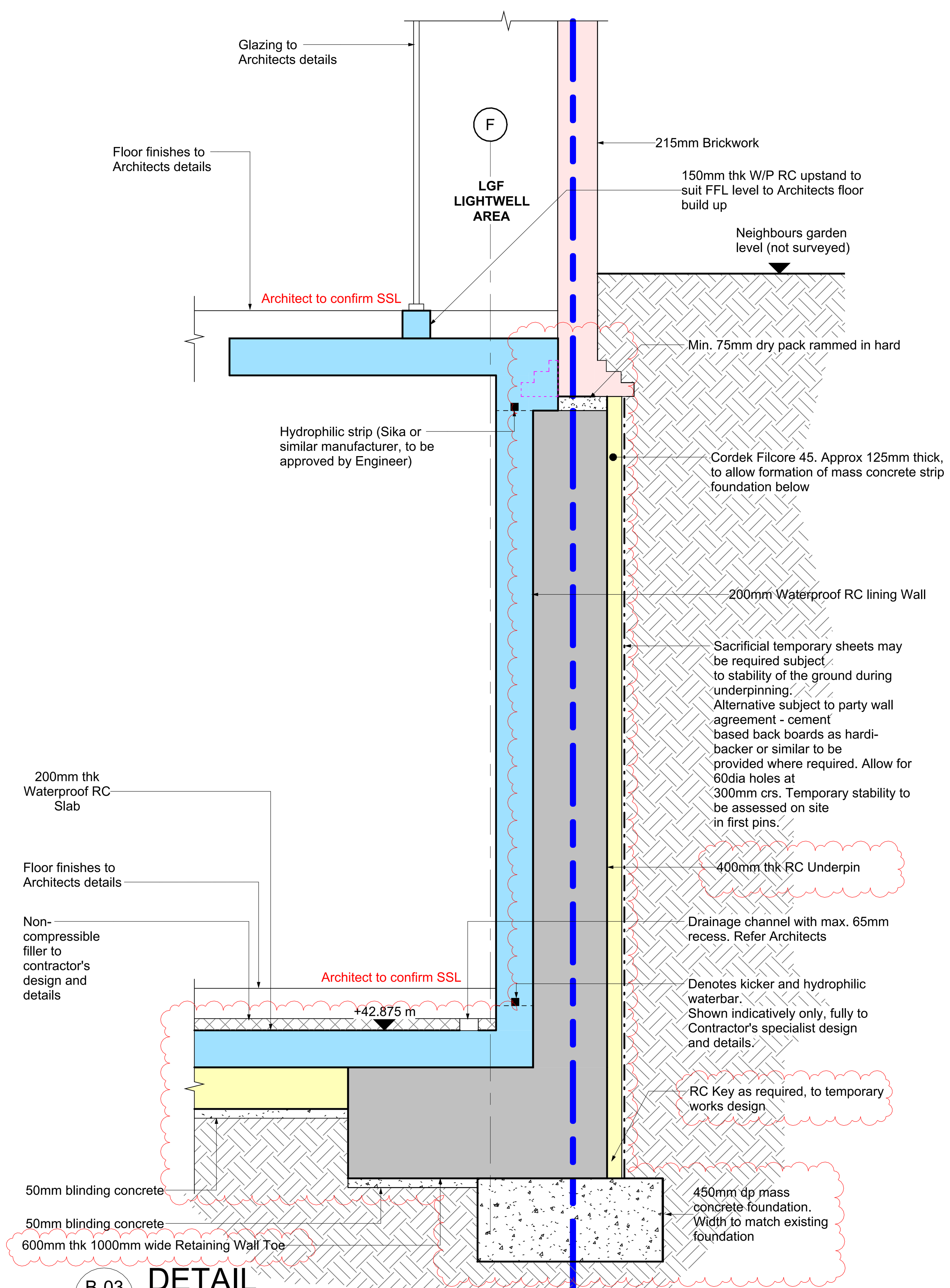
Project:
42 ELSWORTHY ROAD, NW3 3DL

Drawing title:
PARTY WALL SECTION SHEET 1

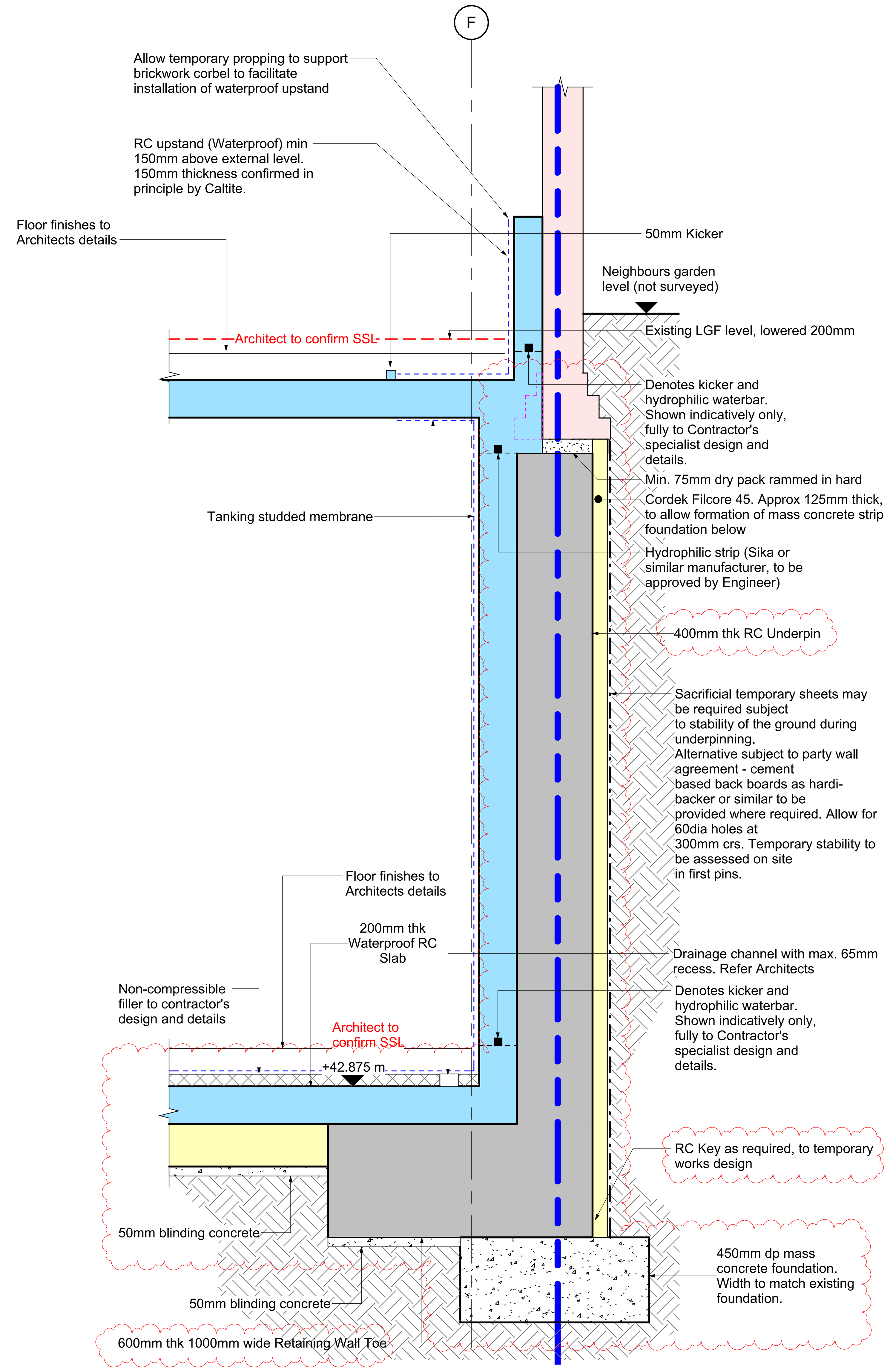
Date: 03/2022
Scale at A1: 1 : 20
Scale at A3:
Drawn by: JA
Designed by: PG
Chk'd by: AB

PROJECT	ORIGINATOR	ZONE	LEVEL	TYPE	ROLE	NUMBER	REVISION
21142	- ASL -	ZZ	- ZZ -	DR -	S -	0210 -	C4

NOTES:
1. If in doubt, please ask.
2. Do not scale this drawing. Any discrepancies are to be reported to the engineer immediately.
3. All dimensions in millimetres, unless noted otherwise.
4. All dimensions and levels are to be checked on site by the contractor prior to preparing any working drawings or commencing on site.
5. The contractor must ensure and will be held responsible for the overall stability of the building/structure/excavation at all stages of the work.
6. All work by the contractor must be carried out in such a way that all requirements under the health and safety at work act are satisfied.
7. All work is to be carried out in compliance with the requirements of the relevant statutory authorities and regulations.
8. **To be read in conjunction with General Notes Drg.No.** 21142-ASL-ZZ-XX-DR-S-0001.



B-03 / 0098 DETAIL 1 : 20



B-07 / 0098 DETAIL 1 : 20

HORIZONTAL AND VERTICAL CONSTRUCTION JOINTS OF ALL WATERPROOF CONCRETE IN THE BASEMENT TO BE FITTED WITH HYDROPHILIC STRIPS TO CONTRACTORS WATERPROOFING DESIGN AND DETAILS.

Rev	Date	Amendments	By	Chkd
C4	04.01.23	0211 - Detail omitted, RC underpin thickness updated	JA	PG
C3	23.11.22	Slab thickness increased, Party wall updates	JA	PG
C2	10.08.22	Detail updated	JA	PG
C1	01.08.22	Construction Issue	JA	PG

FOR CONSTRUCTION

AXIOM STRUCTURES
+44 (0)20 3637 2751
office@axiom-structures.co.uk
www.axiom-structures.co.uk

Client:
PRIVATE

Project:
42 ELSWORTHY ROAD, NW3 3DL

Drawing title:
PARTY WALL SECTION SHEET 2

Date: 03/2022	Scale at A1: 1 : 20	Scale at A3:
Drawn by: JA	Designed by: PG	Chk'd by: AB

PROJECT	ORIGINATOR	ZONE	LEVEL	TYPE	ROLE	NUMBER	REVISION
21142	ASL	ZZ	ZZ	DR	S	0211	C4