masonclarkassociates
civil and structural engineering consultants

1990–2020
30 YEARS IN SERVICE

REBUILDING AND STRENGTHENING TO RETAINING WALL AT ST ANDREW'S CHURCH, KIRBY MALZEARD

HERITAGE STATEMENT

Commissioned by

Harrogate
BOROUGH COUNCIL

Report 18523-Y-RP-003

Rebuilding and strengthening to retaining wall
St Andrew's Church, Kirkby Malzeard
STRUCTURAL APPRAISAL REPORT

CONTENTS

ISSUE LOG FOR REPORT 18523-Y-RP-003

Rev	*Date*	*Description*	*Author*	*Checked*
R0	21st July 2020	**FIRST ISSUE**	MEA	GFP

Issuing office Mason Clark Associates (York). Refer to final page for full office details.

1 INTRODUCTION

1.1 Overview

1.1.1 The project relates to a 40m long length of the churchyard retaining wall at St Andrew's Church, Kirkby Malzerd, North Yorkshire. The church is Grade 1 listed and the boundary wall is listed by virtue of curtilage.

1.1.2 The northern 10m is to be rebuilt following collapse and the southern 30m section is to be repaired and restrained.

1.1.3 Phase 1 of the scheme is to provide lateral support to the 30m section by installing self-drilled passive soil nail anchors.

1.1.4 Phase 2 of the scheme is to rebuild the collapsed section of wall. This will be 500mm thick and consist of an 85mm thick mesh reinforced cavity construction with reclaimed stone face outer leaf and 215mm thick concrete blockwork inner leaf, built off a 850mm wide reinforced strip foundation. Lateral support to the wall will be provided by passive soil nail anchors. The outerface stonework will be rebuilt with a slight outward bulge to align with the section being retained which will aesthetically assist blending in the rebuilt section of wall with the retained section.

1.2 Purpose

1.2.1 Mason Clark Associates have been commissioned to produce this document as part of the forthcoming application for listed building consent and Faculty approval to undertake the remedial works described above.

1.2.2 The purpose of this document is to provide the Local Planning Authority and Faculty with the necessary and appropriate information that will inform the proposals.

1.2.3 It is produced in response to the policies set out in Paragraph 189 of the National Planning Policy Framework, as it states;

In determining applications, local planning authorities should require an applicant to describe the significance of any heritage assets affected, including any contribution made by their setting. The level of detail should be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance. As a minimum the relevant historic environment record should have been consulted and the heritage assets assessed using appropriate expertise where necessary. Where a site on which development is proposed includes, or has the potential to include, heritage assets with archaeological interest, local planning authorities should require developers to submit an appropriate desk-based assessment and, where necessary, a field evaluation.

1.2.4 This document has been commissioned by Mask Coston of Harrogate Borough Council who are the applicants in this case. This document is for the sole purpose for which it has been commissioned and is to be read in conjunction with other application and supporting documents.

1.3 The Author

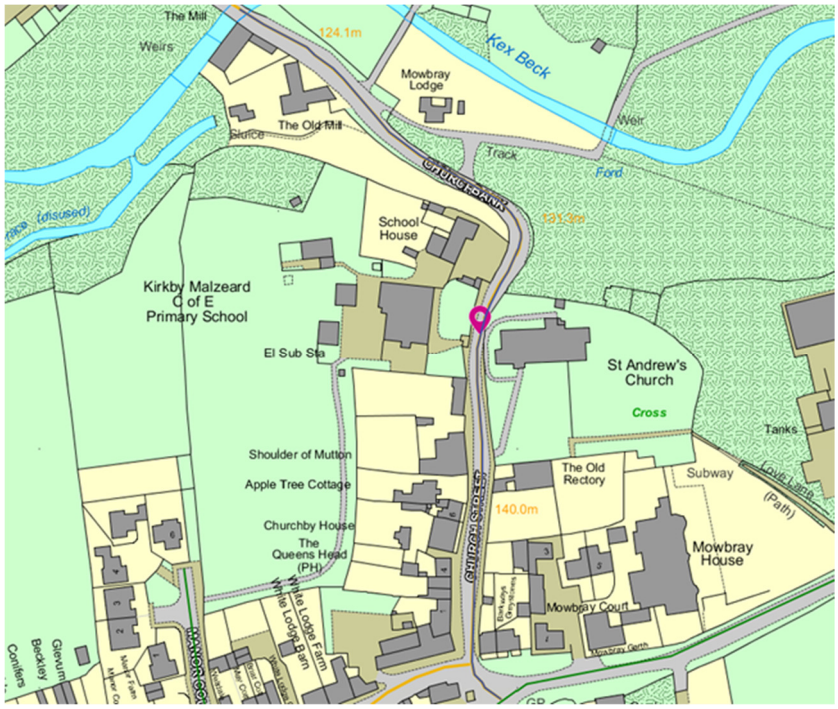
1.3.1 The author if this document, Mark Acey BSc. (Hons) MRICS, is a Chartered Building Surveyor.

1.3.2 The scheme of works is under the supervision of Gez Pegram BSc (Hons) CEng FIC MIStructE, who is a Chartered Engineer Accredited in Building Conservation.

2 LOCATION AND DESCRIPTION

2.1 Site Location

2.1.1 The church of St Andrew's is located in the village of Kirkby Malzeard, North Yorkshire. The church is centred at approximately National Grid Reference SE23547 74527 and is surrounded on all sides by its churchyard.



2.2 Description

2.2.1 The wall that is subject to this programme of works forms the western boundary of the churchyard alongside Church Street (becoming Church Bank at the north end). At the southern end the wall is approximately 1m in height and the churchyard and external street ground levels are comparable. As the wall continues further to the north the adjacent street descends downhill so that by the northwest corner of the churchyard wall is approximately 4m in height and the churchyard ground level is over 3m above street level. This highest section at the north end is the location of the recent collapse. A 30m section between the collapse and the church exhibits an outward bulge and requires remedial lateral restraint to prevent further movement.

Collapsed section to north corner

View look north along the street

3 HERRITAGE DESIGNATIONS

3.1 The Church of St Andrew's is a Grade 1 Listed Building. The listing description, List Entry ID 1173967) includes the following:

Church. C12, C13, C15 and restoration in 1908 after a fire. Coursed squared stone, ashlar with lead roofs. West tower, nave with north aisle and south porch, chancel with north aisle. West tower: C15, 3 stages, plinth with carved frieze, full-height offset diagonal buttresses and buttressed stair tower rising to second stage. First stage: large Perpendicular traceried 3-light pointed arched west window with hoodmould. Second stage: a small one-light ogee-headed opening to south. Band. Belfry windows, basket arched, with 3 chamfered cusped lights and hoodmould, embattled parapet with pinnacles to corners. Nave: C13, 3 bays. Plinth, offset angle buttress to east. To west bay a gabled C13 porch with diagonal offset buttresses. Chamfered pointed arched doorway with hoodmould, to top of gable a sundial. Board inner door in C12 surround; 2 orders of columns with scalloped capitals, 3 orders of arches with zigzag decoration. Other bays have 2-light 4-centred arched Perpendicular traceried windows with hoodmoulds. Plain parapet, stone coping. Gable cross. North aisle similar. Chancel: 4 bays, plinth, diagonal offset buttress to east, between central bays an offset angle buttress. Windows similar to those in nave but slightly larger. To left of central buttress a board priests door in C13 chamfered pointed arched surround with a hoodmould. Plain parapet, stone coping, gable cross. East windows: large 5-light Perpendicular 4-centred arched traceried chancel window with hoodmould. To north aisle 2 rectangular deeply chamfered windows with hoodmoulds, one above the other. Interior: arcade of 7 bays, C13, circular piers, doublechamfered pointed arches. Chancel arch similar but the south jamb is C12. In chancel is C13 sedilia of 3 seats with buttresses, ogee arches; piscina of same date. Nave and chancel have good hammer beam roofs of 1908, good oak seats and fittings of same date. The east end of the north aisle forms a chapel with Thomson (Mouseman) furniture and panelling. To wall at east, 2 blocked up C13 lancet windows. In the vestry fragments of C15 stained glass, including parts of figures.

3.2 In addition to the Grade I church itself the churchyard contains a number of listed associated monuments (four funerary monuments - List UIDs 1150511, 1173993, 1150469 and 1150512 and a medieval cross - 1295957). These are all located to the south and southeast of the church.

4 HISTORICAL AND ARCHAELOGICAL IMPACT ASSESSMENT

4.1 The proposed remedial and rebuilding works to the wall are required to prevent further damage and disturbance to the churchyard and safeguard the highway. The remedial works have been designed specifically to minimise disturbance of the existing wall and churchyard. See Mason Clark Options Appraisal Report enclosed within Appendix A which explores the remedial options considered and reasoning behind the chosen design option.

4.2 The works will however cause some further disturbance to the graveyard in the north corner and to the wall at the junctions with the section to be rebuilt. To mitigate this, the works will be subject to an Archaeological Watching Brief which will ensure any archaeological deposits that might be uncovered are recorded and that if any human remains are disturbed are treated appropriately. See enclosed Archaeological Watching Brief Method Statement within Appendix B.

4.3 The area of wall to be rebuilt will be faced with salvaged stone with coursing details to match the original wall. The mortar will be NHL 3.5 with an aggregate mix to existing areas. The wall will not be rebuilt plumb but will incorporate a slight outward bulge to assist with blending into the existing wall.

4.4 The soil nail pattress plates will be recessed into the wall because of their proximity to the street. The proposal is that these will be painted in a mid-grey colour to closely match the general colour of the stonework.

5 THE WORKS

5.1 Gravestones and memorials close to the area of collapse are to be carefully relocated for safekeeping during the contract and reinstatement on completion under the supervision of the appointed Archaeologist.

5.2 Removal of the loose materials including damaged and collapsed stonework. Stonework to be retained for use in the re-built wall. Following check for local services, the soil nailing can commence beginning with the stabilisation of the existing wall then continuing to include the collapsed section of wall. The wall is to be carefully monitored and temporary shoring introduced if the soil nailing is found to be causing any movement in the existing wall.

5.3 Once the pattress plates have been fitted and grouted to the existing wall the end adjacent to the ends adjacent to the collapsed section will be carefully dismantled to foundation level in preparation for rebuilding the collapsed section.

5.4 The reinforced masonry wall should be constructed from a new concrete foundation in maximum lifts of 800mm between concrete cavity filling. The new wall is to include weep holes to prevent build-up of water behind the wall. The pre-installed soil nails and face pattress plates can be incorporated into the wall as the work progresses. Backfilling behind the wall with clean granular material should be carried out on completion of the wall when the concrete cavity fill of the reinforced masonry has gained its 28 day strength. The stone outer face is to be rebuilt using salvaged stone so far as possible with course sizing to match the adjoining wall. All stonework rebuilding is to be carried out using a Hydraulic Lime Mortar 1:3 using a moderately hydraulic lime NHL 3.5and well grades aggregates from 2.5mm to 75 microns. All aggregates to be to BS EN 13139:2002 and to be well grades, non-staining, clean, sharp, coarse sand uncontaminated by clay and silt. All rebuilding work to be carried out during a period of suitable weather so as to avoid high and low temperatures. The curing of the completed pointing and rebedding is to be managed to prevent it from drying too quickly. This is to be carried out by protecting the pointing with suitable sheeting and applying water using a hand pump or pump action spray to dampen the repointing and surrounding stone to ensure it does not cure too fast. This process should be carried out for a minimum period for one week after the rebuilding or pointing as occurred. All mortar joints are to have a recessed joint rather than a struct or flush finish. The surface of the joint is to receive stipple finish by using a churn brush to stipple the surface of the joint.

5.5 The road surfacing is reinstated on completion. A building regulation compliant handrail/guard rail is to be installed behind the top of the wall to provide edge protection. The churchyard grass is to be re-seeded and any disturbed gravestones and memorials reinstated.

6 DRAWINGS AND DOCUMENTS

6.1 List of documents and drawings (including numbers) accompanying the submission:

Mason Clark Associates

18523-Y-DR-400	Location Plan
18523-Y-DR-401	Elevations
18523-Y-DR-402	Sections & Details

Byland Soil Nailing

2099-001	Soil Nail Layout
2099-002	Soil Nail Details
2099	Soil Nail Design Calculations

Signed on behalf of Mason Clark Associates (York):

Mark Acey *BSc (Hons) MRICS*
Senior Building Surveyor

Gez Pegram *BSc (Hons) CEng FICE MIStructE*
Design Team Leader

9 LIMITATIONS

9.1 Our inspection and report are concerned with the structural aspects of the building such as foundations, walls and floors. We have not concerned ourselves with the condition of items such as doors, windows, and other fittings; or items such as timber infestation / decay, dampness, and testing of services to the property, unless specified in the report.

9.2 Sampling and testing of materials is beyond the scope of this report.

9.3 We have not inspected woodwork or other parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect.

9.4 This report is applicable to the condition and state of the building at the time of inspection. The building may be subject to deterioration in the future and the opinions expressed in this report may need to be revised accordingly.

9.5 This report is limited to the property under consideration. It does not consider the effects that adjoining properties may have, unless with prior agreement, a detailed inspection of all adjoining properties can be made.

9.6 The above recommendations do not constitute a full list of works to be carried out and refer to the main areas of work associated with structural aspects of the building, based on a visual inspection only and under the limitations of our inspection.

9.7 All building and construction works are covered by the requirements of the CDM regulations. Owners/Clients have legal responsibilities to engage persons and companies with appropriate level of skills knowledge and experience to ensure that the requirements of the CDM regulations are met. The works required will be covered by the CDM regulations 2015 and you should understand your obligations and act accordingly.

9.8 Unless specifically mentioned no comment is made in the report as to the presence of new or old mine workings or tunneling, heavy metals, chemical, biological, electromagnetic or radioactive contamination or pollution, or radon methane or other gases, underground services or structures, springs and water courses, sink holes or the like, noise or vibratory pollution, mould, asbestos and asbestos products.

9.9 The report has been prepared for the client alone and no third party should rely on it. For the avoidance of doubt, the Contracts (Rights of Third Parties) Act 1999 shall not apply to this contract.

9.10 The inspection and report will not include any liability in respect of Advice/Design in fire safety to the structure and/or any liability whatsoever in respect of any losses (whether direct or

indirect) arising from combustibility of cladding in delivery of our Services. We shall not be liable for that part of any claim which relates to loss of profits, loss of use, loss of production, loss of contract, liquidated damages or for any cost of decamping or rehousing.

APPENDIX A

MASON CLARK ASSOCIATES OPTION STUDY

(Under Separate Cover)

APPENDIX B

DRAWINGS & DESIGN DOCUMENTS

List of drawings:

Mason Clark Associates

18523-Y-DR-400	Location Plan
18523-Y-DR-401	Elevations
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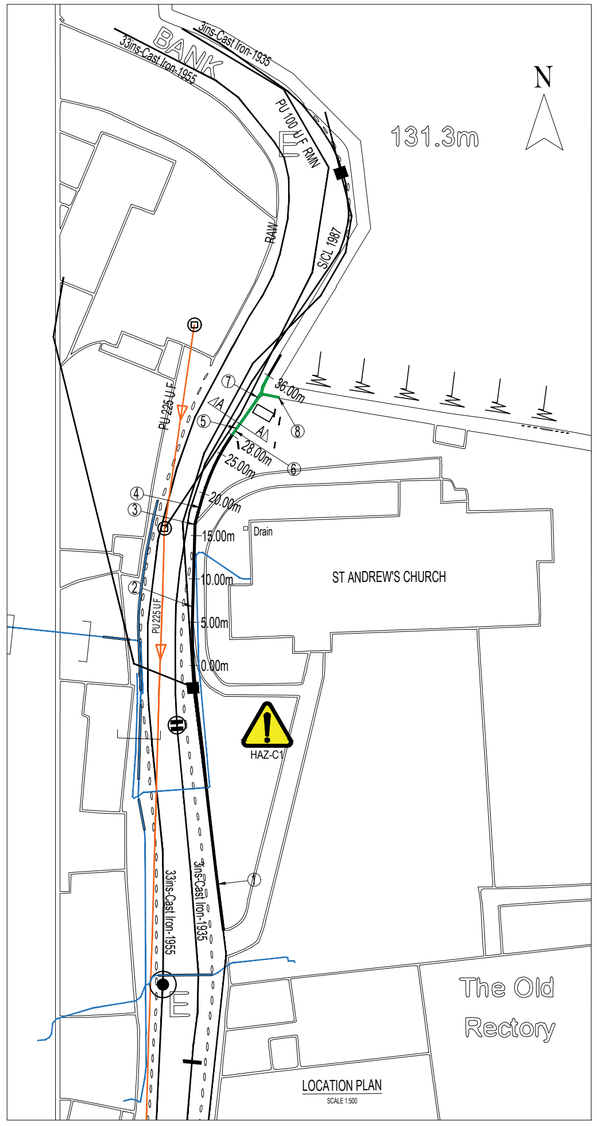

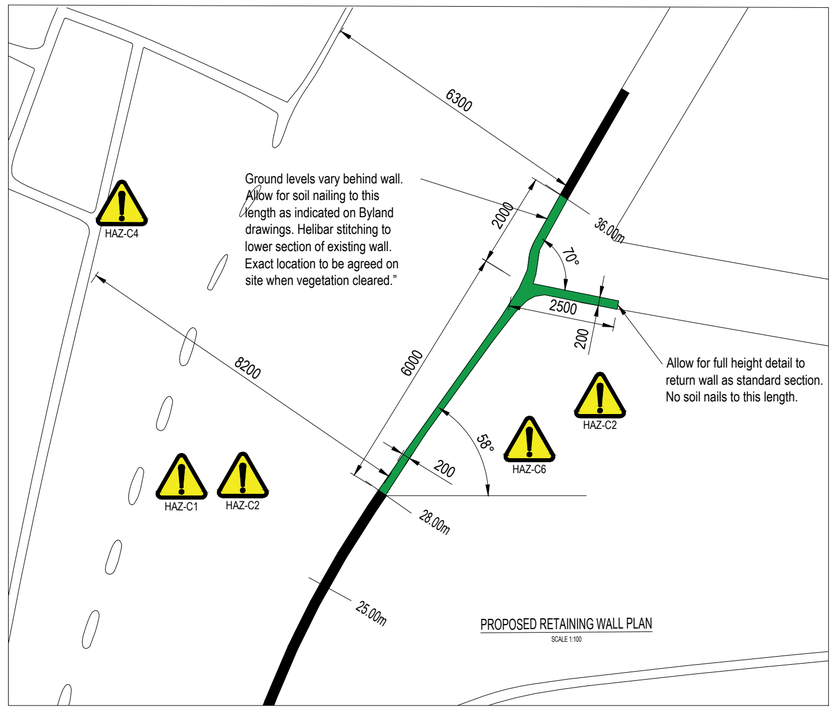

KEY:

- Retaining Wall
- Collapsed section
- Yorkshire Water services
- Yorkshire Water services
- Yorkshire Water services
- Yorkshire Water services
- LV Power Grid services
- BT services

NOTE: Prior to excavation, exact location and depth of underground services TBC on site.

OBSERVATIONS

1- Impact damage - Past repair
2- Bulge in wall + loose pointing
3- Weep hole discharging water
4- Tree growing from wall - Since Removed
5- Vegetation and loose pointing - Past Repair
6- Loose and hollow stonework
7- Cracking and bulging at low level and Ivy at high level
8- Partial collapsed wall

Health & Safety Information

In addition to the hazards and risks normally associated with the type of works detailed on this drawing, please note the following abnormal risks to Health & Safety.

Refer to Mason Clark Associates project specific Design Risk Assessment (DRA).

Construction Phase

HAZ-C1	**Working Adjacent to Buried Services:** Although no clash with services is expected, excavation of foundation can potentially damage the services.
HAZ-C2	**Local Collapse of the Wall:** Areas with crack, excessive bulging, loose pointing and also around current fallen section of the wall may be at risk of further collapse.
HAZ-C3	**Concealed Defects:** Presence of concealed defects could lead to destabilising of the wall during construction. Sequence, method statement and temporary works schedules to be prepared for approval of the Engineer.
HAZ-C4	**Safe Access:** Due to the presence of the school, ensure no covers are unprotected. Also, all areas of unsafe structure to be clearly identified and protected. No entry into excavations which are not sufficiently supported. Only appropriately trained operatives to enter confined spaces.
HAZ-C5	**Water Ingress:** Water ingress is possible and suitable de-watering or pumping techniques may be required, to be proposed and designed by the Contractor for approval, following site investigation.
HAZ-C6	**Slope Instability:** Where the wall collapsed, due to the ground movement, slope instability may occur which would require the Contractor to use soil stabilisation techniques.

Demolition Phase

	Sequencing of demolition to be agreed by the Engineer.

It is assumed that all works will be carried out by a competent contractor working where appropriate to an approved method statement. Only appropriately trained and qualified operatives to work on site.

Structural Masonry Notes

1. The works shall be constructed in accordance with Eurocode 6 with class 2 execution control.
2. All blockwork to be medium dense aggregate blocks (density 1350kg/m3) with a minimum strength of 7N/mm2 unless noted otherwise.
3. The durability of exposed masonry shall be determined by the Architect.
4. All masonry units shall be certified as Category I by the manufacturer.
5. All mortar to be class M6 below DPC and class M4 above DPC.
6. Cavity wall ties to be stainless steel Type 2 ties (eg. Ancon Staifix RT2 or similar) unless noted otherwise. The tie spacing shall be generally 900mm horizontal x 450mm vertical centres.
7. Additional ties shall be incorporated at 225mm vertical centres within 225mm of a reveal or movement joint and at 450mm horizontal centres within 225mm of a window head or cill.

Concrete General Notes

1. All concrete works shall be in accordance with the National Structural Concrete Specification.
2. All concrete to be grade:

Blinding	GEN 1
Underpinning	FND 2
Floor slabs	RC 30
Retaining walls	RC 40

3. The contractor shall allow for making and testing concrete cubes at a rate of three cubes per day per type of concrete mix being poured. The testing shall be undertaken by a UKAS accredited testing house. Records shall be made available to Mason Clark Associates.
4. Finishes to concrete elements to be in accordance with the NSCS. The minimum requirements unless noted otherwise on the drawings shall be:

   Formed finishes
   Exposed faces of walls, soffits of slabs & columns - Plain
   Non-exposed or faces to receive finishes - Ordinary

   Unformed finishes
   Surfaces inc. slabs to receive no finishes - Plain
   Surfaces inc. slabs to receive applied finishes - Ordinary
5. All formwork and temporary propping to be designed and detailed by the contractor.
6. The contractor shall submit their proposals to MCA for pouring sequence, timescales for concrete curing, striking of formwork, back propping of slabs etc...
7. For tender purposes allow the following reinforcement.

Retaining Walls	150kg/m^3

Reinforcement Notes

1. Nominal cover to reinforcement (tolerance 10mm):

Top and sides	40 mm
Bottom	40 mm

2. All reinforcement shall be grade B500B, deformed Type 2 unless noted otherwise.
3. All reinforcement to be tied with 16 gauge black annealed iron wire.
4. The contractor shall provide suitable proprietary stools, spacers and chairs as necessary to provide adequate support to the reinforcement and to maintain the specified cover during casting and compaction.
5. If the contractor wishes to prefabricate reinforcement cages they include for any additional diagonal bracing bars etc... to suit their lifting arrangement to ensure the cages do not deform during lifting and placing.
6. Tension laps shall be a minimum of 40 x bar diameter but minimum 400mm.
7. The laps in mesh shall be 400mm. All mesh to be flying end to avoid multiple layering at lap locations.
8. The contractor shall note that mesh, dowels, anti-crack bars etc... are not scheduled and these shall be scheduled and ordered to suit by the main contractor.
9. The spacing of reinforcement may be locally adjusted to allow for cast in inserts, recesses, holding down bolts etc...

Foundation Notes

1. All concrete works shall be in accordance with the National Structural Concrete Specification.
2. All RC foundations to be cast on a minimum of 50mm concrete blinding.
3. All foundation concrete to be grade FND2.
4. The contractor shall allow for making and testing concrete cubes at a rate of three cubes per day per type of concrete mix being poured. The testing shall be undertaken by a UKAS accredited testing house. Records shall be made available to Mason Clark Associates.
5. Finishes to concrete elements to be in accordance with the NSCS. The minimum requirements unless noted otherwise on the drawings shall be:

   Formed finishes
   Exposed faces of walls, soffits of slabs & columns - Plain
   Non-exposed or faces to receive finishes - Ordinary

   Unformed finishes
   All foundations & below ground structures - Basic
   Surfaces of exposed slabs and bases - Ordinary

   Note: Internal building and external concrete pavements and hardstandings may be subject to specialist finishes. Refer to the relevant Mason Clark Associates drawings for details.
6. Cover to reinforcement shall be 50mm all round unless noted otherwise on the drawings.
7. All holding down bolts to be provided by steel fabricator for casting in to foundations by ground work contractor. The ground work contractor shall allow for making up bolt assemblies including cones, washer plates etc... and to fix in place prior to concrete pour.
8. All DPC's, DPM's and tanking are to be in accordance with the architect's details.
9. For tender purposes allow the following reinforcement.

Pile Caps	125kg/m3
Ground beams	150kg/m3
Retaining Walls	150kg/m3

Scaffolding Notes

1. Scaffolding should allow caps to tie bars or compressible packing to minimise damage to masonry. All fixings into stone or facework should be minimised. Where unavoidable, these should be taking into masonry joints rather than into facework.
2. Scaffold and access proposals to be reviewed by MCA prior to installation.
3. Check for voids or buried services prior to erection & re-locate standards or provide transfer structures / spreaders as necessary.

General Notes

1. Where not stated elsewhere, the minimum standards to be adopted are those given in BS 8000 and the Building Regulations.
2. No allowance has been made for holes, chasings, notches or inserts unless specifically detailed on the drawings. All service entry points, supports etc... are to be agreed prior to works commencing.
3. For existing and proposed services locations and any diversions refer to the Architect / M&E Engineers drawings.
4. The contractor shall site measure all existing structures prior to any works commencing and report any discrepancies in writing to Mason Clark Associates.
5. All temporary works are to be designed and detailed by the main contractor.

Drainage Notes

1. All private drainage works are to be constructed in accordance with the relevant provisions of BS EN 752 including by reference BS 8301, Building regulations part H and Sewers for Adoption 6th edition.
2. The Contractor MUST confirm invert levels of existing points of connection prior to commencement of drainage works.
3. Manhole invert levels relate to the downstream pipe. Pipes at manholes to be laid soffit to soffit level.
4. Unless otherwise shown, foul pipes to be 100mm Ø laid at 1 in 40 minimum gradient unless one w.c. connected where gradient may be 1 in 80 minimum.
5. Unless otherwise shown surface water pipes to be 150mm Ø laid at 1 in 100 minimum gradient.
6. Where cover to top of pipe barrel is less than 900mm in lightly trafficked areas and 600mm in non trafficked areas, pipe to have minimum 150mm ST4 concrete surround.
7. Where cover to pipe barrel located beneath highways is less than 1200mm, pipes are to be protected with concrete surround (bed type Z) Grade C20 in accordance with sewers for adoption 6th edition, table 2.4.
8. Manhole cover levels where not shown are to be confirmed at later stage. Covers are to be fixed to a profile corresponding to the surrounding pavement surface and may be adjusted to suit actual site levels.
9. All pipework up to 300mm Ø to be standard strength vitrified clay to BS EN 295 (min crushing strength 40KN/m) or plastic to BS 4660:2000 and BS EN 1401-1:1998 and shall comply with the requirements of Sewers for Adoption 6th Edition.
10. Bedding to all pipework to be Class S granular bed & surround in accordance with BS882 or Class Z (see manhole schedule and/or details drawing).
11. All backfill above gravel surround in drainage trenches and under building slabs to be Type 1 stone compacted in layers not exceeding 225mm thick.
12. Manholes to be precast concrete to BS EN1917: 2002, Type B, in accordance with the requirements of Sewers for Adoption, 6th Edition unless noted otherwise.
13. Inspection chambers to be polypropylene, 475mm diameter, Hepworth range or similar & approved. Opening restricted to max 350mm where depth of chamber exceeds 1.2m.
14. All manholes covers and gully gratings located in trafficked areas to be ductile iron class D400. Covers located in non trafficked areas to be min class B125 unless noted otherwise on the drainage layout or manhole schedule.
15. Any external recessed cover required or internal manhole covers to be specified by the Architect.
16. Position and details of rainwater pipes, and foul connections to be confirmed by Architect.
17. For above ground and internal drainage, vents, fittings and access points refer to Architects and/or M&E details.
18. Cover levels of private drainage chambers may be adjusted to suit actual site levels.
19. The contractor is responsible for identifying and locating all existing services and ensuring that the levels do not conflict with the proposed drainage system. If there are any such conflicts then the Engineer must be made aware immediately.
20. All existing redundant drainage systems are to be abandoned and grubbed up including redundant manholes and pipework. The voids are to be backfilled with as dug material or suitable fill material and compacted in layers.
21. Any live sewer connections found in any sewers that are to be abandoned are to be picked up and diverted.
22. The Contractor shall undertake a CCTV survey of the as constructed site drainage system on completion of the works. A copy shall be made available to Mason Clark Associates.

Crack Stitching Notes

1. Minor cracking to be repaired using twisted stainless HeliBars set into bedjoints using HeliBond grout. All works to be carried out to HeliFix recommendations.

   Unless noted specifically:
2. Bars generally 1m long, set centrally about vertical crack location.
3. Bars installed every 2no. courses vertically (maximum 150mm ccs).
4. Bars to be bent to repair corner cracks.
5. Where longer bars are required, lapped HeliBars are acceptable to HeliFix recommendations.
6. Repoint with suitable lime mortar to match the existing surrounding brickwork for colour / texture.

Notes

1. This drawing is subject to copyright and must not be reproduced, stored or transmitted in any form without prior permission from Mason Clark Associates.
2. This drawing is not to be scaled. All dimensions are to be checked on site by the contractor. Any discrepancies are to be notified to Mason Clark Associates. Obtain instructions prior to works commencing.
3. This drawing is to be read in conjunction with all the relevant contract drawings and specifications.
4. All dimensions are in millimetres and all levels are in metres AOD unless noted otherwise.
5. All work shall be carried out in accordance with Local Authority, Statutory Authority and Health & Safety Regulations.
6. Mason Clark Associates are not responsible for determining the appropriate fire period, fire boundary conditions or the associated design of fire protection or inherent fire resistance to any elements of structure, including all frames, posts, beams, joists, roof members and secondary structural elements such as lintels. Refer to the Architect or Project Manager for this information

Rev	Details	By	Date
T1	Issued for Tender	MK	05.05.2020
P2	Drawing updated - Issued for comment	MK	08.04.2020
P1	Issued for comments.	PP	07.04.2020

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civil and structural engineering consultants

Client.
Harrogate BOROUGH COUNCIL

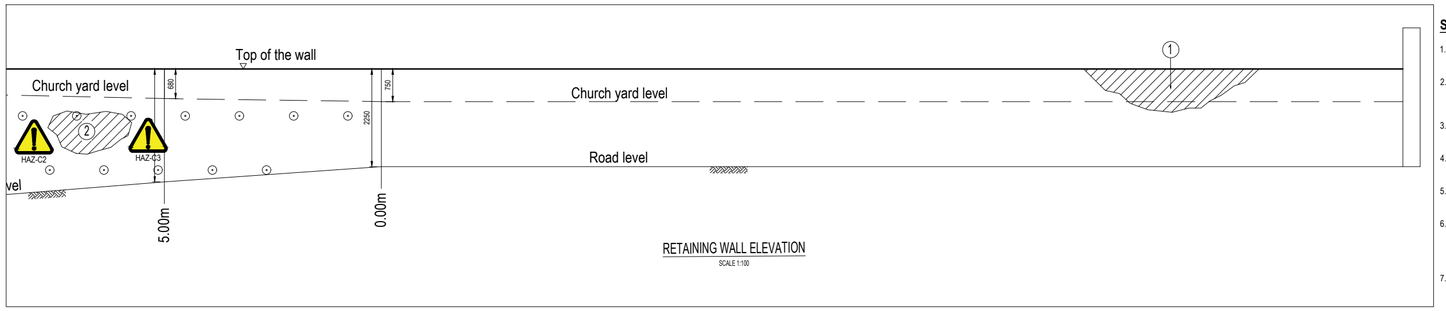
Project.
St Andrew's Church, Kirkby Malzeard

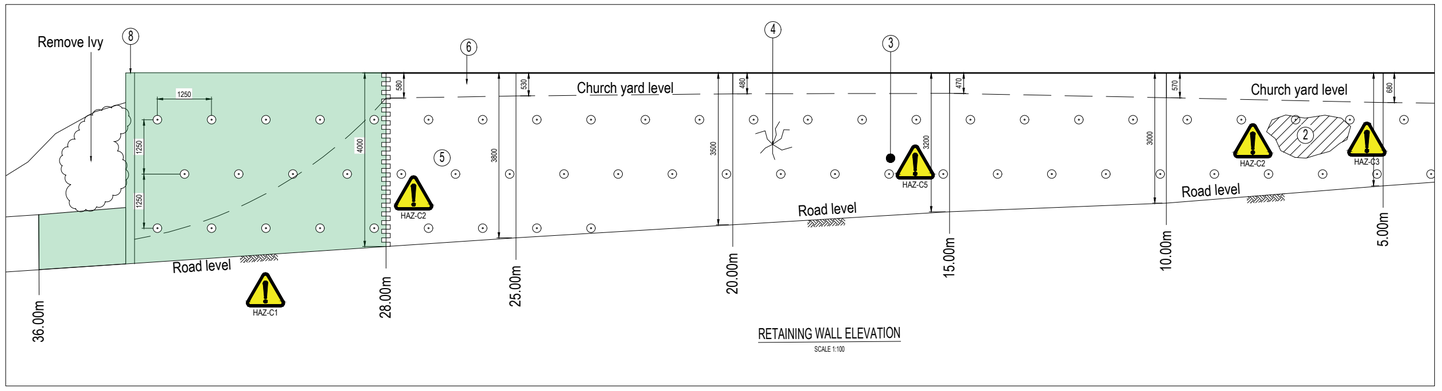
Title.
Location Plan

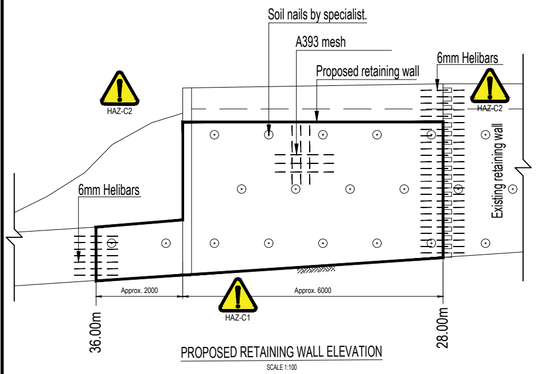
Drawn: PP | Checked: RT | Date: 11.03.2020

Scale @ A2 : As Shown

Drawing No : 18523-Y-DR-400 | Rev: T1

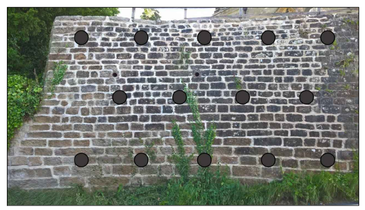






BOUNDARY WALL - BEFORE COLLAPSE

BOUNDARY WALL - CURRENT CONDITION



BOUNDARY WALL - PROPOSED

Structural Masonry Notes

1. The works shall be constructed in accordance with Eurocode 6 with class 2 execution control.
2. All blockwork to be medium dense aggregate blocks (density 1350kg/m3) with a minimum strength of 7N/mm2 unless noted otherwise.
3. The durability of exposed masonry shall be determined by the Architect.
4. All masonry units shall be certified as Category I by the manufacturer.
5. All mortar to be class M6 below DPC and class M4 above DPC.
6. Cavity wall ties to be stainless steel Type 2 ties (eg. Ancon Staifix RT2 or similar) unless noted otherwise. The tie spacing shall be generally 900mm horizontal x 450mm vertical centres.
7. Additional ties shall be incorporated at 225mm vertical centres within 225mm of a reveal or movement joint and at 450mm horizontal centres within 225mm of a window head or cill.

Concrete General Notes

1. All concrete works shall be in accordance with the National Structural Concrete Specification.
2. All concrete to be grade:

Blinding	GEN 1
Underpinning	FND 2
Floor slabs	RC 30
Retaining walls	RC 40

3. The contractor shall allow for making and testing concrete cubes at a rate of three cubes per day per type of concrete mix being poured. The testing shall be undertaken by a UKAS accredited testing house. Records shall be made available to Mason Clark Associates.
4. Finishes to concrete elements to be in accordance with the NSCS. The minimum requirements unless noted otherwise on the drawings shall be:

   Formed finishes
   Exposed faces of walls, soffits of slabs & columns - Plain
   Non-exposed or faces to receive finishes - Ordinary

   Unformed finishes
   Surfaces inc. slabs to receive no finishes - Plain
   Surfaces inc. slabs to receive applied finishes - Ordinary
5. All formwork and temporary propping to be designed and detailed by the contractor.
6. The contractor shall submit their proposals to MCA for pouring sequence, timescales for concrete curing, striking of formwork, back propping of slabs etc...
7. For tender purposes allow the following reinforcement.

Retaining Walls	150kg/m^3

Reinforcement Notes

1. Nominal cover to reinforcement (tolerance 10mm):

Top and sides	40 mm
Bottom	40 mm

2. All reinforcement shall be grade B500B, deformed Type 2 unless noted otherwise.
3. All reinforcement to be tied with 16 gauge black annealed iron wire.
4. The contractor shall provide suitable proprietary stools, spacers and chairs as necessary to provide adequate support to the reinforcement and to maintain the specified cover during casting and compaction.
5. If the contractor wishes to prefabricate reinforcement cages they include for any additional diagonal bracing bars etc... to suit their lifting arrangement to ensure the cages do not deform during lifting and placing.
6. Tension laps shall be a minimum of 40 x bar diameter but minimum 400mm.
7. The laps in mesh shall be 400mm. All mesh to be flying end to avoid multiple layering at lap locations.
8. The contractor shall note that mesh, dowels, anti-crack bars etc... are not scheduled and these shall be scheduled and ordered to suit by the main contractor.
9. The spacing of reinforcement may be locally adjusted to allow for cast in inserts, recesses, holding down bolts etc...

Foundation Notes

1. All concrete works shall be in accordance with the National Structural Concrete Specification.
2. All RC foundations to be cast on a minimum of 50mm concrete blinding.
3. All foundation concrete to be grade FND2.
4. The contractor shall allow for making and testing concrete cubes at a rate of three cubes per day per type of concrete mix being poured. The testing shall be undertaken by a UKAS accredited testing house. Records shall be made available to Mason Clark Associates.
5. Finishes to concrete elements to be in accordance with the NSCS. The minimum requirements unless noted otherwise on the drawings shall be:

   Formed finishes
   Exposed faces of walls, soffits of slabs & columns - Plain
   Non-exposed or faces to receive finishes - Ordinary

   Unformed finishes
   All foundations & below ground structures - Basic
   Surfaces of exposed slabs and bases - Ordinary

   Note: Internal building and external concrete pavements and hardstandings may be subject to specialist finishes. Refer to the relevant Mason Clark Associates drawings for details.
6. Cover to reinforcement shall be 50mm all round unless noted otherwise on the drawings.
7. All holding down bolts to be provided by steel fabricator for casting in to foundations by ground work contractor. The ground work contractor shall allow for making up bolt assemblies including cones, washer plates etc... and to fix in place prior to concrete pour.
8. All DPC's, DPM's and tanking are to be in accordance with the architect's details.
9. For tender purposes allow the following reinforcement.

Pile Caps	125kg/m3
Ground beams	150kg/m3
Retaining Walls	150kg/m3

Scaffolding Notes

1. Scaffolding should allow caps to tie bars or compressible packing to minimise damage to masonry. All fixings into stone or facework should be minimised. Where unavoidable, these should be taking into masonry joints rather than into facework.
2. Scaffold and access proposals to be reviewed by MCA prior to installation.
3. Check for voids or buried services prior to erection & re-locate standards or provide transfer structures / spreaders as necessary.

General Notes

1. Where not stated elsewhere, the minimum standards to be adopted are those given in BS 8000 and the Building Regulations.
2. No allowance has been made for holes, chasings, notches or inserts unless specifically detailed on the drawings. All service entry points, supports etc... are to be agreed prior to works commencing.
3. For existing and proposed services locations and any diversions refer to the Architect / M&E Engineers drawings.
4. The contractor shall site measure all existing structures prior to any works commencing and report any discrepancies in writing to Mason Clark Associates.
5. All temporary works are to be designed and detailed by the main contractor.

Drainage Notes

1. All private drainage works are to be constructed in accordance with the relevant provisions of BS EN 752 including by reference BS 8301, Building regulations part H and Sewers for Adoption 6th edition.
2. The Contractor MUST confirm invert levels of existing points of connection prior to commencement of drainage works.
3. Manhole invert levels relate to the downstream pipe. Pipes at manholes to be laid soffit to soffit level.
4. Unless otherwise shown, foul pipes to be 100mm Ø laid at 1 in 40 minimum gradient unless one w.c. connected where gradient may be 1 in 80 minimum.
5. Unless otherwise shown surface water pipes to be 150mm Ø laid at 1 in 100 minimum gradient.
6. Where cover to top of pipe barrel is less than 900mm in lightly trafficked areas and 600mm in non trafficked areas, pipe to have minimum 150mm ST4 concrete surround.
7. Where cover to pipe barrel located beneath highways is less than 1200mm, pipes are to be protected with concrete surround (bed type Z) Grade C20 in accordance with sewers for adoption 6th edition, table 2.4.
8. Manhole cover levels where not shown are to be confirmed at later stage. Covers are to be fixed to a profile corresponding to the surrounding pavement surface and may be adjusted to suit actual site levels.
9. All pipework up to 300mm Ø to be standard strength vitrified clay to BS EN 295 (min crushing strength 40KN/m) or plastic to BS 4660:2000 and BS EN 1401-1:1998 and shall comply with the requirements of Sewers for Adoption 6th Edition.
10. Bedding to all pipework to be Class S granular bed & surround in accordance with BS882 or Class Z (see manhole schedule and/or details drawing).
11. All backfill above gravel surround in drainage trenches and under building slabs to be Type 1 stone compacted in layers not exceeding 225mm thick.
12. Manholes to be precast concrete to BS EN1917: 2002, Type B, in accordance with the requirements of Sewers for Adoption, 6th Edition unless noted otherwise.
13. Inspection chambers to be polypropylene, 475mm diameter, Hepworth range or similar & approved. Opening restricted to max 350mm where depth of chamber exceeds 1.2m.
14. All manholes covers and gully gratings located in trafficked areas to be ductile iron class D400. Covers located in non trafficked areas to be min class B125 unless noted otherwise on the drainage layout or manhole schedule.
15. Any external recessed cover required or internal manhole covers to be specified by the Architect.
16. Position and details of rainwater pipes, and foul connections to be confirmed by Architect.
17. For above ground and internal drainage, vents, fittings and access points refer to Architects and/or M&E details.
18. Cover levels of private drainage chambers may be adjusted to suit actual site levels.
19. The contractor is responsible for identifying and locating all existing services and ensuring that the levels do not conflict with the proposed drainage system. If there are any such conflicts then the Engineer must be made aware immediately.
20. All existing redundant drainage systems are to be abandoned and grubbed up including redundant manholes and pipework. The voids are to be backfilled with as dug material or suitable fill material and compacted in layers.
21. Any live sewer connections found in any sewers that are to be abandoned are to be picked up and diverted.
22. The Contractor shall undertake a CCTV survey of the as constructed site drainage system on completion of the works. A copy shall be made available to Mason Clark Associates.

Crack Stitching Notes

1. Minor cracking to be repaired using twisted stainless HeliBars set into bedjoints using HeliBond grout. All works to be carried out to HeliFix recommendations.

   Unless noted specifically:
2. Bars generally 1m long, set centrally about vertical crack location.
3. Bars installed every 2no. courses vertically (maximum 150mm ccs).
4. Bars to be bent to repair corner cracks.
5. Where longer bars are required, lapped HeliBars are acceptable to HeliFix recommendations.
6. Repoint with suitable lime mortar to match the existing surrounding brickwork for colour / texture.

Notes

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2. This drawing is not to be scaled. All dimensions are to be checked on site by the contractor. Any discrepancies are to be notified to Mason Clark Associates. Obtain instructions prior to works commencing.
3. This drawing is to be read in conjunction with all the relevant contract drawings and specifications.
4. All dimensions are in millimetres and all levels are in metres AOD unless noted otherwise.
5. All work shall be carried out in accordance with Local Authority, Statutory Authority and Health & Safety Regulations.
6. Mason Clark Associates are not responsible for determining the appropriate fire period, fire boundary conditions or the associated design of fire protection or inherent fire resistance to any elements of structure, including all frames, posts, beams, joists, roof members and secondary structural elements such as lintels. Refer to the Architect or Project Manager for this information

Health & Safety Information

In addition to the hazards and risks normally associated with the type of works detailed on this drawing, please note the following abnormal risks to Health & Safety.

Refer to Mason Clark Associates project specific Design Risk Assessment (DRA).

Construction Phase

HAZ-C1	**Working Adjacent to Buried Services:** Although no clash with services is expected, excavation of foundation can potentially damage the services.
HAZ-C2	**Local Collapse of the Wall:** Areas with crack, excessive bulging, loose pointing and also around current fallen section of the wall may be at risk of further collapse.
HAZ-C3	**Concealed Defects:** Presence of concealed defects could lead to destabilising of the wall during construction. Sequence, method statement and temporary works schedules to be prepared for approval of the Engineer.
HAZ-C4	**Safe Access:** Due to the presence of the school, ensure no covers are unprotected. Also, all areas of unsafe structure to be clearly identified and protected. No entry into excavations which are not sufficiently supported. Only appropriately trained operatives to enter confined spaces.
HAZ-C5	**Water Ingress:** Water ingress is possible and suitable de-watering or pumping techniques may be required, to be proposed and designed by the Contractor for approval, following site investigation.
HAZ-C6	**Slope Instability:** Where the wall collapsed, due to the ground movement, slope instability may occur which would require the Contractor to use soil stabilisation techniques.

Demolition Phase

	Sequencing of demolition to be agreed by the Engineer.

It is assumed that all works will be carried out by a competent contractor working where appropriate to an approved method statement. Only appropriately trained and qualified operatives to work on site.

1- Impact damage - Past repair
2- Bulge in wall + loose pointing
3- Weep hole discharging water
4- Tree growing from wall - Since Removed
5- Vegetation and loose pointing - Past Repair
6- Loose and hollow stonework
7- Cracking and bulging at low level and Ivy at high level
8- Partial collapsed wall

Rev	Details	By	Date
T1	Issued for Tender	MK	05.05.2020
P2	Drawing updated - Issued for comment	MK	08.04.2020
P1	Issued for comments.	PP	07.04.2020

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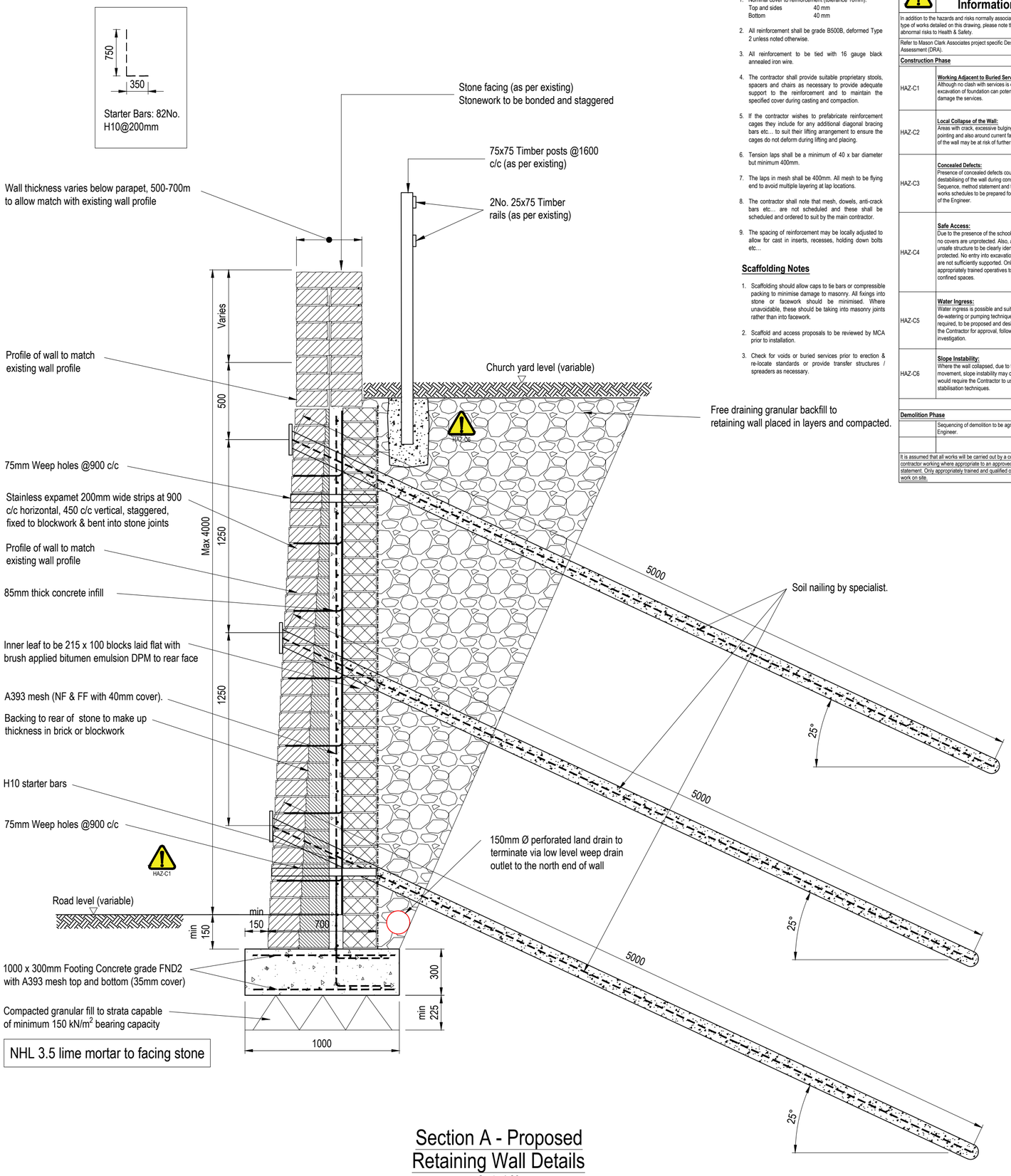
Client.
Harrogate BOROUGH COUNCIL

Project.
St Andrew's Church, Kirkby Malzeard

Title.
West Elevation

Drawn: PP	Checked: RT	Date: 11.03.2020
Scale @ A2 : As Shown		
Drawing No : 18523-Y-DR-401		Rev: T1



Section A - Proposed Retaining Wall Details

Scale 1:20

Reinforcement Notes

1. Nominal cover to reinforcement (tolerance 10mm):
   Top and sides 40 mm
   Bottom 40 mm
2. All reinforcement shall be grade B500B, deformed Type 2 unless noted otherwise.
3. All reinforcement to be tied with 16 gauge black annealed iron wire.
4. The contractor shall provide suitable proprietary stools, spacers and chairs as necessary to provide adequate support to the reinforcement and to maintain the specified cover during casting and compaction.
5. If the contractor wishes to prefabricate reinforcement cages they include for any additional diagonal bracing bars etc… to suit their lifting arrangement to ensure the cages do not deform during lifting and placing.
6. Tension laps shall be a minimum of 40 x bar diameter but minimum 400mm.
7. The laps in mesh shall be 400mm. All mesh to be flying end to avoid multiple layering at lap locations.
8. The contractor shall note that mesh, dowels, anti-crack bars etc… are not scheduled and these shall be scheduled and ordered to suit by the main contractor.
9. The spacing of reinforcement may be locally adjusted to allow for cast in inserts, recesses, holding down bolts etc…

Scaffolding Notes

1. Scaffolding should allow caps to tie bars or compressible packing to minimise damage to masonry. All fixings into stone or facework should be minimised. Where unavoidable, these should be taking into masonry joints rather than into facework.
2. Scaffold and access proposals to be reviewed by MCA prior to installation.
3. Check for voids or buried services prior to erection & re-locate standards or provide transfer structures / spreaders as necessary.

Health & Safety Information

In addition to the hazards and risks normally associated with the type of works detailed on this drawing, please note the following abnormal risks to Health & Safety.

Refer to Mason Clark Associates project specific Design Risk Assessment (DRA).

Construction Phase

HAZ-C1	**Working Adjacent to Buried Services:** Although no clash with services is expected, excavation of foundation can potentially damage the services.
HAZ-C2	**Local Collapse of the Wall:** Areas with crack, excessive bulging, loose pointing and also around current fallen section of the wall may be at risk of further collapse.
HAZ-C3	**Concealed Defects:** Presence of concealed defects could lead to destabilising of the wall during construction. Sequence, method statement and temporary works schedules to be prepared for approval of the Engineer.
HAZ-C4	**Safe Access:** Due to the presence of the school, ensure no covers are unprotected. Also, all areas of unsafe structure to be clearly identified and protected. No entry into excavations which are not sufficiently supported. Only appropriately trained operatives to enter confined spaces.
HAZ-C5	**Water Ingress:** Water ingress is possible and suitable de-watering or pumping techniques may be required, to be proposed and designed by the Contractor for approval, following site investigation.
HAZ-C6	**Slope Instability:** Where the wall collapsed, due to the ground movement, slope instability may occur which would require the Contractor to use soil stabilisation techniques.

Demolition Phase

	Sequencing of demolition to be agreed by the Engineer.

It is assumed that all works will be carried out by a competent contractor working where appropriate to an approved method statement. Only appropriately trained and qualified operatives to work on site.

Structural Masonry Notes

1. The works shall be constructed in accordance with Eurocode 6 with class 2 execution control.
2. All blockwork to be medium dense aggregate blocks (density 1350kg/m3) with a minimum strength of 7N/mm2 unless noted otherwise.
3. The durability of exposed masonry shall be determined by the Architect.
4. All masonry units shall be certified as Category I by the manufacturer.
5. All mortar to be class M6 below DPC and class M4 above DPC.
6. Cavity wall ties to be stainless steel Type 2 ties (eg. Ancon Staifix RT2 or similar) unless noted otherwise. The tie spacing shall be generally 900mm horizontal x 450mm vertical centres.
7. Additional ties shall be incorporated at 225mm vertical centres within 225mm of a reveal or movement joint and at 450mm horizontal centres within 225mm of a window head or cill.
8. A 25mm soft joint shall be provided at the head of masonry walls under steel or concrete beams. The filler material shall be specified by the architect.
9. All floors and roofs to be provided with holding down and lateral restraint straps in accordance with the Building Regulations or as specified on the drawings. The straps shall be built in or fixed to the masonry in accordance with the manufacturers requirements.
10. Movement joints shall be incorporated in locations shown on the drawings. The movement joints shall incorporate a compressible filler (eg. Fosroc Hydrocell XL) and a polysulphide sealant (eg. Fosroc Thioflex 600). The sealant colour shall be specified by the Architect.
11. All finishes to be specified by the Architect. Any finishes shall reflect movement joint locations in the masonry walls.
12. Any additional sealants required at interfaces to achieve air sealing details and / or fire resistance to be specified by the Architect.
13. All lintels to have minimum 150mm end bearings unless noted otherwise.
14. Any single leaf L-shape lintels shall be temporarily propped until the masonry is fully cured in accordance with the manufacturer's recommendations.

Concrete General Notes

1. All concrete works shall be in accordance with the National Structural Concrete Specification.
2. All concrete to be grade:
   Blinding GEN 1
   Underpinning FND 2
   Floor slabs RC 30
   Retaining walls RC 40
3. The contractor shall allow for making and testing concrete cubes at a rate of three cubes per day per type of concrete mix being poured. The testing shall be undertaken by a UKAS accredited testing house. Records shall be made available to Mason Clark Associates.
4. Finishes to concrete elements to be in accordance with the NSCS. The minimum requirements unless noted otherwise on the drawings shall be:

   Formed finishes
   Exposed faces of walls, soffits of slabs & columns - Plain
   Non-exposed or faces to receive finishes - Ordinary

   Unformed finishes
   Surfaces inc. slabs to receive no finishes - Plain
   Surfaces inc. slabs to receive applied finishes - Ordinary
5. All formwork and temporary propping to be designed and detailed by the contractor.
6. The contractor shall submit their proposals to MCA for pouring sequence, timescales for concrete curing, striking of formwork, back propping of slabs etc..
7. For tender purposes allow the following reinforcement.

   Retaining Walls 150kg/m3

Structural Timber Notes

1. All timber and workmanship shall be in accordance with the National Structural Timber Specification.
2. All timber shall be sustainably sourced and be FSC or PEFC certified.
3. All timber sizes are to be as shown on the drawing.
4. Timber to be minimum grade C24 unless noted otherwise.
5. All proprietary joist hangers, framing anchors and other connectors are to be mild steel galvanised and be installed strictly in accordance with the manufacturers details and recommendations.
6. Wanes, fissures, knots or other defects are not permitted at bearings or joints.
7. Strutting, restraint straps and limits on notching of timbers shall be in accordance with the Building Regulations and the NBS Specification.
8. All timber must be stored on site so as to minimise changes in moisture and remain in an undisturbed condition.
9. Any contractor designed engineered timber items (eg. Gang nail roof trusses, engineered joists etc…) shall be designed in accordance with the loadings specified on the Engineers drawings. The timber grade shall be determined by the designer. The contractor shall submit drawings to the Engineer at least 14 days prior to manufacture.
10. Any treated timber identified on the drawings shall be suitable for performance in Use Class 3.
11. All floors joists, roof joists and trusses to be provided with holding down and lateral restraint straps in accordance with the Building Regulations or as specified on the drawings.

Foundation Notes

1. All concrete works shall be in accordance with the National Structural Concrete Specification.
2. All RC foundations to be cast on a minimum of 50mm concrete blinding.
3. All foundation concrete to be grade FND2.
4. The contractor shall allow for making and testing concrete cubes at a rate of three cubes per day per type of concrete mix being poured. The testing shall be undertaken by a UKAS accredited testing house. Records shall be made available to Mason Clark Associates.
5. Finishes to concrete elements to be in accordance with the NSCS. The minimum requirements unless noted otherwise on the drawings shall be:

   Formed finishes
   Exposed faces of walls, soffits of slabs & columns - Plain
   Non-exposed or faces to receive finishes - Ordinary

   Unformed finishes
   All foundations & below ground structures - Basic
   Surfaces of exposed slabs and bases - Ordinary

   Note: Internal building and external concrete pavements and hardstandings may be subject to specialist finishes. Refer to the relevant Mason Clark Associates drawings for details.
6. Cover to reinforcement shall be 50mm all round unless noted otherwise on the drawings.
7. All holding down bolts to be provided by steel fabricator for casting in to foundations by ground work contractor. The ground work contractor shall allow for making up bolt assemblies including cones, washer plates etc… and to fix in place prior to concrete pour.
8. All DPC's, DPM's and tanking are to be in accordance with the architect's details.
9. For tender purposes allow the following reinforcement.
   Pile Caps 125kg/m3
   Ground beams 150kg/m3
   Retaining Walls 150kg/m3

General Notes

1. Where not stated elsewhere, the minimum standards to be adopted are those given in BS 8000 and the Building Regulations.
2. No allowance has been made for holes, chasings, notches or inserts unless specifically detailed on the drawings. All service entry points, supports etc… are to be agreed prior to works commencing.
3. For existing and proposed services locations and any diversions refer to the Architect / M&E Engineers drawings.
4. The contractor shall site measure all existing structures prior to any works commencing and report any discrepancies in writing to Mason Clark Associates.
5. All temporary works are to be designed and detailed by the main contractor.

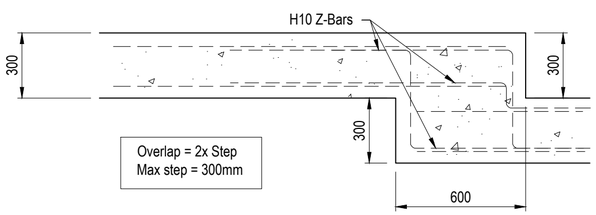
Drainage Notes

1. All private drainage works are to be constructed in accordance with the relevant provisions of BS EN 752 including by reference BS 8301. Building regulations part H and Sewers for Adoption 6th edition.
2. The Contractor MUST confirm invert levels of existing points of connection prior to commencement of drainage works.
3. Manhole invert levels relate to the downstream pipe. Pipes at manholes to be laid soffit to soffit level.
4. Unless otherwise shown, foul pipes to be 100mm Ø laid at 1 in 40 minimum gradient unless one w.c. connected where gradient may be 1 in 80 minimum.
5. Unless otherwise shown surface water pipes to be 150mm Ø laid at 1 in 100 minimum gradient.
6. Where cover to top of pipe barrel is less than 900mm in lightly trafficked areas and 600mm in non trafficked areas, pipe to have minimum 150mm ST4 concrete surround.
7. Where cover to pipe barrel located beneath highways is less than 1200mm, pipes are to be protected with concrete surround (bed type Z) Grade C20 in accordance with sewers for adoption 6th edition, table 2.4.
8. Manhole cover levels where not shown are to be confirmed at later stage. Covers are to be fixed to a profile corresponding to the surrounding pavement surface and may be adjusted to suit actual site levels.
9. All pipework up to 300mm Ø to be standard strength vitrified clay to BS EN 295 (min crushing strength 40KN/m) or plastic to BS 4660:2000 and BS EN 1401-1:1998 and shall comply with the requirements of Sewers for Adoption 6th Edition.
10. Bedding to all pipework to be Class S granular bed & surround in accordance with BS882 or Class Z (see manhole schedule and/or details drawing).
11. All backfill above gravel surround in drainage trenches and under building slabs to be Type 1 stone compacted in layers not exceeding 225mm thick.
12. Manholes to be precast concrete to BS EN1917: 2002, Type B, in accordance with the requirements of Sewers for Adoption, 6th Edition unless noted otherwise.
13. Inspection chambers to be polypropylene, 475mm diameter, Hepworth range or similar & approved. Opening restricted to max 350mm where depth of chamber exceeds 1.2m.
14. All manholes covers and gully gratings located in trafficked areas to be ductile iron class D400. Covers located in non trafficked areas to be min class B125 unless noted otherwise on the drainage layout or manhole schedule.
15. Any external recessed cover required or internal manhole covers to be specified by the Architect.
16. Position and details of rainwater pipes, and foul connections to be confirmed by Architect.
17. For above ground and internal drainage, vents, fittings and access points refer to Architects and/or M&E details.
18. Cover levels of private drainage chambers may be adjusted to suit actual site levels.
19. The contractor is responsible for identifying and locating all existing services and ensuring that the levels do not conflict with the proposed drainage system. If there are any such conflicts then the Engineer must be made aware immediately.
20. All existing redundant drainage systems are to be abandoned and grubbed up including redundant manholes and pipework. The voids are to be backfilled with as dug material or suitable fill material and compacted in layers.
21. Any live sewer connections found in any sewers that are to be abandoned are to be picked up and diverted.
22. The Contractor shall undertake a CCTV survey of the as constructed site drainage system on completion of the works. A copy shall be made available to Mason Clark Associates.

Crack Stitching Notes

1. Minor cracking to be repaired using twisted stainless HeliBars set into bedjoints using HeliBond grout. All works to be carried out to HeliFix recommendations.

   Unless noted specifically:
2. Bars generally 1m long, set centrally about vertical crack location.
3. Bars installed every 2no. courses vertically (maximum 150mm ccs).
4. Bars to be bent to repair corner cracks.
5. Where longer bars are required, lapped HeliBars are acceptable to HeliFix recommendations.
6. Repoint with suitable lime mortar to match the existing surrounding brickwork for colour / texture.



Steps to take place at approx 31m & 34m (corner)

Typical Foundation Step Detail

Scale 1:20

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3. This drawing is to be read in conjunction with all the relevant contract drawings and specifications.
4. All dimensions are in millimetres and all levels are in metres AOD unless noted otherwise.
5. All work shall be carried out in accordance with Local Authority, Statutory Authority and Health & Safety Regulations.
6. Mason Clark Associates are not responsible for determining the appropriate fire period, fire boundary conditions or the associated design of fire protection or inherent fire resistance to any elements of structure, including all frames, posts, beams, joists, roof members and secondary structural elements such as lintels. Refer to the Architect or Project Manager for this information

Rev	Details	By	Date
T2	Soil nail angle revised	MK	08.07.2020
T1	Issued for Tender	MK	05.05.2020
P2	Drawing updated - Issued for comment	MK	08.04.2020
P1	Issued for comments.	PP	07.04.2020

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Client.
Harrogate BOROUGH COUNCIL

Project.
St Andrew's Church, Kirkby Malzeard

Title.
Section & Details

Drawn: PP	Checked: RT	Date: 11.03.2020
Scale @ A2 : As Shown		
Drawing No : 18523-Y-DR-402	Rev: T2	

St Andrews Church, Kirby Malzeard – Stabilisation of an Existing Partially Collapsed Retaining Wall using Soil Nails Rev. A

Soil Nail Designer:

Byland Engineering Limited
3 Concept Court
Kettlestring Lane
Clifton Moor
York YO30 4XF

Tel: 01904 476366

Soil Nailing Contractor:

TBC

Tel: TBC

Consulting Engineer:

Mason Clark Associates
Partnership House
Monks Cross Drive
York
YO32 9GZ

Tel: 01904 438005

Client:

Harrogate Borough Council

Contents

Revision	Date	Details
0	24/03/2020	Initial Issue
A	08/07/2020	Soil nail declination increased to 25 degrees

1. Scope

An existing ~60m long by up to 4.0m high masonry retaining wall supporting the ground around St Andrews Church, Kirby Malzeard, North Yorkshire is showing signs of distress. The northern most 10m section of wall has recently collapsed after being in a poor state of repair for a significant time and subsequently being struck by a vehicle. The wall comprises mortared masonry blocks. The site is located on Church Street with the wall and church on the eastern side of the road approximately 100m north of the village square. The retained height decreases to the south as the road climbs the hill into the village

It is proposed to remediate the worst 40m of the wall at the northern end where retained height is greatest by installing a regular grid of drilled and grouted soil nails through pre-cored holes through the retaining wall to act as “passive ties” and tie it back to competent ground thus stabilising the structure. These soil nails will also strengthen the ground behind to further enhance stability. Byland Engineering Limited (BEL) has been commissioned by the Mason Clarke Clark Associates (MCA) to design the soil nail stabilisation scheme.

The soil nails will comprise of galvanised self drilling hollow rebar installed at a declination of 25^{o} below the horizontal using a 90mm diameter sacrificial drill bit and continuous grout flush. Once installed 300mm diameter x 12mm thick steel galvanised head plates will be bedded on to the wall with cement mortar to distribute the restraining forces safely into the structure.

The head plates will have recessed heads and can be painted and/or ornamental pattress facing plates can be secured.

2. Documentation

The following documentation has been provided for the design:

1. Telecoms, Water and Power Plans for site

3. Specification & References

i) BRE Special Digest 1 Concrete in Aggressive Ground - 3rd Edition 2005

ii) BS EN 1997-1 (2004) – Eurocode 7: Geotechnical Design – Part 1 General Rules – BSI, London.

iii) NA to BS EN 1997 -1 (2004) – UK National Annex to Eurocode 7: Geotechnical Design – Part 1 General Rules – BSI, London.

iv) BS EN 1997 Eurocode 7: Geotechnical design and the associated national annex

v) BE EN 14490: 2010 – Execution of special geotechnical works: Soil Nailing

vi) BS 8006-2: 2011 – Code of practice for strengthened / reinforced soils. Soil Nail Design

vii) BS8081: 1989 – Code of practice for Ground Anchorages, BSI, London

viii) CIRIA C637 – Soil Nailing Best Practice Guidance

ix) Dywidag Self-drilling anchors technical brochure dated 2018

4. Ground Conditions

4.1 Geological Map

Online 1:50,000 scale geological mapping on the British Geological Survey Geo-Index website indicates the site to be underlain by the following geological deposits in order of increasing age:

1. Superficial deposits are mapped as Devensian Glacial Till comprising coarse granular material in a fine grained clay matrix.
2. Alluvial deposits or clay. silt, sand and gravel are mapped to the north while Glacio-fluvial sand and gravel is present to the east.
3. Bedrock is mapped as the Carboniferous age Millstone Grit Group comprising fine- to very coarse-grained feldspathic sandstones, interbedded with grey siltstones and mudstones, with subordinate marine shaly mudstone, claystone, coals and seatearths. A named sandstone unit is mapped below the site as the Wandley Gill Sandstone comprising A sharp upward change in a conformable succession from predominantly grey mudstone to sandstone.

Given the nature of the site and the presence of the graveyard it is anticipated that much of the ground retained by the wall will be reworked Made Ground.

4.2 Ground Investigation

No ground investigation has been undertaken on the site.

The collapsed section has exposed the soil at the northern end of the site which appeared to comprise firm sandy slightly gravelly clay with gravel of brick and other lithologies, which will be suitable for the proposed grout flushed soil nails.

4.3 Design Parameters

The design will conservatively assume that the ground is formed of Made Ground throughout as the majority of the length of the soils nails will be within this stratum. The following ground model and SLS design parameters are proposed.

Soil Type	Density (kN/m^3)	Angle of internal friction (°)	Effective cohesion (kPa)	Ultimate grout to ground bond stress (kN/m^2)
Made Ground	18	28.0	0	50

Groundwater was not recorded during the investigation however groundwater will be assumed to present within the ground. Weep holes are provided in the wall to ensure hydrostatic pressures do not build up on the wall.

The proposed ground model is presented in Appendix B.

5. Soil Nail Design

5.1 Preamble

The existing masonry retaining wall which supports the ground around St Andrews Church, Kirby Malzeard is showing signs of distress and has partially collapsed over the northern most 10m section. In order to stabilise the wall it is proposed to install soil nails through the masonry. The soil nails are designed as permanent 'passive ties' to provide lateral restraint to the wall & to strengthen the ground behind.

The proposed soil nail design will be analysed using the SNAILZWIN software. This program has been widely used throughout North America and the rest of the world for the design of soil nailed slopes. SNAILZWIN uses a bi-linear (2-part) wedge analysis for failure planes exiting at the toe of the slope. It is a fully balanced force equilibrium equation with only soil inter slice forces included, based on a mobilised Φ' and c'. Further details can be obtained from www.dot.ca.gov/hq/esc/geotech

5.2 Soil Nail Analysis

The soil nails are to comprise fully galvanised Dywidag R32-280 self-drilling soil nail (or similar approved) connected together with full strength couplers installed using a sacrificial 90mm cross cut bit. This hollow steel soil nail has an equivalent bar diameter of ~23.4mm.

Bar Type	Nominal Thread Diameter [mm]	Effective External Diameter [mm]	Internal Diameter [mm]	Cross Section Area [mm²]	Ultimate Strength [kN]	Yield Strength [kN]	Steel Grade Yld / Ult [N/mm²]	Weight [kg/m]
R25-200	25	23.8	14	290	200	150	520/690	2.30
R32-210	32	29.5	21.5	340	210	170	530/660	2.80
R32-250	32	29.5	19.7	370	250	190	510/670	3.00
R32-280	32	29.5	18	410	280	220	520/670	3.40
R32-320	32	29.5	16.5	470	320	280	590/680	3.90
R32-360	32	29.5	15	510	360	300	590/710	4.10
R32-400	32	29.5	12.5	560	400	330	590/710	4.40
R38-420	38	36.4	21	660	420	350	510/610	5.30
R38-500	38	36.4	19	750	500	400	530/660	6.00
R38-550	38	36.40	18.2	780	550	430	550/710	6.2

The general SNAILZWIN parameters used in the analyses are given below:

- Soil nail bit diameter = 130mm (nominal 100mm diameter with allowance for enlarged bore which is typically created with this system)
- Soil Nail lengths = 5.0m
- Soil nail declination = 25°
- Soil nail head punching shear = 150kN (unlikely method of failure in view of existing stonework wall)

- Soil nail 'equivalent' diameter after allowing for 1.5mm of sacrificial corrosion= 23.4 – 4.4 = 19mm.
- Soil nail reinforcement yield strength f_y = 520MPa
- Horizontal spacing = 1.25m
- Vertical spacing = 1.25m maximum
- A 5kN/m^2 surcharge acting from 0.5m behind the wall (assumed to be a live load which is conservative)
- No account has been taken of any surcharge from the church foundations which are assumed to be at sufficient depth not to apply a surcharge directly to the wall i.e. a load spread at 45^o would pass below the toe of the wall.
- 3.5m vertical retained wall height at a 3.0° batter.

In accordance with BS 8006-2 (2011) the soil nail analyses follow limit state design principles compatible with BS EN 1997-1 (2004). Characteristic actions, material properties and resistances are multiplied or divided by the relevant partial factor as detailed in BS 8006-2 Table 5 (reproduced below) to obtain the design values used in the analysis.

BRITISH STANDARD BS 8006-2:2011

Table 5 **Partial factors for soil nail design**

Design values are to be obtained by multiplying the representative values of the actions, and dividing the characteristic values of the material properties and soil nail resistances, by the following partial factors.[A]

				Set 1	Set 2
Actions	Self-weight of soil, W		dst[B]	$\gamma_g = 1.35$	$\gamma_g = 1.0$
			stb[B]	$\gamma_g = 1.0$	$\gamma_g = 1.0$
	Permanent surcharge, q_p		dst	$\gamma_{qp} = 1.35$	$\gamma_{qp} = 1.0$
			stb	$\gamma_{qp} = 1.0$	$\gamma_{qp} = 1.0$
	Variable surcharge, q_v		dst	$\gamma_{qv} = 1.5$	$\gamma_{qv} = 1.3$
			stb	$\gamma_{qv} = 0$	$\gamma_{qv} = 0$
	Ground-water pressure, u		dst	$\gamma_u = 1.0$	$\gamma_u = 1.0$
			stb	$\gamma_u = 1.0$	$\gamma_u = 1.0$
Material properties	$\tan \varphi'_k$			$\gamma_{\tan\varphi'} = 1.0$	$\gamma_{\tan\varphi'} = 1.3$
	c'_k			$\gamma_{c'} = 1.0$	$\gamma_{c'} = 1.3$
	cu_k			$\gamma_{cu} = 1.0$	$\gamma_{cu} = 1.4$
	γ_k			$\gamma_\gamma = 1.0$	$\gamma_\gamma = 1.0$
Soil nail resistances [C]	Bond stress[D], τ_{bk}	Empirical		$\gamma_{sb} = 1.1$	$\gamma_{sb} = 1.5$
		Effective stress[E]		$\gamma_{sb} = 1.1$	$\gamma_{sb} = 1.5$
		Total stress[E]		$\gamma_{sb} = 1.1$	$\gamma_{sb} = 1.5$
		Pull-out tests[F]		$\gamma_{sb} = 1.1 - 1.7$	$\gamma_{sb} = 1.5 - 2.25$
	Tendon strength, T_k			$\gamma_s = 1.0$	$\gamma_s = 1.15$ for steel
Model factor	Applied to the effect of unfavourable actions[F],[G] (e.g. to $M_{driving}$ in the case of Bishop's slip circles)			γ_{Sd}	γ_{Sd}

[A] In the case of abnormal risk or unusual or exceptionally difficult ground or loading conditions (Geotechnical Category 3 structures as defined in BS EN 1997-1:2004), all non-unity values in the above table should be increased by 10%.

[B] stb = stabilizing; dst = destabilizing.

[C] The factors shown for soil resistances are a summary of the fuller explanation given in Table 6.

[D] Refer to **4.3** for appropriate choice of characteristic bond stress to reflect whether nails are temporary or permanent.

[E] Calculated on characteristic soil properties and ignoring q_v.

[F] See **4.3.6**.

[G] The values of γ_{Sd} will be dependent on the calculation method used. γ_{Sd} may be set to unity for Bishop's simplified method of slices, or for calculations performed with the two-part wedge mechanism assuming a vertical inter-wedge boundary with a friction value not exceeding $0.5\varphi'$. *For other methods of analysis a safe value of γ_{Sd} should be determined through calibration.*

Three sets of analyses are undertaken under this method and these are:

1. An SLS analysis using unfactored soil properties and requiring a minimum Factor of Safety (FoS) against failure of 1.3
2. A ULS set 1 analysis using factored soil parameters as per the above table and requiring a minimum FoS=1.0
3. A ULS set 2 analysis using factored soil parameters as per the above table and requiring a minimum FoS=1.0

The input variables for each analysis are summarised in the table below:

Soil Type	Analysis	Density (kN/m^3)	Angle of internal friction (°)	Effective cohesion (kPa)	Ultimate grout to ground bond stress (kN/m^2)	Nail strength (MPa)	Punching shear	Surcharge
Made Ground	SLS	18	28.0	0	50	520	150	5.0
	ULS set 1	24.3	28.0	0	45	520	150	7.5
	ULS set 2	18	22.2	0	33	452	130	6.5

The calculation of the pullout resistance of the soil nails will be undertaken using methods as recommended by CIRIA C637. In practice this type of empirical calculation is likely to underestimate the pullout resistance of self-drilled soil nails which are installed and grouted in-situ quickly (minutes) thus reducing the potential for relaxation of the ground. In addition as the grout is injected into the bore it will permeate into the ground enhancing the 'nominal' diameter and producing additional bond.

The grout to ground bond values given above are based upon recommendations in the CIRIA Soil Nail Guide C637 and from experience. The Snail Analyses are given in Appendix A and summarised below. The analyses check for the critical failure mode from:

- Nail head punching failure (unlikely due to thick existing wall).
- Nail pull out failure.
- Nail tensile failure (rupture)

A sensitivity analysis has been undertaken with varying search widths behind the wall from 1m to 10m. Only the critical results are included in this report and indicate the following factors of safety at search widths of 1m for SLS/ULS 1 and 3m for ULS 2 (the critical width).

Analysis	SLS	ULS 1	ULS 2
FoS	1.40	1.31	1.03

The maximum nail force recorded in the SLS analysis is 33.3kN/m. Based on the 1.25m soil nail spacing, the maximum load per soil nail is 41.6kN. The yield load of the R32-280 bar is 220kN and therefore the load is well within the capacity of the bar.

The proposed layout of the soils nail is shown on Byland drawings 2099-001 and 2099-002 and comprises:

- 72 No. x 5m long Dywidag R32-280 hollow galvanised self-drilling soil nails installed in up to 3 No. rows
- Soil Nails installed using a 90mm cross cut sacrificial drill bit
- Declination of 25 degree below the horizontal.
- A horizontal spacing between nails not exceeding 1.25m and a vertical spacing between rows not exceeding 1.25m

5.3 Installation Procedure

The installation procedure for the soil nails is as follows:

a) The existing retaining wall is to be pre-cored at all soil nail locations using a nominal 100mm drill bit and an angle below the horizontal of 25°. This is to prevent damage to the existing wall during soil nail installation

b) The self-drilling hollow bar soil nails are normally installed using grout flush to maintain borehole stability and to achieve a good grout to ground bond capacity, as well as filling up any voids and / or weak areas of ground with high strength fluid grout. However, if the bores remain open then it may be possible to use air flushed drilling techniques. The soil nails **must always** be grouted down the centre of the hollow bars until the bores are completely full of clean grout and the grout levels stabilised, at the end of each day.

c) The soil nails should be installed such that the upper end of the soil nail rebar terminates inside the existing retaining wall and does not protrude out of the face of the wall.

d) The soil nail installation process will continue until all soil nails are completely installed. If access restriction prevents the installation of any of the soil nails then the designer should be informed immediately.

e) Upon completion of the soil nail drilling and grouting works the bespoke pre-fabricated 300mm diameter x 14mm thick galvanised head plates over the soil nails, then a securing washer and nut is to be screwed onto the soil nail and tightened up with a socket wrench using ~0.5m manual leverage (extension attachment required). These head plates should be bedded on cement paste to provide an even bearing if deemed necessary.

5.4 Grout to Hollow Threadbar Bond Stress

Table 2 of BS8081 (1989) a minimum factor of safety of 2.5 is required for the grout to tendon interface. In accordance with BS8081, clause 6.3.2, the ultimate bond stress is assumed to be uniform over the whole of the bond length. BS8081 recommends using a design ultimate bond stress of 2MPa for type 2 deformed bar, however, the proposed fully threaded rebar has a far superior thread than the type 2 bar. Pull out tests have proved a grout to threadbar bond stress varying from 6 to 12MPa, however the conservative value of 2MPa will be adopted.

The factor of safety at the grout to tendon (hollow threadbar) interface, based on an ultimate bond stress of 2.0MPa and for the given tendon dimensions over the fixed length, is calculated as follows:

$$FoS = \frac{\tau_{ult} \times \pi \times D \times l}{T_w} = \frac{2000 \times \pi \times 0.032 \times 5}{30} = 33.5$$

By inspection the above factor of safety is well in excess of the minimum 2.5 and is therefore acceptable.

5.5 Drainage

From the provided photographs weepholes are evident in the existing wall construction. Where these are not present then additional weepholes must be provided at maximum 2.5m centres.

The existing weepholes should be cleaned out and it should be ensured they are functional. It is noted that the drainage from the church roof discharges into a drain at the corner of the building and appeared to be exiting from one of the weep holes. The drainage should be investigated prior to installing soil nails.

5.6 Corrosion Protection

The soil nail design is based on a design life of 120 years.

In accordance with NA to BS EN 1993-5 (2007): Table 4.1 the ground has been assumed to be non-compacted, non aggressive fill. An allowance of 2.2mm of sacrificial corrosion over 100 years on each face has been made. This equates to a reduction in the diameter of 4.4mm and therefore as noted in Section 5.2 the effective diameter of the rebar reduces to 19mm.

In addition the soil nails and exposed metal work will be fully galvanised with a minimum 85 microns of galvanising which will provide an additional 20 years of corrosion protection.

The soil nail solution is dictated by the length and numbers of soil nails rather that the strength of the reinforcing element; there is therefore a relatively high degree of redundancy within the reinforcement element.

5.7 Grout Mix

A neat fluid OPC cement (min 42.5) grout mix with a 0.40 water: cement ratio will be used:

			Specific Gravity		Volume
Cement (minimum 42.5N)	100 kg	¸	3.1	=	32.2 litres
Water (0.4 w/c)	40 kg	¸	1.0	=	40.0 litres
					72.2 litres

This mix has been used on numerous occasions and bonds well to the ground. Average 28 day cube strengths of > 30MPa are achieved. One set of 6 No. 100mm x 100mm x 100mm grout cubes will be taken for each soil nail, for testing at 7 days (2 No.) and 28 days (2 No.) leaving 2 No. spare. We reserve the right to adjust this mix and to introduce sand and / or plasticiser if deemed appropriate. The grout must achieve a 28 day unconfined compressive strength of 35MPa or greater.

5.8 Head Plate Detail

It is proposed to use 300mm diameter x 14mm thick galvanised steel head plates bedded on cement mortar. It is assumed that the retaining wall has sufficient width to evenly distribute the forces acting on the head plates to the back of the wall so that punching failure does not occur using the chosen soil nail spacing.

6. Testing

5 No soil nail pull out tests will be carried out to validate the design assumptions (acceptance tests). The test nails should be debonded through the existing stonework wall to prevent damage to the wall. The soil nail working load is 30kN and therefore the maximum soil nail test load should be 1.25 x 30= 37.5kN.

A 0.5m diameter exclusion reaction zone should be left around the soil nail head to ensure an accurate test without any ‘strut’ effects. The minimum number of load increments is three with the load increasing in stages of 12.5kN, 25kN and 37.5kN.

Standard 100mm x 100mm x 100mm grout cubes should be taken daily basis for UCS testing at a later date (2 at 7 days and 2 at 28 days).

7. Geotechnical Risk Assessment

In accordance with CDM 2015 regulations a full Health and Safety Designers Risk Assessment is provided in Appendix A.

8. Summary

These calculations detail the design of 72 No. permanent self-drilled passive soil nails to stabilise an existing masonry retaining wall which is showing signs of cracking and deterioration and has partially collapsed over a 10m section at the St Andrews Church, Kirby Malzeard.

The design is summarised as follows:

- The soil nail layout is detailed on Byland drawings 2099-001 & 2099-002.
- All soil nails are nominal 5.0m long galvanised Dywidag R32-280 self-drilling hollow steel thread bars (or similar approved) installed with a 90mm sacrificial drill bit and connected using full strength couplers.
- All soil nails are to be installed normal to the existing retaining wall at an angle of 25° below the horizontal
- Soil Nails are designed as permanent and are to be fully galvanised. All head plates and nuts are also to be galvanised
- All soil nails grouted using neat cement grout with a water cement ratio of 0.4. Minimum UCS strength at 28 days = 35MPa.
- All nails to be locked off using a ~0.5m of manual leverage at outer wall facing with 300mm diameter x 14mm thick galvanised steel head plates, a minimum of 24 hours after casting.
- 5 No soil nails will be subject to acceptance tests to 125% of the working load. These must be debonded through the masonry wall. Maximum test load to be 37.5kN.
- Significant risks associated with the proposed works are:
    i. Ground conditions weaker than expected – If the ground conditions are weaker than expected then the designer should be contacted immediately and the design reviewed. The soil nails may need to be extended and additional lengths of bar should be available on site to allow for this to be done.
    ii. Obstruction within the Made Ground - The design employs a 90mm f drill bit which should be able to penetrate through the ground behind using percussive drilling techniques. If the ground cannot be penetrated then the designer should be contacted immediately and the design reviewed. 0.5m penetration into rock will be considered acceptable.
    iii. Services are known to be present behind the wall. These include:
        1. Drainage from the church roof
        2. Electrical cables for the church lighting
        3. LV underground mains cables

    All services must be carefully checked and ground “truthed” on site before works commence.

iv. Stability of the wall during drilling. If necessary the wall should be supported by some suitable means such as stone filled aggregate bags being placed against the wall to support the wall during the works.

- From the provided photographs weepholes are evident in the existing wall construction. Where these are not present then additional weepholes must be provided at maximum 2.5m centres.

  The existing weepholes should be cleaned out and it should be ensured they are functional. It is noted that the drainage from the church roof discharges into a drain at the corner of the building and appeared to be exiting from one of the weep holes. The drainage should be investigated prior to installing soil nails.

- The proposed sequence of works over the failed section must be agreed with the structural engineer prior to works commencing. Specifically, the following must be confirmed:

  i. The extent of wall to be removed.

  ii. Any requirements for the reconstruction of the wall

  iii. Any special precautions that must be adopted with a regard to the existing graves behind this section of the site.

Designer

[redacted]

Will Frampton BSc MSc FGS CGeol

Checker

[redacted]

Jim Martin BSc CEng FICE FGS

Byland	Appendices

Job No.	2099	Designer	W Frampton	Date	08/07/2020
Job Name	St Andrews Church, Kirby Malzeard	Checker	J Martin	Date	08/07/2020
Section	Stabilisation of Existing Retaining Wall using Soil Nails	Revision	A		

Appendix A – Designers Risk Assessment

2099 – St Andrews Church, Kirby Malzeard – Soil Nail Stabilisation of existing Masonry Wall
Designers Risk Assessment

Hazard No	Hazard Description	Undesirable event and/or Consequence	Initial Risk Before Control			Mitigation	Residual Risk After Control		
			P	C	R		P	C	R
Health & Safety Risks									
001	Buried & Overhead Services	Injury or death to construction personnel, delays, increased cost	4	5	20	· Service plans to be obtained in advance of the works · Site to be scanned with a Cable Avoidance Tool · All known service locations to be “ground truthed” by hand dug excavations prior to works commencing · Overhead cables to be provided with suitable protection to prevent accidental strike · Services to be protected where plant operates above them	1	5	5
002	Working at Height above 4.0m high wall	Injury or death to construction personnel, delays, increased cost	4	5	20	· Safety barrier to be provided behind wall during the works · Appropriate access arrangements to be put in place e.g. scaffold or MEWP · Personnel to wear harnesses as necessary	1	5	5
003	Lifting heavy steel components	Injury to personnel	4	3	12	· Appropriate lifting techniques to be adopted · Lifting to be undertaken using plant where possible · Rebar and other components to be provided in short sections	1	3	3
004	Working adjacent to a live highway	Injury or death to construction personnel, delays	3	5	15	· Highway to be closed during works · Suitable access arrangements to be made for local residents / school · Appropriate traffic management to be adopted	1	5	5
005	Exposed steel nail heads protruding from face of wall	Injury to personnel, pedestrians	3	5	15	· Recessed plates to be used such that nut and nail head are covered. · In the event exposed heads are to be adopted for aesthetic reasons then nail heads to be ground smooth to minimise rough metal edges	1	5	5
006	Collapse of the wall during drilling or due to high grout pressures	Injury or death to personnel, delays	3	5	15	· Wall to be pre-cored to limit disturbance & vibration to the wall and form a neat hole · Temporary support to be provided to the wall during drilling and grouting operations e.g. stone filled aggregate bags etc. · Personnel to stand a safe distance away from the wall during drilling and grouting operations i.e. in case there is further collapse · Works to halt if the wall shows signs of movement/distress. · Works not to be undertaken during heavy rain to prevent hydrostatic pressure building up on partially supported wall · Failed section of wall to be inspected by the structural engineer (MCA) and extent to be dismantled agreed before works commence	1	5	5
Construction / Geotechnical Risks									
007	No site investigation	Delays, increased cost	2	3	6	· Careful record of conditions encountered during drilling to be kept · If very soft or loose zones of soil are encountered behind the wall then the geotechnical designer should be contacted immediately before further soil nails are installed.	1	3	3

2099 – St Andrews Church, Kirby Malzeard – Soil Nail Stabilisation of existing Masonry Wall
Designers Risk Assessment

Hazard No	Hazard Description	Undesirable event and/or Consequence	Initial Risk Before Control			Mitigation	Residual Risk After Control		
			P	C	R		P	C	R
008	"Hard" drilling conditions or obstructions	Delays, increased cost	2	3	6	· The design employs a 90mm f drill bit which should be able to penetrate through the ground behind using percussive drilling techniques. · If the ground cannot be penetrated then the designer should be contacted immediately and the design reviewed. · In the event that bedrock is encountered then a penetration of 0.5m into rock will be considered sufficient for the design forces.	1	3	3
009	Loss of grout during pumping	Delays, increased cost, contamination of local water courses	3	3	9	· There are graves located behind the wall and the potential for voids to be associated with them. All statutory requirements should be followed. · For each of the soil nails the theoretical capacity of grout is ~40 litres. A maximum allowable quantity of grout equal to 5 times the theoretical capacity is specified i.e. 200 litres. · If the soil nail is not completely filled after this amount has been pumped then the grouting should be stopped to ensure that excess pressure does not build up behind the wall and the designer contacted immediately	1	3	3
010	Blocked Drainage	Delays, increased cost	4	3	9	· Existing weep holes should be inspected and cleaned prior to works commencing.	1	3	3
011	Church foundations and basement	Delays, increased cost, damage to structure	4	4	16	· The depth of the foundations and presence or absence of a crypt below the tower must be confirmed prior to works commencing	1	4	4
012	Sequence of works with regard the failed section of wall	Delays, increased cost	3	3	9	· Failed section of wall to be inspected by the structural engineer (MCA) and extent to be dismantled agreed before works commence. · Consideration should be given to removal of graves that are present immediately behind the wall which will be affected by the soil nail works · Sequence of works to be agreed in advance of works commencing	1	3	3
013	Damage to the wall during drilling of the soil nails	Delays, increased cost	3	3	9	· Wall to be pre-cored · Temporary support to be provided to the wall during drilling and grouting operations e.g. stone filled aggregate bags etc.	1	3	3
014	Excessive displacement of Soil nail during Pull-out testing.	Delays, increased cost	3	4	12	· Testing should be controlled such that the test load does not exceed 37.5kN. · The equipment used during testing should carry a valid calibration certificate. · The designer should be contacted immediately is the soil nail exhibits excessive displacement.	1	4	5

Scoring System

Probability (P)	Very Likely (5)	Likely (4)	Probable (3)	Unlikely (2)	Negligible (1)
Consequence (C)	Very High (5)	High (4)	Medium (3)	Low (2)	Very Low (1)

Risk (R) = P x C

Where risk score exceeds 8, risk control is required.

Compiler: **Will Frampton** **Approved:** **Jim Martin**

Date: **20th March 2020** **Date:** **20th March 2020**

Job No.	2099	Designer	W Frampton	Date	08/07/2020
Job Name	St Andrews Church, Kirby Malzeard	Checker	J Martin	Date	08/07/2020
Section	Stabilisation of Existing Retaining Wall using Soil Nails	Revision	A		

Appendix B – SNAIL input/output

```
               ************************************************
               *    CALIFORNIA DEPARTMENT OF TRANSPORTATION   *
               *          ENGINEERING SERVICE CENTER          *
               *     DIVISION OF MATERIALS AND FOUNDATIONS    *
               *   Office of Roadway Geotechnical Engineering *
               *    Date: 07-08-2020          Time: 11:35:39  *
               ************************************************
```

Project Identification -

-------- WALL GEOMETRY --------

Vertical Wall Height = 3.50 m
Wall Batter = 3.0 degree

	Angle (Deg)	Length (Meter)
First Slope from Wallcrest.	0.0	36.6
Second Slope from 1st slope.	0.0	0.0
Third Slope from 2nd slope.	0.0	0.0
Fourth Slope from 3rd slope.	0.0	0.0
Fifth Slope from 4th slope.	0.0	0.0
Sixth Slope from 5th slope.	0.0	0.0
Seventh Slope Angle.	0.0	

-------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

-------- SURCHARGE --------

The SURCHARGES imposed on the system are:

Begin Surcharge - Distance from toe = 0.50 m
End Surcharge - Distance from toe = 10.00 m
Loading Intensity - Begin = 5.0 kPa/m
Loading Intensity - End = 5.0 kPa/m

-------- OPTION #1 --------

Ultimate Punching shear, Bond & Yield Stress are used.

-------- SOIL PARAMETERS --------

Soil Layer	Unit Weight (kN/m3)	Friction Angle (Degree)	Cohesion Intercept (kPa)	Bond* Stress (kPa)	Coordinates of Boundary XS1 (m)	YS1 (m)	XS2 (m)	YS2 (m)
1	18.00	28.0	0.0	50.0	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

-------- WATER SURFACE --------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = -5.00 m Y(1)-Coordinate = -2.00 m
X(2)-Coordinate = 0.00 m Y(2)-Coordinate = 1.00 m
X(3)-Coordinate = 10.00 m Y(3)-Coordinate = 3.00 m

-------- SEARCH LIMIT --------

The Search Limit is from 0.00 to 3.00 m

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

-------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	= 3
Horizontal Spacing	= 1.25 m
Diameter of Reinforcement Element	= 19.0 mm
Yield Stress of Reinforcement	= 520.0 MPa
Diameter of Grouted Hole	= 130.0 mm
Punching Shear	= 150.0 kN

--------(For ALL Levels)--------

Reinforcement Lengths	= 5.0 m
Reinforcement Inclination	= 25.0 degrees
Vertical Spacing to First Level	= 0.50 m
Vertical Spacing to Remaining Levels	= 1.25 m

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
Toe	1.396	0.5	80.6	2.8	89.9	0.7

Reinf. Stress at Level 1 = 240.380 MPa (Pullout controls...)
2 = 247.406 MPa (Pullout controls...)
3 = 254.913 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 2						
	1.619	0.7	73.0	2.6	89.9	1.1

Reinf. Stress at Level 1 = 193.489 MPa (Pullout controls...)
2 = 203.485 MPa (Pullout controls...)
3 = 217.046 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 3						
	1.597	1.0	71.9	3.3	89.9	0.4

Reinf. Stress at Level 1 = 189.991 MPa (Pullout controls...)
2 = 204.787 MPa (Pullout controls...)
3 = 219.582 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 4						
	1.608	1.3	69.5	3.7	89.9	0.0

Reinf. Stress at Level 1 = 183.318 MPa (Pullout controls...)
2 = 200.248 MPa (Pullout controls...)
3 = 217.178 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 5						
	1.577	1.6	52.8	1.3	72.0	2.6

Reinf. Stress at Level 1 = 172.696 MPa (Pullout controls...)
2 = 187.600 MPa (Pullout controls...)
3 = 215.234 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 6					
1.591	1.9	43.0	1.5	73.0	2.6

Reinf. Stress at Level 1 = 157.993 MPa (Pullout controls...)
2 = 171.841 MPa (Pullout controls...)
3 = 209.362 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 7					
1.625	2.2	39.1	1.7	70.6	2.6

Reinf. Stress at Level 1 = 145.084 MPa (Pullout controls...)
2 = 160.810 MPa (Pullout controls...)
3 = 203.316 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 8					
1.655	2.4	35.7	1.8	68.3	2.6

Reinf. Stress at Level 1 = 133.305 MPa (Pullout controls...)
2 = 150.791 MPa (Pullout controls...)
3 = 198.059 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 9					
1.694	2.7	37.7	1.7	61.0	2.8

Reinf. Stress at Level 1 = 127.429 MPa (Pullout controls...)
2 = 150.825 MPa (Pullout controls...)
3 = 194.357 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)

```
NODE10
     1.718         3.0       35.0    1.8     58.5    2.9

  Reinf. Stress at Level  1 = 118.366 MPa (Pullout controls...)
                          2 = 143.554 MPa (Pullout controls...)
                          3 = 190.560 MPa (Pullout controls...)


      ********************************************************************
      *                 For Factor of Safety = 1.0                       *
      *          Maximum Average Reinforcement Working Force:            *
      *                     33.319 kN/level                               *
      ********************************************************************
```

```
               ************************************************
               *    CALIFORNIA DEPARTMENT OF TRANSPORTATION      *
               *          ENGINEERING SERVICE CENTER             *
               *     DIVISION OF MATERIALS AND FOUNDATIONS       *
               *   Office of Roadway Geotechnical Engineering    *
               *    Date: 07-08-2020          Time: 11:37:04     *
               ************************************************
```

Project Identification -

-------- WALL GEOMETRY --------

Vertical Wall Height = 3.50 m
Wall Batter = 3.0 degree

	Angle (Deg)	Length (Meter)
First Slope from Wallcrest.	0.0	40.0
Second Slope from 1st slope.	0.0	0.0
Third Slope from 2nd slope.	0.0	0.0
Fourth Slope from 3rd slope.	0.0	0.0
Fifth Slope from 4th slope.	0.0	0.0
Sixth Slope from 5th slope.	0.0	0.0
Seventh Slope Angle.	0.0	

-------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

-------- SURCHARGE --------

The SURCHARGES imposed on the system are:

Begin Surcharge - Distance from toe = 0.50 m
End Surcharge - Distance from toe = 10.00 m
Loading Intensity - Begin = 7.5 kPa/m
Loading Intensity - End = 7.5 kPa/m

-------- OPTION #1 --------

Ultimate Punching shear, Bond & Yield Stress are used.

-------- SOIL PARAMETERS --------

Soil Layer	Unit Weight (kN/m3)	Friction Angle (Degree)	Cohesion Intercept (kPa)	Bond* Stress (kPa)	Coordinates of Boundary XS1 (m)	YS1 (m)	XS2 (m)	YS2 (m)
1	24.30	28.0	0.0	45.0	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

-------- WATER SURFACE --------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = -5.00 m Y(1)-Coordinate = -2.00 m
X(2)-Coordinate = 0.00 m Y(2)-Coordinate = 1.00 m
X(3)-Coordinate = 10.00 m Y(3)-Coordinate = 3.00 m

-------- SEARCH LIMIT --------

The Search Limit is from 0.00 to 3.00 m

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

-------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	= 3
Horizontal Spacing	= 1.25 m
Diameter of Reinforcement Element	= 19.0 mm
Yield Stress of Reinforcement	= 520.0 MPa
Diameter of Grouted Hole	= 130.0 mm
Punching Shear	= 150.0 kN

--------(For ALL Levels)--------

Reinforcement Lengths	= 5.0 m
Reinforcement Inclination	= 25.0 degrees
Vertical Spacing to First Level	= 0.50 m
Vertical Spacing to Remaining Levels	= 1.25 m

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
Toe	1.311	0.5	80.6	2.8	89.9	0.7

Reinf. Stress at Level 1 = 230.432 MPa (Pullout controls...)
2 = 237.168 MPa (Pullout controls...)
3 = 244.364 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 2						
	1.405	0.7	73.0	2.6	89.9	1.1

Reinf. Stress at Level 1 = 200.558 MPa (Pullout controls...)
2 = 210.919 MPa (Pullout controls...)
3 = 224.975 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 3						
	1.350	1.0	73.6	3.6	89.9	0.0

Reinf. Stress at Level 1 = 206.337 MPa (Pullout controls...)
2 = 220.399 MPa (Pullout controls...)
3 = 234.460 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 4						
	1.352	1.3	65.8	1.9	73.3	1.8

Reinf. Stress at Level 1 = 193.164 MPa (Pullout controls...)
2 = 209.358 MPa (Pullout controls...)
3 = 231.051 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 5						
	1.310	1.6	47.7	1.4	75.4	2.5

Reinf. Stress at Level 1 = 183.847 MPa (Pullout controls...)
2 = 196.473 MPa (Pullout controls...)
3 = 230.935 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 6					
1.332	1.9	43.0	1.5	73.0	2.6

Reinf. Stress at Level 1 = 169.830 MPa (Pullout controls...)
2 = 184.715 MPa (Pullout controls...)
3 = 225.047 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 7					
1.352	2.2	44.3	1.5	66.3	2.7

Reinf. Stress at Level 1 = 161.724 MPa (Pullout controls...)
2 = 182.987 MPa (Pullout controls...)
3 = 222.367 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 8					
1.371	2.4	40.8	1.6	63.6	2.7

Reinf. Stress at Level 1 = 150.437 MPa (Pullout controls...)
2 = 173.992 MPa (Pullout controls...)
3 = 217.702 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 9					
1.390	2.7	37.7	1.7	61.0	2.8

Reinf. Stress at Level 1 = 139.759 MPa (Pullout controls...)
2 = 165.420 MPa (Pullout controls...)
3 = 213.164 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)

NODE10

1.411	3.0	35.0	1.8	58.5	2.9

Reinf. Stress at Level 1 = 129.673 MPa (Pullout controls...)
2 = 157.267 MPa (Pullout controls...)
3 = 208.763 MPa (Pullout controls...)

****
* For Factor of Safety = 1.0 *
* Maximum Average Reinforcement Working Force: *
* 43.923 kN/level *
****

```
               ************************************************
               *    CALIFORNIA DEPARTMENT OF TRANSPORTATION   *
               *          ENGINEERING SERVICE CENTER          *
               *     DIVISION OF MATERIALS AND FOUNDATIONS    *
               *   Office of Roadway Geotechnical Engineering *
               *    Date: 07-08-2020          Time: 11:39:15  *
               ************************************************
```

Project Identification -

-------- WALL GEOMETRY --------

Vertical Wall Height = 3.50 m
Wall Batter = 3.0 degree

	Angle (Deg)	Length (Meter)
First Slope from Wallcrest.	0.0	40.0
Second Slope from 1st slope.	0.0	0.0
Third Slope from 2nd slope.	0.0	0.0
Fourth Slope from 3rd slope.	0.0	0.0
Fifth Slope from 4th slope.	0.0	0.0
Sixth Slope from 5th slope.	0.0	0.0
Seventh Slope Angle.	0.0	

-------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

-------- SURCHARGE --------

The SURCHARGES imposed on the system are:

Begin Surcharge - Distance from toe = 0.50 m
End Surcharge - Distance from toe = 10.00 m
Loading Intensity - Begin = 6.5 kPa/m
Loading Intensity - End = 6.5 kPa/m

-------- OPTION #1 --------

Ultimate Punching shear, Bond & Yield Stress are used.

-------- SOIL PARAMETERS --------

Soil Layer	Unit Weight (kN/m3)	Friction Angle (Degree)	Cohesion Intercept (kPa)	Bond* Stress (kPa)	Coordinates of Boundary XS1 (m)	YS1 (m)	XS2 (m)	YS2 (m)
1	18.00	22.2	0.0	33.0	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

-------- WATER SURFACE --------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = -5.00 m Y(1)-Coordinate = -2.00 m
X(2)-Coordinate = 0.00 m Y(2)-Coordinate = 1.00 m
X(3)-Coordinate = 10.00 m Y(3)-Coordinate = 3.00 m

-------- SEARCH LIMIT --------

The Search Limit is from 0.00 to 3.00 m

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

-------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	= 3
Horizontal Spacing	= 1.25 m
Diameter of Reinforcement Element	= 19.0 mm
Yield Stress of Reinforcement	= 452.0 MPa
Diameter of Grouted Hole	= 130.0 mm
Punching Shear	= 130.0 kN

--------(For ALL Levels)--------

Reinforcement Lengths	= 5.0 m
Reinforcement Inclination	= 25.0 degrees
Vertical Spacing to First Level	= 0.50 m
Vertical Spacing to Remaining Levels	= 1.25 m

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
Toe	1.030	0.5	80.6	2.8	89.9	0.7

Reinf. Stress at Level 1 = 215.156 MPa (Pullout controls...)
2 = 221.445 MPa (Pullout controls...)
3 = 228.164 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 2						
	1.083	0.7	73.0	2.6	89.9	1.1

Reinf. Stress at Level 1 = 190.818 MPa (Pullout controls...)
2 = 200.675 MPa (Pullout controls...)
3 = 214.049 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 3						
	1.067	1.0	0.0	0.1	75.2	3.6

Reinf. Stress at Level 1 = 190.363 MPa (Pullout controls...)
2 = 201.958 MPa (Pullout controls...)
3 = 213.553 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 4						
	1.075	1.3	0.0	0.4	75.3	3.6

Reinf. Stress at Level 1 = 176.679 MPa (Pullout controls...)
2 = 188.071 MPa (Pullout controls...)
3 = 199.463 MPa (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 5						
	1.103	1.6	47.7	1.4	75.4	2.5

Reinf. Stress at Level 1 = 160.146 MPa (Pullout controls...)
2 = 171.144 MPa (Pullout controls...)
3 = 201.163 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 6					
1.123	1.9	38.7	1.7	77.1	2.5

Reinf. Stress at Level 1 = 144.061 MPa (Pullout controls...)
2 = 153.394 MPa (Pullout controls...)
3 = 193.965 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 7					
1.145	2.2	39.1	1.7	70.6	2.6

Reinf. Stress at Level 1 = 135.939 MPa (Pullout controls...)
2 = 150.674 MPa (Pullout controls...)
3 = 190.500 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 8					
1.164	2.4	35.7	1.8	68.3	2.6

Reinf. Stress at Level 1 = 125.137 MPa (Pullout controls...)
2 = 141.552 MPa (Pullout controls...)
3 = 185.925 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)
NODE 9					
1.183	2.7	37.7	1.7	61.0	2.8

Reinf. Stress at Level 1 = 120.475 MPa (Pullout controls...)
2 = 142.595 MPa (Pullout controls...)
3 = 183.752 MPa (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (m)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (m)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (m)

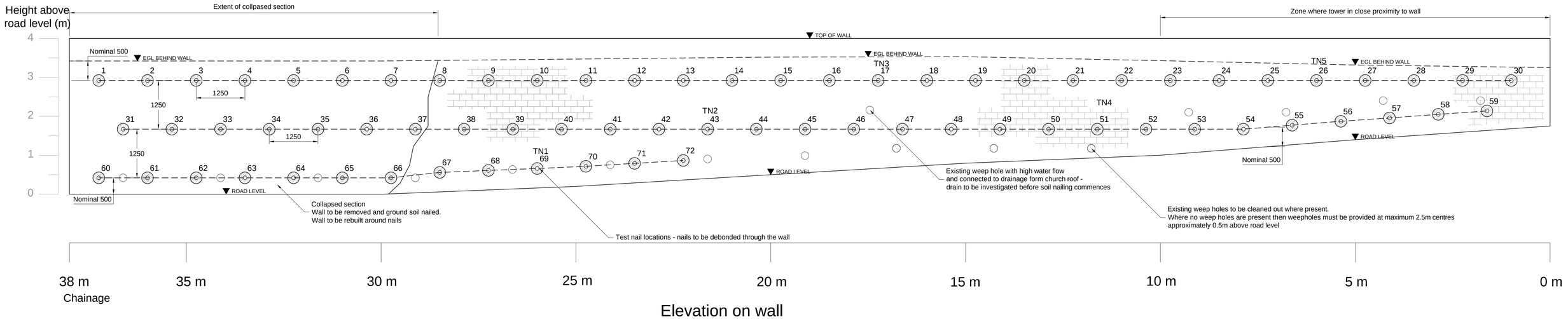
```
NODE10
     1.198         3.0       35.0    1.8     58.5    2.9

  Reinf. Stress at Level  1 = 111.965 MPa (Pullout controls...)
                          2 = 135.790 MPa (Pullout controls...)
                          3 = 180.254 MPa (Pullout controls...)


      ********************************************************************
      *                 For Factor of Safety = 1.0                       *
      *          Maximum Average Reinforcement Working Force:            *
      *                     53.925 kN/level                               *
      ********************************************************************
```

Byland	Appendices

Job No.	**2099**	**Designer**	**W Frampton**	**Date**	**08/07/2020**
Job Name	**St Andrews Church, Kirby Malzeard**	**Checker**	**J Martin**	**Date**	**08/07/2020**
Section	**Stabilisation of Existing Retaining Wall using Soil Nails**	**Revision**	**A**		

Appendix C – Byland Drawings 2099-001 & 2099-002

Refer to MCA calculations / drawings for details on the re-constructed wall



Elevation on wall
(Scale 1:50)

Collapsed Section of wall
(NTS)

Weephole with high flow connected to site drainage
(NTS)

Approximate start point
(NTS)

CDM 2015 :

In accordance with the CDM regulations (2015) a Designers Risk Assessment is included with Appendix A of the Byland Soil Nail Calculations which must be read in conjunction with these drawings.

NOTES :

General

1. All dimensions mm UNO
2. All elevations mOD UNO
3. Do not scale, use figured dimensions only
4. All micropiles to be formed using galvanised Dywidag R32-280 self drilling rebar (or similar approved) and installed using a nominal 90mm Ø sacrificial drill bit
5. Soil Nails to be formed using a neat OPC grout, strength 35N at 28 days and maximum water cement ratio of 0.4
6. All steel work for head plate assembly to Grade S275 UNO
7. Head plates to comprises Anchor Systems Limited Recessed AS90 Pattress Plate or similar approved arrangement
8. Minimum 5 No. soil nail tests to be carried out at the locations shown (marked TN) to a maximum test load of 37.5kN in 3 No. increments at 12.5kN, 25kN & 37.5kN

REV.	AMENDMENTS	DRAWN	CHECK	DATE

Byland engineering limited
Geotechnical Design Engineers

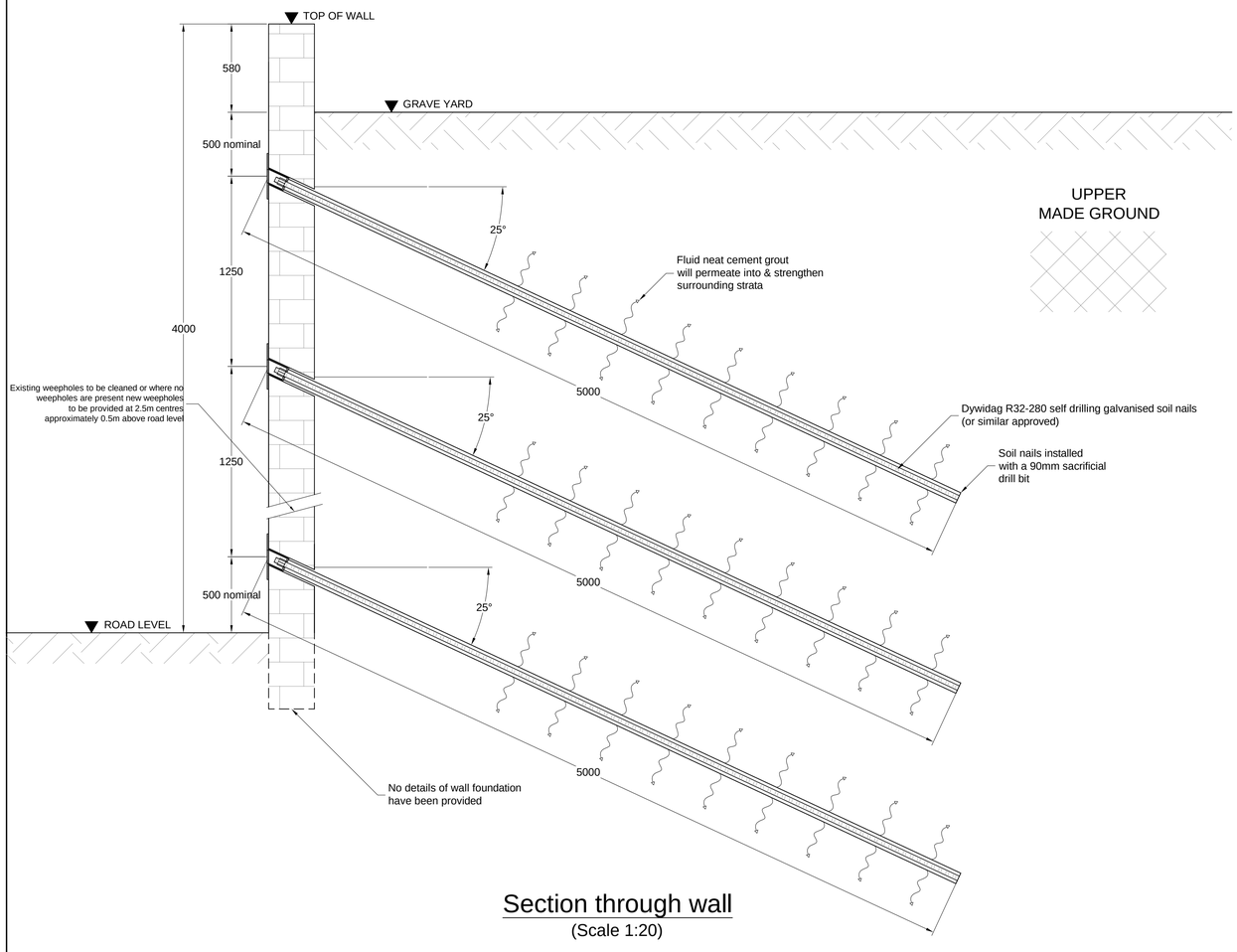
Client:
Mason Clarke Associates

Project :
St Andrews Church, Kirby Malzeard

Title :
Soil Nail Layout Drawing

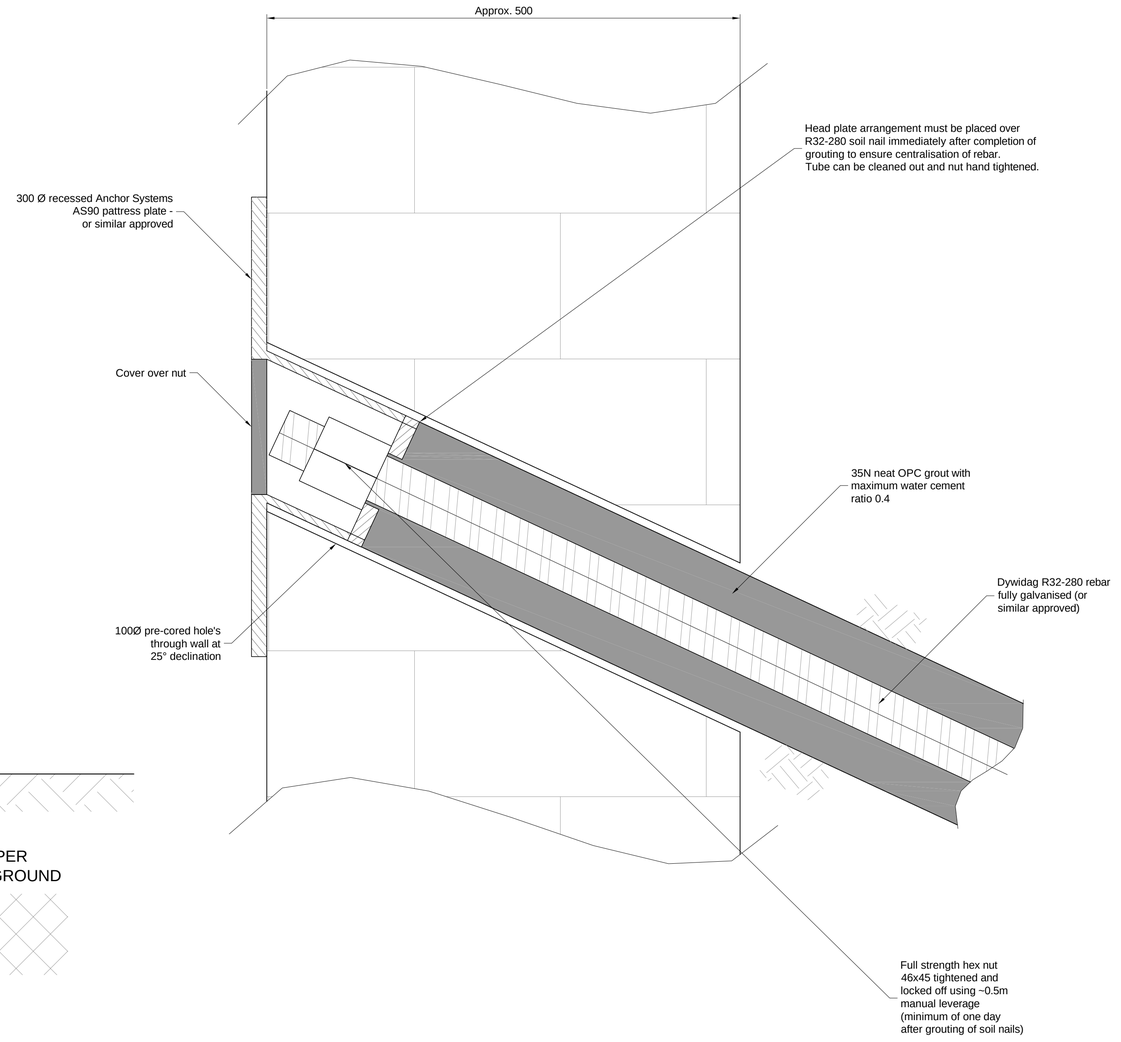
Drawing Status :
FOR APPROVAL

	INITIALS	DATE	SCALE	DRAWING NUMBER
DRAWN	WF	18/03/20	As Shown	2099/001
CHECKED	JM	18/03/20		
DATE : MAR 2020			ORIGINAL SHEET SIZE A1	REVISION : 0



Section through wall

(Scale 1:20)



Detail of Soil Nail Head Plate arrangement

(Scale 1:2)

CDM 2015 :

In accordance with the CDM regulations (2015) a Designers Risk Assessment is included with Appendix A of the Byland Soil Nail Calculations which must be read in conjunction with these drawings.

NOTES :

General

1. All dimensions mm UNO
2. All elevations mOD UNO
3. Do not scale, use figured dimensions only
4. All micropiles to be formed using galvanised Dywidag R32-280 self drilling rebar (or similar approved) and installed using a nominal 90mm Ø sacrificial drill bit
5. Soil Nails to be formed using a neat OPC grout, strength 35N at 28 days and maximum water cement ratio of 0.4
6. All steel work for head plate assembly to Grade S275 UNO
7. Head plates to comprises Anchor Systems Limited Recessed AS90 Pattress Plate or similar approved arrangement
8. Minimum 5 No. soil nail tests to be carried out at the locations shown (marked TN) to a maximum test load of 37.5kN in 3 No. increments at 12.5kN, 25kN & 37.5kN

REV.	AMENDMENTS	DRAWN	CHECK	DATE
A	Soil Nail Declination Increase from 20° to 25°	BS	WF	07/07/20

Byland engineering limited
Geotechnical Design Engineers

Client:
Mason Clarke Associates

Project :
St Andrews Church, Kirby Malzeard

Title :
Soil Nail Details Drawing

Drawing Status :
FOR APPROVAL

	INITIALS	DATE	SCALE	DRAWING NUMBER
DRAWN	WF	18/03/20	As Shown	2099/002
CHECKED	JM	18/03/20		
DATE : MAR 2020			ORIGINAL SHEET SIZE A1	REVISION : A

APPENDIX C

ON SITE ARCHEOLOGY SCHEME OF INVESTIGATION FOR AN ARCHAELOGICAL WATCHING BRIEF

(Under Separate Cover)

masonclarkassociates
civil and structural engineering consultants

1990–2020
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consultants@masonclark.co.uk	www.masonclark.co.uk	www.masonclark.co.uk

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Section 98 and 185 Agreements
Flood Risk Assessments
Coastal erosion flood breach analysis
Flood risk management / prevention schemes
Underground drainage design
Stormwater attenuation
SUDS
Ponds, lakes and balancing ponds

PROJECT MANAGEMENT
QUANTITY SURVEYING & CONTRACT ADVICE
CDM SERVICES

BUILDING SURVEYING SERVICES
Design, Remedial Repair / Improvement Schemes
Contract Administration
Building Surveys
Professional Opinion Reports
Condition Surveys & Schedules of Condition
Measured Surveys
Dilapidation Claims
Party Wall etc. Act Representation
Disabled Adaptations

EXPERT WITNESS SERVICES
Civil & Structural engineering disputes
Project Disputes
Health and Safety Regulations

STRUCTURAL ENGINEERING
Residential and commercial building structures
Education and healthcare facilities
Heavy industrial development
Feasibility studies for development sites
Building Regulations and Planning Applications
Access and maintenance gantries
Modular building design
Blast design
Subsidence management and resolution
Temporary works design and specification
Site and soils investigation
Sulphate attack specialists
Confined spaces assessments

CONSERVATION ENGINEERING
Engineer Accredited in Building Conservation
CARE Registered Engineer
Heritage and conservation engineering
Listed Building refurbishment
Historic Parks and Gardens
Scheduled Ancient Monuments
Monitoring and investigations
Liaison with Local Conservation Officers
Buildings at Risk and Managed Ruins

3D LASER SCANNING AND DATA CAPTURE
Latest Generation 3D Laser Scanning
Measured Building Surveys
Topographical Surveys
Monitoring Surveys
3D modelling (Revit, CAD, Inventor, Solidworks)
M & E Modelling
Volumetric / Level analysis
Scan to BIM
Scan data cloud hosting
Hi-Def HDR photographic surveys