P8743 Pyenest Street, Stoke
<u>SHAFT TREATMENT SPECIFICATION</u>

Mineshaft 387346-002

Shaft Location Investigation Works

- The shaft has been located during the demolition of the building, with its current location being currently demarcated by a metal post which is surrounded by security fencing. The departure to the shaft can therefore be reduced accordingly. According to photographs taken by others the shaft is brick-lined and isn't capped. The shaft is domed at surface, with an initial opening measuring approximately 1.80m wide. The portion of the shaft below the surface extends outwards to approximately 2.30m. Therefore our current assumption is that the shaft is at least 2.50m wide. It is therefore considered feasible that the shaft can be located to a reasonable accuracy by probe drilling.

- The probe drilling shall investigate both the depth to rockhead outside of the shaft and the depth of the shaft itself to assess two conditions:

  1) The level at which competent strata exists, and
  2) The amount of treatment required.

The level at which competent strata exists will determine the zone of influence for the shaft. It is inferred from existing information for the site that rockhead may be around 5.0m below existing ground level. A probe hole will be drilled outside of the inferred shaft position to determine the depth to rockhead.

Shaft Treatment Works

The treatment works shall be as follows:

- A rotary drilling rig will drill one borehole down to prove the base of the shaft for a distance of at least 5m into the rock below the base.

- If the shaft is full then the shaft will be pressure grouted in stages using a 10:1 PFA:OPC mix. Where necessary to suit the current backfill and grout takes, sand and/or gravel will be added to the mix.

- Once the primary borehole is full, a second borehole is drilled and grouted in the same way, being located part way between the centre borehole and the shaft edge.

- The second borehole should take less grout than the first borehole. If it does not, or takes more than three times the boreholes volume, a third borehole will be drilled with the same treatment specification. This borehole should only take the borehole volume of grout, indicating that the shaft fill has been fully grouted.

- Once the drill and grout programme has been completed and the grout has cured sufficiently the shaft cap construction shall begin.

- The shaft cap design details are appended to this document. The principal contractor shall be responsible for any temporary works required to maintain safe excavation during the construction of the cap.

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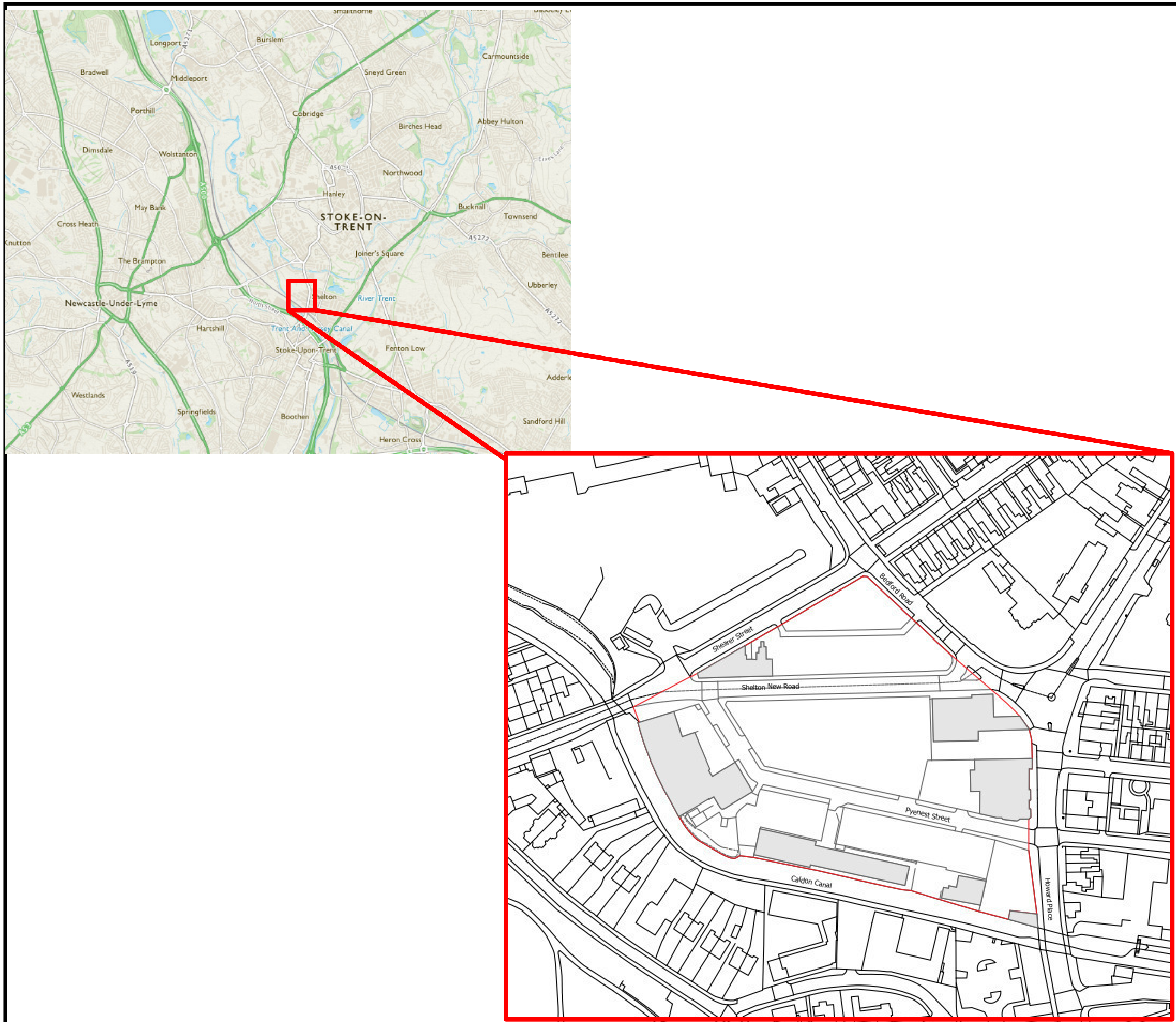

DO NOT SCALE

NOTES:

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CLIENT:
Stoke City Council

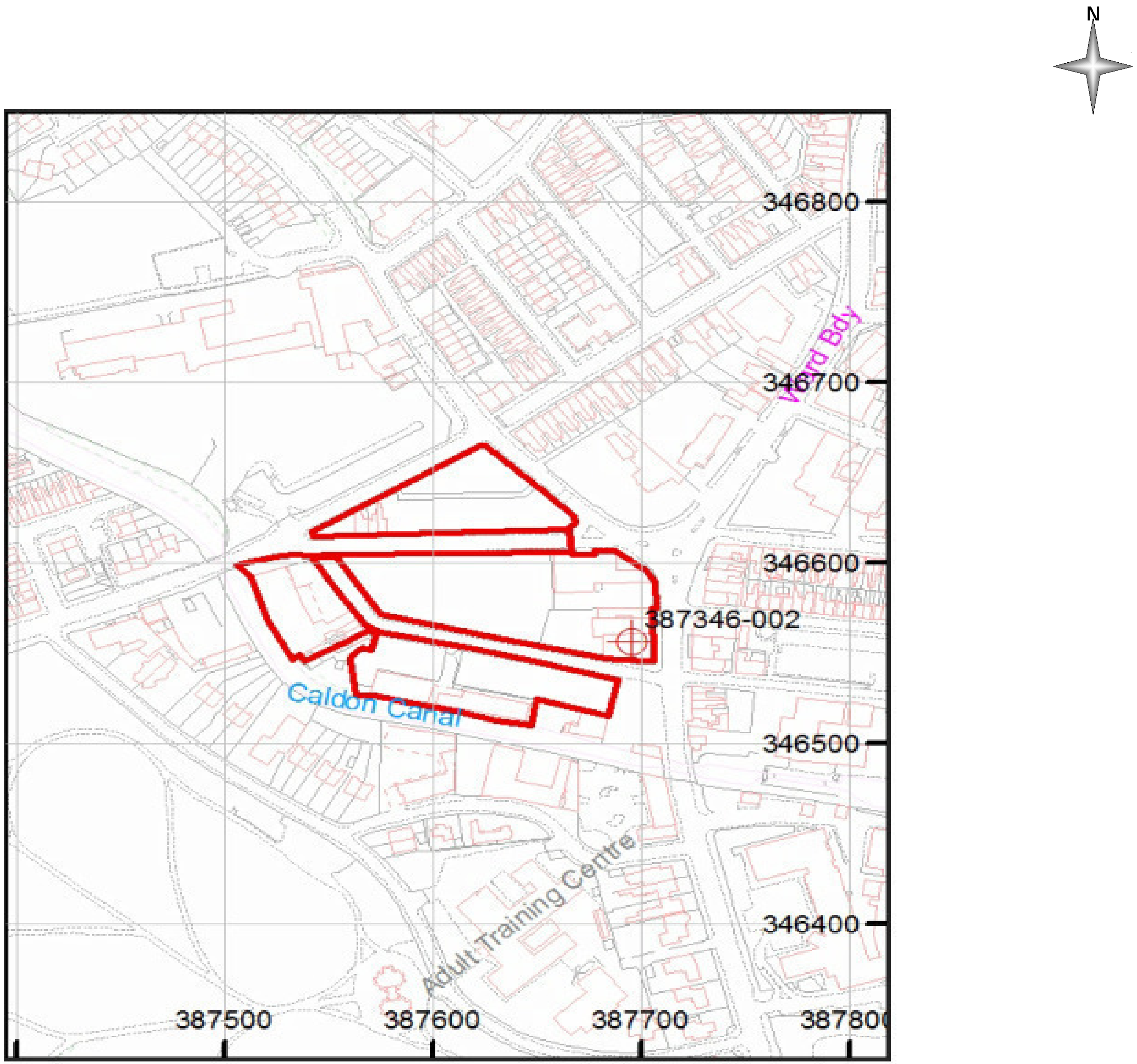
PROJECT:
Pyenest Street, Shelton, Stoke-on-Trent

TITLE:
Site Location Plan

SCALE@SIZE :	ISSUE:
NTS	FINAL
DESIGN/DRAWN by : AB	DATE: Dec 2018
PROJECT No: P8743	DRAWING No: 1

DO NOT SCALE

NOTES:



Key

Approximate position of enquiry boundary shown	(red square)
Disused mineshaft	(red crosshair)

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CLIENT:
Stoke City Council

PROJECT:
Pyenest Street, Shelton, Stoke-on-Trent

TITLE:
Shaft Location Plan

SCALE@SIZE :	ISSUE:
NTS	FINAL
DESIGN/DRAWN by : AB	DATE: Dec 2018
PROJECT No: P8743	DRAWING No: 2

Photo 1: Photo of the Shaft during demolition

Photo 2: Photo of the Shaft during demolition

N

DO NOT SCALE

NOTES:

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CLIENT:

Stoke City Council

PROJECT:

Pyenest Street, Shelton, Stoke-on-Trent

TITLE:

Shaft Photos Plan

SCALE@SIZE :	ISSUE:
NTS	FINAL
DESIGN/DRAWN by : AB	DATE: Dec 2018
PROJECT No: P8743	DRAWING No: 3

Drawing Issue Register

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Project	Pyenest Street Shelton Stoke on Trent
Client	Stoke on Trent City Council
Job Ref:	**P8743**

Day	21								
Month	12								
Year	18								

Description	Drawing No	Revision								
Capping Slab Details for Mine Shaft 387346-002	P8743_600	*								
Reinforcement Schedule	P8743_600.01	*								
Issued by -		CW								
Purpose of issue		P								

Distribution									
Christian Stayner - Stoke on Trent City Council	E								

F:\PROJECT.QA\8700-8799\P8743\[P8743 Drawing Issue Sheet.xls]Sheet1

A= For Approval
I= For Information
C= For Construction

GRM Development Solutions geoenvironmental - civil - structural	Laurus House, First Avenue, Centrum 100, Burton on Trent, Staffs. DE14 2WH Tel: 01283 551249 Fax: 01283 211968	Project No:	P8743
		Prepared by:	PR
		Checked by:	SAJ
		Date	21/12/2018

Superstructure Calculations

Client: Stoke-on-Trent City Council

Project: Pyenest Street, Stoke-on-Trent

Mine Shaft Capping Slab Design

GRM Development Solutions geoenvironmental - civil - structural	Laurus House, First Avenue, Centrum 100, Burton on Trent, Staffs. DE14 2WH Tel: 01283 551249	Project No:	P8743
		Prepared by:	PR
		Checked by:	SAJ
		Date	21/12/2018

Mine Shaft Capping Slab Loads **Pyenest Street, Stoke-on-Trent**

Circular Mine Shaft

Shaft Diameter	2.5 m	Density of Backfill	19 kN/m³
		Depth to Rock	5 m
Depth of Slab	0.35 m	Surcharge	33 kN/m²

Dead Loads:

Backfill	5 x 19 x 1 =	95 kN/m²
RC Capping Slab	0.35 x 24 x 1 =	8.4 kN/m²
Total		103.40 kN/m²

Imposed Loads:

Surcharge		33 kN/m²
Factored Design Load	(103.4 x 1.4) + (33 x 1.6) =	**197.56 kN/m²**
Effective Span 2.3 m		
Design Shear (per m width)	(197.56 x 2.3)/2 =	**227.19 kN**

RC SLAB DESIGN (BS8110) - CIRCULAR SHAFT

RC SLAB DESIGN (BS8110:PART1:1997)

TEDDS calculation version 1.0.04

TWO WAY SPANNING SLAB DEFINITION – SIMPLY SUPPORTED

Overall depth of slab h = **350** mm

Outer sagging steel

Cover to outer tension reinforcement resisting sagging c_{sag} = **75** mm

Trial bar diameter D_{tryx} = **10** mm

Depth to outer tension steel (resisting sagging)

$d_x = h - c_{sag} - D_{tryx}/2$ = **270** mm

Inner sagging steel

Trial bar diameter D_{tryy} = **10** mm

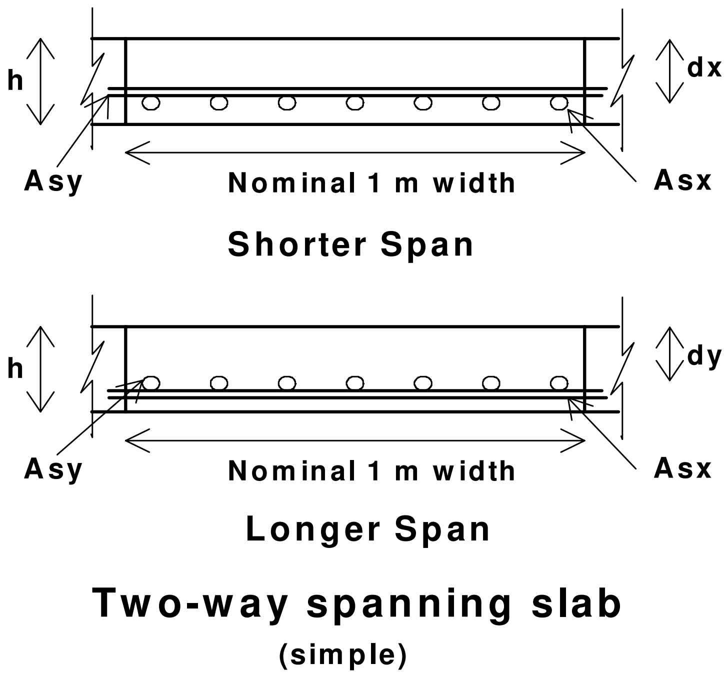
Depth to inner tension steel (resisting sagging)

$d_y = h - c_{sag} - D_{tryx} - D_{tryy}/2$ = **260** mm

Materials

Characteristic strength of reinforcement f_y = **500** N/mm^2

Characteristic strength of concrete f_{cu} = **35** N/mm^2



MAXIMUM DESIGN MOMENTS

Length of shorter side of slab l_x = **2.500** m

Length of longer side of slab l_y = **2.500** m

Design ultimate load per unit area n_s = **198.0** kN/m^2

Moment coefficients

$\alpha_{sx} = (l_y / l_x)^4 / (8 \times (1+(l_y / l_x)^4)) =$ **0.063**

$\alpha_{sy} = (l_y / l_x)^2 / (8 \times (1+(l_y / l_x)^4)) =$ **0.063**

Maximum moments per unit width - simply supported slabs

$m_{sx} = \alpha_{sx} \times n_s \times l_x^2 =$ **77.3** kNm/m

$m_{sy} = \alpha_{sy} \times n_s \times l_x^2 =$ **77.3** kNm/m

CONCRETE SLAB DESIGN – SAGGING – OUTER LAYER OF STEEL (CL 3.5.4)

Design sagging moment (per m width of slab) $m_{sx} =$ **77.3** kNm/m

Moment Redistribution Factor $\beta_{bx} =$ **1.0**

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu}) =$ **0.030**

$K'_x = \min(0.156 , (0.402 \times (\beta_{bx} - 0.4)) - (0.18 \times (\beta_{bx} - 0.4)^2)) =$ **0.156**

Outer compression steel not required to resist sagging

Slab requiring outer tension steel only - bars (sagging)

$z_x = \min((0.95 \times d_x),(d_x \times (0.5+\sqrt{(0.25-K_x/0.9)}))) =$ **257** mm

Neutral axis depth $x_x = (d_x - z_x) / 0.45 =$ **30** mm

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x) =$ **694** mm^2/m

Tension steel

Provide 10 dia bars @ 100 centres outer tension steel resisting sagging

$A_{sx\_prov} = A_{sx} =$ **785** mm^2/m

Area of outer tension steel provided sufficient to resist sagging

Concrete Slab Design - Sagging - Inner layer of steel (cl. 3.5.4)

Design sagging moment (per m width of slab) $m_{sy} =$ **77.3** kNm/m

Moment Redistribution Factor $\beta_{by} =$ **1.0**

Area of reinforcement required

$K_y = abs(m_{sy}) / (d_y^2 \times f_{cu}) =$ **0.033**

$K'_y = \min(0.156 , (0.402 \times (\beta_{by} - 0.4)) - (0.18 \times (\beta_{by} - 0.4)^2)) =$ **0.156**

Inner compression steel not required to resist sagging

Slab requiring inner tension steel only - bars (sagging)

$z_y = \min((0.95 \times d_y),(d_y \times (0.5+\sqrt{(0.25-K_y/0.9)}))) =$ **247** mm

Neutral axis depth $x_y = (d_y - z_y) / 0.45 =$ **29** mm

Area of tension steel required

$A_{sy\_req} = abs(m_{sy}) / (1/\gamma_{ms} \times f_y \times z_y) =$ **720** mm^2/m

Tension steel

Provide 10 dia bars @ 100 centres inner tension steel resisting sagging

$A_{sy\_prov} = A_{sy} =$ **785** mm^2/m

Area of inner tension steel provided sufficient to resist sagging

Check min and max areas of steel resisting sagging

Total area of concrete $A_c = h$ = **350000** mm^2/m

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c$ = **455** mm^2/m

$A_{st\_max} = 4 \% \times A_c$ = **14000** mm^2/m

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **785** mm^2/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging A_{sy_prov} = **785** mm^2/m

Area of inner steel provided (sagging) OK

SHEAR PERIMETERS FOR A CIRCULAR CONCENTRATED LOAD (CL 3.7.7)

Diameter of loaded circle D_L=**2500** mm

Depth to tension steel d_x = **270** mm

Dimension from edge of load to shear perimeter $l_p = k_p \times d_x$ = **405** mm where k_p = **1.50**

For punching shear cases not affected by free edges or holes:

Total length of inner perimeter at edge of loaded area $u_{0\_gen} = \pi \times D_L$ = **7854** mm

Total length of outer perimeter at l_p from loaded area $u_{gen} = 4 \times D_L + 8 \times l_p$ = **13240** mm

PUNCHING SHEAR AT CONCENTRATED LOADS (CL 3.7.7)

Tension steel resisting sagging

Total length of inner perimeter at edge of loaded area u_0 = **7854** mm

Total length of outer perimeter at dimension l_p from loaded area u = **13240** mm

Depth to outer steel d_x = **270** mm

Depth to inner steel d_y = **260** mm

Average depth to "tension" steel $d_{av} = (d_x + d_y)/2$ = **265.0** mm

Area of outer steel per m effective through the perimeter A_{sx_prov} = **785** mm^2 /m

Area of inner steel per m effective through the perimeter A_{sy_prov} = **785** mm^2 /m

Max shear effective across either perimeter under consideration V_p = **227** kN

Characteristic strength of concrete f_{cu} = **35** N/mm^2

Applied shear stress

Stress around loaded area $v_{max} = V_p / (u_0 \times d_{av})$ = **0.109** N/mm^2

Stress around perimeter $v = V_p / (u \times d_{av})$ = **0.065** N/mm^2

Check shear stress to clause 3.7.7.2

$v_{allowable} = \min((0.8\ N^{1/2}/mm) \times \sqrt{(f_{cu})}, 5\ N/mm^2)$ = **4.733** N/mm^2

Shear stress - OK

Shear stresses to clause 3.7.7.4

Design shear stress

$f_{cu\_ratio} = \text{if}\ (f_{cu} > 40\ N/mm^2, 40/25, f_{cu}/(25\ N/mm^2))$ = **1.400**

Effective steel area for shear strength determination: A_{s_eff} =**785** mm^2/m

$v_c = 0.79\ N/mm^2 \times \min(3, 100\times(A_{s\_eff} / d_{av}))^{1/3} \times \max(0.67, (400\ mm / d_{av})^{1/4}) / 1.25 \times f_{cu\_ratio}^{1/3}$

v_c = **0.522** N/mm^2

No shear reinforcement required

CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)

Slab span length l_x = **2.500** m

Design ultimate moment in shorter span per m width m_{sx} = **77** kNm/m

Depth to outer tension steel d_x = **270** mm

Tension steel

Area of outer tension reinforcement provided A_{sx_prov} = **785** mm^2/m

Area of tension reinforcement required A_{sx_req} = **694** mm^2/m

Moment Redistribution Factor β_{bx} = **1.00**

Modification Factors

Basic span / effective depth ratio (Table 3.9) $ratio_{span\_depth}$ = **20**

The modification factor for spans in excess of 10m (ref. cl 3.4.6.4) has not been included.

$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_prov} \times \beta_{bx})$ = **294.5** N/mm^2

$factor_{tens} = \min(2, 0.55 + (477 \text{ N/mm}^2 - f_s) / (120 \times (0.9 \text{ N/mm}^2 + m_{sx} / d_x^2)))$ = **1.326**

Calculate Maximum Span

This is a simplified approach and further attention should be given where special circumstances exist. Refer to clauses 3.4.6.4 and 3.4.6.7.

Maximum span $l_{max} = ratio_{span\_depth} \times factor_{tens} \times d_x$ = **7.16** m

Check the actual beam span

Actual span/depth ratio l_x / d_x = **9.26**

Span depth limit $ratio_{span\_depth} \times factor_{tens}$ = **26.51**

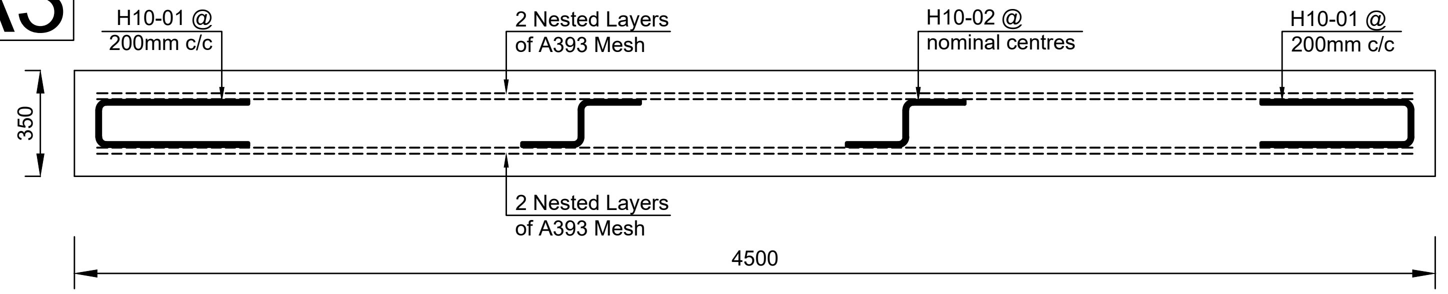
Span/Depth ratio check satisfied

Therefore to achieve reinforcement area of 785mm²/m two nested layers of A393 mesh may be used.

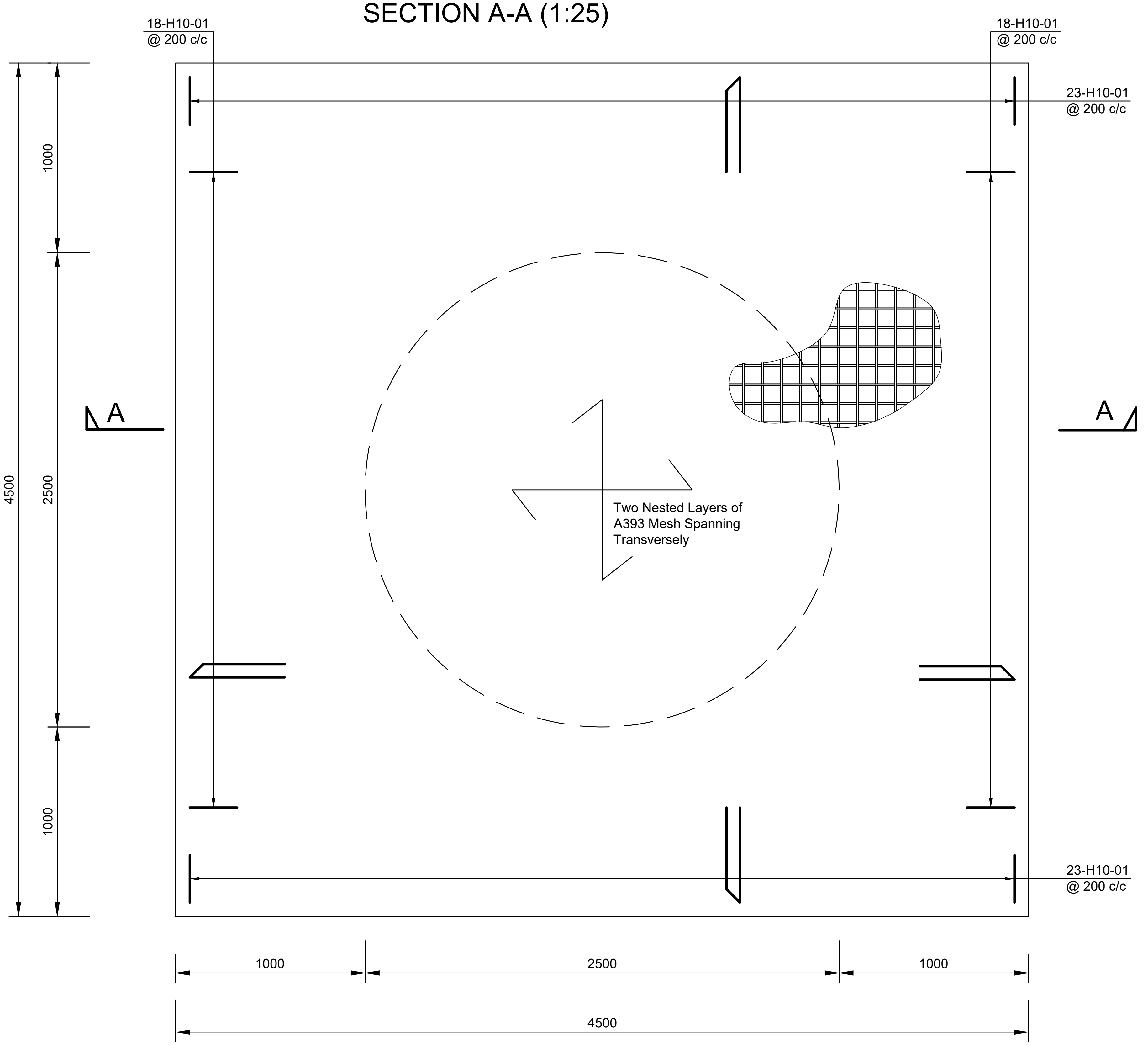
A3

Approximate Shaft centre coordinates
E: 387686
N: 346549

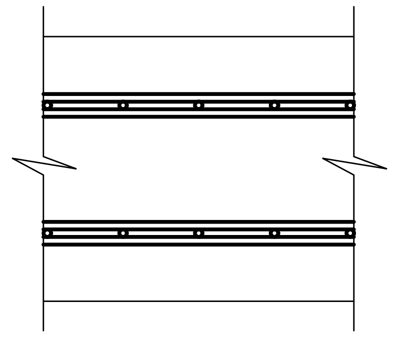
For reinforcement information refer to Bar Schedule Ref: P8743_600.01



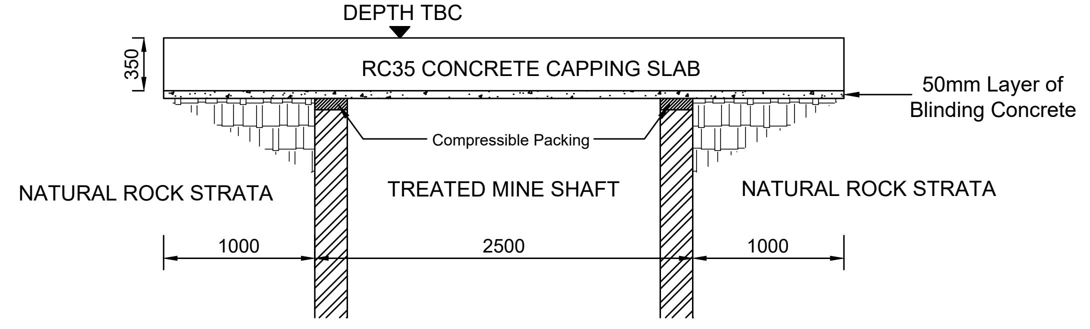
SECTION A-A (1:25)



2.5m DIAMETER MINE SHAFT CAPPING SLAB PLAN



SECTION THROUGH SLAB SHOWING MESH NESTED



SHAFT CAP DETAILS

General Notes

Until such time as the regulatory authorities have approved this drawing, all information contained is assumed to be preliminary and not for construction purposes. If ground conditions are different than anticipated GRM should be contacted for advice.
This drawing is not to be scaled.

Concrete Specification

Concrete to be RC35. Reinforced concrete is to comply with BS8110 and all other relevant British standards.

Loading Conditions

Capping slab designed for surcharge of 33kN/m² as recommended by National Coal Board. Overburden pressure of granular backfill above also included for 5m of depth.

Reinforcement

Cover to reinforcement to be 75mm, unless noted otherwise. Mesh reinforcement to have a minimum lap of 400mm.
Reinforcement is to comply with BS8666 and all other relevant British standards.

PRELIMINARY

Suffix	Date	Initials	Revision	SE	GEO
				Checked	

CLIENT
STOKE ON TRENT CITY COUNCIL

PROJECT
PYENEST STREET
SHELTON
STOKE ON TRENT

GRM Development Solutions
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TITLE
CAPPING SLAB DETAILS FOR MINE SHAFT
387346-002

REF	DRAWING NO.	REVISION
P8743	600	

DATE	SCALE
21/12/2018	1:50 & 1:25

DRAWN BY	CHECKED	APPROVED
CW	PR	SAJ