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# STRUCTURAL APPRAISAL REPORT
# FOR INSTALLATION OF WIND TURBINE AT
# 222 UPPER STREET,
# LONDON N1.

**Ref:** 060493

**By:** HMH

**Date:** NOV 2006

28531



28531

## Structural Inspection Report

**Job No.:** 060493 **Date:** 6th December 2006

**Property Address:** 222 Upper Street, Islington. N1

**Client Contact:** Graham Lowe, Energy Conservation officer, Islington Council.

**Client Brief:** To report on the feasibility of the existing roof structure to provide support for a wind turbine (details of which have been provided), and to provide a design of a suitable base for the mast for costing purposes. Information provided by Proven, the mast and turbine's manufacturer and designer, which has been used for this report, is included in Appendix A.

### Observations:

The following information was obtained during two site visits on the 7th and 20th November, 2006 and viewing record drawings of 222 Upper Street at Islington's Building Control on 20th November, of which some copies were taken of reinforcement drawings.

1. The roof is a fairly uninterrupted flat roof, with an existing designated area for plant. There are some rain water pipe inlets and air vents.
2. We understand it is planned to re-asphalt the roof in the near future, so that any bases for the proposed wind turbine system maybe incorporated into the roof structure and suitably weather proofed at this time with without much further cost involved. Present items on the roof viewed do not puncture the asphalt.
3. The building structure is of reinforced concrete, with perimeter columns and a few internal columns supporting reinforced concrete floor slabs. The roof slab is 250mm thick reinforced concrete.
4. Reinforcement plans of the building, including the roof ('Block B') were found at Islington's Building Control; however whilst these provide guidance it is possible they are not exactly as built.
5. The present plant is located on a grillage which secured to the roof by concrete blocks, there do not seem to be any positive fixings through to the r.c.slab. No details of this were available at Building Control.
6. Other items, such as an aerial, have been held down with concrete blocks on the support brackets, with no visible connection to the roof.
7. Existing photographs of the roof are attached.
8. Presently there is no balustrade around the perimeter of this portion of the roof.
9. In conversation with David Watson at Proven Energy, it is understood that the winch to lower the mast for maintenance approximately twice a year is not a permanent fixture and needs no fixing. The winch, at approx 1000mmx300mm has enough self-dead weight to counteract the forces induced by the lifting and lowering of the mast and mast head.

## Conclusions & Suggested Works:

1. A wind turbine mast and winch may be structurally supported by this building.
2. The reinforced concrete roof is a sufficient supporting structure for the mast base with support detail provided; which deepens the depth of the slab in an isolated area to allow the slab to take and spread the over-turning moments provided.
3. A layout has been chosen that provides 2.5m clear space around the mast head, when laid flat, so that the turbine unit may rest on to the roof slab with sufficient room for maintenance to take place as required.
4. It is proposed to increase the depth of the slab locally to support the winch and mast base. This will provide a greater depth for embedment of bolts. The existing reinforced concrete surface will need to be scored or roughened with high pressure water jets to achieve a suitable bonding of the new concrete overlay. Refer to Drawings 02 & 03.
5. The vibrations from the wind turbine are assumed to be negligible, and by experience may be dealt with in one of two ways:
    a. Introduction of a 'damper' system into the connection of the mast into the roof, either dampening units or rubber washers;
    b. The vibrations being dampened by the dead weight of the supporting structure;

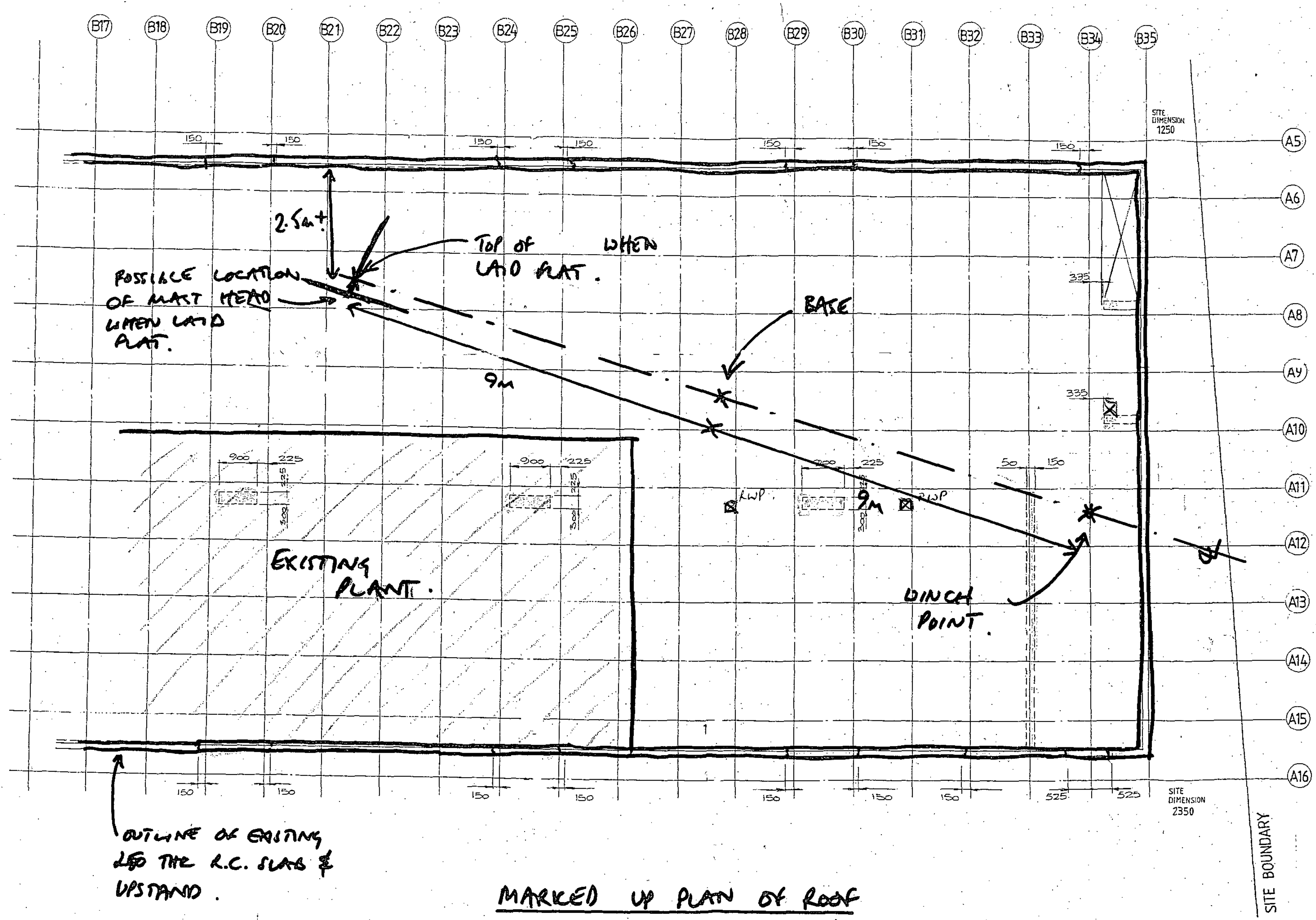
    In this case, we consider that the reinforced concrete framed building has sufficient dead-load and stiffness to dampen any vibrations incurred via the mast.
6. Steel bases plates to the mast may then be bolted though the new concrete pads and into the existing reinforced concrete slab.
7. The winch itself does not need any fixing into the roof, as it is self-weighted and is bought in as maintenance is required. The proposed location of the winch is indicated on Drawings 01 & 02. Whilst the weight of the winching unit is unknown, the existing reinforced concrete slab has been checked, and is sufficient to take a winch and loads induced as necessary.
8. As the winch will be bought into the position whenever maintenance is required, a suitable path, or surface should be provided over which the winch may be run and to locate it on to protect the (new) weather protection layer.
9. To satisfy working-at-height Health & Safety for the erection and maintenance of the mast, a balustrade or safety system may be required. This should be considered at this stage to be included in the works if necessary.
10. It is important that the area where the works to the new reinforced concrete base are to take place are scanned to check and record existing reinforcement in the top of the slab and to enable existing reinforcement to be avoided.

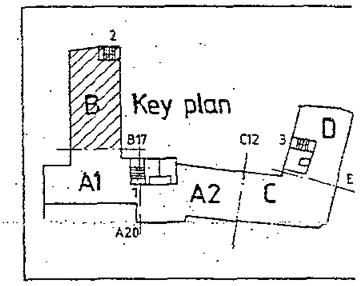
**Photographs.**

*Photo 1: View* South-West

*Photo 2: View south, taken from foot path next to plant area (not seen).*

DRAWINGS AND DETAILS OF PROPSED BASE DESIGN.




: R.C. STRUCTURE BELOW.

MARKED UP PLAN OF ROOF TO SHOW PROPOSED LOCATION OF MAST & WINCH.

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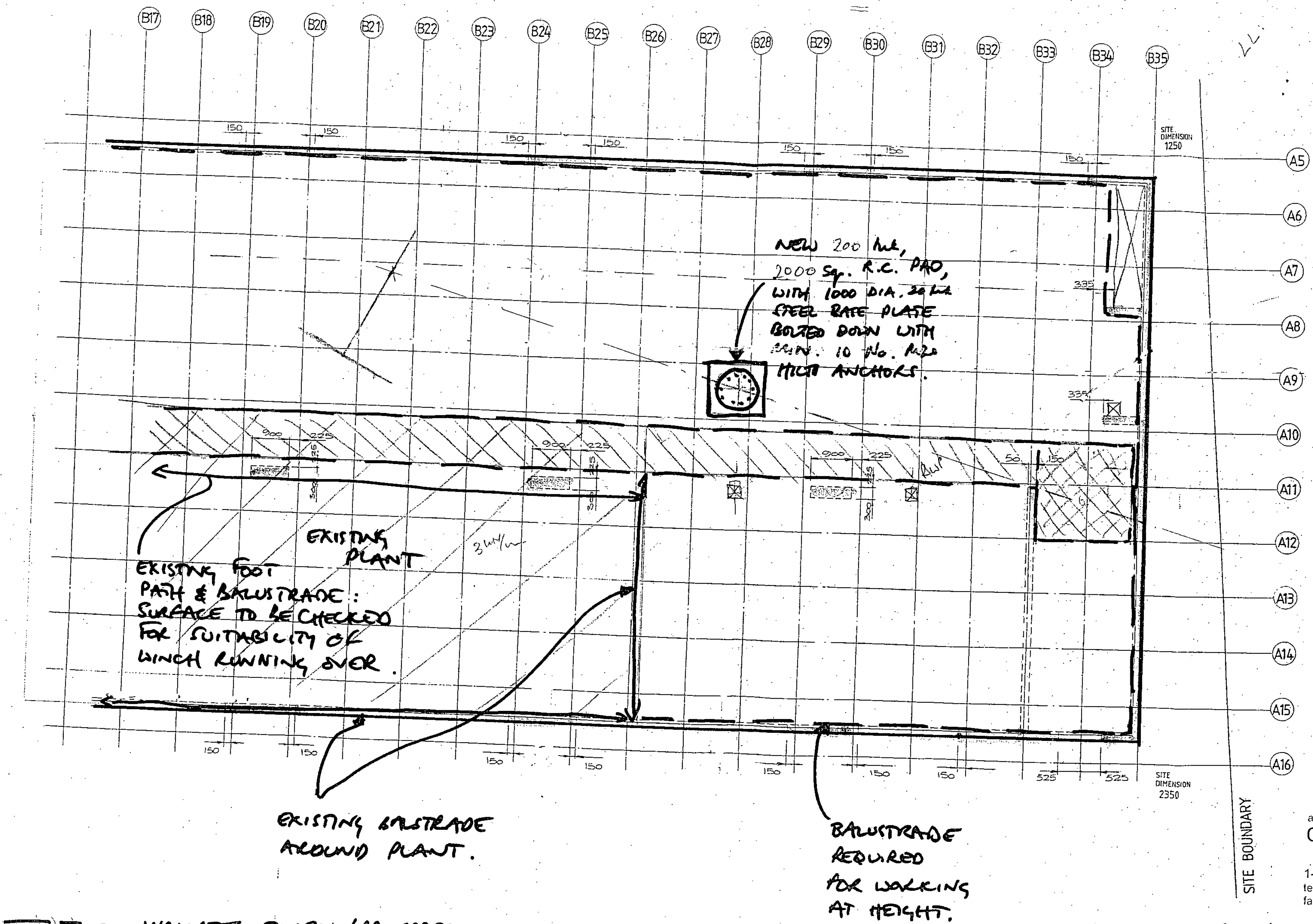
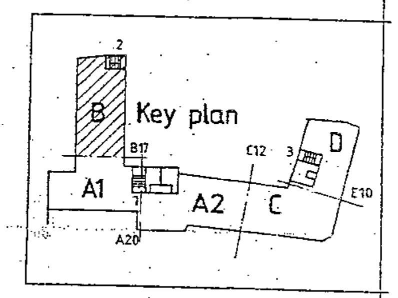
| | |
|---|---|
| project WIND TURBINE: 222 UPPER STREET. | job no. 060493 |
| | drg. no. 01 |
| title MARKED UP PLAN TO SHOW BASE LOCATIONS. | scale 1:100 |
| | date DEC 06 |
| | drawn HMN |
| | checked |




INDICATES EXISTING/PROPOSED AREA/WALKWAY TO BE SUITABLE FOR WINCH MOVEMENT

INDICATES AREA FOR WINCH

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REV A. CHANGES MADE. HMH.

| | |
|---|---|
| project WIND TURBINE -222 UPPER STREET. | job no. 060493. |
| | drg. no. 02 |
| title PLAN TO SHOW MAST BASE & SURFACE LOCATIONS | scale 1:100 |
| | date DEC 06. |
| | drawn HMH. |
| | checked |

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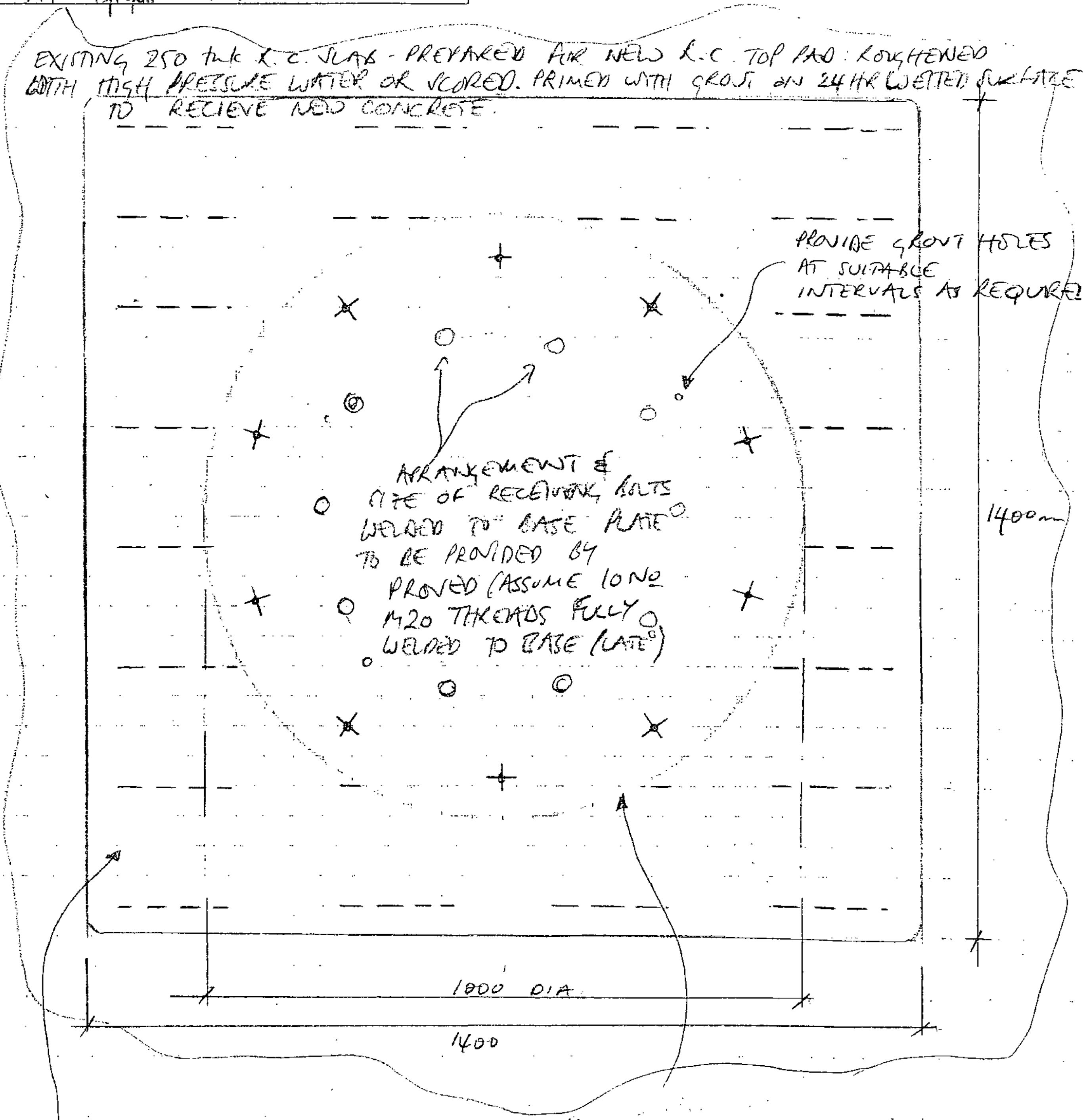
| | |
|---|---|
| project | WIND TURBINE. 222 UPPER STREET. |
| title | BASE DETAIL – MAST. PLAN. |
| job no. | 060493 |
| drg. no. | 03 |
| scale | 1:10 |
| date | 5-12-06 |
| drawn | HMH |
| checked | |

| rev. | date | |
|---|---|---|
| A | 13/12/06 | CHANGES MADE HMH. |




2000 SQ R.C PAD, 200mm HIGH DOWELED TO EXISTING ROOF SLAB. U-BARS RESIN ANCHORED INTO EXISTING R.C, WITH MIN 150mm EMBEDMENT DEPTH AVOID EXISTING REINFORCEMENT. UBARS AT 200/400 mm c/c. 10mm DIA. T12S@150 c/c IN TOP, BOTH DIRECTIONS IN TOP & BOTTOM OF NEW 200thk CONC, THREADED THROUGH UBARS WHERE POSSIBLE

*1000 mm DIA., 20mmTHK STEEL PLATE (GALVANIZED OR STAINLESS STEEL), BOLTED TO NEW + EXISTING R.C. WITH MIN 10 NO M20 HDA-P HILTI ANCHORS. ALLOW FOR 25mm NON-SHRINK GROUT. SUITABLE WASHERS TO BE USED TO AVOID BI-METALLIC CORROSION IF DIFFERING MATERIALS USED.

NOTES: REFER TO DRAWING 03.

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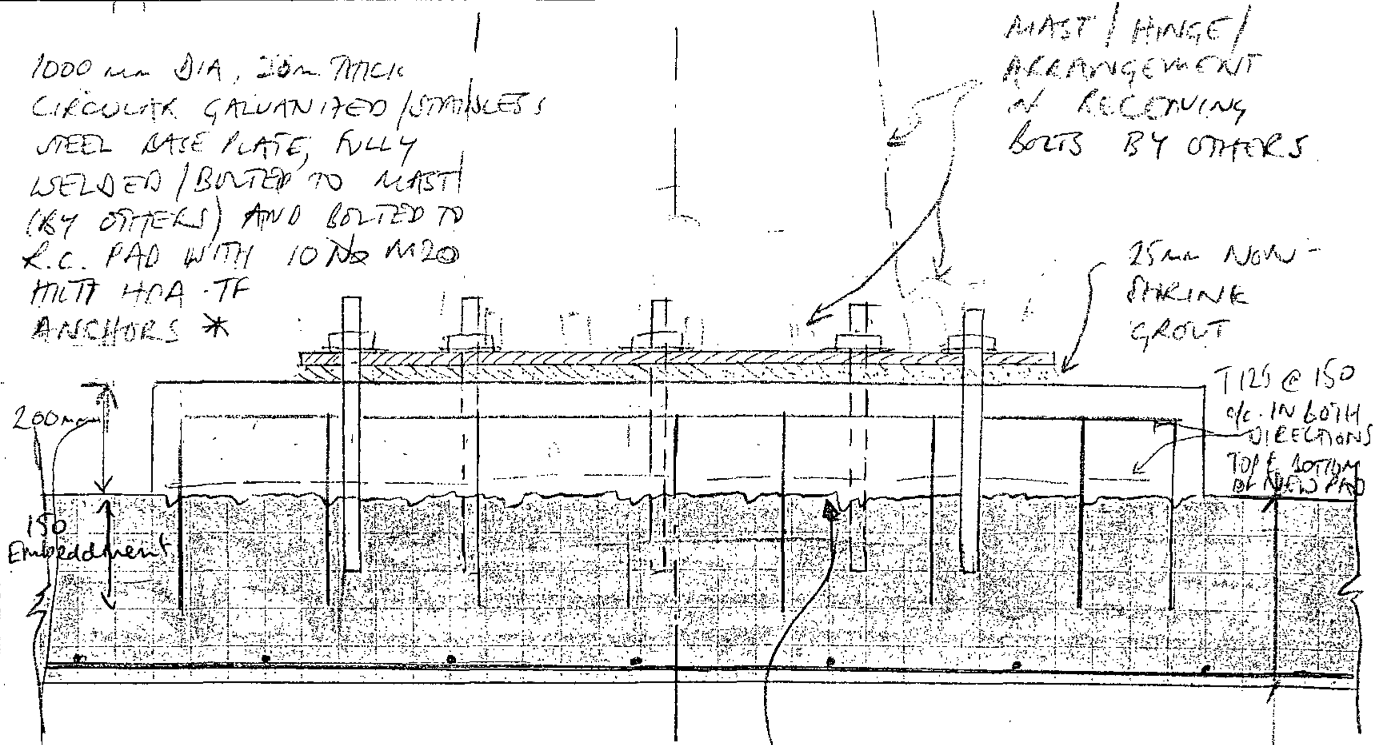
| project | job no. 060493 |
|---|---|
| WIND TURBINE – 222 UPPER STREET, N1 | drg. no. 04 |
| title | scale 1:10 |
| BASE DETAIL – MAST – SECTION | date 5-12-06 |
| | drawn HMH |
| | checked |

| rev. | date | |
|---|---|---|
| A | 13/12/06 | CHANGES MADE HMH |




200 THK NEW 2000 mm SQ R.C. PAD WITH U-BARS AT 200 mm C/C. RESIN BONDED INTO EXISTING 250 MM SLAB, 150 mm EMBEDMENT ENSURE NO CLASHES WITH EXISTING REINFORCEMENT. ALSO T12S @ 150 c/c TOP & BOTTOM IN BOTH DIRECTIONS. EXPECTED ≈20 mm COVER TO ANY EXISTING TOP REINFORCEMENT. LAY ON WET PRIMER (THICK CEMENT MORTAR – AS RECOMMENDED BY HILTI).

EXISTING 250 mm THICK REINFORCED CONCRETE ROOF SLAB.

SURFACE OF EXISTING R.C. SLAB SCABLED OR ROUGHENED WITH HIGH PRESSURE WATER JETS TO ACHIEVE GOOD BONDING SURFACE. PRE-TREAT WITH PRIMER OF THICK CEMENT MORTAR TO PRE-WETTED (24 HRS) OLD CONCRETE. NEW CONCRETE PLACED ONTO WET BRUSHED IN PRIMER.

NOTES

- DO NOT DIMENSION FROM THIS DRAWING.
- THIS DRAWING IS FOR COSTING ONLY
- CONCRETE GRADE C35
- ALL STEEL TO BE STAINLESS OR GALVANISED GRADE S275.
- ALL REINFORCEMENT TO BE HIGH YIELD.
- COVER TO REINFORCEMENT 40 mm.

* SIZE OF STEEL PLATE & LOCATION & SIZE OF RECEIVING BOLTS TO BE AGREED WITH PROVEN ENERGY. ALSO DETAIL OF HINGE.

# APPENDIX A

## INFORMATION PROVIDED ON 6KW TURBINE
## USED FOR CALCULATIONS

# Turbine Foundation Loads

## Anchor Point Loading During Winching

## Proven Energy WT 6000 Wind Turbine TM900

| Revision | | | Prepared by | |
|---|---|---|---|---|
| Status | Date | No. | Author | Checked |
| Issued | 20/03/05 | 0.1 | NJH | JA |
| | | | | |
| | | | | |
| | | | | |

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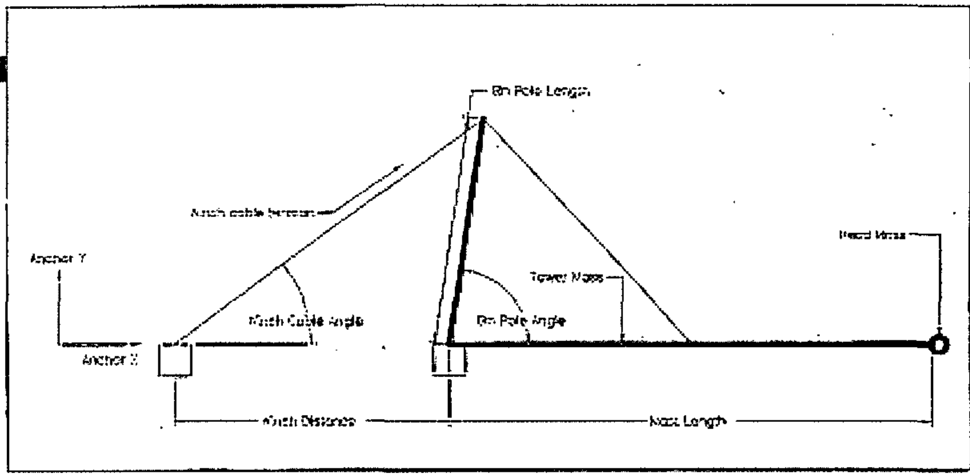
### Input Parameters

| | |
|---|---|
| Head Mass = | 500 kg => 5.0 kN |
| Mast Mass = | 300 kg => 3.6 kN |
| Mast Length = | 9 m |
| Mast CoG = | 3.9 m[i] |
| Gin pole length = | 3 m |
| Min Winching distance = | 7 ← 9 m |
| Gin Pole angle | 82 deg |
| | 1.4 rads |
| Winch cable angle = | 18 deg |
| | 0.3 rads |




### Find the lifting moment required due to the head weight and tower weight

Assume highest loading is when the turbine is horizontal, and has just left the ground, this causes the greatest moment,

| | |
|---|---|
| Total moment due to head and mast weight = | 57.5 kNm |
| Horizontal force at the end of the gin pole = | 19.5 kN |

**Winch Cable tension =** 20.4 kN

**Winch Anchor X =** 19.5 kN
**Winch Anchor Y =** 6.2 kN

### References


i. From Technical Specifications pdf on Proven Website
ii. From SE model

# Turbine Foundation Loads
## Wind Thrust Overturning Moment
## Proven Energy WT 6000 Wind Turbine TM900

| Revision | | | Prepared by | |
|---|---|---|---|---|
| Status | Date | No. | Author | Checked |
| Issued | 18/05/05 | 0.1 | NJH | JA |
| | | | | |
| | | | | |
| | | | | |

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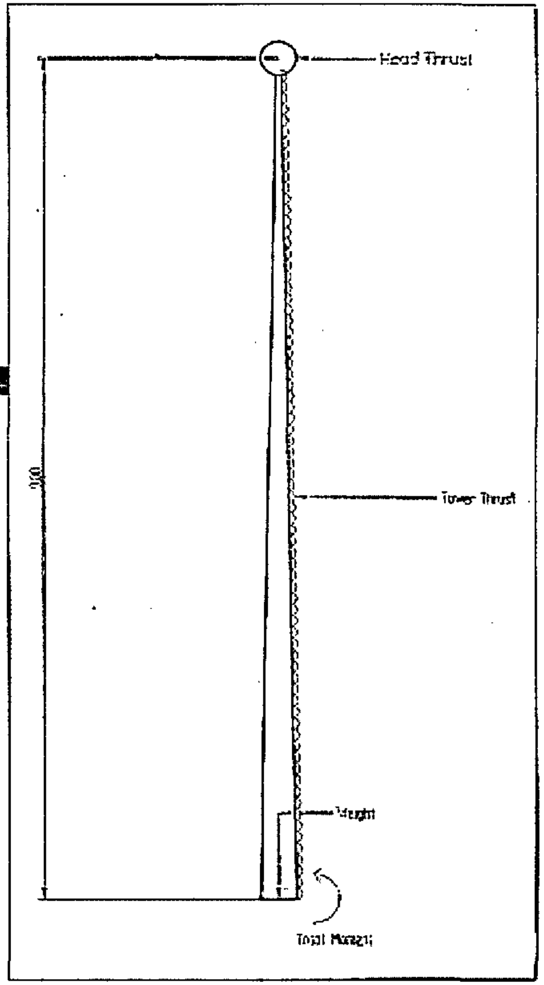
Calculate the Tower foundation loads due the wind loading on the turbine
Loads in accordance with international norm: IEC 61400-2
Assume that the tower wind loading is a uniformly distibuted load, variations in wind speed with height will be neglected in this calculation.

## Input Parameters

| | |
|---|---|
| Head Mass = | 500 kg[i] |
| Mast Mass = | 350 kg[i] |
| Mast Length = | 9 m |
| Head Thrust = | 10 kN[i] |
| Tower Thrust = | 7.7 kN[ii] |

**Total Overturning Moment =** **118.9 kNm**
**Total Horizontal Thrust =** **17.7 kN**
**Turbine Weight =** **8.4 kN** (vertical force ex. foundation)




## References

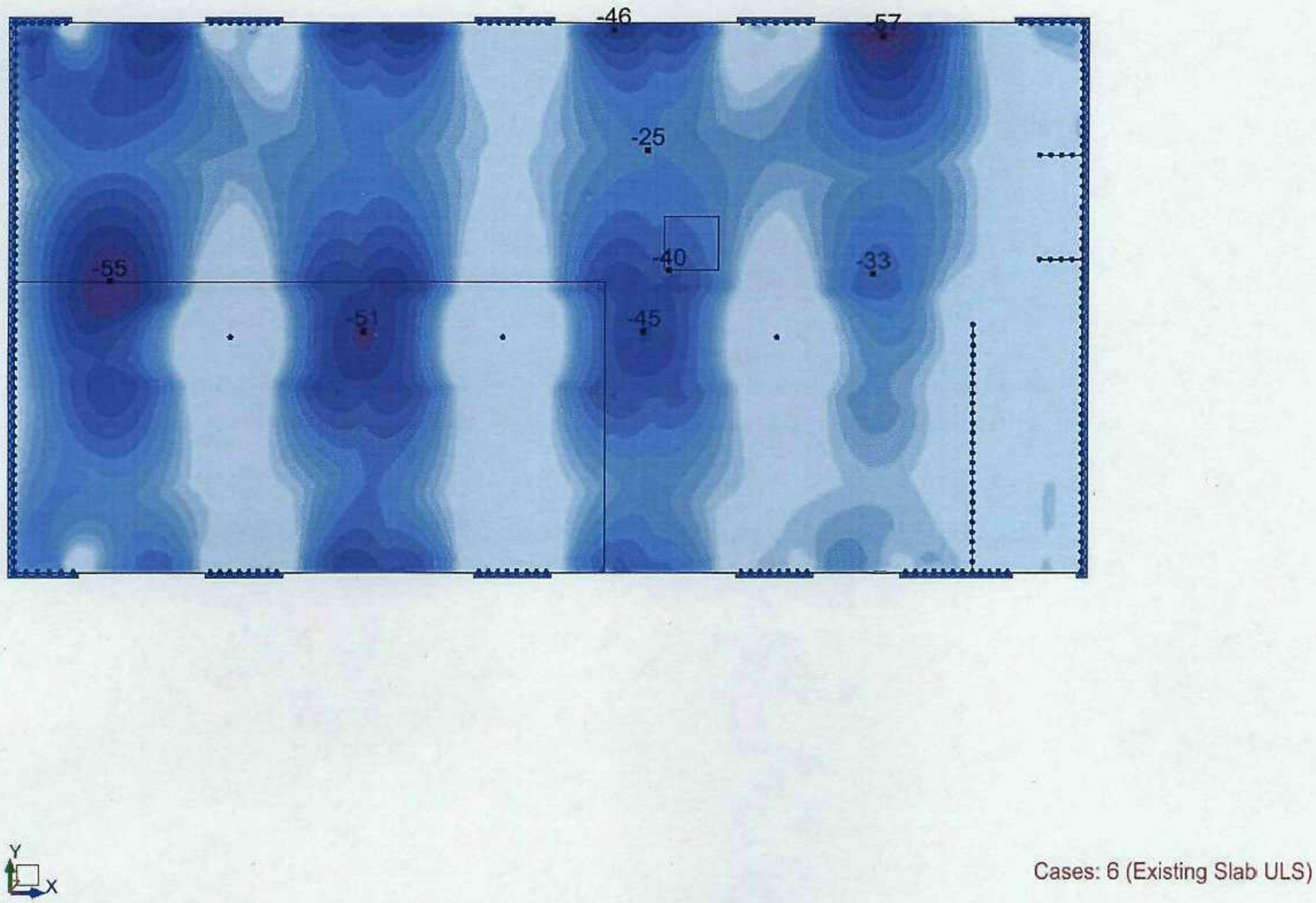

i. From Technical Specifications pdf on Proven Website
ii. From Tower wind loading calculations spreadsheet

# APPENDIX B

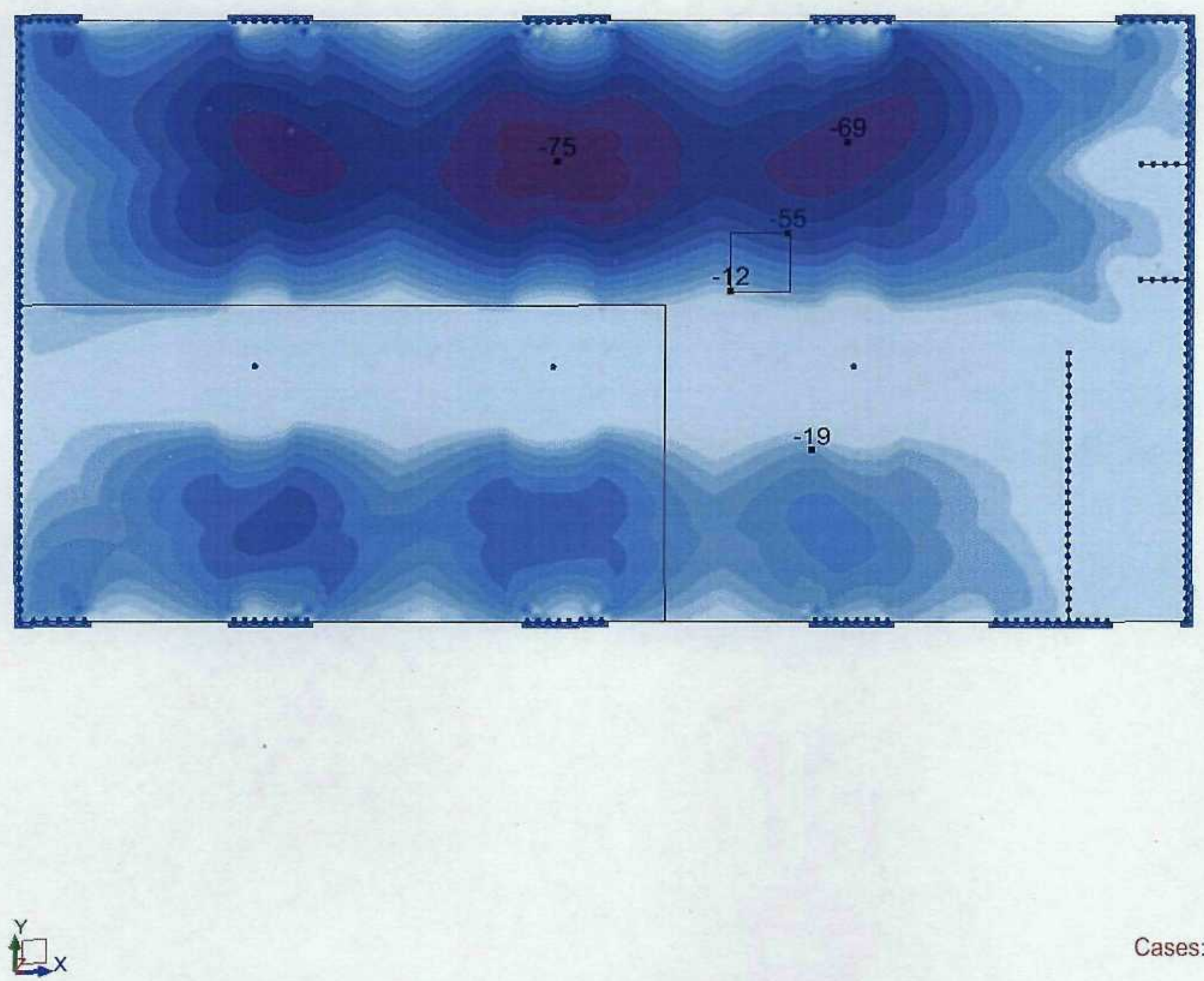
## ANALYSIS OF REINFORCED CONCRETE ROOF FOR EXISING AND PROPOSED CONDITIONS

**View - MXX- (W&A) Cases:**

**6 (Existing Slab ULS)**

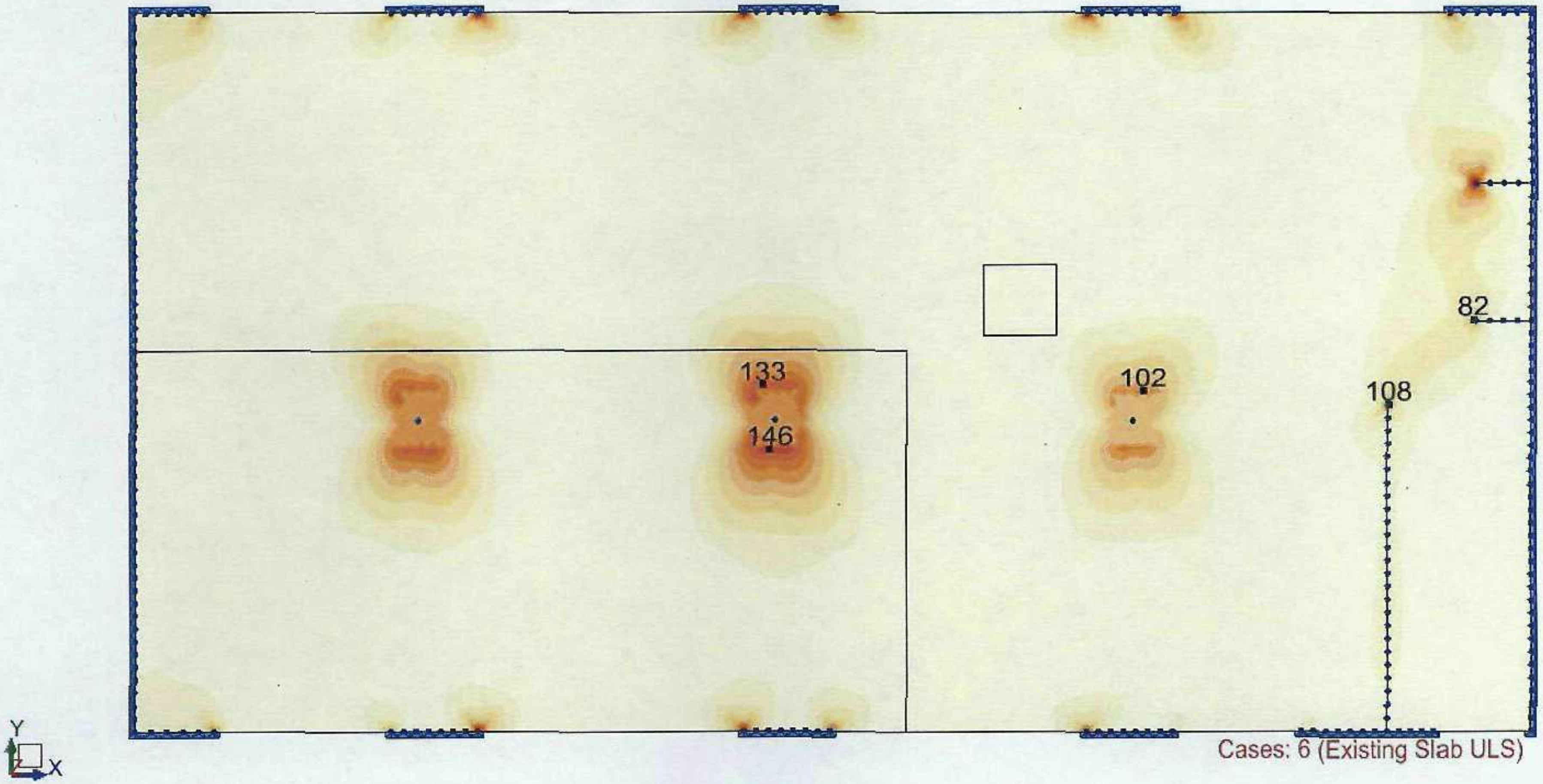



View - MYY- (W&A) Cases: 6 (Existing Slab ULS)

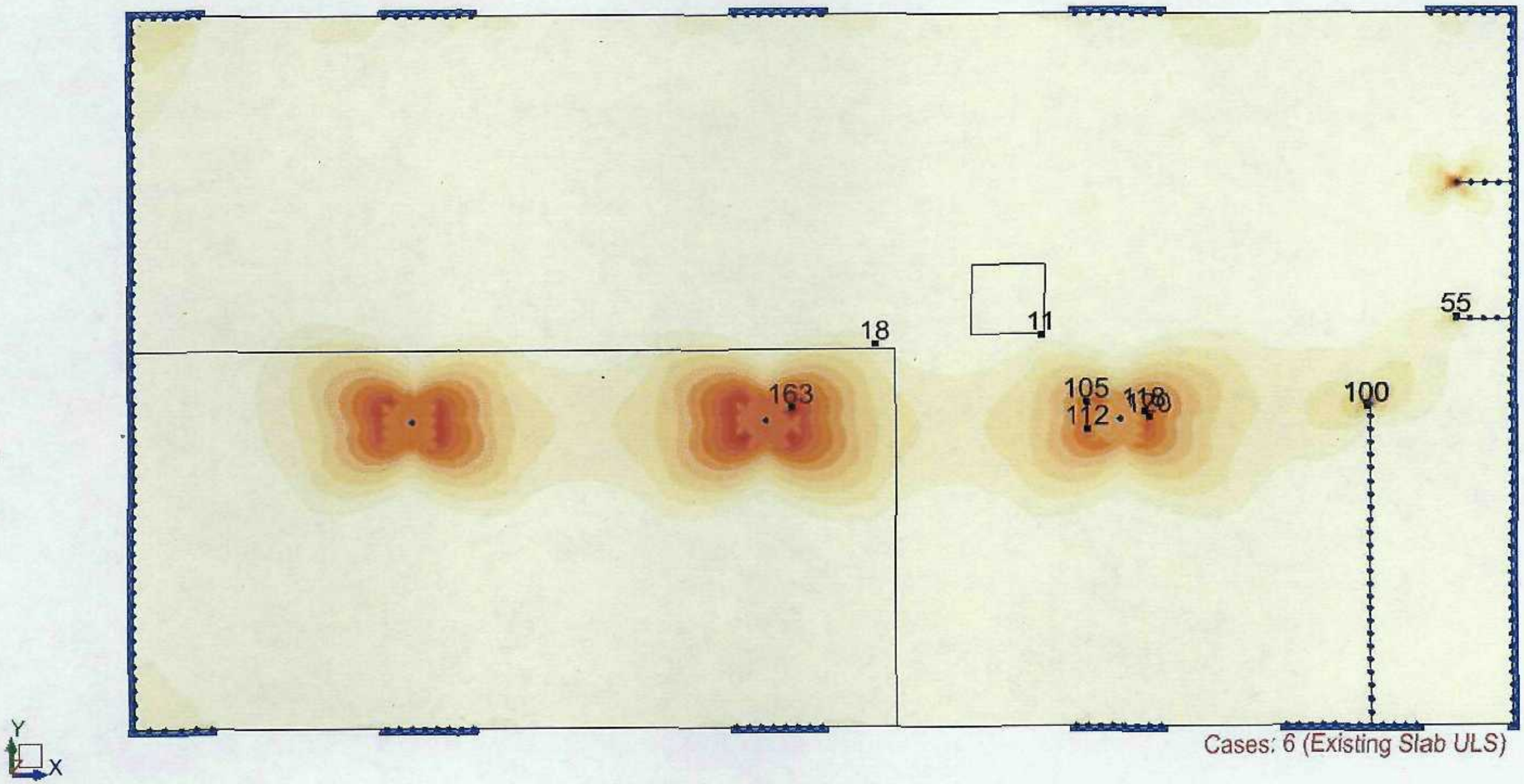



Cases: 6 (Existing Slab ULS)

View - MXX+ (W&A) Cases: 6 (Existing Slab ULS)




View - MYY+ (W&A) Cases: 6 (Existing Slab ULS)


18
11
55
163
105
118
112
120
100
Y
Z
X
Cases: 6 (Existing Slab ULS)

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project: WIND TURBINE, 222 UPPER STREET

job no. 060493

sheet no.

title: Existing Roof Floor Slab
**Bottom Mxx N-S REINFORCEMENT**

date 14.12.2006
engineer MG
checked

rev | date

**Material Properties**

| | | | | | |
|---|---|---|---|---|---|
| BS 8007 | Concrete strength | $f_{cu}$ | 30 N/mm² | | |
| Table 3.1 | Reinforcement strength | $f_y$ | 460 N/mm² | = 130 N/mm² x 1.45 fos | |

**Slab dimensions**

| | | | | |
|---|---|---|---|---|
| Overall thickness | $h$ | 250 mm | | |
| Breadth | $b$ | 1000 mm /m width | | |
| Cover | | 43 mm | | |
| Effective depth | $d$ | 207 mm | = h - cover | d = 207 mm |

**Forces (ultimate)**

| | | | | |
|---|---|---|---|---|
| Maximum applied moment | $M$ | 40.0 kNm /m width | | M = 40.0 kNm/m |
| Maximum applied shear | $F$ | 18.0 kN /m width | | F = 18.0 kN/m |
| Ultimate moment capacity | $M_u$ | 201 kNm /m width | $= 0.156 f_{cu} b d^2$ | $M_u$ = 201 kNm/m |

1 Design as singly reinforced beam.

**Design as singly reinforced beam.**

***Tension Reinforcement***

| | | | | |
|---|---|---|---|---|
| Factor | $K$ | 0.031 | $= M / f_{cu} b d^2$ | K = 0.0311 |
| Lever arm factor | $z$ | 197 mm | $= d \{ 0.5 + \sqrt{(0.25 - K / 0.9)} \}$ | z = 197 mm |
| Neutral axis depth factor | $x$ | 23 mm | $= ( d - z ) / 0.45$ | x = 23 mm |
| Minimum area of steel | $A_{s,min}$ | 325 mm²/m width | $= 0.0013 b h$ | |
| Area of steel required | $A_s$ | 465 mm²/m width | $= M / 0.95 f_y z$ | $A_{s,req}$ = 465.46 mm²/m |

**Tension Reinforcement Provided**

| | | | | |
|---|---|---|---|---|
| Bar diameter | Ø' | 12 mm | | |
| Bar spacing | | 200 mm centers | OK EXISTING RF'MT T12'S@150C/C | |
| Area provided | $A_{s,prov}$ | 565 mm²/m width | | |
| Bar diameter | Ø' | 0 mm | | |
| Number of bars | No. | 200 mm centers | | |
| Area provided | $A_{s,prov}$ | 0 mm²/m width | | |
| Total area provided | $A'_{s,prov}$ | 565.5 mm²/m width | OK | $A_{s,prov}$ = 565.49 mm²/m |

**Shear Strength**

| | | |
|---|---|---|
| Shear stress | $v$ | 0.09 N/mm² |
| Shear stress limits | | 5.00 N/mm² OK |
| | | 4.38 N/mm² OK |
| Factor | $R$ | 0.273 |
| Design concrete shear stress | $v_c$ | 0.514 N/mm² 1 |

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project: WIND TURBINE
222 UPPER STREET

job no. 060493
sheet no.

title: Existing Roof Floor Slab
**Bottom Myy (E-W)**

date 14.12.2006
engineer MG
checked

rev | date

**Material Properties**

| | | | | | |
|---|---|---|---|---|---|
| BS 8007 | Concrete strength | $f_{cu}$ | 30 N/mm² | | |
| Table 3.1 | Reinforcement strength | $f_y$ | 460 N/mm² | $= 130\ N/mm^2 \times 1.45$ fos | |

**Slab dimensions**

| | | | | |
|---|---|---|---|---|
| Overall thickness | $h$ | 250 mm | | |
| Breadth | $b$ | 1000 mm /m width | | |
| Cover | | 31 mm | | |
| Effective depth | $d$ | 219 mm | $= h - cover$ | $d =$ 219 mm |

**Forces (ultimate)**

| | | | | |
|---|---|---|---|---|
| Maximum applied moment | $M$ | 55.0 kNm /m width | | $M =$ 55.0 kNm/m |
| *Maximum applied shear* | $F$ | *18.0 kN /m width* | | $F =$ 18.0 kN/m |
| Ultimate moment capacity | $M_u$ | 224 kNm /m width | $= 0.156 f_{cu} b d^2$ | $M_u =$ 224 kNm/m |

1 Design as singly reinforced beam.

**Design as singly reinforced beam.**

**Tension Reinforcement**

| | | | | |
|---|---|---|---|---|
| Factor | $K$ | 0.038 | $= M / f_{cu} b d^2$ | $K =$ 0.0382 |
| Lever arm factor | $z$ | 208 mm | $= d\{0.5 + \sqrt{(0.25 - K/0.9)}\}$ | $z =$ 208 mm |
| Neutral axis depth factor | $x$ | 24.33 mm | $= (d - z)/0.45$ | $x =$ 24 mm |
| Minimum area of steel | $A_{s,min}$ | 325 mm² /m width | $= 0.0013\ b\ h$ | |
| Area of steel required | $A_s$ | 605 mm² /m width | $= M / 0.95 f_y z$ | $A_{s,req} =$ 604.94 mm²/m |

**Tension Reinforcement Provided**

| | | | |
|---|---|---|---|
| Bar diameter | Ø' | 12 mm | |
| Bar spacing | | 150 mm centers | OK EXISTING PROVIDED IS T12'S @150 C/C |
| Area provided | $A_{s,prov}$ | 754 mm² /m width | |
| Bar diameter | Ø' | 0 mm | |
| Number of bars | No. | 200 mm centers | |
| Area provided | $A_{s,prov}$ | 0 mm² /m width | |
| Total area provided | $A'_{s,prov}$ | 754 mm² /m width | OK — $A_{s,prov} =$ 753.98 mm²/m |

**Shear Strength**

| | | |
|---|---|---|
| Shear stress | $v$ | 0.08 N/mm² |
| Shear stress limits | | 5.00 N/mm² OK |
| | | 4.38 N/mm² OK |
| Factor | $R$ | 0.344 |
| Design concrete shear stress | $v_c$ | 0.547 N/mm² 1 |

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project: WIND TURBINE
222 UPPER STREET

job no. 060493

sheet no.

title: Proposed Roof Floor Slab
**Bottom Mxx**

date 14.12.2006
engineer MG
checked

rev | date

**Material Properties**

| | | | | | |
|---|---|---|---|---|---|
| BS 8007 | Concrete strength | $f_{cu}$ | 30 N/mm² | | |
| Table 3.1 | Reinforcement strength | $f_y$ | 460 N/mm² | = 130 N/mm² x 1.45 fos | |

**Slab dimensions**

| | | | | |
|---|---|---|---|---|
| Overall thickness | $h$ | 450 mm | | |
| Breadth | $b$ | 1000 mm /m width | | |
| Cover | | 43 mm | | |
| Effective depth | $d$ | 407 mm | = h - cover | d = 407 mm |

**Forces (ultimate)**

| | | | | |
|---|---|---|---|---|
| Maximum applied moment | $M$ | 111.0 kNm /m width | | M = 111.0 kNm/m |
| Maximum applied shear | $F$ | 18.0 kN /m width | | F = 18.0 kN/m |
| *Ultimate moment capacity* | $M_u$ | 775 kNm /m width | $= 0.156 f_{cu} b d^2$ | $M_u$ = 775 kNm/m |

1 Design as singly reinforced beam.

__Design as singly reinforced beam.__

**Tension Reinforcement**

| | | | | |
|---|---|---|---|---|
| Factor | $K$ | 0.022 | $= M / f_{cu} b d^2$ | K = 0.0223 |
| Lever arm factor | $z$ | 387 mm | $= d ( 0.5 + \sqrt{(0.25 - K / 0.9)} )$ | z = 387 mm |
| Neutral axis depth factor | $x$ | 45.22 mm | $= ( d - z ) / 0.45$ | x = 45 mm |
| Minimum area of steel | $A_{s,min}$ | 585 mm² /m width | $= 0.0013 b h$ | |
| *Area of steel required* | $A_s$ | *657 mm² /m width* | $= M / 0.95 f_y z$ | $A_{s,req}$ = 656.94 mm²/m |

**Tension Reinforcement Provided**

| | | | |
|---|---|---|---|
| Bar diameter | Ø' | 12 mm | |
| Bar spacing | | 150 mm centers | LESS THAN AS EXISTING |
| Area provided | $A_{s,prov}$ | 754 mm² /m width | + ACTUALLY OVER 2 SQ M=OK |
| Bar diameter | Ø' | 0 mm | |
| Number of bars | No. | 200 mm centers | |
| Area provided | $A_{s,prov}$ | 0 mm² /m width | |
| Total area provided | $A'_{s,prov}$ | 754 mm² /m width | OK — $A_{s,prov}$ = 753.98 mm²/m |

**Shear Strength**

| | | |
|---|---|---|
| Shear stress | $v$ | 0.04 N/mm² |
| Shear stress limits | | 5.00 N/mm² OK |
| | | 4.38 N/mm² OK |
| Factor | $R$ | 0.185 |
| Design concrete shear stress | $v_c$ | 0.383 N/mm² 1 |

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project: WIND TURBINE, 222 UPPER STREET

job no. 060493

sheet no.

title: Proposed Roof Floor Slab — **Bottom Mxx**

date 14.12.2006

engineer MG

checked

rev | date

**Material Properties**

| | | | | | |
|---|---|---|---|---|---|
| BS 8007 | Concrete strength | $f_{cu}$ | 30 $N/mm^2$ | | |
| Table 3.1 | Reinforcement strength | $f_y$ | 460 $N/mm^2$ | $= 130\ N/mm^2 \times 1.45$ fos | |

**Slab dimensions**

| | | | | |
|---|---|---|---|---|
| Overall thickness | $h$ | 450 mm | | |
| Breadth | $b$ | 1000 mm /m width | | |
| Cover | | 43 mm | | |
| Effective depth | $d$ | 407 mm | $= h - cover$ | $d =$ 407 mm |

**Forces (ultimate)**

| | | | | |
|---|---|---|---|---|
| Maximum applied moment | $M$ | 111.0 kNm /m width | | $M =$ 111.0 kNm/m |
| Maximum applied shear | $F$ | 18.0 kN /m width | | $F =$ 18.0 kN/m |
| Ultimate moment capacity | $M_u$ | 775 kNm /m width | $= 0.156\, f_{cu}\, b\, d^2$ | $M_u =$ 775 kNm/m |

1 Design as singly reinforced beam.

**Design as singly reinforced beam.**

**Tension Reinforcement**

| | | | | |
|---|---|---|---|---|
| Factor | $K$ | 0.022 | $= M / f_{cu}\, b\, d^2$ | $K =$ 0.0223 |
| Lever arm factor | $z$ | 387 mm | $= d\,(0.5 + \sqrt{(0.25 - K/0.9)})$ | $z =$ 387 mm |
| Neutral axis depth factor | $x$ | 45.22 mm | $= (d - z)/0.45$ | $x =$ 45 mm |
| Minimum area of steel | $A_{s,min}$ | 585 $mm^2$ /m width | $= 0.0013\, b\, h$ | |
| Area of steel required | $A_s$ | 657 $mm^2$ /m width | $= M / 0.95\, f_y\, z$ | $A_{s,req} =$ 656.94 $mm^2/m$ |

**Tension Reinforcement Provided**

| | | | |
|---|---|---|---|
| Bar diameter | Ø' | 12 mm | |
| Bar spacing | | 150 mm centers | LESS THAN AS EXISTING |
| Area provided | $A_{s,prov}$ | 754 $mm^2$ /m width | + ACTUALLY OVER 2 SQ M=OK |

| | | |
|---|---|---|
| Bar diameter | Ø' | 0 mm |
| Number of bars | No. | 200 mm centers |
| Area provided | $A_{s,prov}$ | 0 $mm^2$ /m width |

| | | | | |
|---|---|---|---|---|
| Total area provided | $A'_{s,prov}$ | 754 $mm^2$ /m width | OK | $A_{s,prov} =$ 753.98 $mm^2/m$ |

**Shear Strength**

| | | | |
|---|---|---|---|
| Shear stress | $v$ | 0.04 $N/mm^2$ | |
| Shear stress limits | | 5.00 $N/mm^2$ | OK |
| | | 4.38 $N/mm^2$ | OK |

| | | | |
|---|---|---|---|
| Factor | $R$ | 0.185 | |
| Design concrete shear stress | $v_c$ | 0.383 $N/mm^2$ | 1 |

Provide minimum links

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date 14.12.2006
engineer MG
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**Material Properties**

| | | | | | |
|---|---|---|---|---|---|
| BS 8007 | Concrete strength | $f_{cu}$ | 30 N/mm$^2$ | | |
| Table 3.1 | Reinforcement strength | $f_y$ | 460 N/mm$^2$ | = 130 N/mm$^2$ x 1.45 fos | |

**Slab dimensions**

| | | | | |
|---|---|---|---|---|
| Overall thickness | $h$ | 450 mm | | |
| Breadth | $b$ | 1000 mm /m width | | |
| Cover | | 31 mm | | |
| Effective depth | $d$ | 419 mm | $= h - cover$ | $d =$ 419 mm |

**Forces (ultimate)**

| | | | | |
|---|---|---|---|---|
| Maximum applied moment | $M$ | 90.0 kNm /m width | | $M =$ 90.0 kNm/m |
| Maximum applied shear | $F$ | 18.0 kN /m width | | $F =$ 18.0 kN/m |
| Ultimate moment capacity | $M_u$ | 822 kNm /m width | $= 0.156\, f_{cu}\, b\, d^2$ | $M_u =$ 822 kNm/m |

1 Design as singly reinforced beam.

**Design as singly reinforced beam.**

**Tension Reinforcement**

| | | | | |
|---|---|---|---|---|
| Factor | $K$ | 0.017 | $= M / f_{cu}\, b\, d^2$ | $K =$ 0.0171 |
| Lever arm factor | $z$ | 398 mm | $= d\{0.5 + \sqrt{(0.25 - K/0.9)}\}$ | $z =$ 398 mm |
| Neutral axis depth factor | $x$ | 46.56 mm | $= (d - z) / 0.45$ | $x =$ 47 mm |
| Minimum area of steel | $A_{s,min}$ | 585 mm$^2$ /m width | $= 0.0013\, b\, h$ | |
| *Area of steel required* | $A_s$ | 585 mm$^2$ /m width | $= M / 0.95\, f_y\, z$ | $A_{s,req} =$ 585 mm$^2$/m |

**Tension Reinforcement Provided**

| | | | |
|---|---|---|---|
| Bar diameter | Ø' | 12 mm | |
| Bar spacing | | 150 mm centers | AS EXISTING=OK |
| Area provided | $A_{s,prov}$ | 754 mm$^2$ /m width | |
| Bar diameter | Ø' | 0 mm | |
| Number of bars | No. | 200 mm centers | |
| Area provided | $A_{s,prov}$ | 0 mm$^2$ /m width | |
| Total area provided | $A'_{s,prov}$ | *754 mm$^2$ /m width* | *OK* |

$A_{s,prov} =$ 753.98 mm$^2$/m

**Shear Strength**

| | | |
|---|---|---|
| Shear stress | $v$ | 0.04 N/mm$^2$ |
| Shear stress limits | | 5.00 N/mm$^2$ OK |
| | | 4.38 N/mm$^2$ OK |
| Factor | $R$ | 0.18 |
| Design concrete shear stress | $v_c$ | 0.379 N/mm$^2$ 1 |

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| alan conisbee and associates | project | job no. 060493 |
|---|---|---|
| **consulting structural engineers** | WIND TURBINE<br>222 UPPER STREET | sheet no. |
| 1-5 Offord Street London N1 1DH<br>tel 020 7700 6666 fax 020 7700 6686<br>email tec@conisbee.co.uk<br>web www.conisbee.co.uk | title<br>Proposed Roof Floor Slab<br>**Top Mxx** | date 14.12.2006<br>engineer MG<br>checked |

rev | date

**Material Properties**

| | | | | | | |
|---|---|---|---|---|---|---|
| BS 8007 | Concrete strength | $f_{cu}$ | 30 N/mm² | | | |
| Table 3.1 | Reinforcement strength | $f_y$ | 460 N/mm² | = 130 N/mm² x 1.45 fos | | |

***Slab dimensions***

| | | | | | |
|---|---|---|---|---|---|
| Overall thickness | $h$ | 450 mm | | | |
| Breadth | $b$ | 1000 mm /m width | | | |
| Cover | | 43 mm | | | |
| Effective depth | $d$ | 407 mm | = h - cover | $d$ = | 407 mm |

**Forces (ultimate)**

| | | | | | |
|---|---|---|---|---|---|
| Maximum applied moment | $M$ | 50.0 kNm /m width | | $M$ = | 50.0 kNm/m |
| Maximum applied shear | $F$ | 18.0 kN /m width | | $F$ = | 18.0 kN/m |
| Ultimate moment capacity | $M_u$ | 775 kNm /m width | $= 0.156 f_{cu} b d^2$ | $M_u$ = | 775 kNm/m |

1 Design as singly reinforced beam.

<u>Design as singly reinforced beam.</u>

**Tension Reinforcement**

| | | | | | |
|---|---|---|---|---|---|
| Factor | $K$ | 0.01 | $= M / f_{cu} b d^2$ | $K$ = | 0.0101 |
| Lever arm factor | $z$ | 387 mm | $= d\{0.5 + \sqrt{(0.25 - K/0.9)}\}$ | $z$ = | 387 mm |
| Neutral axis depth factor | $x$ | 45.22 mm | $= (d - z) / 0.45$ | $x$ = | 45 mm |
| Minimum area of steel | $A_{s,min}$ | 585 mm² /m width | $= 0.0013 b h$ | | |
| Area of steel required | $A_s$ | 585 mm² /m width | $= M / 0.95 f_y z$ | $A_{s,req}$ = | 585 mm²/m |

**Tension Reinforcement Provided**

| | | | |
|---|---|---|---|
| *Bar diameter* | *Ø'* | *12 mm* | |
| Bar spacing | | 150 mm centers | ACTUAL PROVIDED T12'S @200 OVER |
| Area provided | $A_{s,prov}$ | 754 mm² /m width | 2m WIDTH, TOTAL=1132mm OR 566 OVER 1m. |
| Bar diameter | Ø' | 0 mm | |
| Number of bars | No. | 200 mm centers | |
| Area provided | $A_{s,prov}$ | 0 mm² /m width | |
| Total area provided | $A'_{s,prov}$ | 754 mm² /m width | OK   $A_{s,prov}$ = 753.98 mm²/m |

**Shear Strength**

| | | |
|---|---|---|
| Shear stress | $v$ | 0.04 N/mm² |
| Shear stress limits | | 5.00 N/mm² OK |
| | | 4.38 N/mm² OK |
| Factor | $R$ | 0.185 |
| Design concrete shear stress | $v_c$ | 0.383 N/mm² 1 |

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job no. 060493

sheet no.

title: Proposed Roof Floor Slab, **Top Myy**

date 14.12.2006

engineer MG

checked

rev | date

BS 8007 Table 3.1

**Material Properties**

| | | | | |
|---|---|---|---|---|
| Concrete strength | $f_{cu}$ | 30 N/mm² | | |
| Reinforcement strength | $f_y$ | 460 N/mm² | = 130 N/mm² x 1.45 fos | |

***Slab dimensions***

| | | | | |
|---|---|---|---|---|
| Overall thickness | $h$ | 450 mm | | |
| Breadth | $b$ | 1000 mm /m width | | |
| Cover | | 31 mm | | |
| Effective depth | $d$ | 419 mm | = h - cover | d = 419 mm |

**Forces (ultimate)**

| | | | | |
|---|---|---|---|---|
| Maximum applied moment | $M$ | 32.0 kNm /m width | | M = 32.0 kNm/m |
| Maximum applied shear | $F$ | 18.0 kN /m width | | F = 18.0 kN/m |
| Ultimate moment capacity | $M_u$ | 822 kNm /m width | $= 0.156 f_{cu} b d^2$ | $M_u$ = 822 kNm/m |

1 Design as singly reinforced beam.

__Design as singly reinforced beam.__

**Tension Reinforcement**

| | | | | |
|---|---|---|---|---|
| Factor | $K$ | 0.006 | $= M / f_{cu} b d^2$ | K = 0.0061 |
| Lever arm factor | $z$ | 398 mm | $= d \{ 0.5 + \sqrt{(0.25 - K / 0.9)} \}$ | z = 398 mm |
| Neutral axis depth factor | $x$ | 46.56 mm | $= (d - z) / 0.45$ | x = 47 mm |
| Minimum area of steel | $A_{s,min}$ | 585 mm² /m width | $= 0.0013 b h$ | |
| Area of steel required | $A_s$ | 585 mm² /m width | $= M / 0.95 f_y z$ | $A_{s,req}$ = 585 mm²/m |

**Tension Reinforcement Provided**

| | | | | |
|---|---|---|---|---|
| *Bar diameter* | Ø' | *12 mm* | | |
| Bar spacing | | 150 mm centers | **AS Mxx** | |
| Area provided | $A_{s,prov}$ | 754 mm² /m width | | |
| Bar diameter | Ø' | 0 mm | | |
| Number of bars | No. | 200 mm centers | | |
| Area provided | $A_{s,prov}$ | 0 mm² /m width | | |
| Total area provided | $A'_{s,prov}$ | 754 mm² /m width | OK | $A_{s,prov}$ = 753.98 mm²/m |

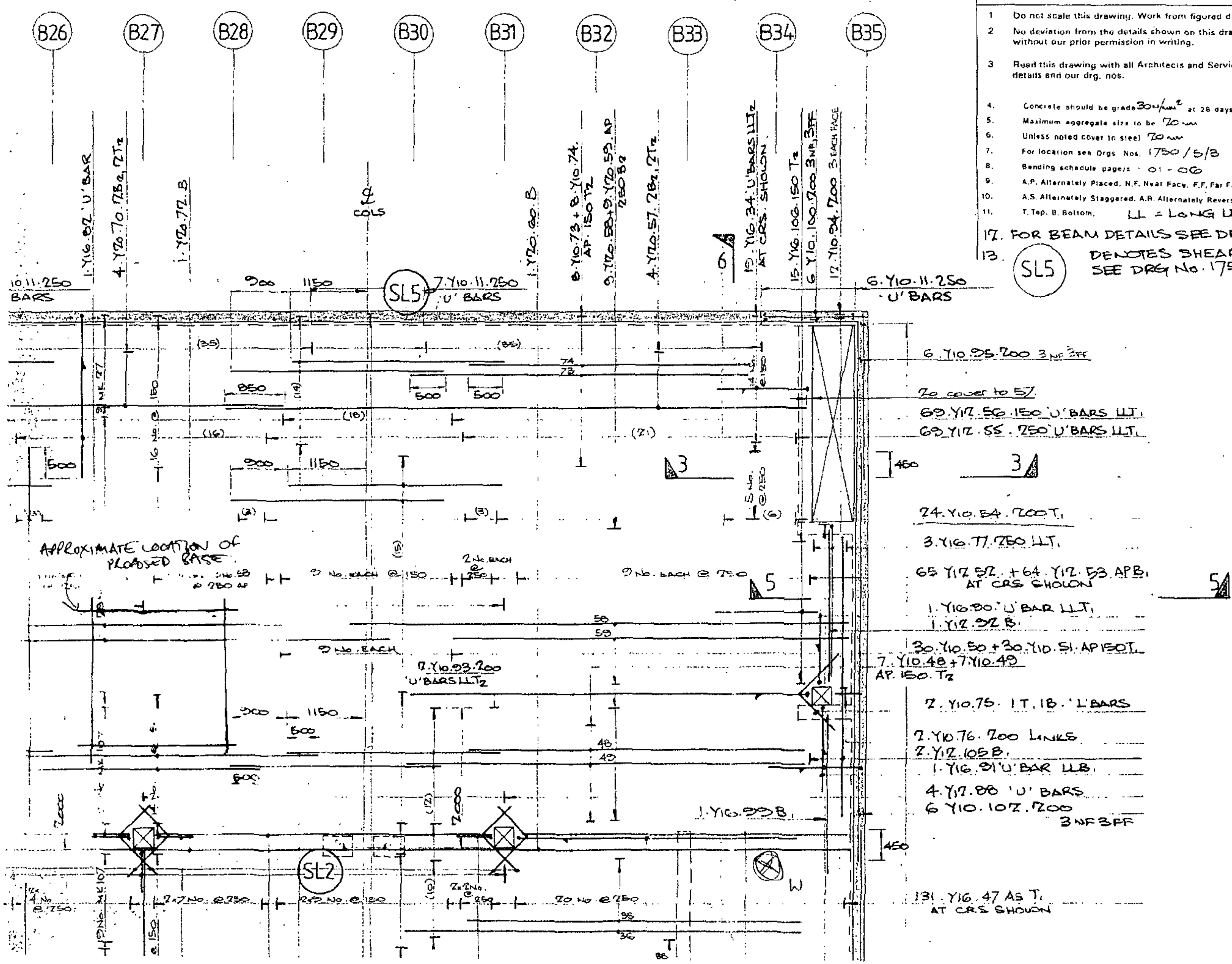
**Shear Strength**

| | | | |
|---|---|---|---|
| Shear stress | $v$ | 0.04 N/mm² | |
| Shear stress limits | | 5.00 N/mm² | OK |
| | | 4.38 N/mm² | OK |
| Factor | $R$ | 0.18 | |
| Design concrete shear stress | $v_c$ | 0.379 N/mm² | 1 |

Provide minimum links

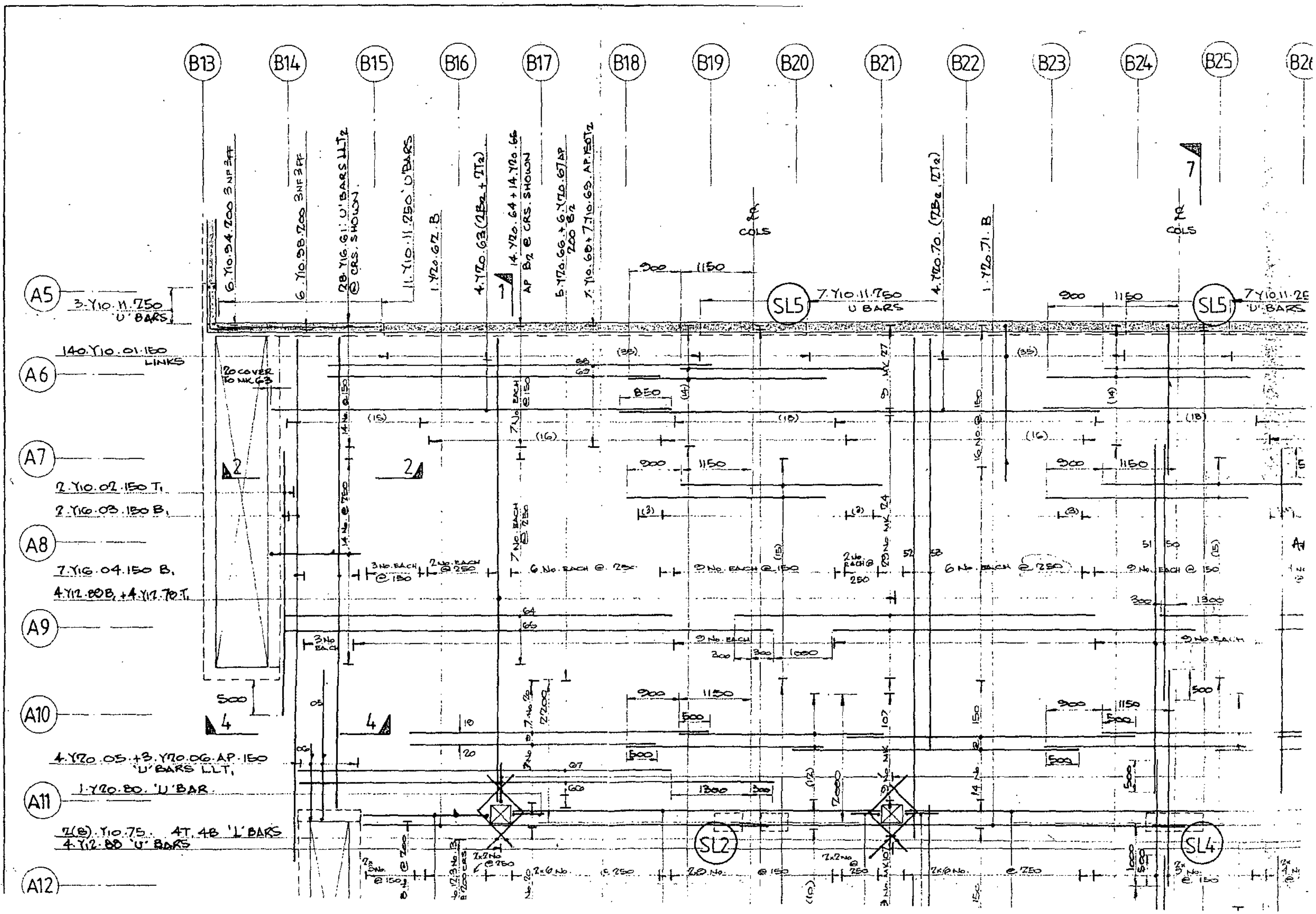
## APPENDIX C

## SCAN OF EXSITING REINFORCMENT DRAWINGS

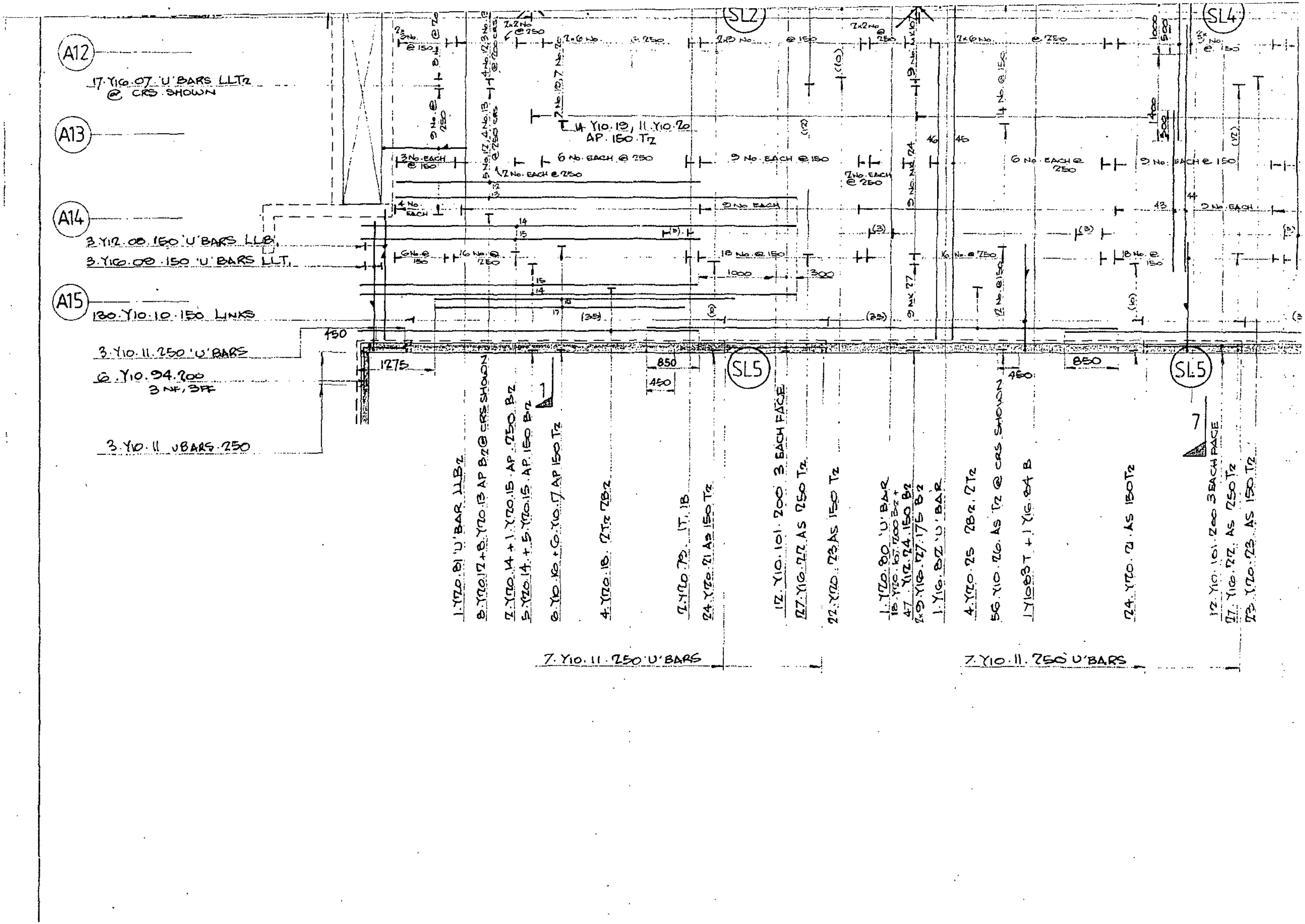



## notes

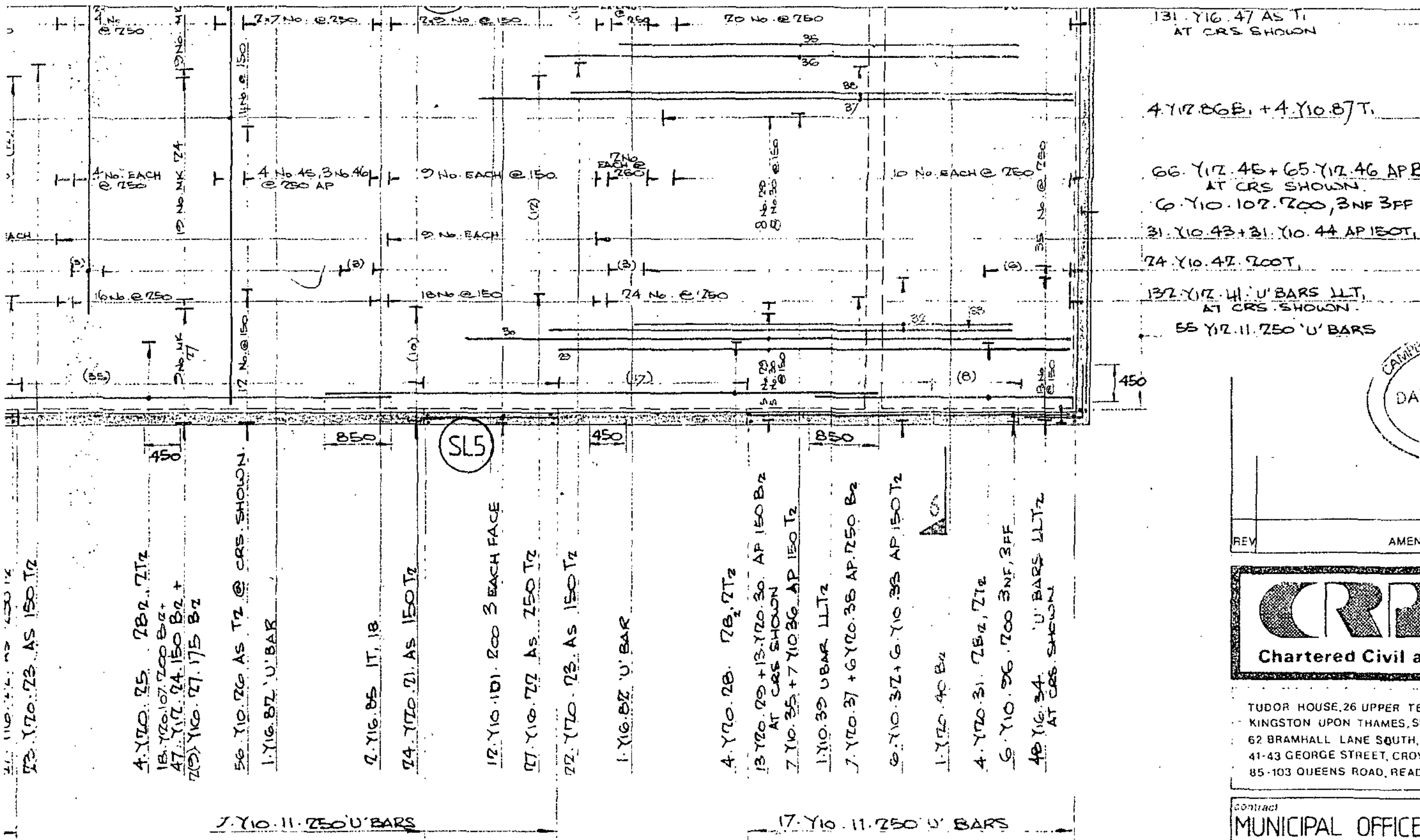
1. Do not scale this drawing. Work from figured dimensions only.
2. No deviation from the details shown on this drawing is allowed without our prior permission in writing.
3. Read this drawing with all Architects and Service Engineers relevant details and our drg. nos.
4. Concrete should be grade 30N/mm² at 28 days.
5. Maximum aggregate size to be 20 mm
6. Unless noted cover to steel 20 mm
7. For location see Drgs. Nos. 1750/5/3
8. Bending schedule page/s : 01 - 06
9. A.P. Alternately Placed, N.F. Near Face, F.F. Far Face.
10. A.S. Alternately Staggered, A.R. Alternately Reversed.
11. T. Top, B. Bottom. LL = LONG LEG
12. FOR BEAM DETAILS SEE DRG No. 1750/5/
13. (SL5) DENOTES SHEAR LINK DETAILS SEE DRG No. 1750/5/



B13
B14
B15
B16
B17
B18
B19
B20
B21
B22
B23
B24
B25
A5
A6
A7
A8
A9
A10
A11
A12
SL5
SL5
SL2
SL4
3.Y10.11.250 'U' BARS
140.Y10.01.150 LINKS
2.Y10.02.150 T1
2.Y16.03.150 B1
7.Y16.04.150 B1
4.Y12.80B1 + 4.Y12.70T1
4.Y20.05 + 3.Y20.06.AP.150 'U' BARS LLT1
1.Y20.80. 'U' BAR
7.Y10.11.250 U BARS
COLS
20 COVER TO MK.63
500
900
1150
1300
1000



A12
17.Y16.07 'U' BARS LLT2 @ CRS SHOWN
A13
A14
3.Y12.08.150 'U' BARS LLB
3.Y16.08.150 'U' BARS LLT
A15
130.Y10.10.150 LINKS
3.Y10.11.250 'U' BARS
6.Y10.94.200 3NF, 3FF
3.Y10.11 UBARS.250
SL2
SL4
SL5
14 Y10.19, 11.Y10.20 AP.150.T2
6 No. EACH @ 250
9 No. EACH @ 150
7.Y10.11.250 'U' BARS
7.Y10.11.250 'U' BARS






| REV | AMENDMENT |
|---|---|

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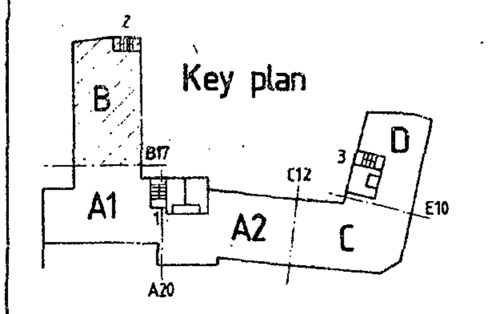


contract
MUNICIPAL OFFICES - ISLINGTON

architect
T. P. BENNETT & SON

R.C. DETAILS OF ROOF SL
BLOCK B

drawn LN checked
date 16 : 7 : 82 scale 1:50

**Job no.** 1750 **Drg.no.** R5/3