

**DUTCH BARN AT PLAS
FARM
CILYBEBYLL**

**STRUCTURAL SURVEY
AND APPRAISAL
REPORT**

APRIL 2022

***ateb*Consult**

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Ystalyfera

Swansea

SA9 2HY

☎ 01639 849279

DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

STRUCTURAL SURVEY AND APPRAISAL REPORT

April 2022

22/013

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DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

STRUCTURAL SURVEY AND APPRAISAL REPORT

1.0 Brief

The structural condition survey and building appraisal the existing Dutch barn at Plas Farm Cilybebyll, Pontardawe SA8 3J was commissioned in February 2022 by the owners and the proposed developer Mr Richard Bowen, with the brief being,

- 1.1** To undertake a structural and condition survey of the barns at Plas Cilybebyll in order to ascertain their current general structural condition
- 1.2** To review the barn building condition and suitability for future remodeling refurbishment, and conversion in accordance with the proposals tabled in Rio Architects scheme drawings [Appendix B],
- 1.3** To address the technical query items raised by Neath Port Talbot Planning dept. [following the scheme submission for planning consent] in relation to
 - 1] Height of existing retaining walls that form part of the building
 - 2] Extents of the retaining wall
 - 3] Structural condition and of existing retaining walls and design of any new retaining walls needed
 - 4] Details of any ancillary walls if needed to support ground adjacent to the barn building
- 1.3** To prepare a report giving the general structural condition of the barn building, which would include a response the queries raised by NPT Planning dept. and give recommendations for any structural or remedial work that may be required to ensure the long term structural integrity of the barn building and to facilitate its adoption and remodeling /conversion as envisaged in the Rio Architects proposal drawings.

DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

STRUCTURAL SURVEY AND APPRISAL REPORT

2.0 Basis of Report

2.1 Survey Approach

The approach taken was,

- 1] A structural inspection of the barn building by atebConsult in February 2022.
- 2] A review of the scheme proposals and drawings and of the query items raised by the NPT Planning Officer.
- 3] An appraisal of the as existing building and survey results to ascertain suitability for Conversion and the engineering measures needed to facilitate its conversion
- 4] Review of the information gathered and conclusions drawn and drafting of the report

2.2 Survey methodology

- 2.2.1 A visual inspection the Dutch Barn was carried out by Gareth M George MSc DIC MICE of atebConsult in February 2022,
- 2.2.2 In parallel to the survey a photographic record was also taken which is reproduced in Appendix A of the report.
Following the survey work the results were reviewed, conclusions drawn as to the condition of the property and cause of any defects apparent, and recommendations drawn up for remedial work that will be needed to rectify any defects present so as to maintain the barn structural integrity as well as for structural and building measures needed to allow for their remodeling and conversion
- 2.2.3 The survey results and conclusions and recommendations were then presented in this report.

DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

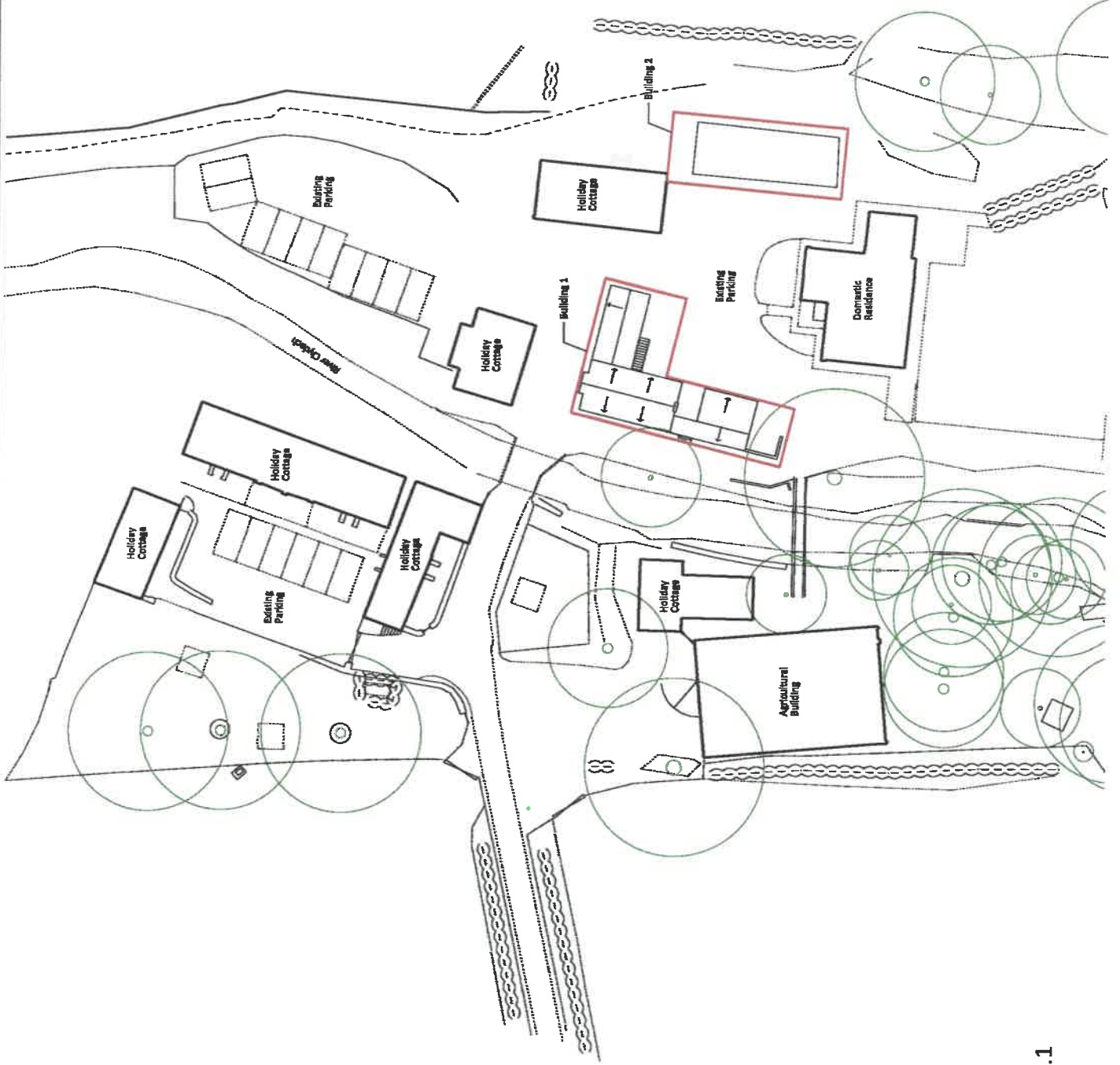
STRUCTURAL SURVEY AND APPRISAL REPORT

3.0 General Description

- 3.1** The existing Dutch barn at Plas Cilybebyll near the farm domestic residence, and adjacent to existing holiday let accommodation at the farm. The building [architects ref building No2 is shown on figure 1 ,
- 3.2** The barn was we understand constructed circa 1960 and was used a silage store, but has now been disused for some years
- 3.3** With reference to the architects drawings it is proposed to refurbish and remodel the building to form ancillary facilities for the holiday let cottages operated on the farm

Notes

The drawings are prepared and used not for approval or reference to other media without the prior written consent of the Architect Ltd.
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 CDM notes are provided to assist the contractor in managing the work safely. Any work must be carried out in accordance with the relevant regulations. Any work must not be carried out until the contractor has received the relevant CDM regulations.



PLANNING APPLICATION			
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100	10/01/2023	100	AS

RIO

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Swansea Valley
 Holiday Cottages

PROJECT TYPE
 Phase 1: Farm Building
 Renovation and
 Conversion

DRAWING TITLE
 Existing Site Plan

OWNER: AS
 CIPROD PT
 SCALE: 1:100 @ A1 (JAN 2023)

DATE	REVISION	BY	NO	DL	XX	DR	A	00002
02/01/2023	1	AS	0274	NO	DL	XX	DR	A

Fig.1

DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

STRUCTURAL SURVEY AND APPRISAL REPORT

4.0 Structural & Condition Survey

4.1 General

The barn currently is high single story building, with floor level at some 149.81m AOD as shown on the survey drawings with concrete walls some 2400mm high at ground level, and a generally open structure in steelwork above, raising to a level of 156.67m at the curved apex of the steel frame and corrugated metal sheeted roof, giving an internal height of some 6800mm at apex

The barn is some 14.2m long and 6.2m wide as shown on the survey drawing fig.2

4.2 Roof and roof structure

The roof is of corrugated single skin metal sheets carried on four curved steelwork trusses with steel section columns at some 3.73m centers on the east and west elevations

These columns in 512*102 UB steel columns sit in turn on the concrete walls

On inspection the roof sheeting was noted to be in poor condition, with corrosion visible in areas and holes within the metal sheets.

There are remains of gutters present in places, but all rainwater goods where present are in v poor condition and will need replacement

4.3 Steelwork Structure

The steelwork structure to the building comprises of four curved trusses in light Angle and channel steelwork carried off the main columns, with secondary lateral purlins at roof level and exposed light angle sheeting rails on the side and gable end as seen in the record photographs

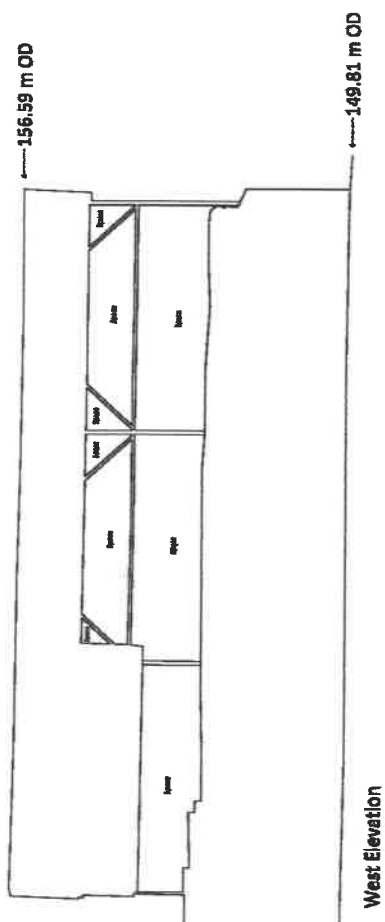
The main trusses and steel columns were painted in a red oxide type primer which has afforded the steel some protection, but the main steels did show signs of corrosion and pitting, but were considered to be in a condition where they could if cleaned and repaired and repainted with a protective system be reused, subject to introduction of additional diagonal bracing members

The secondary sheeting and roof rails were in a poor condition, and also due to the spans and lengths not considered suitable for repair or reuse

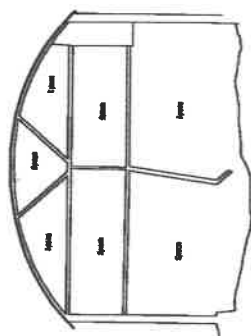
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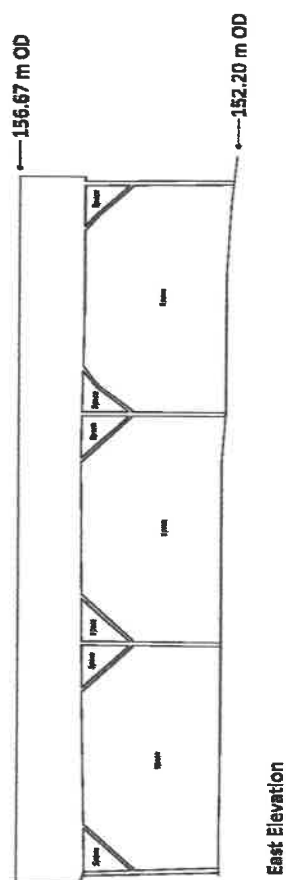
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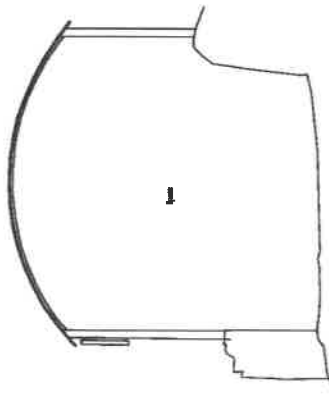
West Elevation



North Elevation



East Elevation



South Elevation

PERSONAL INFORMATION		PLANNING APPLICATION	
A	Serial No. recorded	As	As for 2002
NAME	First Name	LAST NAME	DATE
SPONSOR INFORMATION SPONSOR NAME: _____ SPONSOR ADDRESS: _____ SPONSOR CITY: _____ SPONSOR STATE: _____ SPONSOR ZIP: _____ SPONSOR PHONE: _____ SPONSOR FAX: _____ SPONSOR E-MAIL: _____ SPONSOR WEBSITE: _____ SPONSOR COMMENTS: _____			
PLANNING INFORMATION PLANNING NAME: _____ PLANNING ADDRESS: _____ PLANNING CITY: _____ PLANNING STATE: _____ PLANNING ZIP: _____ PLANNING PHONE: _____ PLANNING FAX: _____ PLANNING E-MAIL: _____ PLANNING WEBSITE: _____ PLANNING COMMENTS: _____			

10/27

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 +44 (0)20 8693 7985

**Swansea Valley
Holiday Cottage**

19.11.2019

PROJECT TITLE:

— 1995

Building 2 Existing Elevations

DRAWN BY: AB	CHECKED BY:	APPROVED BY: AB
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[illegible]

Fig.2

DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

STRUCTURAL SURVEY AND APPRISAL REPORT

4.4 Walls

4.4.1 West side wall

The west wall to the barn is a mass concrete wall which was cast to form the support walls of the original silage pit structure., with shutters in timber used to form the internal face and cast possibly against an earlier brickwork wall on the external face, resulting in a combined wall thickness of some 500mm. The wall is free standing some 2400mm high and carries the steelwork columns above. Generally the wall appeared in fairly reasonable condition considering its age and could be used in the remodeling scheme subject to concrete repair and sealing /infill of minor cracks and pitting.

4.4.2 East side wall

The east wall of the barn is in what appears mass concrete construction and retains the ground to the east of the barn as well as supporting the four east line of steel columns and forming the barn side wall at ground level. The overall height retained is some 2300-2400mm. On inspection at the south east corner of the building it is apparent that this concrete wall was cast up against an earlier masonry /stonework retaining wall in this area that must have held up the bank prior to barn construction. This masonry wall also remains in place and runs to the south of the eastern side of the barn and serves to retain the bank and difference in levels in the ground there at this time. Whilst overgrown it appears to serve its purpose.

4.4.3 South Gable elevation

The south end of the building is open giving access to the barn, with no structure present.

4.4.4 North Gable Elevation

The North gable elevation consists of a concrete wall again cast against earlier masonry structures and a flight of external steps that runs alongside the barn and nearby holiday cottage. Part of the wall appears retaining and part free standing. The wall appears fit for purpose but with local defects and cracking present that would need repair.

DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

STRUCTURAL SURVEY AND APPRISAL REPORT

4.5 Ground Floor

There does not appear to be a formal floor construction to the barn, with the ground compacted. In any refurbishment and remodeling a new 200mm mesh reinforced concrete floor slab on 100mm hardcore, with a damp proof [dpm] membrane laid under the slab will need to be provided, with the slab also dowelled into the side walls or linked with reinforcement.

DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

STRUCTURAL SURVEY AND APPRISAL REPORT

5.1 Building Conversion – Appraisal

5.1 General

An appraisal of the existing barn structure has been carried out in relation to its suitability for remodeling and refurbishment as part of the proposed conversion works detailed on the architectural drawings.

It is concluded that the barn is suitable for conversion, with the main existing structural elements retained, and added to so as to provide a suitable support and envelope for the proposed conversion works, as discussed below.

- 5.2 Roof** – The existing steel sheeting and secondary purlins will need to be removed, and new purlins introduced to carry a new light weight insulated roof covering, with the existing curved steel trusses all closely inspected and cleaned and repainted with a suitable rust inhibitor/primer. In addition a new diagonal system of bracing in steel tubes or flat plates should be introduced to provide a lateral resistance, taken back to the walls at ground floor level.

New rainwater gutters and downpipes will also need to be provided

- 5.3 Steelwork**- The existing steelwork columns all need to be cleaned and rust/corrosion removed and then the steel treated with a suitable paint system. The existing sheeting rails and secondary steels all need to be replaced with suitable rails to take the new side walls/cladding

- 5.4 Walls** -Whilst the existing ground floor walls appear stable and can be retained, they do not comply with current building regulation standards and are not where cast against the ground providing a waterproof barrier

It is thus recommended that exposed face of existing concrete walls are made good and a water proof membrane laid against that , with a new retaining walls in reinforced blockwork or concrete built inside , with suitable insulation also provided ,as detailed in Appendix C

- 5.5 First floor**- a new first floor can be provided in engineered timber joists off the new support walls

- 5.6 Ground floor** – a new 200mm mass reinforced slab is recommended with the slab tied into the new side walls to form a new structural box at ground level , which will carry the building and also support the existing steel columns /walls

DUTCH BARN AT PLAS FARM CILYBEBYLL PONTARDAWE

STRUCTURAL SURVEY AND APPRISAL REPORT

6.0 Conclusions & Recommendations

6.1 General -Structure

- 6.1.1** It is concluded that the basic structure of the existing Dutch barn is suitable for repair and retention as part of the proposed conversion and remodeling works , subject to the engineering works as outlined in section 5.0 and detailed in appendix C of the report being implemented as part of the conversion work program

6.2 Responses to NPT Planning Comments

- 6.2.1 Heights of existing walls** – these are detailed on the attached survey drawings and as noted above are some 2400mm high
- 6.2.2 Existing Retaining walls** – it is proposed to keep the existing walls and build a new retaining wall inside to provide add support and allow waterproofing measures.
- 6.2.3 Extents of walls** –as described in report and shown on plans
- 6.2.4 Design of new walls** –as appendix C
- 6.2.5 Walls /retention of ground away from Building** – there are already existing masonry walls in these areas and no add walls are deemed necessary – the existing walls need to be cleaned of vegetation and made good as appropriate

APPENDIX A



Sent from my iPhone





Gareth George

From: SHARON MAINWARING <atebion@aol.com>
Sent: 20 February 2022 13:22
To: Gareth George















APPENDIX B

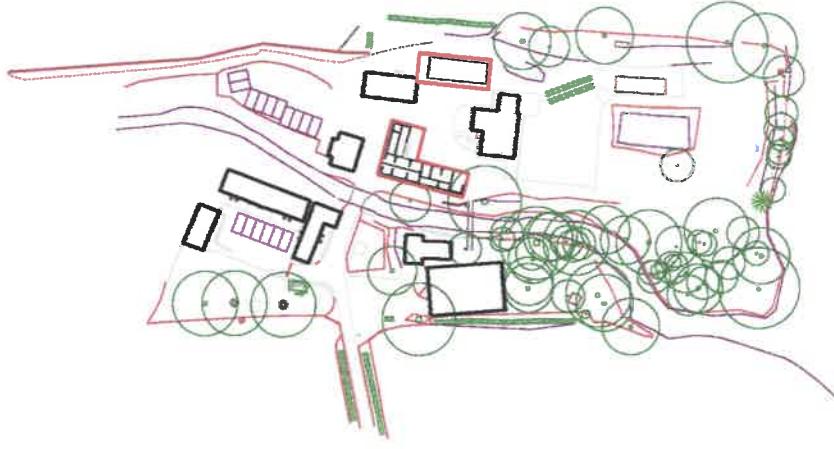
Notes

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Rev	Description	Rev'd Date	Rev'd By

PLANNING APPLICATION

ACTING HEAD OF OFFICE
PLANNING
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444 (020) 8981 7895

Swansea Valley
Holiday Cottage

PROJECT TITLE:
Pais Farm Building
Regeneration and
Conversion

DRAWING TITLE:
Site Location Plan

DRAWN BY: AB CHECKED BY: APPROVED BY: AB
JOB NO: 0274 SCALE: 1:1250 @ A3

AUTOMATICITY: S2

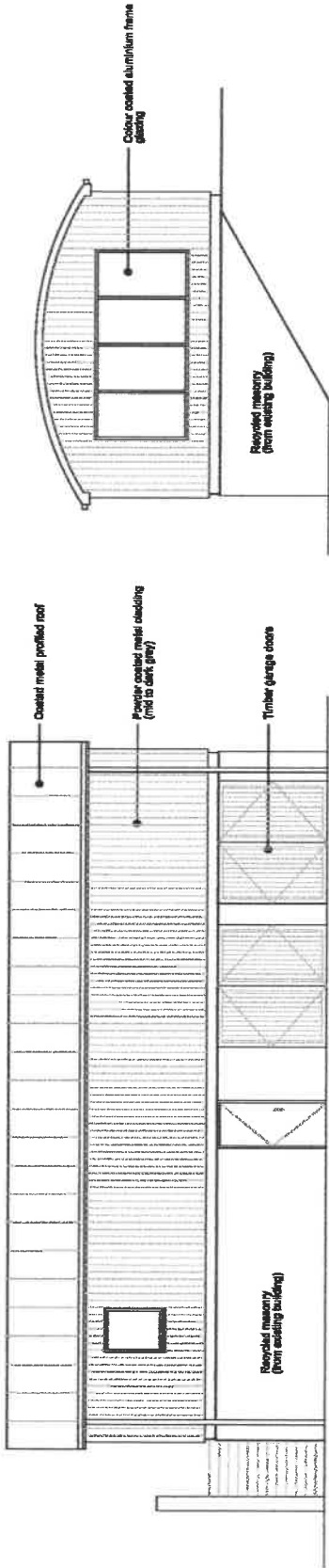
DATE: 14/05/2020

PROJECT CODE: 0274

PROJECT CODE: 0274

PROJECT CODE: 0274

Report
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reflect the contractor's design shall be subject to the relevant CMA Regulations.



West Elevation

South Elevation

NOTE:
Specialist repair and clean to existing
external cement wall finish to all areas
except where new timber cladding applied

PLANNING			
APP	DESCRIPTION	DATE	REF
A	Planning permission	14/05/2020	A
B	Planning permission	14/05/2020	B
C	Planning permission	14/05/2020	C
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Y	Planning permission	14/05/2020	Y
Z	Planning permission	14/05/2020	Z

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25-27, The Arcade
Cardiff, CF10 1AT
+44 (0)29 2031 0069
+44 (0)29 2031 7926

Swansea Valley
Holiday Cottage

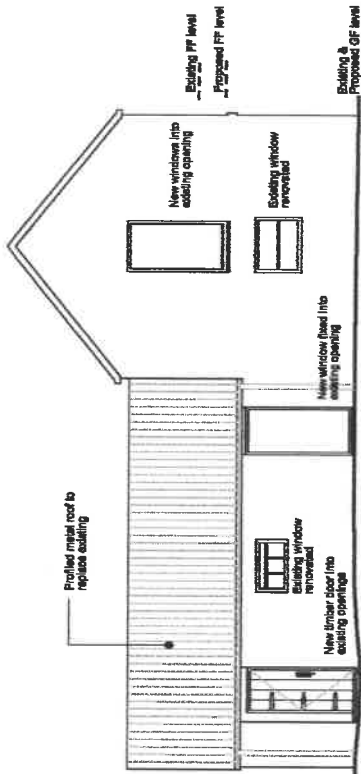
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Pine Farm Building
Renovation and
Conversion

CLIENT TITLE:
Building 2
Proposed Elevations

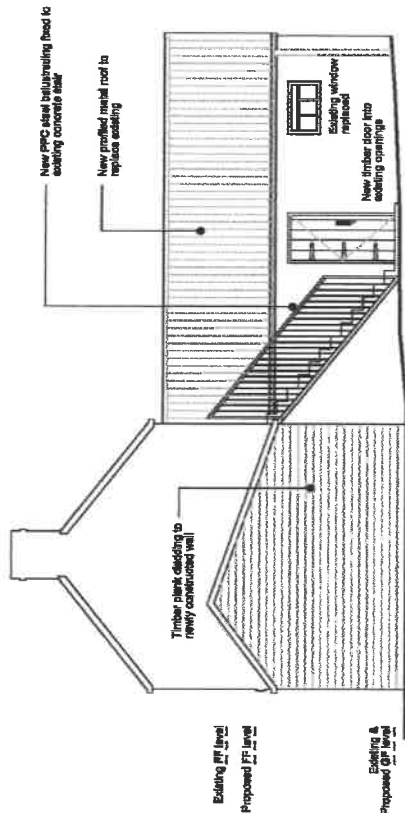
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Notes:
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CAD notes are provided to assist the contractor in installing and/or installing materials during the design stage. Any such notes do not reflect the contractor's design or the design of the project.

NOTE:
Specialist repair and clean to existing external cement wall finish to all areas except where new timber cladding applied



North Elevation



South Elevation

PLANNING			
Ref	Description	Drawn	Date
A	Final Set Approved	AB	14/05/2023

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Swansea Valley
Holiday Cottage

PROJECT TITLE
Rivers Farm Building
Renovation and
Conversion

DRAWING TITLE:
Building 1
Proposed Elevations
Sheet 2

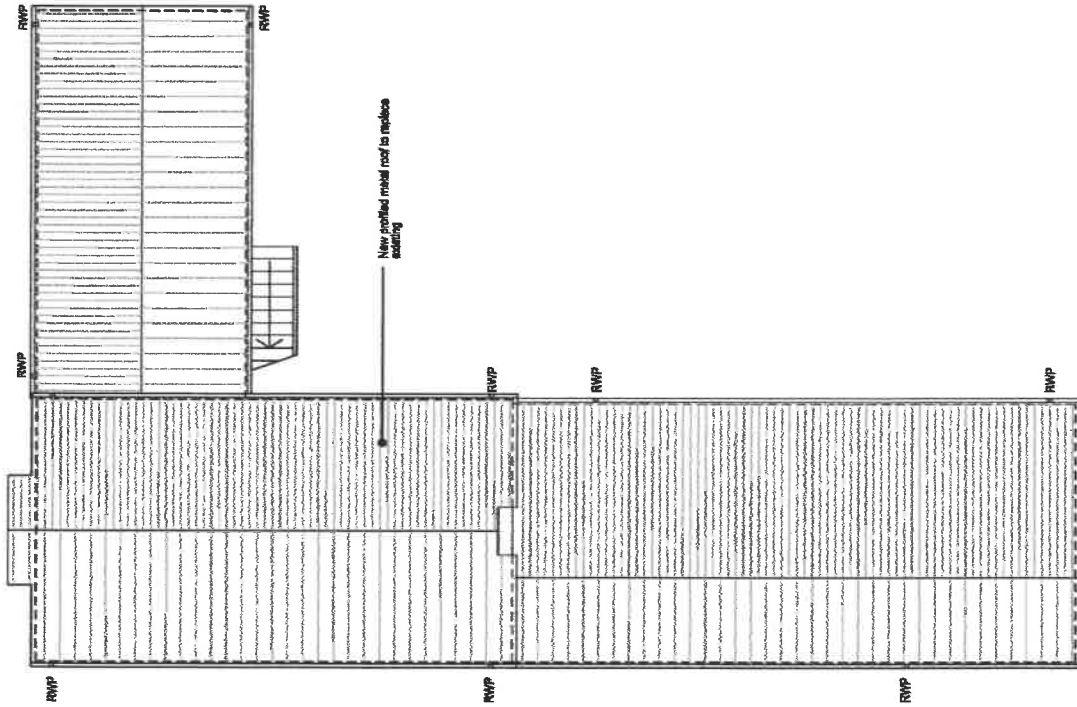
DRAWN BY: AB
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SCALE: 1:100 @ A1 / 1:200 @ A0

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DATE:	14/05/2023	REVISION:	A
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Notes:

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A		Basis last amended		AP		AB		AS		AS/MS/ASCS	

APPENDIX C

ateb Consult

Job No: 22/013

Contract:

Pely Wall 6 Burn

Desn

Sheet No:

Date:

Designer:

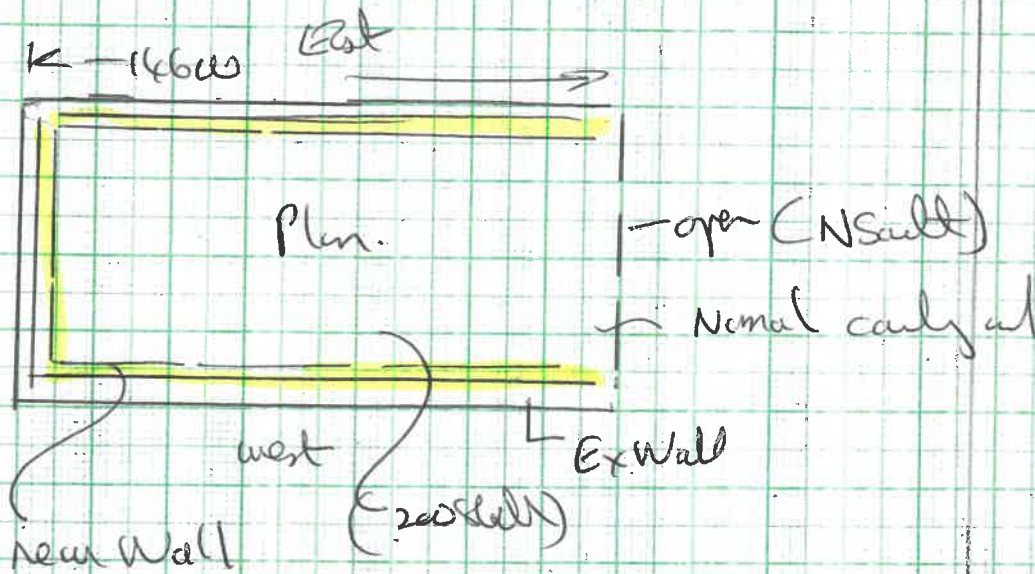
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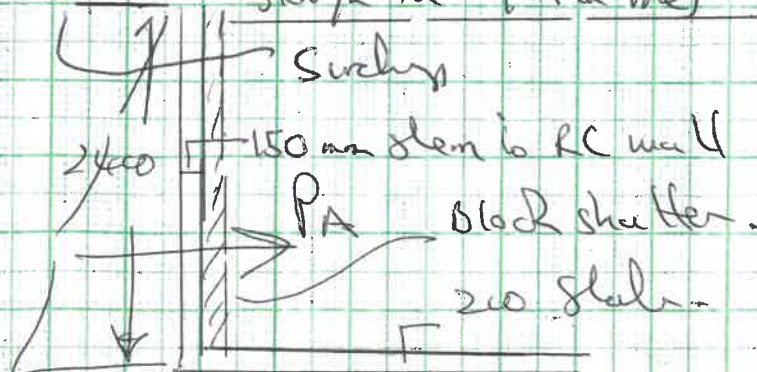
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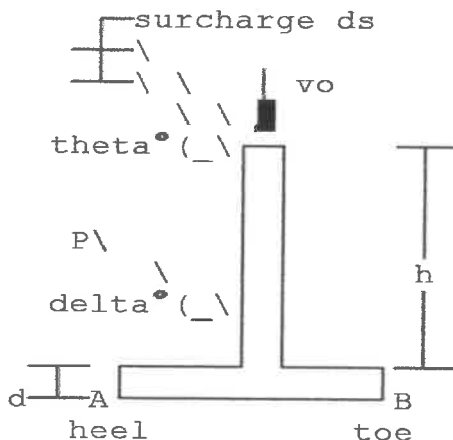


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Desn Sedin

Location: wall to barn apter 22 of 'Reinforced Concrete Design' by Bray



Reinforced concrete retaining wall

Using either Rankine or Coulomb theory, the following assumptions are made:

Surface of rupture is a plane.

Point of resultant pressure P on back of wall is at one third of the distance up from the base of the wall to the surface of the earth at the back of the wall and P is parallel to the surface.

Both Rankine and Coulomb give formula for resultant earth pressure on back of wall as $P = C_e \cdot w \cdot h^2 / 2$ where C_e is a pressure coefficient.
Weight/unit vol. of retained soil $w = 18.8 \text{ kN/m}^3$
Height of back of wall $h = 2.4 \text{ m}$
Pressure due to surcharge $\text{press} = 1.5 \text{ kN/m}^2$
Equivalent depth of surcharge $ds = \text{press} / w = 1.5 / 18.8 = 0.079787 \text{ m}$
Load above wall supported on stem $vo = 10 \text{ kN/m run}$
Angle of slope of soil (if any) $\theta = 0 \text{ degrees}$
Internal friction angle of soil $\phi = 30 \text{ degrees}$
Angle of wall-to-soil friction $\delta = 20 \text{ degrees}$
Friction factor on underside base $fb = 0.4$
Thickness of wall $t = 0.15 \text{ m}$
Density of wall (stem) $dt = 24 \text{ kN/m}^3$
Data 0.15 entered, is less than minimum expected value 0.2

Pressure from retained soil

Cosine of surcharge angle (θ) $ct = \cos(\text{RAD}(\theta)) = 1$
Sine of friction angle (ϕ) $sp = \sin(\text{RAD}(\phi)) = 0.5$
Cosine of friction angle (ϕ) $cp = \cos(\text{RAD}(\phi)) = 0.86603$
Cosine of wall-soil friction (δ) $cd = \cos(\text{RAD}(\delta)) = 0.93969$
Sine of ($\phi + \delta$) $ss1 = \sin(\text{RAD}(\phi) + \text{RAD}(\delta)) = \sin(\text{RAD}(30) + \text{RAD}(20)) = 0.76604$

Sine of ($\phi - \theta$) $ss2 = \sin(\text{RAD}(\phi) - \text{RAD}(\theta)) = \sin(\text{RAD}(30) - \text{RAD}(0)) = 0.5$

Coulomb theory:

Factor $f = cd * (1 + \text{SQR}(ss1 * ss2 / (cd * ct)))^2 = 0.93969 * (1 + \text{SQR}(0.76604 * 0.5 / (0.93969 * 1)))^2 = 2.5226$

Pressure coefficient $Cec = cp^2 / f = 0.86603^2 / 2.5226 = 0.29731$

Rankine theory:

Factor $f = \text{SQR}(ct^2 - cp^2) = \text{SQR}(1^2 - 0.86603^2) = 0.5$

Pressure coefficient $Cer = ct * (ct - f) / (ct + f) = 1 * (1 - 0.5) / (1 + 0.5) = 0.33333$

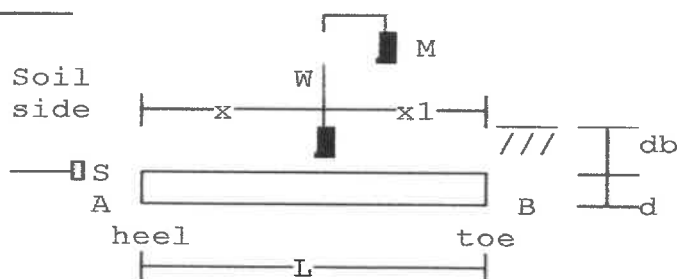
Rankine pressure coefficient is chosen.

Resultant earth force (active)	$P = C_e * w * h^2 / 2 = 0.33333 * 18.8 * 2.4^2 / 2$ =18.048 kN/m run
Horiz.component of this force	$P_h = P * \cos(\text{RAD}(\theta))$ =18.048 * $\cos(\text{RAD}(0))$ =18.048 kN/m run
Vertical component of this force	$P_v = P * \sin(\text{RAD}(\theta))$ =18.048 * $\sin(\text{RAD}(0))$ =0 kN/m run
Pressure coefficient (surcharge)	$C_a = (1 - s_p) / (1 + s_p) = (1 - 0.5) / (1 + 0.5)$ =0.33333
Resultant earth force (surcharge)	$P_s = C_a * w * d_s * h$ =0.33333 * 18.8 * 0.079787 * 2.4 =1.2 kN/m run
Horiz.component of this force	$P_{sh} = P_s * \cos(\text{RAD}(\theta))$ =1.2 * $\cos(\text{RAD}(0))$ =1.2 kN/m run
Vertical component of this force	$P_{sv} = P_s * \sin(\text{RAD}(\theta))$ =1.2 * $\sin(\text{RAD}(0))$ =0 kN/m run

Forces and moments on wall

Maximum B.M. at base of stem	$M = P_h * h / 3 + P_{sh} * h / 2$ =18.048 * 2.4 / 3 + 1.2 * 2.4 / 2 =15.878 kNm/m
Maximum S.F. at base of stem	$S = P_h + P_{sh} = 18.048 + 1.2 = 19.248$ kN/m
Weight of wall	$v = h * t * \rho = 2.4 * 0.15 * 24 = 8.64$ kN/m run
Weight of wall plus load over	$v = v + v_o = 8.64 + 10 = 18.64$ kN/m run

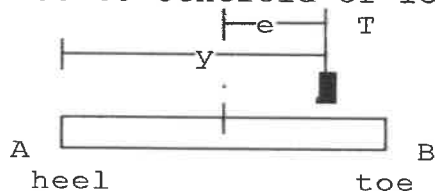
Base



Thickness of base	$d = 0.2$ m
Length of base	$L = 2.5$ m
Distance from A to centre of stem	$x = 0.2$ m
Depth of soil over base at toe	$db = 0$ m
Depth of soil for passive resist.	$dp = 1.5$ m
For simplicity, the relatively-trivial effects of the self-weight and location of any key on the pressures, etc beneath the base are ignored.	
Distance from stem to front toe	$x_1 = L - x = 2.5 - 0.2 = 2.3$ m
Allowable ground pressure	$p = 100$ kN/m ²
Self-weight of foundation	$Sw = L * d * \rho = 2.5 * 0.2 * 24 = 12$ kN/m run
Wt. of soil behind wall (earth)	$w_{be} = (h + d_s) * (x - t/2) * w$ = (2.4 + 0.079787) * (0.2 - 0.15/2) * 18.8 = 5.8275 kN/m run
Wt. of soil behind wall (slope)	$w_{bs} = w * (x - t/2)^2 * \tan(\text{RAD}(\theta)) / 2$ = 18.8 * (0.2 - 0.15/2) ² * $\tan(\text{RAD}(0)) / 2$ = 0 kN/m run

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Total weight of soil behind wall $w_b = w_{be} + w_{bs} = 5.8275 + 0 = 5.8275$ kN/m run
Weight of soil at front of wall $w_f = d_b * (x_1 - t/2) * w = 0 * (2.3 - 0.15/2) * 18.8 = 0$ kN/m run
Total earth pressure (active) $P_{ab} = C_e * c_t * w * (h+d)^2/2 = 0.33333 * 1 * 18.8 * (2.4 + 0.2)^2/2 = 21.181$ kN/m run
Horiz.component of this force $P_{abh} = P_{ab} * \cos(\text{RAD}(\theta)) = 21.181 * \cos(\text{RAD}(0)) = 21.181$ kN/m run
Vertical component of this force $P_{abv} = P_{ab} * \sin(\text{RAD}(\theta)) = 21.181 * \sin(\text{RAD}(0)) = 0$ kN/m run
Total earth pressure (surcharge) $P_{sb} = C_a * w * d_s * (h+d) = 0.33333 * 18.8 * 0.079787 * (2.4 + 0.2) = 1.3$ kN/m run
Horiz.component of this force $P_{sbh} = P_{sb} * \cos(\text{RAD}(\theta)) = 1.3 * \cos(\text{RAD}(0)) = 1.3$ kN/m run
Vertical component of this force $P_{sbv} = P_{sb} * \sin(\text{RAD}(\theta)) = 1.3 * \sin(\text{RAD}(0)) = 0$ kN/m run
Total load on soil beneath base $T = v + S_w + w_b + w_f + P_{abv} + P_{sbv} = 18.64 + 12 + 5.8275 + 0 + 0 + 0 = 36.468$ kN/m run
Overturning moment due to earth pressure $M_t = P_{abh} * (h+d)/3 + P_{sbh} * (h+d)/2 = 21.181 * (2.4 + 0.2)/3 + 1.3 * (2.4 + 0.2)/2 = 20.047$ kNm/m run
Force u/s base (earth pressure) $S_t = P_{abh} + P_{sbh} = 21.181 + 1.3 = 22.481$ kN/m run
Clockwise moments about A due to weight of soil behind wall $M_{cb} = (3 * w_{be} + 2 * w_{bs}) * (x - t/2)/6 = (3 * 5.8275 + 2 * 0) * (0.2 - 0.15/2)/6 = 0.36422$ kNm/m
Clockwise moments about A due to vert.component of earth pressure $M_{cbv} = (P_{abv} + P_{sbv}) * (x - t/2) = (0 + 0) * (0.2 - 0.15/2) = 0$ kNm/m
Total clockwise moments about A $M_c = v * x + M_t + S_w * L/2 + M_{cb} + M_{cbv} + w_f * (L - (x_1 - t/2)/2) = 18.64 * 0.2 + 20.047 + 12 * 2.5/2 + 0.36422 + 0 + 0 * (2.5 - (2.3 - 0.15/2)/2) = 39.139$ kNm/m
Distance to centroid of load $y = M_c / T = 39.139 / 36.468 = 1.0733$ m



Eccentricity $e = y - L/2 = 1.0733 - 2.5/2 = -0.17673$ m
WARNING: Eccentricity is negative, i.e. pressure at heel (A) is greater than pressure at toe (B).
Centroid of load lies within middle third. Pressure varies from p_a at A to p_b at B.



pa - - - - - pb

Base area modulus

$$z = 1 * L^2 / 6$$

$$= 1 * 2.5^2 / 6$$

$$= 1.0417 \text{ cu.m per metre run}$$

Pressure at A

$$p_a = T / (L * 1) - T * e / z$$

$$= 36.468 / (2.5 * 1) - 36.468 * -0.17673 / 1.0417$$

$$= 20.774 \text{ kN/m}^2$$

Pressure at B

$$p_b = T / (L * 1) + T * e / z$$

$$= 36.468 / (2.5 * 1) + 36.468 * -0.17673 / 1.0417$$

$$= 8.3998 \text{ kN/m}^2$$

Maximum pressure is at A

$$p_{max} = p_a = 20.774 \text{ kN/m}^2$$

As p_{max} does not exceed p ($20.774 \text{ kN/m}^2 < 100 \text{ kN/m}^2$),
pressure beneath base is within specified limit.

Shear forces and bending moments on base

Pressure under back of wall

$$p_{wa} = p_a + (p_b - p_a) * (x - t/2) / L$$

$$= 20.774 + (8.3998 - 20.774) * (0.2 - 0.15 / 2) / 2.5$$

$$= 20.155 \text{ kN/m}^2$$

Pressure under front of wall

$$p_{wb} = p_a + (p_b - p_a) * (x + t/2) / L$$

$$= 20.774 + (8.3998 - 20.774) * (0.2 + 0.15 / 2) / 2.5$$

$$= 19.413 \text{ kN/m}^2$$

Downward S.F. on heel

$$S_{ad} = dt * d * (x - t/2) + w_b$$

$$= 24 * 0.2 * (0.2 - 0.15 / 2) + 5.8275$$

$$= 6.4275 \text{ kN/m}$$

Upward S.F. on heel

$$S_{au} = (p_a + p_{wa}) * (x - t/2) / 2$$

$$= (20.774 + 20.155) * (0.2 - 0.15 / 2) / 2$$

$$= 2.5581 \text{ kN/m}$$

Downward B.M. on toe

$$M_{bd} = (dt * d * (x_1 - t/2) + w_f) * (x_1 - t/2) / 2$$

$$= (24 * 0.2 * (2.3 - 0.15 / 2) + 0) * (2.3 - 0.15 / 2) / 2$$

$$= 11.882 \text{ kNm/m}$$

Downward B.M. on heel

$$M_{ad} = (3 * w_{be} + 4 * w_{bs} + 3 * dt * d * (x - t/2)) * (x - t/2) / 6$$

$$= (3 * 5.8275 + 4 * 0 + 3 * 24 * 0.2 * (0.2 - 0.15 / 2)) * (0.2 - 0.15 / 2) / 6$$

$$= 0.40172 \text{ kNm/m}$$

Total S.F. on toe (plus is up)

$$S_{wb} = ((p_{wb} + p_b) / 2 - dt * d) * (x_1 - t/2) - w_f$$

$$= ((19.413 + 8.3998) / 2 - 24 * 0.2) * (2.3 - 0.15 / 2) - 0$$

$$= 20.262 \text{ kN/m}$$

Total S.F. on heel (plus is up)

$$S_{wa} = S_{au} - S_{ad} = 2.5581 - 6.4275$$

$$= -3.8694 \text{ kN/m}$$

Total B.M. on toe (plus is up)

$$M_{wb} = (2 * p_b + p_{wb}) * (x_1 - t/2)^2 / 6 - M_{bd}$$

$$= (2 * 8.3998 + 19.413) * (2.3 - 0.15 / 2)^2 / 6 - 11.882$$

$$= 17.998 \text{ kNm/m}$$

Total B.M. on heel (plus is up)

$$M_{wa} = (2 * p_a + p_{wa}) * (x - t/2)^2 / 6 - M_{ad}$$

$$= (2 * 20.774 + 20.155) * (0.2 - 0.15 / 2)^2 / 6 - 0.40172$$

$$= -0.24103 \text{ kNm/m}$$

Resistance to sliding

Frictional resistance $F = f_b * T = 0.4 * 36.468 = 14.587 \text{ kN/m run}$
Rankine coeff.of passive pressure $K_p = (\tan(\text{RAD}(45) + \text{RAD}(\phi/2)))^2$
 $= (\tan(\text{RAD}(45) + \text{RAD}(30/2)))^2$
 $= 3$
Passive resistance $R = 0.5 * K_p * w * d_p^2 = 0.5 * 3 * 18.8 * 1.5^2$
 $= 63.45 \text{ kN/m}$
FoS sliding (frict.resist.only) $FOSF = F / St = 14.587 / 22.481$
 $= 0.64885$
WARNING: As factor of safety against sliding (considering frictional
resistance only) is less than unity, wall may be unstable.
WARNING: Factor of safety against sliding (considering frictional
resistance only) is less than 1.5.
FoS sliding (friction/cohesion + passive) $FOSS = (F + R) / St$
 $= (14.587 + 63.45) / 22.481$
 $= 3.4712$

Resistance to overturning

Rotation assumed to occur about lowest forward edge of base (i.e. toe).

Restraining moments:

Due to soil behind wall $M_{re} = w_{be} * (L - (x - t/2)/2) + w_{bs} * (L - (x - t/2)/3)$
 $= 5.8275 * (2.5 - (0.2 - 0.15/2)/2) + 0 * (2.5$
 $- (0.2 - 0.15/2)/3)$
 $= 14.205 \text{ kNm/m}$

Due to base, wall and soil on toe $M_{rw} = v * x_1 + S_w * L/2 + w_f * (x_1 - t/2)/2$
 $= 18.64 * 2.3 + 12 * 2.5/2 + 0 * (2.3 - 0.15$
 $/2)/2$
 $= 57.872 \text{ kNm/m}$

Due to vert.comp.of earth pres. $M_{rv} = (P_{abv} + P_{sbv}) * (x_1 + t/2)$
 $= (0 + 0) * (2.3 + 0.15/2)$
 $= 0 \text{ kNm/m}$

Total restraining mt.(with M_{rv}) $M_{r1} = M_{re} + M_{rw} + M_{rv} = 14.205 + 57.872 + 0$
 $= 72.077 \text{ kNm/m}$

ditto (without M_{rv}) $M_{r2} = M_{re} + M_{rw} = 14.205 + 57.872$
 $= 72.077 \text{ kNm/m}$

Total overturning moment $M_{ot} = M_t = 20.047 \text{ kNm/m}$

Safety factors against overturning:

Including vert.comp.of pressure $FOSOT1 = M_{r1} / M_{ot} = 72.077 / 20.047$
 $= 3.5953$

Ignoring vert.comp.of pressure $FOSOT2 = M_{r2} / M_{ot} = 72.077 / 20.047$
 $= 3.5953$

RC Design

BM
ult

$$\text{Bendy Mut} = \begin{matrix} \text{Stem} = 15.8 \\ \text{Base} = 17.98 \end{matrix} \times 1.5 = \begin{matrix} 23.7 \\ 26.97 \end{matrix} \text{ all } \neq \text{w/c}$$

Adapt w/c to mt

$$q \text{ in } \text{w/hd}^2 = 26 \times 10^6 / 10^3 \times 125^2 = 1.66$$

$$d = 150 \\ d_{eff} = 125$$

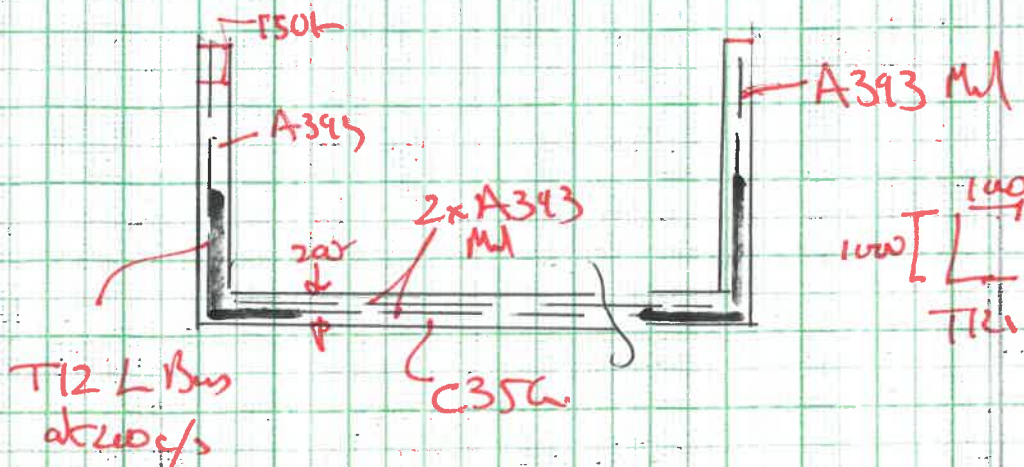
For Tally $A_s = \frac{100 A_s}{hd} = 0.3$

$$A_s = 0.3 \times \frac{100 \times 125}{100} = 375 \text{ mm}^2$$

Use A343 Mm at L Bus T12 ϕ 1200 c/s

$$A_s \text{ T12 } \phi - 200 \text{ c/s} = 565 \text{ mm}^2 - \text{SMA}$$

RC Detail as Follows:-



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Job No:

Contract:

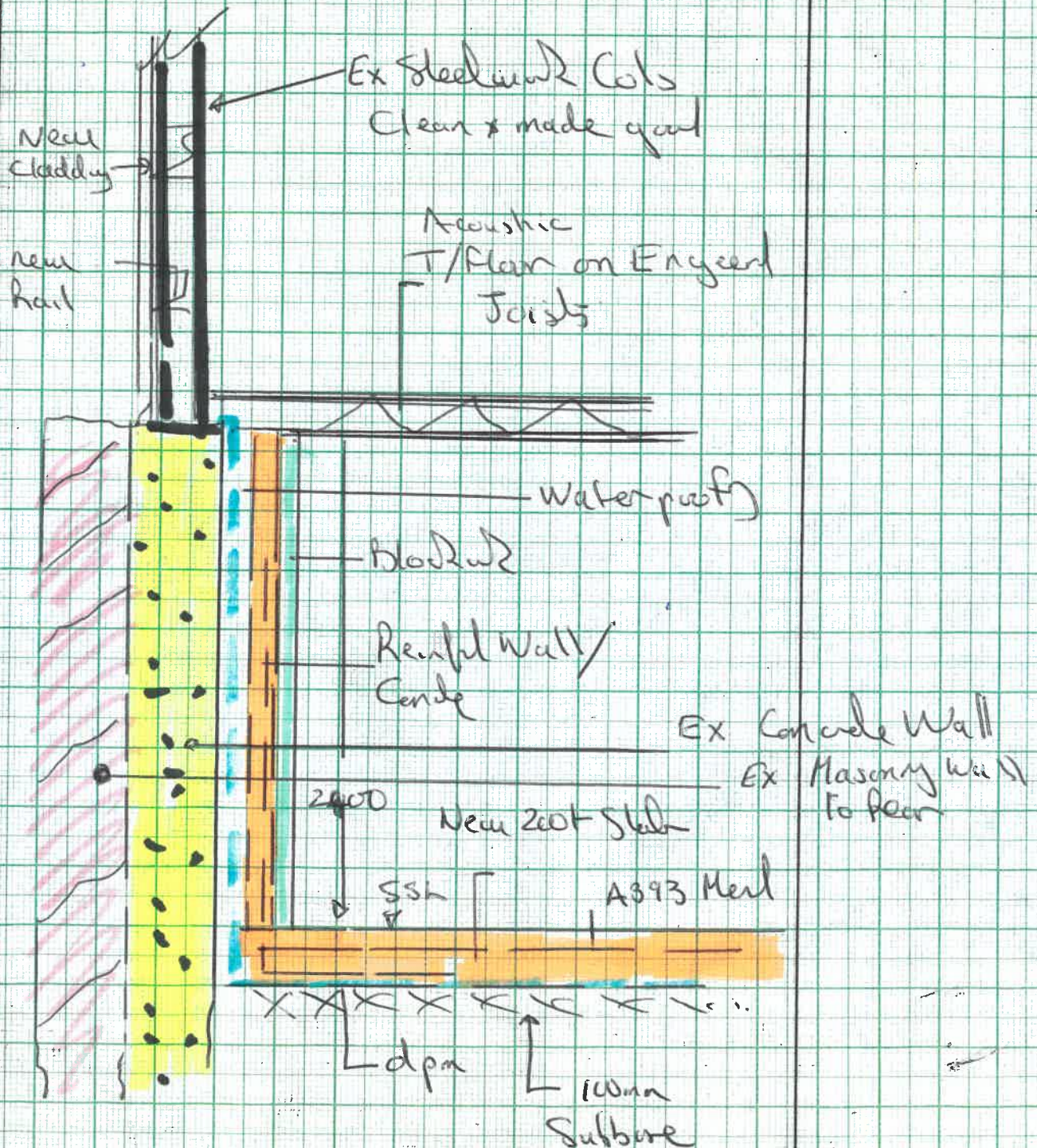
Dutch Barn
Proposed Section

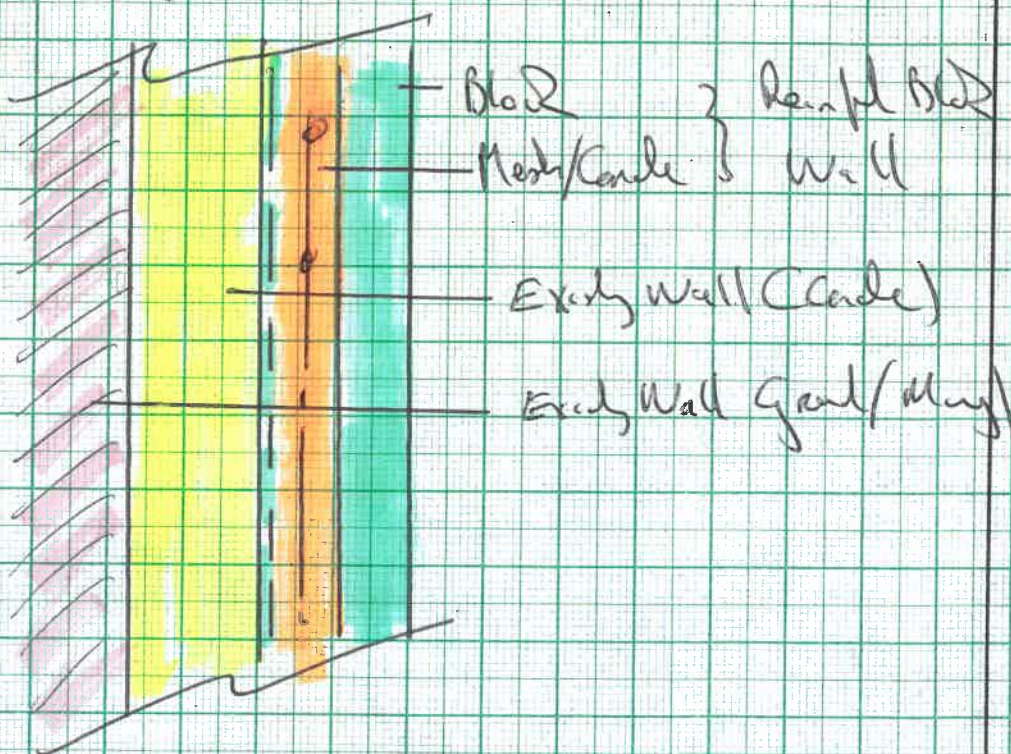
Sheet No:

Date: 5/1/11

Designer:

Checked:





Plan View on East Wall

PROJECT Dutch Barn Conversion

Retaining Wall Details

Construction

ORIGINAL NOTES

- The note shown in this drawing only applies to the original paper stock.
- It is not such from this trading table format including only.
- Any discrepancies to be reported to the central.
- Drawings in PDF format are not to scale and are for reference only.

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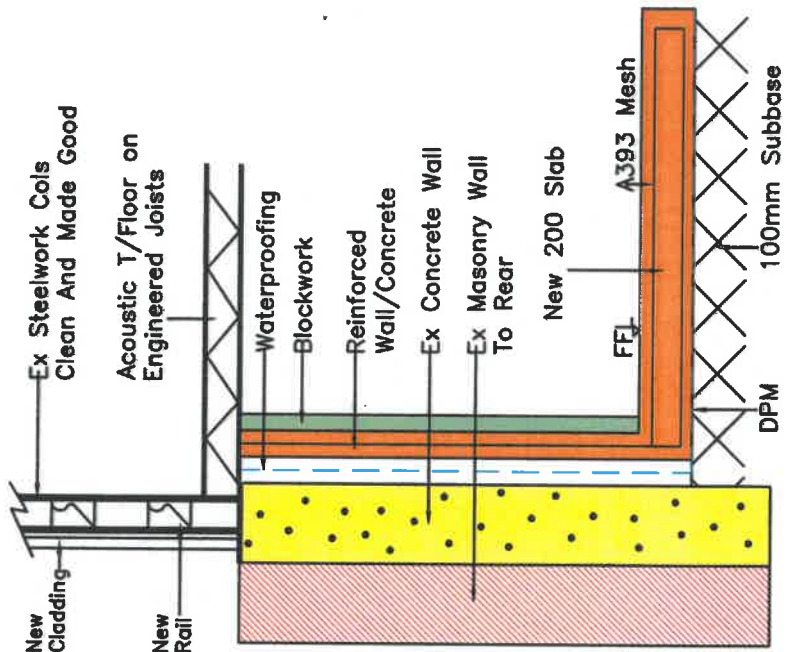
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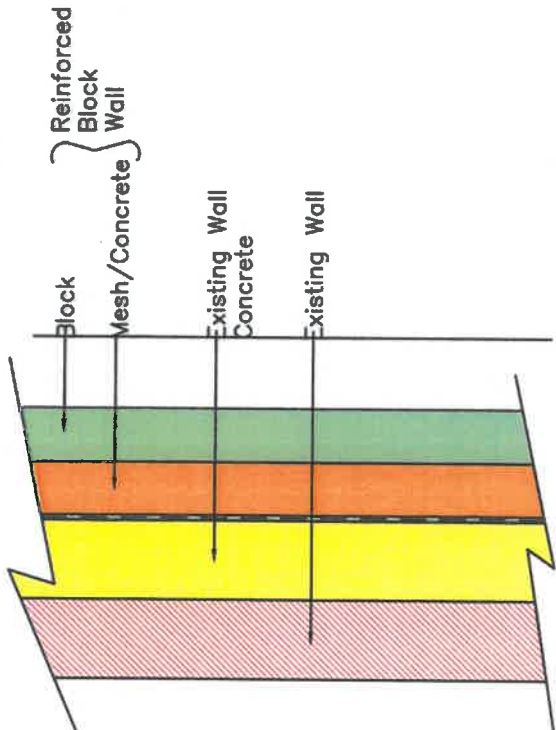
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Fax: 01639 849884

E-mail: info@diadocconsult.co.uk			
ISS NUMBER	ISSN NUMBER		

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Dutch Barn Proposed Detail



Plan View On East Wall