Planning

From: Hilary Saunders
Sent: 19 September 2018 15:08
To: Planning
Subject: FW: Hill View Barn, Staintondale
Attachments: Calculations sheets no.s 25102259 - 01 to 07 inclusive.pdf

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From: Neil Duffield
Sent: 19 September 2018 14:57
To: Hilary Saunders
Subject: Hill View Barn, Staintondale

Hi Hilary,

This email has pictures at the bottom showing the timber joists being laid on and over railway sleepers, struct calcs which include a note re lifespan are attached.

As mentioned previously to try and repair/make good a structure like that with very reduced life span would be cost prohibitive, ie pouring good money after bad!

Hope this helps
Neil

STRUCTURAL CALCULATIONS

AND SKETCHES

FOR

NEW BUILD TIMBER

FRAMED DWELLING

AT

WHITEGATE BUNGALOW

STAINTONDALE

FOR

MR. GARY HILL

Byrom Clark Roberts

Consulting Civil and Structural Engineers

PROJECT	Job No.	Sheet no.	Rev.
WHITEGATE BUNGALOW, STAINTONDALE	25/10/2259	01	
STRUCTURAL ELEMENT	**Calc. by** NGW	**Date** MAR.'10	**Chck'd by** / **Date**

PROPOSALS

NEW BUILD TEMPORARY TIMBER-FRAMED BUNGALOW TO BE BUILT ON SITE OF EXISTING BUNGALOW. DETACHED BUILDING. BUNGALOW REQUIRED FOR MAXIMUM OF 5 YEARS.

REFER TO HALL ASSOCIATES DRAWINGS.

CONSTRUCTION

PITCHED ROOFS OF ROOFING FELT ON OSB BOARDS ON TIMBER RAFTERS. CEILING AND GROUND FLOOR OF TIMBER JOISTS. ALL WALLS AND PARTITIONS OF TIMBER STUDDING WITH SHIPLAP BOARDING ON EXTERNAL ELEVATIONS. FOUNDATIONS OF TIMBER SLEEPERS ON COMPACTED CRUSHER RUN HARDCORE. ORIGINAL BRICK CHIMNEY & FLUE RETAINED.

LOADINGS

ROOF

3 LAYER FELT	0.12	
OSB BOARDS	0.13	
RAFTERS & INSULN.	0.11	
	0.36 @ 30°	
	× 1/cos 30° =	0.42
IMPOSED (SNOW)		0.75
		1.17 kN/m²

CEILING

BOARDS	0.18	
JOISTS	0.09	
PLASTERB'D & SKIM	0.15	
	0.37	
IMPOSED (LOFT)	0.25	
	0.62 kN/m²	

GROUND FLOOR

BOARDS & FINISHES	0.24	
JOISTS & INSULN.	0.17	
	0.41	
IMPOSED (DOMESTIC)	1.50	
	1.91 kN/m²	

EXTERNAL WALLS

SHIPLAP	0.22	
STUDS & INSULN.	0.06	
PLASTERB'D & SKIM	0.15	
	0.43 kN/m²	

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PROJECT	Job No. 25/10/2259	Sheet no. 02	Rev.
STRUCTURAL ELEMENT	Calc. by NAW / Date MAR.'10	Chck'd by	Date

WIND LOADING

$V_b = 25.0 m/s$ $\quad S_a = 1 + 0.001 \times 150 = 1.15$

LET $S_d = S_s = S_p = 1.0$

$\Rightarrow V_s = 1.15 \times 25.0 = 28.75 m/s$

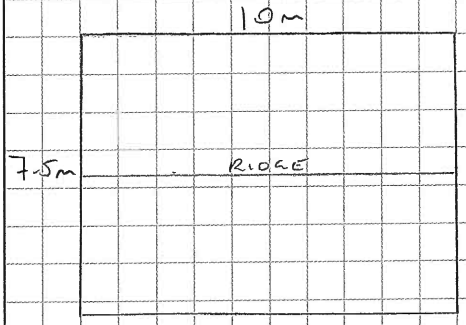
$H_e = 4.5m$ TO APEX

DISTANCE FROM SEA $= 1.15m \Rightarrow S_b = 1.60$

$\Rightarrow V_e = 1.60 \times 28.75 = 46.0 m/s$

$q_s = 0.613 V_e^2 = \underline{1.30 kN/m^2}$

EXTERNAL WIND PRESSURE $\quad p_e = q_s C_{pe} C_a$



10m SIDES: $a = \sqrt{10^2 + 2.5^2} = 10.3$

$\Rightarrow \alpha = \underline{0.955}$

7.5m SIDES: $a = \sqrt{7.5^2 + 2.5^2} = 7.9$

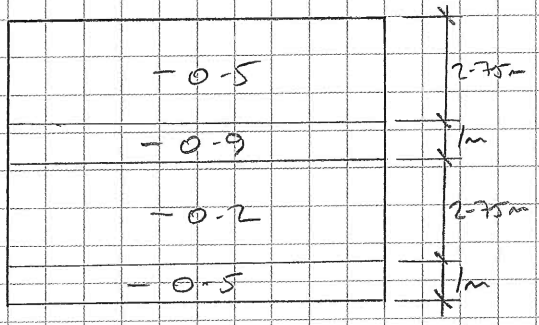
$\Rightarrow \alpha = \underline{0.971}$

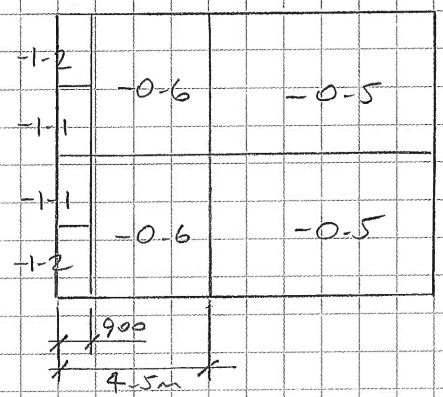
$D/H = 1.66 = 2.22$

10m SIDES: $C_{pe} = \underline{+0.795}$ & $\underline{-0.50}$

7.5m SIDES: $C_{pe} = \underline{+0.748}$ & $\underline{-0.50}$

ROOF: 30° PITCH $\Rightarrow$ C_{pe} SHOWN ON PLANS:





400mm OVERHANGS $\Rightarrow$ SMALL OVERHANGS $\Rightarrow C_{pe_{MAX}} = -0.5 + 0.795 = 1.30$

$C_{pi} = -0.30$ OR $+0.20$

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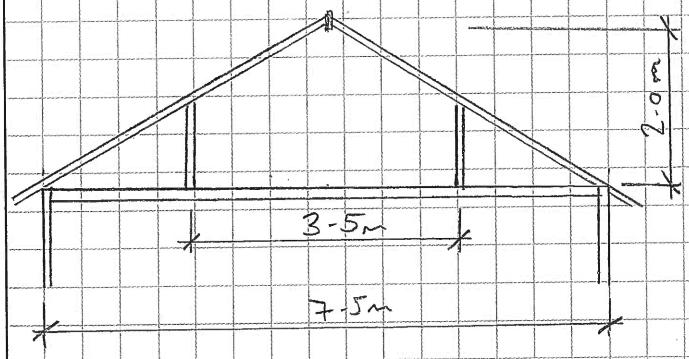
PROJECT	Job No. 25/10/2259	Sheet no. 03	Rev.
STRUCTURAL ELEMENT ROOF & CEILING	Calc. by NCW / Date MAR. '10	Chck'd by	Date

RAFTERS ARE 50×100 AT 400 CRS.



UDL PER RAFTER = 1.17 × 0.4
= 0.47 kN/m

(SUCTION = [1.3 × (0.6 + 0.2) − 0.36] × 0.4
= 0.27 kN/m)

MAX. SPAN = 2.0m
⇒ M = 0.47 × $2.0^2/8$ = 0.23 kNm

Z = 83.3 × 10^3 mm^3 I = 4.16 × 10^6 mm^4 δ_{PERM} = 0.003 × 2000 = 6mm

σ_{11} = 0.23 × 10^6 / 83.3 × 10^3 = 2.8 N/mm^2 < 5.3 × 1.1 = 5.83 N/mm^2
⇒ O.K.

$\delta \simeq \frac{5 \times 0.47 \times 2000^4}{384 \times 8800 \times 4.16 \times 10^6}$ = 2.7mm ⇒ O.K.

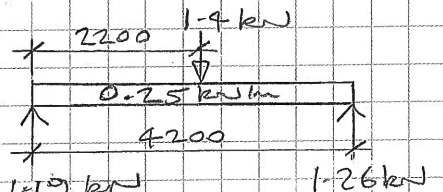
USE 50×100 RAFTERS AT 400 CRS.

NOTE – SCREW RAFTERS DOWN TO STUD PARTITIONS TO PREVENT UPLIFT.

CEILING JOISTS SPAN MAX. 4.2m FROM FRONT WALL TO SPINE WALL.

UDL = 0.62 × 0.4 = 0.25 kN/m / JOIST.

POINT LOAD FROM ROOF / STUD PARTITION = (1.17 × 5.5/2 + 0.21 × 1.1m) × 0.4 = 1.4 kN / JOIST



R_L = 0.25 × $4.2^2/2$ + 1.4 × $2.0^1/4.2$ = 1.19 kN

R_R = 0.25 × $4.2^2/2$ + 1.4 × $2.2/4.2$ = 1.26 kN

M = 1.19 × 2.2 − 0.25 × $2.2^2/2$ = 2.01 kNm / JOIST

USING GRADE C24 TIMBER: $\sigma_{11\,PERM}$ = 1.1 × 1.25 × 5.3 = 7.3 N/mm^2

δ_{PERM} = 0.003 × 4200 = 12.6mm E_{MEAN} = 18,800 N/mm^2

EQUIV. UDL = $\frac{8 \times 2.01}{4.2^2}$ = 0.91 kN/m.

$Z_{REQ'D}$ = 2.01 × 10^6 / 7.3 = 276 × 10^3 mm^3

$I_{REQ'D} = \frac{5 \times 0.91 \times 4200^4}{384 \times 8800 \times 12.6}$ = 33.3 × 10^6 mm^4

USE 50×200 DP. JOISTS AT 400 c/c
(Z = 333 × 10^3 ; I = 33.3 × 10^6)

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PROJECT	Job No. 25/10/2259	Sheet no. 04	Rev.
STRUCTURAL ELEMENT CEILING	Calc. by NCW / Date MAR.'10	Chck'd by	Date

NOTE – CEILING JOISTS USED ARE 50×150 AT 400 CRS.

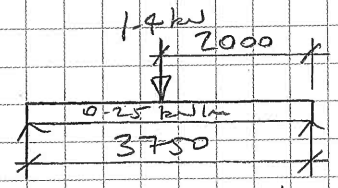
IF CEILING JOISTS SPANNING 4.2m SUPPORT ROOF LOAD THE JOISTS WILL BE THEORETICALLY OVERSTRESSED.

ALTERNATIVE – USE PLY SKIN ON STUD PARTITION TO FORM 1.1m DEEP BEAM BETWEEN EXTERNAL WALL AND INTERNAL WALL.

SPAN = 3.6m.

CHECK SHORTER SPAN CEILING JOISTS:

2ND LONGEST SPAN = 3.75m



$R_L = 0.25 \times 3.75/2 + 1.4 \times 2.0/3.75 = 1.22\text{kN}$

$R_R = 0.25 \times 3.75/2 + 1.4 \times 1.75/3.75 = 1.12\text{kN}$

$M = 1.22 \times 1.75 - 0.25 \times 1.75^2/2 = 1.75\text{kNm/JOIST}$

$Z_{REQ'D} = 1.75 \times 10^6/7.3 = 240 \times 10^3\text{mm}^3$

$I_{REQ'D} = \frac{5 \times 1.0 \times 3750^4}{384 \times 8800 \times 11.2} = 26.0 \times 10^6\text{mm}^4$

50×150 JOISTS
$Z = 187 \times 10^3\text{mm}^3$
$I = 14.0 \times 10^6\text{mm}^4$

⇒ USE SAME TECHNIQUE FOR 3.75m SPAN JOISTS.

& 3.5m SPAN & 3.1m SPAN JOISTS

ROOF OVERHANG 400mm OVERHANG. CANTILEVER ≈ 0.5m.

MAX. UPLIFT DUE TO WIND = $(1.30 \times 1.30 - 0.36) \times 0.4 = 0.53\text{kN/m}$

$M = 0.53 \times 0.5^2/2 = 0.07\text{kNm}$

BY INSPECTION, ROOF RAFTERS ARE SATISFACTORY FOR OVERHANG.

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PROJECT	Job No. 25/10/2259		Sheet no. 05	Rev.
STRUCTURAL ELEMENT EXTERNAL WALLS	Calc. by NAW	Date MAR.'10	Chck'd by	Date

MAXIMUM VERTICAL LOAD = $(1.17 \times 5.5/2 + 0.21 \times 1.1) \times 2.2/4.2$

$+ 1.17 \times (2.0/2 + 0.4) + 0.43 \times 2.4m$

$= 4.48$ kN/m

STUDS AT 400mm CRS.

LOAD PER STUD = $4.48 \times 0.4 = 1.79$ kN / STUD

TRY 100 × 50 STUDS. USE NOGGINS AT 750mm CRS.

$L/b = 750/50 = 15$. $E/\sigma_{c\perp} = 5800/6.8 = 853$

$\Rightarrow K_{12} \approx 0.725$

$\Rightarrow$ ALLOWABLE LOAD $= 0.725 \times 6.8 \times 100 \times 50 \times 10^{-3} = 24.6$ kN

$\Rightarrow$ O.K.

CONSIDER WIND LOADS ON STUDS.

MAX. LOADING = $1.30 \times 0.955 \times (0.795 + 0.3) = 1.36$ kN/m²

$\Rightarrow$ UDL / STUD = $1.36 \times 0.4 = 0.54$ kN/m

STUDS SPAN FROM GROUND FLOOR TO CEILING LEVEL; 2.3m.

$M = 0.54 \times 2.3^2/8 = 0.36$ kNm / STUD.

100 × 50 STUDS $\Rightarrow Z = 83.3 \times 10^3$ mm³ $I = 4.16 \times 10^6$ mm⁴

$\sigma_{\perp\,ACTUAL} = 0.36 \times 10^6 / 83.3 \times 10^3 = 4.32$ N/mm² < 5.83 N/mm²

$\Rightarrow$ O.K.

$\delta \approx \frac{5 \times 0.54 \times 2300^4}{384 \times 8800 \times 4.16 \times 10^6} = 5.4$mm ($\sim 0.0023$ SPAN) $\Rightarrow$ O.K.

100×50 STUDS AT 400 CRS. ARE SATISFACTORY

CONSIDER RACKING.

WALLS REQUIRE BRACING.

INTERNALLY, PLASTERBOARD PROVIDES SOME RESTRAINT.

EXTERNALLY, SCREW SHIPLAP TO EVERY STUD TO PROVIDE RESTRAINT AGAINST RACKING.

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PROJECT	Job No. 25/10/2259	Sheet no. 06	Rev.
STRUCTURAL ELEMENT INTERNAL WALLS	Calc. by NCW / Date MAR.'10	Chck'd by	Date

IN GENERAL, 100 x 50 STUDS AT 400 CRS. CAPABLE OF CARRYING VERTICAL LOADS APPLIED.

CHECK VERTICAL LOAD FROM 'BEAMS' IN ROOF SPACE.

MAXIMUM LOAD = $\left(1.7 \times 5.5/2 + 0.21 \times 1.1\right) \times 6.2/2 = \underline{10.7\ kN}$

ALLOWABLE LOAD PER STUD (SEE SHEET No. 05) = $\underline{24.6\ kN} > 10.7\ kN$

$\Rightarrow$ O.K.

ALL STUD WALLS ARE SATISFACTORY

GROUND FLOOR JOISTS

SPAN FROM FRONT & BACK WALLS ONTO CENTRAL SPINE FOUNDATION.

SPAN $\approx$ 3.7m.

MAX. UDL FROM WALL OVER = $24.6/3.0 + 0.40 \times 2.2 + 1.91 \times 0.5 = 1.0\ kN/m$

$M = 1.0 \times 3.7^2/8 = \underline{1.71\ kNm}$ $\qquad \delta_{PERM} = 0.003 \times 3700 = \underline{11\ mm}$

$Z_{REQD} = 1.71 \times 10^6 / 5.3 = \underline{323 \times 10^3\ mm^3}$

$I_{REQD} = \dfrac{5 \times 1.0 \times 3700^4}{384 \times 5800 \times 11} = \underline{38.2 \times 10^6\ mm^4}$

USE 50 x 225 DEEP JOISTS AT 500 c/c

FOUNDATIONS

FOUNDATIONS FOR ORIGINAL TIMBER HUT WERE TIMBER SLEEPERS LAID DIRECTLY ONTO THE GROUND. THERE ARE NO TREES NEARBY. NO EVIDENCE OF SUBSIDENCE OR HEAVE IN ORIGINAL BUNGALOW.

NEW FOUNDATIONS ARE MIN. 300mm WELL COMPACTED STONE SUBGRADE WITH TIMBER SLEEPERS LAID ON TOP AT LOWER LEVEL THAN ORIGINAL.

LOADS ARE SMALL. CLAY SUBSOIL. FOUNDATIONS WILL BE ADEQUATE FOR TEMPORARY CONDITION (SAY 5 YEARS). SLIGHT DIFFERENTIAL MOVEMENT TO BE ACCOMODATED BY TIMBER FRAME CONSTRUCTION.

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PROJECT	Job No. 25/10/2259		Sheet no. 07	Rev.
STRUCTURAL ELEMENT WIND UPLIFT	Calc. by NCW	Date MAR'10	Chck'd by	Date

CONSIDER EFFECT OF WIND UPLIFT ON BUNGALOW.

WORST CASE (SEE SHEET 02) : $1.30 \times \left(\frac{1.15 \times 0.9 + 0.6 \times 3.6 + 0.5 \times 5.5}{10} + 0.2 \right)$

$\times 7.5 \times 10.0 = 77.5\text{kN}$

DEAD LOAD OF BUILDING:

ROOF	$7.5 \times 10.0 \times 0.42$	=	31.5
CLG.	$7.5 \times 10.0 \times 0.37$	=	27.8
6$^{\text{ND}}$ FLOOR	$7.5 \times 10.0 \times 0.41$	=	30.7
WALLS	$0.43 \times (2 \times [7.5 + 10.0]) \times 2.8$	=	34.6
			124.6 kN

F.o.S. OF 1.6 EVEN EXCLUDING INTERNAL PARTITIONS & IMPOSED LOADINGS

$\Rightarrow$ OVERALL BUNGALOW IS ADEQUATE IF ELEMENTS HAVE GOOD CONNECTIONS.