

Proposed Barn Conversion at Montrose, Henton, Wells



Design Calculations and Details

M2388

September 2020

Client: Mr. K. Armstrong

**Brian Jones (*Structural Engineers*) Ltd.,
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(Tel. 01278 686934)**

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	Sheet no	01
	Date	Sep-20
	Eng	CF <i>V</i>
Job: Proposed Barn Conversion at Montrose, Henton	Element	

CLIENT: Mr. K. Armstrong

**CALCULATIONS & DETAILS SUBJECT TO BUILDING
REGULATION APPROVAL**

**FOR ARCHITECTURAL DETAILS REFER TO
DRAWINGS BY TCD ARCHITECTURE**

**CALCULATIONS & DETAILS FOR STRUCTURAL ELEMENTS
FOR PART A BUILDING REGULATIONS**

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	Date	Sep-20
	Eng	C.F. ✓
Job: Proposed Barn Conversion at Montrose, Henton		Element

Loadings

<u>Pitched Roof</u> =	<u>Dead</u> =	<i>Tiles</i>	0.60 kN/m²	
		<i>Felt & Battens</i>	0.10 kN/m²	
		<i>Rafters</i>	0.15 kN/m²	
		<i>Insulation</i>	0.05 kN/m²	
		<i>Ceiling</i>	0.2 kN/m²	
			<hr/>	1.1 kN/m²
	<u>Imposed</u> =		0.75 kN/m²	
			<hr/>	
			1.85 kN/m²	
			<hr/>	
<u>Floor</u> =	<u>Dead</u> =	<i>Joists</i>	0.15 kN/m²	
		<i>Boards</i>	0.15 kN/m²	
		<i>Ceiling</i>	0.2 kN/m²	
			<hr/>	0.5 kN/m²
		<u>Imposed</u> =	<i>Domestic</i>	1.5 kN/m²
				<hr/>
			<hr/>	
<u>Wall</u> =	<u>Dead</u> =	<i>Brickwork / Blockwork</i>	22 kN/m³	
		<i>Stonework</i>	20 kN/m³	
			<hr/>	<hr/>

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Job no M2388.

Sheet no 03.

Date Sept 2020

Eng C.F.V.

Job Montrose, Henton, wells.

Element

Rafters over two story roof

Le. 3.5m on plan

Le_h 4.35m

Loading at 400 c/c $\Rightarrow 0.4 \times 1.85 = 0.74 \text{ kN/m}$

$$\hat{M} = \frac{0.74 \times 3.5^2}{8} = 1.13 \text{ kNm}$$

$$\hat{V} = \frac{0.74 \times 3.5}{2} = 1.13 \text{ kN}$$

Grade C24 Timber.

$$M_{in} \text{ required} = \frac{1.13 \times 10^3}{7.5 \times 1.25} = \frac{121 \times 10^3 \text{ mm}^3}{1.25} < 317 \times 10^3 \text{ mm}^3$$

$$M_{in} \text{ required} = \frac{5 \times 0.74 \times 4.35^4 \times 10^{12}}{384 \times 10800 \times 0.003 \times 4350 \times 10^6} = \frac{24.5 \times 10^6 \text{ mm}^4}{1.25} < 30.9 \times 10^6 \text{ mm}^4$$

Provide 50 x 195 C24 Rafters

at 400 c/c. Doubled up
either side of rooflight.

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Job no M2388

Sheet no 04.

Date Sept 2020

Eng C.A.V

Job Montrose, Henton, Wells.

Element

Rafters over west Elevation roof.

$l_e = 2.9m$ on plan

$l_e = 3.1m$

Loading at 400 c/c = $0.4 \times 1.85 = 0.74 kN/m$

$$\bar{M} = \frac{0.74 \times 2.9^2}{8} = 0.78 kNm$$

$$\bar{U} = \frac{0.74 \times 2.9}{2} = 1.07 kNm$$

Grade C24 Timber.

$$M_{in} 2 \text{ required} = \frac{0.78 \times 10^3}{7.5 \times 1.25} = \frac{83.2 \times 10^3}{9.375} < 187.5 \times 10^3$$

$$M_{in} 3 \text{ required} = \frac{5 \times 0.74 \times 3.1 \times 4 \times 10^{12}}{384 \times 10800 \times 0.003 \times 3100 \times 10^6} = \frac{8.9 \times 10^6}{14.1 \times 10^6} < 14.1 \times 10^6$$

Provide 50 x 150 grade C24

Rafters at 400 c/c

by Visual inspection provide

50 x 150 C24's at 400 c/c

over stiles

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Job no M2388

Sheet no 05.

Date Sept 2020

Eng LIF ✓

Job Montrose, Humber, wells.

Element

Floor beam A-B

$L_e = 5.1m$

Loadings

$$\text{Floor} = \text{dead} = \frac{3}{2} \times 0.5 = 0.75 \text{ k/m}$$

$$\text{Imposed} = \frac{3}{2} \times 1.5 = 2.25 \text{ k/m}$$

$$\text{Handrail} = \text{dead} = 1.1 \times 0.5 = 0.55 \text{ k/m}$$

$$\text{Imposed} = 0.9 \text{ k/m}$$

$$\text{Self wt} = \text{dead} = 0.5 \text{ k/m}$$

$$\underline{\underline{= 4.79 \text{ k/m}}}$$

ULS

$$114 \mu = 1.8 = 1.6 \mu = 2.99 = \underline{\underline{7.3 \text{ k/m}}}$$

$$\bar{M} = \frac{7.3 \times 5.1^2}{8} = 23.73 \text{ kNm}$$

$$\bar{V} = \frac{7.3 \times 5.1}{2} = 18.6 \text{ kN}$$

Try 152 x 152 x 30 UC S355 grade.

$$T = 76 \text{ mm} < 16 \text{ mm} \therefore R_y = 355 \text{ N/mm}^2$$

Section is semi compact

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Job no 112388

Sheet no 06.

Date Sept 2020

Eng C.F. ✓

Job Apartment, Heron, wells.

Element

Beam A-B.

$$L_e = 5.00 - 0.75 = 3825$$

$$\text{all at } 3.23 = \underline{59.5 \text{ kN}} = 32.73 \text{ kN} \quad \text{10k}$$

$$\text{Allowable} = \frac{5100}{360} = 14.2$$

$$\text{Total} = \frac{5 \times 479 + 5.14 \times 10^2}{364 + 205000 + 1750 \times 10^4} = \underline{11.8 \text{ mm}} = 14.2 \text{ mm} \quad \text{10k}$$

Provide 152 x 152, 50 UC

Provide 152 x 152, 23 UC over doorway.

where beam bears.

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Job no ML188

Sheet no 07.

Date Sept 2020

Eng C.F. ✓

Job Motrose, Herton, wells.

Element

Floor Joists

Max L_{span} = 2.8m

Loadings at 400kN/m = 0.4 × 2.0 = 0.8kN/m

$$\dot{w} = \frac{0.8 \times 2.8^3}{8} = 0.78 \text{ kNm}$$

$$\dot{v} = \frac{0.8 \times 2.8}{2} = 1.12 \text{ kNm}$$

Grade C24 Timber

$$M_{in} R \text{ required} = \frac{0.78 \times 10^3}{7.5 \times 1.1} = \frac{95 \times 10^3 \text{ mm}^3}{2187.5 \times 10^3 \text{ mm}^3}$$

$$M_{in} I \text{ required} = \frac{5 \times 0.8 \times 2.8^4 \times 10^{12}}{384 \times 10800 \times 0.003 \times 2800 \times 10^6} = \frac{7.06 \times 10^6 \text{ mm}^4}{14.1 \times 10^6 \text{ mm}^4}$$

Provide 50 × 150 grade C24's

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Job no M2388

Sheet no 08.

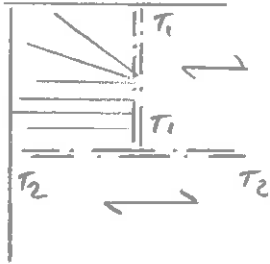
Date Sept 2020

Eng C.F.V

Job Montrose, Herton, wells.

Element

Floor Trimmers.



Trimmer T₁ - T₂

$$l_e = 2.1m$$

Loaders

$$\text{Floor} = \frac{1.5 \times 2.0}{2} = 1.8 \text{ kN/m}$$

$$\text{Stud} = 0.4 \times 2.3 = 0.92 \text{ kN/m}$$

$$\text{Self wt} = 0.16 \text{ kN/m}$$

$$\underline{\underline{\Sigma 2.82 \text{ kN/m}}}$$

$$\bar{M} = \frac{2.82 \times 2.1^2}{8} = 1.55 \text{ kNm}$$

$$\bar{V} = \frac{2.82 \times 2.1}{2} = 2.96 \text{ kN}$$

$$M_{min} \text{ I required} = \frac{1.55 \times 10^3}{7.5 \times 1.25} = \frac{165 \times 10^3 \text{ mm}^3}{1375} = 103 \text{ mm}^3$$

$$M_{min} \text{ Z required} = \frac{5 \times 2.82 \times 2.1^4 \times 10^{-2}}{384 \times 10800 \times 0.003 \times 2100 \times 10^6} = \frac{10.5 \times 10^6 \text{ mm}^4}{128 \times 10^6} = 103 \text{ mm}^4$$

Provide 2 Nos. 50 x 150 C24s

Bolts together with M12

Bolts at 500c/c.

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Job no 12388.

Sheet no 09.

Date Sept 2020

Eng C.F.

Job Martrose, Henbury, Wells.

Element

floor Trimmers.

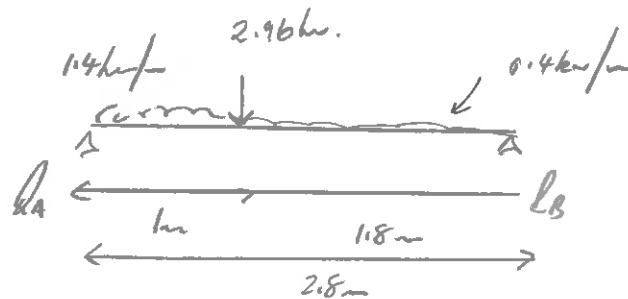
Trimmer T2-T2

$$l_e = 2.8m$$

$$\text{Loading} = 0.2 \times 2.0 = 0.4 \text{ k/m}$$

$$P_L = 2.96 \text{ kN}$$

$$I_{\text{stat}} = 0.5 \times 2.0 = 1 \text{ k/m}$$



$$E_{\text{MA}} = 0.207$$

$$R_B = \frac{(1.4 \times 1 \times 0.5) + (2.96 \times 1) + (0.4 \times 1.8 \times 1.9)}{2.8} = 1.18 \text{ kN} = R_B$$

$$R_A = (1.4 \times 1) + 2.96 + (0.4 \times 1.8) - 1.18 = 3.28 \text{ kN} = R_A$$

\hat{M} max at 1m from R_A.

$$\hat{M} = (3.28 \times 1) - (1.4 \times 1 \times 0.5) = 2.58 \text{ kNm}$$

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Job no. M2328.

Sheet no. 10.

Date Sept 2020

Eng C.F.V.

Job Montrose. Heron wells.

Element

Floor Trimmers.

$$M_{in} \text{ required} = \frac{2.58 \times 10^3}{7.5 \times 1.25} = \frac{275.2 \times 10^3 \text{ mm}^3}{\lt 375 \times 10^3 \text{ mm}^3}$$

$$\text{Equivalent u.d.l} = \frac{2.58 \times 8}{2.8^2} = 2.63 \text{ kN/m}$$

$$M_{in} \text{ I required} = \frac{5 \times 2.63 \times 2.8^4 \times 10^{12}}{384 \times 10800 \times 0.003 \times 2800 \times 10^6} = \frac{23.2 \times 10^6 \text{ mm}^4}{\lt 28 \times 10^6 \text{ mm}^4}$$

Provide 2N, 50 x 150 C24s
bolled together.