



FROG HALL FARM

CROW LANE

SHEEPY MAGNA, CV9 2QX



**STRUCTURAL REPORT
ON
STEEL FRAMED BARNs**

Date of inspection

14 March 2025

DRAFT

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JGB Birdwood MA CEng MICE MStructE

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1. Introduction

We were appointed by Mr & Mrs Fisher, of Frog Hall Farm, Sheepy Magna, CV9 2QX to report on the structural condition of two steel framed barns at the property and their suitability for conversion to residential use.

Our report is concerned only with this structural issue; all other aspects of the barns are outside our report.

Our report is prepared for the use of the above named client in connection with a planning submission only and is not to be relied upon by third parties without our specific written authorisation.

A site visit was carried out by James Birdwood of BTA Structural Design Ltd on 14th March 2025. Weather conditions were dry.

No exposing work was carried out. Our report is based on a visual inspection.

Our report contains photographs of the buildings taken on the day of inspection.

Calculations to justify the steel frames are also attached.

2. General Description

The two barns that form the subject of this report are situated in a traditional farmstead in an agricultural setting, as follows:

Barn 1

This building is a detached steel framed agricultural barn approximately 23m long x 27m wide overall, with spans of 15m and 12m.

There are two parallel ridges, and a centre valley, all orientated E-W. The front of the barn (as shown on the cover of this report) is open and faces west.

The larger and older part of the barn is a double-pitched frame about 15m wide, with an eaves height of about 3.8m, and a ridge height of 6.5m. It is in five equal bays of 4.6m, divided by steel portal frames.

Attached to this section is a slightly newer frame with a span of 12m also in five bays and of similar construction.

Barn 2

The building being considered here is the southern half of another steel framed barn, with the same orientation.

This is about 18m long x 14m wide, and is in two sections:

The northern part is in 4 bays, double pitched, with lattice trusses spanning between steel stanchions. The eaves height is about 5m, and the ridge about 7m.

To the south is a lean-to with lattice roof frames and another steel stanchion, also in 4 bays, with a height to eaves of about 3m.

To the north there is a further barn, joined to it with an informal 'pole' structure. These elements will be removed and are not considered in this report.

3. External Observations

Barn 1

The roof is clad in corrugated cement sheeting. This is straight and level with no sign of movement or deflection.

External walls are clad in concrete blockwork at low level and timber boarding above.

The cladding is showing signs of age but there is no evidence of structural movement or deficiency.

The barn walls stand plumb and there is no evidence of foundation movement.

Barn 2

The roof is clad in corrugated cement sheeting. This is straight and level with no sign of movement or deflection.

External walls are clad in a mixture of concrete blockwork at low level, timber boarding and metal sheeting. At the west end of the lean-to there is a brick wall which may pre-date the steel buildings.

The cladding is showing signs of age but there is no evidence of structural movement or deficiency.

The barn walls stand plumb and there is no evidence of foundation movement.

4. Internal Observations

Barn 1

The steel portal frames in the older (south) part consist of:

- 203x133UB25 Principal Rafters
- 254x146UB31 Stanchions
- Haunched eaves and ridge connections

There is a steel tie bar running between the eaves haunches with a central anti-sag hanger from the ridge.

The corrugated cement sheet roof is supported on steel purlins at about 1.25m centres.

There are cross-bracing wires in the roof planes in one bay.

In the north part the steel frames have 178x102UB19 principal rafters, bolted to the existing stanchions at one end, and their own at the other, again 254x146UB31.

There is a similar steel bar tie and hanger arrangement on this frame.

Roof sheets are supported on steel purlins at similar centres.

There is square tube diagonal bracing on one end bay, and cross bracing in one outer wall bay.

In both parts, the wall cladding above the blockwork is supported on timber sheeting rails.

In the closed end gables there are intermediate stanchions supporting the sheeting rails.

There is no evidence of significant movement in the structural elements.

The steelwork is affected by surface corrosion, but not to any significant degree structurally.

The south section of the barn has a concrete floor slab. The north part has a slab in the front bay, and a gravel floor to the rear.

There are a few minor cracks in the slabs, but they remain sound and fit for purpose.

Barn 2

In the double pitched section, the lattice trusses are of fully welded steel angles, fabricated from 50x50L section.

These have been well designed and fabricated and are intrinsically strong and efficient structural elements.

In the lean-to the lattice trusses have parallel top and bottom chords, made from the same angle sections.

The frames meet the stanchions with moment connections that give stability to the structure as a whole.

The corrugated cement sheet roof is supported on steel L purlins at about 1.4m centres.

The stanchions are connected longitudinally by further lattice trusses, also contributing to the stability of the frame.

The wall cladding above the blockwork is supported on timber sheeting rails.

In the gables there are intermediate stanchions supporting the sheeting rails and door openings.

There is no evidence of significant movement in the structural elements.

The steelwork is affected by surface corrosion, but not to any significant degree structurally.

The barn has a concrete floor slab. There are a few cracks in the slabs, but it remains sound and fit for purpose.

5. Comments & Conclusions

Existing Structure

Barn 1

This is a typical steel framed agricultural barn which has been in use for many years.

There are no signs of significant movement in the main frames.

The roof structure is adequately sized for the current loadings. We have checked the structure for the addition of ceiling linings, insulation and services and the frames are adequate for these. Calculations are attached in support of this.

Steel stanchions and rafters are affected by surface rust and would benefit from a thorough wire brushing and treatment with an effective primer, but this is not an urgent requirement.

At present no repairs are needed to maintain the building in good structural condition.

Barn 2

This is an older style of steel framed agricultural barn, relying on roof trusses rather than portal frames.

It has been in use for many years, and there are no signs of significant movement in the main frames.

The roof structure is adequately sized for the current loadings. We have checked the structure for the addition of ceiling linings, insulation and services and the structure is adequate for these. Calculations are attached to this report in support of this.

Steel stanchions and trusses are affected by surface rust and would benefit from a thorough wire brushing and treatment with an effective primer, but this is not an urgent requirement.

At present no repairs are needed to maintain the building in good structural condition.

Proposed Conversion

The proposed conversion will include the following elements:

Barn 1

- Provision of cladding and glazed areas to the open part of the elevations.
- Forming of door and window openings in the external wall cladding.
- New insulation and ceiling finishes, fixed under the existing roof sheeting and supported on the existing roof structure, as justified in the attached calculations.
- Insulation and finishes to the external walls. This can be done from inside within the existing cladding depth.
- New concrete floor slab to areas currently gravelled, with damp membranes, insulation and floor finishes above.
- New damp membranes, insulation and floor finishes laid above existing ground slabs.
- New first floor structure to en-suite bed and bathroom in NE corner of barn. This will be supported on new internal columns and walls, and on existing external columns. No new structure will be required on the external perimeter of the building.
- Staircase supported on the new floor slab.
- Construction of non-loadbearing partitions supported on the floor slab.
- False ceilings (non-structural) to some ground floor rooms.

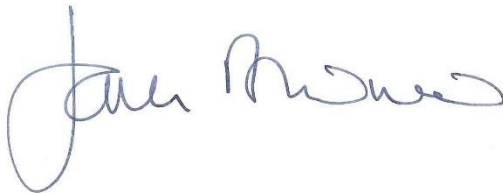
Barn 2

- Provision of secondary framing cladding and windows to the new north elevation.
- Forming of door and window openings in the external wall cladding.
- New insulation and ceiling finishes, fixed under the existing roof sheeting and supported on the existing roof structure, as justified in the attached calculations.
- Insulation and finishes to the external walls. This can be done from inside within the existing cladding depth.
- New damp membranes, insulation and floor finishes laid above existing ground slabs.
- Construction of non-loadbearing partitions supported on the floor slab.
- False ceilings (non-structural) to some ground floor rooms.

These works to both barns can be done with the existing structural elements in place, and without significant reconstruction of these elements.

We therefore conclude that the two barns are in good structural condition and capable of conversion.

We will be pleased to answer any questions on this report.



James Birdwood MA CEng MICE FIStructE
991 / JGBB

Photographs



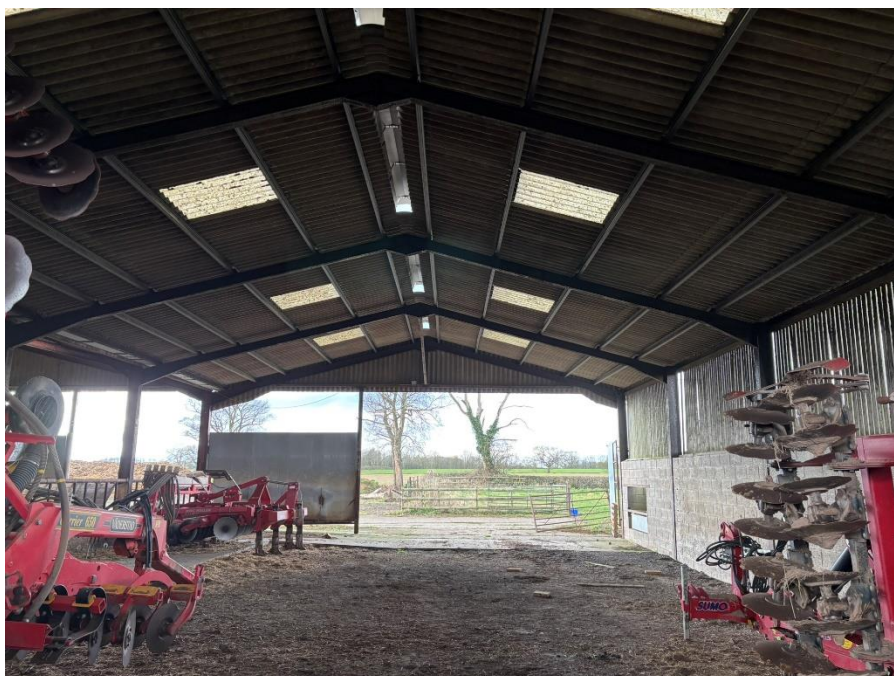
Barn 1 North Elevation



Barn 1 North East Corner



Barn 1 Interior Looking East



Barn 1 Interior Looking West



Barn 1 Eaves Haunch



Barn 1 Internal Stanchion



Barn 2 East Elevation



Barn 2 from South West



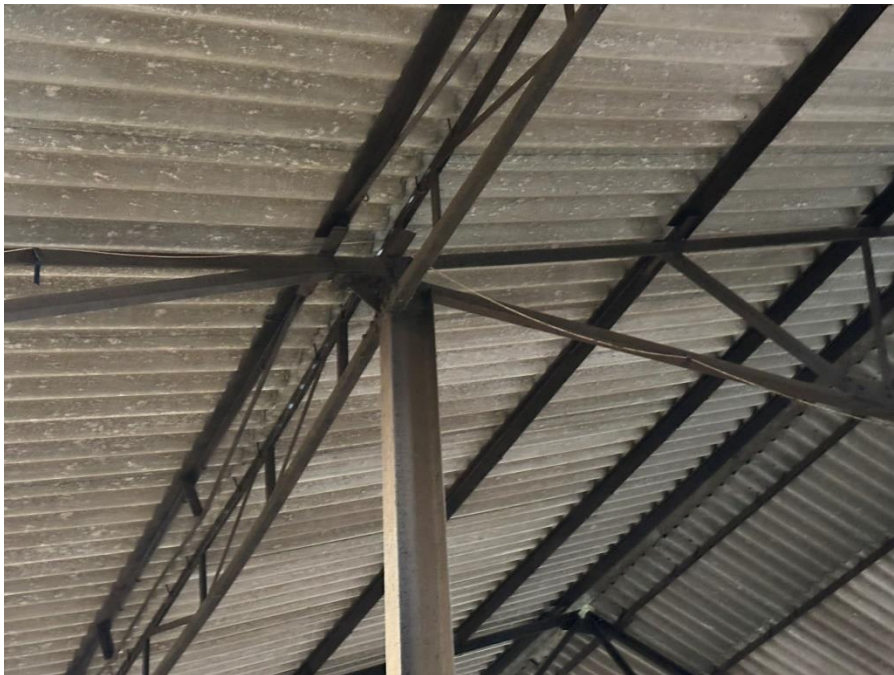
Barn 2 Main Frame Interior



Barn 2 Lean-to Interior



Barn 2 Lean-to Eaves



Barn 2 Internal Stanchion



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Appendix A

Structural Calculations

for

Steel Framed Barns

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Barn Portal Frames

Structural Calculations

These calculations analyze the main steel frames for Barns 1 and 2 to check that they are adequately designed and capable of carrying insulation, roof finishes and lighting services in addition to the existing roof sheeting, or replacement cladding.

*These calculations are issued for the purposes of a planning submission.
They are not intended for construction.*

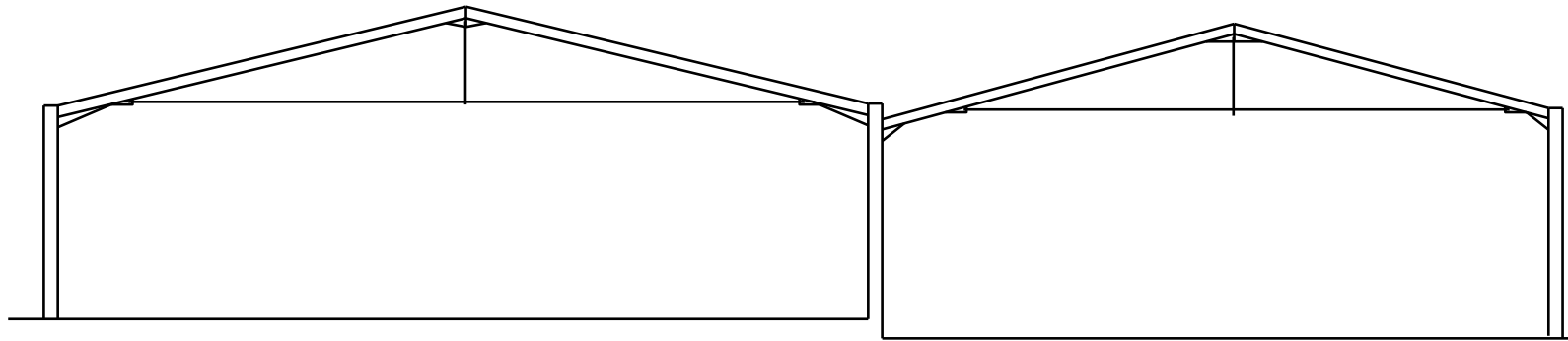
Design Criteria

<u>Loading</u>	<u>Dead</u>	<u>Live</u>	<u>Total</u>
Roof sheets	0.10		
Insulation	0.02		
Purlins	0.02		
Lining	0.10		
Services	0.10		

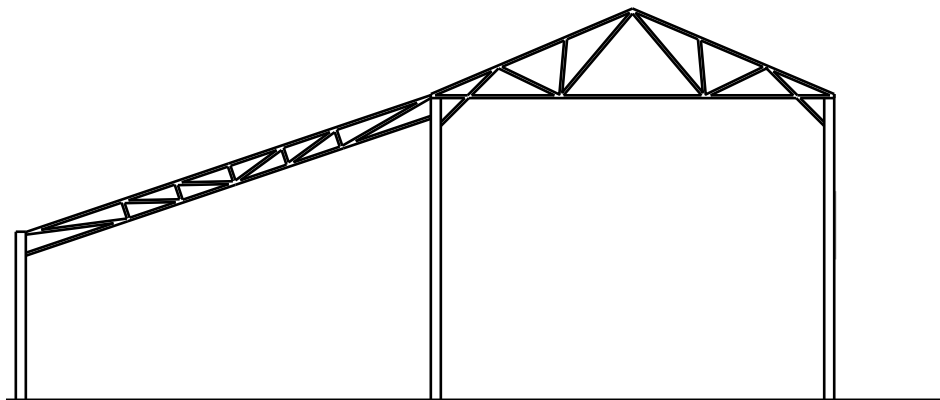
	0.40	0.60	1.00 kN/m ²
Wind		0.60	0.60 kN/m ²

These figures are all unfactored working loads.

The calculations show that the structures can safely carry the additional loads referred to above, and that the frames are stable under wind loading. The deflections in buildings of this type can be higher than in a normal residential or office building and could cause cosmetic cracking in brittle finishes such as plasterboard. We therefore recommend that a more flexible finish is used for all ceilings, such as timber boarding, or self-finished double skin roof panels.



Barn 1

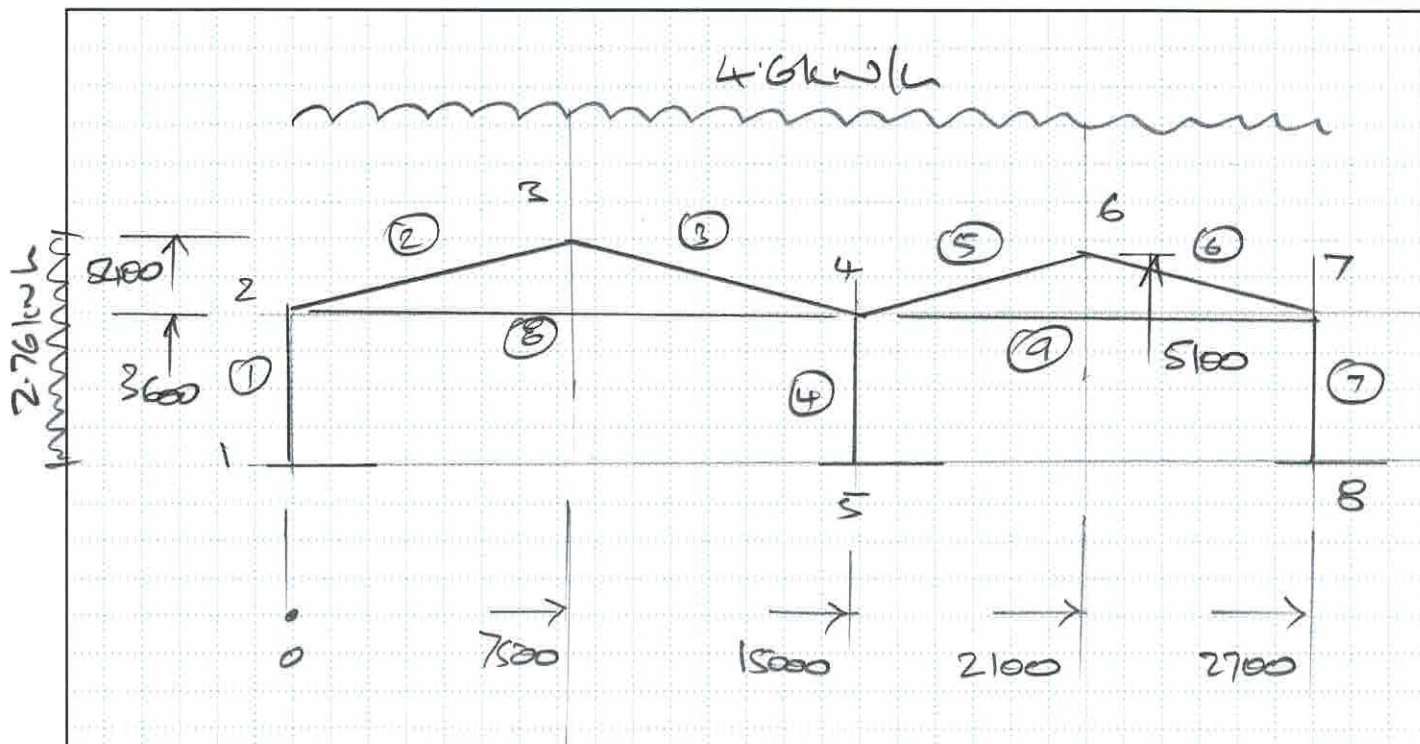


Barn 2

STRUCTURAL
DESIGN

WWW.BTA.CO.UK

JOB NO 991		
SHEET NO FH/01	REV	
DRG REF	MADE BY JB	CHD
DATE 3/25		

PROJECT
Rear HallLOCATION
BARN 1DATE
3/25Notes

(Frames @ 4.6kN/c)

- ① 272x146 UA 31
- ②/③ 202x133 UA 25
- ④ AS ①
- ⑤/⑥ 178x102 UA 19
- ⑦ AS ①
- ⑧/⑨ 25φ BAR (NO SW IN MODEL)

TABULATE ALL
PRINT DATA RESULTS FROM 1
TYPE PLANE FRAME
NUMBER OF JOINTS 8
NUMBER OF MEMBERS 9
NUMBER OF SUPPORTS 3
NUMBER OF LOADINGS 1
JOINT COORDINATES

1 0 0 SUPPORT
2 0 3.6
3 7.5 5.4
4 15 3.6
5 15 0 SUPPORT
6 21 5.1
7 27 3.6
8 27 0 SUPPORT

MEMBER INCIDENCES

1 1 2
2 2 3
3 3 4
4 4 5
5 4 6
6 6 7
7 7 8
8 2 4
9 4 7

CONSTANTS E 205E6 ALL G 79E6 ALL DENSITY 77 ALL CTE 12E-6 ALL

MEMBER PROPERTIES

1 ISECTION DY 0.2514 DZ 0.1461 TZ 0.006 TY 0.0086
2 THRU 3 ISECTION DY 0.2032 DZ 0.1332 TZ 0.0057 TY 0.0078
4 AS 1
5 THRU 6 ISECTION DY 0.1778 DZ 0.1012 TZ 0.0048 TY 0.0079
7 AS 1
8 THRU 9 CONIC DZ 0.025 DY 0.025

LOADING Case 1

MEMBER LOADS

1 THRU 2 FORCE X PROJECTED UNIFORM W 2.76
2 THRU 3 FORCE Y PROJECTED UNIFORM W -4.6
5 THRU 6 FORCE Y PROJECTED UNIFORM W -4.6

MEMBER SELF WEIGHTS

1 THRU 7 1

SOLVE

LOADING Case 1

JOINT DISPLACEMENTS

JOINT	X DISPLACEMENT	Y DISPLACEMENT	Z ROTATION
1	0.000000000	0.000000000	0.000000000
2	-0.002312590	-0.000163179	-0.001803529
3	0.001218227	-0.018383040	0.000715226
4	0.004684693	-0.000295517	-0.000518506
5	0.000000000	0.000000000	0.000000000
6	0.006836829	-0.011632534	0.000496981
7	0.009028444	-0.000132169	-0.001409189
8	0.000000000	0.000000000	0.000000000

Am

12mm

LOADING Case 1
MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	BENDING MOMENT
1	1	36.9507	-6.8231	-13.7784
	2	-35.8646	16.7591	-28.6696
2	2	70.3121	20.0084	28.6717
	3	-66.6553	16.5159	-15.2032
3	3	66.8907	15.5351	15.2032
	4	-75.3783	19.8298	-31.7654
4	4	65.3913	7.9571	13.0391
	5	-66.4774	-7.9571	15.6064
5	4	55.6136	15.4922	18.7294
	6	-48.6451	12.3817	-9.1106
6	6	48.7488	11.9668	9.1106
	7	-55.7173	15.9071	-21.2953
7	7	28.9459	13.7700	21.2975
	8	-30.0320	-13.7700	28.2746
8	2	-46.9420	-0.0002	-0.0021
	4	46.9420	0.0002	-0.0015
9	4	-36.4257	-0.0003	-0.0016
	7	36.4257	0.0003	-0.0022

LOADING Case 1

ELASTIC STRESSES: POSITIVE=COMPRESSION FOR AXIAL AND Y POSITIVE BENDING

MEMBER	JOINT	AXIAL STRESS	AV.SHEAR STRESS	BENDING STRESS
1	1	9430.7169	-5269.1765	39838.9634
	2	9153.5169	12942.2911	-82895.3716
2	2	22340.8674	20037.0408	-126759.0248
	3	21178.9751	16539.5886	-67213.8391
3	3	21253.7679	15557.3870	-67213.8391
	4	23950.5989	19858.1842	-140436.2183
4	4	16689.4645	6144.8903	-37701.4395
	5	16966.6645	-6144.8903	45124.2877
5	4	23400.8774	20929.8116	-125684.0076
	6	20468.7082	16727.5165	-61136.7616
6	6	20512.3515	16167.0133	-61136.7616
	7	23444.5207	21490.3147	-142902.6616
7	7	7387.7035	10633.9580	-61579.6220
	8	7664.9035	-10633.9580	81753.3370
8	2	-95629.5370	-0.5468	1400.5173
	4	-95629.5370	0.5468	-961.4680
9	4	-74205.7510	-0.7247	1062.1609
	7	-74205.7510	0.7247	-1442.5567

140N/m²

LOADING Case 1

SUPPORT REACTIONS

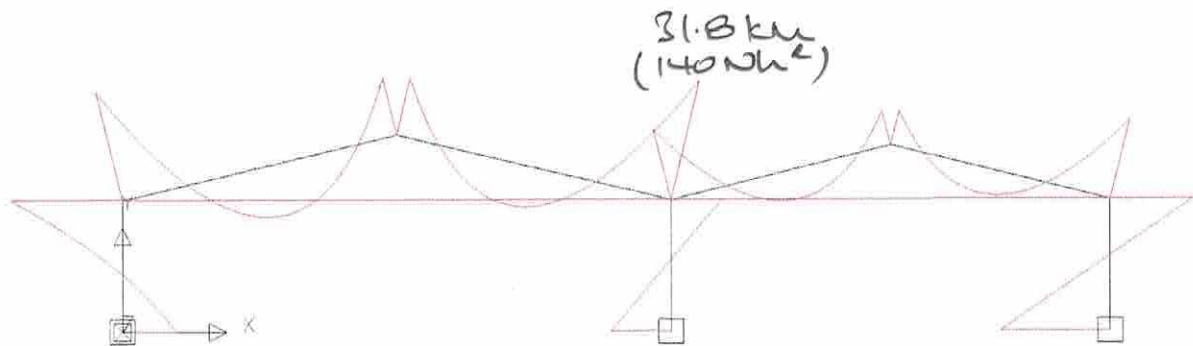
JOINT	X FORCE	Y FORCE	Z MOMENT
1	6.8231	36.9507	-13.7784
5	-7.9571	66.4774	15.6064
8	-13.7700	30.0320	28.2746

BTA Structural Design
Frog Hall Farm
Barn 1 Frame

Page: **FH/04**
Made by:
Date: 18/03/25
Ref No: 991

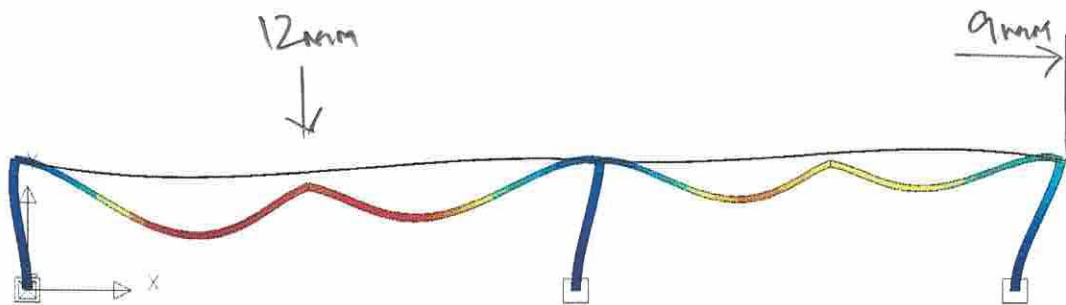
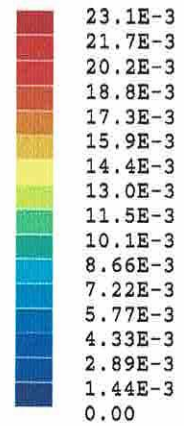
EQUILIBRIUM CHECK	SUM OF FORCES	REACTION
FORCES IN DIRECTION X	14.9040	-14.9040
FORCES IN DIRECTION Y	-133.4601	133.4601
MOMENTS ABOUT AXIS Z	-1838.5685	1838.1283

Bending Moment MZ.
LOADING Case 1



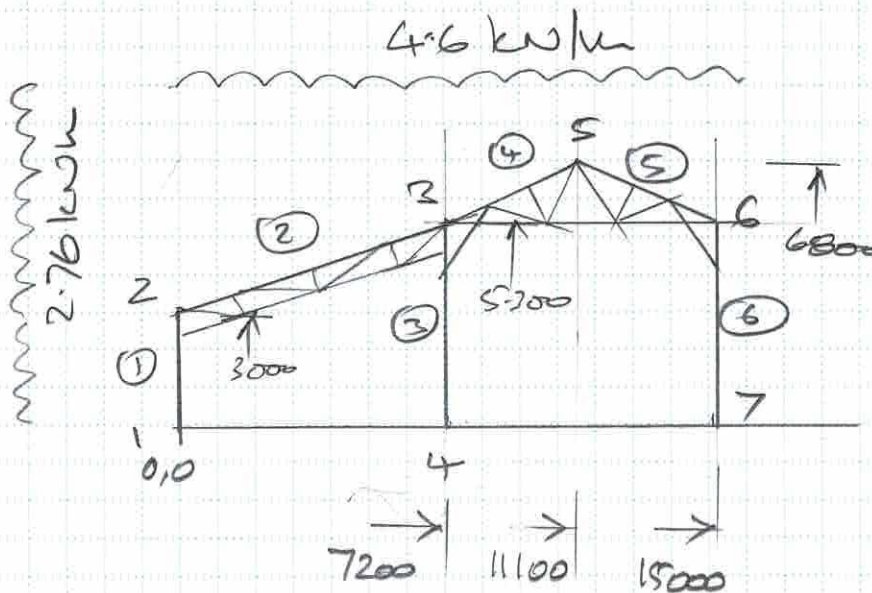
Displaced Shape, displacements magnified 140 times.

Key: DS





JOB NO 991		
SHEET NO F1107	REV	
DRG REF	MADE BY JB	CHD
DATE 31/2/15		

PROJECT
FLEX HALLLOCATION
BARN 2FRAMES @
4.6m c/c
(158m)FOR ELASTIC ANALYSIS
MODEL TREATED AS
I BEAMS WITH
SIMILAR I VALUESWIND PRESSURE - Assume 0.6 kN/m^2 ROOF LOAD - 0.4 kN/m^2 D
- 0.6 kN/m^2 LMembers① $178 \times 102 \text{ UAL9}$

② Truss

400

* $\rightarrow$ $50 \times 50 \text{ L5}$ (A: 4.80 cm^2)* $\rightarrow$ $50 \times 50 \text{ L5}$ $I: (4.8 \times 20^4) \times 2 = 3840 \text{ cm}^4$ See Spreadsheet I: 3297 cm^4 Z: 165 cm^3 ③/⑥. 178×102

④/⑤

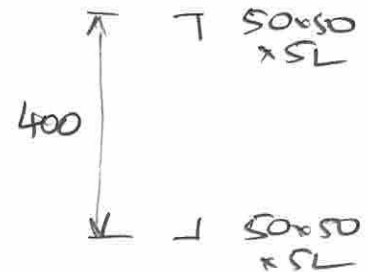
Max Depth: 750

See Spreadsheet I: 12380 Z: 330

Calculation of I values

(all values entered in mm)

	1	2	3	4	5
Width	50	50	5	5	
Depth	5	5	45	45	
Dist to CL	397.5	2.5	372.5	27.5	
Area	250	250	225	225	0
Ax	99375	625	83812.5	6187.5	0
Dist to NA	200				
I	521	521	37969	37969	0
A(x'-x) ²	9751563	9751563	6695156	6695156	0
Total I value for combined section:			32970417	=	3297 cm ⁴

LEAN - TO TRUSS
SECTION**Calculation of Section Modulus**

Overall depth:	400		
Distance to extreme fibre (bottom):	200	Zb	164.9 cm ³
Distance to extreme fibre (top):	200	Zt	164.9 cm ³

(Model As 203x133 UB30, I, 2890)

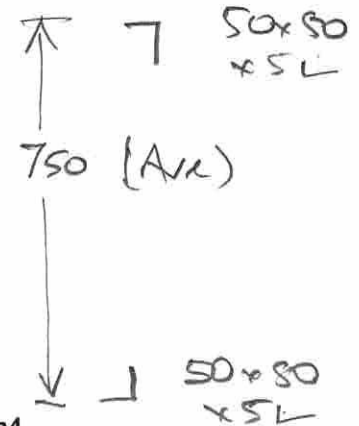
991/AN/09

Calculation of I values

(all values entered in mm)

	1	2	3	4	5
Width	50	50	5	5	
Depth	5	5	45	45	
Dist to CL	747.5	2.5	722.5	27.5	
Area	250	250	225	225	0
Ax	186875	625	162562.5	6187.5	0
Dist to NA	375				
I	521	521	37969	37969	0
$A(x'-x)^2$	34689063	34689063	27170156	27170156	0
Total I value for combined section:			1.24E+08	=	12380 cm ⁴

CENTRAL TRUSS
AVE SECTION



Calculation of Section Modulus

Overall depth:	750		
Distance to extreme fibre (bottom):	375	Zb	330.1 cm ³
Distance to extreme fibre (top):	375	Zt	330.1 cm ³

MODEL AS 316x171 UB 45 ($I=12100$).

TABULATE ALL

PRINT DATA RESULTS FROM 1

TYPE PLANE FRAME

NUMBER OF JOINTS 7

NUMBER OF MEMBERS 6

NUMBER OF SUPPORTS 3

NUMBER OF LOADINGS 1

JOINT COORDINATES

1 0 0 SUPPORT

2 0 3

3 7.2 5.3

4 7.2 0 SUPPORT

5 11.1 6.8

6 15 5.3

7 15 0 SUPPORT

MEMBER INCIDENCES

1 1 2

2 2 3

3 3 4

4 3 5

5 5 6

6 6 7

CONSTANTS E 205E6 ALL G 79E6 ALL DENSITY 77 ALL CTE 12E-6 ALL

MEMBER PROPERTIES

1 ISECTION DY 0.1778 DZ 0.1012 TZ 0.0048 TY 0.0079

2 ISECTION DY 0.2068 DZ 0.1339 TZ 0.0064 TY 0.0096

3 AS 1

4 THRU 5 ISECTION DY 0.3514 DZ 0.1711 TZ 0.007 TY 0.0097

6 AS 1

LOADING Case 1

MEMBER LOADS

1 THRU 2 FORCE X PROJECTED UNIFORM W 2.76

4 FORCE X PROJECTED UNIFORM W 2.76

2 FORCE Y PROJECTED UNIFORM W -4.6

4 THRU 5 FORCE Y PROJECTED UNIFORM W -4.6

MEMBER SELF WEIGHTS

1 THRU 6 1

SOLVE

LOADING Case 1

JOINT DISPLACEMENTS

JOINT	X DISPLACEMENT	Y DISPLACEMENT	Z ROTATION
1	0.000000000	0.000000000	0.000000000
2	0.016839793	-0.000082199	-0.007483510
3	0.016970405	-0.000474797	-0.000296323
4	0.000000000	0.000000000	0.000000000
5	0.018178063	-0.003679966	-0.000109790
6	0.019484273	-0.000207530	0.001037370
7	0.000000000	0.000000000	0.000000000

LOADING Case 1

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	BENDING MOMENT
1	1	13.6234	10.5217	18.4171
	2	-13.0744	-2.2417	0.7279
2	2	1.8431	13.1365	-0.7279

	3	2.8561	22.4354	-34.4147
3	3	43.1601	3.4741	9.0544
	4	-44.1300	-3.4741	9.3581
4	3	8.0998	19.2981	25.3603
	5	-4.8719	0.6270	13.6486
5	5	4.0364	2.7993	-13.6486
	6	-11.1283	15.6396	-13.1780
6	6	18.5920	4.7723	13.1780
	7	-19.5618	-4.7723	12.1149

LOADING Case 1

ELASTIC STRESSES: POSITIVE=COMPRESSION FOR AXIAL AND Y POSITIVE BENDING

MEMBER	JOINT	AXIAL STRESS	AV.SHEAR STRESS	BENDING STRESS
1	1	5732.4027	14214.6820	-123588.7022
	2	5501.4027	-3028.4958	4884.9314
2	2	488.6901	11419.0946	2637.8138
	3	-757.2915	19502.2902	-124705.7549
3	3	18160.7357	4693.4073	-60759.8805
	4	18568.8357	-4693.4073	62797.7461
4	3	1435.2788	9202.5011	-37676.9297
	5	863.3055	298.9733	20277.2911
5	5	715.2511	1334.8827	20277.2911
	6	1971.9342	7457.8954	-19578.1949
6	6	7823.0610	6447.2660	-88431.7514
	7	8231.1610	-6447.2660	81297.5789

125 N/m²

LOADING Case 1

SUPPORT REACTIONS

JOINT	X FORCE	Y FORCE	Z MOMENT
1	-10.5217	13.6234	18.4171
4	-3.4741	44.1300	9.3581
7	-4.7723	19.5618	12.1149

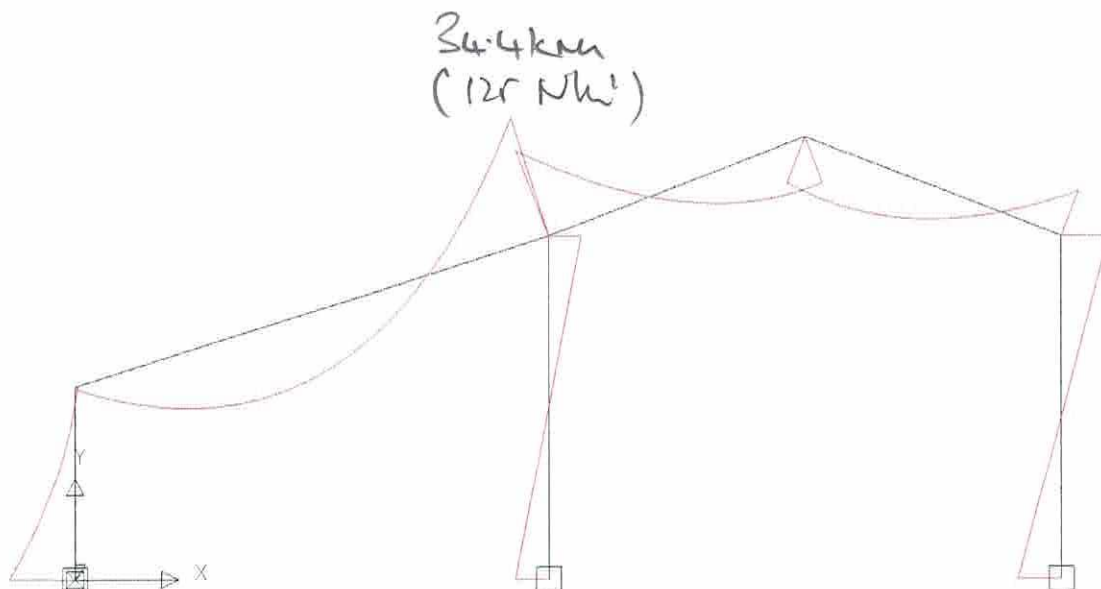
EQUILIBRIUM CHECK

SUM OF FORCES

REACTION

FORCES IN DIRECTION X	18.7680	-18.7680
FORCES IN DIRECTION Y	-77.3152	77.3152
MOMENTS ABOUT AXIS Z	-652.3813	651.0535

Bending Moment MZ.
LOADING Case 1



Displaced Shape, displacements magnified 73 times.

Key: DS

