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AMENDED STRUCTURAL ENGINEERS REPORT

October 2022 - August 2024

FOR CHANGE OF USE

OF THE CHICKEN SHED TO

A RESIDENTIAL BUILDING

AT STOKES FARM

WOKINGHAM

This second report was provided in support of class Q application for the change of use of an agricultural building to residential use and was commissioned following removal of all incumbrances to properly inspect the structure to allow production of a technical design statement and intent for the conversion of the existing building to a residential dwelling.

The report confirms that the existing structure is structurally sound and satisfactory for its intended change of use from a farm shed to a residential building

2021/RWO/SR03

08-2024

INTRODUCTION:

This report was commissioned following refusal of our application for class Q change of use for this agricultural building. The refusal was based on proposals which could not be tested or substantiated due to the inaccessibility of the building which was permanently obstructed due to its agricultural use as a chicken shed, occupation of over 3000 chickens and the substantial control of movement due to Avian Flu which was widespread at the time. Our initial report, based on a number of assumptions therefore provided the worst-case scenario of removal and replacement of substantial structural elements.

Our client, who has since emptied the building and provided full accessibility, has instructed us to update our feasibility study on the suitability of converting this building on Stokes Farm, utilising all the principle structural elements including the ground floor slab and structural frame.

The building has since been vacated of livestock and was inspected on 31st March 2022. A full structural and visual inspection was carried out with sufficient exploratory work undertaken to ensure that a substantiated technical response and proposal could be made. A further inspection made August 2024 to confirm integrity of building. No changes were observed.

DESCRIPTION

The chicken shed comprises of structural steel portal frames with a span of approximately 10.8m, height to eaves of 2.8m and a roof pitch of 15°.

The building with an overall length of 42.7m has seven bays of frames along its length at approximately 6.1m centres.

To each side of the main central portal frames for the full length of the structure and added at a later date are small lean-to frames with a span of 2.75m, height to eaves of 2.05m and a roof pitch of 15°

To the right-hand side of the front gable there is also a small lean-to frame 4.4m long with a span of 1.4m.

The structural portal frame sections have a galvanized finish and are seen to be in good condition. The remainder of the structural steelwork is either galvanized or painted and was also found to be in good condition.

The roof profile is pitched with a ridge running the length of the shed.

The roof is clad with profiled metal cladding supported on timber purlins at approximately 1.35m ctrs provided between the portal rafters, an insulation board is fixed to the underside of the purlins.

The walls are clad with vertical profiled metal cladding supported on timber rails provided between the portal columns, an insulation board is fixed to the inside.

Along the line of the main portal columns a 900 high block walls edges a raised grated floor area.

Foundations are mass concrete bases at column locations.

The ground floor is a ground bearing concrete slab and is in good condition. (The slab is stepped on the main portal lines)

PHOTOGRAPHIC RECORD - CHICKEN SHED AT STOKES FARM, WOKINGHAM

Date :- 22nd January 2021



Photo 01 – Side - West Elevation



Photo 02 – Rear - South Elevation



Photo 03 – Side - East Elevation



Photo 04 – Front - North Elevation



Photo 05 – Internal View towards side east elevation



Photo 06 – Internal View towards side east elevation



Photo 07 – Internal View towards side east / rear south elevations



Photo 08 – Internal View towards side west elevation



Photo 09 – Ridge detail



Photo 10 – Lean-to section



Photo 11 – Portal Column detail – showing block wall and raised floor grating



Photo 12 – Substantial Portal Column head restraint detail



Photo 13 – Portal Column haunch detail



Photo 14 – Portal Column detail

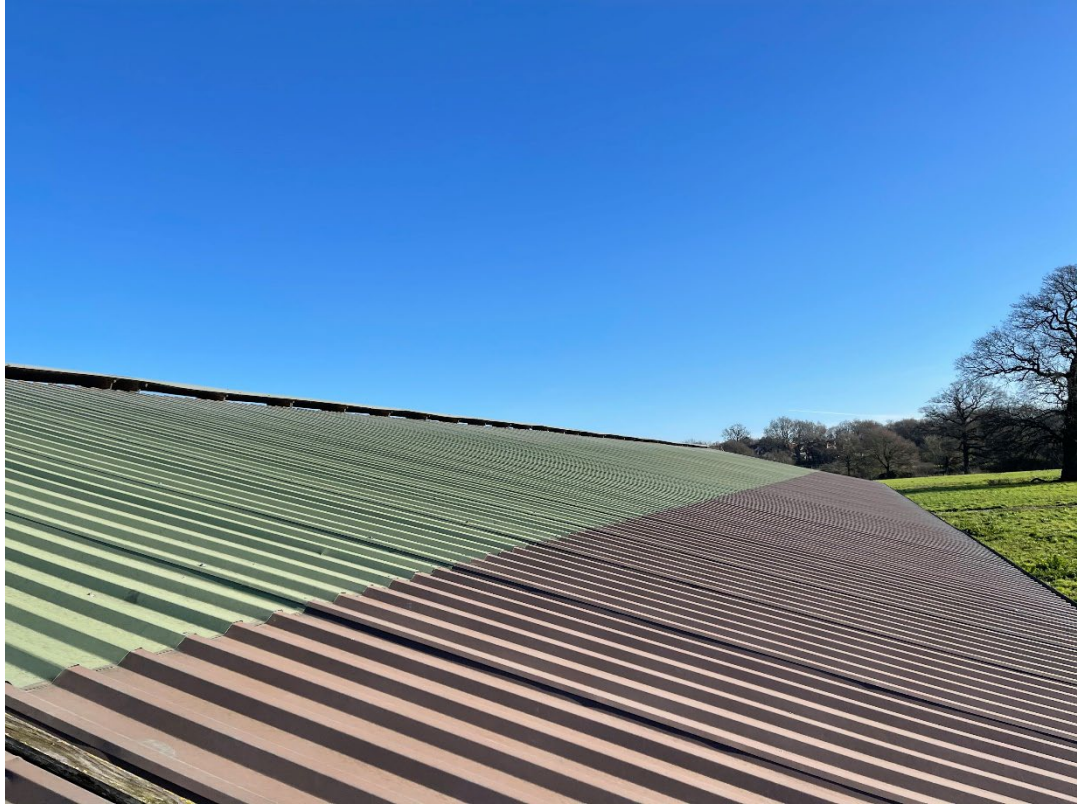


Photo 15 – Roof – Lean-to added at a later date shown by brown sheeting

Unoccupied Shed

Date :- 31st March 2022



**Photo 16 – Inside looking toward the rear with floor grating removed
Concrete floor slab exposed and found to be in good condition**



**Photo 17 – Inside to rear with floor grating removed
Stepped concrete floor slab exposed and found to be in good condition**



**Photo 18– Portal roof rafters with timber purlins
All in good condition**

Unoccupied Shed

Date :- August 2024



Photo 19 & 20 – Inside to rear with floor grating removed Concrete floor slab cleaned and found to be in excellent condition. No change in structural integrity of the building.



METHODOLOGY:

We have undertaken a computer analysis of the existing portal framed structure using existing member sizes, and compared the results for member strengths and deflections, for the existing and proposed loads and parameters for the conversion to a residential dwelling.

We have also checked the results against the design requirements set out in SCI Publication: Steel Portal Frames to BS 5950: 2000. (Recommended deflection limits)

KEY RESULTS:

The steel sizes and deflections have been checked based upon the maximum possible existing and proposed design dead and imposed loading applied to the roof.

Sway in the building is estimated from a design case including wind load.

COMMENTS:

Buildings of this type are usually built to withstand the loads applied, with a small margin for a service load but no more. For reasons of economy there is usually very little capacity for additional loads and stresses and for this reason it is imperative that in any alteration or refurbishment new loads are similar to the ones being replaced, especially roof loads.

For semi-industrial buildings / farm buildings the amount of sway permitted is significantly greater than would be permitted for a domestic building.

DESIGN PRINCIPLES:

The existing structural steelwork frame and timber purlins and sheeting rails together with the existing concrete ground bearing slab are to be retained.

Structural works to the existing building envelope will not require the removal of existing structural components.

The complete construction will retain the structural integrity of the existing building while providing new internal partitioning, servicing and external cladding for 2 new residential units.

PROPOSALS:

It is proposed to retain the existing structural steel portal frameworks with associated secondary steels and purlins and re-clad to provide a weatherproof envelope.

The existing concrete ground floor slab which is to be levelled.

DESIGN LOAD ASSESSMENT:

Existing roof load applied to the rafters is as follows:

Metal Cladding	0.05 kN/m ²
Timber Purlins	0.06 kN/m ²
Insulation Board	0.04 kN/m ²
Service Load	0.10 kN/m ²
Roof Imposed Load	0.75 kN/m ²
TOTAL EXISTING LOAD:	<u>1.00 kN/m²</u>

Proposed roof load applied to rafters is as follows:

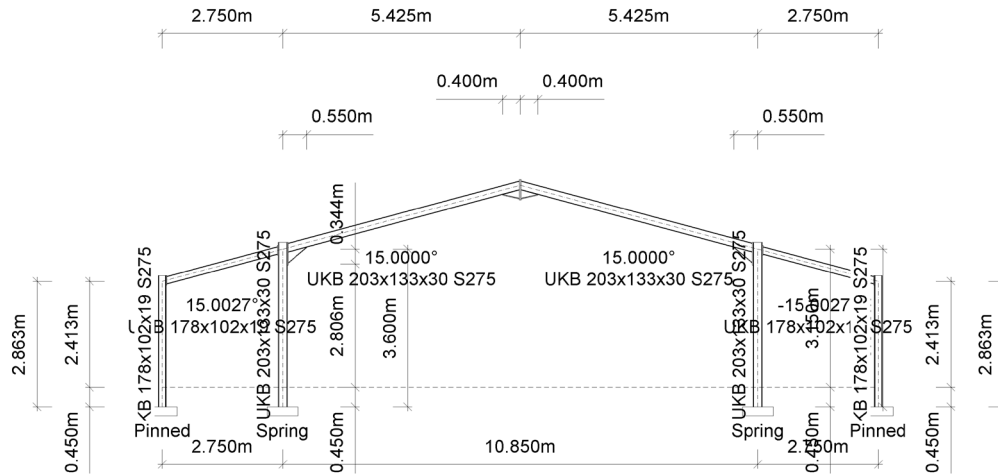
New Metal Cladding	0.05 kN/m ²
Existing Timber Purlins	0.06 kN/m ²
New Insulation	0.04 kN/m ²
New Timber Boarding	0.15 kN/m ²
Service Load	0.10 kN/m ²
Roof Imposed Load	0.60 kN/m ²
TOTAL PROPOSED LOAD:	<u>1.00 kN/m²</u>

This represents NO increase in load

Notes:

The following are the results from the computer analysis for the existing and proposed frames. This is based upon a load combination of 1.4x Dead Load +1.6x Imposed Load. Wind load combinations have also been considered.

EXISTING Portal Frame Frame Diagram



Frame Details

No. Spans 3
Effective Frame Centres 6.100 m

Span Geometry

Span	Type	Axis	Lh Eaves [m]	Lh Apex [m]	Apex [m]	Rh Apex [m]	Rh Eaves [m]
Span 1	Monopitch	X	0.0	-	-	-	2.750
		Z	2.413	-	-	-	3.150
Span 2	Standard	X	2.750	-	8.175	-	13.600
		Z	3.150	-	4.604	-	3.150
Span 3	Monopitch	X	13.600	-	-	-	16.350
		Z	3.150	-	-	-	2.413

Wind Options

Wind Method Standard
Basic Wind Speed (Vb) 21.0 m/s
Ground Roughness Country
Upwind distance from sea to site 0.0 km
Altitude factor (Sa) 1.1000
Seasonal factor (Ss) 1.0000
Probability factor (Sp) 1.0000

Base Fixities

Base	Type	Level [m]	Vertical [kN/m]	Horizontal [kN/m]	Rotational [kNm/rad]	Capacity [%]	Capacity [kNm]
Span 1 Lh	Pinned	-0.450 ULS	Restr.	Restr.	Free	1.00	
		-0.450 SLS	Restr.	Restr.	Free	N/A	N/A
		-0.450 Stab	Restr.	Restr.	Free	1.00	
Span 1 Rh	Spring	-0.450 ULS	Restr.	Restr.	Free	1.00	
		-0.450 SLS	Restr.	Restr.	Free	N/A	N/A
		-0.450 Stab	Restr.	Restr.	659.546	1.00	
Span 2 Rh	Spring	-0.450 ULS	Restr.	Restr.	Free	1.00	
		-0.450 SLS	Restr.	Restr.	Free	N/A	N/A
		-0.450 Stab	Restr.	Restr.	659.546	1.00	
Span 3 Rh	Pinned	-0.450 ULS	Restr.	Restr.	Free	1.00	
		-0.450 SLS	Restr.	Restr.	Free	N/A	N/A
		-0.450 Stab	Restr.	Restr.	Free	1.00	

Haunches

Haunch	Section	Length [m]	Depth [m]	Beta [°]	Gamma [°]	Offset X1 [mm]	Offset X2 [mm]	Filler Plate
Span 2 Lh Eaves	UKB 203x133x30							
	0	0.550	0.344	39.7464	24.7464	154.0	401.8	
Span 2 Apex Lh	UKB 203x133x30							
	0	0.400	0.317	13.0429	28.0429	42.8	346.5	
Span 2 Apex Rh	UKB 203x133x30							
	0	0.400	0.317	13.0429	28.0429	42.8	346.5	
Span 2 Rh Eaves	UKB 203x133x30							
	0	0.550	0.344	39.7464	24.7464	154.0	401.8	

[illegible]

Member	Sh	Sc	Tc	St	Tt	gt	Sb	Vs [m/s]	Ve [m/s]
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Wind Loads

Member	qs [kN/m ²]	Cpi	Cpe	L [m]	a [m]	Cae	Cai	%
Span 1 Lh Column	0.866	0.2000	0.4580	2.863	6.738	0.9828	1.0000	100.00
Span 1 Mono Rafter	0.866	0.2000	-0.7999	0.953	6.732	0.9828	1.0000	100.00
Span 1 Mono Rafter			-0.4000	1.894				
Span 2 Lh Rafter	0.866	0.2000	-0.8000	0.953	8.292	0.9700	1.0000	100.00
Span 2 Lh Rafter			-0.4000	4.663				
Span 2 Rh Rafter	0.866	0.2000	-0.5000	4.663	8.292	0.9700	1.0000	100.00
Span 2 Rh Rafter			-0.9000	0.953				
Span 3 Mono Rafter	0.866	0.2000	-1.0000	0.953	6.732	0.9828	1.0000	100.00
Span 3 Mono Rafter			-0.9000	1.894				
Span 3 Rh Column	0.866	0.2000	-0.3693	2.863	6.738	0.9828	1.0000	100.00

SLS, Wind: Side Left, Cpi -0.3000, Roof Cpe -ve

Frame is considered to be in Intermediate zone

Building Length	24.000	m
Building Width	10.850	m
Building reference height, H _r	4.604	m
Building effective height, H _e	4.604	m
Altitude factor, Sa	1.1000	
Seasonal factor, Ss	1.0000	
Probability factor, Sp	1.0000	
Directional factor, Sd	1.0000	
Eaves Line orientation EON	0.0	°
Critical Wind Angle	270.0000	°

Wind Speeds

Member	Sh	Sc	Tc	St	Tt	gt	Sb	Vs [m/s]	Ve [m/s]
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Wind Loads

Member	qs [kN/m ²]	Cpi	Cpe	L [m]	a [m]	Cae	Cai	%
Span 1 Lh Column	0.866	-0.3000	0.4580	2.863	6.738	0.9828	1.0000	100.00
Span 1 Mono Rafter	0.866	-0.3000	-0.7999	0.953	6.732	0.9828	1.0000	100.00
Span 1 Mono Rafter			-0.4000	1.894				
Span 2 Lh Rafter	0.866	-0.3000	-0.8000	0.953	8.292	0.9700	1.0000	100.00
Span 2 Lh Rafter			-0.4000	4.663				
Span 2 Rh Rafter	0.866	-0.3000	-0.5000	4.663	8.292	0.9700	1.0000	100.00
Span 2 Rh Rafter			-0.9000	0.953				
Span 3 Mono Rafter	0.866	-0.3000	-1.0000	0.953	6.732	0.9828	1.0000	100.00
Span 3 Mono Rafter			-0.9000	1.894				
Span 3 Rh Column	0.866	-0.3000	-0.3693	2.863	6.738	0.9828	1.0000	100.00

SLS, Wind: Gable End Top, Cpi 0.2000, Roof Cpe -ve

Frame is considered to be in Intermediate zone

Building Length	24.000	m
Building Width	10.850	m
Building reference height, H _r	4.604	m
Building effective height, H _e	4.604	m
Lh Gap	7.200	m
Rh Gap	7.200	m
Altitude factor, Sa	1.1000	
Seasonal factor, Ss	1.0000	

Probability factor, Sp 1.0000
 Directional factor, Sd 1.0000
 Eaves Line orientation EON 0.0 °
 Critical Wind Angle 0.0 °

Wind Speeds

Member	Sh	Sc	Tc	St	Tt	gt	Sb	Vs [m/s]	Ve [m/s]
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Wind Loads

Member	qs [kN/m ²]	Cpi	Cpe	L [m]	a [m]	Cae	Cai	%
Span 1 Lh Column	0.866	0.2000	-0.8000	2.863	6.738	0.9828	1.0000	100.00
Span 1 Mono Rafter	0.866	0.2000	-0.8000	2.847	6.732	0.9828	1.0000	100.00
Span 2 Lh Rafter	0.866	0.2000	-0.6000	5.616	8.292	0.9700	1.0000	100.00
Span 2 Rh Rafter	0.866	0.2000	-0.6000	5.616	8.292	0.9700	1.0000	100.00
Span 3 Mono Rafter	0.866	0.2000	-0.8000	2.847	6.732	0.9828	1.0000	100.00
Span 3 Rh Column	0.866	0.2000	-0.8000	2.863	6.738	0.9828	1.0000	100.00

SLS, Wind: Gable End Top, Cpi -0.3000, Roof Cpe -ve

Frame is considered to be in Intermediate zone

Building Length 24.000 m
 Building Width 10.850 m
 Building reference height, H_r 4.604 m
 Building effective height, H_e 4.604 m
 Lh Gap 7.200 m
 Rh Gap 7.200 m
 Altitude factor, Sa 1.1000
 Seasonal factor, Ss 1.0000
 Probability factor, Sp 1.0000
 Directional factor, Sd 1.0000
 Eaves Line orientation EON 0.0 °
 Critical Wind Angle 0.0 °

Wind Speeds

Member	Sh	Sc	Tc	St	Tt	gt	Sb	Vs [m/s]	Ve [m/s]
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Wind Loads

Member	qs [kN/m ²]	Cpi	Cpe	L [m]	a [m]	Cae	Cai	%
Span 1 Lh Column	0.866	-0.3000	-0.8000	2.863	6.738	0.9828	1.0000	100.00
Span 1 Mono Rafter	0.866	-0.3000	-0.8000	2.847	6.732	0.9828	1.0000	100.00
Span 2 Lh Rafter	0.866	-0.3000	-0.6000	5.616	8.292	0.9700	1.0000	100.00
Span 2 Rh Rafter	0.866	-0.3000	-0.6000	5.616	8.292	0.9700	1.0000	100.00
Span 3 Mono Rafter	0.866	-0.3000	-0.8000	2.847	6.732	0.9828	1.0000	100.00
Span 3 Rh Column	0.866	-0.3000	-0.8000	2.863	6.738	0.9828	1.0000	100.00

Combinations

Sw + Dead + Serv. + Imp.

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.4000	1.0000
Frame Dead Load	Dead	1.4000	1.0000
Frame Service Load	Dead	1.4000	1.0000
Frame Imposed Load	Imposed	1.6000	1.0000

Combination 2

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.0000	1.0000
Frame Dead Load	Dead	1.0000	1.0000
SLS, Wind: Side Left, Cpi 0.2000, Roof Cpe -ve	Wind	1.4000	1.0000

Combination 3

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.0000	1.0000
Frame Dead Load	Dead	1.0000	1.0000
SLS, Wind: Gable End Top, Cpi 0.2000, Roof Cpe -ve	Wind	1.4000	1.0000

Combination 4

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.2000	1.0000
Frame Dead Load	Dead	1.2000	1.0000
Frame Service Load	Dead	1.2000	1.0000
Frame Imposed Load	Imposed	1.2000	1.0000
SLS, Wind: Side Left, Cpi -0.3000, Roof Cpe -ve	Wind	1.2000	1.0000

Combination 5

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.2000	1.0000
Frame Dead Load	Dead	1.2000	1.0000
Frame Service Load	Dead	1.2000	1.0000
Frame Imposed Load	Imposed	1.2000	1.0000
SLS, Wind: Gable End Top, Cpi -0.3000, Roof Cpe -ve	Wind	1.2000	1.0000

Design Wizard Options

Design Criteria

BS5950 Part1 : 2000

Maximum Hinge Rotation	6.0000	°
Percent Mp for Plasticity	99.00	%
Axial Load Factor	1.2500	

Design Limits

Eaves Deflection	Relative Limit	100.0	mm
Apex Deflection	Relative Limit	200.0	mm
Cladding Stiffness		0.0	%
Tie Elongation	No Limit		

Design Code: BS5950

Design Summary

Design Combination	Lambda p	Lambda r	Status
Sw + Dead + Serv. + Imp.	1.834	1.000	Pass
Combination 2	4.396	1.000	Pass
Combination 3	6.503	1.000	Pass
Combination 4	2.599	1.000	Pass
Combination 5	2.693	1.000	Pass

Member Stability Status: Not Checked

Design Cases

Sw + Dead + Serv. + Imp.

Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.0	0.126
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.570
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	85.6	0.587
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.3	0.663
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.3	0.662
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	85.6	0.586
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.569
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.126
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	1.5072	-	Formed	Span 2 Lh Rafter	0.542	0.542	
Event 2	1.5083	-	Formed	Span 2 Rh Rafter	0.542	0.542	
Event 3	1.7197	-	Formed	Span 2 Lh Rafter	5.175	5.152	
Event 4	1.7245	-	Formed	Span 2 Rh Rafter	2.858	3.988	
Event 5	1.7245	-	Reversed	Span 2 Lh Rafter	5.175	5.152	
Event 6	1.7245	-	Formed	Span 2 Lh Rafter	0.542	0.542	
Event 7	1.7319	-	Formed	Span 1 Rh Column	3.256	3.256	
Event 8	1.7319	-	Formed	Span 2 Rh Column	3.256	3.256	
Event 9	1.8338	-	Formed	Span 1 Lh Column	2.863	2.863	

Strength

Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.570	Pass
Span 2 Lh Rafter	0.662	Pass
Span 2 Rh Rafter	0.661	Pass
Span 3 Mono Rafter	0.569	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.126	Pass
Span 1 Rh Column	0.581	Pass
Span 2 Rh Column	0.581	Pass
Span 3 Rh Column	0.126	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.521	Pass
Span 2 Lh Rafter Lh Apex	0.360	Pass
Span 2 Rh Rafter Rh Eaves	0.521	Pass
Span 2 Rh Rafter Rh Apex	0.360	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	-9.8/28.6	na	na	na	-9.8/36.0
Span 2	Pass	-9.8/36.0	na	37.1/54.3	na	9.8/36.0
Span 3	Pass	9.8/36.0	na	na	na	9.8/28.6

Frame Stability

None

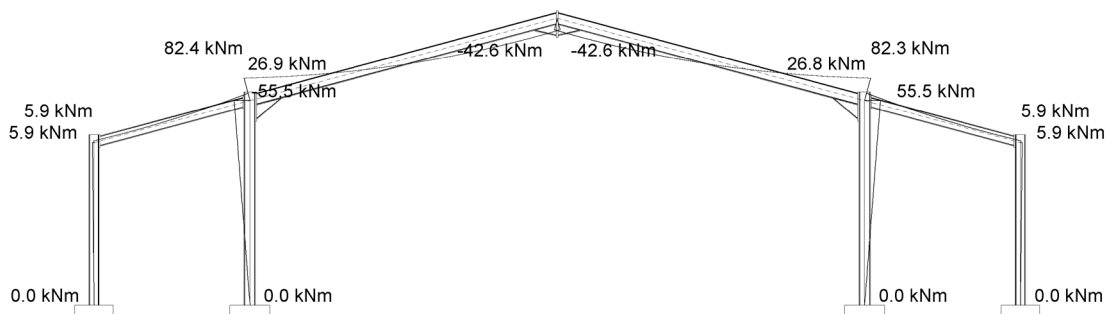
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	2.1	19.3
Span 1 Rh Column	0.0	15.4	77.8
Span 2 Rh Column	0.0	-15.4	77.8
Span 3 Rh Column	0.0	-2.1	7.5

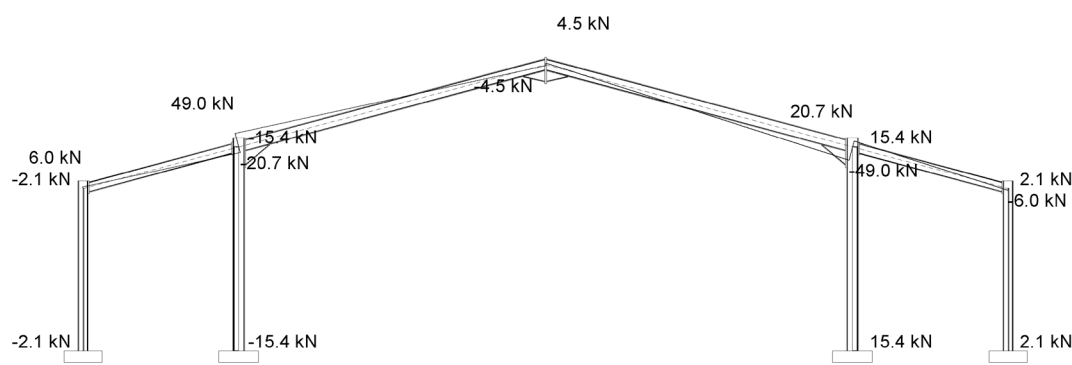
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	5.4	5.9	2.1	-	-	-
Span 1 Rh Eaves	26.9	-20.9	2.1	-	-	-
Span 2 Lh Eaves	77.2	54.4	17.5	57.2	43.8	29.9
Span 2 Lh Apex	-42.6	0.0	17.5	-43.6	-0.3	18.0
Span 2 Rh Apex	-42.6	0.0	17.5	-43.6	-0.3	18.0
Span 2 Rh Eaves	77.1	54.4	17.5	57.2	43.8	29.9
Span 3 Lh Eaves	24.7	19.8	2.1	-	-	-
Span 3 Rh Eaves	5.9	-6.8	2.0	-	-	-

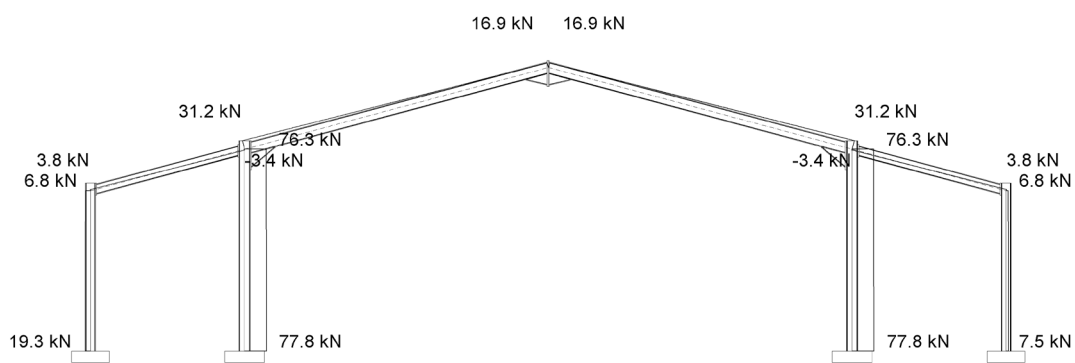
Bending Moment Diagram



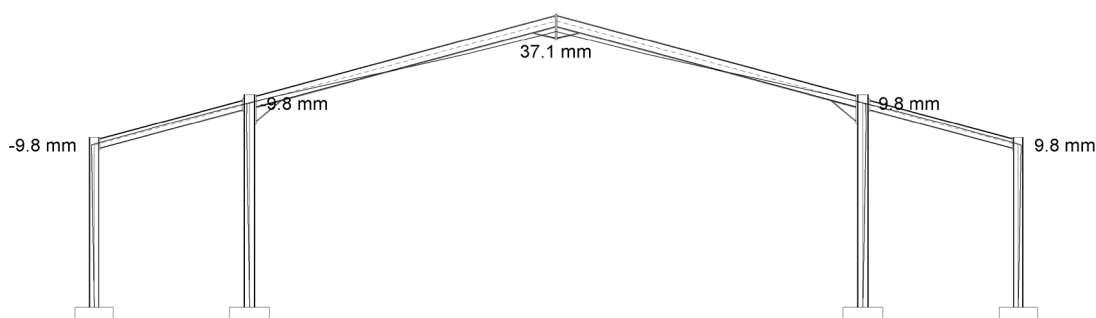
Shear Force Diagram



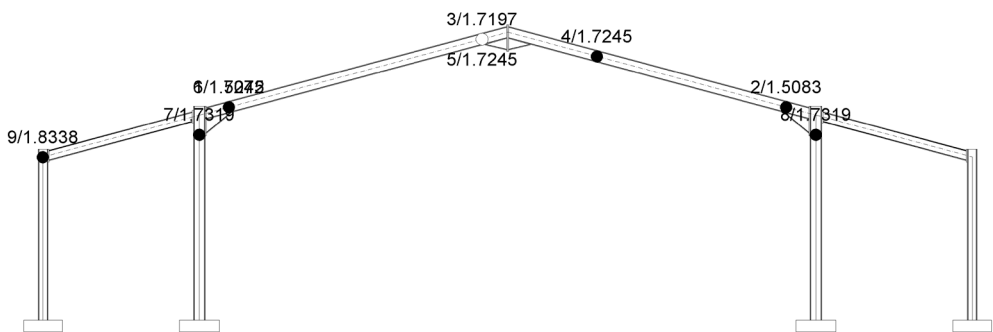
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Combination 2
Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.215
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.215
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.5	0.298
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.5	0.238

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.5	0.161
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.5	0.037
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.401
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.135
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History

Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	2.4920		- Formed	Span 3 Mono Rafter	0.0	0.0	
Event 2	3.1599		- Formed	Span 1 Rh Column	3.256	3.256	
Event 3	3.5981		- Formed	Span 1 Lh Column	2.863	2.863	
Event 4	4.2209		- Formed	Span 2 Lh Rafter	0.542	0.542	
Event 5	4.3853		- Formed	Span 2 Rh Rafter	2.858	3.533	
Event 6	4.3960		- Formed	Span 3 Mono Rafter	2.847	2.654	

Strength

Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.215	Pass
Span 2 Lh Rafter	0.238	Pass
Span 2 Rh Rafter	0.161	Pass
Span 3 Mono Rafter	0.401	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.215	Pass
Span 1 Rh Column	0.298	Pass
Span 2 Rh Column	0.037	Pass
Span 3 Rh Column	0.135	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.192	Pass
Span 2 Lh Rafter Lh Apex	0.089	Pass
Span 2 Rh Rafter Rh Eaves	0.136	Pass
Span 2 Rh Rafter Rh Apex	0.102	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	12.3/28.6	na	na	na	12.3/36.0
Span 2	Pass	12.3/36.0	na	-9.6/54.3	na	7.4/36.0
Span 3	Pass	7.4/36.0	na	na	na	7.4/28.6

Frame Stability

None

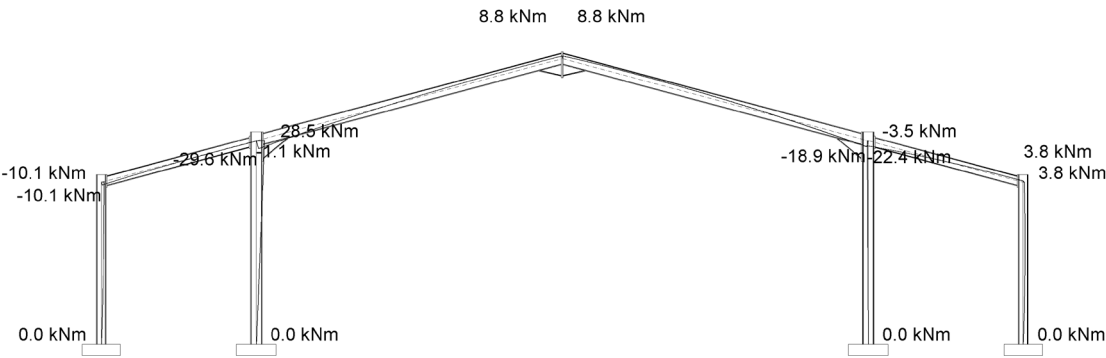
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	-6.2	-1.9
Span 1 Rh Column	0.0	-7.9	-22.1
Span 2 Rh Column	0.0	1.0	-35.6
Span 3 Rh Column	0.0	-7.3	-2.8

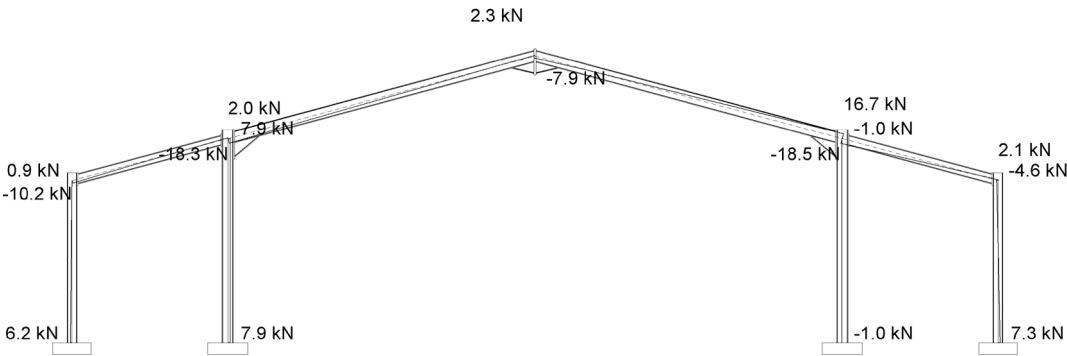
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	-9.2	-10.3	-1.1	-	-	-
Span 1 Rh Eaves	-1.1	0.8	-4.8	-	-	-
Span 2 Lh Eaves	-27.6	-21.7	-13.0	-20.5	-15.0	-18.3
Span 2 Lh Apex	8.8	2.9	-19.8	9.5	0.9	-19.7
Span 2 Rh Apex	8.8	-2.9	-19.8	11.6	4.9	-18.2
Span 2 Rh Eaves	-20.6	-20.1	-11.8	-13.9	-14.6	-16.8
Span 3 Lh Eaves	-17.0	-15.4	-10.5	-	-	-
Span 3 Rh Eaves	3.8	3.4	-4.6	-	-	-

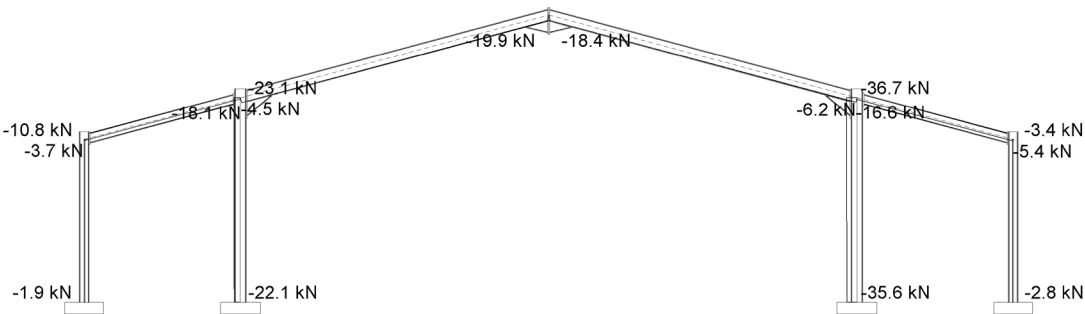
Bending Moment Diagram



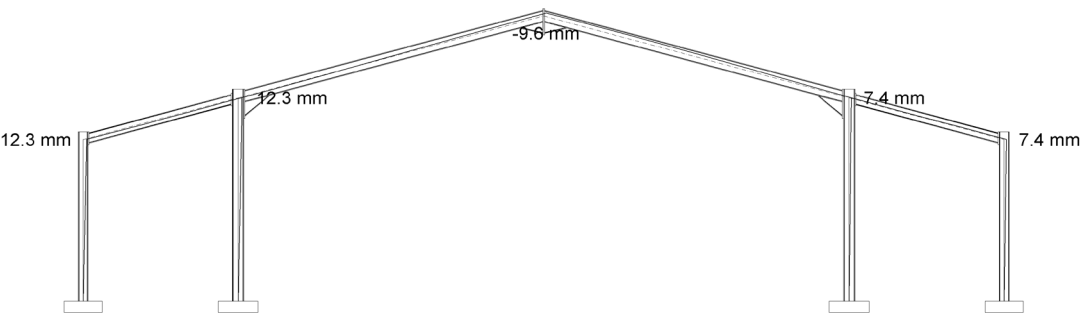
Shear Force Diagram



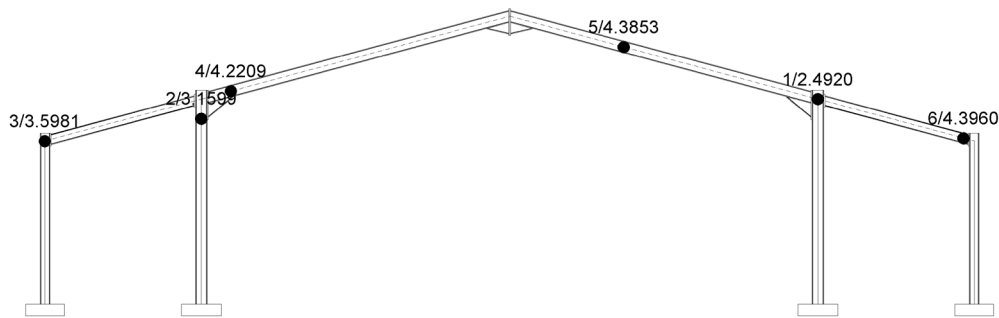
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Combination 3

Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.141
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.198
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.5	0.163
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.5	0.184
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.5	0.184
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.5	0.164
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.198
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.141
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History

Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	5.0396	-	Formed	Span 3 Mono Rafter	0.0	0.0	
Event 2	5.0565	-	Formed	Span 1 Mono Rafter	2.847	2.847	
Event 3	5.5007	-	Formed	Span 2 Rh Rafter	0.542	0.542	
Event 4	5.5007	-	Reversed	Span 3 Mono Rafter	0.0	0.0	
Event 5	5.5072	-	Formed	Span 2 Lh Rafter	0.542	0.542	
Event 6	5.5072	-	Reversed	Span 1 Mono Rafter	2.847	2.847	
Event 7	5.9767	-	Formed	Span 2 Rh Column	3.256	3.256	
Event 8	5.9813	-	Formed	Span 1 Rh Column	3.256	3.256	
Event 9	6.0920	-	Formed	Span 1 Mono Rafter	2.847	2.847	
Event 10	6.0920	-	Reversed	Span 2 Lh Rafter	0.542	0.542	
Event 11	6.0921	-	Formed	Span 3 Mono Rafter	0.0	0.0	
Event 12	6.0921	-	Reversed	Span 2 Rh Rafter	0.542	0.542	
Event 13	6.2770	-	Formed	Span 1 Lh Column	2.863	2.863	
Event 14	6.5033	-	Formed	Span 2 Lh Rafter	5.175	4.533	

Strength

Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.198	Pass
Span 2 Lh Rafter	0.184	Pass
Span 2 Rh Rafter	0.184	Pass
Span 3 Mono Rafter	0.198	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.141	Pass
Span 1 Rh Column	0.163	Pass
Span 2 Rh Column	0.164	Pass
Span 3 Rh Column	0.141	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.161	Pass
Span 2 Lh Rafter Lh Apex	0.065	Pass
Span 2 Rh Rafter Rh Eaves	0.161	Pass
Span 2 Rh Rafter Rh Apex	0.065	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	2.0/28.6	na	na	na	2.0/36.0
Span 2	Pass	2.0/36.0	na	-8.3/54.3	na	-2.1/36.0
Span 3	Pass	-2.1/36.0	na	na	na	-2.0/28.6

Frame Stability
 None

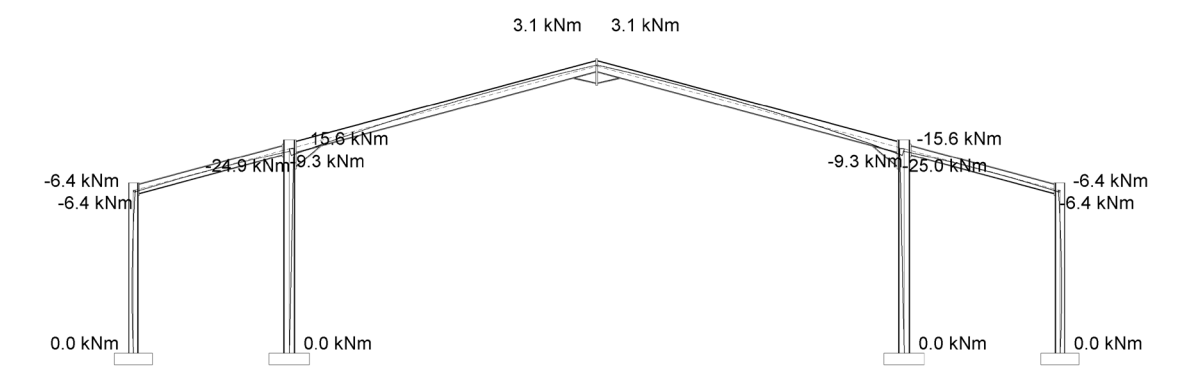
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	8.2	-2.6
Span 1 Rh Column	0.0	-4.3	-28.9
Span 2 Rh Column	0.0	4.3	-29.0
Span 3 Rh Column	0.0	-8.2	-11.0

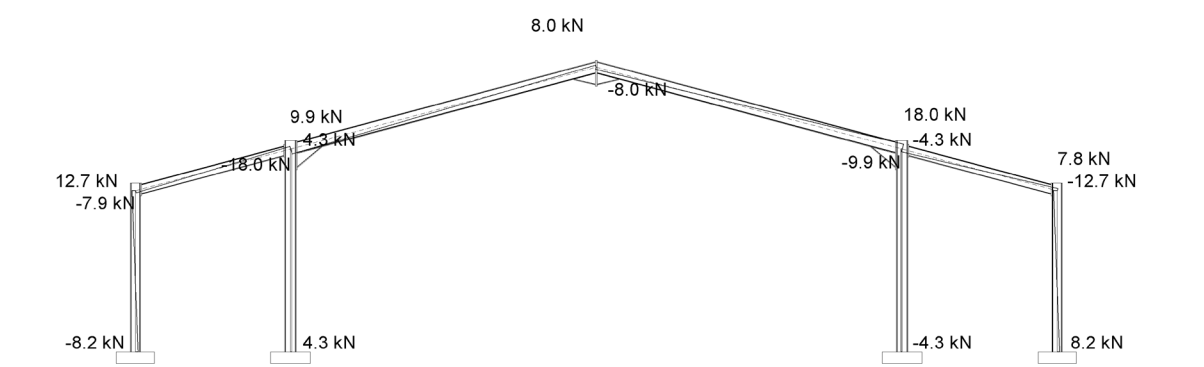
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	-5.7	-11.0	-12.9	-	-	-
Span 1 Rh Eaves	-9.3	5.4	-18.1	-	-	-
Span 2 Lh Eaves	-23.0	-24.1	-22.6	-15.9	-15.5	-28.2
Span 2 Lh Apex	3.1	0.0	-30.8	6.2	5.9	-29.6
Span 2 Rh Apex	3.1	0.0	-30.8	6.2	5.9	-29.6
Span 2 Rh Eaves	-23.1	-24.1	-22.6	-15.9	-15.5	-28.2
Span 3 Lh Eaves	-8.3	-4.8	-17.9	-	-	-
Span 3 Rh Eaves	-6.4	11.5	-12.7	-	-	-

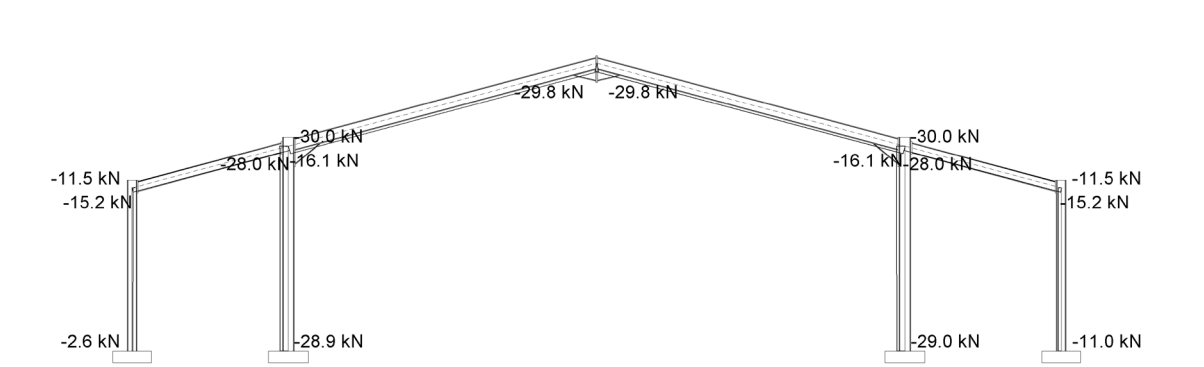
Bending Moment Diagram



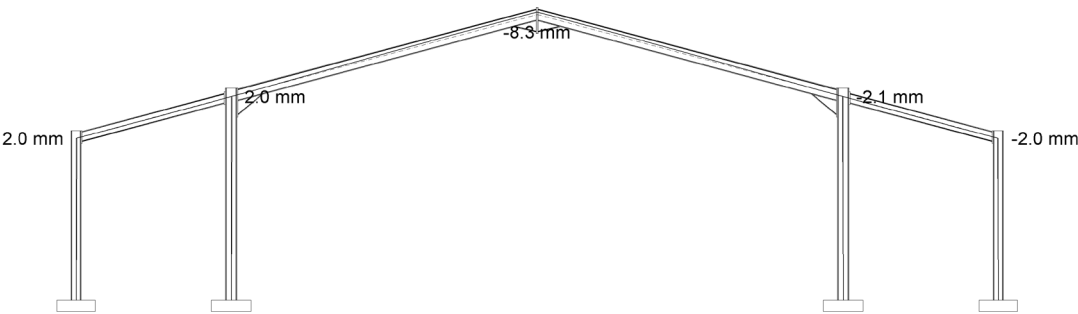
Shear Force Diagram



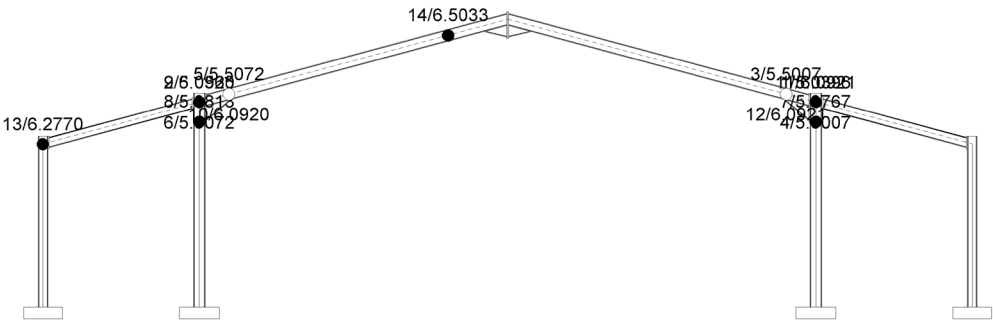
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Combination 4
Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.031
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.509
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.0	0.277
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.4	0.396
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.4	0.462
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.2	0.501
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.223
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.223
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History
Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	1.9661	-	Formed	Span 1 Mono Rafter	2.847	2.847	
Event 2	1.9691	-	Formed	Span 2 Rh Column	3.256	3.256	
Event 3	2.2983	-	Formed	Span 2 Rh Rafter	0.542	0.542	
Event 4	2.5458	-	Formed	Span 2 Lh Rafter	5.175	5.044	
Event 5	2.5728	-	Formed	Span 3 Rh Column	2.863	2.863	
Event 6	2.5988	-	Formed	Span 2 Lh Rafter	0.542	0.542	

Strength
Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.509	Pass
Span 2 Lh Rafter	0.396	Pass
Span 2 Rh Rafter	0.462	Pass
Span 3 Mono Rafter	0.223	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.119	Pass
Span 1 Rh Column	0.276	Pass
Span 2 Rh Column	0.500	Pass
Span 3 Rh Column	0.223	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.315	Pass
Span 2 Lh Rafter Lh Apex	0.235	Pass

Member	U.R.	Status
Span 2 Rh Rafter Rh Eaves	0.363	Pass
Span 2 Rh Rafter Rh Apex	0.224	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	1.6/28.6	na	na	na	1.6/36.0
Span 2	Pass	1.6/36.0	na	31.2/54.3	na	18.1/36.0
Span 3	Pass	18.1/36.0	na	na	na	18.1/28.6

Frame Stability

None

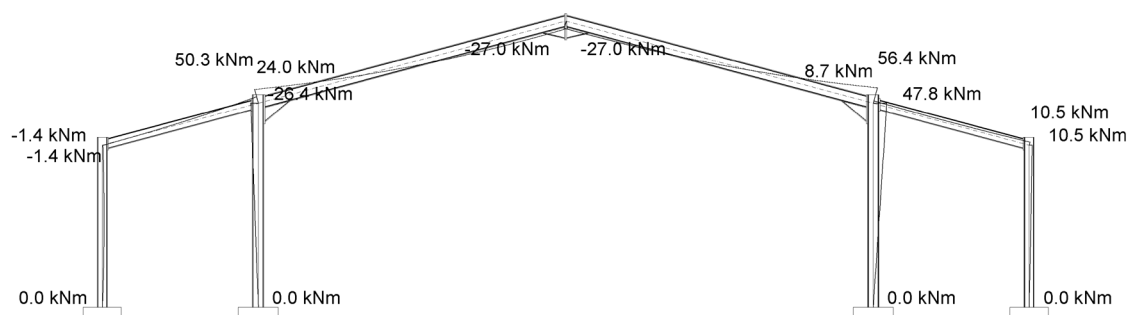
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	-7.3	11.0
Span 1 Rh Column	0.0	7.3	53.9
Span 2 Rh Column	0.0	-13.3	42.2
Span 3 Rh Column	0.0	-4.2	7.3

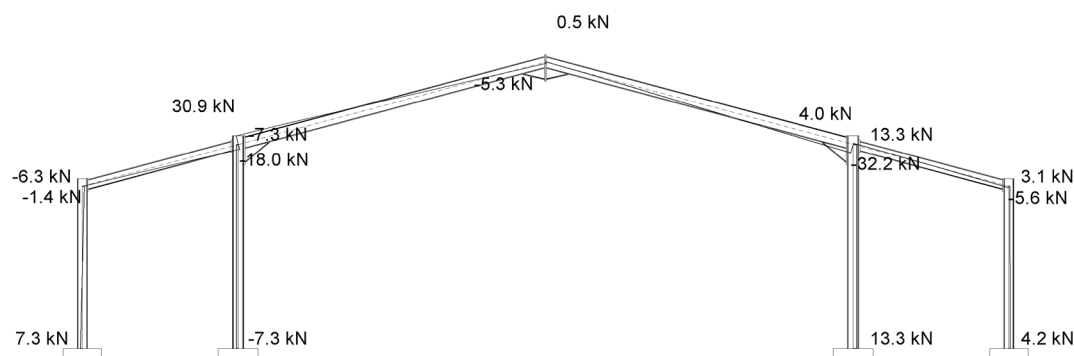
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	-1.3	-0.1	6.2	-	-	-
Span 1 Rh Eaves	24.0	-17.3	5.3	-	-	-
Span 2 Lh Eaves	47.0	34.8	12.5	34.2	28.5	20.2
Span 2 Lh Apex	-27.0	2.4	11.3	-28.7	-2.2	11.1
Span 2 Rh Apex	-27.0	-2.5	11.2	-26.9	1.2	12.3
Span 2 Rh Eaves	53.0	36.2	13.5	39.9	28.8	21.5
Span 3 Lh Eaves	8.3	3.7	0.3	-	-	-
Span 3 Rh Eaves	10.5	-6.7	3.1	-	-	-

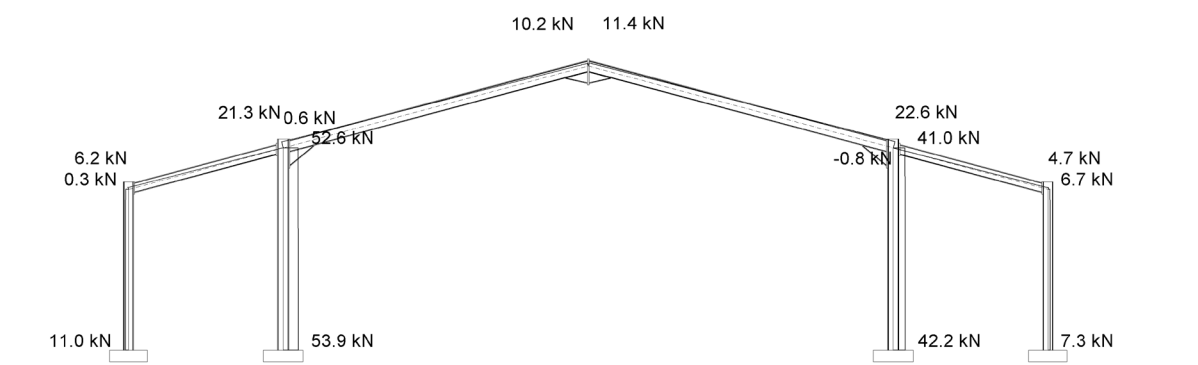
Bending Moment Diagram



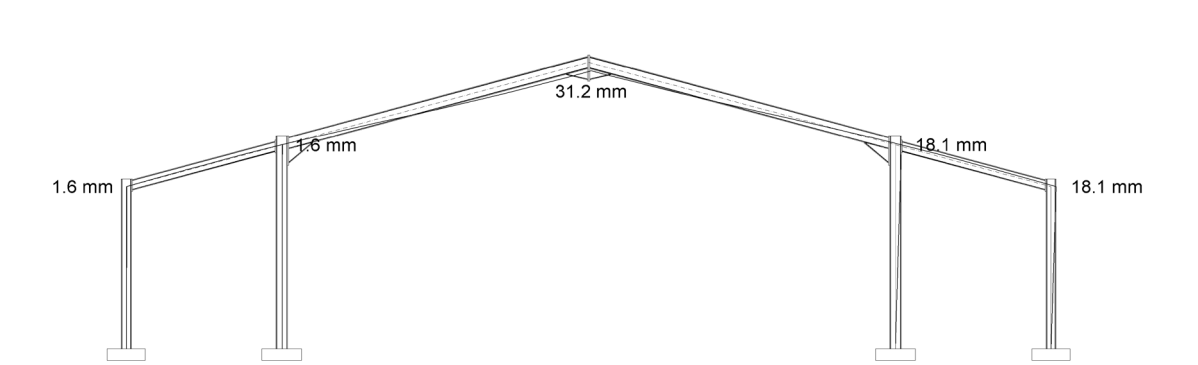
Shear Force Diagram



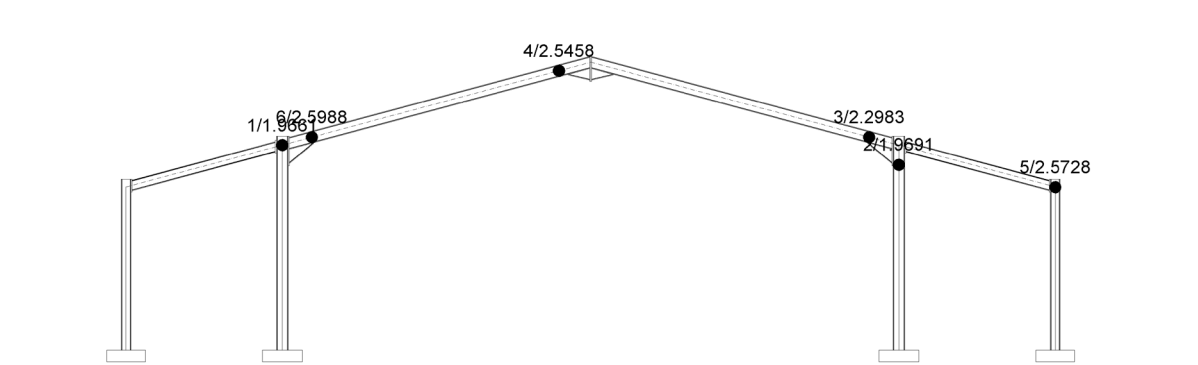
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Combination 5
Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.037
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.359
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.1	0.393
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.4	0.443
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.4	0.442
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.1	0.393
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.358
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.087
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History
Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	2.2546	-	Formed	Span 2 Lh Rafter	0.542	0.542	
Event 2	2.2566	-	Formed	Span 2 Rh Rafter	0.542	0.542	
Event 3	2.4804	-	Formed	Span 2 Lh Rafter	5.175	5.175	
Event 4	2.5131	-	Formed	Span 1 Rh Column	3.256	3.256	
Event 5	2.5131	-	Formed	Span 2 Rh Column	3.256	3.256	
Event 6	2.6929	-	Formed	Span 1 Lh Column	2.863	2.863	Warning

Strength Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.359	Pass
Span 2 Lh Rafter	0.442	Pass
Span 2 Rh Rafter	0.442	Pass
Span 3 Mono Rafter	0.358	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.087	Pass
Span 1 Rh Column	0.391	Pass
Span 2 Rh Column	0.391	Pass
Span 3 Rh Column	0.087	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.342	Pass
Span 2 Lh Rafter Lh Apex	0.255	Pass
Span 2 Rh Rafter Rh Eaves	0.342	Pass
Span 2 Rh Rafter Rh Apex	0.255	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	-8.7/28.6	na	na	na	-8.7/36.0
Span 2	Pass	-8.7/36.0	na	32.6/54.3	na	8.6/36.0
Span 3	Pass	8.6/36.0	na	na	na	8.7/28.6

Frame Stability

None

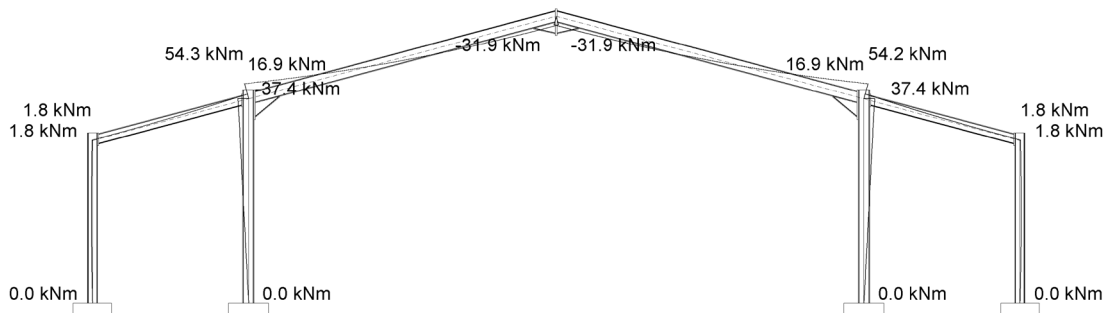
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	5.0	10.4
Span 1 Rh Column	0.0	10.4	48.0
Span 2 Rh Column	0.0	-10.4	48.0
Span 3 Rh Column	0.0	-5.0	0.3

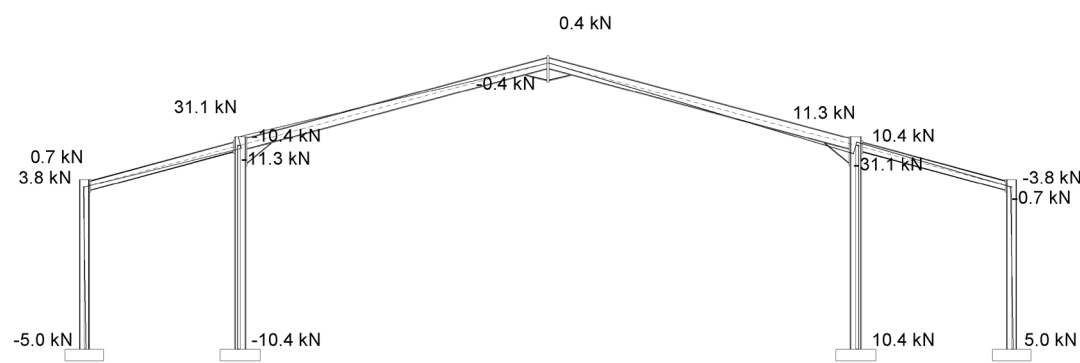
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	1.7	-0.7	-3.9	-	-	-
Span 1 Rh Eaves	16.9	-13.3	-6.0	-	-	-
Span 2 Lh Eaves	51.0	32.8	4.3	38.2	28.1	11.7
Span 2 Lh Apex	-31.9	0.0	1.7	-31.6	2.0	2.5
Span 2 Rh Apex	-31.9	0.0	1.7	-31.6	2.0	2.5
Span 2 Rh Eaves	50.9	32.8	4.3	38.2	28.1	11.7
Span 3 Lh Eaves	15.7	12.8	-6.0	-	-	-
Span 3 Rh Eaves	1.8	0.3	-3.8	-	-	-

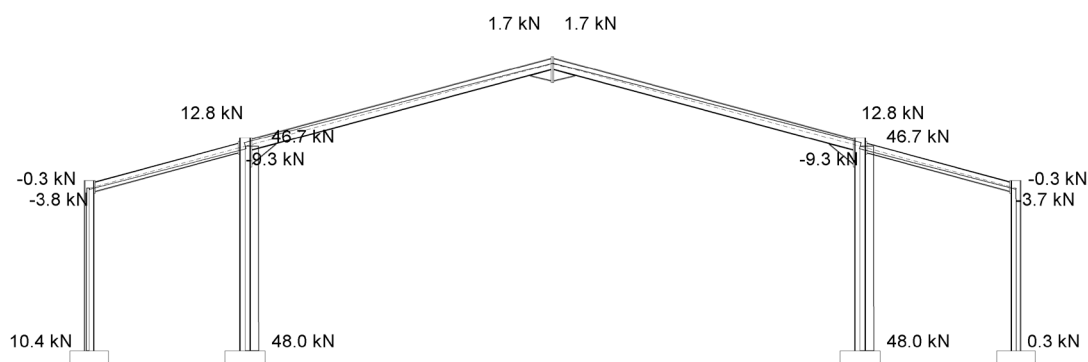
Bending Moment Diagram



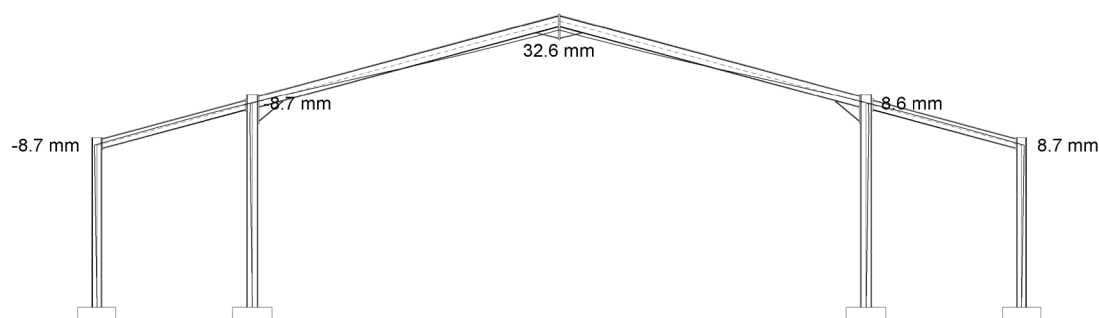
Shear Force Diagram



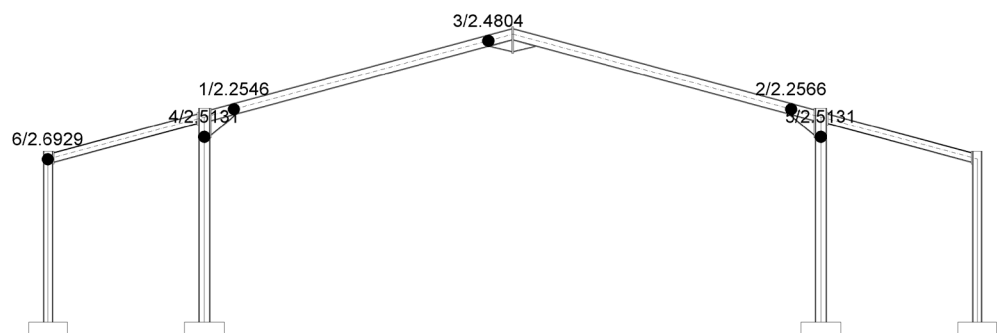
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Foundation Loads

Self weight

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	0.1	0.6
Span 1 Rh Column	0.0	0.5	3.2
Span 2 Rh Column	0.0	-0.5	3.2
Span 3 Rh Column	0.0	-0.1	0.6

Frame Dead Load

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	0.2	9.0
Span 1 Rh Column	0.0	1.4	7.1
Span 2 Rh Column	0.0	-1.4	7.1
Span 3 Rh Column	0.0	-0.2	0.6

Frame Service Load

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	0.1	0.4
Span 1 Rh Column	0.0	1.0	4.7
Span 2 Rh Column	0.0	-1.0	4.7
Span 3 Rh Column	0.0	-0.1	0.4

Frame Imposed Load

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	1.0	3.3
Span 1 Rh Column	0.0	7.1	35.5
Span 2 Rh Column	0.0	-7.1	35.5
Span 3 Rh Column	0.0	-1.0	3.3

SLS, Wind: Side Left, Cpi 0.2000, Roof Cpe -ve

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	-4.6	-8.2
Span 1 Rh Column	0.0	-7.0	-23.1
Span 2 Rh Column	0.0	2.0	-32.8
Span 3 Rh Column	0.0	-5.0	-2.9

SLS, Wind: Side Left, Cpi -0.3000, Roof Cpe -ve

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	-7.4	-4.1
Span 1 Rh Column	0.0	-3.9	-5.6
Span 2 Rh Column	0.0	-1.1	-15.3
Span 3 Rh Column	0.0	-2.2	1.2

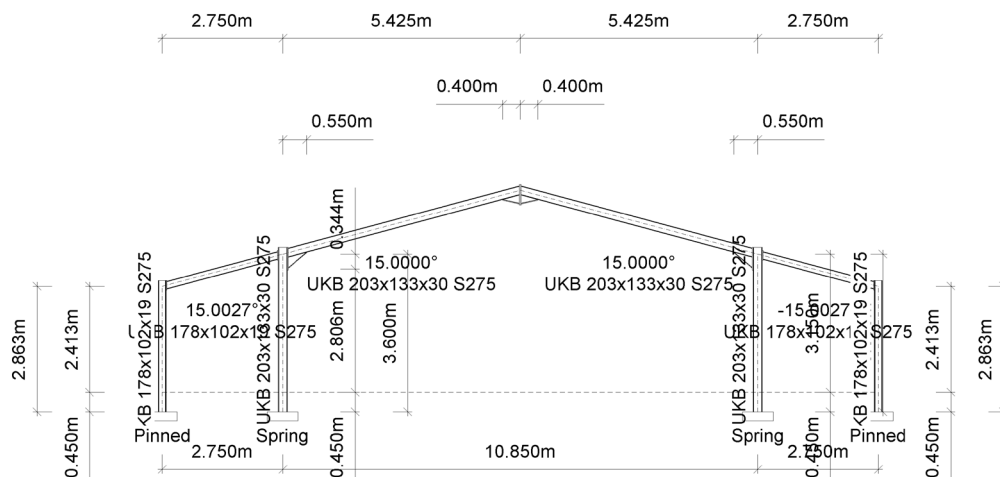
SLS, Wind: Gable End Top, Cpi 0.2000, Roof Cpe -ve

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	5.7	-8.7
Span 1 Rh Column	0.0	-4.5	-28.0
Span 2 Rh Column	0.0	4.5	-28.0
Span 3 Rh Column	0.0	-5.7	-8.7

SLS, Wind: Gable End Top, Cpi -0.3000, Roof Cpe -ve

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	2.9	-4.6
Span 1 Rh Column	0.0	-1.3	-10.5
Span 2 Rh Column	0.0	1.3	-10.5
Span 3 Rh Column	0.0	-2.9	-4.6

PROPOSED Portal Frame Frame Diagram



Frame Details

No. Spans

Effective Frame Centres

3
6.100 m

Span Geometry

Span	Type	Axis	Lh Eaves [m]	Lh Apex [m]	Apex [m]	Rh Apex [m]	Rh Eaves [m]
Span 1	Monopitch	X	0.0	-	-	-	2.750
		Z	2.413	-	-	-	3.150
Span 2	Standard	X	2.750	-	8.175	-	13.600
		Z	3.150	-	4.604	-	3.150
Span 3	Monopitch	X	13.600	-	-	-	16.350
		Z	3.150	-	-	-	2.413

Wind Options

Wind Method

Basic Wind Speed (V_b)

Ground Roughness

Upwind distance from sea to site

Altitude factor (S_a)

Seasonal factor (Ss)

Probability factor (Sp)

Standard

21.0 m/s

Country

0.0 km

1.1000

1.0000

Base Fixities

Base	Type	Level [m]	Vertical [kN/m]	Horizontal [kN/m]	Rotational [kNm/rad]	Capacity [%]	Capacity [kNm]	
Span 1 Lh	Pinned	-0.450	ULS	Restr.	Restr.	Free	1.00	N/A
		-0.450	SLS	Restr.	Restr.	Free	N/A	
		-0.450	Stab	Restr.	Restr.	Free	1.00	
Span 1 Rh	Spring	-0.450	ULS	Restr.	Restr.	Free	1.00	N/A
		-0.450	SLS	Restr.	Restr.	Free	N/A	
		-0.450	Stab	Restr.	Restr.	659.546	1.00	
Span 2 Rh	Spring	-0.450	ULS	Restr.	Restr.	Free	1.00	N/A
		-0.450	SLS	Restr.	Restr.	Free	N/A	
		-0.450	Stab	Restr.	Restr.	659.546	1.00	
Span 3 Rh	Pinned	-0.450	ULS	Restr.	Restr.	Free	1.00	N/A
		-0.450	SLS	Restr.	Restr.	Free	N/A	
		-0.450	Stab	Restr.	Restr.	Free	1.00	

Haunches

Haunch	Section	Length [m]	Depth [m]	Beta [°]	Gamma [°]	Offset X1 [mm]	Offset X2 [mm]	Filler Plate
Span 2 Lh Eaves	UKB 203x133x3	0.550	0.344	39.7464	24.7464	154.0	401.8	
	0							
Span 2 Apex Lh	UKB 203x133x3	0.400	0.317	13.0429	28.0429	42.8	346.5	
	0							
Span 2 Apex Rh	UKB 203x133x3	0.400	0.317	13.0429	28.0429	42.8	346.5	
	0							
Span 2 Rh Eaves	UKB 203x133x3	0.550	0.344	39.7464	24.7464	154.0	401.8	
	0							

Member	Sh	Sc	Tc	St	Tt	gt	Sb	Vs [m/s]	Ve [m/s]
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Wind Loads

Member	qs [kN/m ²]	Cpi	Cpe	L [m]	a [m]	Cae	Cai	%
Span 1 Lh Column	0.866	0.2000	0.4580	2.863	6.738	0.9828	1.0000	100.00
Span 1 Mono Rafter	0.866	0.2000	-0.7999	0.953	6.732	0.9828	1.0000	100.00
Span 1 Mono Rafter			-0.4000	1.894				
Span 2 Lh Rafter	0.866	0.2000	-0.8000	0.953	8.292	0.9700	1.0000	100.00
Span 2 Lh Rafter			-0.4000	4.663				
Span 2 Rh Rafter	0.866	0.2000	-0.5000	4.663	8.292	0.9700	1.0000	100.00
Span 2 Rh Rafter			-0.9000	0.953				
Span 3 Mono Rafter	0.866	0.2000	-1.0000	0.953	6.732	0.9828	1.0000	100.00
Span 3 Mono Rafter			-0.9000	1.894				
Span 3 Rh Column	0.866	0.2000	-0.3693	2.863	6.738	0.9828	1.0000	100.00

SLS, Wind: Side Left, Cpi -0.3000, Roof Cpe -ve

Frame is considered to be in Intermediate zone

Building Length	24.000	m
Building Width	10.850	m
Building reference height, H _r	4.604	m
Building effective height, H _e	4.604	m
Altitude factor, Sa	1.1000	
Seasonal factor, Ss	1.0000	
Probability factor, Sp	1.0000	
Directional factor, Sd	1.0000	
Eaves Line orientation EON	0.0	°
Critical Wind Angle	270.0000	°

Wind Speeds

Member	Sh	Sc	Tc	St	Tt	gt	Sb	Vs [m/s]	Ve [m/s]
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Wind Loads

Member	qs [kN/m ²]	Cpi	Cpe	L [m]	a [m]	Cae	Cai	%
Span 1 Lh Column	0.866	-0.3000	0.4580	2.863	6.738	0.9828	1.0000	100.00
Span 1 Mono Rafter	0.866	-0.3000	-0.7999	0.953	6.732	0.9828	1.0000	100.00
Span 1 Mono Rafter			-0.4000	1.894				
Span 2 Lh Rafter	0.866	-0.3000	-0.8000	0.953	8.292	0.9700	1.0000	100.00
Span 2 Lh Rafter			-0.4000	4.663				
Span 2 Rh Rafter	0.866	-0.3000	-0.5000	4.663	8.292	0.9700	1.0000	100.00
Span 2 Rh Rafter			-0.9000	0.953				
Span 3 Mono Rafter	0.866	-0.3000	-1.0000	0.953	6.732	0.9828	1.0000	100.00
Span 3 Mono Rafter			-0.9000	1.894				
Span 3 Rh Column	0.866	-0.3000	-0.3693	2.863	6.738	0.9828	1.0000	100.00

SLS, Wind: Gable End Top, Cpi 0.2000, Roof Cpe -ve

Frame is considered to be in Intermediate zone

Building Length	24.000	m
Building Width	10.850	m
Building reference height, H _r	4.604	m
Building effective height, H _e	4.604	m
Lh Gap	7.200	m
Rh Gap	7.200	m
Altitude factor, Sa	1.1000	
Seasonal factor, Ss	1.0000	

Probability factor, Sp 1.0000
 Directional factor, Sd 1.0000
 Eaves Line orientation EON 0.0 °
 Critical Wind Angle 0.0 °

Wind Speeds

Member	Sh	Sc	Tc	St	Tt	gt	Sb	Vs [m/s]	Ve [m/s]
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Wind Loads

Member	qs [kN/m ²]	Cpi	Cpe	L [m]	a [m]	Cae	Cai	%
Span 1 Lh Column	0.866	0.2000	-0.8000	2.863	6.738	0.9828	1.0000	100.00
Span 1 Mono Rafter	0.866	0.2000	-0.8000	2.847	6.732	0.9828	1.0000	100.00
Span 2 Lh Rafter	0.866	0.2000	-0.6000	5.616	8.292	0.9700	1.0000	100.00
Span 2 Rh Rafter	0.866	0.2000	-0.6000	5.616	8.292	0.9700	1.0000	100.00
Span 3 Mono Rafter	0.866	0.2000	-0.8000	2.847	6.732	0.9828	1.0000	100.00
Span 3 Rh Column	0.866	0.2000	-0.8000	2.863	6.738	0.9828	1.0000	100.00

SLS, Wind: Gable End Top, Cpi -0.3000, Roof Cpe -ve

Frame is considered to be in Intermediate zone

Building Length 24.000 m
 Building Width 10.850 m
 Building reference height, H_r 4.604 m
 Building effective height, H_e 4.604 m
 Lh Gap 7.200 m
 Rh Gap 7.200 m
 Altitude factor, Sa 1.1000
 Seasonal factor, Ss 1.0000
 Probability factor, Sp 1.0000
 Directional factor, Sd 1.0000
 Eaves Line orientation EON 0.0 °
 Critical Wind Angle 0.0 °

Wind Speeds

Member	Sh	Sc	Tc	St	Tt	gt	Sb	Vs [m/s]	Ve [m/s]
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	1.6276	23.1	37.6
Span 1 Lh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 1 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Lh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 2 Rh Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Mono Rafter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Span 3 Rh Column	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Wind Loads

Member	qs [kN/m ²]	Cpi	Cpe	L [m]	a [m]	Cae	Cai	%
Span 1 Lh Column	0.866	-0.3000	-0.8000	2.863	6.738	0.9828	1.0000	100.00
Span 1 Mono Rafter	0.866	-0.3000	-0.8000	2.847	6.732	0.9828	1.0000	100.00
Span 2 Lh Rafter	0.866	-0.3000	-0.6000	5.616	8.292	0.9700	1.0000	100.00
Span 2 Rh Rafter	0.866	-0.3000	-0.6000	5.616	8.292	0.9700	1.0000	100.00
Span 3 Mono Rafter	0.866	-0.3000	-0.8000	2.847	6.732	0.9828	1.0000	100.00
Span 3 Rh Column	0.866	-0.3000	-0.8000	2.863	6.738	0.9828	1.0000	100.00

Combinations

Sw + Dead + Serv. + Imp.

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.4000	1.0000
Frame Dead Load	Dead	1.4000	1.0000
Frame Service Load	Dead	1.4000	1.0000
Frame Imposed Load	Imposed	1.6000	1.0000

Combination 2

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.0000	1.0000
Frame Dead Load	Dead	1.0000	1.0000
SLS, Wind: Side Left, Cpi 0.2000, Roof Cpe -ve	Wind	1.4000	1.0000

Combination 3

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.0000	1.0000
Frame Dead Load	Dead	1.0000	1.0000
SLS, Wind: Gable End Top, Cpi 0.2000, Roof Cpe -ve	Wind	1.4000	1.0000

Combination 4

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.2000	1.0000
Frame Dead Load	Dead	1.2000	1.0000
Frame Service Load	Dead	1.2000	1.0000
Frame Imposed Load	Imposed	1.2000	1.0000
SLS, Wind: Side Left, Cpi -0.3000, Roof Cpe -ve	Wind	1.2000	1.0000

Combination 5

Frame Imperfection off

Loadcase	Type	Ultimate P.S.F.	Service P.S.F.
Self weight	Dead	1.2000	1.0000
Frame Dead Load	Dead	1.2000	1.0000
Frame Service Load	Dead	1.2000	1.0000
Frame Imposed Load	Imposed	1.2000	1.0000
SLS, Wind: Gable End Top, Cpi -0.3000, Roof Cpe -ve	Wind	1.2000	1.0000

Design Wizard Options

Design Criteria

BS5950 Part1 : 2000

Maximum Hinge Rotation	6.0000	°
Percent Mp for Plasticity	99.00	%
Axial Load Factor	1.2500	

Design Limits

Eaves Deflection	Relative Limit	100.0	mm
Apex Deflection	Relative Limit	200.0	mm
Cladding Stiffness		0.0	%
Tie Elongation	No Limit		

Design Code: BS5950

Design Summary

Design Combination	Lambda p	Lambda r	Status
Sw + Dead + Serv. + Imp.	1.869	1.000	Pass
Combination 2	5.243	1.000	Pass
Combination 3	9.299	1.000	Pass
Combination 4	2.599	1.000	Pass
Combination 5	2.693	1.000	Pass

Member Stability Status: Warning

Design Cases

Sw + Dead + Serv. + Imp.

Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.0	0.124
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.560
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	85.6	0.576
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.3	0.650
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.3	0.650
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	85.6	0.575
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.559
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.124
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	1.5358	-	Formed	Span 2 Lh Rafter	0.542	0.542	
Event 2	1.5369	-	Formed	Span 2 Rh Rafter	0.542	0.542	
Event 3	1.7524	-	Formed	Span 2 Lh Rafter	5.175	5.152	
Event 4	1.7567	-	Formed	Span 2 Rh Rafter	2.858	3.988	
Event 5	1.7567	-	Reversed	Span 2 Lh Rafter	5.175	5.152	
Event 6	1.7567	-	Formed	Span 2 Lh Rafter	0.542	0.542	
Event 7	1.7651	-	Formed	Span 1 Rh Column	3.256	3.256	
Event 8	1.7651	-	Formed	Span 2 Rh Column	3.256	3.256	
Event 9	1.8687	-	Formed	Span 1 Lh Column	2.863	2.863	

Strength

Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.560	Pass
Span 2 Lh Rafter	0.650	Pass
Span 2 Rh Rafter	0.649	Pass
Span 3 Mono Rafter	0.559	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.123	Pass
Span 1 Rh Column	0.570	Pass
Span 2 Rh Column	0.570	Pass
Span 3 Rh Column	0.124	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.512	Pass
Span 2 Lh Rafter Lh Apex	0.354	Pass
Span 2 Rh Rafter Rh Eaves	0.511	Pass
Span 2 Rh Rafter Rh Apex	0.354	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	-9.8/28.6	na	na	na	-9.8/36.0
Span 2	Pass	-9.8/36.0	na	37.1/54.3	na	9.8/36.0
Span 3	Pass	9.8/36.0	na	na	na	9.8/28.6

Frame Stability

None

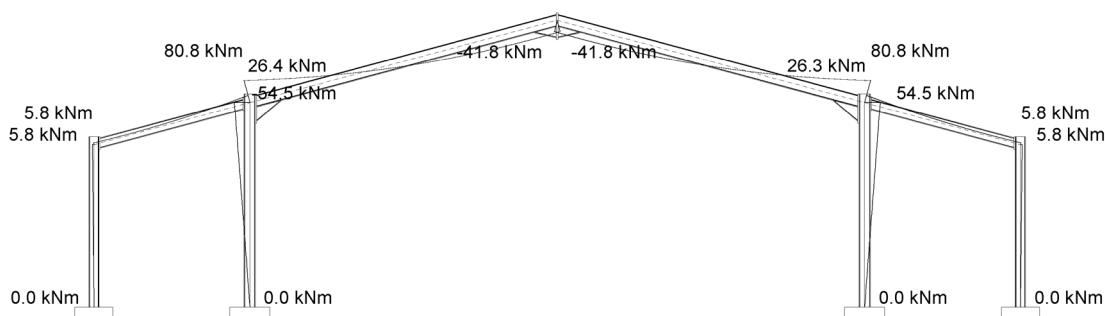
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	2.0	19.2
Span 1 Rh Column	0.0	15.1	76.4
Span 2 Rh Column	0.0	-15.1	76.3
Span 3 Rh Column	0.0	-2.0	7.4

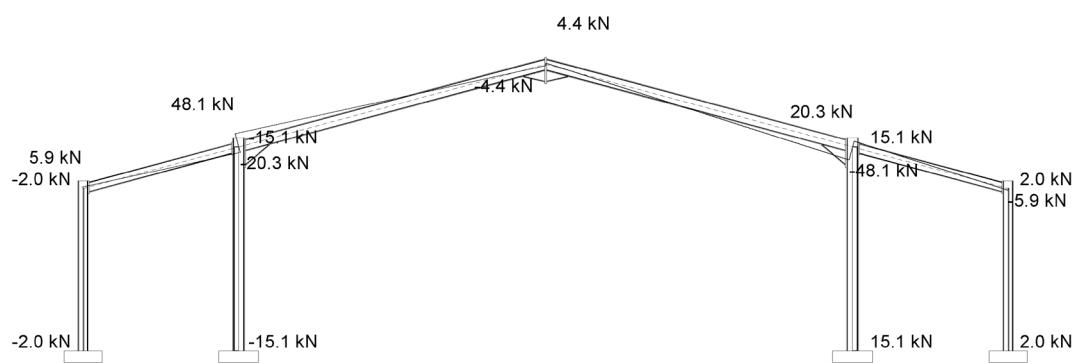
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	5.3	5.8	2.0	-	-	-
Span 1 Rh Eaves	26.4	-20.5	2.0	-	-	-
Span 2 Lh Eaves	75.7	53.4	17.2	56.2	43.0	29.3
Span 2 Lh Apex	-41.8	0.0	17.2	-42.8	-0.3	17.7
Span 2 Rh Apex	-41.8	0.0	17.2	-42.8	-0.3	17.7
Span 2 Rh Eaves	75.7	53.3	17.2	56.1	43.0	29.3
Span 3 Lh Eaves	24.2	19.5	2.0	-	-	-
Span 3 Rh Eaves	5.8	-6.7	2.0	-	-	-

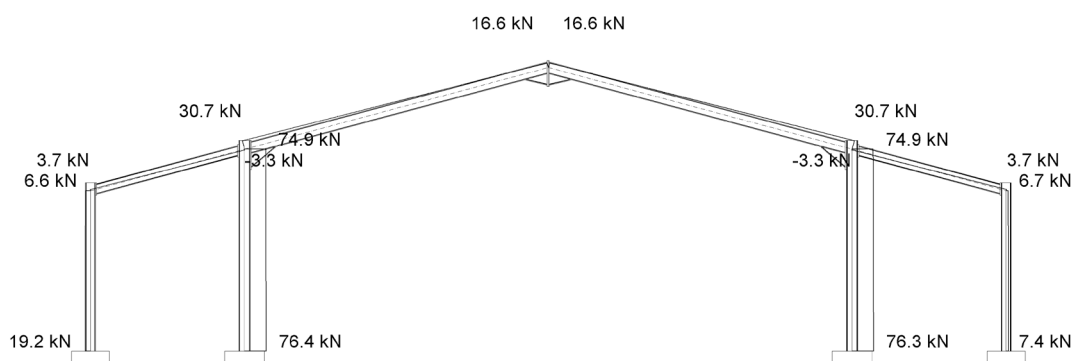
Bending Moment Diagram



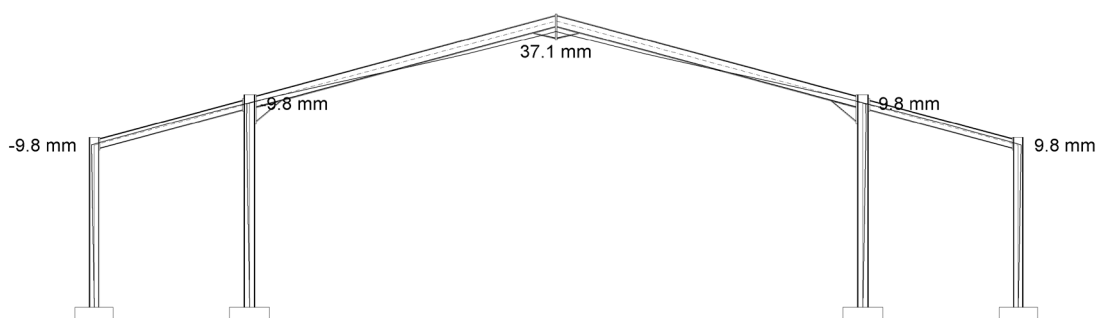
Shear Force Diagram



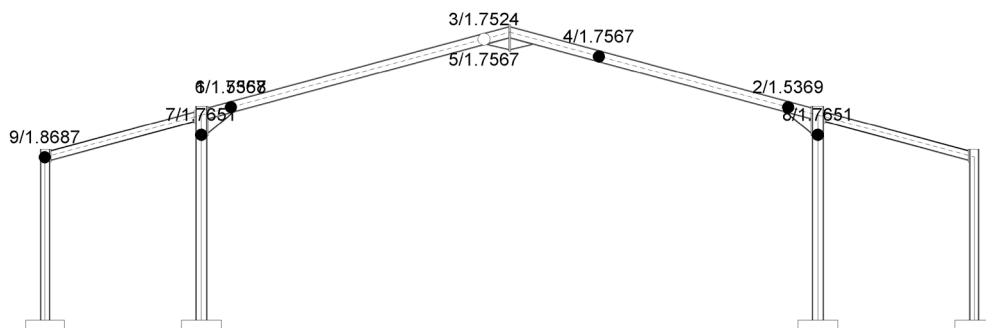
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Combination 2
Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.203
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.203
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.5	0.244
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.5	0.176

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.5	0.114
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.5	0.017
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.348
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.142
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History

Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	2.8708		- Formed	Span 3 Mono Rafter	0.0	0.0	
Event 2	3.8179		- Formed	Span 1 Rh Column	3.256	3.256	
Event 3	4.1108		- Formed	Span 1 Lh Column	2.863	2.863	
Event 4	4.9970		- Formed	Span 3 Mono Rafter	2.847	2.658	
Event 5	5.2398		- Formed	Span 2 Lh Rafter	0.542	0.542	
Event 6	5.2426		- Formed	Span 2 Rh Rafter	2.858	3.352	

Strength

Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.203	Pass
Span 2 Lh Rafter	0.176	Pass
Span 2 Rh Rafter	0.114	Pass
Span 3 Mono Rafter	0.348	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.203	Pass
Span 1 Rh Column	0.244	Pass
Span 2 Rh Column	0.028	Pass
Span 3 Rh Column	0.142	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.144	Pass
Span 2 Lh Rafter Lh Apex	0.055	Pass
Span 2 Rh Rafter Rh Eaves	0.088	Pass
Span 2 Rh Rafter Rh Apex	0.068	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	10.9/28.6	na	na	na	10.9/36.0
Span 2	Pass	10.9/36.0	na	-4.3/54.3	na	8.8/36.0
Span 3	Pass	8.8/36.0	na	na	na	8.8/28.6

Frame Stability

None

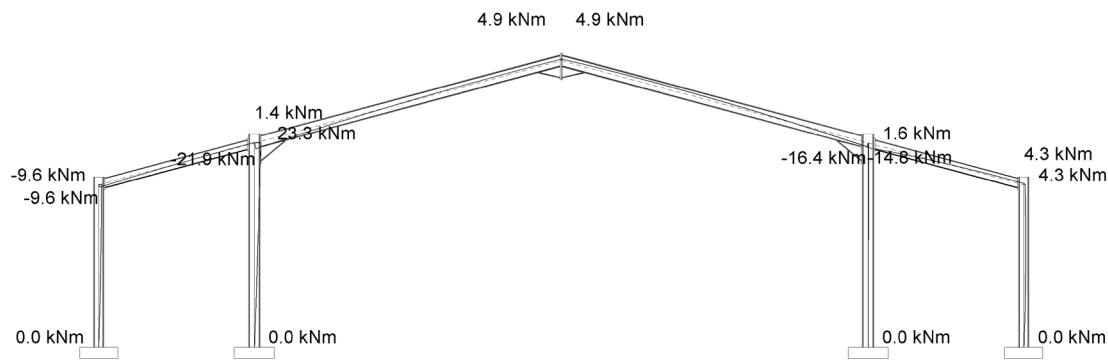
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	-6.0	-1.2
Span 1 Rh Column	0.0	-6.5	-15.0
Span 2 Rh Column	0.0	-0.5	-28.5
Span 3 Rh Column	0.0	-7.5	-2.2

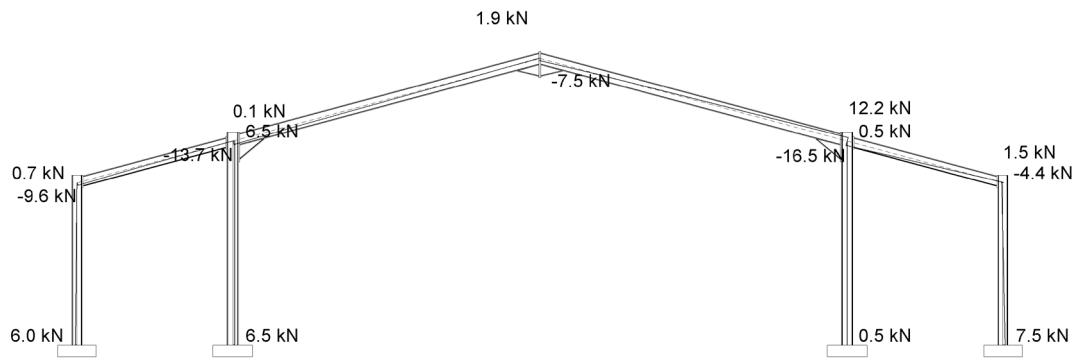
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	-8.7	-9.7	-0.9	-	-	-
Span 1 Rh Eaves	1.4	-1.2	-4.6	-	-	-
Span 2 Lh Eaves	-20.5	-16.7	-11.3	-15.2	-10.9	-15.5
Span 2 Lh Apex	4.9	2.9	-18.1	5.5	0.9	-18.0
Span 2 Rh Apex	4.9	-2.9	-18.1	7.6	4.9	-16.5
Span 2 Rh Eaves	-13.5	-15.0	-10.2	-8.6	-10.6	-14.0
Span 3 Lh Eaves	-14.7	-13.6	-10.3	-	-	-
Span 3 Rh Eaves	4.3	2.7	-4.5	-	-	-

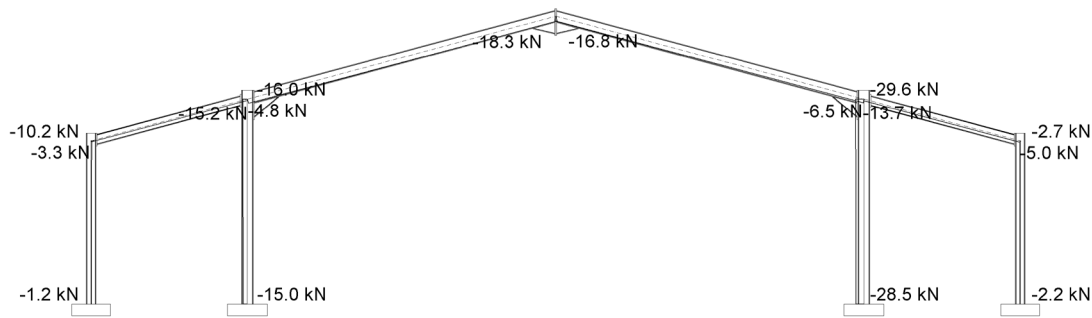
Bending Moment Diagram



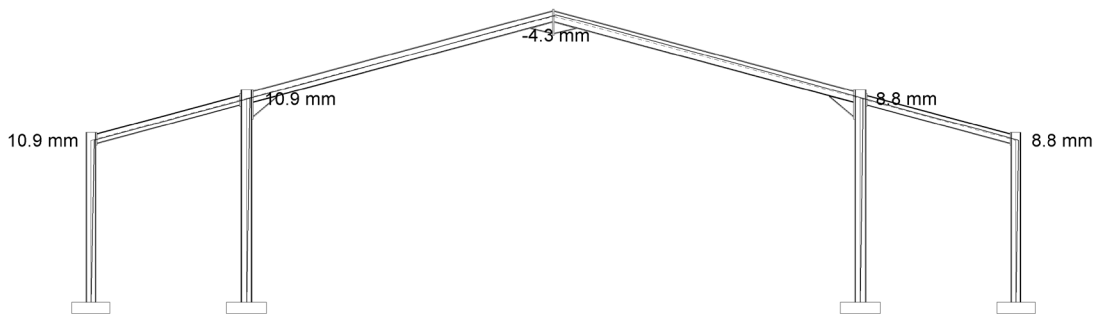
Shear Force Diagram



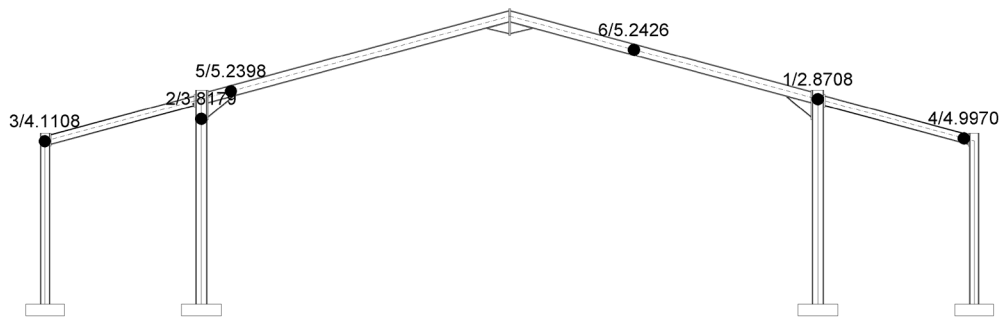
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Combination 3

Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.124
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.145
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.5	0.110
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.5	0.122
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.5	0.123
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.5	0.110
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.145
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.124
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History

Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	6.8735	-	Formed	Span 3 Mono Rafter	0.0	0.0	
Event 2	6.9048	-	Formed	Span 1 Mono Rafter	2.847	2.847	
Event 3	7.7310	-	Formed	Span 1 Lh Column	2.863	2.863	
Event 4	7.7725	-	Formed	Span 3 Rh Column	2.863	2.863	
Event 5	8.2963	-	Formed	Span 1 Rh Column	3.256	3.256	
Event 6	8.2963	-	Reversed	Span 3 Rh Column	2.863	2.863	
Event 7	8.3052	-	Formed	Span 2 Rh Column	3.256	3.256	
Event 8	9.2991	-	Formed	Span 2 Lh Rafter	5.175	4.397	

Strength

Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.145	Pass
Span 2 Lh Rafter	0.122	Pass
Span 2 Rh Rafter	0.123	Pass
Span 3 Mono Rafter	0.145	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.124	Pass
Span 1 Rh Column	0.110	Pass
Span 2 Rh Column	0.110	Pass
Span 3 Rh Column	0.124	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.112	Pass
Span 2 Lh Rafter Lh Apex	0.032	Pass
Span 2 Rh Rafter Rh Eaves	0.113	Pass
Span 2 Rh Rafter Rh Apex	0.032	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	0.6/28.6	na	na	na	0.6/36.0
Span 2	Pass	0.6/36.0	na	-3.0/54.3	na	-0.7/36.0
Span 3	Pass	-0.7/36.0	na	na	na	-0.6/28.6

Frame Stability

None

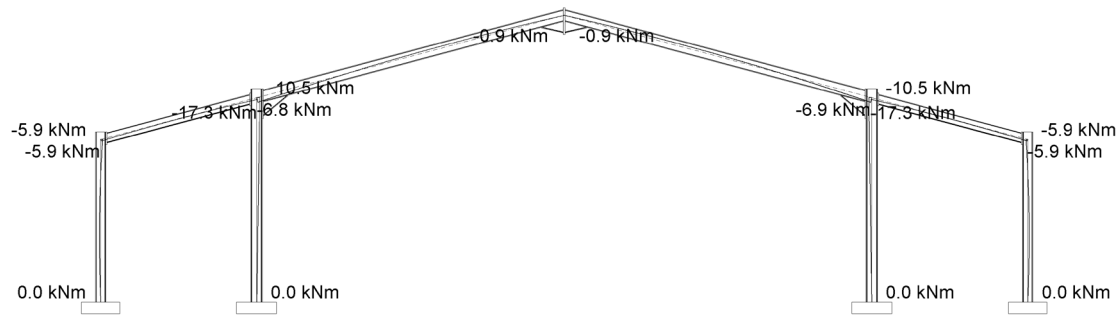
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	8.4	-2.0
Span 1 Rh Column	0.0	-2.9	-21.8
Span 2 Rh Column	0.0	2.9	-21.9
Span 3 Rh Column	0.0	-8.4	-10.3

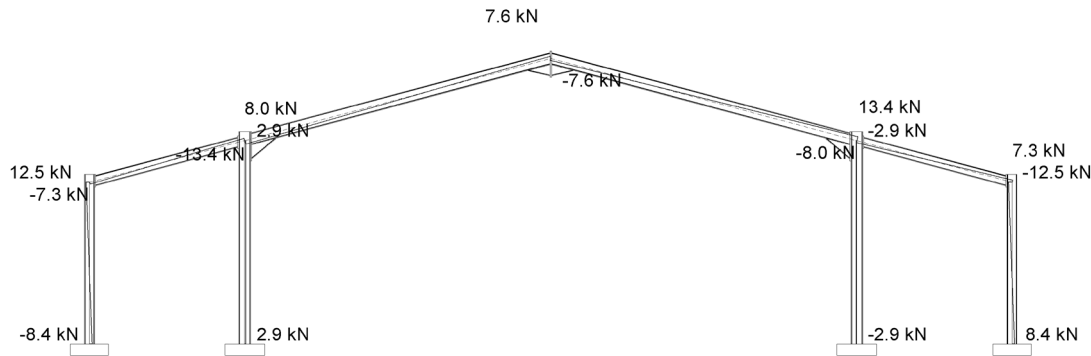
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	-5.2	-10.4	-12.7	-	-	-
Span 1 Rh Eaves	-6.8	3.4	-17.9	-	-	-
Span 2 Lh Eaves	-15.9	-19.1	-20.9	-10.6	-11.4	-25.4
Span 2 Lh Apex	-0.9	0.0	-29.2	2.1	5.9	-27.9
Span 2 Rh Apex	-0.9	0.0	-29.2	2.1	5.9	-27.9
Span 2 Rh Eaves	-15.9	-19.1	-20.9	-10.6	-11.4	-25.4
Span 3 Lh Eaves	-6.0	-2.9	-17.7	-	-	-
Span 3 Rh Eaves	-5.9	10.9	-12.5	-	-	-

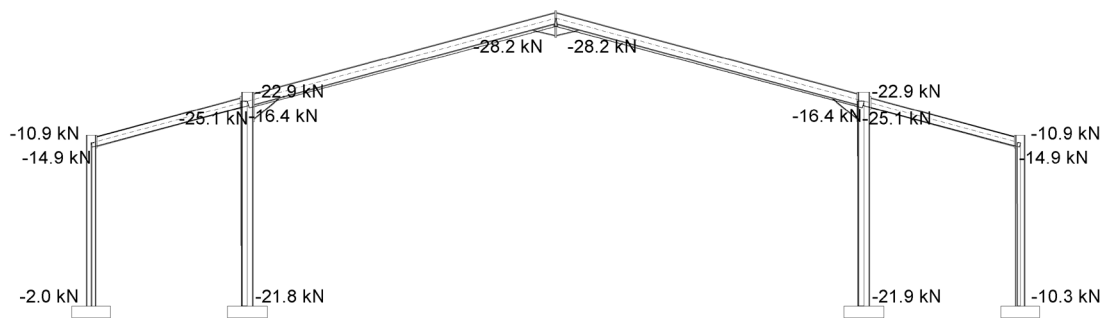
Bending Moment Diagram



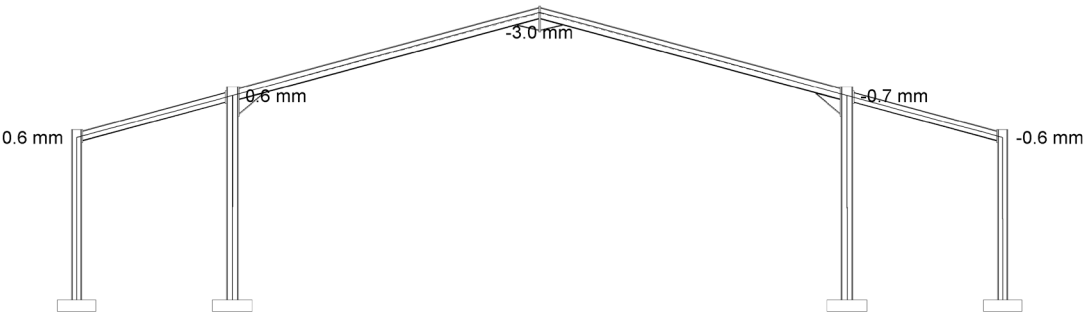
Shear Force Diagram



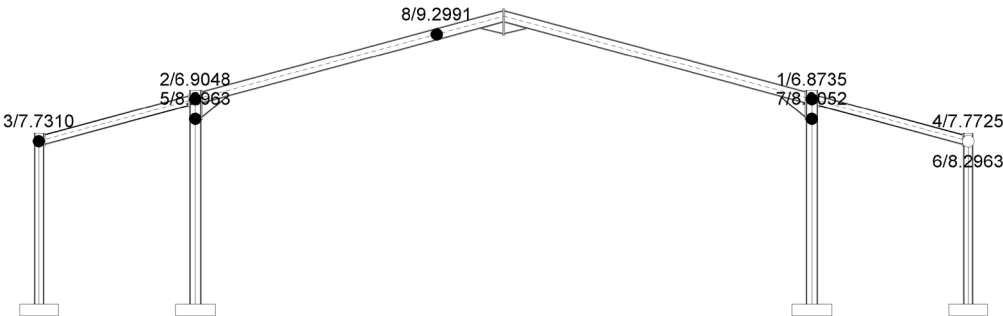
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Combination 4

Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.031
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.509
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.0	0.277
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.4	0.396
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.4	0.462
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.2	0.501
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.223
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.223
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History

Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	1.9661		- Formed	Span 1 Mono Rafter	2.847	2.847	
Event 2	1.9700		- Formed	Span 2 Rh Column	3.256	3.256	
Event 3	2.2978		- Formed	Span 2 Rh Rafter	0.542	0.542	
Event 4	2.5463		- Formed	Span 2 Lh Rafter	5.175	5.044	
Event 5	2.5733		- Formed	Span 3 Rh Column	2.863	2.863	
Event 6	2.5991		- Formed	Span 2 Lh Rafter	0.542	0.542	

Strength

Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.509	Pass
Span 2 Lh Rafter	0.396	Pass
Span 2 Rh Rafter	0.462	Pass
Span 3 Mono Rafter	0.223	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.119	Pass
Span 1 Rh Column	0.276	Pass
Span 2 Rh Column	0.500	Pass
Span 3 Rh Column	0.223	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.315	Pass
Span 2 Lh Rafter Lh Apex	0.235	Pass

Member	U.R.	Status
Span 2 Rh Rafter Rh Eaves	0.363	Pass
Span 2 Rh Rafter Rh Apex	0.224	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	1.6/28.6	na	na	na	1.6/36.0
Span 2	Pass	1.6/36.0	na	31.2/54.3	na	18.1/36.0
Span 3	Pass	18.1/36.0	na	na	na	18.1/28.6

Frame Stability

None

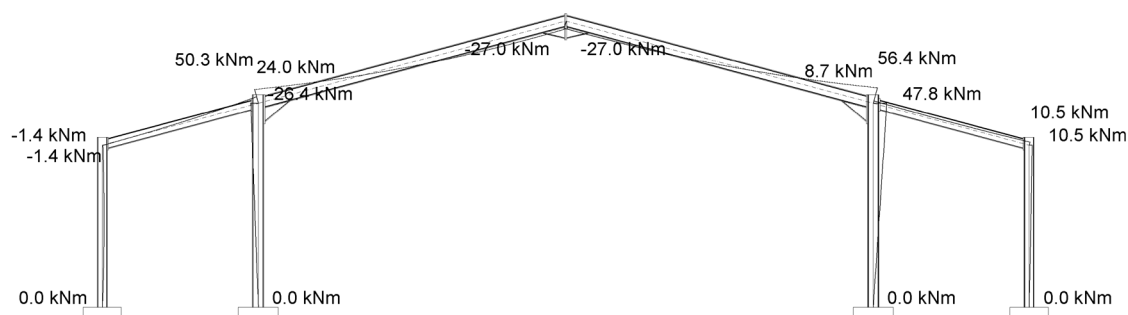
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	-7.3	11.0
Span 1 Rh Column	0.0	7.3	53.9
Span 2 Rh Column	0.0	-13.3	42.2
Span 3 Rh Column	0.0	-4.2	7.3

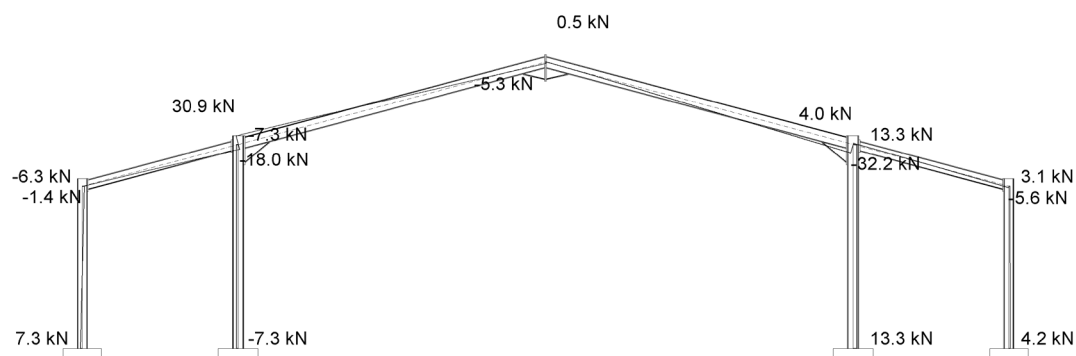
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	-1.3	-0.1	6.2	-	-	-
Span 1 Rh Eaves	24.0	-17.3	5.3	-	-	-
Span 2 Lh Eaves	47.0	34.8	12.5	34.2	28.5	20.2
Span 2 Lh Apex	-27.0	2.4	11.3	-28.7	-2.2	11.1
Span 2 Rh Apex	-27.0	-2.5	11.2	-26.9	1.2	12.3
Span 2 Rh Eaves	53.0	36.2	13.5	39.9	28.8	21.5
Span 3 Lh Eaves	8.3	3.7	0.3	-	-	-
Span 3 Rh Eaves	10.5	-6.7	3.1	-	-	-

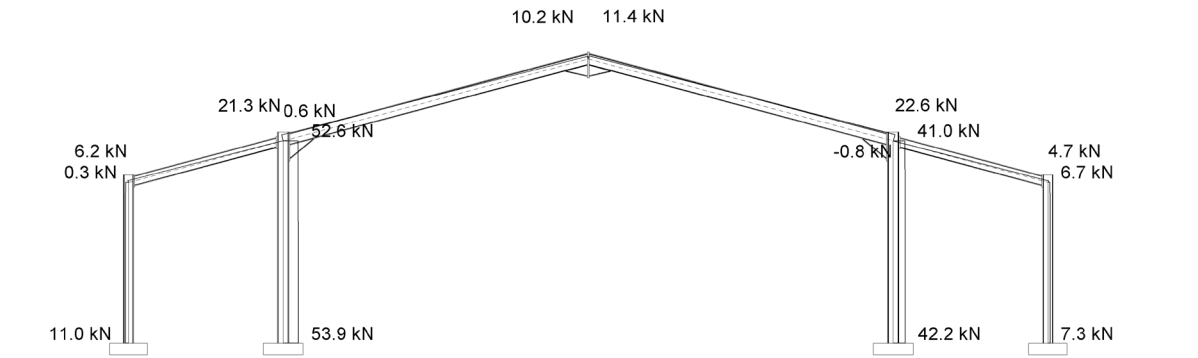
Bending Moment Diagram



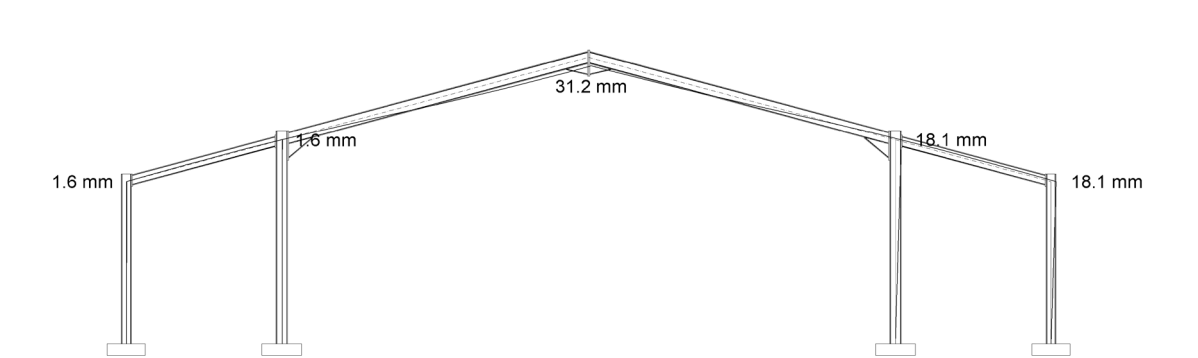
Shear Force Diagram



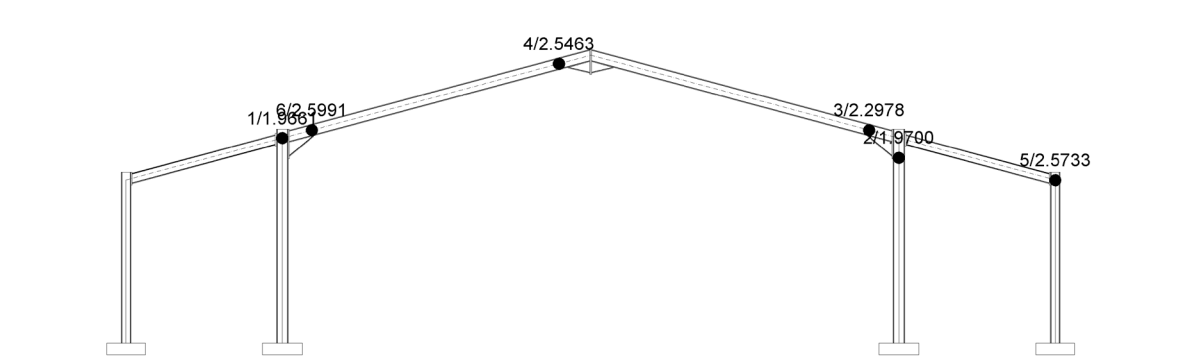
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Combination 5
Sections

Member	Section	Grade	Length	Mass	Weight	Mp	Mpr	UR
Span 1 Lh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.037
Span 1 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.359
Span 1 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.1	0.393
Span 2 Lh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.4	0.443
Span 2 Rh Rafter	UKB 203x133x30	S275	5.616	30.00	168.47	86.5	86.4	0.442
Span 2 Rh Column	UKB 203x133x30	S275	3.600	30.00	107.98	86.5	86.1	0.393
Span 3 Mono Rafter	UKB 178x102x19	S275	2.847	19.05	54.22	47.1	47.1	0.358
Span 3 Rh Column	UKB 178x102x19	S275	2.863	19.05	54.53	47.1	47.1	0.087
Total Rafter					445.38			
Total Column					325.02			
Total Haunch					27.86			
Total					798.26			

Hinge History
Hinge History

Event	Lambda 1st Order	Lambda 2nd Order	Status	Member	Distance(B)	Distance(A)	Status
Event 1	2.2548	-	Formed	Span 2 Lh Rafter	0.542	0.542	
Event 2	2.2568	-	Formed	Span 2 Rh Rafter	0.542	0.542	
Event 3	2.4806	-	Formed	Span 2 Lh Rafter	5.175	5.175	
Event 4	2.5137	-	Formed	Span 1 Rh Column	3.256	3.256	
Event 5	2.5137	-	Formed	Span 2 Rh Column	3.256	3.256	
Event 6	2.6933	-	Formed	Span 1 Lh Column	2.863	2.863	Warning

Strength Rafters

Member	U.R.	Status
Span 1 Mono Rafter	0.359	Pass
Span 2 Lh Rafter	0.442	Pass
Span 2 Rh Rafter	0.442	Pass
Span 3 Mono Rafter	0.358	Pass

Columns

Member	U.R.	Status
Span 1 Lh Column	0.087	Pass
Span 1 Rh Column	0.391	Pass
Span 2 Rh Column	0.391	Pass
Span 3 Rh Column	0.087	Pass

Haunches

Member	U.R.	Status
Span 2 Lh Rafter Lh Eaves	0.342	Pass
Span 2 Lh Rafter Lh Apex	0.255	Pass
Span 2 Rh Rafter Rh Eaves	0.342	Pass
Span 2 Rh Rafter Rh Apex	0.255	Pass

Serviceability

Span	Status	Lh Eaves(H)	Lh Apex(V)	Apex(V)	Rh Apex(V)	Rh Eaves(H)
Span 1	Pass	-8.7/28.6	na	na	na	-8.7/36.0
Span 2	Pass	-8.7/36.0	na	32.6/54.3	na	8.6/36.0
Span 3	Pass	8.6/36.0	na	na	na	8.7/28.6

Frame Stability

None

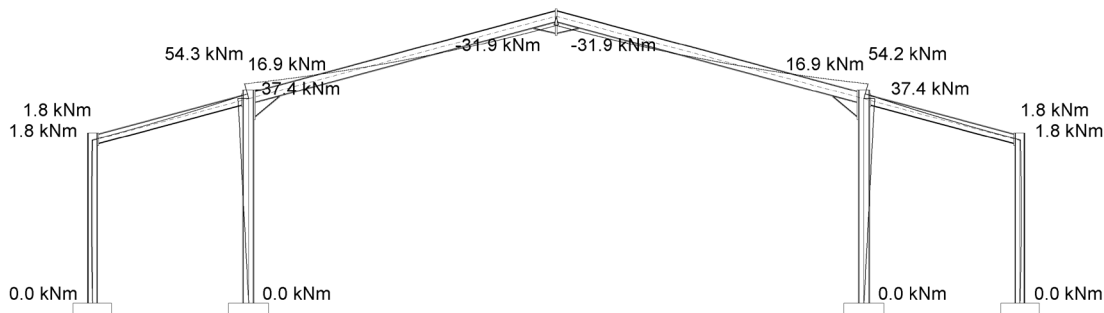
Base Loads

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	5.0	10.4
Span 1 Rh Column	0.0	10.4	48.0
Span 2 Rh Column	0.0	-10.4	48.0
Span 3 Rh Column	0.0	-5.0	0.3

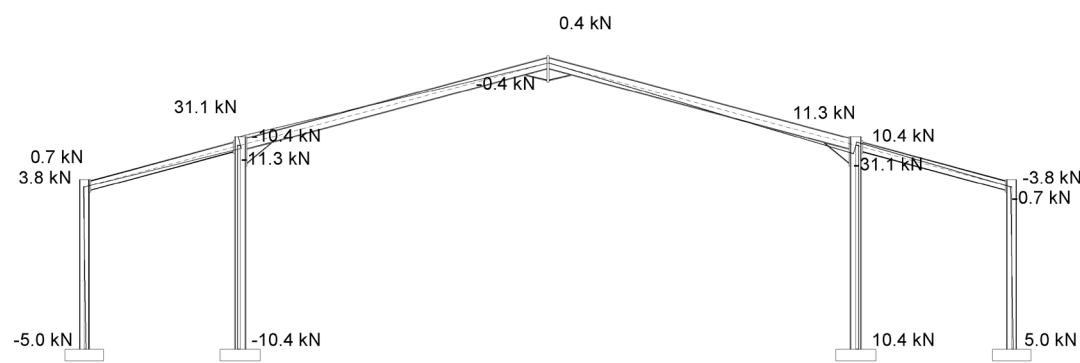
Connection Forces

Span	Mf [kNm]	Ff [kN]	Nf [kN]	Mh [kNm]	Fh [kN]	Nh [kN]
Span 1 Lh Eaves	1.7	-0.7	-3.9	-	-	-
Span 1 Rh Eaves	16.9	-13.3	-6.0	-	-	-
Span 2 Lh Eaves	51.0	32.8	4.3	38.2	28.1	11.7
Span 2 Lh Apex	-31.9	0.0	1.7	-31.6	2.0	2.5
Span 2 Rh Apex	-31.9	0.0	1.7	-31.6	2.0	2.5
Span 2 Rh Eaves	50.9	32.8	4.3	38.2	28.1	11.7
Span 3 Lh Eaves	15.7	12.8	-6.0	-	-	-
Span 3 Rh Eaves	1.8	0.3	-3.8	-	-	-

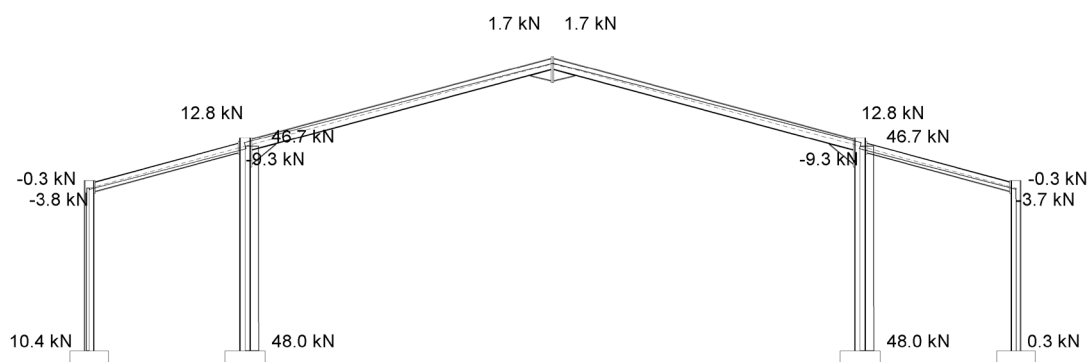
Bending Moment Diagram



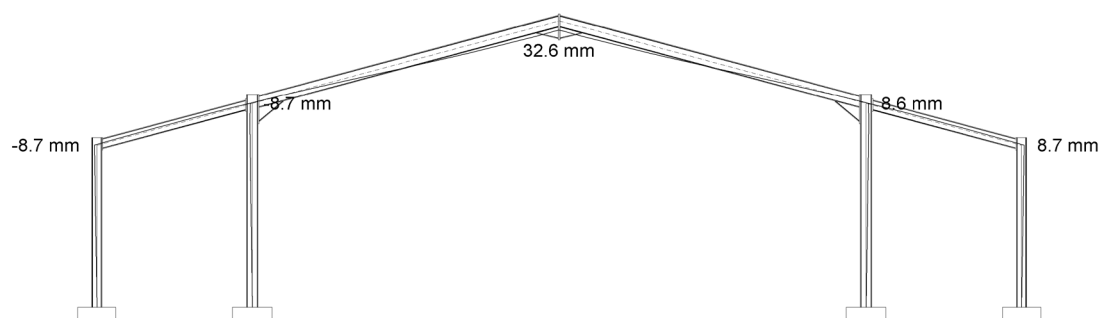
Shear Force Diagram



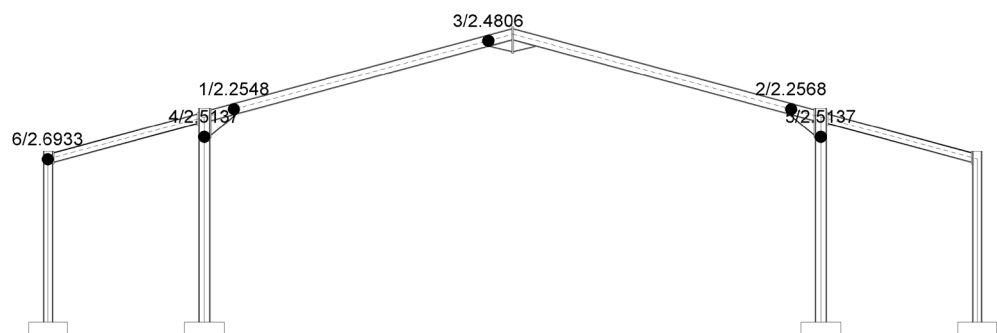
Axial Load Diagram



Deflected Shape Diagram



Hinge History Diagram



Foundation Loads

Self weight

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	0.1	0.6
Span 1 Rh Column	0.0	0.5	3.2
Span 2 Rh Column	0.0	-0.5	3.2
Span 3 Rh Column	0.0	-0.1	0.6

Frame Dead Load

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	0.4	9.7
Span 1 Rh Column	0.0	2.9	14.2
Span 2 Rh Column	0.0	-2.9	14.2
Span 3 Rh Column	0.0	-0.4	1.3

Frame Service Load

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	0.1	0.4
Span 1 Rh Column	0.0	1.0	4.7
Span 2 Rh Column	0.0	-1.0	4.7
Span 3 Rh Column	0.0	-0.1	0.4

Frame Imposed Load

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	0.8	2.6
Span 1 Rh Column	0.0	5.7	28.4
Span 2 Rh Column	0.0	-5.7	28.4
Span 3 Rh Column	0.0	-0.8	2.6

SLS, Wind: Side Left, Cpi 0.2000, Roof Cpe -ve

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	-4.6	-8.2
Span 1 Rh Column	0.0	-7.0	-23.1
Span 2 Rh Column	0.0	2.0	-32.8
Span 3 Rh Column	0.0	-5.0	-2.9

SLS, Wind: Side Left, Cpi -0.3000, Roof Cpe -ve

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	-7.4	-4.1
Span 1 Rh Column	0.0	-3.9	-5.6
Span 2 Rh Column	0.0	-1.1	-15.3
Span 3 Rh Column	0.0	-2.2	1.2

SLS, Wind: Gable End Top, Cpi 0.2000, Roof Cpe -ve

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	5.7	-8.7
Span 1 Rh Column	0.0	-4.5	-28.0
Span 2 Rh Column	0.0	4.5	-28.0
Span 3 Rh Column	0.0	-5.7	-8.7

SLS, Wind: Gable End Top, Cpi -0.3000, Roof Cpe -ve

Span	M [kNm]	F [kN]	N [kN]
Span 1 Lh Column	0.0	2.9	-4.6
Span 1 Rh Column	0.0	-1.3	-10.5
Span 2 Rh Column	0.0	1.3	-10.5
Span 3 Rh Column	0.0	-2.9	-4.6

DESIGN SUMMARY:

A summary of the result is as follows:

Ultimate Limit State:

Existing Frame

Columns at 58% section capacity

Rafters at 66% section capacity

Serviceability Limit State:

Existing Frame

The total existing vertical deflection at the ridge is 37.1mm. => (span/292)

Dead load deflection is 10.5mm. => (span/1033)

Imposed load deflection is 26.6mm. => (span/407)

The total horizontal deflection at the eaves is 18.1mm => (height/199)

Foundation Loads

Existing 77.8 kN

Ultimate Limit State:

Proposed Frame

Columns at 57% section capacity

Rafters at 65% section capacity

Serviceability Limit State:

Proposed Frame

The total existing vertical deflection at the ridge is 37.1mm. => (span/292)

Dead load deflection is 15.8mm. => (span/686)

Imposed load deflection is 21.3mm. => (span/508)

The total horizontal deflection at the eaves is 18.1mm => (height/199)

Foundation Loads

Proposed 76.4 kN

Based on a BP of 90 kN/m² this equates to a 900sq Mass concrete base which is reasonable.

From the design it can be seen that the sections are comfortably within their design capacity and the portal frame members will be adequately restrained for member stability.

Connections are structurally satisfactory

The deflections of the portal frame are well within acceptable limits for its intended use.

Existing Ground Floor Loading is as follows:

The existing ground floor is a 150 thick concrete slab over hardcore sub-base.

An allowable increase in bearing pressure of 15 kN/m² could be adopted giving a safe design floor slab loading of 10kN/m²

Ground Floor Imposed Load	10.00 kN/m ²
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TOTAL EXISTING LOAD:	<u>10.00 kN/m²</u>
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Proposed Ground Floor Loading is as follows:

Screed	1.20 kN/m ²
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Insulation	0.05 kN/m ²
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Concrete capping	1.20 kN/m ²
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Partition Load (Including Ceiling Load)	1.50 kN/m ²
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Ground Floor Imposed Load	
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Residential	1.50 kN/m ²
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TOTAL PROPOSED LOAD:	<u>5.45 kN/m²</u>
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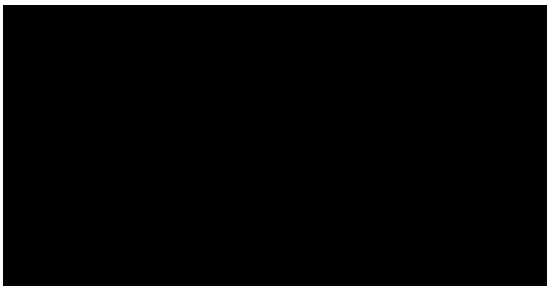
CONCLUSION:

The existing chicken shed structural framework is in good condition and has been sized to give a strong robust structure unlike many farm buildings.

The proposed alteration works within the existing building envelope will not alter the structures stability and stiffness and deflections will be within acceptable limits for it intended use.

Existing ground bearing concrete slab is in good condition and structurally acceptable to be retained and used as existing.

We can confirm that the existing structure is structurally satisfactory for its intended change of use from a farm shed to a residential building with limited building operations other than the installation of windows, doors, roof and exterior walls..



Roger Oliver BSc. CEng. MStructE
Roger Oliver Consulting Engineers Ltd - Report 12-10-2022