SNOW LOAD CALCULATION RESULT

Snow Load：150kg/m2

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Chapter Ⅰ Project Overview

1.1 Basic Situation of Project

The horizontal projection area is approximately 135m2, 15m long, 9m wide and column height 3m. The structural style is Door-type Steel Support Structure. Roof beam:口 120x60x3, end span beam: 口 120x60x3, middle span beam: 口 140x80x4, roof purlin: 口 60x40x1.8, all of them are Q235B steel.

Chapter II Design Basis

2.1 Design Resources

The construction side provides the design task book and specific requirements.

2.2 Design Specifications

1	Unified standard for reliability design of building structures	GB50068-2001
2	Construction Engineering seismic classification	GB50223-2008
3	Building structural load specification	GB50009-2012
4	Design of steel structures	GB50017-2003
5	Quality Acceptance of Steel Structure Engineering	GB50205-2001
6	Portal rigid frame light house technical specification for steel structure	CECS102-2012
7	Standard for structural drawing	GB/T 50105-2001

Chapter III Design Conditions and Parameters

3.1 The Choice of Main Structural Material

3.1.1 Steel

The main structure steel is Q235B. Its chemical composition and mechanical properties should be consistent with requirements of "carbon steel" (GB / T700).

Physical properties of the steel

Steel Types	Modulus of Elasticity E (N/mm^2)	Shear Modulus G (N/mm^2)	Coefficient of Linear Expansion α (1/℃)	Mass Density ρ (kg/m^3)
Steel & Cast Steel	2.06x105	0.79x105	1.20x10-5	7.85x103

Steel intensity design value

Marks	Thickness or Diameter(mm)	Tensile Strength, Crush Resistance, Bending Resistance f	Shearing Resistance f_v	Bearing Stress (planning and top tight) f_{ce}	Nominal Yield Strength of Steel f_y	Minimum Value of Ultimate Tensile Strength f_u
Q235	≤16	215	125	325	235	370
	>16~40	205	120		225	370
	>40~60	200	115		215	370
	>60~100	200	115		205	370

3.2 Load

The design loads are mainly based on Chinese "structural design load" GB50009-2012 and specifications provided by the construction side. The load values are as follows:

3.2.1 Load Value

Constant load standard value：0. 15kN/m^2

The weight of structural parts is calculated automatically by the software

Standard snow load values: 1.5 kN / m^2, coefficient for combination value: 0.7, distribution factor of snow pressure: 0.85.

3.2.2 Load Combinations

1)1.2D+1.4L

2)1.35D+0.98L

3)1.0D+1.0L

D -constant load, L- snow load

3.3 Control Standards

Design working life: 25 years

Structure importance factor: 0.9

3.3.1 Deformation Limit Value

Building (House) cover beam or truss, working platform beams (except for item 3) and platform boards Main beam or truss (including lifting equipment has suspended beams and trusses) Supporting only bearing metal roofing and cold-formed steel purlins In addition to the support bearing metal roofing and cold-formed steel purlins, have ceiling Plaster ceiling girders In addition to (1), (2) other beams (including beams stairs) Roof purlins Supporting bearing metal plate, without fouling of corrugated iron and asbestos roofing Supporting fouling of corrugated iron and asbestos roofing Supporting other roofing materials Have ceiling	$l/400$ $l/180$ $l/240$ $l/250$ $l/250$ $l/150$ $l/200$	$l/500$ $l/350$ $l/300$ — — —

3.3.2 Limit Slenderness Ratios

component classification	rafter	upright
compression parts	150	150

3.3.3 Stress Ratio Limit

component classification	rafter	upright
stress ratio limit	1.0	1.0

Chapter IV Steel Structure Design

4.1 Calculation Software

The procedures of engineering calculation and analysis were calculated by series program of SAP (Structure Analysis Program) initiated by Edwards Wilson, sap2000, version V15.1.1. Roof purlins were calculated by PKPM-STS （V2012.06）

4.2 Steel Structure Calculation and Analysis

4.2.1 Calculation Model

Place	Dimension	Place	Dimension
Rafter	口 120x60x3	Upright	口 120x60x3
			口 140x80x4

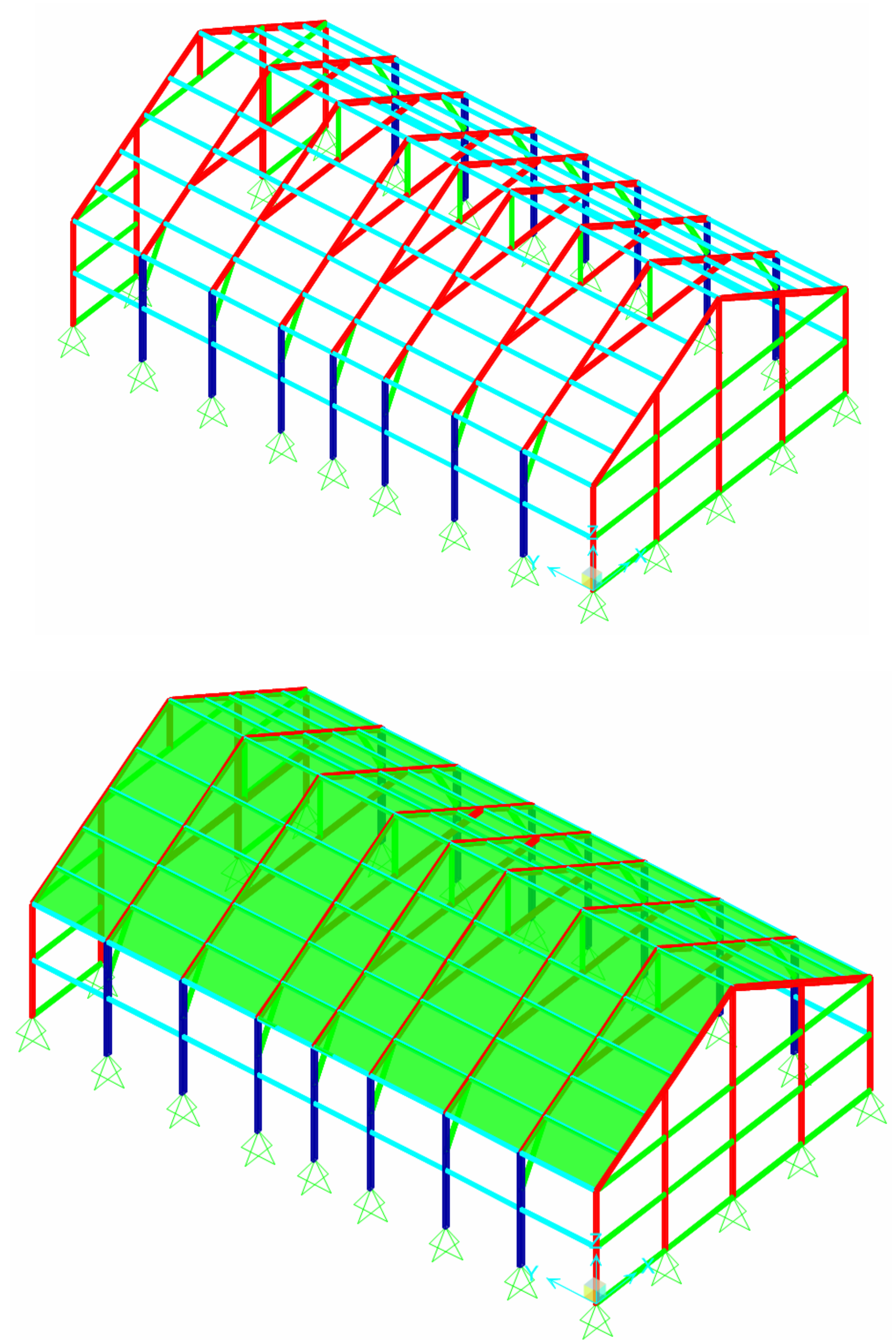


Figure 4.2.1 3D view of model

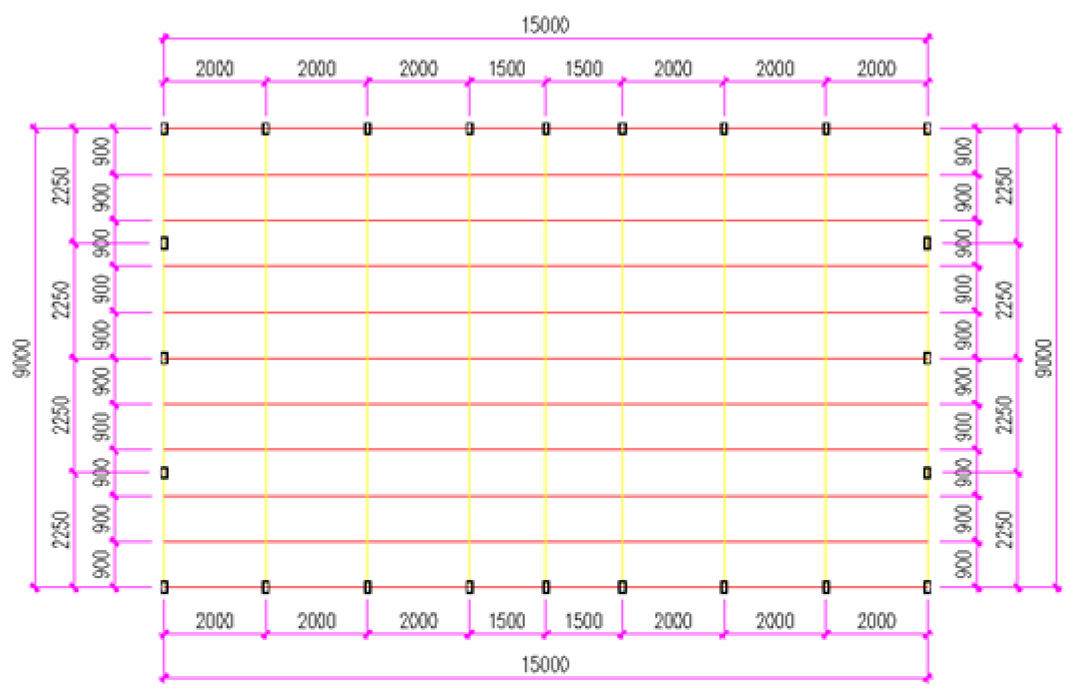
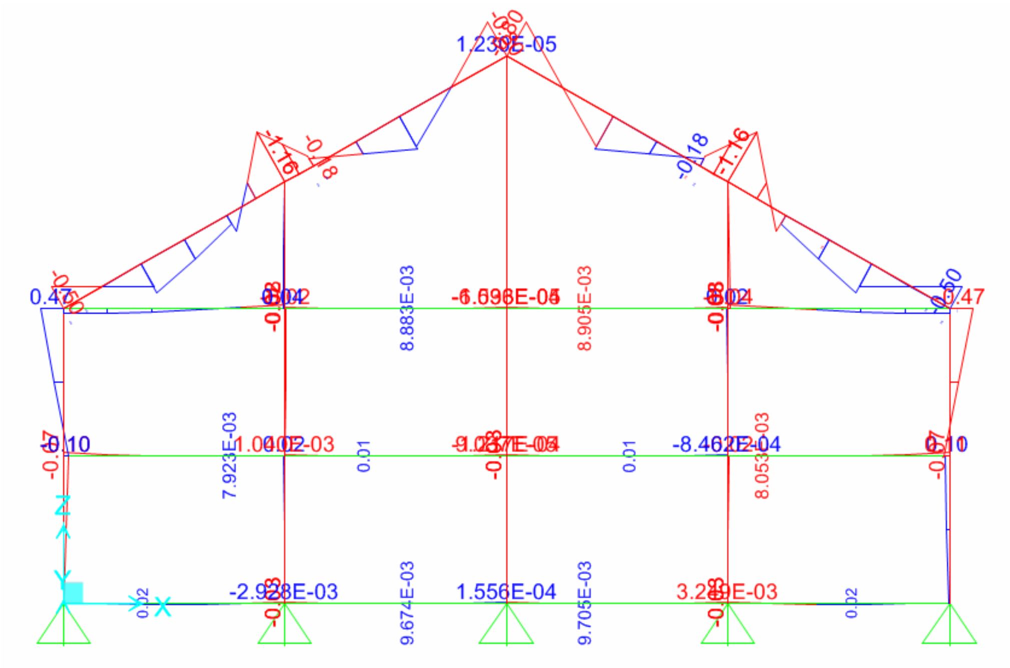


Figure 4.2.2 Architecture floor plan and dimensions

4.2.2 Internal Forces Analysis



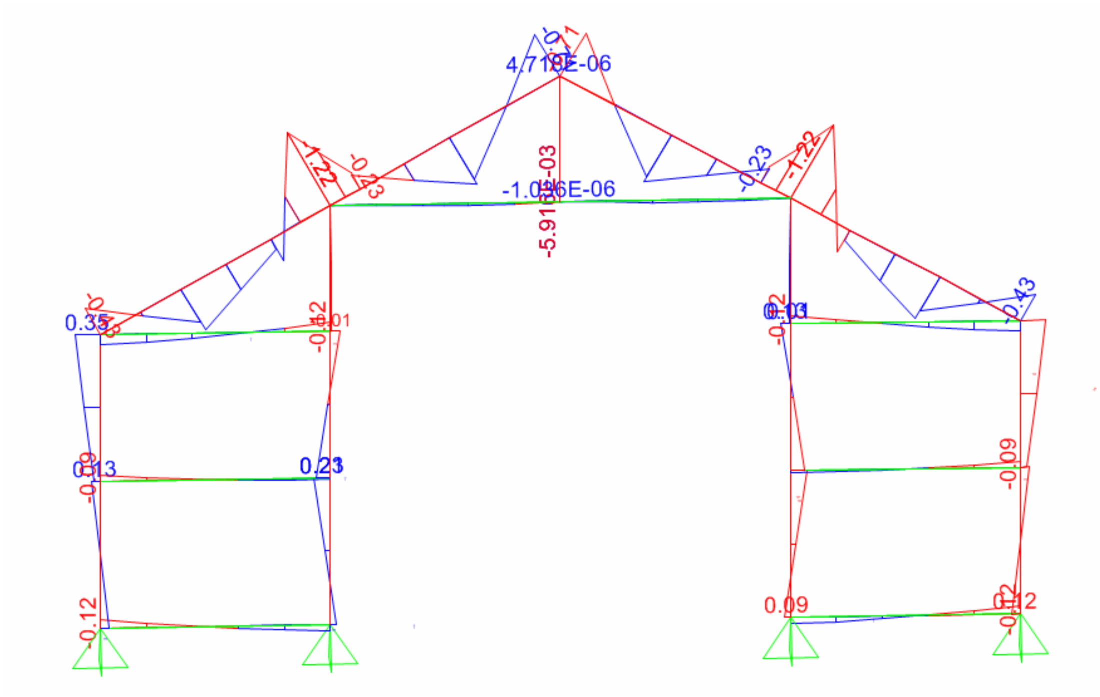


Figure 4.2.3 End arch bending moment

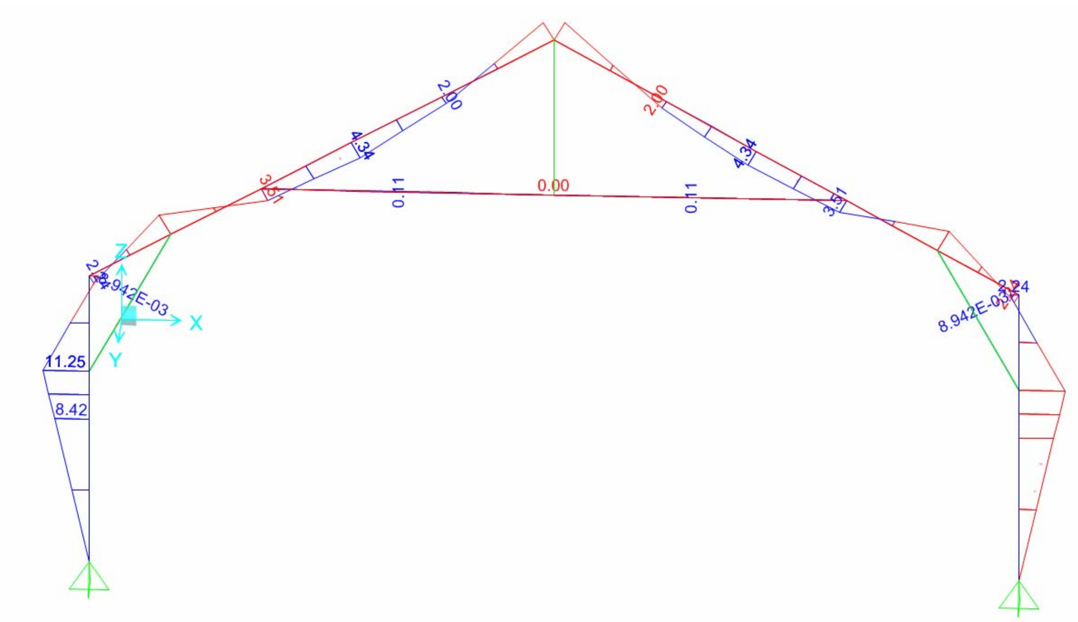


Figure 4.2.4 Middle arch bending moment

4.2.3 Structural Deformation Analysis

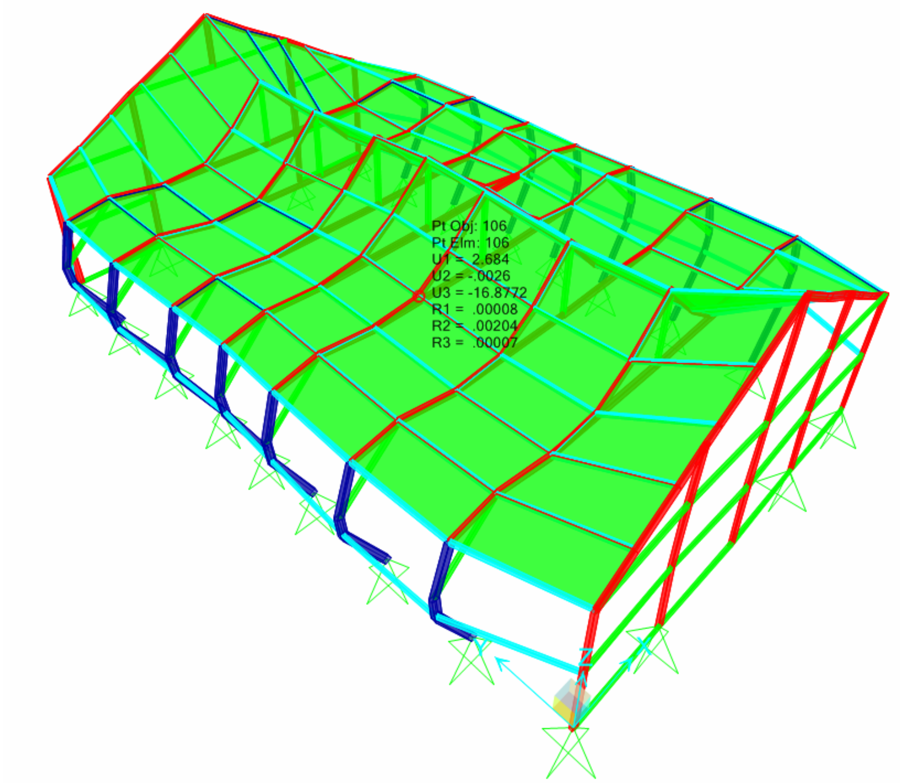


Figure 4.2.5 Overall deformation

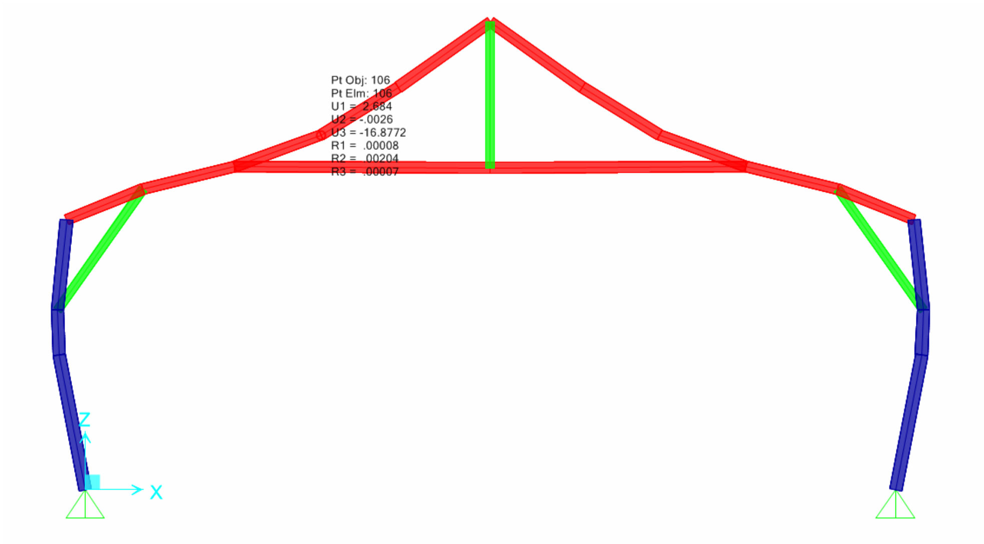


Figure 4.2.6 Single arch deformation

Under the effect of standard combination 1.0D + 1.0L, the maximum vertical displacement of the structure is 1/603＜1/400, can meet the normal requirements.

4.2.4 Stress Ratio Analysis

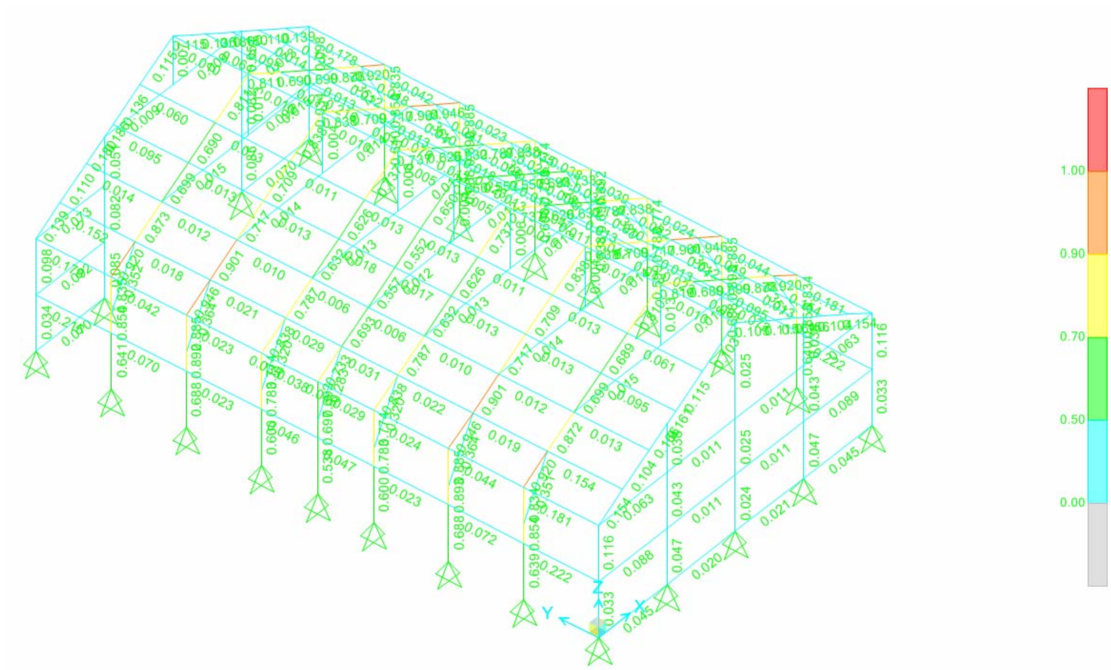


Figure 4.2.3 Stress ratio of overall model

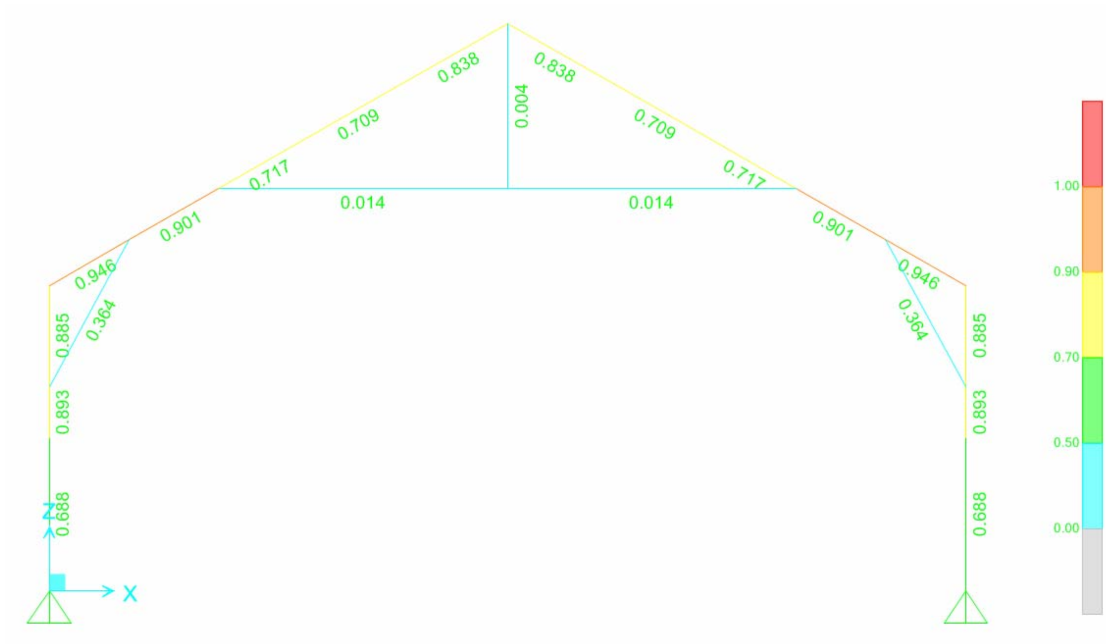
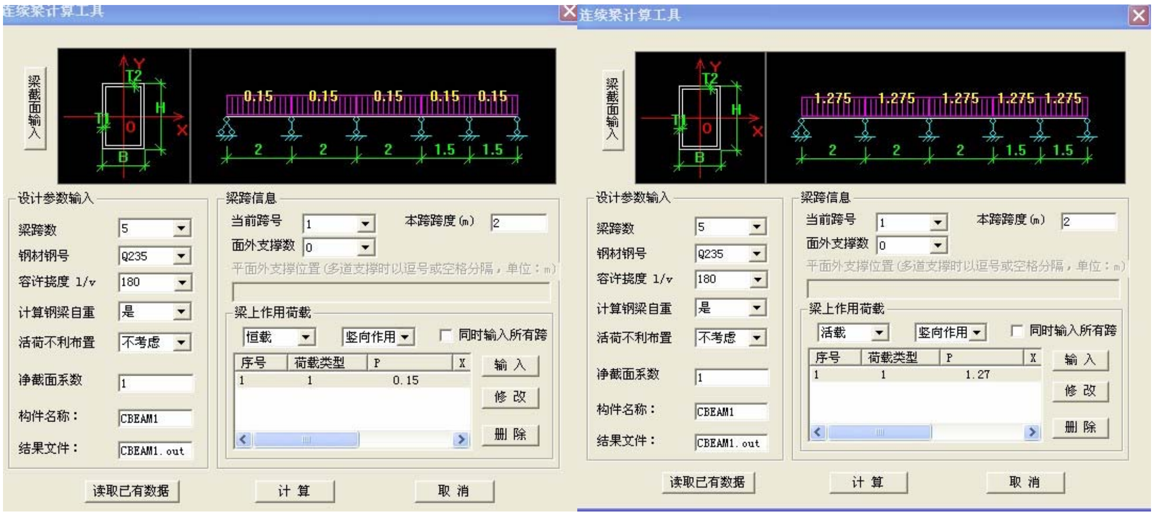


Figure 4.2.4 Stress ratio of single arch

Thus, the stress ratio of rafter and upright is less than 1.0, can meet the design requirements

4.2.5 Stress Ratio Analysis for Purlins



----- Design information-----

Steel：Q235

Allowable deflection limit [υ]: 1 / 180

Factor of net-section strength calculation: 1.000

Beam own weight calculation: Calculation

Live load mode of action: one-time loading

Factor of net-section strength calculation: 1.000

Rafter cross section: box-section:

B * H * T1 * T2 = 40 * 60 * 1.8 * 1.8

Information of each arch:

Arch number:	1	2	3	4	5
Span (m):	2.00	2.00	2.00	1.50	1.50
The outer face of the support	0	0	0	0	0

----- Design Basis -----

"Steel Design Code" (GB 50017-2003)

----- Steel beam function and checking-----

1, Section properties calculation

A = 3.4704e-004; Ix = 1.7580e-007; Iy = 9.3326e-008;

Wx1 = 5.8600e-006; Wx2 = 5.8600e-006; Wy1 = 4.6663e-006; Wy2 = 4.6663e-006;

2, Steel beam load

△ Dead load

Arch No.	Direction	Load Type	Load Value1	Load Parameter 1	Load Parameter 2	Load Value 2
1	vertical	1	0.15	0.00	0.00	0.00
2	vertical	1	0.15	0.00	0.00	0.00
3	vertical	1	0.15	0.00	0.00	0.00
4	vertical	1	0.15	0.00	0.00	0.00
5	vertical	1	0.15	0.00	0.00	0.00

Steel weight conversion line (KN/m): 0.0272;

△ Live load

Arch No.	Direction	Load Type	Load Value1	Load Parameter 1	Load Parameter 2	Load Value 2
1	vertical	1	1.27	0.00	0.00	0.00
2	vertical	1	1.27	0.00	0.00	0.00
3	vertical	1	1.27	0.00	0.00	0.00
4	vertical	1	1.27	0.00	0.00	0.00
5	vertical	1	1.27	0.00	0.00	0.00

△ Wind load

Arch No.	Direction	Load Type	Load Value1	Load Parameter 1	Load Parameter 2	Load Value 2

3. Load effect combination

△ Basic combination

△ Group 1：1.2 dead load + 1.4 live load

△ Group 2：1.2 dead load + 1.4 live load + 0.6×1.4 wind load

△ Group 3：1.2 dead load + 0.7×1.4 live load + 1.4 wind load

△ Group 4：1.35 dead load + 0.7×1.4 live load

△ Standard combination

△ Group 5：1.0 dead load + 1.0 live load

4. The calculation of strength and stability for arch No.1

An upper tension (negative moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = -0.835; My = 0.000 (Group 1)

Negative Bending Strength Calculation of maximum stress (N / mm2): 135.629 <f = 215.000

The negative moment strength calculation of arch No.1 meets the requirements.

The lower portion of tensile (positive moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = 0.623; My = 0.000 (Group 1)

Positive moment strength calculation of maximum stress (N / mm2): 101.312 <f = 215.000

The positive moment calculation of arch No.1 meets the requirements.

Cross-checking the upper flange pressure stability control internal forces (kN.m): Mx = 0.623; My = 0.000 (Group 1)

Overall stability factor flexural member: φb = 1.000

Stable calculate the maximum stress (N / mm2): 106.377 <f = 215.000

The upper flange pressure stability calculation of arch No.1 meets the requirements.

Shear checking control internal forces (kN): V = 2.415 (Group 1)

Stable calculate the maximum stress (N / mm2): 24.222 <f = 125.000

The shearing strength calculation of arch No.1 meets the requirements.

5. The calculation of strength and stability for arch No.2

An upper tension (negative moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = -0.835; My = 0.000 (Group 1)

Negative Bending Strength Calculation of maximum stress (N / mm2): 135.629 <f = 215.000

The negative moment strength calculation of arch No.2 meets the requirements.

The lower portion of tensile (positive moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = 0.253; My = 0.000 (Group 1)

Positive moment strength calculation of maximum stress (N / mm2): 41.111 <f = 215.000

The positive moment calculation of arch No.2 meets the requirements.

Cross-checking the upper flange pressure stability control internal forces (kN.m): Mx = 0.253; My = 0.000 (Group 1)

Overall stability factor flexural member: φb = 1.000

Stable calculate the maximum stress (N / mm2): 43.166 <f = 215.000

The upper flange pressure stability calculation of arch No.2 meets the requirements.

Shear checking control internal forces (kN): V = 2.086 (Group 1)

Stable calculate the maximum stress (N / mm2): 20.926 <f = 125.000

The shearing strength calculation of arch No.2 meets the requirements.

6. The calculation of strength and stability for arch No.3

An upper tension (negative moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = -0.657; My = 0.000 (Group 1)

Negative Bending Strength Calculation of maximum stress (N / mm2): 106.816 <f = 215.000 3.

The negative moment strength calculation of arch No.3 meets the requirements.

The lower portion of tensile (positive moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = 0.404; My = 0.000 (Group 1)

Positive moment strength calculation of maximum stress (N / mm2): 65.705 <f = 215.000

The positive moment calculation of arch No.3 meets the requirements.

Cross-checking the upper flange pressure stability control internal forces (kN.m): Mx = 0.404; My = 0.000 (Group 1)

Overall stability factor flexural member: φb = 1.000

Stable calculate the maximum stress (N / mm2): 68.990 <f = 215.000

The upper flange pressure stability calculation of arch No.3 meets the requirements.

Shear checking control internal forces (kN): V = 2.060 (Group 1)

Stable calculate the maximum stress (N / mm2): 20.666 <f = 125.000

The shearing strength calculation of arch No.3 meets the requirements.

7. The calculation of strength and stability for arch No.4

An upper tension (negative moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = -0.532; My = 0.000 (Group 1)

Negative Bending Strength Calculation of maximum stress (N / mm2): 86.441 <f = 215.000

The negative moment strength calculation of arch No.4 meets the requirements.

The lower portion of tensile (positive moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = 0.081; My = 0.000 (Group 1)

Positive moment strength calculation of maximum stress (N / mm2): 13.241 <f = 215.000

The positive moment calculation of arch No.4 meets the requirements.

Cross-checking the upper flange pressure stability control internal forces (kN.m): Mx = 0.081; My = 0.000 (Group 1)

Overall stability factor flexural member: φb = 1.000

Stable calculate the maximum stress (N / mm2): 13.903 <f = 215.000

The upper flange pressure stability calculation of arch No.4 meets the requirements.

Shear checking control internal forces (kN): V = 1.567 (Group 1)

Stable calculate the maximum stress (N / mm2): 15.717 <f = 125.000

The shearing strength calculation of arch No.4 meets the requirements.

8. The calculation of strength and stability for arch No.5

An upper tension (negative moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = -0.429; My = 0.000 (Group 1)

Negative Bending Strength Calculation of maximum stress (N / mm2): 69.702 <f = 215.000

The negative moment strength calculation of arch No.5 meets the requirements.

The lower portion of tensile (positive moment zone) strength checking:

Strength checking calculation control internal forces (kN.m): Mx = 0.368; My = 0.000 (Group 1)

Positive moment strength calculation of maximum stress (N / mm2): 59.733 <f = 215.000

The positive moment calculation of arch No. 5 meets the requirements.

Cross-checking the upper flange pressure stability control internal forces (kN.m): Mx = 0.368; My = 0.000 (Group 1)

Overall stability factor flexural member: φb = 1.000

Stable calculate the maximum stress (N / mm2): 62.720 <f = 215.000

The upper flange pressure stability calculation of arch No.5 meets the requirements.

Shear checking control internal forces (kN): V = 1.784 (Group 1)

Stable calculate the maximum stress (N / mm2): 17.896 <f = 125.000

The shearing strength calculation of arch No.5 meets the requirements.

9. Continuous steel beam deflection checking

Checking Group: 5

The maximum deflection of arch No.1 (mm): 4.187

The maximum deflection of arch No.1 (mm): 4.187 (L / 478) <allowable deflection: 11.111

The calculation for deflection for arch No.1 meets the requirements.

The maximum deflection of arch No.2 (mm): 0.822

The maximum deflection of arch No.2 (mm): 0.822 (L / 2434) <allowable deflection: 11.111

The calculation for deflection for arch No.2 meets the requirements.

The maximum deflection of arch No.3 (mm): 2.340

The maximum deflection of arch No.3 (mm): 2.340 (L / 855) <allowable deflection: 11.111

The calculation for deflection for arch No.3 meets the requirements.

The maximum deflection of arch No.4 (mm): 0.000

The maximum deflection of arch No.4 (mm): 0.000 (L / 1) <allowable deflection: 8.333

The calculation for deflection for arch No.4 meets the requirements.

The maximum deflection of arch No.5 (mm): 1.430

The maximum deflection of arch No.5 (mm): 1.430 (L / 1049) <allowable deflection: 8.333

The calculation for deflection for arch No.5 meets the requirements.

****** The calculation for continuous steel beam meets the requirements. *****

4.2.6 Steel consumption statistics

Parts	consumption（kN）
Rafter	10.9
Upright	8.54
Purlin	8.96
Total	28.4