INDIAN INSTITUTE OF TECHNOLOGY

PATNA

GROUP :03

SESSION:2024-2025

STEEL STRUCTURE PROJECT REPORT

FINK TRUSS

Course: CE320 – Steel Structures

Department: Civil Engineering

PROJECT TITLE:

FINK TRUSS ANALYSIS

GROUP :03

Group Members

Name	**Roll Number**
Khushboo	2201CE26
Khushboo	2201CE25
Ratan Priya	2201CE51
Sakshi Priya	2201CE55
Kumar Anurag	2201CE27
Harsh Srivastav	2201CE19
Aditya Anand	2201CE05
Priyanshu Aryan	2201CE47

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OBJECTIVE

Designing an industrial building roof truss with the following features:

• Proposed location of the industrial building to be designed for 50 years of life – **Silchar.**

• Dimension of industrial shed – 60 m × 20 m

• Ceiling Height – 10 m (floor to roof truss bottom)

• Spacing of columns – 15 m (centre to centre)

• Spacing of trusses – not more than 5 m

• Rise of the roof truss – approx 4 m

• Truss type – Fink Truss

• Roof span – 20 m

• Yield strength of steel members = 250 MPa

• Wind speed – 55 m/s (Silchar falls in terrain category 1)

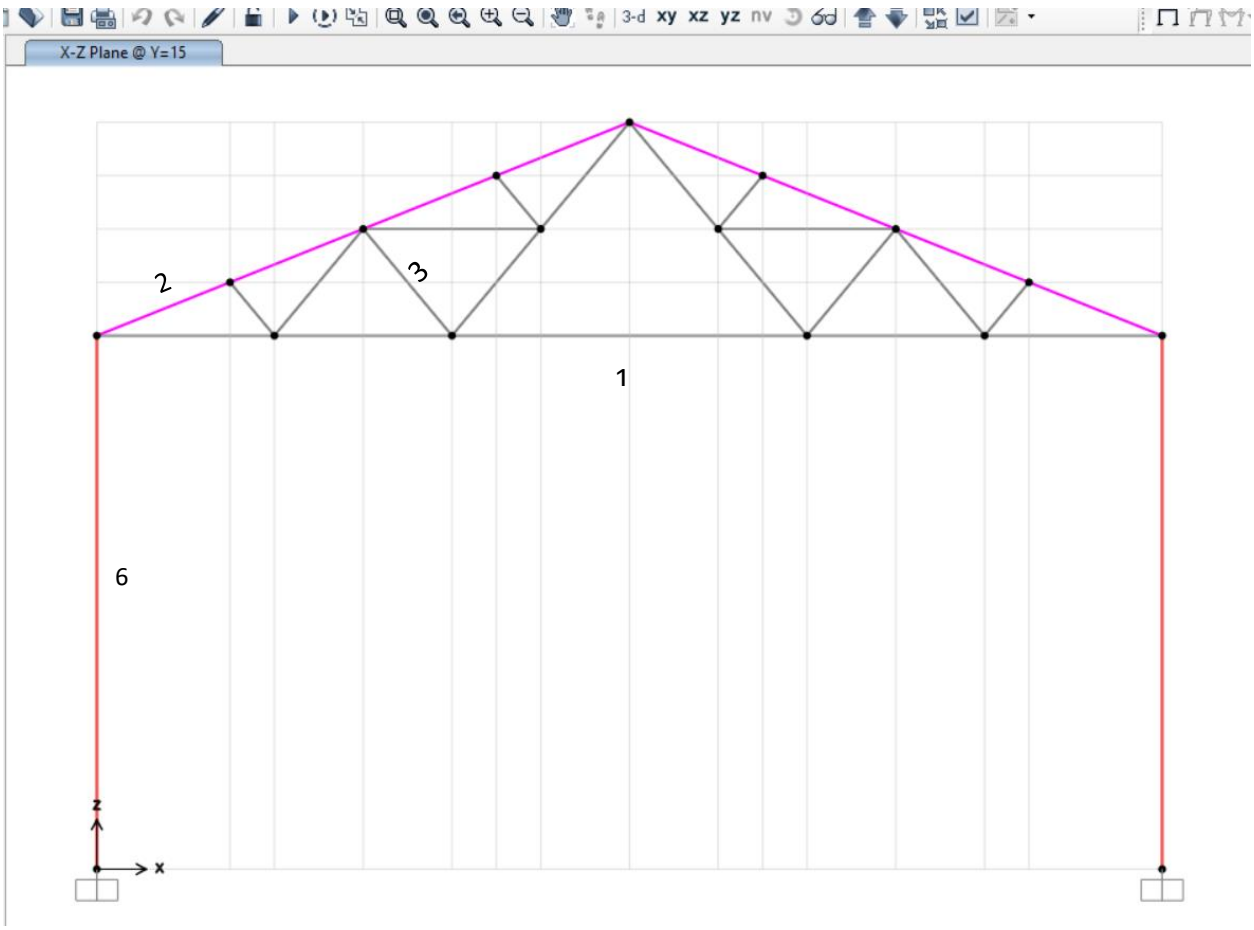
• Wind Pressure – 2.81 kN/m²

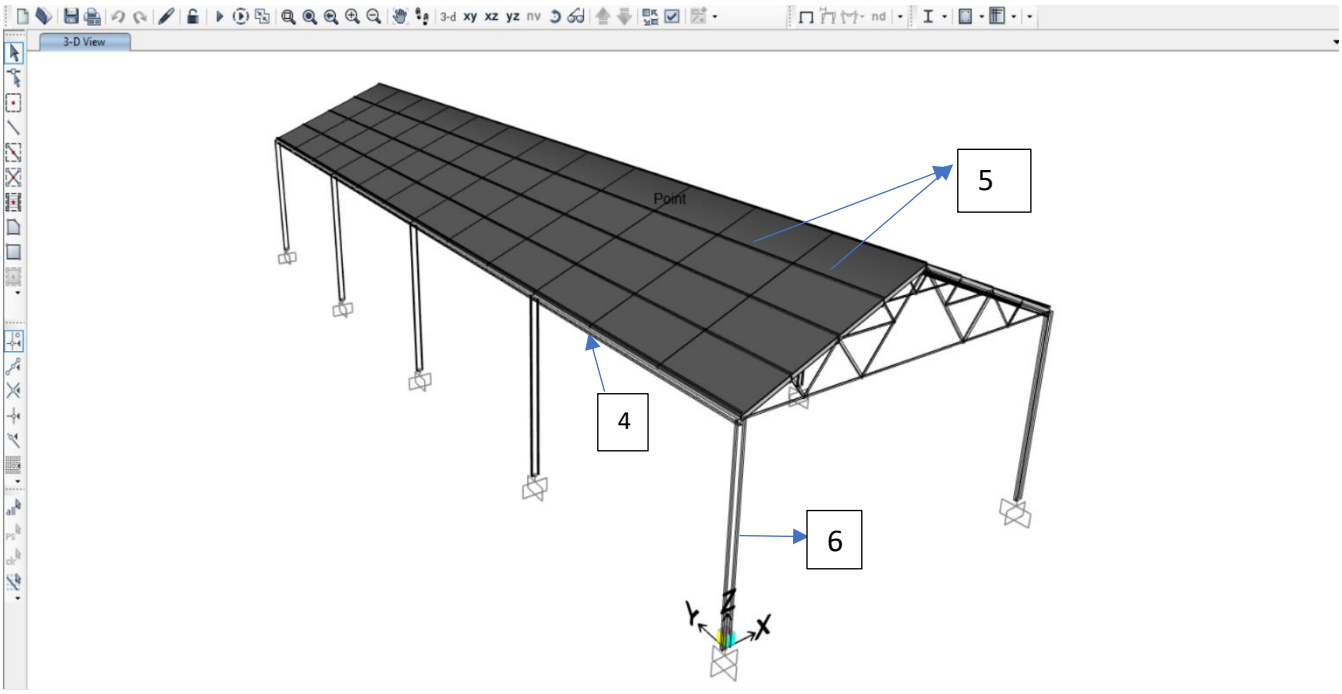
Load cases:

• **Dead load – 1.2 kN/m²**

• **Live load – 1 kN/m²**

- **2D & 3D View**
- **2D View of Fink Truss Geometry**





IS: 875(Part 3): Wind Loads on Buildings and Structures -Proposed Draft & Commentary

WIND LOAD CALCULATION

5.3 –Design Wind Speed (v_z) = v_bk1 k2 k3 k4,

Where,

Basic wind speed**, v_b =55m/s**

Vz = design wind speed at any height z in m/s,

k1 = 1, probability factor (risk coefficient) (5.3.1) (Mean Probable design life of structure in years, 50 years)

k2 = 1.082, terrain roughness and height factor, **Terrain category = 1** (5.3.2)

k3 = 1 topography factor (5.3.3)

k4 = 1.15 importance factor for the cyclonic region (5.3.4).

v_z = 1×1.082×1×1.15×55 **=68.4365m/s**

5.4 – Design Wind Pressure

P_z= 0.6v_z ^{2} = 0.6×(68.4365)^2

=2.81013KN/m^2

where

P_z = wind pressure in N/m2 at height z, and

v_z = design wind speed in m/s at height z.

The design wind pressure pd can be obtained as,

P_d = Kd. Ka. Kc. P_z = 0.9×0.9×1×2.81013 **= 2.276KN/m^2** where

Kd = 0.9 Wind directionality factor

Ka =0.9 Area averaging factor

Kc = 1 Combination factor (6.2.3.13)

Wind force (F):

F = (C_{Pe}– C_{Pi}) ×Ae×P_d α = 21.80°

h/w≤0.5

FOR C_{Pe};

For 0°		For 90°	
EF	**GH**	**EF**	**GH**
-0.328	**-0.4**	**-0.7**	**-0.6**

ForC_{Pi}:

For 0°	
EF	**GH**
±0.764	**±0.5**

So, $(C_{Pe} - C_{Pi})$: -

For 0°	
EF	**GH**
-1.092	**-0.9**

Perpendicular Distance between two purlin = **2.6925m*Cos(21.80°)= 2.4999 m**

F_w = Force in the windward direction per unit length

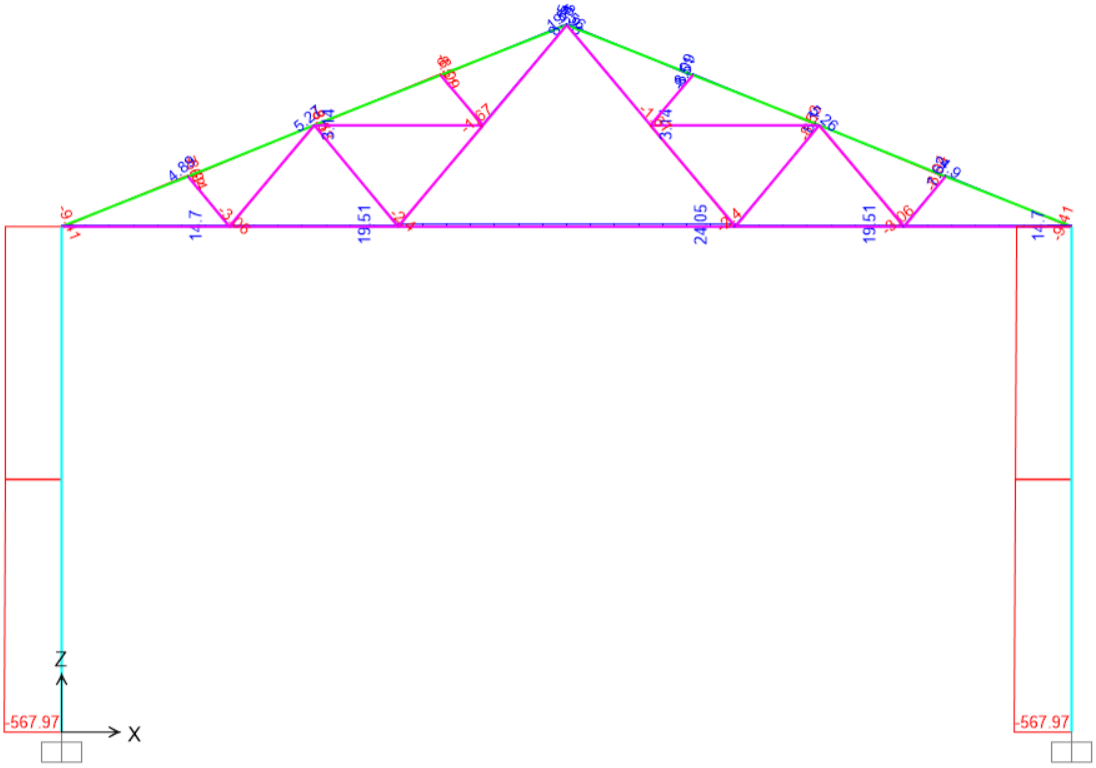
= -1.092 × 2.4999 × 2.276 **= -6.2133 KN/m**(governing)

F_w = Force in the Leeward direction per unit length

= -0.9 × 2.4999 × 2.276 **= 5.1208 KN/m**

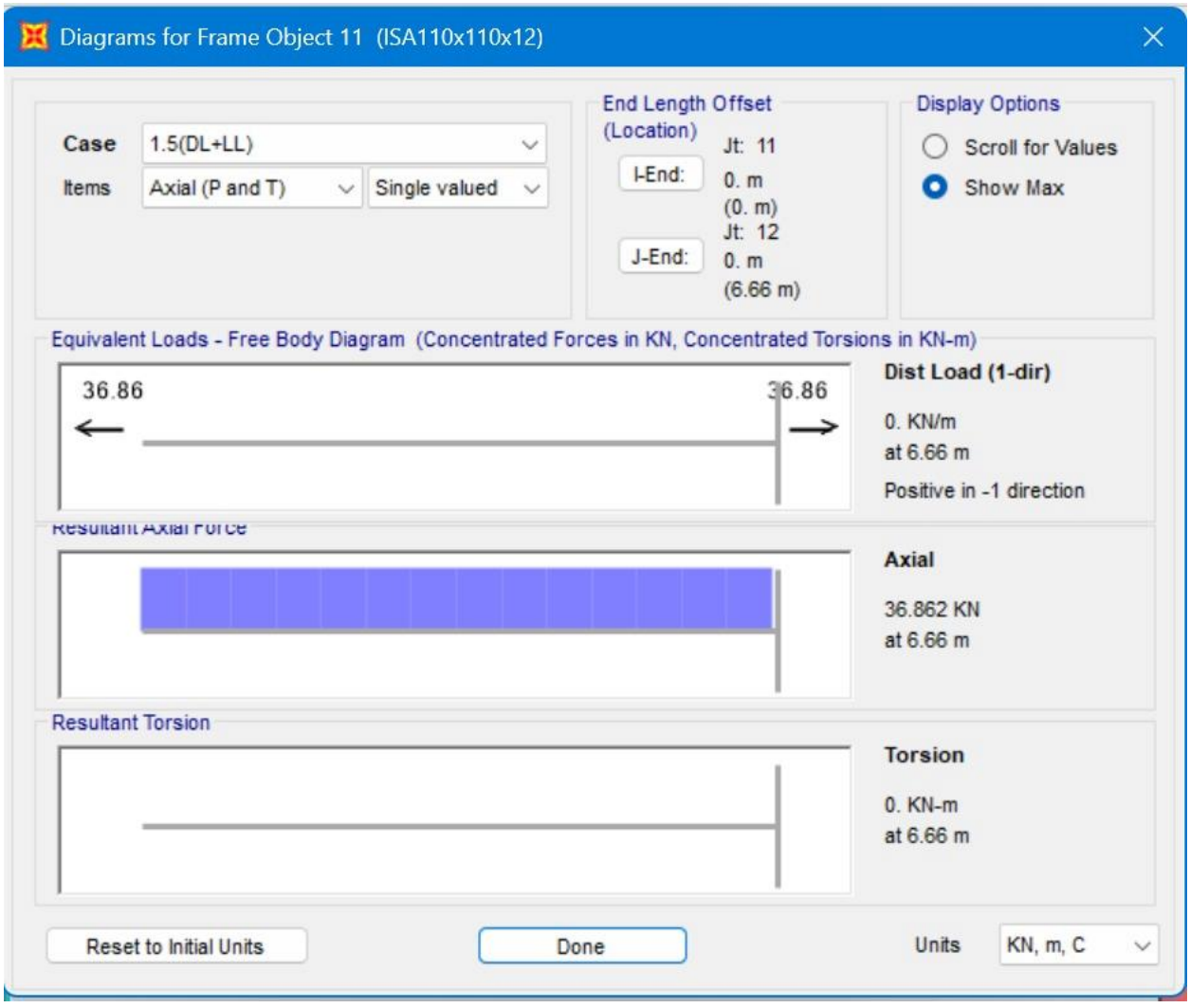
ANALYSIS

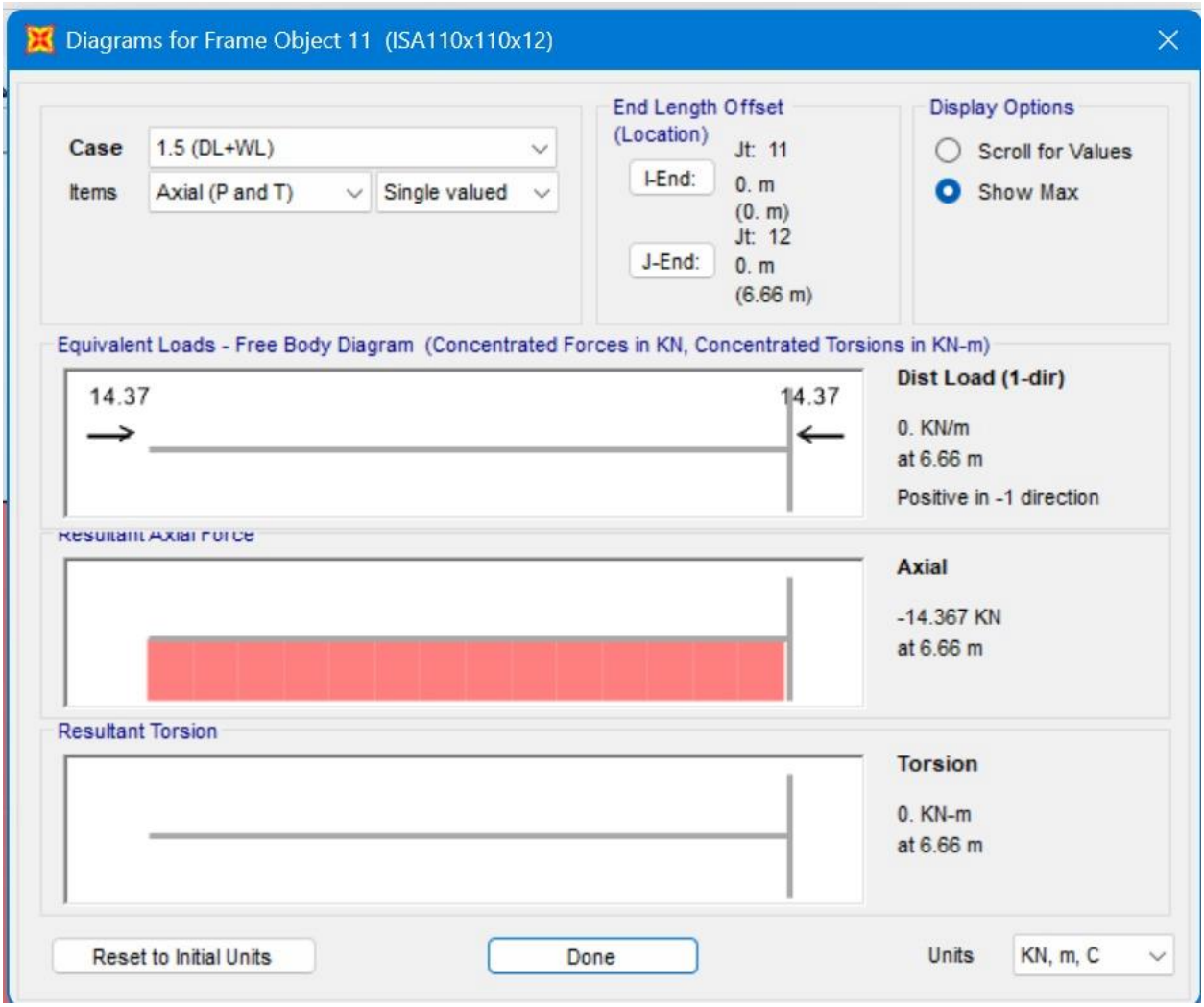
For Truss Member

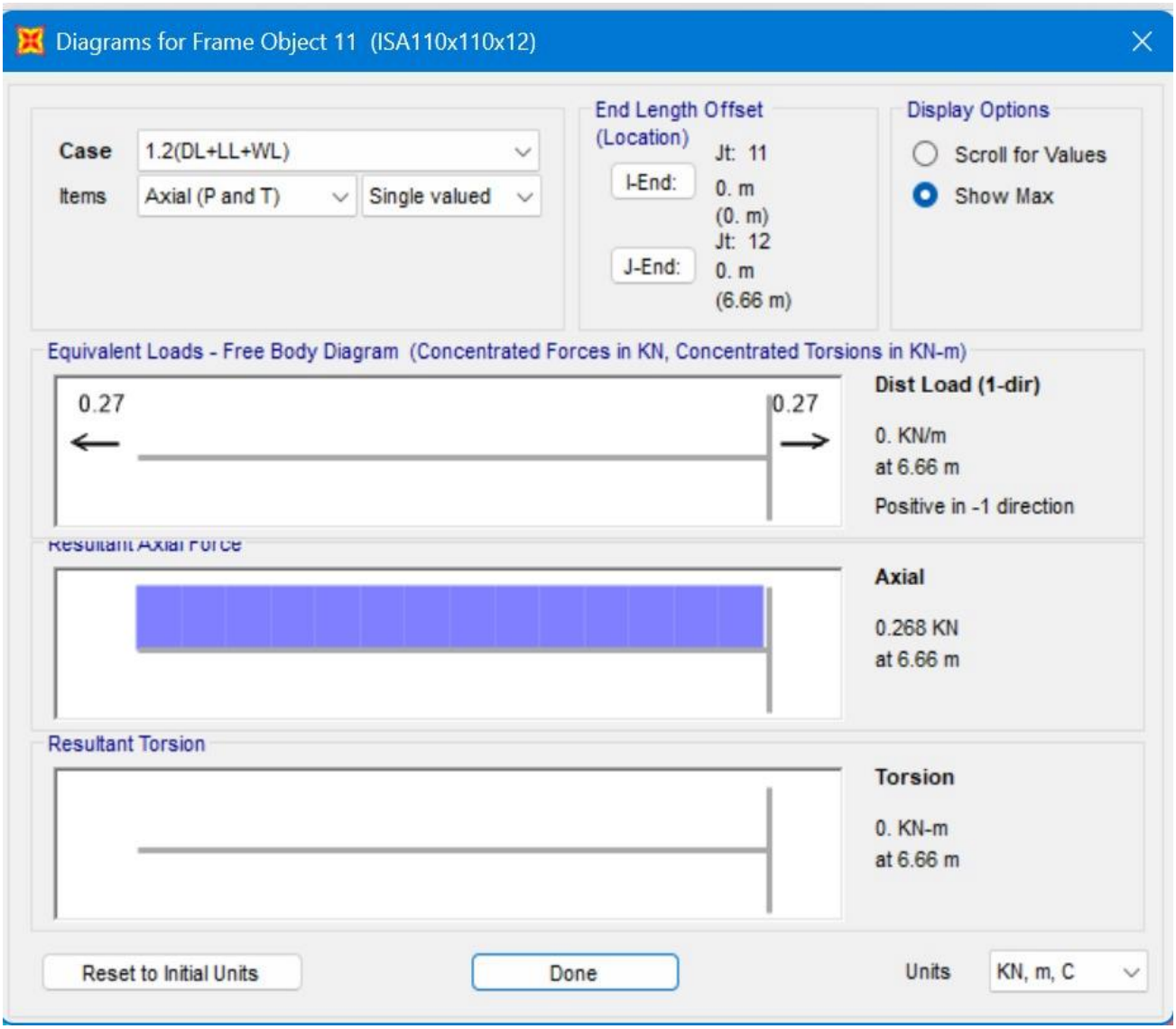


• Bottom chord (Member 1)

Maximum Axial Tension Load = 36.862 kN ,Load Combination = 1.5(DL+LL)

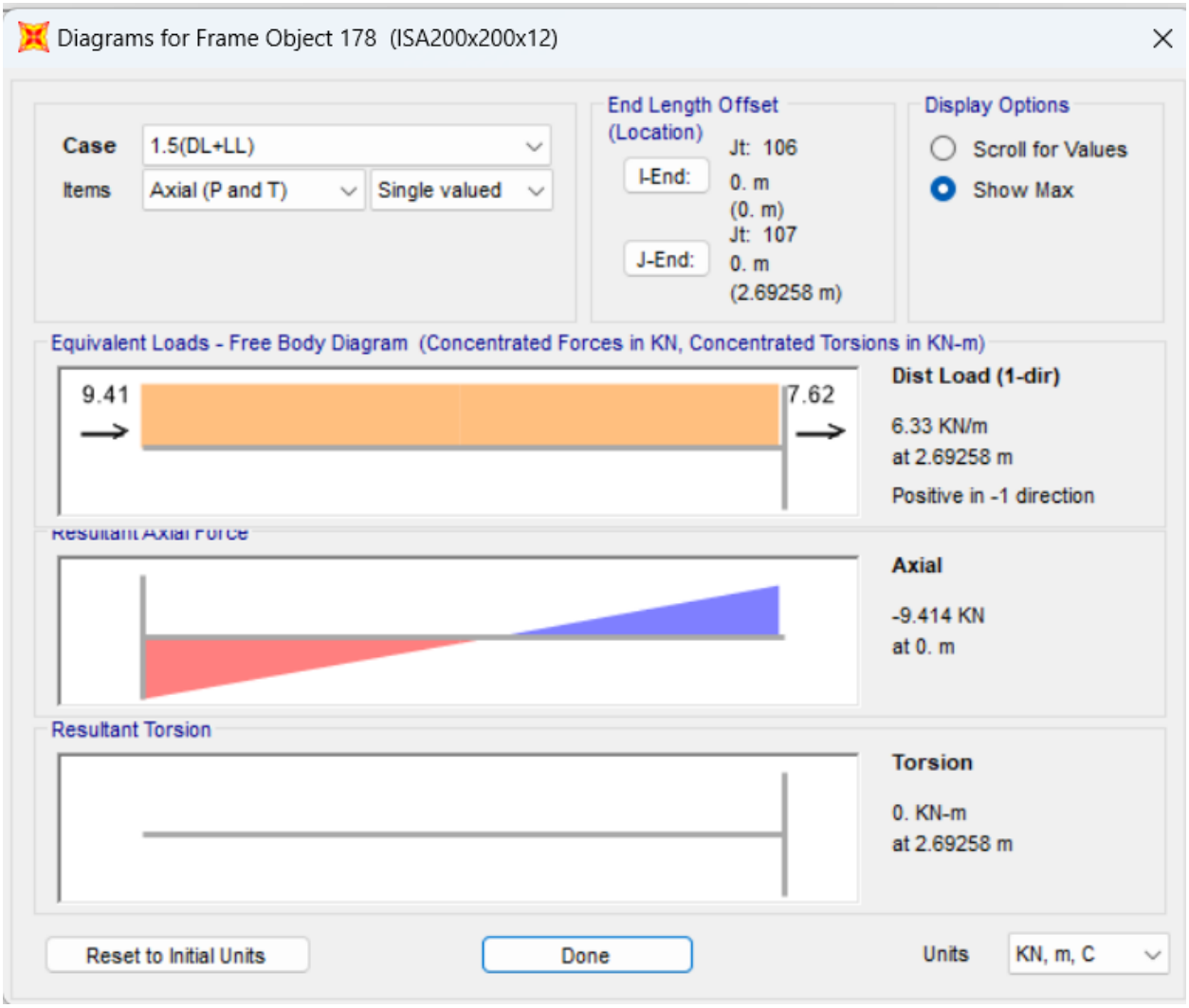


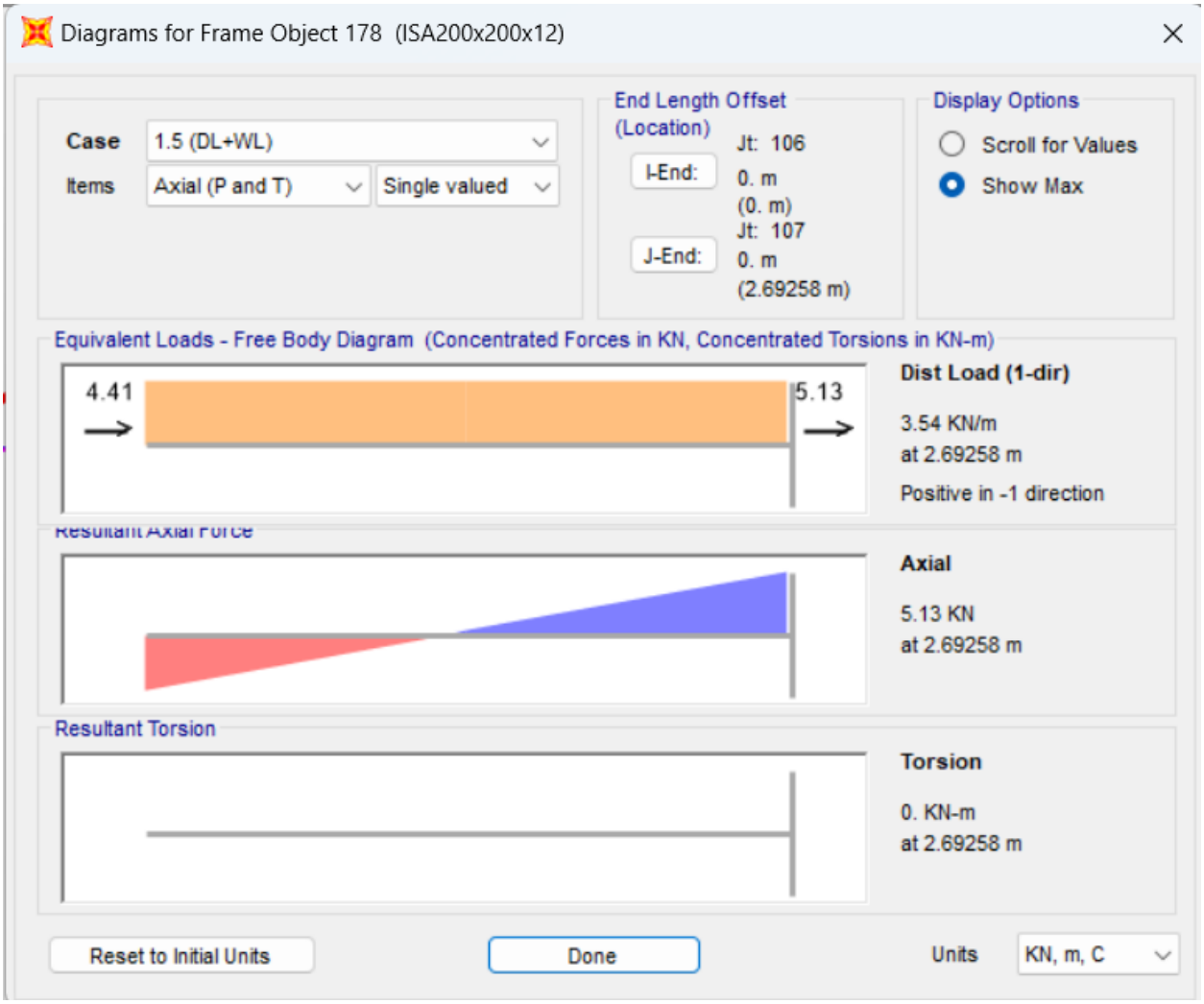

Diagrams for Frame Object 11 (ISA110x110x12)
Case
1.5 (DL+WL)
Items
Axial (P and T)
Single valued
End Length Offset (Location)
I-End:
Jt: 11
0. m
(0. m)
J-End:
Jt: 12
0. m
(6.66 m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
14.37
14.37
Dist Load (1-dir)
0. KN/m
at 6.66 m
Positive in -1 direction
Axial
-14.367 KN
at 6.66 m
Resultant Torsion
Torsion
0. KN-m
at 6.66 m
Reset to Initial Units
Done
Units
KN, m, C

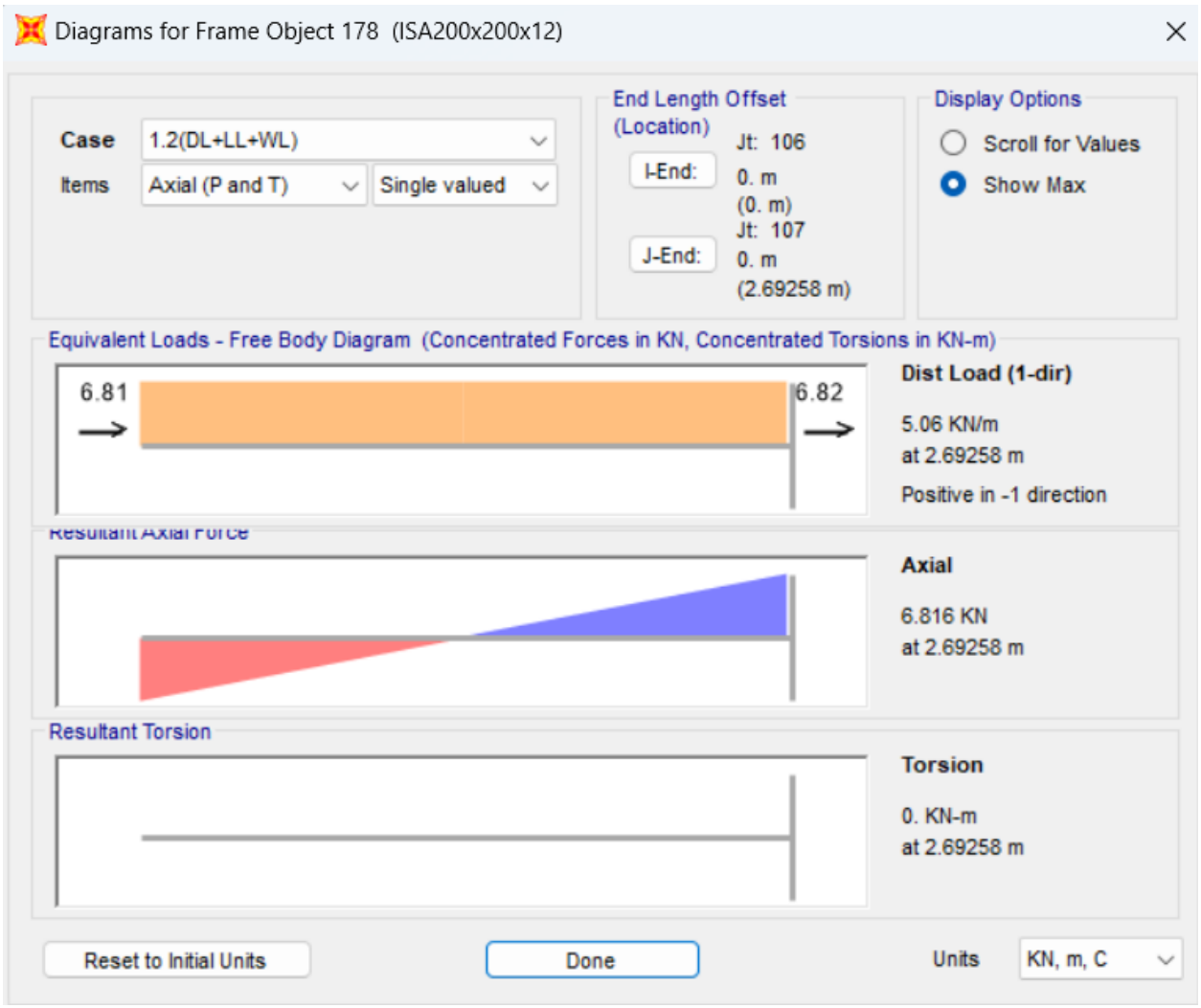

Diagrams for Frame Object 11 (ISA110x110x12)
Case
1.2(DL+LL+WL)
Items
Axial (P and T)
Single valued
End Length Offset (Location)
I-End:
Jt: 11
0. m
(0. m)
J-End:
Jt: 12
0. m
(6.66 m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
0.27
0.27
Dist Load (1-dir)
0. KN/m
at 6.66 m
Positive in -1 direction
Resultant Axial Force
Axial
0.268 KN
at 6.66 m
Resultant Torsion
Torsion
0. KN-m
at 6.66 m
Reset to Initial Units
Done
Units
KN, m, C

- Top chord (Member 2)

Maximum Axial Compression Load = -9.414 kN ,Load Combination = 1.5(DL+LL)

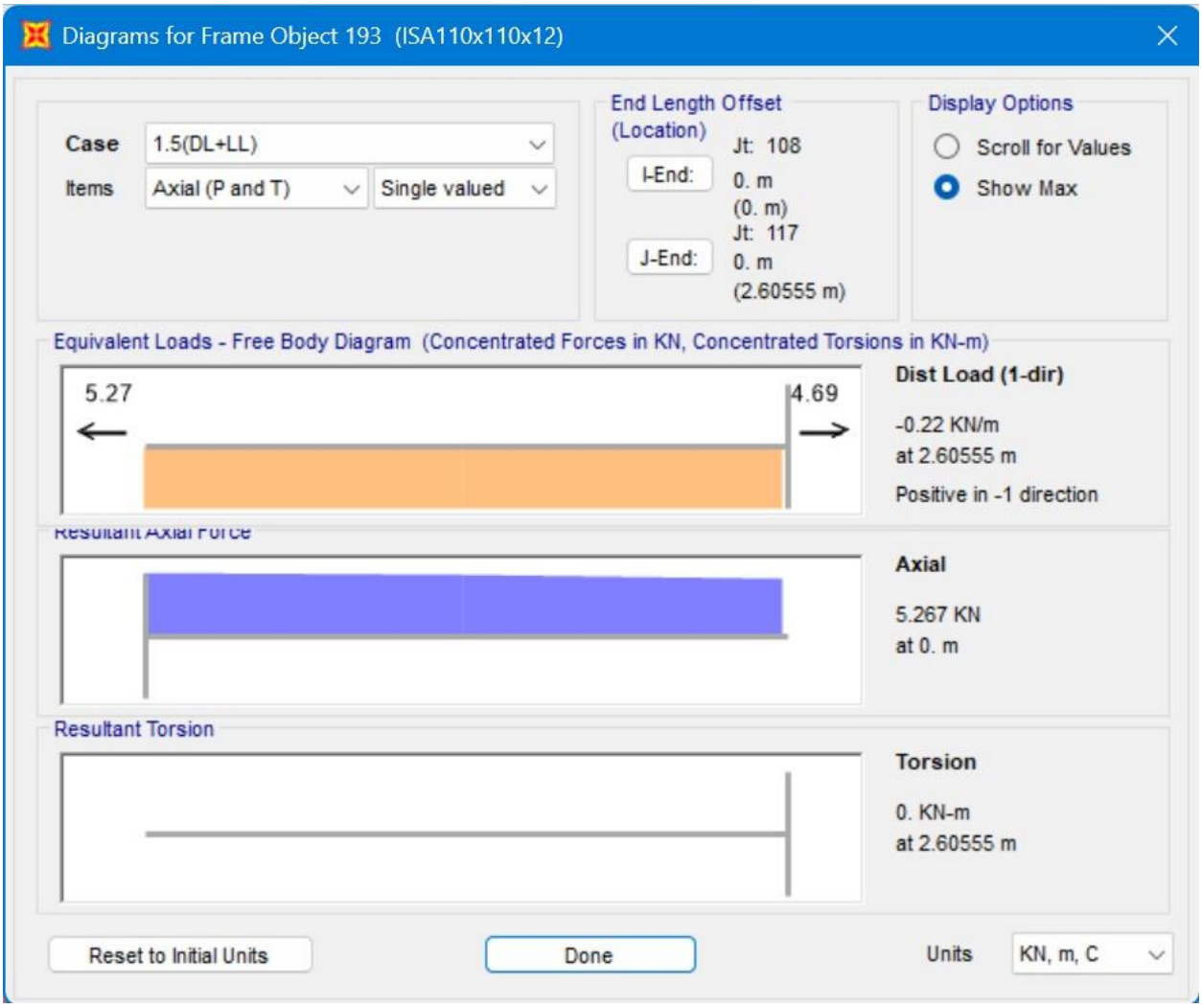


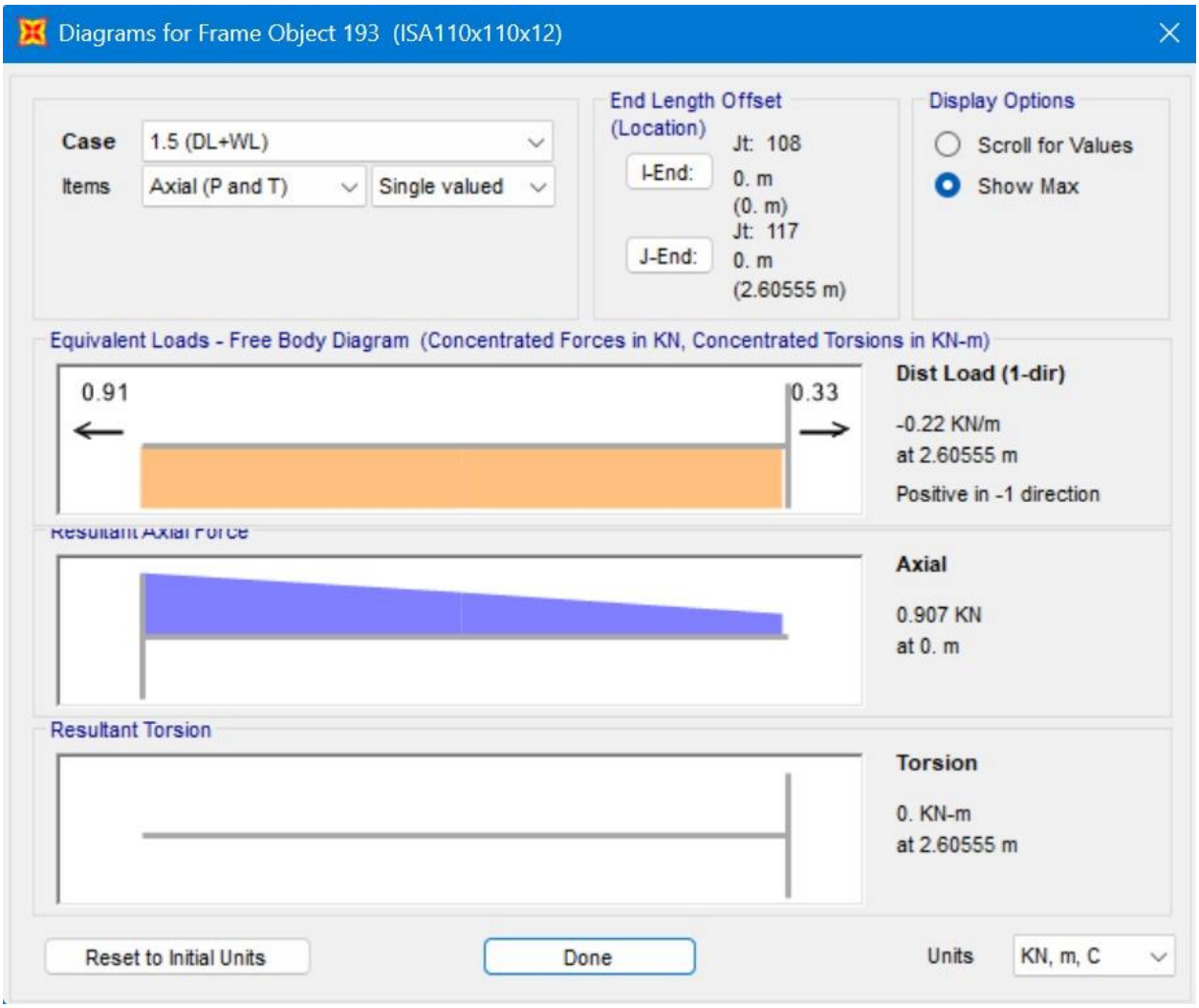

Diagrams for Frame Object 178 (ISA200x200x12)
Case
1.5 (DL+WL)
Items
Axial (P and T)
Single valued
End Length Offset (Location)
I-End:
Jt: 106
0. m
(0. m)
J-End:
Jt: 107
0. m
(2.69258 m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
4.41
5.13
Dist Load (1-dir)
3.54 KN/m
at 2.69258 m
Positive in -1 direction
Axial
5.13 KN
at 2.69258 m
Resultant Torsion
Torsion
0. KN-m
at 2.69258 m
Reset to Initial Units
Done
Units
KN, m, C

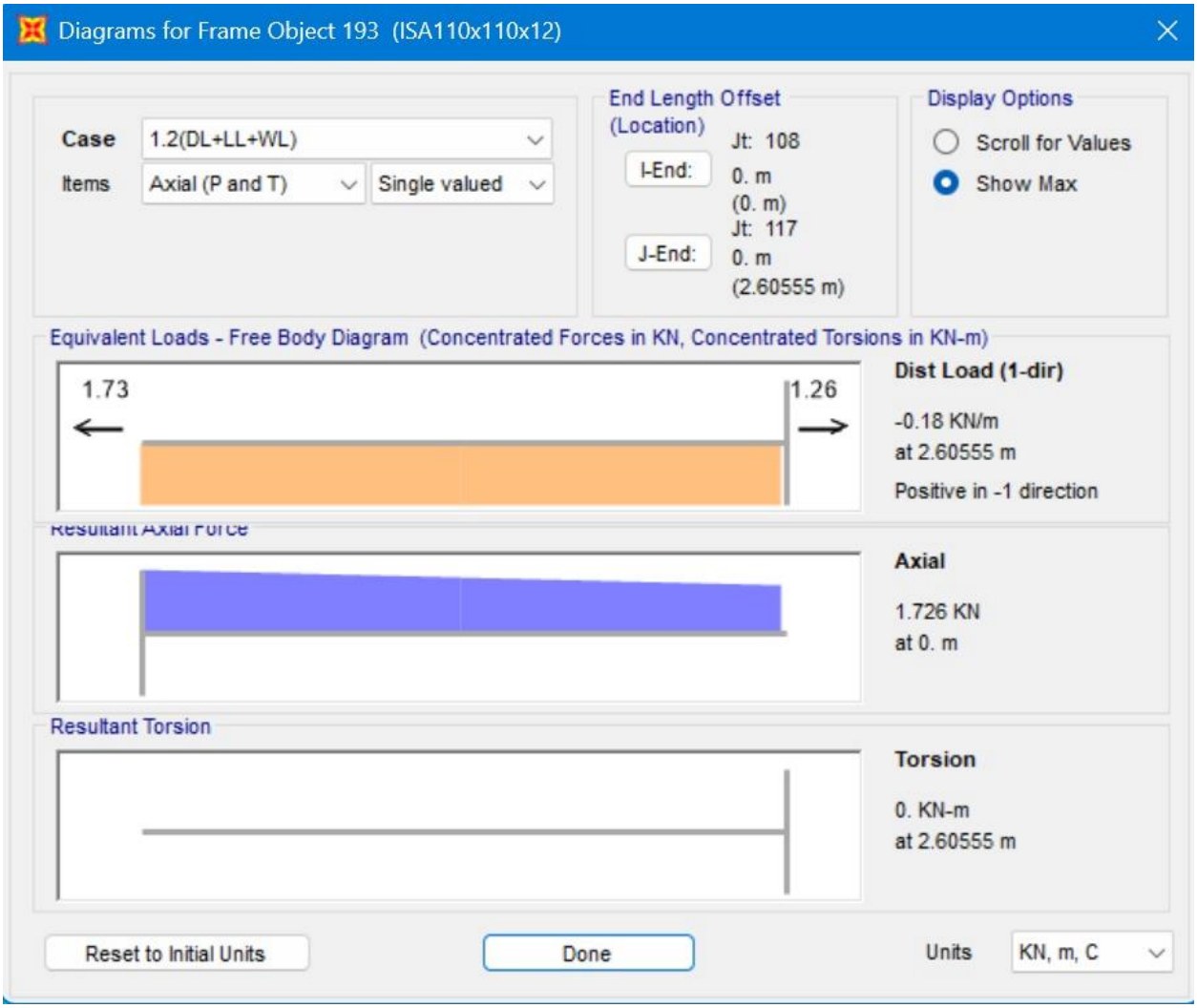

Diagrams for Frame Object 178 (ISA200x200x12)
Case
1.2(DL+LL+WL)
Items
Axial (P and T)
Single valued
End Length Offset (Location)
I-End:
Jt: 106
0. m
(0. m)
J-End:
Jt: 107
0. m
(2.69258 m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
6.81
6.82
Dist Load (1-dir)
5.06 KN/m
at 2.69258 m
Positive in -1 direction
Resultant Axial Force
Axial
6.816 KN
at 2.69258 m
Resultant Torsion
Torsion
0. KN-m
at 2.69258 m
Reset to Initial Units
Done
Units
KN, m, C

- Diagonal Chord (Member 3)

Maximum Axial Tension Load = 5.267 kN ,Load Combination = 1.5(DL+LL)




Diagrams for Frame Object 193 (ISA110x110x12)
Case
1.5 (DL+WL)
Items
Axial (P and T)
Single valued
End Length Offset
(Location)
I-End:
Jt: 108
0. m
(0. m)
J-End:
Jt: 117
0. m
(2.60555 m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
0.91
0.33
Dist Load (1-dir)
-0.22 KN/m
at 2.60555 m
Positive in -1 direction
Axial
0.907 KN
at 0. m
Resultant Torsion
Torsion
0. KN-m
at 2.60555 m
Reset to Initial Units
Done
Units
KN, m, C

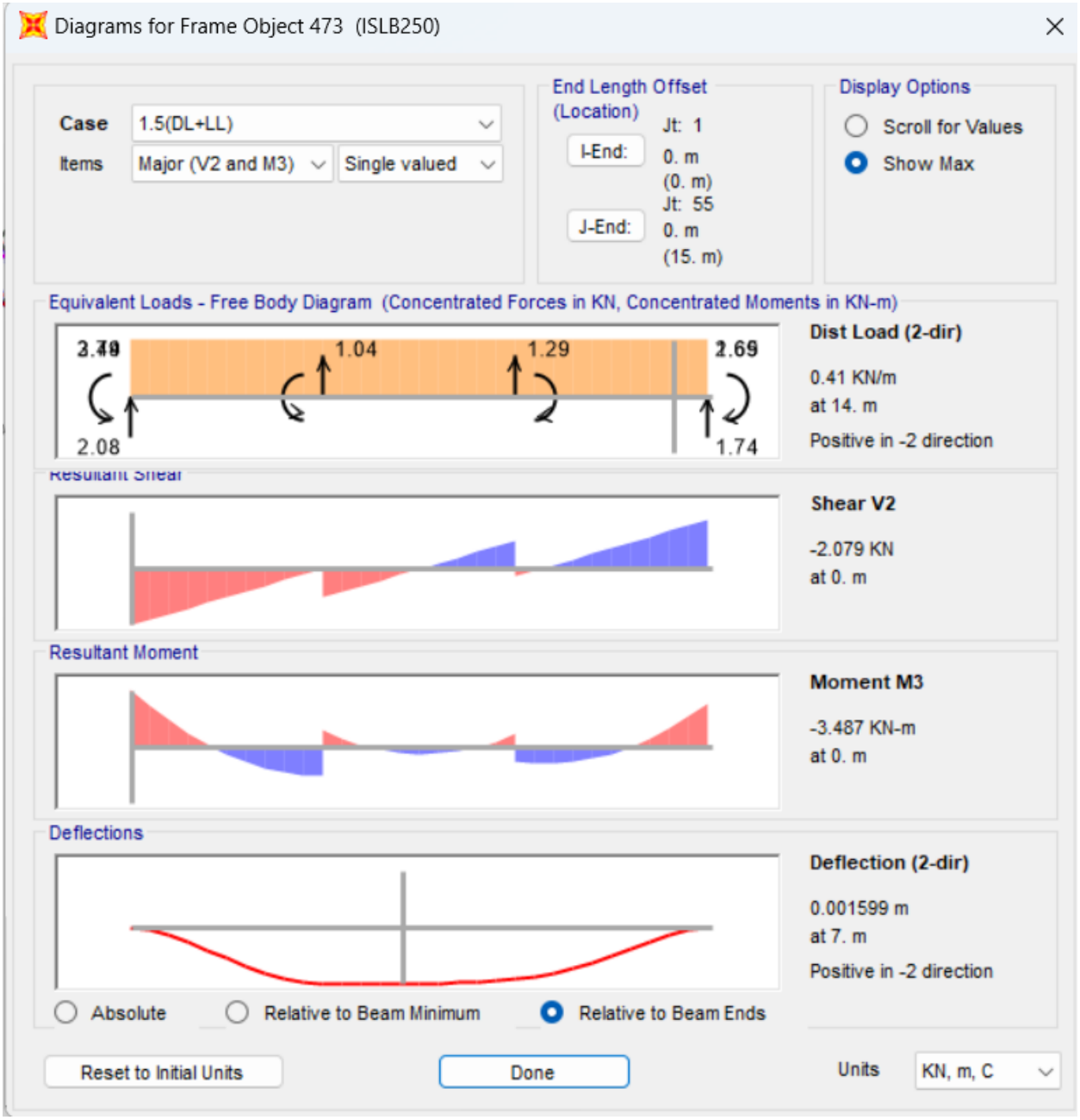

Diagrams for Frame Object 193 (ISA110x110x12)
Case
1.2(DL+LL+WL)
Items
Axial (P and T)
Single valued
End Length Offset
(Location)
I-End:
Jt: 108
0. m
(0. m)
J-End:
Jt: 117
0. m
(2.60555 m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
1.73
1.26
Dist Load (1-dir)
-0.18 KN/m
at 2.60555 m
Positive in -1 direction
Axial
1.726 KN
at 0. m
Resultant Torsion
Torsion
0. KN-m
at 2.60555 m
Reset to Initial Units
Done
Units
KN, m, C

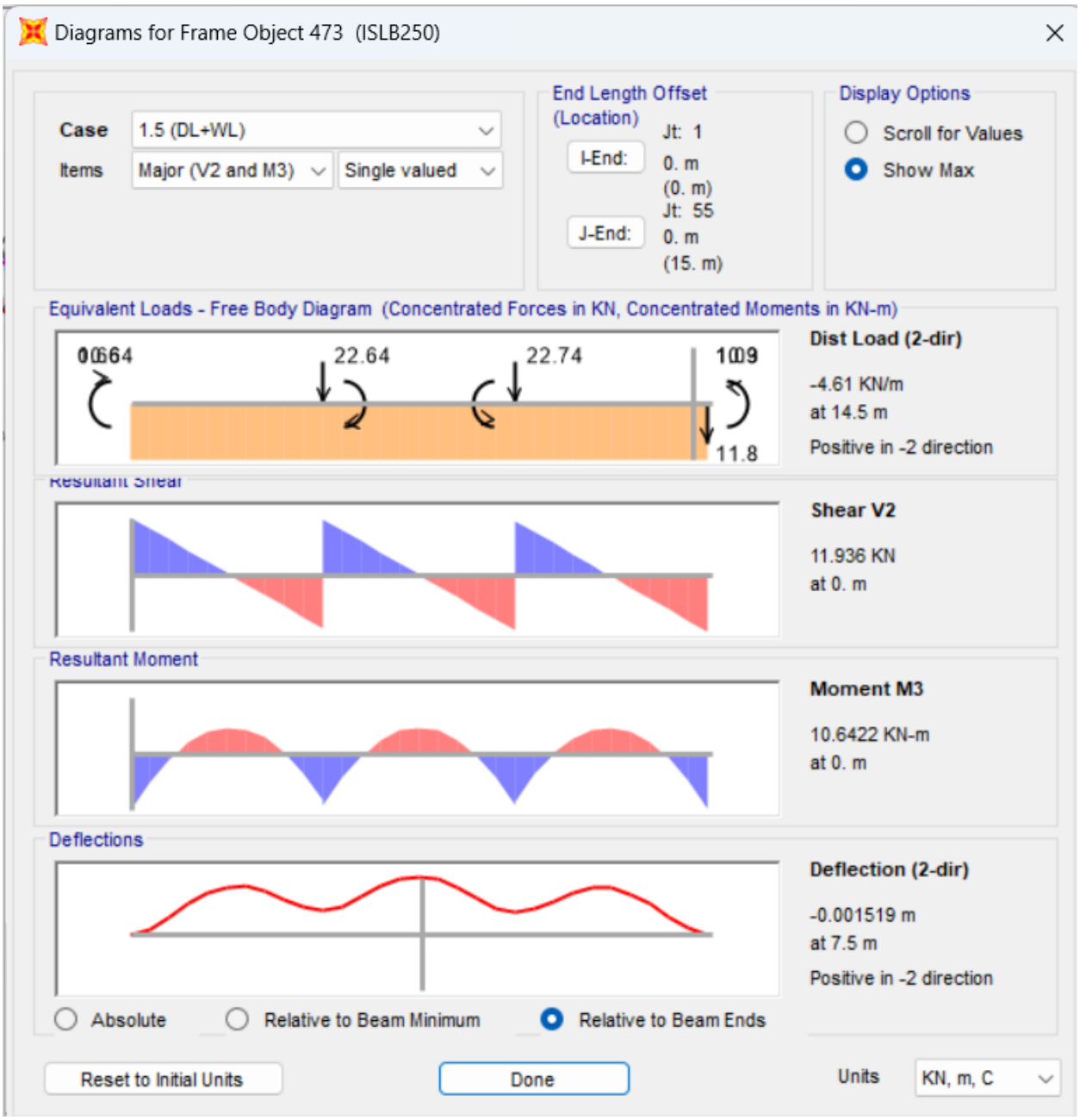
- For Beams(Member 4)

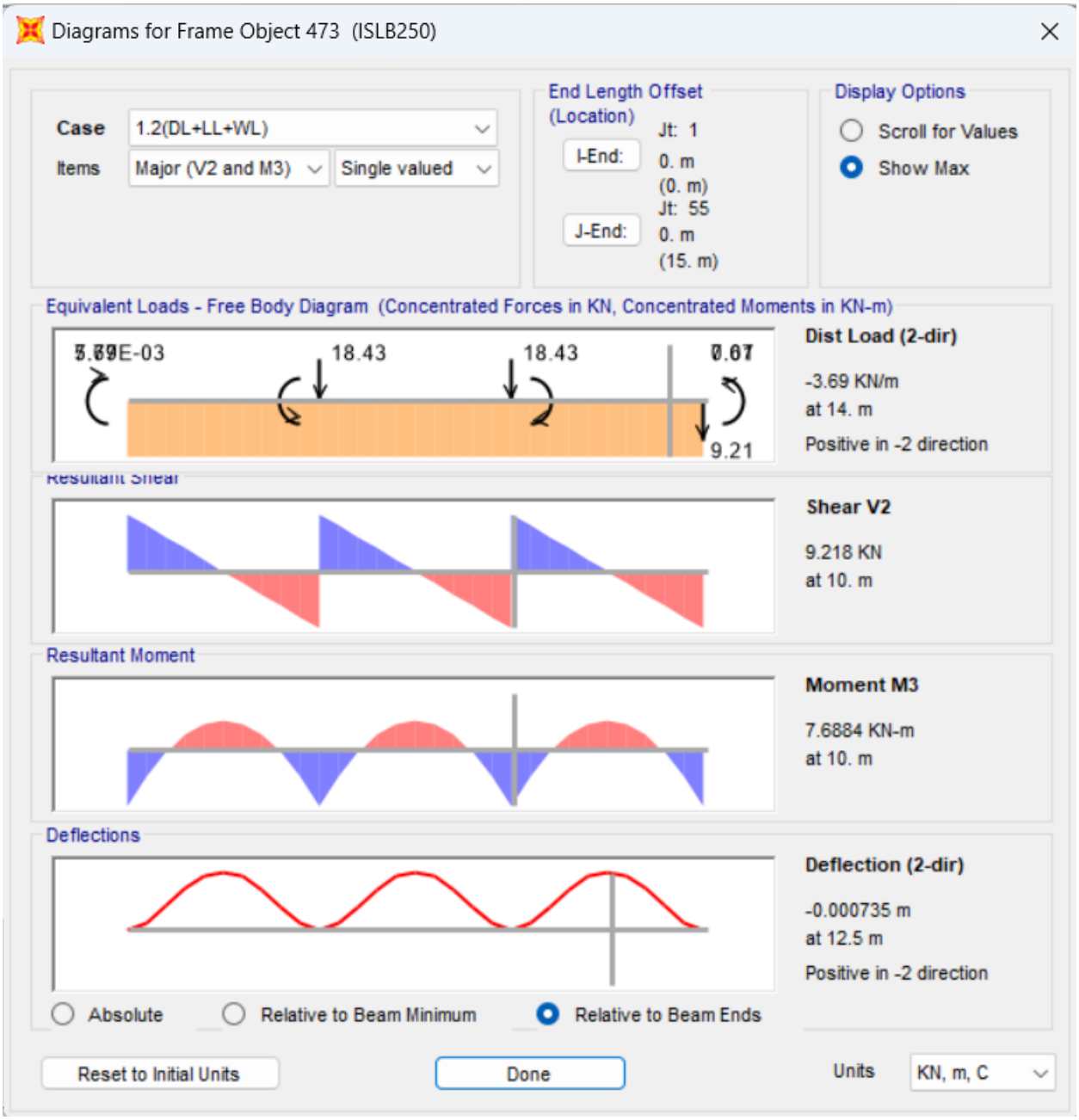
Maximum Bending Moment :10.6422 KNm

Maximum Shear Force :11.936 KN

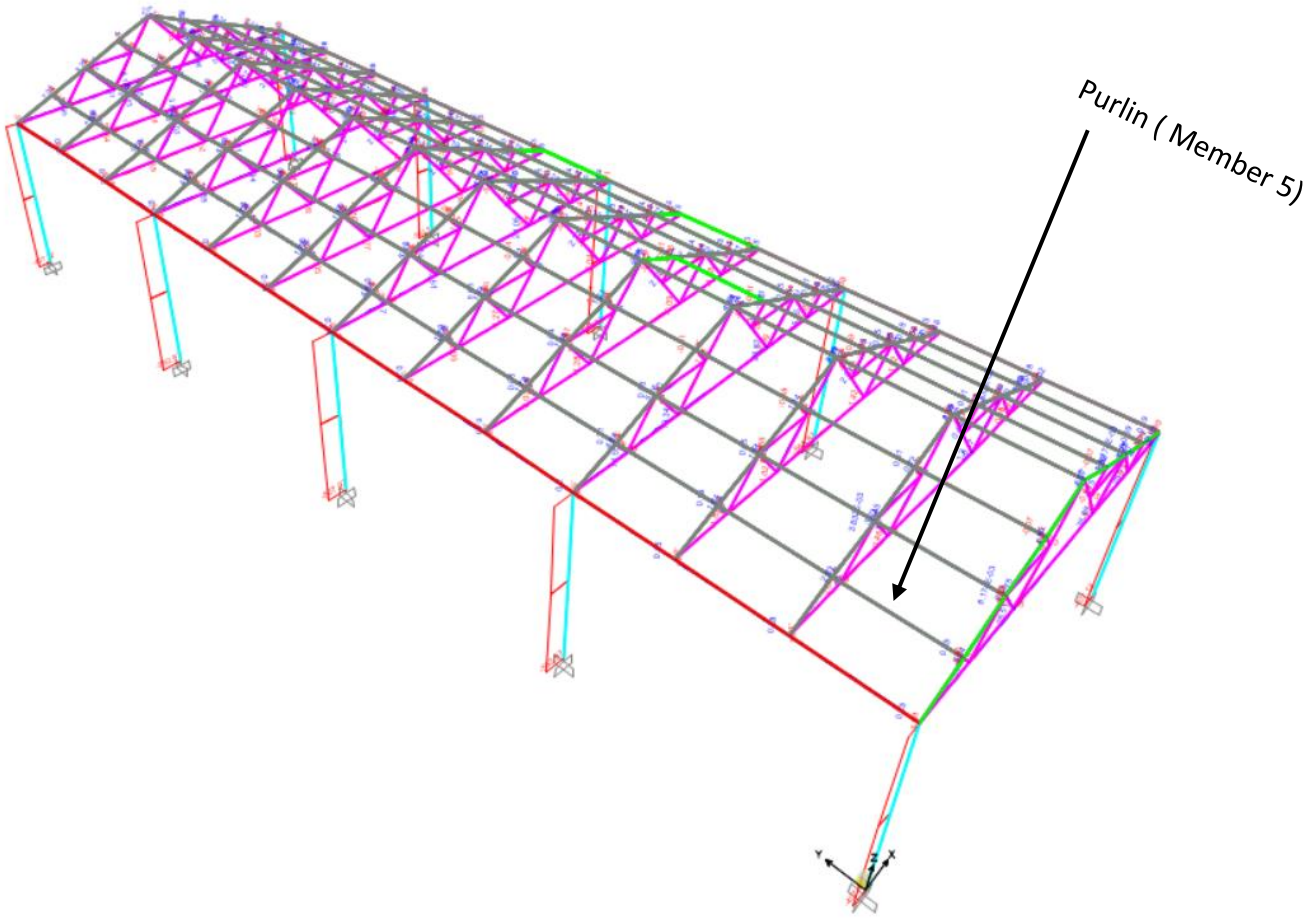
Load Combination :1.5(DL+WL)




Diagrams for Frame Object 473 (ISLB250)
Case
1.5 (DL+WL)
Items
Major (V2 and M3)
Single valued
End Length Offset
(Location)
I-End:
Jt: 1
0. m
(0. m)
J-End:
Jt: 55
0. m
(15. m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Moments in KN-m)
22.64
22.74
11.8
Dist Load (2-dir)
-4.61 KN/m
at 14.5 m
Positive in -2 direction
Shear V2
11.936 KN
at 0. m
Resultant Moment
Moment M3
10.6422 KN-m
at 0. m
Deflections
Deflection (2-dir)
-0.001519 m
at 7.5 m
Positive in -2 direction
Absolute
Relative to Beam Minimum
Relative to Beam Ends
Reset to Initial Units
Done
Units
KN, m, C

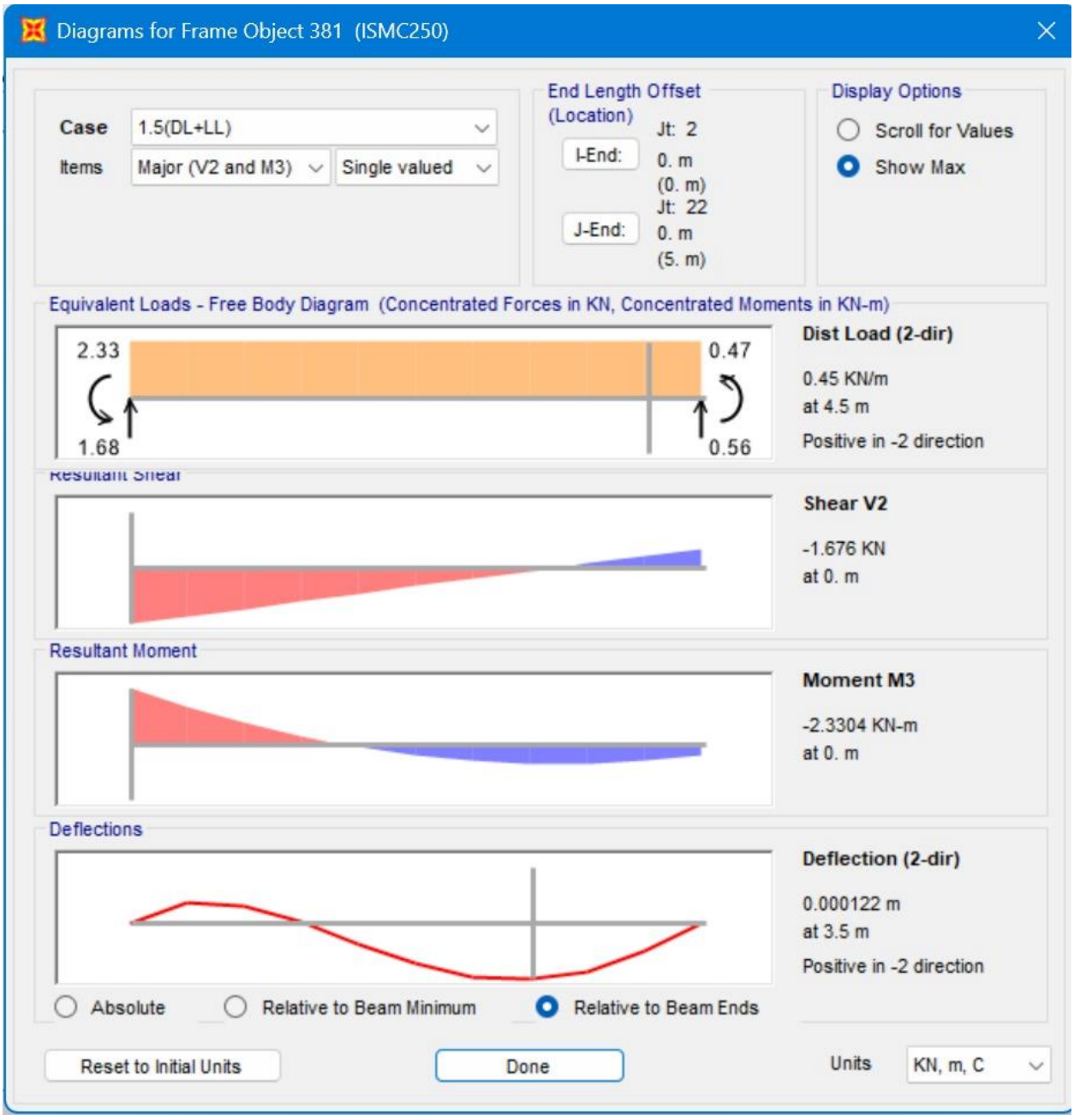

Diagrams for Frame Object 473 (ISLB250)
Case
1.2(DL+LL+WL)
Items
Major (V2 and M3)
Single valued
End Length Offset (Location)
I-End:
Jt: 1
0. m
(0. m)
J-End:
Jt: 55
0. m
(15. m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Moments in KN-m)
18.43
18.43
9.21
Dist Load (2-dir)
-3.69 KN/m
at 14. m
Positive in -2 direction
Shear V2
9.218 KN
at 10. m
Resultant Moment
Moment M3
7.6884 KN-m
at 10. m
Deflections
Deflection (2-dir)
-0.000735 m
at 12.5 m
Positive in -2 direction
Absolute
Relative to Beam Minimum
Relative to Beam Ends
Reset to Initial Units
Done
Units
KN, m, C

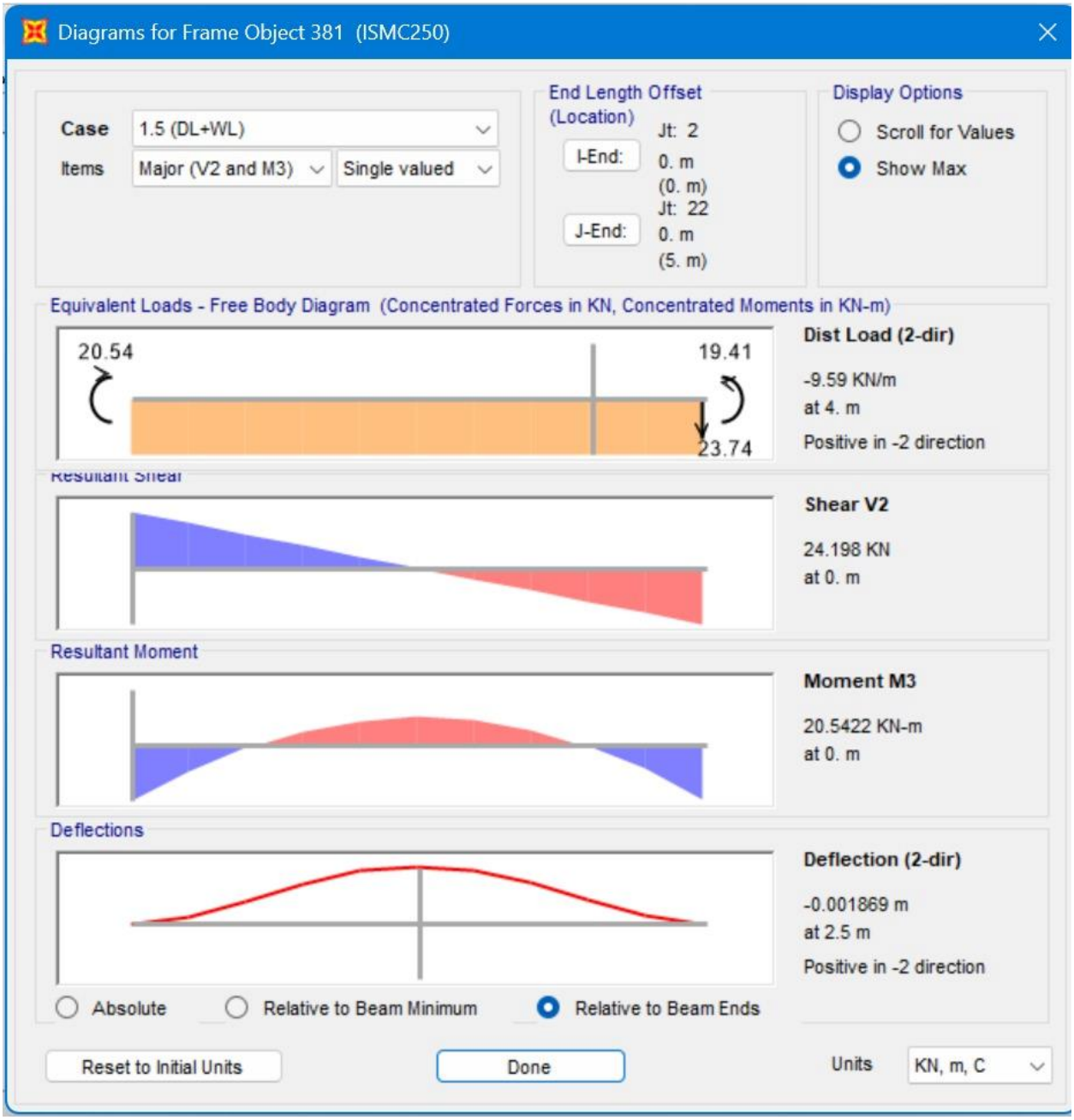
- For Purlin(Member 5)

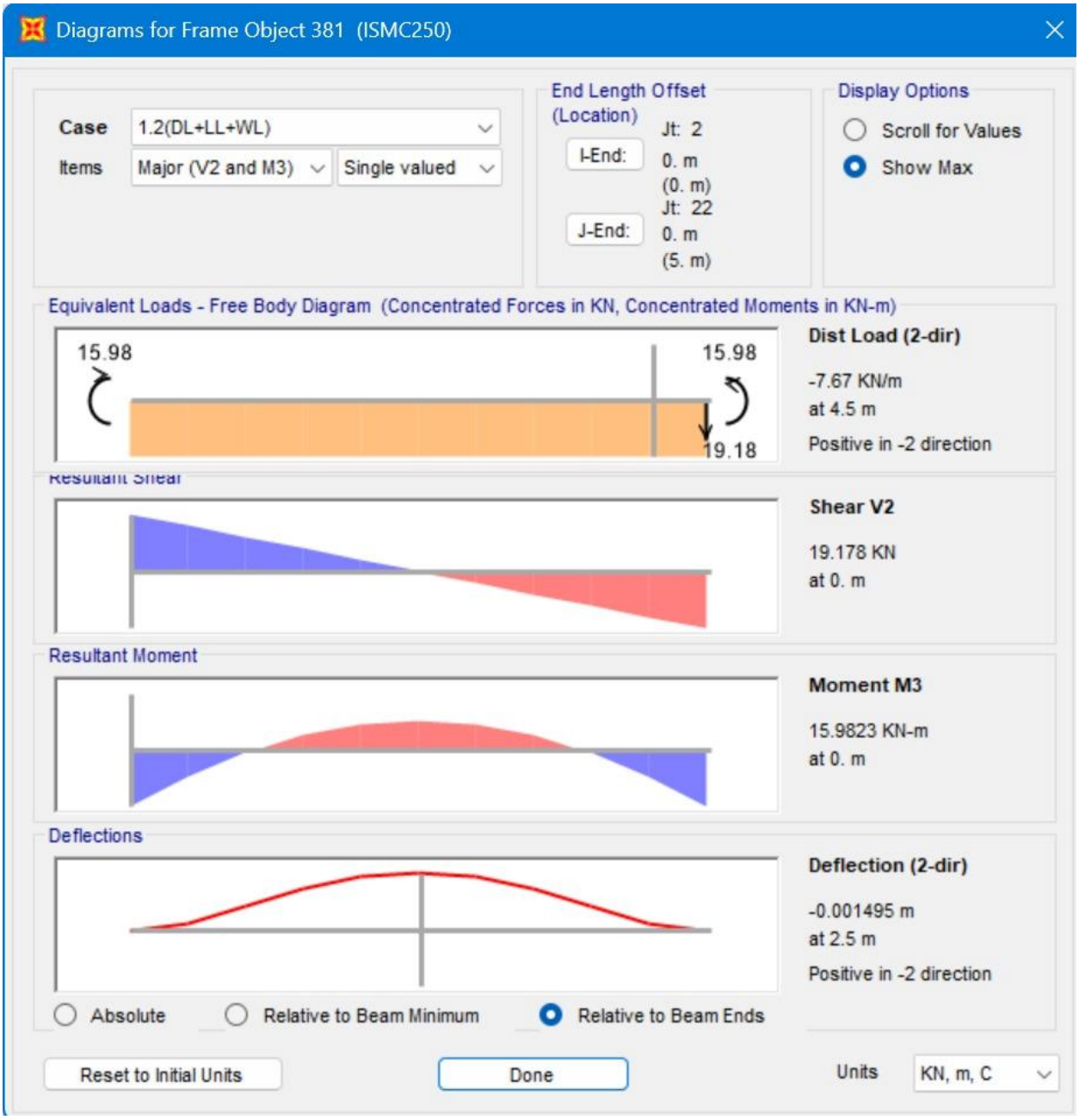


Maximum Shear Force:24.198KN

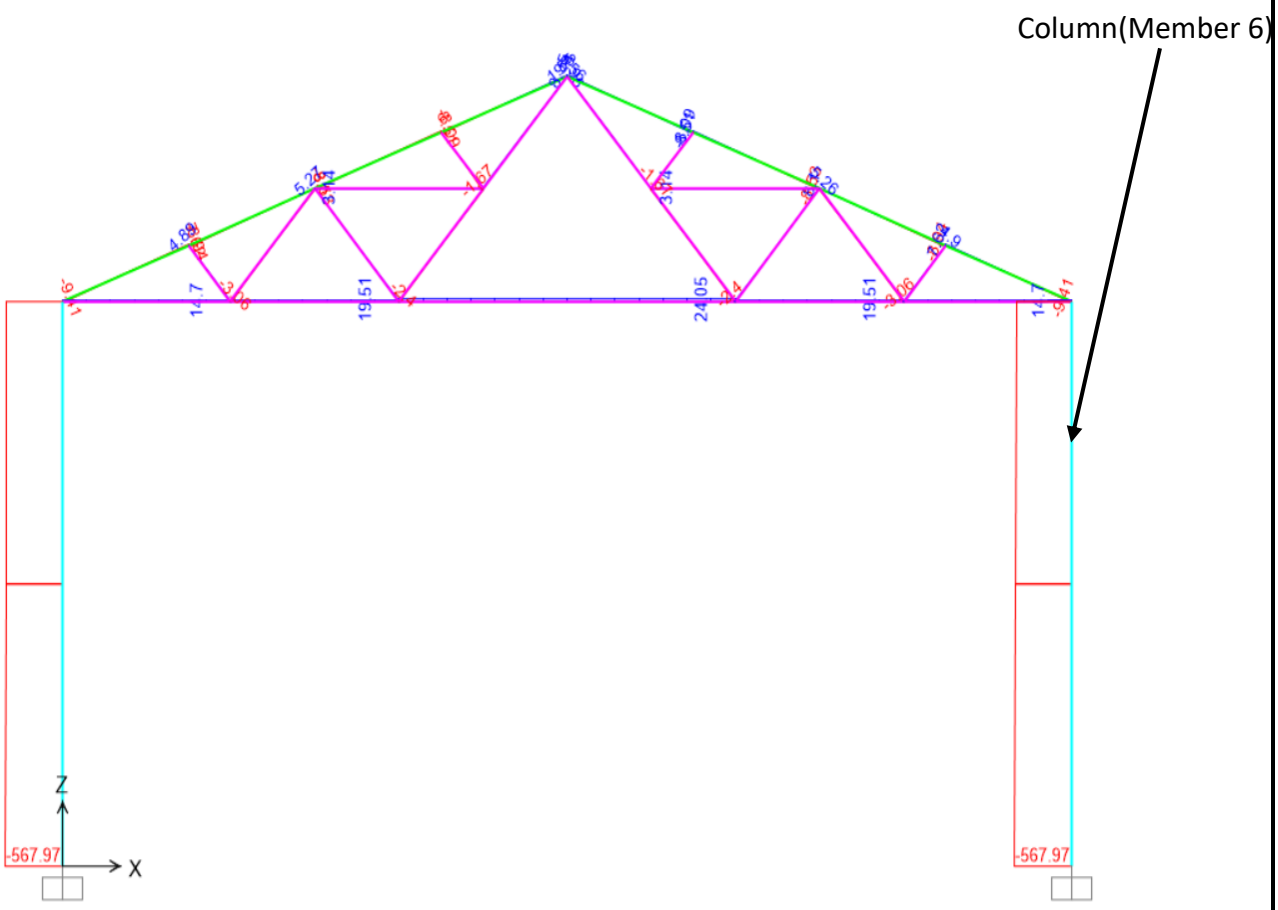
Maximum Bending Moment :20.5422 KNm




Diagrams for Frame Object 381 (ISMC250)
Case
1.5 (DL+WL)
Items
Major (V2 and M3)
Single valued
End Length Offset
(Location)
I-End:
Jt: 2
0. m
(0. m)
J-End:
Jt: 22
0. m
(5. m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Moments in KN-m)
20.54
19.41
23.74
Dist Load (2-dir)
-9.59 KN/m
at 4. m
Positive in -2 direction
Shear V2
24.198 KN
at 0. m
Resultant Moment
Moment M3
20.5422 KN-m
at 0. m
Deflections
Deflection (2-dir)
-0.001869 m
at 2.5 m
Positive in -2 direction
Absolute
Relative to Beam Minimum
Relative to Beam Ends
Reset to Initial Units
Done
Units
KN, m, C

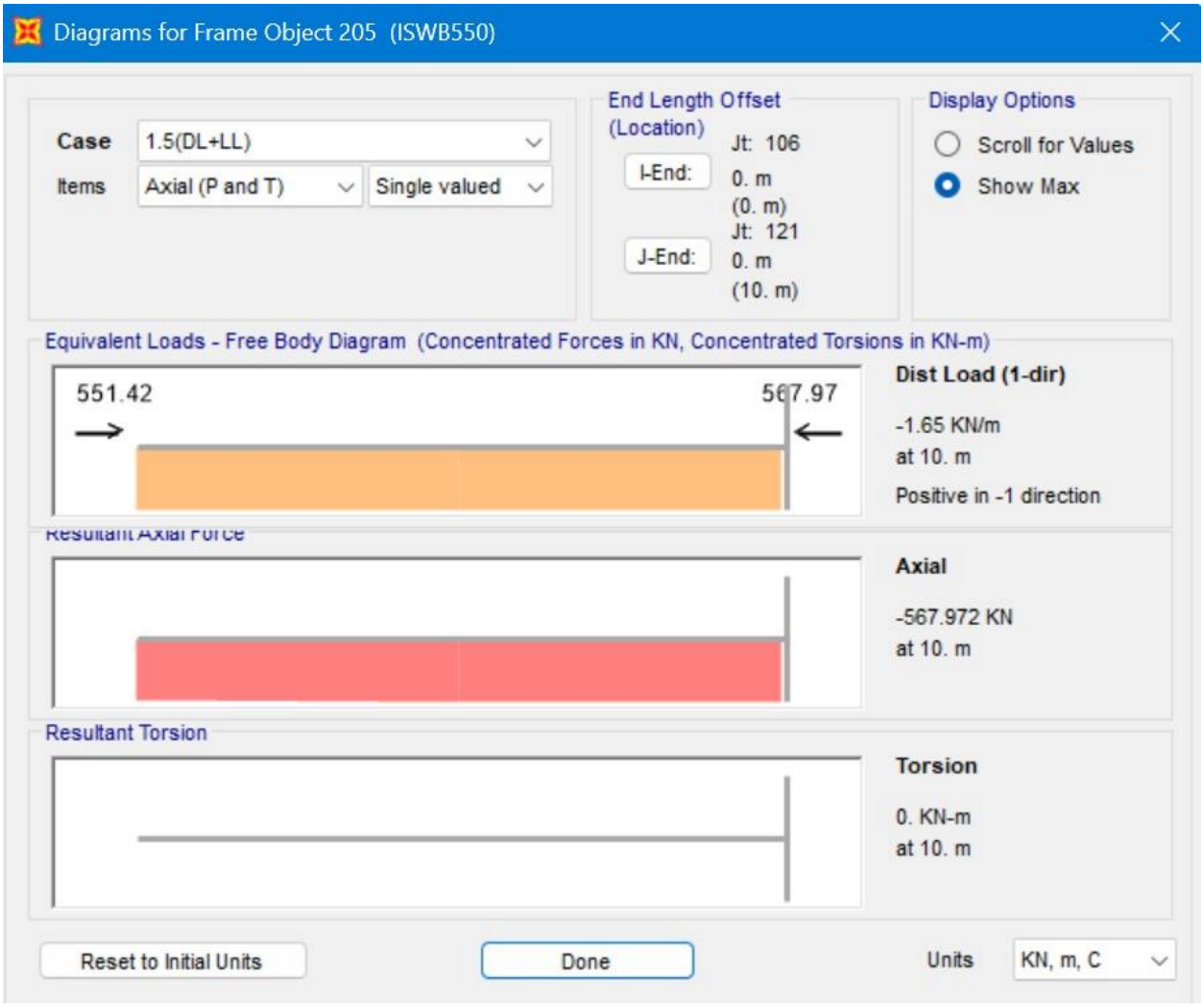

Diagrams for Frame Object 381 (ISMC250)
Case
1.2(DL+LL+WL)
Items
Major (V2 and M3)
Single valued
End Length Offset (Location)
I-End:
Jt: 2
0. m
(0. m)
J-End:
Jt: 22
0. m
(5. m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Moments in KN-m)
15.98
15.98
19.18
Dist Load (2-dir)
-7.67 KN/m
at 4.5 m
Positive in -2 direction
Shear V2
19.178 KN
at 0. m
Resultant Moment
Moment M3
15.9823 KN-m
at 0. m
Deflections
Deflection (2-dir)
-0.001495 m
at 2.5 m
Positive in -2 direction
Absolute
Relative to Beam Minimum
Relative to Beam Ends
Reset to Initial Units
Done
Units
KN, m, C

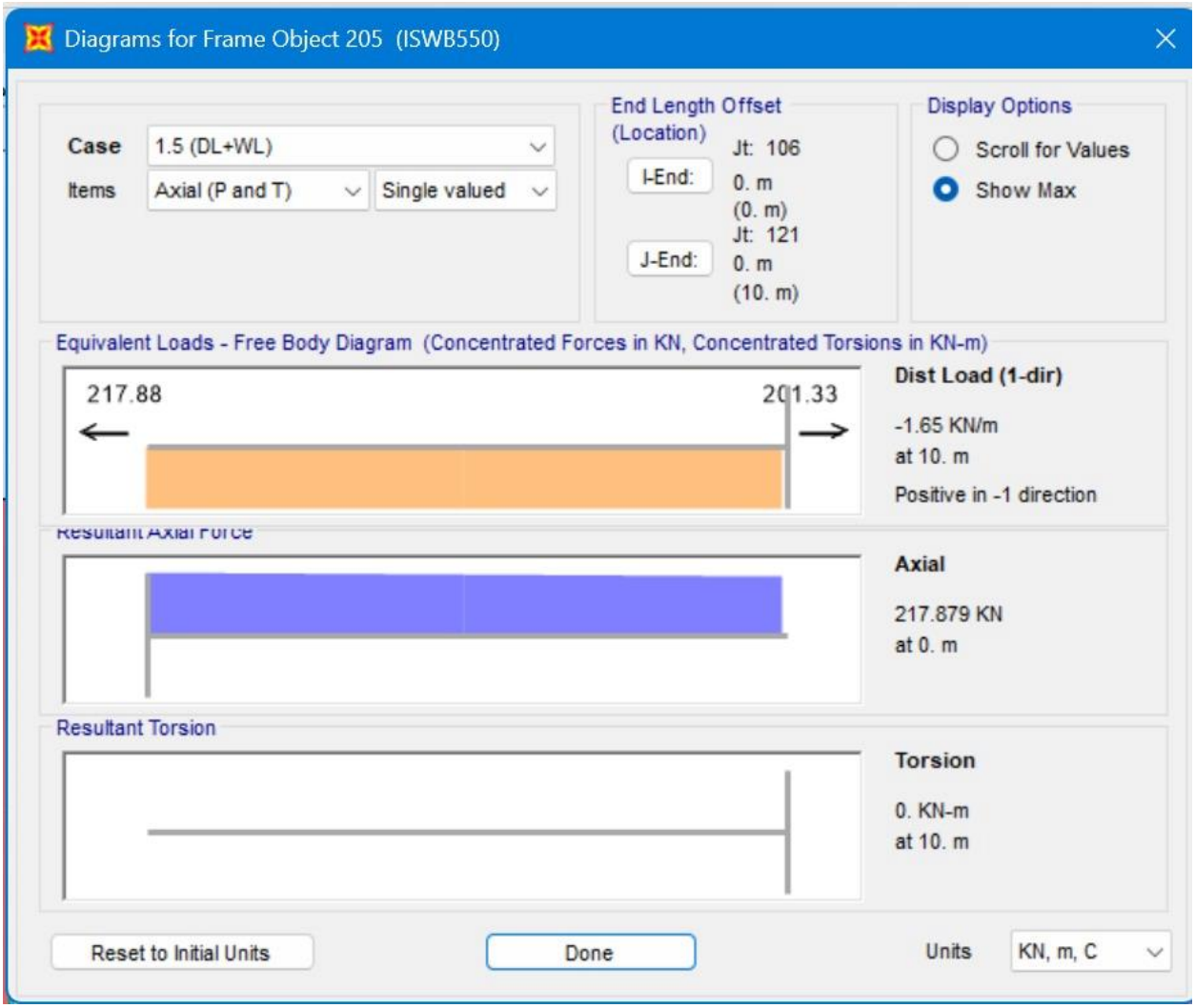
- For Column(Member 6)



Maximum Axial Compression Load: -567.97 KN

Load Combination:1.5(DL+LL)


Diagrams for Frame Object 205 (ISWB550)
Case
1.5(DL+LL)
Items
Axial (P and T)
Single valued
End Length Offset (Location)
I-End:
Jt: 106
0. m
(0. m)
J-End:
Jt: 121
0. m
(10. m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
551.42
567.97
Dist Load (1-dir)
-1.65 KN/m
at 10. m
Positive in -1 direction
Axial
-567.972 KN
at 10. m
Resultant Torsion
Torsion
0. KN-m
at 10. m
Reset to Initial Units
Done
Units
KN, m, C


Diagrams for Frame Object 205 (ISWB550)
Case
1.5 (DL+WL)
Items
Axial (P and T)
Single valued
End Length Offset (Location)
I-End:
Jt: 106
0. m
(0. m)
J-End:
Jt: 121
0. m
(10. m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
217.88
201.33
Dist Load (1-dir)
-1.65 KN/m
at 10. m
Positive in -1 direction
Axial
217.879 KN
at 0. m
Resultant Torsion
Torsion
0. KN-m
at 10. m
Reset to Initial Units
Done
Units
KN, m, C

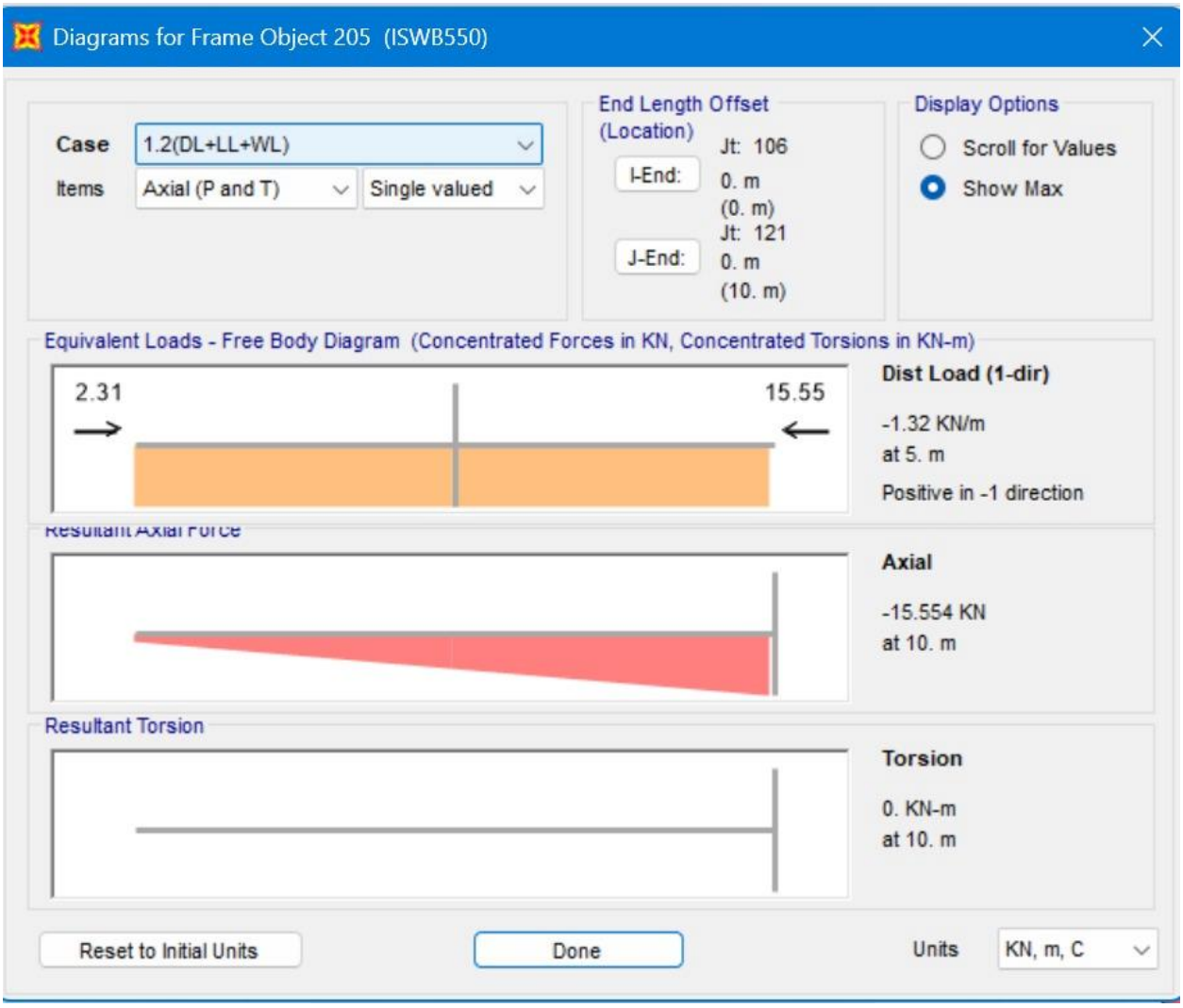

Diagrams for Frame Object 205 (ISWB550)
Case
1.2(DL+LL+WL)
Items
Axial (P and T)
Single valued
End Length Offset
(Location)
I-End:
Jt: 106
0. m
(0. m)
J-End:
Jt: 121
0. m
(10. m)
Display Options
Scroll for Values
Show Max
Equivalent Loads - Free Body Diagram (Concentrated Forces in KN, Concentrated Torsions in KN-m)
2.31
15.55
Dist Load (1-dir)
-1.32 KN/m
at 5. m
Positive in -1 direction
Axial
-15.554 KN
at 10. m
Resultant Torsion
Torsion
0. KN-m
at 10. m
Reset to Initial Units
Done
Units
KN, m, C

Table Forces in Critical Members

Member No.	Member	Load Type	Maximum Load	Load Case
1	Top Chord	Axial Force	-9.414 kN	1.5 (DL+LL)
			5.13 kN	1.5 (DL+WL)
			6.816 kN	1.2 (DL+LL+WL)
2	Bottom Chord	Axial Force	36.862 kN	1.5 (DL+LL)
			-14.367 kN	1.5 (DL+WL)
			0.268 kN	1.2 (DL+LL+WL)
3	Diagonal Chord	Axial Force	5.267 kN	1.5 (DL+LL)
			0.907 kN	1.5 (DL+WL)
			1.726 kN	1.2 (DL+LL+WL)
4	Beam	Shear Force	-2.079 kN	1.5 (DL+LL)
			11.936 kN	1.5 (DL+WL)
			9.218 kN	1.2 (DL+LL+WL)
		Bending Moment	-3.487 kN-m	1.5 (DL+LL)
			10.6422 kN-m	1.5 (DL+WL)
			7.6884 kN-m	1.2 (DL+LL+WL)
5	Purlin	Shear Force	-1.676 kN	1.5 (DL+LL)
			24.198 kN	1.5 (DL+WL)
			19.178 kN	1.2 (DL+LL+WL)
		Bending Moment	-2.3304 kN-m	1.5 (DL+LL)
			20.5422 kN-m	1.5 (DL+WL)
			15.9823 kN-m	1.2 (DL+LL+WL)
6	Column	Axial Force	-567.972 kN	1.5 (DL+LL)
			217.879 kN	1.5 (DL+WL)
			-15.554 kN	1.2 (DL+LL+WL)