MODEC Beam Sensei - User Manual 1.0

Welcome to MODEC Beam Sensei. This web application allows you to:
1) Retrieve both predefined and custom beam properties.
2) Analyze and visualize key aspects of beam behavior such as shear forces and bending moments.
This guide will walk you through each section of the application and how to use it effectively.

Click here to access ----------→ **MODEC Beam Sensei**

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1. Beam Section Library

This section allows you to explore predefined beam types and properties. You can choose a specific beam type and see the material properties, dimensions, and other relevant information. The section library database is created using 3 beam standards:

1) Products Handbook Structural Steel 2006 from consteel (W)
2) National Standards of the People's Republic of China GB/T 11263-2005 (HW, HM, HN)
3) Excel file 221220_NSHYPER BEAM_all. (HY)

Steps:

1. **Select Beam Type:**
    - From the drop-down menu, choose the desired **beam type**.

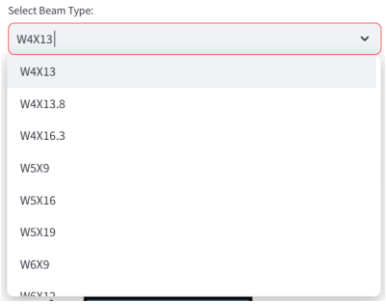


Fig. 1.1: Select Beam Type

2. **Select Similarity Type and Yield Strength (MPa):**
    - From the drop-down menu, choose the desired **similarity type**. Based on the selected similarity type, the most similar beam from the other 2 beam standards will be displayed in the table generated, in order of similarity.
    - From the drop-down menu, choose the desired **yield strength**.

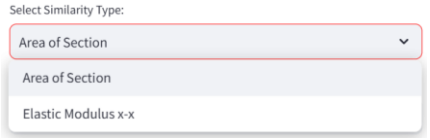


Fig. 1.2: Select Similarity Type

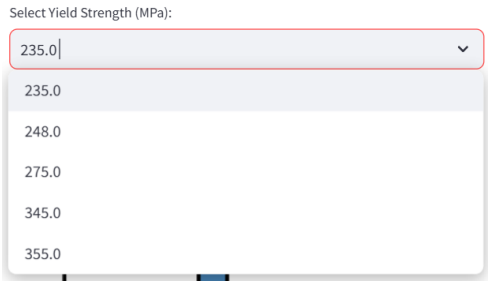


Fig. 1.3: Select Similarity Type

3. **View Beam Properties:**
    - After selecting the options, click the **Generate Properties from Database** button. This will display a table with the beam's properties such as dimensions, second moment of area, elastic modulus, etc. Web and flange classification is also calculated based on dimensions and selected **yield strength**.

Alt. Std. 1: HM148 Alt. Std. 2: HY400X65.4

	Variable	Symbol	=	Chosen	1	Alt. Std. 1	2	Alt. Std. 2	3
0	Mass per Metre	-	=	19.4	kg/m	20.7	kg/m	65.4	kg/m
1	Depth	D	=	105.7	mm	148	mm	400	mm
2	Flange Width	B	=	103.1	mm	100	mm	200	mm
3	Flange Thickness	tf	=	8.8	mm	9	mm	12	mm
4	Web Thickness	tw	=	7.1	mm	6	mm	9	mm
5	Root Radius	r	=	6.4	mm	8	mm	13	mm
6	Toe Fillet Distance	d	=	75.5	mm	114	mm	350	mm
7	Area of Section	A	=	24.7	mm	26.35	mm	83.29	mm
8	Surface Area /m	-	=	0.60	m2	0.67	m2	1.56	m2
9	Second Moment Of Area (X)	Ix	=	472	cm4	995.3	cm4	22600	cm4
10	Second Moment Of Area (Y)	Iy	=	160	cm4	150.3	cm4	1600	cm4
11	Radius Of Gyration (X)	rx	=	4.38	cm	6.15	cm	16.5	cm
12	Radius Of Gyration (Y)	ry	=	2.55	cm	2.39	cm	4.4	cm
13	Elastic Modulus (X)	Sex	=	89.4	cm3	134.5	cm3	1130	cm3
14	Elastic Modulus (Y)	Sey	=	31.1	cm3	30.1	cm3	160	cm3
15	Plastic Modulus (X)	Zpx	=	103	cm3	153.92	cm3	1280	cm3
16	Plastic Modulus (Y)	Zpy	=	47.8	cm3	46.59	cm3	249	cm3
17	Flange Ratios For Local Buckling	b/T	=	5.45	-	5.22	-	7.96	-
18	Web Ratios For Local Buckling	d/t	=	10.63	-	19	-	38.89	-
19	Web Section Class.	-	=	Compact	-	Compact	-	Compact	-
20	Flange Section Class.	-	=	Slender	-	Slender	-	Slender	-

Fig. 1.4: Properties Table

4. **I-Beam Diagram:**
    - The I-beam diagram will automatically be drawn based on the selected beam type. The diagram will display the beam's geometry and label key dimensions for easy visualization.

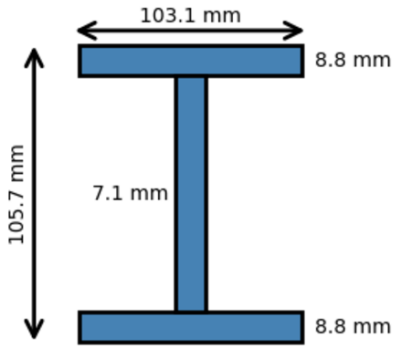
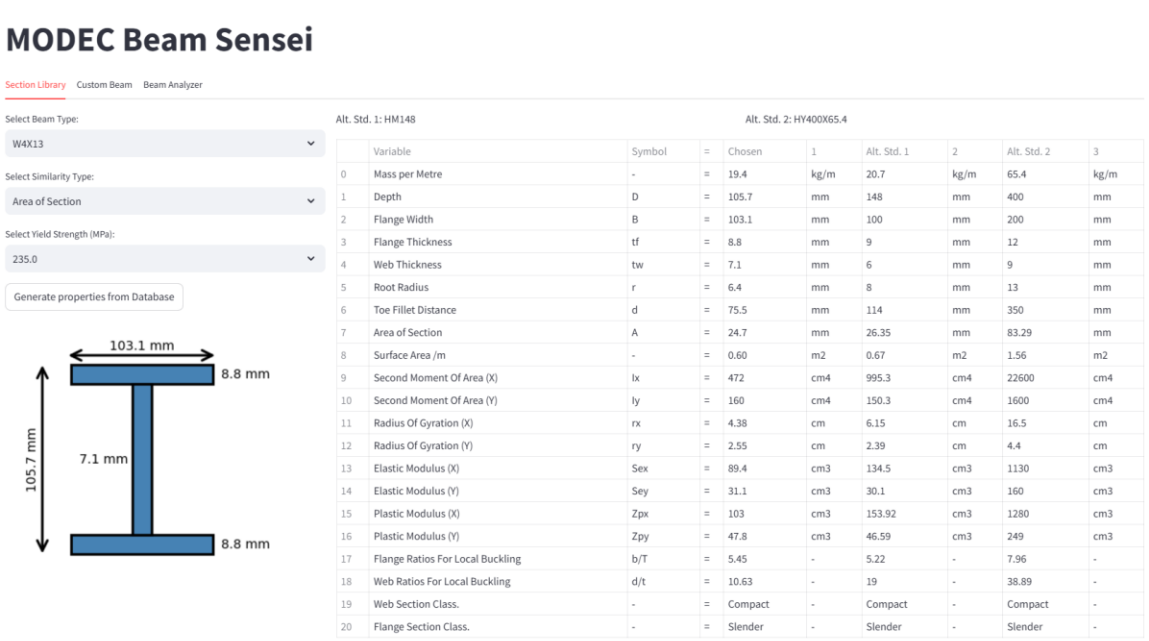


Fig. 1.5: Beam Section Display



MODEC Beam Sensei

Section Library | Custom Beam | Beam Analyzer

Select Beam Type: W4X13

Select Similarity Type: Area of Section

Select Yield Strength (MPa): 235.0

Generate properties from Database

	Variable	Symbol	=	Chosen	1	Alt. Std. 1	2	Alt. Std. 2	3
						Alt. Std. 1: HM148		Alt. Std. 2: HY400X65.4	
0	Mass per Metre	-	=	19.4	kg/m	20.7	kg/m	65.4	kg/m
1	Depth	D	=	105.7	mm	148	mm	400	mm
2	Flange Width	B	=	103.1	mm	100	mm	200	mm
3	Flange Thickness	tf	=	8.8	mm	9	mm	12	mm
4	Web Thickness	tw	=	7.1	mm	6	mm	9	mm
5	Root Radius	r	=	6.4	mm	8	mm	13	mm
6	Toe Fillet Distance	d	=	75.5	mm	114	mm	350	mm
7	Area of Section	A	=	24.7	mm	26.35	mm	83.29	mm
8	Surface Area /m	-	=	0.60	m2	0.67	m2	1.56	m2
9	Second Moment Of Area (X)	Ix	=	472	cm4	995.3	cm4	22600	cm4
10	Second Moment Of Area (Y)	Iy	=	160	cm4	150.3	cm4	1600	cm4
11	Radius Of Gyration (X)	rx	=	4.38	cm	6.15	cm	16.5	cm
12	Radius Of Gyration (Y)	ry	=	2.55	cm	2.39	cm	4.4	cm
13	Elastic Modulus (X)	Sex	=	89.4	cm3	134.5	cm3	1130	cm3
14	Elastic Modulus (Y)	Sey	=	31.1	cm3	30.1	cm3	160	cm3
15	Plastic Modulus (X)	Zpx	=	103	cm3	153.92	cm3	1280	cm3
16	Plastic Modulus (Y)	Zpy	=	47.8	cm3	46.59	cm3	249	cm3
17	Flange Ratios For Local Buckling	b/T	=	5.45	-	5.22	-	7.96	-
18	Web Ratios For Local Buckling	d/t	=	10.63	-	19	-	38.89	-
19	Web Section Class.	-	=	Compact	-	Compact	-	Compact	-
20	Flange Section Class.	-	=	Slender	-	Slender	-	Slender	-

Fig. 1.6: Section Library output example

2. Custom Beam

In this section, you can define custom beam dimensions and visualize the resulting properties. You can input specific values for the beam's dimensions, and the tool will generate the corresponding beam diagram.

Steps:

1. **Select Beam Type:**
    - Choose a **beam type** from the drop-down menu. This will set default values for the beam's dimensions. (E.g. Circular Beam – Diameter and Thickness)

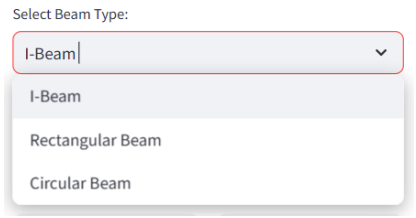


Fig. 2.1: Beam Type Selection

2. **Enter Custom Dimensions (I-Beam):**
    - **Height**: Enter beam height.
    - **Width**: Enter beam width.
    - **Flange Thickness (Tf)**: Enter thickness of the top and bottom flanges.
    - **Web Thickness (Tw)**: Enter thickness of the vertical web.

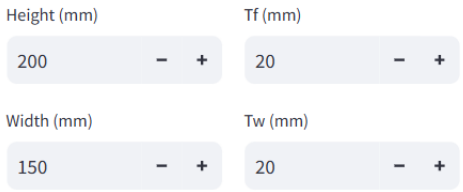


Fig. 2.2: Custom Dimensions Input

3. **Select Similarity Type and Yield Strength (MPa):**
    - From the drop-down menu, choose the desired **similarity type**. Based on the selected similarity type, the most similar beam from **all 3 beam standards** will be displayed in the table generated, in order of similarity.
    - From the drop-down menu, choose the desired **yield strength**.

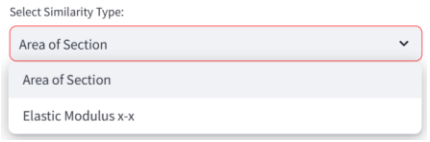


Fig. 2.3: Select Similarity Type

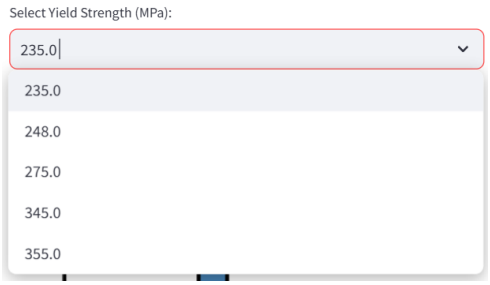


Fig. 2.4: Select Similarity Type

4. **Generate Beam Properties:**
    - After entering the dimensions, click the **Generate Properties** button. This will display a table with the beam's properties such as dimensions, second moment of area, elastic modulus, etc. Web and flange classification is also calculated based on dimensions and selected yield strength.

Alt. Std. 1: HY500X72.4 Alt. Std. 2: HW250X250 Alt. Std. 3: W14X48

	Variable	Symbol	=	Chosen	1	Alt. Std. 1	2	Alt. Std. 2	3	Alt. Std. 3	4
0	Depth	D	=	200	mm	500	mm	250	mm	350.3	mm
1	Flange Width	B	=	150	mm	200	mm	250	mm	204	mm
2	Flange Thickness	tf	=	20	mm	12	mm	14	mm	15.1	mm
3	Web Thickness	tw	=	20	mm	9	mm	9	mm	8.6	mm
4	Root Radius	r	=	0	mm	13	mm	13	mm	15.2	mm
5	Toe Fillet Distance	d	=	160	mm	450	mm	196	mm	289.7	mm
6	Area of Section	A	=	92	mm	92.29	mm	91.43	mm	91.2	mm
7	Surface Area /m	-	=	0.96	m2	1.76	m2	1.46	m2	1.47	m2
8	Second Moment Of Area (X)	Ix	=	5562.67	cm4	37500	cm4	10689	cm4	20170	cm4
9	Second Moment Of Area (Y)	Iy	=	1135.67	cm4	1600	cm4	3648	cm4	2140	cm4
10	Radius Of Gyration (X)	rx	=	7.78	cm	20.2	cm	10.81	cm	14.9	cm
11	Radius Of Gyration (Y)	ry	=	3.51	cm	4.2	cm	6.32	cm	4.84	cm
12	Elastic Modulus (X)	Sex	=	556.27	cm3	1500	cm3	855	cm3	1151	cm3
13	Elastic Modulus (Y)	Sey	=	151.42	cm3	160	cm3	292	cm3	210	cm3
14	Plastic Modulus (X)	Zpx	=	668	cm3	1720	cm3	952.57	cm3	1285	cm3
15	Plastic Modulus (Y)	Zpy	=	241	cm3	251	cm3	443.73	cm3	322	cm3
16	Flange Ratios For Local Buckling	b/T	=	3.25	-	7.96	-	8.61	-	6.47	-
17	Web Ratios For Local Buckling	d/t	=	8	-	50	-	21.78	-	33.69	-
18	Web Section Class.	-	=	Compact	-	Non-Compact	-	Compact	-	Compact	-
19	Flange Section Class.	-	=	Compact	-	Slender	-	Slender	-	Slender	-

Fig. 2.5: Custom Beam Properties Table

5. **I-Beam Diagram:**
    - The I-beam diagram will automatically be drawn based on the selected beam type. The diagram will display the beam's geometry and label key dimensions for easy visualization.

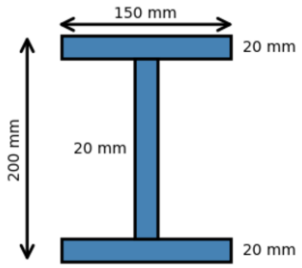


Fig. 2.6: Custom Beam Section Display

MODEC Beam Sensei

Section Library | Custom Beam | Beam Analyzer

Select Beam Type: I-Beam

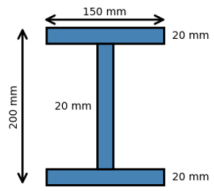
Height (mm): 200 | Tf (mm): 20

Width (mm): 150 | Tw (mm): 20

Select Similarity Type: Area of Section

Select Yield Strength (MPa): 235.0

Generate Properties



Alt. Std. 1: HY500X72.4 | Alt. Std. 2: HW250X250 | Alt. Std. 3: W14X48

	Variable	Symbol	=	Chosen	1	Alt. Std. 1	2	Alt. Std. 2	3	Alt. Std. 3	4
0	Depth	D	=	200	mm	500	mm	250	mm	350.3	mm
1	Flange Width	B	=	150	mm	200	mm	250	mm	204	mm
2	Flange Thickness	tf	=	20	mm	12	mm	14	mm	15.1	mm
3	Web Thickness	tw	=	20	mm	9	mm	9	mm	8.6	mm
4	Root Radius	r	=	0	mm	13	mm	13	mm	15.2	mm
5	Toe Fillet Distance	d	=	160	mm	450	mm	196	mm	289.7	mm
6	Area of Section	A	=	92	mm	92.29	mm	91.43	mm	91.2	mm
7	Surface Area /m	-	=	0.96	m2	1.76	m2	1.46	m2	1.47	m2
8	Second Moment Of Area (X)	Ix	=	5562.67	cm4	37500	cm4	10689	cm4	20170	cm4
9	Second Moment Of Area (Y)	Iy	=	1135.67	cm4	1600	cm4	3648	cm4	2140	cm4
10	Radius Of Gyration (X)	rx	=	7.78	cm	20.2	cm	10.81	cm	14.9	cm
11	Radius Of Gyration (Y)	ry	=	3.51	cm	4.2	cm	6.32	cm	4.84	cm
12	Elastic Modulus (X)	Sex	=	556.27	cm3	1500	cm3	855	cm3	1151	cm3
13	Elastic Modulus (Y)	Sey	=	151.42	cm3	160	cm3	292	cm3	210	cm3
14	Plastic Modulus (X)	Zpx	=	668	cm3	1720	cm3	952.57	cm3	1285	cm3
15	Plastic Modulus (Y)	Zpy	=	241	cm3	251	cm3	443.73	cm3	322	cm3
16	Flange Ratios For Local Buckling	b/T	=	3.25	-	7.96	-	8.61	-	6.47	-
17	Web Ratios For Local Buckling	d/t	=	8	-	50	-	21.78	-	33.69	-
18	Web Section Class.	-	=	Compact	-	Non-Compact	-	Compact	-	Compact	-
19	Flange Section Class.	-	=	Compact	-	Slender	-	Slender	-	Slender	-

Fig. 2.7: Custom Beam output example

3. Beam Analyzer

In this section, you can simulate a beam under load and view the reactions, shear force diagram, and bending moment diagram. This is ideal for analyzing the behavior of the beam under various loading conditions.

Steps:

1. **Enter Beam Parameters:**
    - **Beam Span (m)**: Enter the span (length) of the beam.
    - **Left Support Type**: Choose the type of support at the left end of the beam (either "Pinned" or "Fixed").
    - **Right Support Type**: Choose the type of support at the right end of the beam (either "Pinned" or "Fixed").
    - **Load Location (m)**: Enter the distance of point load from left support.
    - **Load Magnitude (kN)**: Enter the magnitude of the applied load in kilonewtons.

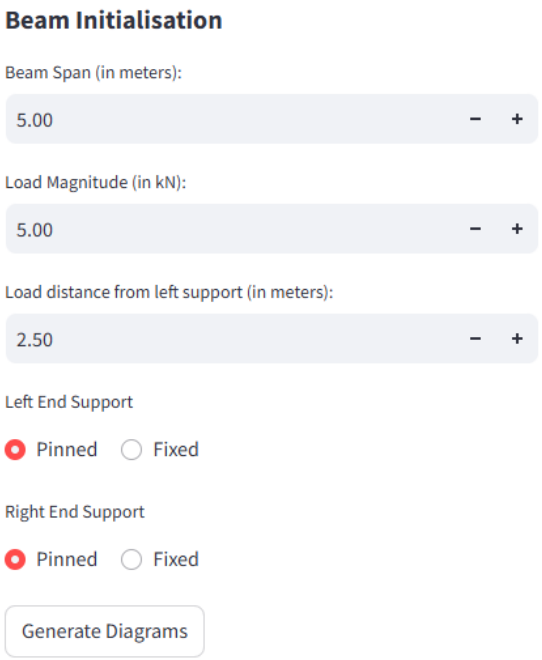


Fig. 3.1: Beam parameters input

2. **Generate Diagrams:**
    - Once all the parameters are entered, click the **Generate Diagrams** button. This will generate three diagrams:
        - **Beam Diagram**: A visual representation of the beam with supports and the applied load.

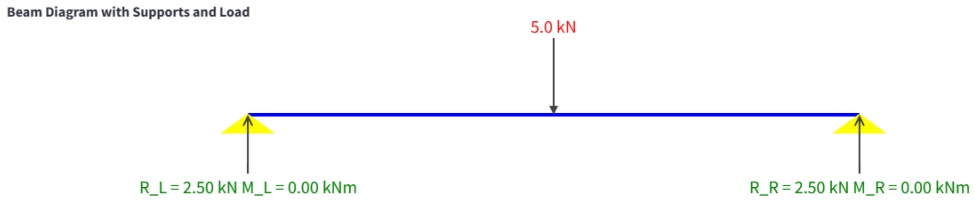


Fig. 3.2: Beam diagram with supports and load.

- **Shear Force Diagram**: A graph showing the shear force at various points along the beam.

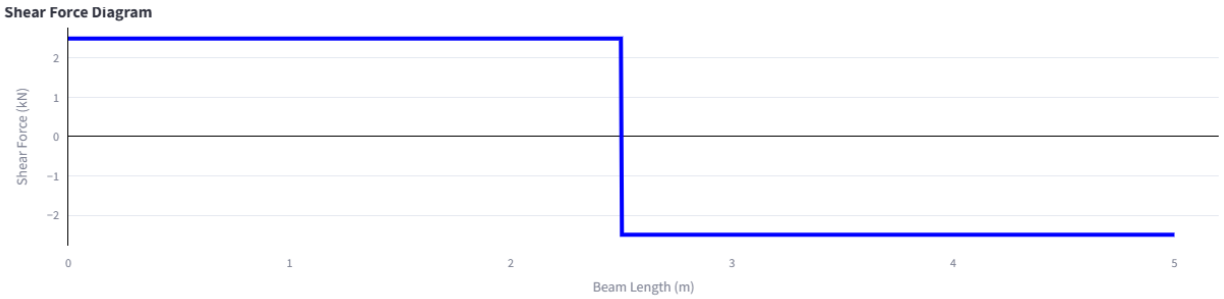


Fig. 3.3: Shear Force Diagram

- **Bending Moment Diagram**: A graph showing the bending moment at various points along the beam.

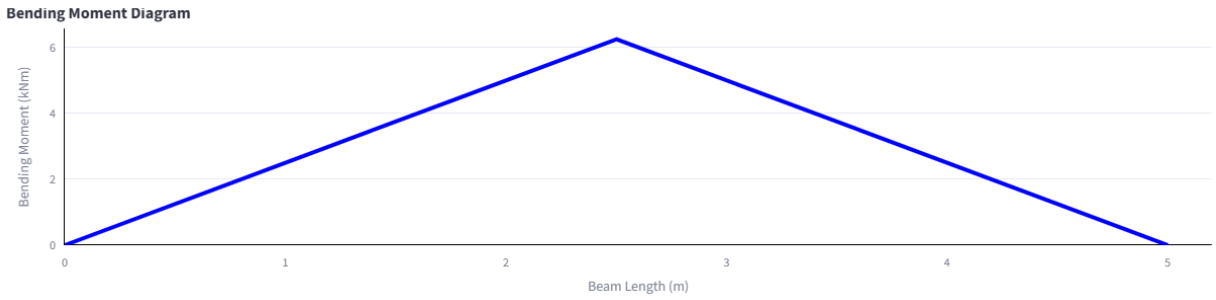


Fig. 3.4: Bending Moment Diagram

4. Help and Support

If you need assistance or encounter issues while using the application, please refer to the following resources:

1. **Frequently Asked Questions (FAQ) (in progress)**:
   Access the FAQ section for common queries about beam properties, how to interpret diagrams, or troubleshooting tips.
2. **Contact Support**:
   If you have more specific questions or need help, you can contact support.

Additional Notes

- **Units**: All dimensions are assumed to be in **millimeters (mm)** for custom beam geometry, whereas **meters (m)** for beam analyzer and all loads are assumed to be in **kilonewtons (kN)**.
- **Reactions and Moments**: The reactions and moments at the beam supports are automatically calculated based on the span, load magnitude, and load location.

Thank you for using **MODEC Beam Sensei**! We hope this helps in your structural analysis tasks.