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Laboratory Course Matlab WS23/24

Static Truss

Submitted to
Lehrstuhl für Technische Mechanik

Submitted by,
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1 Code Questions:

1.1 Which command did you use to realise the support connections in the plot and why? Which other command could you use as well?

The connections are depicted using the plot function, the quiver function, commonly used for displaying arrows to indicate forces, has been used to visualize both supports and forces consistently. We can also use 'scatter' to plot the nodes themselves as points to represent their positions in space.

1.2 How did you determine the size of the coefficient matrix A, the force vector f, and the result vector r?

The number of nodes (which represent degrees of freedom) and the constraints (which are supports and connections) in the structural system define the size of the coefficient matrix A.

•The number of nodes is obtained from length(coordinates(:, 1)), and multiplying it by 2, it accounts for both horizontal and vertical degrees of freedom at each node (2 * length(coordinates(:, 1))).

•The constraints include both supports (bearing) and connections (connections). The total number of constraints is given by length(bearing(:, 1)) + length(connections(:, 1)).

•Combining degrees of freedom and constraints, the size of the coefficient matrix A is [2 * number of nodes, total supports and connections].

1.3 With which commands did you terminate the script, if the necessary and sufficient conditions are not fulfilled, and why?

The 'error' function terminates the program if a necessary condition is not fulfilled. So that no excess computation will take place. If f is not 0 or fa is greater than 0, it shows an error indicating that the system is not statically determined.

1.4 How did you realise the computation of the coefficient matrix entries A(i, j) that depend on the bar forces S. Please explain it in a few key points?

Based on the equilibrium equations for every node in the truss system, the values of the coefficient matrix A are computed. Two components in A are contributed by each bar or truss member (connection), which represent the x and y directions. Angle(w) determines the angle it makes with the x-axis, and cos(w) and sin(w)—two trigonometric functions calculate its influence. Forces in truss members are represented by the result vector r, which is calculated as the matrix algebraic solution to the system of equations.

2 Presentation of results

Degree of freedom of the bounded system **f = 2k-(a+s)**

k-number of **Nodes**

a-number of **Supported Connections**

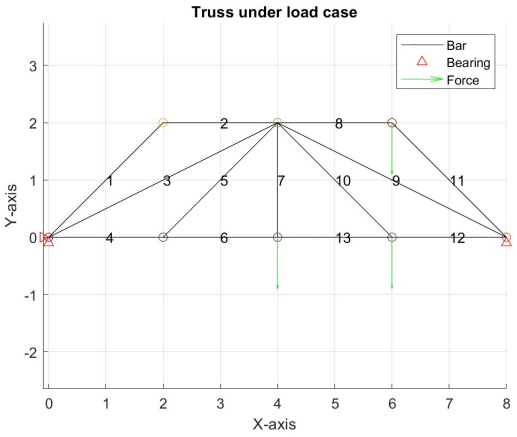
s-number of **Bars**

Degree of freedom of the bounded system for each truss:

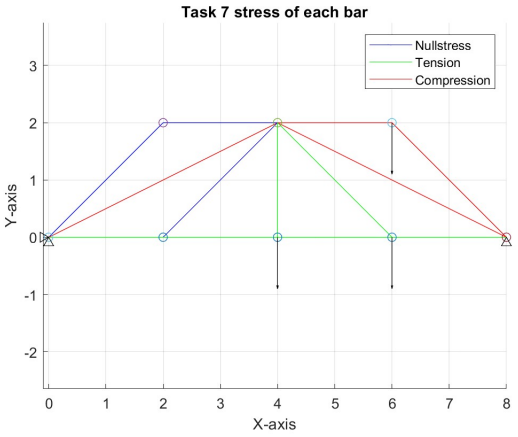
- Truss 1 = 0 (statically determined)
- Truss 2 = 1 (Not statically determined)
- Truss 3 = 0 (statically determined)
- Truss 4 = 0 (statically determined)

3 Plot of the truss under the given load case and plot of the resulting tension, compression and zero bars.

3.1 Truss 1



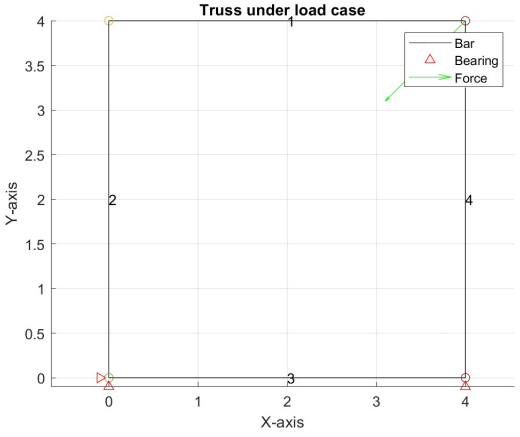
(a) Truss 1 under the given load case



(b) Truss 1 under resulting tension, compression and zero bars

Figure 1: Truss 1, F = 0, statically determined

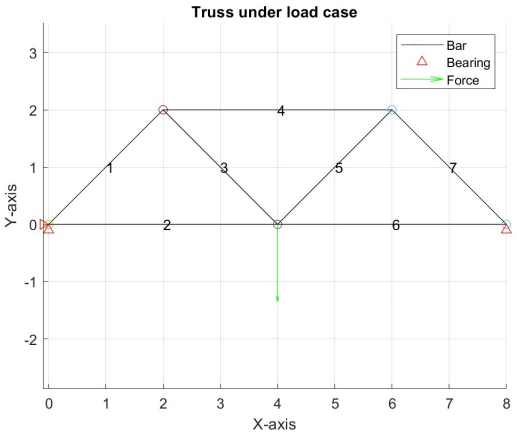
3.2 Truss 2



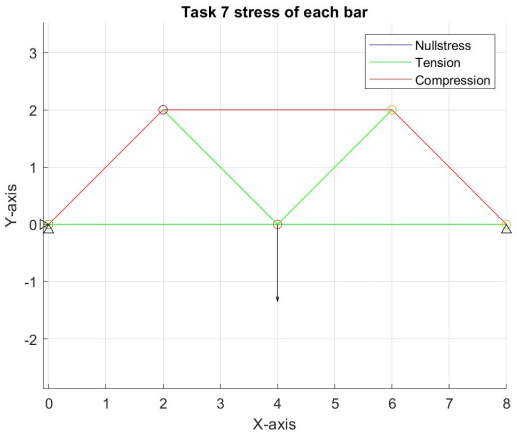
(a) Truss 2 under the given load case

Figure 2: Truss 2, F = 1, Not statically determined

3.3 Truss 3



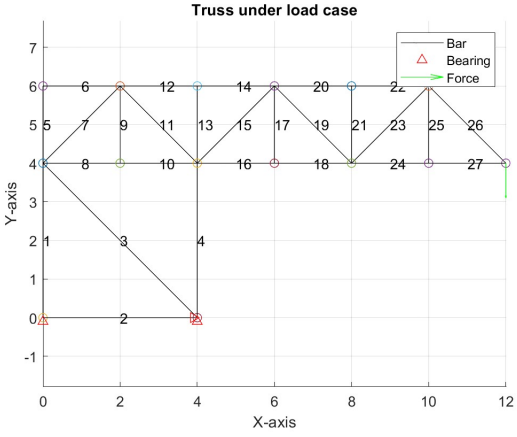
(a) Truss 3 under the given load case



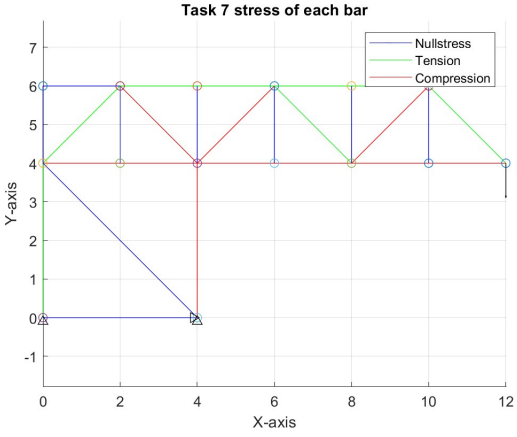
(b) Truss 3 under resulting tension, compression and zero bars

Figure 3: Truss 3, F = 0, statically determined

3.4 Truss 4



(a) Truss 4 under the given load case



(b) Truss 4 under resulting tension, compression and zero bars

Figure 4: Truss 4, F = 0, statically determined