Spaghetti Bridge Final Report

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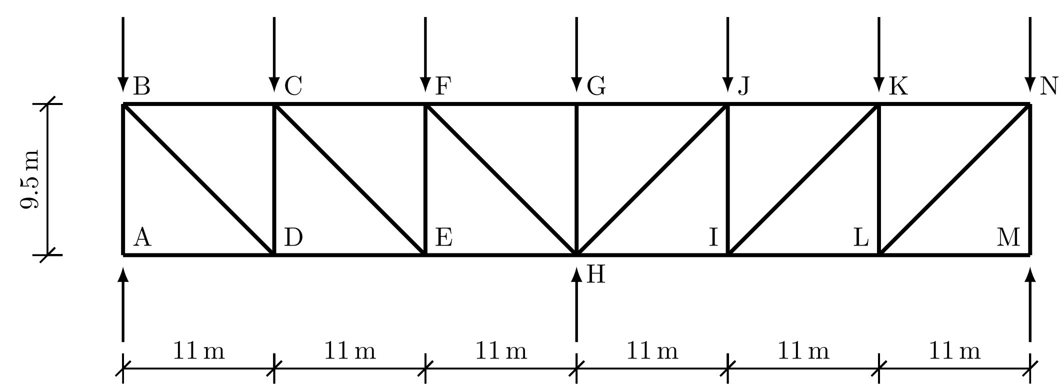


The figure above depicts the free body diagram of our bridge design. Where A_y and M_y are the reaction forces, the forces perpendicular to the beam $B-N$ are a spread out load of the weight of the bridge and the road which is $(0.142+0.780)g$. In all the calculations $g = 9.81$N

First we calculate the individual weight values at each point along the top.

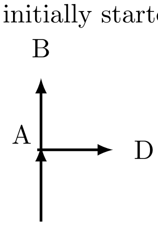
$$\begin{aligned}
B_y = C_y = F_y = G_y = J_y = K_y = N_y &= \frac{W}{7} \\
W &= \frac{142 + 780}{1000} \times g \\
W &= 9.04482\text{N} \\
B_y = C_y = F_y = G_y = J_y = K_y = N_y &= 1.29212\text{N}
\end{aligned}$$

Now we can calculate the reaction forces at A_y and M_y.

$$\begin{aligned}
\zeta{+}\Sigma M_A = 0 &= -W_{total} \times 0.33 + M_y \times 0.66 \\
\zeta{+}\Sigma M_A = 0 &= -2.984791 + M_y \times 0.66 \\
\zeta{+}\Sigma M_A = 2.984791 &= M_y \times 0.66 \\
\zeta{+}\Sigma M_A = 4.52241 &= M_y = A_y
\end{aligned}$$

6.2 Internal Loading

For the calculation of the internal loading we will use the method of joints. We initially started with point:A.

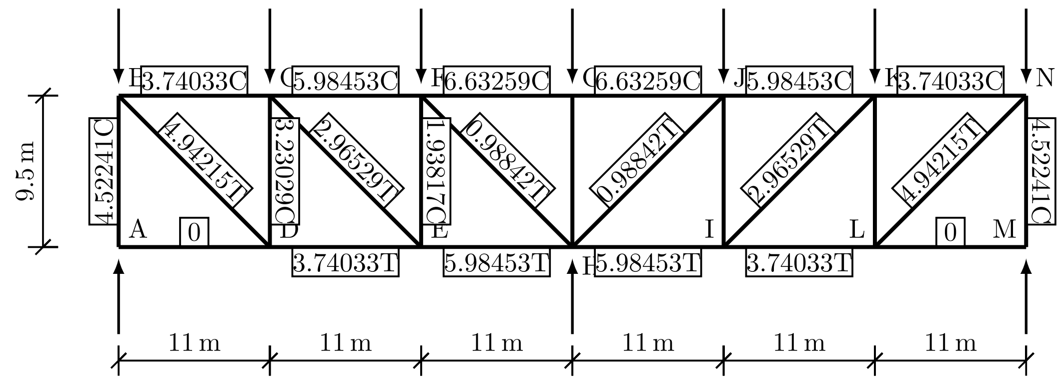


As you can see from this diagram, the summation of forces is very simple and will easily give us the force of both F_{AB} and F_{AD}.

$$\begin{aligned}
\Sigma F_y = 0 &= A_y + F_{AB} \\
\Sigma F_y = F_{AB} &= -A_y \\
\Sigma F_y = F_{AB} &= -4.52241\text{N} \\
\Sigma F_y = F_{AB} &= 4.52241\text{N in compression} \\
\Sigma F_x = 0 &= F_{AD}
\end{aligned}$$

We can then use this same process to find out the forces on each member in the diagram which is shown below. It is important to note that this bridge is symmetrical along the $H - G$ beam meaning that we only had the calculate one side in order to also find out the forces on each member on the other side.

Internal Force diagram where blue is compression and red is tension.



7 Stress Analysis

7.1 Tensile and Compression Strength

7.2 Factor of Safety

8 Conclusions