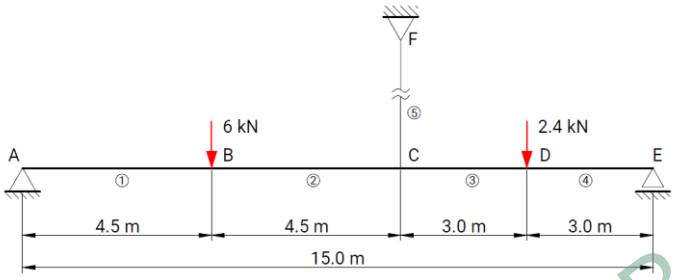
Problem 7

Figure



Description

Consider the composite structure shown in figure. A 15-m timber beam (cross-section 15×20 cm) is supported at points A and E. Two vertical loads act on the beam: 6 kN at point B and 2.4 kN at point D. At point C, the beam is connected to a 12-mm diameter steel rod, 12 m long, which is anchored to an overhead support at F.

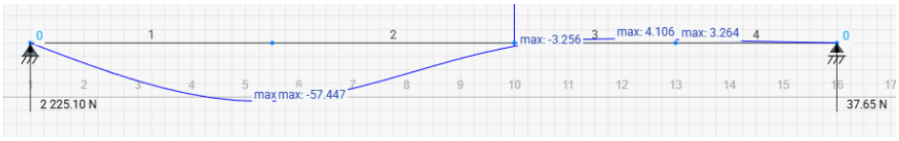
Determine:

- The vertical displacement of point C
- The support reactions at A and E
- The axial force in the hanger rod

Model

Units:	m, kN
Element:	Beam element, truss element
Material:	Steel, E = 2.0×10^{8} kN/m^2; timber, E = 1.0×10^{7} kN/m^2
Section property:	Timber beam: 0.15×0.20 m, hanger: Ø0.012 m
Constraints:	Node A – pinned; node E – roller; node F – pinned
Load Case:	Nodal load -6 kN and -2.4 kN at nodes B and D respectively

Results



Units:			N-mm	
Element	x/L	N	Q	M
5	0	6137.25	0	0
5	1	6137.25	0	0

Comparison of Results

Node	Deformations, mm		
	Theoretical	RodX	Midas/Civil
Δy(C)	–3.256	–3.256	–3.256

Rod	Axial Force, kN		
	Theoretical	RodX	Midas/Civil
5	6.137	6.137	6.137

Node	Reactions, kN		
	Theoretical	RodX	Midas/Civil
A	2.225	2.225	2.225
E	0.0377	0.0377	0.0376

Reference

1. C.K. Wang, Intermediate Structural Analysis, 1985, McGraw-Hill, p.586