Application Sheet
Burncrooks Bridge

Context: Footbridge at Burncrooks Reservoir (near Glasgow)
Objective: Technical assessment of a bridge beam for bending strength

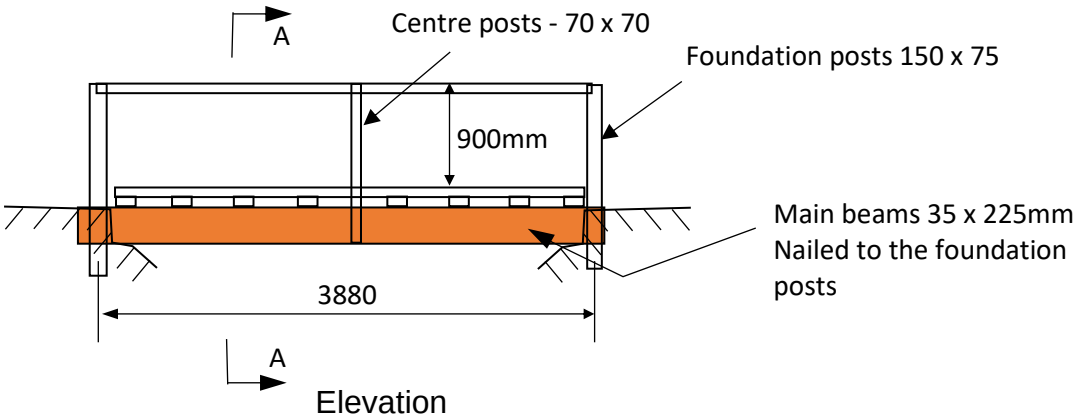
Concepts used in this application sheet

- Force: applied load, uniformly distributed load, total load
- Stress: bending stress, allowable stress, actual stress
- Bending theory: bending moment, bending stress, section properties

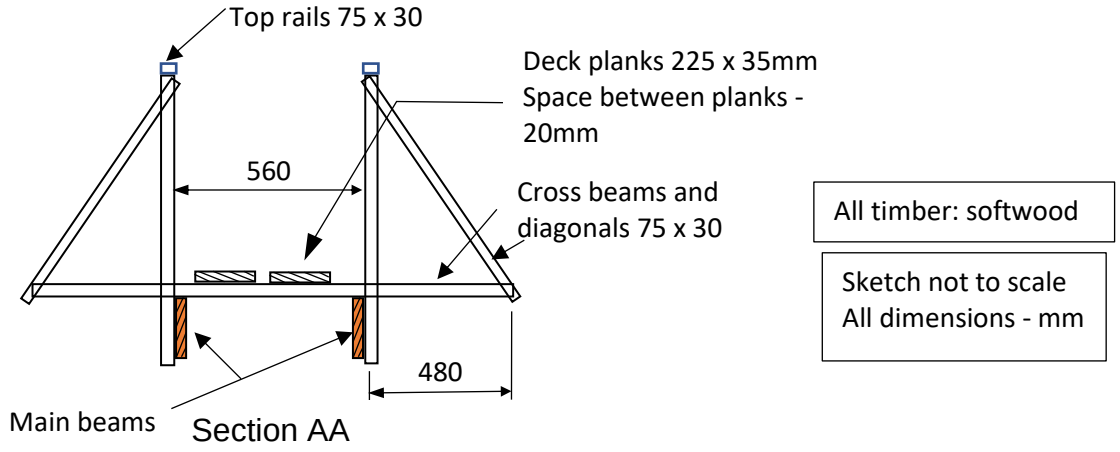
Front view of the bridge

Side view of the bridge

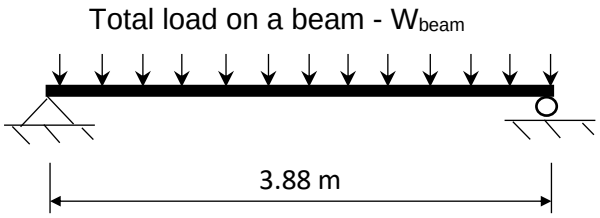
Engineering model



Elevation



Structural Analysis



Analysis model

All forces and dimensions are given in N and mm respectively, unless otherwise stated.

Working load:
Uniformly distributed load per metre on the deck of the bridge, w = 1.5 kN/m

Apply partial factor for load

Partial safety factor for load $\gamma_f = 1.5$ (for preliminary checking)

Design load $W_{Ed} = w \times \gamma_f = 1.5*1.5 = 2.25$ kN/m

Calculate the loading on the beam
Total load on the deck $W = W_{Ed}*L = 2.25*3.88 = 8.7$ kN
Load from the deck is assumed to be distributed evenly between the two main beams:
$W_{beam} = W/2 = 8.7/2 = 4.4$ kN

Design bending moment

$M_{Ed} = W_{beam}L/8 = 4.4*3.88/8 = 2.1$ kNm

Assessment

Strength Criterion for bending
Use the partial factor method
$M_{Ed} / M_{Rd} \leq 1.0$

- M_{Ed} is the design bending moment due to the applied load
- M_{Rd} is the design moment of resistance

$M_{Rd} = Z f_{m.k} / \gamma_m$
where Z is the elastic modulus for the section ($Z = bd^2/6$ for a rectangular section)
γ_m is the partial safety factor for resistance

Data Input
Span L = 3.88 m
Section dimensions: depth d = 225 mm, width b = 35 mm
Bending strength $f_{m,k}$ = 16 N/mm^2 (for C16 timber from EN338 - Table 1)
Partial safety factor for material resistance γ_m = 1.2 (from Eurocode)

Calculations
Section modulus Z = $bd^2/6$ = 35*225^2/6 = 2.95*10^5 mm^3
Design moment resistance $M_{Rd} = Z\, f_{m,k}/\gamma_m$ = (2.95*10^5*16)/1.2 = 3.9*10^6 Nmm

Apply the criterion
M_{Ed} / M_{Rd} = 2.1*10^6/3.9*10^6 = 0.54 < 1 ∴ acceptable
Decision: Suitable section size

Metadata
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