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Exercise #5: Bridge Girder Design Against Lateral Torsional Buckling

The simple supported pedestrian bridge shown in the figure below has a span of 24,00m. The deck is 8,00m long. The load resisting system consists of: (1) two main steel girders that are welded; (2) secondary beams; and (3) from a concrete slab (γ=25kN/m^3) with thickness of 20cm as shown in Figure 1. The steel girders are made of S235 steel (nominal f_y =235MPa, γ=78.5kN/m^3). Assume that the slab does not provide continuous lateral support at the top of the girder.

1. Calculate the moment of inertia I_{yy}, I_{zz}, warping and torsional constants of the main girder.
2. Check if the cross-section is Class 1 or 2.
3. Compute the normalized slenderness of the girder λ_{LT} (requires calculation of $M_{y,cr}$)
4. Compute the reduction factor χ_{LT} due to lateral torsional buckling.
5. Check if the girder is adequate for lateral torsional buckling due to dead load. The dead load calculations should be based on the self-weight of the girder and the concrete (1.35xDL).
6. In case that the girder is under designed, suggest one simple way to improve the design without changing the girder size.

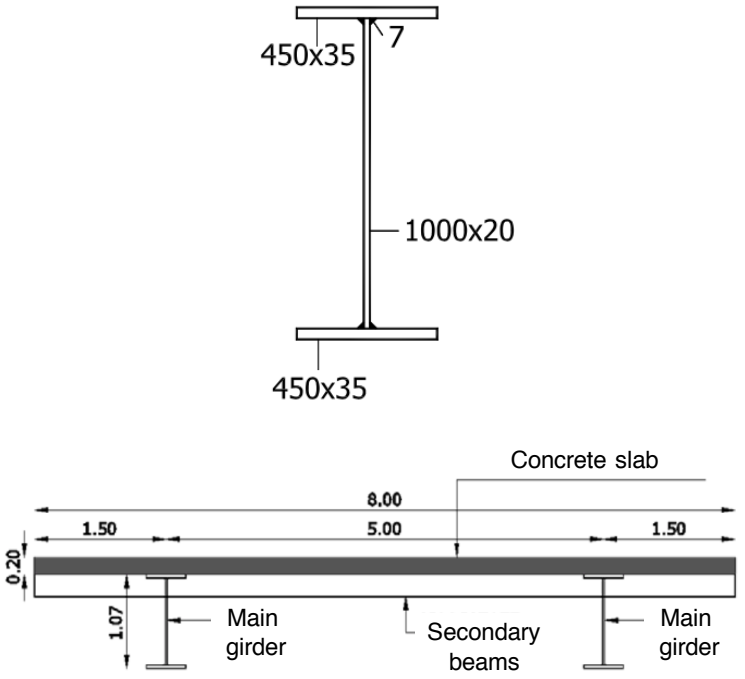

Figure 1. Section of pedestrian bridge deck (cross-section dimensions in mm; bridge dimensions in meters)