

EXAMINATION SYNOPSIS

STEEL AND COMPOSITE BRIDGES

for the students in *STRUCTURAL ENGINEERING, 2016-17*

Prof. Nikolaj RANGELOV

1. Advantages and disadvantages of the steel bridges. Effective ranges of application. Main parts and structural systems. Types of main load-carrying systems – fundamental bridge forms.
2. Fatigue – the phenomenon and factors. Fatigue assessment: $S-N$ curves, stress range spectrum, reservoir method, Palmgren-Miner rule of cumulative damage.
3. Open grid decks for railway bridges. Loads, analysis and detailing.
4. Bracings at deck level of railway bridges. Nosing forces, bracing between stringers. Acceleration/ braking forces – braking girders.
5. Ballasted decks for railway bridges.
6. Road bridge decks. Loads and general arrangement. Aspects of analysis.
7. Orthotropic decks – arrangement, structural behaviour and detailing.
8. Orthotropic decks – basic principles of analysis. Aspects of member calculations.
9. Main plate girders. Arrangements, loading, analysis, envelope diagrams. Cross-sections, local buckling.
10. Main plate girders. Detailing aspects. Cover of the internal force envelope diagrams. Erection splices.
11. Shear lag. Stability of longitudinally stiffened plates.
12. Box girder bridges. Advantages. Structural arrangement and main parts. Aspects of detailing.
13. Box girder bridges. Aspects of their behaviour and analysis: torsion, warping torsion and distortion.
14. Main truss girders. Configurations. Cross-sections of members. Aspects of the analysis.
15. Truss girders. Joint design and detailing aspects. Chord splices. Gusset plates.
16. Bracing system of steel beam bridges. Basic principles. Different types of plan bracing configurations and interaction with the main girders. Loading on the bracing system and aspects of the analysis.
17. Cross bracing and portal frames. Half-through bridges and U-frames. Lateral stability of the “free” flange.
18. Composite bridges. Structural arrangement. Geometrical properties of the cross-section and stress state in elastic stage. Stages of work.
19. Composite bridges. Effects of isostatic self-balanced situations: shrinkage and temperature changes. Secondary hyperstatic effects.
20. Continuous composite beam bridges. Analysis. Elastic and plastic bending resistance. Shear resistance.
21. Shear connection between the R/C slab and the steel beam in composite bridges. End effects. Shear connectors – types and resistance.
22. Longitudinal shear in the slab. Filler beam decks. Ideas for controlling the stress state in single-span and continuous composite bridges.
23. Bearing systems. Basic principles and bridge articulation. Bearing displacements. Types of bearings.
24. Support joints and bearing stiffeners. Brief information of steel bearings, PTFE, elastomeric and hybrid bearings.
25. Specific aspects of seismic-resistant design of beam bridges. Special bearings and other devices.