

5.4 RAILWAYS, BRIDGES AND TUNNELS

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RATIONALE

The subject will cater to the needs of those technicians who would like to find employment in the construction of railway tracks, bridges and tunnels. The subject aims at providing broad based knowledge regarding various components and construction of railway track, bridges and tunnels.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

- CO1 Describe different component parts of permanent way such as rails, sleepers and ballast.
- CO2 Distinguish different types of rail gauges used in India.
- CO3 Classify bridges and select suitable type of bridge for a particular purpose.
- CO4 Describe essential components of bridge foundations and substructures.
- CO5 Classify the tunnels and have the knowledge of Bored Tunnel Method of tunnel construction
- CO6 Carry out ventilation, drainage and lightening of tunnels

DETAILED CONTENTS

PART – A: RAILWAYS

UNIT – I

- 1.1 Introduction to Indian Railways
- 1.2 Advantages of Railways: Political, Social, Economic and Techno-Economic Advantages.
- 1.3 Classification of Indian Railways: On the basis of the Importance of Route, Traffic Carried and Maximum Permissible Speed on the routes.
- 1.4 Railway surveys: Traffic surveys, Reconnaissance survey, Preliminary Survey and Detailed Survey.
- 1.5 Permanent Way: Requirement of an ideal permanent way, Capacity of railway track, Gauges in railway track – Broad, Meter and Narrow Gauges, Selection and Uniformity of gauges, Conning of wheels.

- 1.6 Subgrade and Embankment for Railway Tracks: Functions of subgrade, Subgrade materials and its improvement - use of geo-synthetics, Slopes of embankment their protection, Stability of embankment – Control of erosion, Toe Wall
- 1.7 Track Alignment: Basic requirements of good alignment, Factors influencing the track alignment.
- 1.8 Geometric Design of the Railway Track: Necessity of geometric design of a railway track, Gradient and Grade compensation, Speed of the train, Degree of curve, Super-elevation and Negative super-elevation. (Simple Numerical Problems)

UNIT – II

- 2.1 Construction of Track: Earth work - formation and consolidation, Plate laying – laying of a railway track, laying of ballast on the track.
- 2.2 Track Drainage: Sources of moisture in a railway track, Drainage systems – Surface drainage and subsurface drainage.
- 2.3 Maintenance of Track: Necessity of maintenance, Daily and Periodic maintenance, Maintenance of track alignment, Maintenance of gauge, Maintenance of proper drainage, maintenance of sleepers.
- 2.4 Rails: Functions of rails, Requirements of rails, Types of rails – Double Headed Rails, Bull Headed Rails, Flat Footed Rails, Selection of rails, Length of rails.
- 2.5 Ballast: Functions of ballast, Requirement of the good ballast, Types of ballast, Size and section of ballast, Quantity of ballast.
- 2.6 Sleepers: Functions of sleepers, Requirements of sleepers, Reinforced and Prestressed Concrete Sleepers.
- 2.7 Stations and Platforms: Site selection for railway station, Requirement of a railway station, Platforms – Passenger and Goods platforms.

PART – B: BRIDGES

UNIT-III

- 3.1 Bridges: Definition and Basic forms, Components of a bridge, Difference between a bridge and a culvert, Classifications of bridges (only names), Importance of bridges, Standard specifications.
- 3.2 Investigation for Bridges: Need of investigation, Selection of bridge site, Linear waterway, Economical Span, Location of Piers and Abutments, Vertical clearance above highest flood level, Scour Depth. Factors influencing the choice of the bridge type and its basic features.

- 3.3 Bridge Foundations: Well foundations – Components and Sinking of wells, Pneumatic Caissons, Cofferdams for bridge piers, Box Caissons.
- 3.4 Bridge Substructure: Pier and Abutment Caps, Materials for Piers and Abutments, Pier – Loads and Forces to be considered in the design of piers, Abutments - Loads and Forces to be considered in the design of abutments, Back-fill behind the abutments, Wing walls – Straight, Splayed, Return and Curved wing walls.

UNIT-IV

- 4.1 Reinforced Concrete Bridges:
 - 4.1.1 Slab bridges – Components of a slab bridge, Number and spacing of main girders, Cross beams.
 - 4.1.2 Introduction only for the: Balanced Cantilever Bridges, Continuous Girder Bridges, Rigid Frame Bridges.
- 4.2 Prestressed Concrete Bridges: Types of prestressed concrete bridges, Erection of precast girders, Segmental cantilever construction, Cast-in-place segments, Precast segments, Connection at mid-span, Advantages.
- 4.3 Construction of Bridges: Incremental Push Launching Method
- 4.4 Bridge Bearings: Purpose of bearings, Types of Bearing – Sliding Plate Bearing, Sliding-cum-Rocker Bearing, Steel Roller-cum-Rocker Bearing, Elastomeric Bearing.
- 4.5 Maintenance of Bridges: Inspection of bridges, Maintenance – Routine, Preventive, Repairs and Strengthening / Replacement Maintenances, Maintenance of Bearings.

PART - III: TUNNELS

UNIT-V

- 5.1 Necessity, Advantages and Classifications of tunnels, Size and shape of tunnel, Site investigation for tunnels, Geotechnical considerations of tunneling.
- 5.2 Alignment of tunnel, Portals and shafts, Bored Tunnel method of Tunnel Construction
- 5.3 Typical section of tunnels for a national highway.
- 5.4 Typical section of tunnels for single and double broad gauge railway track.
- 5.5 Ventilation – Necessity and methods of ventilation: by blowing, exhaust and combination of blowing and exhaust, Dust control in tunnels.
- 5.6 Drainage method of draining water from tunnels.
- 5.7 Lighting of tunnels.
- 5.8 Uses of geo-synthetics in tunnels.

RECOMMENDED BOOKS

1. “Railway Engineering” by Vaswani, NK; Publishing House, Roorkee
2. “Railway Engineering” by Rangwala, SC; Anand, Charotar Book Stall
3. “A Text Book of Railway Engineering” by Deshpande, R; Poonam United Book Corporation
4. “Bridge Engineering” by Algia, JS; Charotar Book Stall, Anand
5. “Essentials of Bridge Engineering” by Victor Johnson; Oxford and IBH, Delhi
6. “Bridge Engineering” by Rangwala S.C; Charotar Book Stall, Anand
7. IRC Bridge Codes
8. MoRTH drawings for various types of bridges
9. MoRTH pocket books for bridge Engineers, 2000 (First Revision)
10. “Tunnel Engineering” by Subhash C Saxena; Dhanpat Rai and Sons, Delhi
11. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

RECOMMENDED WEBSITES

1. <https://swayam.gov.in/>
2. <https://www.udemy.com/>
3. <https://www.upgrad.com/>
4. <https://www.khanacademy.org/>

INSTRUCTIONAL STRATEGY

This subject is of practical nature. While imparting instructions, teachers are expected to organize demonstrations and field visits to show various components and construction of railway track, bridges and tunnel. This subject contains five units of equal weightage.