

CILTHK Seminar

Topic: Introduction to Railway Bridges

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Contents

1. Introduction
2. History of Railway Bridge
3. MTR Bridge
4. Types of Railway Bridge
5. Railway Bridge Key Functional Requirements
6. Railway Bridge Structure
7. Types of Railway Bridge Trackform
8. Basic Railway Bridge Design Principle
9. Principles of Railway Bridge Aesthetics
10. Question and Answer



Introduction



What is the Railway Bridge?

A railroad bridge is a structure constructed for the exclusive purpose of carrying **railroad traffic across an obstruction**, railway bridge built to carry a railway over a road, river, etc.

Source: Collins English Dictionary

Nanjangud Railway Bridge built in 1735



Source:Wikipedia

Whirlpool Rapids Bridge over the Niagara River (1983).



Source:Wikipedia

Railway bridge in China Songhua River in 1903



The deck-girder bridge spanning the Colorado River near rural Topock, Arizona circa 1964.



The Tongjiang Sino-Russian Heilongjiang Railway Bridge (first cross-river railway bridge between China and Russia) was completed in July 2019



Lo Wu Railway Bride, 1980



Rambler Channel Bridge

Single-cell box girder bridges

- Length

1,100 metres

- Bridge surface

23 140 m²

- Span lengths of main bridge

5 × 121 m - 2 × 90 m - 60 m



Tsing Ma Bridge

Double-decked suspension bridge

- Width

41 metres (135 ft)

- Longest span

1,377 metres (4,518 ft)

- Clearance below

53 metres (174 ft) (official shipping height restriction)[1]

- No. of lanes

6 (upper deck), 2 (lower deck)



Kap Shui Mun Bridge

Double-decked cable-stayed bridge

- Total length
750 metres (2,460 ft)
- Width
32.5 metres (107 ft)
- Longest span
430 metres (1,410 ft)
- Clearance below
47 metres (154 ft)



Aberdeen Channel Bridge

Reinforce Concrete bridge

- Total length
246m
- Width
40 m
- Total 24 pairs of segments weighing up to 160 tons were cast for the bridge



Types of Railway Bridge



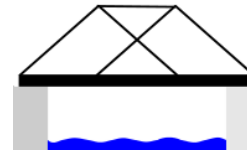
Simple Support Beam



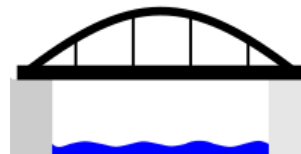
Cantilever



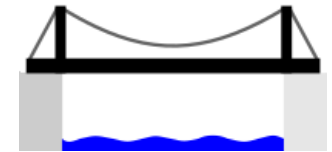
Arch Bridge



Truss



Tied Arch Bridge

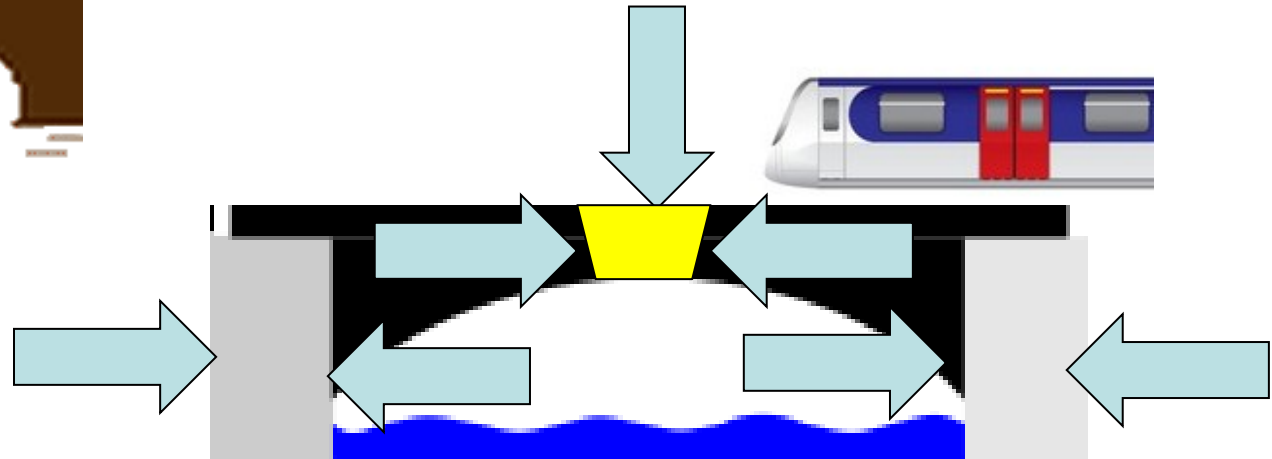


Suspension Bridge



Cable-stayed Bridge

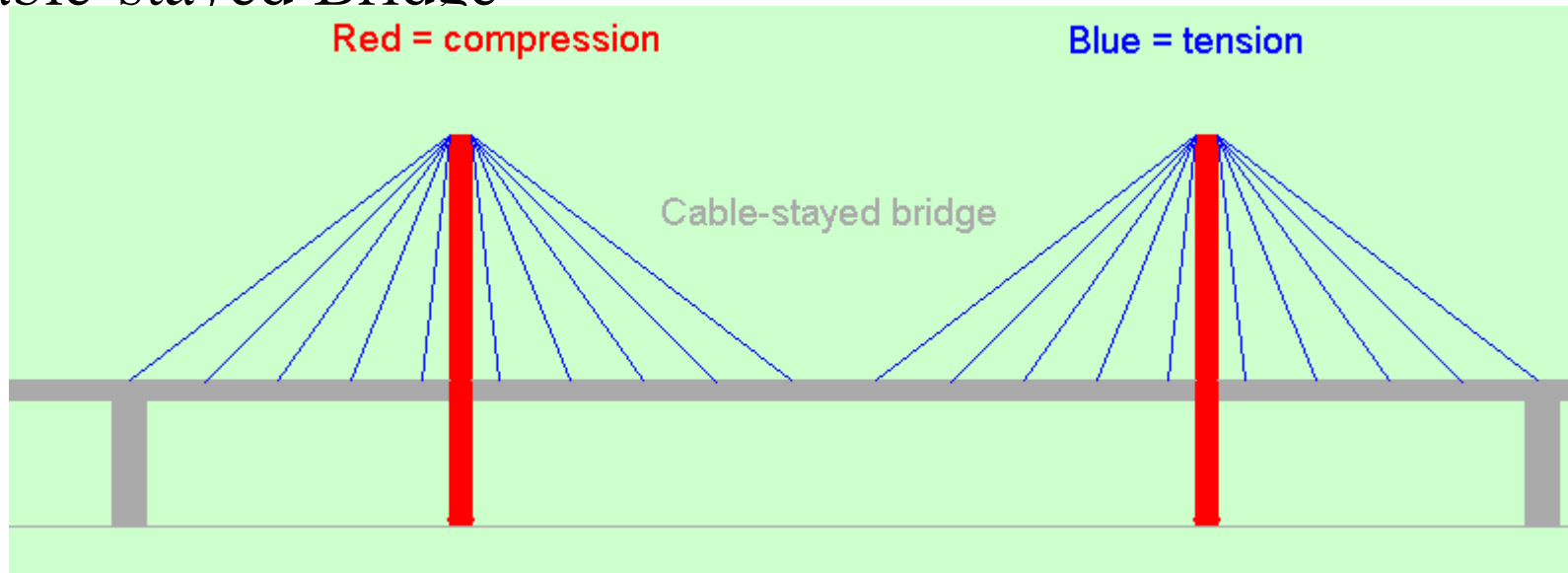
Arch Bridge



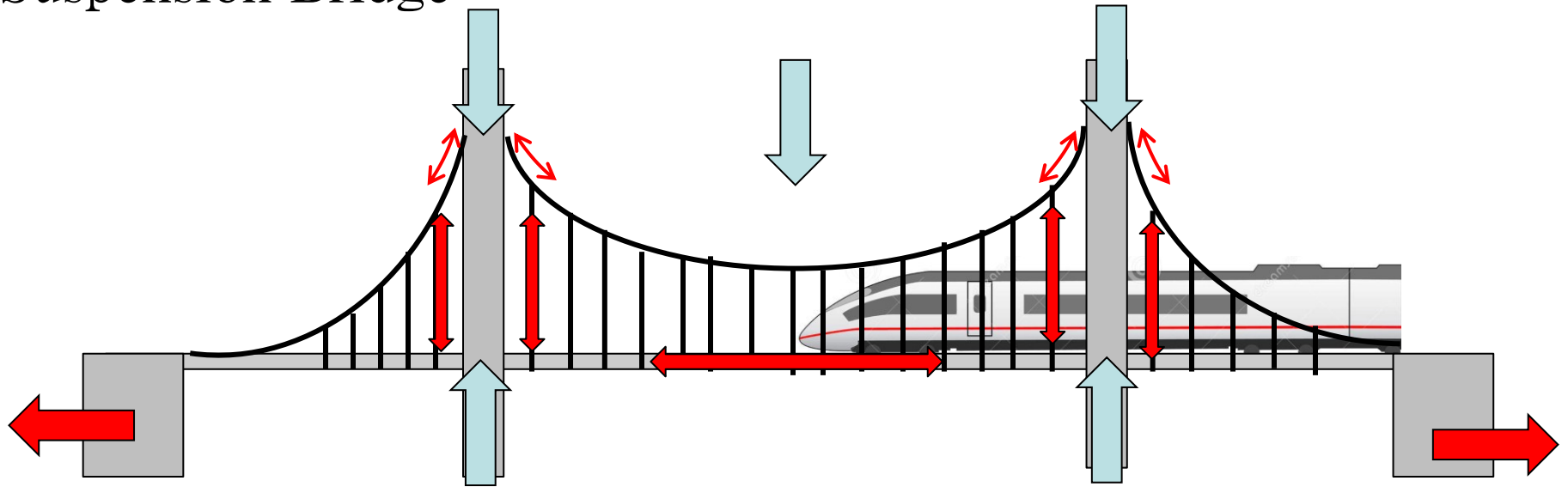
Work by Compression



Cable-stayed Bridge



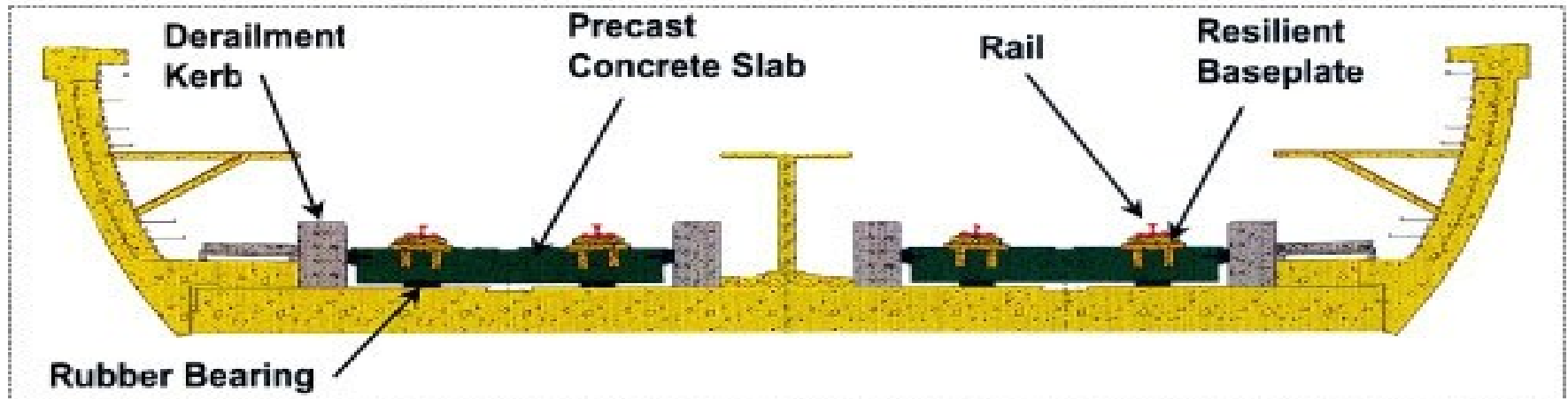
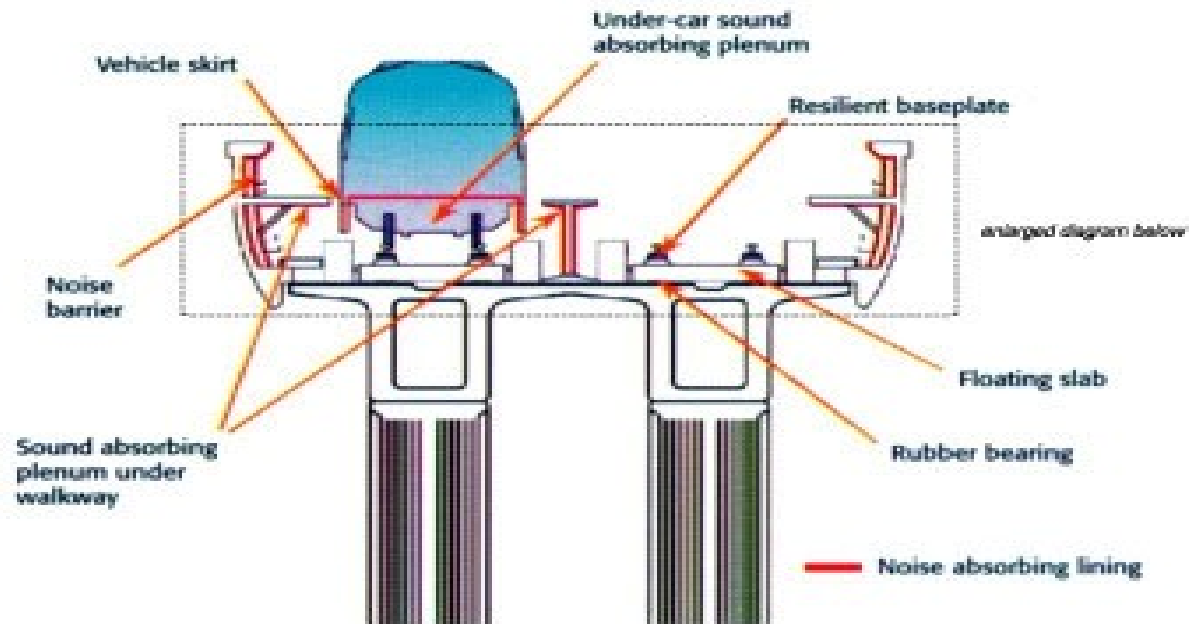
Suspension Bridge



Works by *Tension* and *Compression*



Typical Railway Bridge Trackform



Railway Bridge Trackform – Floating Slab Track



Source: WIKIPEDIA

Railway Bridge Trackform – Ballasted Track



Source: WIKIPEDIA

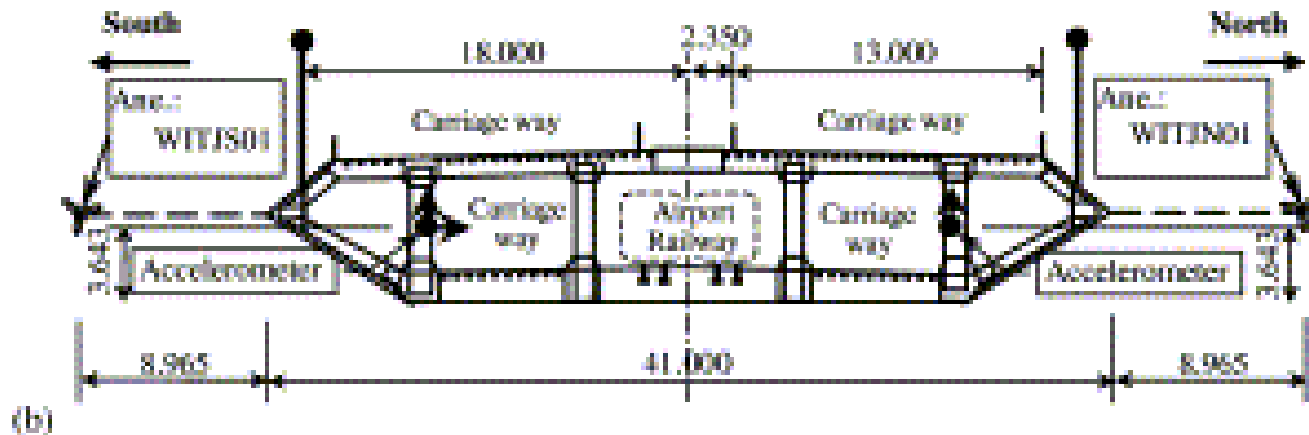
Railway Bridge Trackform – Discrete Concrete Plinth



Railway Bridge Trackform – Timber Support



Railway Bridge Trackform – Rail Bearer Support



Source: WIKIPEDIA



Railway Bridge Trackform – Plinth Track



Source: WIKIPEDIA

Railway Bridge Trackform – Low Vibration Track



Source: WIKIPEDIA

Key Functional Requirements

1. Provision of satisfactory support to the railway traffic and infrastructure throughout the life of the railway bridge
2. Provision of adequate clearances between the structure and the traffic on and beneath the bridge

Note:

The first requirement should fulfill the below four basic requirements:

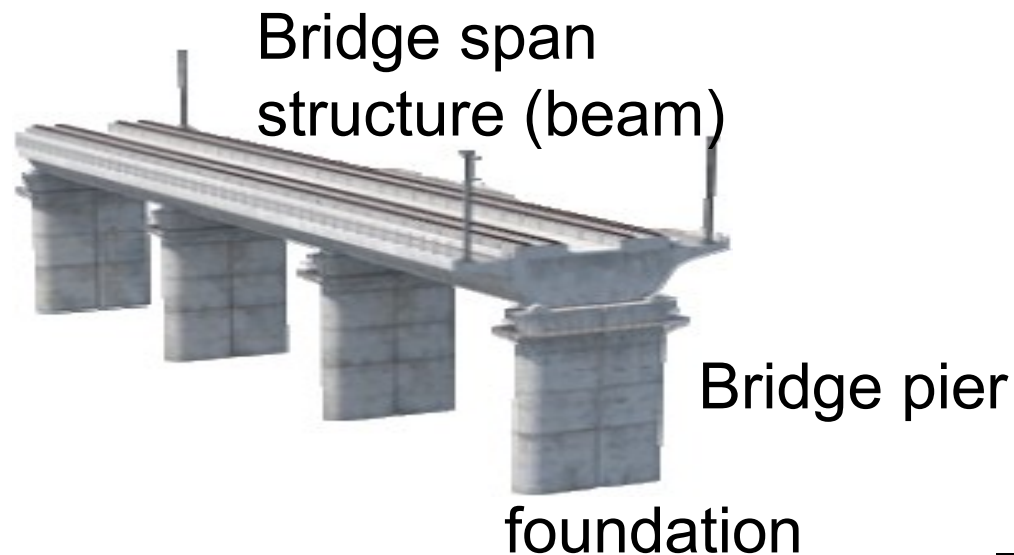
- Strength and Fatigue endurance
- Limiting the railway bridge deformation
- Robustness
- Durability

The second requirement is expressed in terms of various 'Clearance, Structure & Kinematic Gauge.

Source: Design Guide for steel Railway Bridge SCI Publication P318

Railway Bridge Structure

The main bridge is composed of bridge span structure, bridge pier, abutment and foundation. The bridge span structure is usually also called the beam and connect the abutments at both ends. The abutment connect the beam and the embankment at the bridge head. The bridge pier is to support various forces from the beam. The foundation is to spread the various forces from the bridge piers and abutments to the foundation.



Railway Bridge Design Principle

1. To ensure safety and comfort under rail traffic
2. Strictly control the inelastic deformation of the bridge structure to maintain continuous stability and high smoothness of the track
3. The concept of environmental adaptability
4. Pay attention to the concept of service transportation and comprehensive benefits

The Construction of Railway Bridges Then and Now

The history of construction methods may be categorized:

1825 to 1900 Pre-mechanized age

- From 1875 Railway cranes
- From 1950s Road mobile cranes
- From 1980s Rolling-in, sliding, launching, transporters
- From 1960s Substructure developments
- From 2000s Mobile Framework and crane



Source: int. j. for the history of eng. & tech., Vol. 84 No. 1, January 2014, 59–87

Widening of overbridge at Queens Park Station in 1962 using wartime stored prestressed beams.



Traveller used for bridge erection, Great Central Railway, 1894 – 99



Erection of bridge over River Wye, Monmouth, 1873, supported by timber piles and using traveller.



Erection of type A bridge near Bedford with 45 ton and 75 ton breakdown cranes, 1964. Thirty-hour possession.



125 t Kirow crane erecting 27 m span bridge on North York Moors Railway, 2010.



Exeter River Exe Bridge, one track rolled in from each side, 1997.



Sliding-in of Brinnington Bridge 70A over M63 and M66, 1988.



Erection using Transporters of New Cross Gate Bridge, East London Line, 2010.



Modern Railway Bridge Construction Plant



Principles of Railway Bridge Aesthetics

- (1) Satisfaction of purpose and function;
- (2) Have good and harmonious proportions in three-dimensional space;
- (3) The principle of the sequence of lines and edges of structures;
- (4) Refined form;
- (5) Must be combined with the environment, landscape or urban style, and must be connected with the size of the person;
- (6) The choice of materials, surface texture, color, etc. are compatible with environmental requirements;
- (7) The important role of color;
- (8) Show the characteristics, characteristics or purpose, status of the building should have;
- (9) Show the artistic charm produced by the integration of the complexity and variability of the building;
- (10) Protect and construct natural environment, develop landscape resources.

Q & A



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