

## Design of Tall Railway Bridges in North Eastern States, India

**Sumantra Sengupta**

*B&S Engineering Consultants Pvt. Ltd.*

Contact: [sumantrasengupta@bsecpl.in](mailto:sumantrasengupta@bsecpl.in)

### Abstract

Northeast Frontier railway (NFR) intends to connect Manipur, Mizoram and Nagaland with rest part of India. The railway lines pass through eastern trail of Himalaya resulting construction of large number of tunnels and bridges. The entire area is under seismic zone V. The heights of the piers vary from 20m to 141m with maximum length of bridges 700m. The configurations of the bridges were finalized taking into consideration of the parameters like span, location of the pier on the hill slope, constructability, maintainability, safety and economy. Multi modal analysis using site specific spectrum, spectrum compatible time history analysis and spatially varying time history analysis was performed to understand the behaviour of the structure under seismic and deformed shape of the continuous rail on the superstructure for safety of the train movement. Wind tunnel analysis was performed to understand the behaviour of bridge under wind force.

**Keywords:** Tall piers, High seismic zone, Slope stability, Site specific spectrum, Spectrum compatible time history analysis, Pushover curve, Spatially varying time history analysis, Track movement, Wind tunnel test.

### 1 Introduction

Indian Railway intends to connect the capitals of the four North-East states, Manipur, Mizoram, Nagaland and Arunachal Pradesh with Assam by railway link. The work of Manipur and Mizoram and Nagaland has been started and the designs of 5 tall bridges in Manipur and 6 tall bridges in Mizoram are already complete and 3 tall bridges in Nagaland are in progress. Construction in Manipur is almost complete and the first stretch of 60km length has already opened to traffic in which the tallest bridge is having 100m height of pier. Construction in Mizoram and Manipur is progressing in full swing. The piers are being constructed using slip form technology and the superstructures are being launched by cantilever erection method. The length of railway line in Manipur is about 125km, that of Mizoram is about 60km and in Nagaland is about 80km which are under construction now. The alignments of the railway lines pass through steep rolling hills of Patkai region, eastern trail of Himalaya, and as a result large number of tunnels

and bridges need to be designed and constructed. While the high mountains are penetrated by tunnel, the deep gorges between the mountain ridges are connected by tall bridges. The tallest of such bridges spans over a gorge at about 140m above its bed level with an overall length about 700m at rail level. With extensive study and discussion on possible alternative span arrangement of the bridges, considering the parameters like the length of span, type of span, location of the piers, constructability, maintainability, safety and economy it was finally decided that main superstructures would be steel open web through type girders of span up to 103,5m (c./c bearing). The piers are of RCC hollow type with the tallest piers of 141m height. Other piers on the slope of the hills vary from 20m to 120m height. The foundations were designed with 1,5m diameter piles that penetrate into rock layers with maximum length of 30m. The critical issues of analysis and design involve preparation of site-specific spectrum for seismic design of the bridge, spectrum compatible time history analysis and