

Study on Design and Analysis of a Steel Access Bridge Over a River

Sanu Karmakar¹, Chitrnanjan Kumar²

¹M.Tech Scholar, Dept. of Civil Engineering, Shri Venkateshwara University, U.P.

²Assistant Professor & Supervisor, Dept. of Civil Engineering, Shri Venkateshwara University, U.P.

Abstract - The increasing demand for efficient and safe construction practices in riverine environments has led to the widespread use of temporary steel platforms for infrastructure development. This paper presents the design and analysis of a steel finger platform bridge constructed over a river to facilitate crane operations, material handling, and equipment movement during construction. The study focuses on the structural behaviour of a pile-supported steel platform subjected to dead load, live load, heavy crane loading, wind forces, and water current effects, designed as per IRC 6:2017 and IS 800:2007. A three-dimensional model was analysed in STAAD.Pro to evaluate load distribution through deck panels, main girders, cross beams, and bracing systems, and to determine governing bending moments, shear forces, and stresses. Results show that crane loading, particularly the 150T crawler crane during front lifting, governs the design and produces the maximum stresses in the deck panels and main beams. All structural components-deck panels, beams, bracing members, and bolted connections-were found to be within permissible limits. The study concludes that steel finger platforms offer an efficient, economical, and structurally reliable solution for temporary access in bridge construction projects.

Key Words: Steel finger platform, temporary access bridge, STAAD.Pro, crane loading, IRC 6, IS 800.

1. INTRODUCTION

Infrastructure development in riverine environments presents unique engineering challenges due to difficult site conditions, limited accessibility, and the presence of water currents and environmental forces. During construction of bridges across rivers, it becomes essential to provide temporary access for heavy machinery, material transportation, and workforce movement. Steel finger platforms, typically supported on piles and extending from the riverbank into the water body, are widely adopted for this purpose because of their high load-carrying capacity and ease of fabrication and erection. This paper presents the design and analysis of a steel finger platform bridge over a river, evaluating its performance under dead load, live load, crane load, wind load, and water current load, in accordance with IRC 6 and IS 800. The primary aim is to understand the behaviour of deck panels, beams, bracing systems, and connections under applied loads, and to ensure their adequacy in strength and serviceability, thereby contributing to safer and more economical design practices for temporary steel access platforms.

2. METHODOLOGY

The geometry of the finger platform-span length, number of girders, spacing, and overall layout-was defined based on project requirements over the river. All relevant loads acting on the structure, namely dead load, live load, crane load, wind load, and water current load, were computed as per IRC 6:2017. A three-dimensional structural model was then developed in STAAD.Pro to evaluate bending moments, shear forces, axial forces, and stress distribution in the deck panels, main beams, cross beams, and bracing members, and to identify the governing load combinations.

Material properties conforming to IS 2062 structural steel were adopted, with modulus of elasticity $E = 200,000$ MPa, yield strength $F_y = 250$ MPa, ultimate strength $F_u = 410$ MPa, and density 78.5 kN/m³. Steel was modelled as a linear elastic material with rigid joints, supports were modelled per actual pile restraint conditions, and self-weight was generated automatically by STAAD.Pro. Based on the analysis results, structural components were designed as per IS 800:2007, with each element checked for bending capacity, shear capacity, buckling resistance, and connection safety.

Crawler crane loading of 150T, 100T, and 75T capacity was considered for side lifting, front lifting, and marching conditions, with front lifting producing the highest forces. A BG-38 piling rig load and IRC Class 70R vehicular loading (central, edge, single-axle, and multi-axle positions) were also applied. The structure was checked for factored load combinations as per IS 800:2007 and IRC provisions, including $1.35DL+1.5LL$, $1.35DL+1.5(Crane\ Load)$, $1.35DL+1.5(Rig\ Load)$, $1.35DL+1.5(IRC\ Load)$, and $1.35DL+1.5LL+Horizontal\ Load$ for stability.

Table -1: STAAD.Pro Forces Summary of Main Beam, Cross Beam and Floor Beam

Member	Axial (t)	Fy (t)	Mz (t-m)
Main Beam	47.70	66.50	58.17
Cross Beam	8.69	10.00	10.00
Floor Beam	7.08	35.69	38.65

Pressure calculations showed that front lifting of the 150T crane produces the highest deck contact pressure (36.95 t/m²), exceeding the pressure due to IRC Class 70R loading (40.48 t/m² at the axle contact patch) and the BG-38 rig marching pressure (16.67 t/m²). Consequently, the deck panels and main beams were checked and designed for the crane front-lifting case as the governing condition, with all utilisation ratios found within permissible limits.

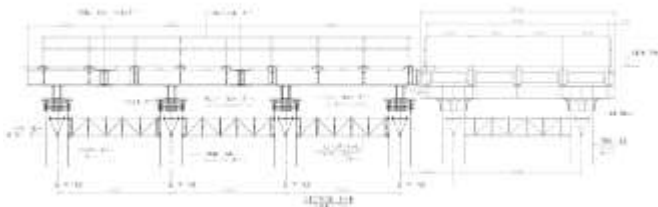
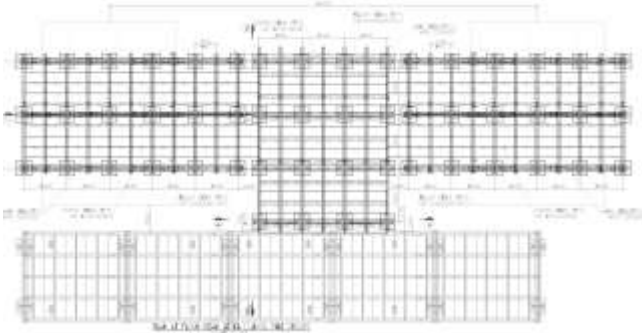


Fig -1: Typical Elevation of the Steel Finger Platform (Section B-B)

Fig -2: Typical Plan of the Finger Platform at Floor Beam Level (12-Pile Group)



3. CONCLUSIONS

The study confirms that the designed steel finger platform is structurally safe under all considered loading conditions, including dead load, live load, crane load, piling rig load, wind load, and water current effects. STAAD.Pro analysis demonstrated acceptable stresses, reactions, and deflections for the heavy construction equipment operating on the platform. Crane loading, particularly front lifting of the 150T crawler crane, was found to govern the design, producing the maximum forces in the main beams (axial 47.7 t, F_y 66.5 t, M_z 58.17 t-m) and deck panels. The adopted steel sections, bracing systems, and bolted connections provide adequate strength and stability, and the structure satisfies the relevant IRC and IS code provisions for temporary bridge systems. Proper construction planning and periodic maintenance remain essential for safe field performance. Future work may extend this study through finite element modelling, fatigue analysis, and digital structural health monitoring to further improve reliability.

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BIOGRAPHIES (Optional not mandatory)



Sanu Karmakar is an M.Tech scholar (Civil Engineering) at Shri Venkateshwara University, U.P. His research interests include steel structures and temporary marine access platforms.