

# Experimental Study on Design of Astra Portable Bridge

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**Abstract** - Abstract - India faces frequent bridge connectivity challenges during floods, monsoons, and disasters due to the high cost and long construction time of permanent bridges. This project presents the design of the ASTRA Portable Bridge — a lightweight, modular, rapidly deployable steel bridge using a Pratt truss system. The bridge spans 15 metres with a 3.5 m carriageway and is designed for IRC Class A loading. It uses standard IS 2062 Grade E250 steel sections and fully bolted HSFG connections for easy assembly and disassembly without welding. The design includes truss members, deck system, and connections. Standard structural analysis (Method of Joints/Sections) and IS:800 limit state design were performed. The bridge weighs only 8.2 tonnes, can be transported in two trucks, and assembled by 8–10 persons in 6–8 hours. Results show maximum deflection of 21.5 mm (within  $L/600$  limit) and optimum performance at low cost ( $\approx$  INR 14 lakhs).

Key Words: portable bridge, modular steel bridge, Pratt truss, rapid deployment, IRC Class A loading, disaster management

truss bridge. The main design parameters are as follows:

Clear span : 15 metres  
Carriageway width : 3.5 metres  
Truss depth : 2.0 metres  
Panel length : 3.0 metres (5 panels per truss)  
Structural steel : IS 2062 Grade E250  
Connections : M20 HSFG bolts (fully bolted and demountable)  
Live loading : IRC Class A loading  
Structural analysis of the truss was carried out using Method of Joints and Method of Sections. All member sizes were designed using Limit State Method as per IS: 800-2007. Dead load, live load with impact, and wind load were considered in the design.

## 1. INTRODUCTION

Bridges are vital for connectivity, but conventional bridges require months to build and huge investment. In disaster situations and rural areas, there is an urgent need for temporary, reusable bridges. Existing systems like Bailey Bridge are military-oriented and costly, while imported modular bridges (ACROW, Mabey) are too expensive for civilian use in India.

The ASTRA Portable Bridge (Adaptable Structural Temporary Rapid-Assembly) is designed to overcome these limitations. It provides quick, low-cost, and reusable connectivity for disaster relief, rural roads, and temporary access. The project follows IRC:6, IRC:24, IS:800, and IS:2062 standards.

## 2. Methodology

The ASTRA Portable Bridge is designed as a 15 m clear span, single-lane, through-type Pratt

Table 1: Design Assumptions and Parameters

Parameter	Value
Clear Span	15 m
Carriageway Width	3.5 m
Truss Type	Pratt Truss
Steel Grade	IS 2062 E250 ( $f_y=250$ MPa)
Design Code	IS:800-2007 (LSM)
Live Load	IRC Class A
Impact Factor	0.214

Table 2: Key Member Sizes Adopted

Member	Section Adopted
Top Chord	2 × ISMC 250 (laced)
Bottom Chord	250 × 16 mm flat plate
Diagonals (End)	ISA 150×150×12
Cross-Girders	ISMB 300
Stringers	ISMB 200
Deck Plate	6mm chequered plate

Table 3: Summary of Critical Member Forces and Utilisation

Member	Design Force (kN)	Nature	Capacity (kN)	Utilisation
Top Chord	851.3	Compression	1351	63%
Bottom Chord	851.3	Tension	909	94%
End Diagonal	511.3	Tension	778	66%
Cross-Girder	95 kNm	Bending	Adequate	73%

Table 4: Performance Results

Parameter	Result	Limit	Status
Max. Midspan Deflection	21.5 mm	25 mm (L/600)	Safe
Total Bridge Weight	8.2 tonnes	—	—
Assembly Time	6–8 hours	—	—
Estimated Cost	INR 14 lakhs	—	—

### 3. CONCLUSIONS

The ASTRA Portable Bridge design successfully meets all structural and functional requirements. The Pratt truss configuration with standard Indian steel sections provides excellent strength-to-weight ratio and full reusability. All members satisfy IS:800 design checks, deflection is within permissible limits, and the bridge can be assembled rapidly without heavy equipment. At just 8.2 tonnes and INR 14 lakhs, it offers a practical, low-cost solution for disaster relief, rural connectivity, and temporary infrastructure needs in India. The modular bolted system ensures sustainability through multiple deployments.

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