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"FEASIBILITY OF TEMPORARY STEEL BRIDGE ON MUTHA RIVER AT WARJE (PUNE)"

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Abstract
This study shows the construction of temporary steel bridge and the analysis of traffic. A bridge is a structure designed to support vehicles or other moving loads over an obstruction or over other structures. In addition to being crucial components of contemporary railroad and highway transportation networks, bridges also act as "lifelines" for social infrastructure networks. This chapter covers the selection of bridge types, bridge components (superstructure, bearing, substructure, etc.), and bridge categorization (e.g., based on materials of construction, span length, span type, deck placement, usage, geometric shape, and structural form).

Prefabricated crossing devices consisting of beams and platforms, temporary bridges are easily erected on various job locations. Temporary bridges can be positioned in a wide range of ways to suit various settings. The primary function of temporary bridges is to provide a path for automobiles, pedestrians, and/or large machinery. As the name implies, temporary bridges are designed to serve as a makeshift bridge for events, construction projects, and other brief purposes. They are not intended to be permanent structures. After a project is over, temporary bridges can be taken down and put back in place.

Keywords-
Temporary Bridge, Transportation, component, temporary steel bridge, prefabricated.

1. Introduction
Bridges are not just functional structures; they are symbols of human ingenuity and progress, facilitating connectivity and enabling socio-economic development. As traffic congestion becomes increasingly burdensome in urban areas like Warje, the construction of temporary steel bridges emerges as a pragmatic solution to alleviate the strain on existing infrastructure. Civil engineers play a pivotal role in this process, striving to balance functionality, aesthetics, and environmental considerations in their designs. The evolution of engineering curricula reflects a growing emphasis on bridge engineering, highlighting the interdisciplinary nature of the field. In this pursuit, achieving harmony between the bridge's superstructure and substructure emerges as a critical objective, ensuring both economic viability and structural integrity. Thus, the construction of bridges transcends mere practicality; it embodies the intersection of innovation, necessity, and societal advancement.

1.1 Aim:
To reduce the traffic congestion at Warje Bridge, we are going to design the temporary steel bridge on Mutha River for particular types of vehicles (two wheelers, auto-rickshaws, four wheelers, etc.) and remaining vehicles will continue the same route.

1.2 Objective:
- To analyze the traffic congestion at Warje.
- To design the temporary steel bridge as per the IS Code.
- To make sure the traffic congestion gets less and to have easy traffic flow.

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1.3 Problem statement:

Incremental delays comprise traffic congestion difficulties. Fuel consumption, pollutant emissions, and stress from other vehicles causing interference in the traffic stream are examples of vehicle operational costs. Accidents can occasionally result from minor delays and traffic jams. especially when traffic numbers go closer to the capacity of the road. The temporary bridge's construction would not have been possible without the skilled labour shortage, in addition to scheduling issues, poor communication on the working site, and late work

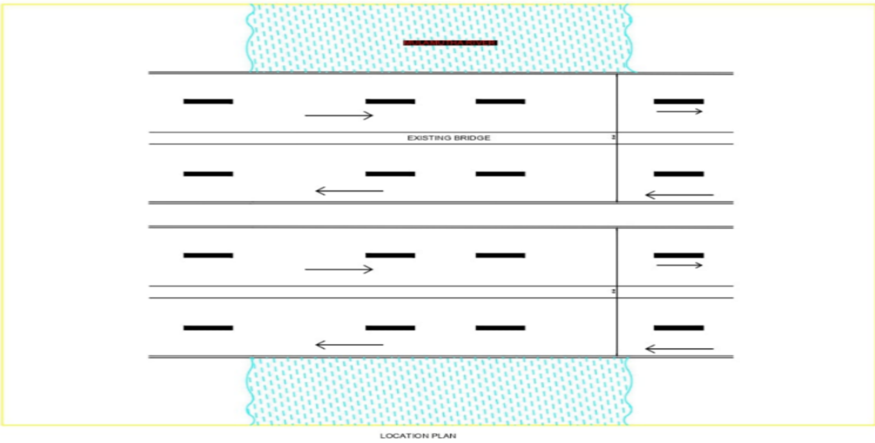

Fig no.1.2 Location Plan

2. Literature Review

2.1 Temporary works in construction of bridges near third-party asset, "Ganga Kasi V. Prakhya" (February 2021)

This paper gives a summary of the construction of a temporary steel bridge near third-party asset. This paper also gives information about the new techniques used for the construction of temporary steel bridges. It also helps in the efficient cost of building the steel bridge. It gives a brief literature survey of the construction techniques. This paper also describes the case histories and the information about the construction of a temporary steel bridge. We understand the measures to implement to ensure safety by monitoring and back analysis. [3]

2.2 Challenges in design and construction of temporary bridges across water bodies, "Vivek Ganesh Abhyankar" (March 2017)

This paper gives us information about the method used for the construction of temporary steel bridges, it also gives us an idea about the challenges we faced while constructing the temporary steel bridge. It also tells us about the design and analysis of the bridge. The 2-D and 3-D views are useful for the design of temporary steel bridges. This paper tells us the importance of planning and site selection for the construction of a temporary steel bridge. [7]

2.3 Fatigue resistance and durability of new mechanical connections of currently developed temporary steel footbridges, "Jindrich Melcher" (March 2015)

This paper gives a summary of the experimental studies of the fatigue behavior and resistance of several new types of steel mechanical connections. The new techniques and supports are used to solve the problem occur while constructing the temporary steel bridges and foot-over bridges. The different type of methods and fatigue tests are performed. The experimental studies have been oriented to the verification of the behavior of those connections and especially, the fatigue strength. [5]

2.4 Reduction of seismic acceleration parameters for temporary bridge design, "C Stucki" (March 2018)

This paper gives a summary of the significant impact on the cost, construction method and construction safety of the supported permanent structures. In this study, proposed spectral reduction factors are defined and used to reduce the spectral response acceleration parameters. The spectral reduction factors proposed in this report will operate as the ratio between the return period used for the seismic design of a permanent bridge and the return period used for the seismic design of a temporary bridge. [2]

2.5 The effect of earthquake on temporary structures during bridge construction with different column heights, "KriangkraiSuphrom" (September 2023)
This research aims to study the effect of the earthquakes on temporary structures during bridge construction with different column heights for analysis and evaluation of the damage to temporary structures. This studies the temporary structure. It also gives the history of the earthquake magnitudes. The paper suggests required methods to reduce the damage to the temporary structures. It helps to safeguard the temporary structures. [6]

2.6 Effects on a nearby bridge of dismantling temporary lining during excavation of a shallow-buried rectangular tunnel, "Guilin Sheng, Sen Wen" (December 2021)
This paper gives a summary of techniques used for the new bridge structures to be constructed as an offset for others undergoing Construction bridges. A numerical model was created and tests were conducted on a large-scale physical model to investigate the effects of dismantling temporary lining on a nearby bridge structure. [4]
Summary: By going through these papers we have understood the following points, they are as follows:
Safety and Regulations (Articles 1, 5, 6):

- Emphasize the importance of qualified personnel, hazard identification, and following industry standards for temporary bridge construction, especially in earthquake zones.
- Highlight potential dangers of neglecting safety protocols and the importance of learning from past failures. Design and Construction of Temporary Bridges (Articles 2, 4):
- Provide details on designing and building temporary bridges, including pile supports, steel beams, and fatigue resistance of connections (Articles 2 & 4).
- Easy to understand. Alternative Construction Methods for Permanent Bridges (Article 3):
- Discuss Accelerated Bridge Construction (ABC) using prefabricated elements for faster and more cost-effective construction of permanent bridges (Article 3).

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3. Methodology
Methodology is the model to explain the method or techniques used to design develop or plan a project. This project explains about the construction of temporary bridge to reduce the traffic congestion that will be used for developing this project further. The results are going to be analyzed to achieve the objective of project.

3.1 Bridge Overview:
A bridge is an engineering structure intended to span a physical barrier (such as a river, valley, road, or railroad) without causing obstructions to traffic below it. The impediment is usually something that would be difficult or impossible to cross otherwise, thus it is created to facilitate passage over it. Bridges are available in a vast array of designs, each with a distinct purpose and range of potential uses. Many factors influence bridge designs, such as the intended use of the bridge, the kind of terrain the structure is built and supported on, the materials used in construction, and the funds available.

3.2 Site Analysis and Site Investigation:
A site investigation encompasses all phases of the data gathering, analysis, reporting, and assessment process. Gathering this data effectively, quickly, and to the amount required for every design and development step is imperative. This lowers risk and liability, increases the likelihood of a safe and

economical design, and increases the likelihood that the project will be completed on time and under budget. Inadequate site investigations can lead to dangerous or ill-considered ground construction work execution, damage to surrounding buildings or other structures, poor design selection, inaccurate dimensioning, an inadequate foundation solution, and encroachment on nearby properties or easements (such as road reserves, pipelines, and overhead supply lines). The cost in money could be substantial.

3.3 Traffic Survey:
The main tool for learning more about how people moves across a certain location is a traffic survey. Understanding traffic patterns, locating bottlenecks, and developing plans to enhance transportation infrastructure and management all depend on this data.
The purpose of traffic surveys is to collect data on a range of topics related to traffic flow, such as:
- Volume: The quantity of cars using a section of road at a given time.
- Speed: The mean velocity of automobiles throughout the day.
- Origin-Destination: Knowing the origins and destinations of drivers.
- Vehicle Classification: In order to evaluate the makeup of traffic, vehicles (cars, trucks, buses, etc.) are categorized.

3.4 Traffic Analysis:
The formula for traffic density (D) is:

$$D = \frac{N}{L}$$

Where:
D = Traffic density (vehicles per unit length)
N = Number of vehicles passing through a section of road
L = Length of the bridge (unit length)
= 180 m

Traffic analysis of Monday (9 am to 10 am):
Number of vehicles = total of motor/bikes + total of Car/Jeep/Taxi/Bus
= 445 + 550 + 455 + 490 + 550 + 700 + 640 + 800
= 4630 vehicles

Length of bridge = 180 m

Traffic density $(D) = \frac{N}{L}$

$= \frac{4630}{180}$

= 25.72 vehicles/m

Traffic analysis of Monday (5pm to 6pm):
Number of vehicles = total of motor/bikes + total of Car/Jeep/Taxi/Bus
= 600 + 800 + 765 + 660 + 700 + 756 + 876 + 665
= 5822 vehicles
Length of bridge = 180 m

Traffic density $(D) = \frac{N}{L}$

$= \frac{5822}{180}$

= 32.34 vehicles/m

Traffic analysis of Tuesday (8am to 9am):
Number of vehicles = total of motor/bikes + total of Car/Jeep/Taxi/Bus

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= 500 + 660 + 555 + 600 + 700 + 630 + 590 + 800
= 5035 vehicles
Length of bridge = 180 m
Density of Traffic $(D) = \frac{N}{L}$

$= \frac{5035}{180}$
= 27.97 vehicles/m

Traffic analysis of Tuesday (7pm to 8pm):
Number of vehicles = total of motor/bikes + total of Car/Jeep/Taxi/Bus
= 900 + 876 + 688 + 777 + 600 + 845 + 569 + 698
= 5953 vehicles
Length of bridge = 180 m
Traffic density $(D) = \frac{N}{L}$
$= \frac{5953}{180}$
= 33.07 vehicles/m

Traffic analysis of Wednesday (9am to 10am):
Number of vehicles = total of motor/bikes + total of Car/Jeep/Taxi/Bus
= 456 + 987 + 678 + 567 + 700 + 897 + 697 + 976
= 5958 vehicles
Length of bridge = 180 m
Traffic density $(D) = \frac{N}{L}$

$= \frac{5958}{180}$
= 33.1 vehicles/m

Traffic analysis of Wednesday (7pm to 8pm):
Number of vehicles = total of motor/bikes + total of Car/Jeep/Taxi/Bus
= 765 + 888 + 678 + 688 + 700 + 908 + 890 + 578
= 6095 vehicles
Length of bridge = 180 m
Traffic density $(D) = \frac{N}{L}$
$= \frac{6095}{180}$
= 33.86 vehicles/m

Traffic analysis of Thursday (7am to 8am):
Number of vehicles = total of motor/bikes + total of Car/Jeep/Taxi/Bus
= 445 + 498 + 300 + 500 + 550 + 698 + 432 + 500
= 3923 vehicles
Length of bridge = 180 m
Traffic density $(D) = \frac{N}{L}$
$= \frac{3923}{180}$
= 21.79 vehicles/m

Traffic analysis of Thursday (6pm to 7pm):
Number of vehicles = total of motor/bikes + total of Car/Jeep/Taxi/Bus

= 987 + 843 + 589 + 766 + 469 + 876 + 567 + 967
= 6064 vehicles

Length of bridge = 180 m

$$\text{Traffic density } (D) = \frac{N}{L}$$
$$= \frac{6064}{180}$$
= 33.68 vehicles/m

3.5 Calculate Uniformly Distribution Load (UDL):

Step 1: Calculate the average traffic density for each day

- Monday = (25.72 + 32.34)/2 = 29.03 vehicles/m
- Tuesday = (27.97 + 33.07)/2 = 30.52 vehicles/m
- Wednesday =(33.1+33.86)/2 = 33.48 vehicles/m
- Thursday = (21.79+33.68)/2 = 27.735 vehicles/m

Step 2: Determine live load (LL) intensity:
According to IS code, let’s assume a live load intensity of 5 KN/m^2 per vehicle.
Step 3: Apply live load factor:
Let’s assume a live load factor of 1.5 as per IS code.
Step 4: calculate UDL:
UDL= Average traffic density × Live load intensity × Live load factor × Length of bridge
Here we calculate day wise traffic density and uniformly distributed Load. Which is mention in below table

Table 1: Traffic Density and UDL

Day	Traffic Density (vehicles/m)	Uniformly Distribution Load (KN)
Monday	29.03	39190.5
Tuesday	30.52	41202
Wednesday	33.48	45198
Thursday	27.735	37442.25

3.6 Structural Analysis and Design:

STAAD Pro: Bentley Systems created STAAD Pro, a feature-rich software program intended primarily for structural analysis and design. It serves a broad spectrum of professions in civil engineering, including as drafters, architects, and structural engineers. STAAD Pro makes it easier to design a variety of structural components, such as:

Beam and Column: Analysing and designing the load-bearing capacity of beams and columns. Refer the below figure (Fig 3.6.1 for better understanding).

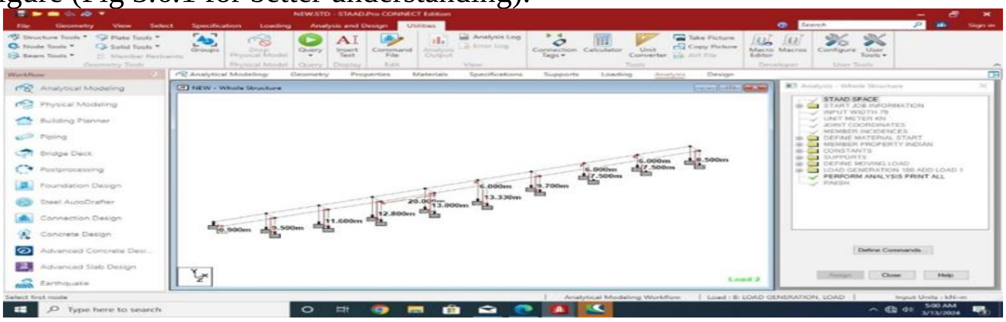

Fig 3.6.1 Design of Slab in Staad pro

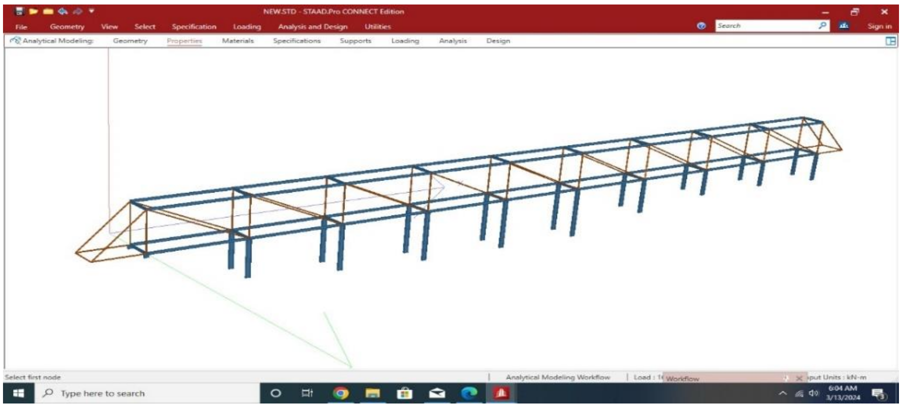

Fig 3.6.2 Design of Truss in Staad pro (3D View)

In below (Table 2) we mention the dimensions of column (width, length) which are used in Staad pro structure design.

Table 2: Dimensions of column

Column No.	Dimension	Width	Length
C1	0.900 m	6.000 m	20 m
C2	9.500 m	6.000 m	20 m
C3	11.600 m	6.000 m	20 m
C4	12.800 m	6.000 m	20 m
C5	13.000 m	6.000 m	20 m
C6	13.330 m	6.000 m	20 m
C7	9.700 m	6.000 m	20 m
C8	7.500 m	6.000 m	20 m
C9	7.500 m	6.000 m	20 m
C10	8.500 m	6.000 m	20

4. Estimation

This consists of approximate estimate of the project. It considers the quantity of concrete and steel required for the project. It also gives us idea about labour cost required to complete the work.

Span of pier (1) = 9.5m

Volume of pier = $\frac{\pi}{4}\times (d^2)\times$ h

$=\frac{\pi}{4}\times (0.6^2)\times 8.5$

$= 2.40\ m^3$

Volume of pier cap [shape (1)] = l × b × h

= 3 × 1.5 × 0.5

= 2.25 m^3

Volume of pier cap [shape (2)] = $\frac{Sum\ of\ parallel\ side}{2}\times 0.5\times 1.5$

$=\frac{3+0.8}{2}\times 0.5\times 1.5$

= 1.42 m^3

Total volume of pier (1) is 6.075 m^3

Total volume of pier = 6.075 × 2

= 12.15 m^3

In total we have 9 piers, each of different size.

Volume of pier (1) = 12.15 m^3

Volume of pier (2) = 13.32 m^3

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Volume of pier (3) = 14m^3
Volume of pier (4) = 14.12 m^3
Volume of pier (5) = 14.31 m^3
Volume of pier (6) = 12.24 m^3
Volume of pier (7) and (8) = 11 m^3
Volume of pier (9) = 11.54 m^3

Therefore, total volume of all piers is 102.68 m^3
Rate of RMC per m^3= Rs 6000
Therefore, total cost of RMC= 102.68 × 6000
= Rs 6,16,080/-

Table 3: Rate analysis for steel

Girders plates	Width (mm)	Thickness (mm)	Length (m)	Kg/m	Quantity	Unit	Rate	Total
Top flange Grade350	450	25	180	62.5	112.5	kg	144	162000
Bottom flange grade 350	650	45	95	307.89	29248.55	kg	144	421135
Bottom flange grade 350	650	55	85	420.58	3574.3	kg	144	514699
Web grade 250	1415	20	10	2830	2830	kg	136	384880
Diagonal grade 250	1415	20	22.361	1265.5	2829.84	kg	136	384851
Total					132846.6			Rs 1867573

Add 10% contingences = 1867573 × 0.10
= 186757.3
= Rs 186758/-
Add 5% wastage = 1867573× 0.05
= 93378.65
= Rs 93379
Therefore, total quantity of steel = 1867573 + 186758 + 93379
= Rs 2147710

Table 4: Quantity Estimation

Description	**Rate**	**Unit**	**Quantity**	**Total**
Material				
Concrete	6000	Per m^3	102.68	616080
Steel (Fe350)	144	Per kg	7624	1097834
Steel (Fe 250)	136	Per kg	5659	769738
Add 10% contingences				186758
Add 5% wastage				93379
Total				Rs 2763790
Labour				
Skilled	915	Per design	1	915
Mason	500-1000	Per day	1	700
Iron workers		Per		
Mazdoor	350-400	Per day	6	2100

5. Results and Discussion

Temporary steel bridges serve as crucial tools for facilitating rapid and economical traffic flow, especially in emergency situations or temporary crossings. Their versatility and eco-friendliness make them well-suited for short-term transportation challenges. However, their limited load capacity and suitability for prolonged use must be recognized. Successful deployment of temporary steel bridges requires careful planning to meet safety standards, regulations, and eventual replacement with permanent structures as needed. This strategic approach ensures the effectiveness of temporary solutions while laying the groundwork for lasting infrastructure improvements.

Fig 4.1 Steel Bridge Model

5.1 Dimension of the model:

In below Table 6 we mention the dimensions of model (length, width, slab thickness, Truss size and column to column distance).

Table 5: Dimensions of Model

Length of the bridge	90 cm
Width of the bridge	2 cm (20-20mm)
Column to column distance	17.5 cm
Slab thickness	18 gage msc.
Tringle truss size	1 cm (10-10mm)

5.2 Discussion:

- Temporary bridges have specified load limitations and a limited lifespan. They are not meant to support as much weight as permanent bridges.
- If the results and discussion points were customized for a specific temporary steel bridge project, they would be more thorough.
- A more focused examination of the bridge's efficacy and potential drawbacks would be possible with information such as its span, location, and intended usage included.

6. Conclusion

To sum up, temporary truss steel bridges provide a nice mix of strength, versatility, and quick deployment. When compared to other temporary bridge choices, their weight and possible difficulty of assembly call for careful consideration of site limits and project needs. From the discussion thus far, it should be evident how crucial a temporary bridge is to the success of any ordinary bridge construction project spanning a river or other body of water. The completion of the temporary steel bridge project signifies a smooth transition from building an essential link to having a fully operational route.

The temporary steel bridge is operational after completion of the building phase. This offers, depending on the bridge's construction, a dependable and safe route for cars or pedestrians. Traffic flow is restored when a bridge replaces an existing structure that is being repaired, reducing disturbances. The temporary bridge removes the need for lengthy diversions for new building projects.

During a permanent bridge project, the bridge guarantees ongoing passage over a body of water, a road, or another obstruction construction.

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