Analysis and Design of T- Girder Bridge using STAAD Pro

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Abstract- *The bridge is one of the important structures in civil engineering. Bridge is the structure which constructed on the across river or any obstacles. In bridges different type of constructions are there T-girder bridges box-girder and I-girder deck slab bridges masonry bridges and suspension bridges. In this study we are discussing about the T-girder Bridge. This analysis part of this study is done in STAAD PRO soft ware. In this study the loads are considered as for the IRC loadings are class A and class 70 R. We are done on the analysis loads are considered as for the IRC class A and class 70 R loadings were considered for IRC: 6-2000 for loading and analysis were carried out for moving loads, dead loads and earth quake loads. The load combinations were taken as per IRC: 6-2000. Analysis was carried out by STAAD PRO.*

Present study analysis part carried in the STAAD PRO. T-girder are create in STAAD PRO and loads calculation as for the IRC specifications they are dead loads moving loads and earth quake loads are applied on the given span. In analysis part we are check shear force bending moments and deflections. Use this shear force bending moments done design the T-girder Bridge. The moments and shear force are considered where the maximum for designs. The design the T-girder Bridge as for the specifications the IRC codes. The design consideration and detailing of steel as for the IRC 21.

Pre-cast slab panels shall be designed for in-situ decking are

- *Presented in the following are the detailed calculations of girders and pre-cast panels under the mentioned stage loadings and other service stage requirements.*
- *The girder-deck system is analyzed and detailed design is done and the calculations and drawings for various elements of the superstructure are provided.*
- *Analysis of the girder-deck slab system for various dead loads, SDLs and vehicular live loads with impact effects is done on a grillage model using STAAD analysis program.*
- *The structural elements are designed and detailed as per the stipulations of IRC:21*

I. INTRODUCTION

Definition:

A bridge is a structure providing passage over an obstacle without closing the way beneath. The required passage may be for a road, a railway, pedestrians, a canal or a pipeline. The obstacle to be crossed may be a river, a road, railway or a valley.

In other words, bridge is a structure for carrying the road traffic or other moving loads over a depression or obstruction such as channel, road or railway.

a) Minor Bridge: A minor bridge is a bridge having a total length of up to 60m.

b) Major Bridge: A major bridge is a bridge having a total length of above 60m.

c) Bridges shall be graded as important essentially on the basis of the seriousness of the

Consequences of their distress/failure and the extent of remedial measures involved.

1.1.2 Culvert:

Culvert is a cross-drainage structure having a total length of 6 meters or less between the inner faces of the dirt walls or extreme vent way boundaries measured at right angles. The width of the carriageway is the minimum clear width measured at right angles to the longitudinal centre line of the bridge between the inside faces of road way Kerbs or wheel guards.

1.1.3 Width of footway or safety kerb:

The width of the footway or safety kerb shall be taken as the minimum clear width anywhere within a height of 2.25 meters above the surface of footway or safety kerb, such width being measured at right angles to the centre line of the bridge.

1.2 Background:

This chapter presents a background review of the historical reference and design for the current day applications of bridges. Many types of bridge systems have been used in rehabilitation projects to replace deteriorating bridges. Numerous manufacturers currently offer prefabricated bridges to accommodate applications including:

Temporary Bridges: As an alternative to costly detours, maintenance of traffic, and increased traffic volume, prefabricated bridges are utilized to divert traffic during bridge repair, rehabilitation, construction, or replacement. These bridges are installed as a temporary structure during construction and then disassembled and stored until used again as a temporary structure.

Emergency Bridges: Are also needed from a security standpoint, and due to man-made non-terrorist hazards like ship impact, truck impact, fire, and blast. Natural disasters such as hurricanes, mudslides, fires, and tornados can destroy a bridge by washout or collapse. Typical prefabricated bridges can be erected much faster than the time of constructing a cast-in-place structure. Moreover, with the increased threat to our nation's infrastructure due to terrorism, these systems could be utilized in a time of national emergency.

Permanent Bridges: A permanent structure requires a design service life of 75 years in accordance with the AASHTO LRFD Bridge Design Specifications, third edition (2004). A major objective of this study is to provide recommendations that will increase the use of prefabricated bridges as permanent bridges.

The systems in use today have evolved greatly from the original designs conceived over 60 years ago. Today, the designs are longer, wider, stronger, and more durable. This chapter presents the development history and discusses common practices in use today as well as innovations that are present in the prefabricated bridge industry. Although some of the systems are relatively costly, allowance for the rapid replacement of decks or entire superstructures makes them an attractive option. Also, as they gain widespread acceptance and use, mass production of the systems will make them more economical.

The involvement of the prefabrication industry in bridge construction is primarily in providing components that are prefabricated in a factory. Through mass production and reduction of on-site construction time, economical benefits are most often achieved.

Innovative bridge designers and builders are finding ways to prefabricate entire segments of the superstructure. Prefabricated composite units include steel elements prefabricated with a composite deck, transported to the project site, and then erected in place. Prefabricated systems could also be constructed in the right-of-way along side of the bridge and then lifted into place. Prefabrication on this scale offers advantages of easier constructability, reduced on-site construction time and therefore reduced maintenance of traffic control and detours to the travelling public and transportation of goods.

The bridge was completed in 1912 and replaced the Steel Bridge that was built in 1888 as a double-deck swing-span bridge. The 1888 structure was the first railroad bridge across the Willamette River in Portland. Its name originated because steel, instead of wrought iron, was used in its construction, very unusual for the time. When the current Steel Bridge opened, it was simply given its predecessor's name.

Bridge is a structure which provides a passage to people, vehicles, railways or pipelines to cross various obstacles to travel. Engineers build bridges over obstacles such as lakes, rivers, canyons, and dangerous roads and railway tracks. Without bridges, people would need boats to cross waterways and would have to travel around canyons and ravines.

Bridges range in length from a few meters to several kilometers. They are among the largest structures built by man. The demands on design and on materials are very high. A bridge must be strong enough to support its own weight as well as the weight of the people and vehicles that use it. The structure also must resist various natural occurrences, including earthquakes, strong winds, and changes in temperature. Most bridges have a concrete, steel, or wood framework and an asphalt or concrete roadway on which people and vehicles travel.

Logs or vines that extended across streams probably served as the first bridges. The first bridge known to historians was an arch bridge built in Babylon in about 2200 B.C. The ancient Chinese, Egyptians, Greeks, and Romans also built arch bridges, using bricks and stone as building materials.

During the middle Ages, drawbridges were built across the moats of many castles in Europe. Truss bridges were developed in the 1500's. Most bridges were made of stone or wood until the late 1700's, when cast iron and wrought iron began to be used for such structures. Many suspension bridges that hung from wrought iron chains were built during the early 1800's. The first plate girder bridge was completed in 1847. The first bridge made with concrete was built in 1869 and the modern cantilever bridge was introduced in about 1870.In the late 1800's, steel became the chief material used in bridge construction. The development of railways caused a widespread increase in steel bridges.

A short time later, builders began using reinforced concrete for bridges. During the 1930's, prestressed concrete became important for bridge building. The modern cable-stayed bridge was introduced in 1955.

1.3 Basic Components Of Bridge:

The majority of bridges are held up by at least two supports set in the ground. The distance between two adjacent supports is called a span of a bridge. The supports at each end of the bridge are called abutments, and the supports that stand between the abutments are called piers. The total length of the bridge is the distance between the abutments. Most short bridges are supported only by abutments and are known as single-span bridges. Bridges that have one or more piers in addition to the abutments are called multi-span bridges. Most long bridges are multi-span bridges.In special cases, like in a pontoon bridge no piers or abutments are provided. It is supported by pontoons (flat-bottomed boats) or other portable floats.

There are three main components of a typical bridge in general, namely

- Superstructure
- Substructure
- Foundation

1.3.1 Superstructure:

a) The main constituent of any superstructure is the decking, which Comprises of a slab, girder, trusses, etc.
b) The handrails, crash barriers, Kerbs, etc.

The three basic types of bridge spans are shown below. Any of these spans may be constructed using beams, girders or trusses. Arch bridges are either simple or continuous (hinged). A cantilever bridge may also include a suspended span.

1.3.2 Substructure:

a) Abutments at the extreme ends of the bridge.
b) Piers at intermediate supports in case of multiple span bridges.
c) Bearings and pedestals for the decking.

1.3.3 Foundation:

These include foundations for both abutments and piers. Foundations may be of the type open, well, pile, etc. Apart from the above, river training works and the approaches to a bridge also form a part of a bridge works

II. LITERATURE REVIEW

JOHN AIDOO, DR. KENT A. HARRIES and DR. MICHAEL F. PETROU1, presented a paper many tests have been conducted investigating strengthening reinforced concrete members with FRP materials, there are still many aspects of their use that remain to be investigated. The fatigue behavior of reinforced concrete beams strengthened with FRP composite sheets and strips, for instance, which is described in this paper, provides valuable information regarding the expected long-term performance of the FRP strengthening systems. The present study examines the effects of one-dimensional FRP composite rehabilitation systems on the flexural fatigue performance of reinforced concrete bridge girders. Experiments are being conducted on reinforced concrete tee-beams with and without bonded FRP reinforcement on their tensile surfaces. The objective of this investigation is to determine whether such external FRP repair methods are able to resist fatigue loads and to establish the effect that these repair systems have on the fatigue behavior and remaining life of the girders. Eight 508 mm deep reinforced concrete tee-beams having 5.6 m clear spans were tested with a concentrated load at mid span under constant amplitude cyclic loading. The details of these beams represent a 62% scaling of full-scale beams, removed from a 1961 Interstate, to be tested in 2002. Two commercially available CFRP repair systems were used to retrofit the stem soffits of the girders. The two retrofit systems were designed such that their stiffness was approximately equivalent. Results from the fatigue tests are presented with particular attention paid to the FRP concrete interface and its significant degradation and eventual failure under fatigue loading conditions.

III. METHODOLOGY

Designing and detailing requirements:

a) Precast girders shall be designed and checked for the following two conditions of loading

A. For service condition loading

B. For handling loads during transportation and in-situ decking

b) Pre-cast slab panels shall be designed for in-situ decking

- Presented in the following pages the detailed calculations of girders and pre-cast panels under the above mentioned stage loadings and other service stage requirements.

- The girder-deck system is analyzed and detailed design is done and the calculations and drawings for various elements of the superstructure are provided.

- Analysis of the girder-deck slab system for various dead loads, SDLs and vehicular live loads with impact effects is done on a grillage model using stadd analysis program.

- The structural elements are designed and detailed as per the stipulations of IRC:21.

IV. DISCUSSIONS & RESULTS

Discussions:

- We have taken 70R Tracked, wheeled and class A loading as worst condition in different combinations and the maximum moment are checked for different conditions.
- When live loads are runned on the slab the maximum moment obtained in 54th member and designed for the max moment.
- When dead load condition is taken max moment obtained in 30th member and accordingly design is done.
- We also checked for the lifting condition for bearings.

Results:

- For end longitudinal girder we have done shear check and it is safe by providing a reinforcement of 2 L #12 stirrups @757mm
- For intermediate girder we have done shear check and it is safe by providing a reinforcement of 2 L #12 stirrups @757mm
- We have designed cross girder as DEEP beam and the reinforcement provided is adequate.
- Shear connectors are also designed and they are also adequate.
- In pre cast planks we have checked that shear stress in concrete is more than shear stress ,hence safe.
- The depth provided in deck slab is adequate.

V. CONCLUSION

T-girder bridge is designed as safe and economically using the STAAD PRO analysis and designed the manual using the IRC code books. The design of T-girder bridge stable any forces of the loads like acting on bridges . present design bridge constructed at Ongole town by pass ridge The designer should, however, be able to evolve the most economical type of superstructure based on his judgment and experience given the particular conditions prevailing at the particular site at the particular time. The bridge is safe all aspects of the safe construction economical and quickly complete project of bridge.

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