MANTECH Publications
Journal of Transportation Engineering and Its Applications
Volume 1, Issue 2, May-August, 2016

Testing the Principles of a T-Beam Bridge Construction to Ensure Flawless Workflow

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Abstract

Our main motto is to design a T beam bridge with standard specification which was given by Indian road congress. So coming to the bridge designing it's an art of civil engineering projects which replicates the usage of structural drawing where remaining project deals with engineering drawings. Here in this project first we are going to specify the classification of bridges and types and where they are located if we get a clarification we get a small view on how bridges are constructed based on classification. So finally from the project the main criteria are the output. The output of our project is to get a keen knowledge about designing a T beam bridge by manual analysis with all reinforcement details

In this paper, the basics of bridge designs are examined for their effectiveness. It is important to be perfect in designing a bridge as it needs to carry a huge load of vehicles and people. Examining the various principles on which a bridge is constructed gives us a solid precedent to fall back on if and when something goes wrong during its construction.

Keywords: *Bridge, T Beam Bridge, Rail Over Bridge,*

INTRODUCTION

A bridge is a structure that crosses over a river, bay, or other obstruction, permitting the smooth and safe passage of vehicles, trains, and pedestrians. An elevation view of a typical bridge is A bridge structure is divided into an upper part (the superstructure), which consists of the slab, the floor system, and the main truss or girders, and a lower part (the substructure), which are columns, piers, towers, footings, piles, and abutments. The superstructure provides horizontal spans such as deck and girders and carries traffic loads directly. The substructure supports the horizontal spans, elevating above the ground surface.

The main criteria for the project are to design a road over bridge of span 60 metres. So here in this, first we are going to study the history, classification, fundamentals and basics of a bridge. So this is very important before going into the main part.

There are different types of structures in civil engineering, but the construction of bridge is somewhat typical and different from other types of structures, because for designing a bridge we should follow different code books and should follow proper specifications.

Objective

The main reason for taking bridge design as our project is, we are very much interested in doing projects on bridges because after our study it will be very useful in our research on bridges so for that we should be perfect in basics so, that is the reason why we took bridge designing as our main project.

The output of our project is to get a keen knowledge about designing a rail over bridge by manual analysis and also the total quantity and estimation for the bridge. By this project we get a clear view about bridges and how they are been classified.

Scope

Rail over bridges are very important for the country because there are so many lakes, rivers, canals passing from one place to other so to cross those water bodies rail over bridges are to be constructed.

So there are so many rail over bridges in our country some bridges are constructed with concrete some with steel. So depending upon the soil conditions, area, load classifications the material of the bridge is been fixed.

Mostly rail over bridges are constructed by T beam design analysis. Mostly bridges like highway bridges, railway bridges, aqueducts, viaducts are constructed by T beam design analysis.

If we take our area Vijayawada here we are having four bridges linking Krishna Guntur districts, which are constructed by T beam design analysis and there are two bridges in Ibhrahimpatnam linking

Krishna river one bridge is for canal inflow and another for canal outflow, these bridges are also constructed on T beam design analysis.

Mostly in our country bridges are constructed by T beam design analysis, it became a standard design for all type of bridges because it is most economical, effective and strength of the bridge will withstand up to 10 to 20 years.

A simple beam bridge is generally used to span a distance of 250 ft (76.2 m) or less. Longer distances can be spanned by connecting a series of simple beam bridges into what is known as a continuous span. In fact, the world's longest bridge, the Lake Pontchartrain Causeway in Louisiana, is a pair of parallel, two- lane continuous span bridges almost 24 mi (38.4 km) long. The first of the two bridges was completed in 1956 and consists of more than 2,000 individual spans. The sister bridge (now carrying the north-bound traffic) was completed 13 years later; although it is 228 ft longer than the first bridge, it contains only 1,500 span.

COMPONENETS OF T BEAM BRIDGE

T-Beam

A T-beam (or tee beam), used in construction, is a load-bearing structure of reinforced concrete, wood or metal, with a t-shaped cross section. The top of the t-shaped cross section serves as a flange or compression member in resisting compressive stresses. The web (vertical section) of the beam below the compression flange serves to resist shear stress and to provide greater separation for the coupled forces of bending.

The T-beam has a big disadvantage compared to an I-beam because it has no bottom flange with which to deal with tensile forces. One way to make a T-beam more efficient structurally is to use an inverted T-beam with a floor slab or bridge deck joining the tops of the beams. Done properly, the slab acts as the compression flange.

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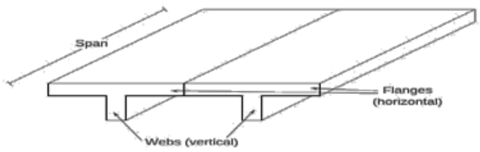

Fig: 1 T beam

History of T Beam Bridge

A T-beam is a structural element able to withstand large loads by resistance in the beam or by internal reinforcements. In some respects, the T-beam dates back to the first time a human formed a bridge with a pier and a deck. After all, a T-beam is, in one sense, no more than a pillar with a horizontal bed on top, or, in the case of the inverted T-beam, on the bottom. The upright portion carrying the tension of the beam is termed a web or stem, and the horizontal part that carries the compression is termed a flange. However, the materials used have changed over the years but the basic structure is the same. T-beams structures such as highway overpasses, buildings and parking garages, have extra material added on the underside where the web joins the flange to reduce the T-beam's vulnerability to shear stress. However, when one investigates more deeply into the design of T-beams, some distinctions appear.

Deck Slab

A bridge deck or road bed is the roadway, or the pedestrian walkway, surface of a bridge, and is one structural element of the superstructure of a bridge. It is not to be confused with any deck of a ship. The deck may be constructed of concrete, steel, open grating, or wood. Sometimes the deck is covered with asphalt concrete or other pavement. The concrete deck may be an integral part of the bridge structure (T-beam or double tee structure) or it may be supported with I-beam or steel girders.

When a bridge deck is installed in a through truss, it is sometimes called a floor system. A suspended bridge deck will be suspended from the main structural elements on a suspension or arch bridge. On some bridges, such as a tied-arch or a cable-stayed, the deck is a primary structural element, carrying tension or compression to support the span.

Spatial structure is a truss-like, lightweight geometric form. Usually from these structures is used in covering of long-span roofs. But these structures due to the lightness, ease and expedite of implementation are a suitable replacement for bridge deck.

Girder Bridge

A girder bridge, in general, is a bridge that uses girders as the means of supporting the deck. A bridge consists of three parts: the foundation (abutments and piers), the superstructure (girder, truss, or arch), and the deck. A girder bridge is very likely the most commonly built and utilized bridge in the world. Its basic design, in the most simplified form, can be compared to a log ranging from one side to the other across a river or creek. In modern girder steel bridges, the two most common shapes are plate girders and box-girders.

The term "girder" is often used interchangeably with "beam" in reference to bridge design. However, some authors define beam bridges slightly differently from girder bridges.

A beam may be made of concrete or steel - many shorter bridges, especially in rural areas where they may be exposed to overtopping and corrosion, will utilize concrete box beams. The term "girder" is typically used to refer to a steel beam. In a beam or girder bridge, the beams themselves are the primary support for the deck, and are responsible for transferring the load down to the foundation. Material type, shape, and weight all affect how much weight a beam can hold. Due to the properties of inertia, the height of a girder is the most significant factor to affect its load capacity. Longer spans, more traffic, or wider spacing of the beams will all directly result in a deeper beam. In truss and arch-style bridges, the girders are still the main support for the deck, but the load is transferred through the truss or arch to the foundation. These designs allow bridges to span larger distances without requiring the depth of the beam to increase beyond what is practical - however, with the inclusion of a truss or arch the bridge is no longer a true girder bridge.

abutment

In engineering, abutment refers to the substructure at the ends of a bridge span or dam whereon the structure's superstructure rests or contacts. Single-span bridges have abutments at each end which provide vertical and lateral support for the bridge, as well as acting as retaining walls to resist lateral movement of the earthen fill of the bridge approach.

Multi-span bridges require piers to support ends of spans unsupported by abutments. Dam abutments are generally either side of a valley or gorge but may be artificial in order to support arch dams such as Kurobe Dam in Japan.

The term may also refer to the structure supporting one side of an arch, or masonry used to resist the lateral forces of a vault. The word derives from the verb "abut", meaning to "touch by means of a mutual border".

Pier

A pier, in architecture, is an upright support for a structure or superstructure such as an arch or bridge. Sections of structural walls between openings (bays) can function as piers.

The simplest cross section of the pier is square, or rectangular, but other shapes are also common. In medieval architecture, massive circular supports called drum piers, cruciform (cross-shaped) piers, and compound piers are common architectural elements. Columns are a similar upright support, but stand on a round base. In buildings with sequence of bays between piers, each opening (window or door) between two piers is considered a single bay.

Single-span bridges have abutments at each end that support the weight of the bridge and serve as retaining walls to resist lateral movement of the earthen fill of the bridge approach. Multi-span bridges require piers to support the ends of spans between these abutments. In cold climates the upstream edge of a pier may include a stark water to prevent accumulation of broken ice during peak snowmelt flows. The stark water has a sharpened upstream edge sometimes called a cutwater. The cutwater edge may be of concrete or masonry, but is often capped with a steel angle to resist abrasion and focus force at a single point to fracture floating pieces of ice striking the pier. In cold climates the starling is typically sloped at an angle of about 45° so current pushing against the ice tends to lift the downstream edge of the ice translating horizontal force of the current to vertical force against a thinner cross-section of ice until unsupported weight of ice fractures the piece of ice allowing it to pass on either side of the pier.

Bridge Bearing

A bridge bearing is a component of a bridge which typically provides a resting surface between bridge piers and the bridge deck. The purpose of a bearing is to allow controlled movement and thereby reduce the stresses involved. Movement could be thermal expansion or contraction, or movement from other sources such as seismic activity. There are several different types of bridge bearings which are used depending on a number of different factors including the bridge span. The oldest form of bridge bearing is simply two plates resting on top of each other. A common form of modern bridge bearing is the elastomeric bridge bearing. Another type of bridge bearing is the mechanical bridge bearing. There are several types of mechanical bridge bearing, such as the pinned bearing, which in turn includes specific types such as the rocker bearing, and the roller bearing. Another type of mechanical bearing is the fixed bearing, which allows rotation, but not other forms of movement.

i Elastomeric bridge bearing

Elastomeric bridge bearing are a commonly used modern bridge bearing. There are several different similar types of bridge bearings that include neoprene bearing pads, neoprene bridge bearings, laminated elastomeric bearings and seismic isolators which are all generally referred to as bridge bearing pads in the construction industry. They are designed and manufactured based on standards and specifications of such organizations as British Standard, AASHTO, and European Norms En 1337. Internal structure consists of a sandwich of mild steel shims and rubber moulded as one unit. Elastomeric bearing pads compress on vertical load and accommodate horizontal rotation and provide lateral shear movement. Elastomeric bearing pads are the most economical solution used in construction of large span bridges and buildings.

Pile Foundation

A deep foundation is a type of foundation which transfers building loads to the earth farther down from the surface than a shallow foundation does, to a subsurface layer or a range of depths.

A pile is a vertical structural element of a deep foundation, driven deep into the ground at the building site. There are many reasons a geotechnical engineer would recommend a deep foundation over a shallow foundation, but some of the common reasons are very large design loads, a poor soil at shallow depth, or site constraints (like property lines). There are different terms used to describe different types of deep foundations including the pile (which is analogous to a pole), the pier (which is analogous to a column), drilled shafts, and caissons. Piles are generally driven into the ground in situ; other deep foundations are typically put in place using excavation and drilling. The naming conventions may vary between engineering disciplines and firms. Deep foundations can be made out of timber, steel, reinforced concrete or pre stressed concrete.

i. Pile foundation systems

Foundations relying on driven piles often have groups of piles connected by a pile cap (a large concrete block into which the heads of the piles are embedded) to distribute loads which are larger than one pile can bear. Pile caps and isolated piles are typically connected with grade beams to tie the foundation elements together; lighter structural elements bear on the grade beams, while heavier elements bear directly on the pile cap.

CONCLUSION

In this paper, the basics of bridge designs have been examined for their effectiveness. It is important to be perfect in designing a bridge as it needs to carry a huge load of vehicles and people, and the relevant implementation has been reported in this paper. Examining the various principles on which a bridge is constructed gives us a solid precedent to fall back on if and when something goes wrong during its construction.

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