"DESIGN AND DEVELOMENT OF VERTICAL LIFTING BRIDGE"

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ABSTRACT :-

The motivation behind the project is the DESIGEN AND DEVELOPMENT OF VERTICAL LIFTING BRIDGE, HAMSBERG, GERMANY. The bridge was built in 1972. The bridge has a unique future that it based on the "Vertical Lift Mechanism", its middle (movable) part lifts to give way to the ship passing by thus maintaining waterways transport. Till now no bridge such has been built in India. Experimental systems can measure the actual response of a structure subjectedto various loading. However, with most systems only a few selected points on a structure can be monitored. An optimum evaluation system would incorporate both analytical and experimental techniques. An analytical model of such a system can be systematically modified until it simulates structural behaviour observed under experimental conditions. We considered the deck and truss of the bridge for analysis because to eliminate the complexity of the project. We considered the bridge as a fixed beam and the load to be a uniformly distributed load and calculated total deformation, maximumstresses and strains.

Index Terms — Vertical lift bridge, Rope drive, Recouvrance, Bascule bridge, Span, Sheave, Teflon, D.C. Pump

1. INTRODUCTION

A vertical-lift bridge or lift bridge is a type of movable bridge in which a span rises vertically while remaining parallel with the deck which ensures passing of ships underneath. They cost less to build for longer moveable spans. The counterweights in a vertical lift are only required to be equal to the weight of the deck. Thus heavier materials can be used in the deck, and so this type of bridge is especially suited for heavy railroad use. It is also more energy efficient, requiring comparatively less power to lift the bridge.

Among mobile bridges, lift ones appear as the right answer when relatively long spans are needed. Bascule bridges or rotating ones are more limited, because of their overhanging decks. In France the existing lift bridge with the longest span is edourande Bridge in Brest, with an 87.5 meters lifting span. But most large bridges of this kind are located in New Jersey, USA where many waterways allowmaritime traffic. The longest lifting span in the world belongs to Arthur Kill Bridge with 170 meters, no longer in operation. Another significant structure is the Gil Hodges Memorial Bridge with a main span in the range of 160 meters.

The project is a prototype of such a bridge and utilizes a chain drive mechanism to lift the middle span of the bridge.

This project is a model and a simplified version of Vertical Lifting Bridge and has been madeunder the constraints of space, time and resources available

Although good approximations can be made in the development of analytical models. For existing structures, construction tolerances, deterioration of seals, and wear at support points are factors that further alter loading and structural conditions. To ensure that a safe structural design is produced assumptions on loading and structural characteristics can generally be conservative.

A vertical-lift bridge or lift bridge is a type of movable bridge in which a span rises vertically while remaining parallel with the deck which ensures passing of ships underneath. They cost less to build for longer moveable spans. The counterweights in a vertical lift are only required to be greater the weight of the deck. Thus heavier materials can be used in the deck, and so this type of bridge is specialy suited for heavy railroad use. It is also more energy efficient, requiring comparatively less power to lift the bridge. The project is a prototype of such a bridge and utilizes a rope drive mechanism to lift the middlespan of the Bridge.

2.LITERATURE REVIEW

A brief review of the available literature is presented in this chapter. It deals with past research work on posttensioning and reliability analysis of steel trusses. A brief introduction to the bridges, posttensioning,and basic concepts of reliability analysis (both probabilistic and fuzzy based) is also given in the beginning of this chapter. The chapter ends with an appraisal of the reviewed literature.

The bridges are the structures, which provide means of communication over a gap and they provide passage for the highway and/or railway traffic over these gaps. There are several classifications of bridges based on different considerations. Some of the major classifications are based on: materials used, makeup of main load carrying elements, the structural layout of the principal load carrying members, floor location, type of connections, the level of crossing of highway and railway track and thenature of movement of the bridge.

An engineering project is systematic combination of numerous activities carried out by entrepreneurs, organizers, developers, planners, engineers, technicians, workers and many other agencies related with such activities. It is a time bound activity. An engineer plays a very important role in the success of every project. The success of project depends upon the engineer's ability, intelligence, hardwork and technical knowledge.

P = Planning before carrying out the work.R =
Raw material required for the work.
O = Organization of work.

J = Joint efforts put together in the work.E =
Estimation of the work.
C = Costing of the work.

T = Techniques used in performing the work.

The first vertical lifts bridge designed. This bridge type locates the power on top of the lift truss span. The actual lifting is a accomplished using up-haul and down-haul ropes where turning drums windthe up-haul (lifting) ropes as they simultaneously unwind the down-haul ropes. Vertical lift bridge machinery is located on top of the lift truss span, and the operating drums rotate to wind the up-haul (lifting) ropes as they simultaneously unwind the down-haul ropes. A variation of this type provides drive pinions at both ends of the lift span.

Which engage racks on the towers. Electronic material submitted is crucial since the content is not recreated, but rather converted into the final published version. In truss bridges, the trusses are used asthe main load carrying members. Trusses are a series of axially loaded members arranged in the formof triangles. The arrangement of the members and the connections at their ends are such that, the external loads are applied to the joints and the centroidal axis of all the members meet at joints. The members of a truss are classified as chord members and the web members: the uppermost and lowermost members constitute the top and bottom chord respectively; whereas the verticals and diagonal members form the web. For typical gravity loads on a simple span truss, the upper chord members will be in compression and lower chord members will be in tension; whereas the web members will be in tension or compression depending upon the truss type and their location.

3.MATERIALS USED

TECHNICAL SPECIFICATIONS OF MATERIAL

The provisional specifications of the vertical-lift bridge are specified as below:The length of the bridge frame is 2ft.

The height of the bridge frame is 3ft.

The aluminium strips at form the truss are 0.5 inch in thickness and the height of the middlespan is 7 inches.

MATERIALSUSED

1.Mild Steel rods

2.MS plates, angles and screws
3.Plastic

4.DESIGN

The main parts and components have been discussed in the following sections.The vertical-lift bridge is divided into the following 3 broad categories:

Rope Drive Mechanism

An object's gravitational energy depends on how high it is, and also on its weight. Specifically, the gravitational energy is the product of weight time's height:

Gravitational energy = (weight) x (height)

To calculate the energy required to lift the bridge to know the force produces by the bridge on downword direction. Weight of the bridge with empty water tank and valve is 6.2kg
Force = weight x Gravitational Acceleration

BRIDGE SPAN

The bridge span includes the following.
Middle span
Side span

MIDDLE SPAN

Function:-The base of the bridge which is to be lifted.

MATERIAL:- Plastic, Aluminium ,Mild Steel

DIMENSIONS:

Wooden base length of 21 in and width 8 inches.
Aluminium strips of 0.5 inch thickness
2 wooden Top chords of length 21 in and thickness 1 inch.2MS
connecting rods

SIDE SPANS

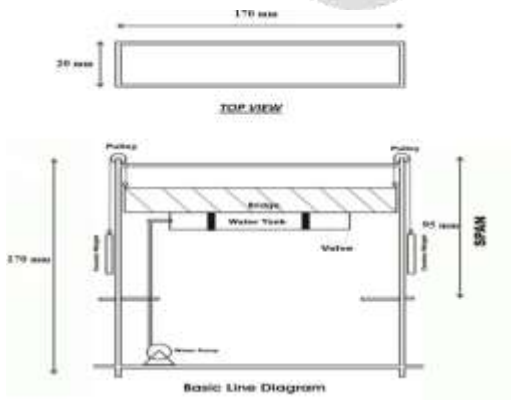
Function of Side Spans:- The extensions of the span on either side of the middle span

Material of Side Spans:

Plastic,Aluminium

Dimensions of Side Spans:

2 Top chords: Length of 9.5 inches, height=1.5 inches, width=1inch



4.1.DESIGN OF WIRE-ROPE

When power is to be transmitted over long distances then belts cannot be used due to the heavy lossesin power. In such cases ropes can be used. Ropes are used in elevators, mine hoists, cranes, oil well drilling, aerial conveyors, tramways, haulage devices, lifts and suspension bridges etc. two types of ropes are commonly used. They are fibre ropes and metallic ropes. Fibre ropes are made of Manila, hemp, cotton, jute, nylon, coir etc., and are normally used for transmitting power. Metallic ropes are made of steel, aluminium. alloys, copper, bronze or stainless steel and are mainly used in elevator, minehoists, cranes, oil well drilling, aerial conveyors, haulage devices and suspension bridges.

Material Of Wire-Rope:

Nylon

Figure:- Wire-Properties:

Modulus of elasticity = 3.9 x 103 Mpa
Density = 1140 Kg/m3
Ultimate tensile strength = 616 Mpa
Specific gravity = 1.13 M/s2 Maximum
temperature = 99°c Minimum
temperature = -70°c
Mass of span (without water) = 10 Kg
Weight of span (without water) = 98.1 N
Weight of span (with water) = (Weight of span (without water)) + Weight of water

= 10 + 98.1 = 108.1 N

Mass of counter weight = 8 Kg Weight
of counter weight = 78.48 N
Total Weight (acting on frame) = Weight of span (with water) + Weight of counter

= 108.1 + 78.48

= 186.58 N

So, we are using 4 numbers of pulley's and wire-rope for lifting the span.Load
on the single rope = 46.645 N

SELECTION OF PULLEY

A pulley is also called a sheave or a drum, is a mechanism composed of a wheel on as axleor shaft that may have a groove between two flanges around its circumference. A rope, belt, cable, or chain usually runs over the wheel and inside the groove, if present. Pulleys are used to change the direction of an applied force, transmit rotational motion, or reliead a mechanical advantage in eithera linear or rotational system of motion. Two or more pulleys together called a block or tackle.

Figure:- Pulley

Material Of Pulley:

Teflon.

Properties:

1. Teflon consists of lowest coefficient of friction.
2. Teflon is very unreactive.
3. High melting point at 327°c.
4. High wear resistant

4.2.SELECTION OF TANK

The water tank is used in this project for the purpose of arranging the across of counterweight, when the tank is filled with water then the bridge is at its bottom position and when the water is removefrom the tank then the bridge is get at the top of the towers .This tank is made with plastic material.

Specification of tank :

Length of tank: 36 cm
Height of tank: 25.5 cm
Width of tank: 14.5 cm

Thickness: 1 cm

Area of tank = L x B x H

= 34 x 12.5 x 24.5

= 10412 mm^2

Hence the tank capacity for water is 10 litre. When the water is added 10 litter then the mass of wateris 10 kg and weight is 98.1 N. Mass of tank is 1.5 kg and weight is 14.715 N

Total weight = weight of tank + weight of water

= 98.1 N + 14.715

= 112.815 N

Figure :-Tank

4.3. SELECTION OF WATER PUMP

The pump is powered by an electric motor that drive an impeller or centrifugal pump. The impeller moves water, called drives water from a well through a narrow orifice or jet mounted in the housing in front of the impeller .Its function is to slow down the water and increase the pressure.

Figure :- Water pump

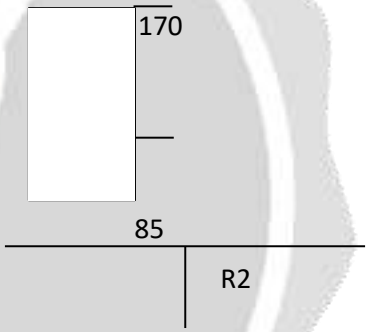
Specification of water pump:

Voltage: 265V 230V/50Hz ACPower:
40 W
Lifting High Of Water:2.8 M
Output :3800 L/h

CALCULATION

Assumptions 20

Area of frame = 170 × 20 mm^2)



Total load on frame is about 20kgF =
20× 9.81
= 196.2N

This load is applied at the centre as shown in fig.

From fig

R1 +R2 = F

And

$\Sigma M_{R1} = 0$

F × 85 - R2 × 170 = 0

196.2× 85 – R2 × 170 = 0

Therefore,
R2 = 98.1
R1 + 98.1 = 196.1

R1 = 98.1

M_b = 98.1 × 85

M_b = 8338.5

Y= b/2..... (b = width of angle or pipe use for frame)

= 20/2

= 10 mm

$I = bd^3 / 12$

$= d^4 / 12$

$= (20)^4 / 12$

= **13333.33**

Stress on frame,σ
= Mb× y / I
σ = (8338.5× 10) / 13333.33

σ = 6.25 N / mm2

σ = Syt / fos Therefore, Syt = σ × fos
= 6.25 × 5.....(assuming fos = 5)

= 31.25 N / mm2

Selecting material GCI 15 having Tensile strength (min) = 150 N / mmTherefore all assumptions are in safer state.

5. FUTURE SCOPE

Vertical lifting bridge have been an integral part of the U.S. transportation system, their developmentbeing in concert with that of:

(1) The development of the railroads.

(2) The development of our highway system.

(3) The development of the marine transportation

While sometimes referred to as draw bridges Vertical lifting bridge have proved to be an economical solution to the problem of how to carry a rail line or highway across an active waterway. It is not surprising to learn that movable bridges are found most commonly in states that have low coastal zones such as California, Florida, Louisiana, and New Jersey, or a large number of inland waterways such as Michigan, Illinois, and Wisconsin Jurisdiction for movable bridges currently lies with the U.S. Coast Guard. In most instances, marine craft have priority, and the movable span must open to marine traffic upon demand. This precedence is reflected in the terms closed and open, used to describe the position of the movable span.

A vertical lifting bridge has used for waterway to marine traffic, while an open bridge has opened the waterway to marine traffic. Highway bridges are typically designed to remain in the closed position and only to be opened when required by marine traffic. However, movable railroad bridges canbe designed to remain in either the open or closed position, depending on how frequently they are used by train traffic. The difference is important as different wind and seismic load design conditions are used to design for a bridge that is usually open vs. one that is usually closed. The first specification forthe design of vertical lifting bridge was published by the American Railway Engineering Association (AREA) in its 1922 Manual of Railway Engineering. But this project required more power supply.

This project is used to carry a rail line or highway across an active waterway by using low power supply by arranging counterweight and water tank arrangement.

6. RESULT

When Water Operated Vertical Lifting Bridge is actually implemented it consumes powers which is less than that of vertical lifting bridge. Hence, project is required approximately 75% efficient than thatof other types of bridge.

Means vertical lifting bridge which operate by gear mechanism is required more power supplyand when we operate this bridge by using water tank and counterweight then power supply required approximately 25% less

This way we can reduce the requirement of electric power supply.

7. CONCLUSION

According to the results, Water operated vertical bridge lifting acquires less consumption of power than that of the conventional type of bridges. It not only eliminates the complicated gear mechanism but also eliminates highly rated electric motors. while travelling, naturally rivers are to be faced, therefore from both point of view i.e. ship and automobile transport bridge to be constructed is as perour project, which would be best solution as power saving. We are confident that our project will notonly add a feather to our cap but also it will rise the bar of our knowledge of various sections which are include in the syllabus of course. It will also enable to the junior friends to carry out experiment successfully.

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