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Role Of Reduction Factor In The Design Of Highway Bridge Pier

Vennam Swathi[1],Muppalla Venkata Sai Surya Pratap Chowdary[2],SS.Asadi[3],B.J.N.Satish[4]

[1&2] Research Scholar, Department of Civil Engineering, Vignan's Foundation for Science, Technology and Research, Vadlamudi, Guntur, Andhra Pradesh-522 213, India, vennam.swathichowdary@gmail.com
[3]Professor, Department of Civil Engineering, Vignan's Foundation for Science, Technology and Research, Vadlamudi, Guntur, Andhra Pradesh-522 213, India.
[4] Assistant Professor, Department of Civil Engineering, Vignan's Foundation for Science, Technology and Research, Vadlamudi, Guntur, Andhra Pradesh-522 213, India.

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Abstract:
This report is attempt towards understanding the design procedure of highway bridge pier. The span of simply supported bridge is selected to design purpose. For these procedure for design of bridge pier for both static and seismic forces are shown in the results are compared. Transverse reinforcement in plastic hinge region is obtained from different codes and the results are compared. Finally, the role of response reduction factor in the design of bridge pier is also discussed. Verification of achieved ductility and R factor is determined using moment curvature analysis.

Keywords:*Bridges, seismic conditions, bridge pier, reinforcement,analytical model*

INTRODUCTION

High way Bridge pier is the building construction and load bearing of the member which is an intermediate support for the structure.Any bridge structure has combined of two components,super structure and sub structure.For these bridges bearing is the major components which transfer the load from beraing to the underground level is called substructure.It consists of Girgers,Deck or such as roads,Arches etc.In these Highway Bridge pier which is to support the span of the bridge and loads from tranfer to the superstructure to the Foundation.Pier is the Strong to take the both horizontal and vertical loads.

They are different types of piers which are Solid Piers and Open Piers.Solid piers are Impermeable Structure these are mostly used in the Construction of piers in bricks,stone masonry and concrete etc.Open piers are which allows the water and passing through structure are called as open piers.These are also classified into the different types.Cylindrical piers,column bents and pile bents.

The Failure of bridges was mostly observed in the structural performance of the bridge.Generally damages will occur in during earthquakes. In these damages to reduces only to provide pier cap.The section is pier having height of 15 m and pier cap are shown in fig.1

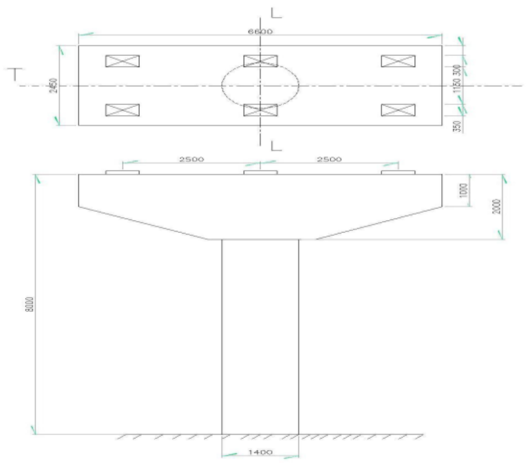

Fig.1:pier and pier cap

OBJECTIVES

The objective is to determine the Linear Analysis Using SAP2000(software)

- Create a dead load and live load.
- Dead load is to be taken as self weight of the deck.
- Live load to be take as per IRC:6-2010

METHODOLOGY

3.1 FUNDAMENTAL NATURAL TIME PERIOD

In these fundamental natural period is the calculating the property of time and Frequency.In these fundamental time peirod is the major parameter of Evaluation of seismic and shear which it is calculated from following equation:

$$t = 2\,\pi \sqrt{(\delta / g)}$$

Were, δ is the displacement and top of the pier when they force are equal to the weight of structure, varying different percentages which are some percentages of live load is taken as in longitudinal direction and in transverse direction.. Fig.2 and fig.3 shows single pier bridge vibration unit in longitudinal and transverse directions respectively.

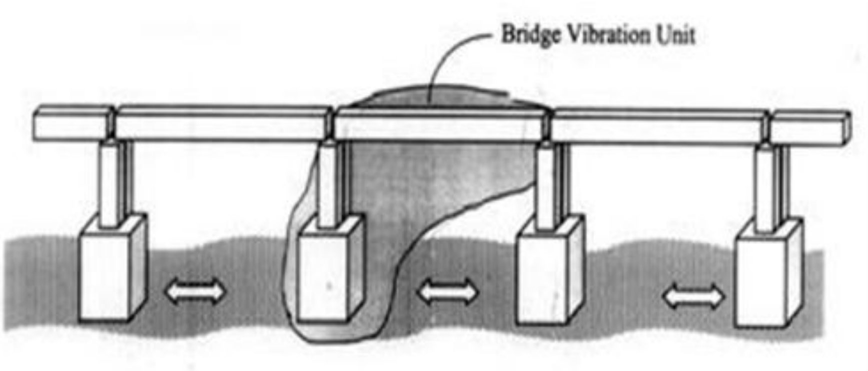

Fig.2: Vibration unit of pier bridge in Longitudinal direction

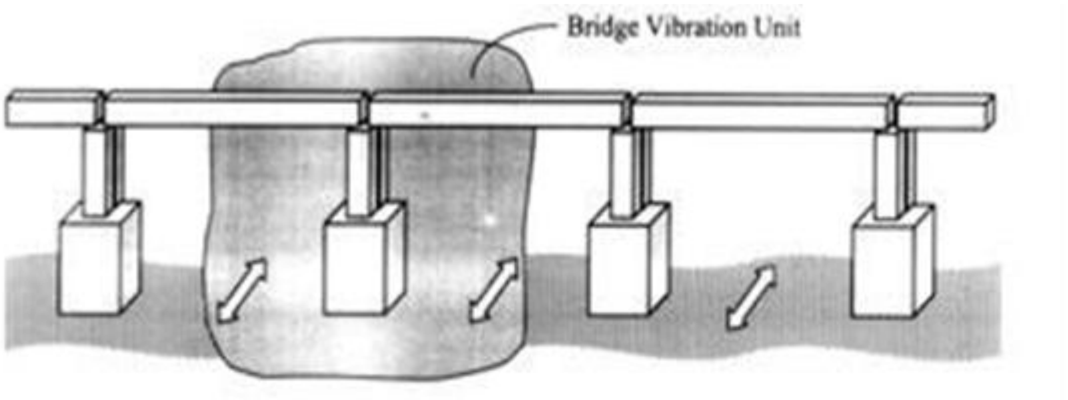

Fig.3: Vibration unit of pier bridge inTransverse directio

3.2 RESPONSE REDUCTION FACTOR:

The Role of reduction factor is the factor by its shear force and it would be reduced,to obtain the design of lateral force and basically which depends on Strength and ductility. The r factor which allow the structure and to be damage in those case of severe shaking.Generally the Structure is designed in seismic force and lower than the expected under earth quakes.If the following structure is to be designed for low force and than implies the strong shaking by considered the following factors:overStrength,Ductility,and which will prevent the collapse of the structure.

In these reponse reduction factor which yields with a Structure of and it load lower than the higher which it various due to partial safety factors and to overcome the structural and non-structural elements and it was contributing the over Strength and it defined the shear and the roof displacement and corresponds the limit state of the response spectrum.

In Ductility is the capacity of material and absorb energy by defining the elastic range.Ductlity is the ratio of ultimate code and specify the yield displacement.

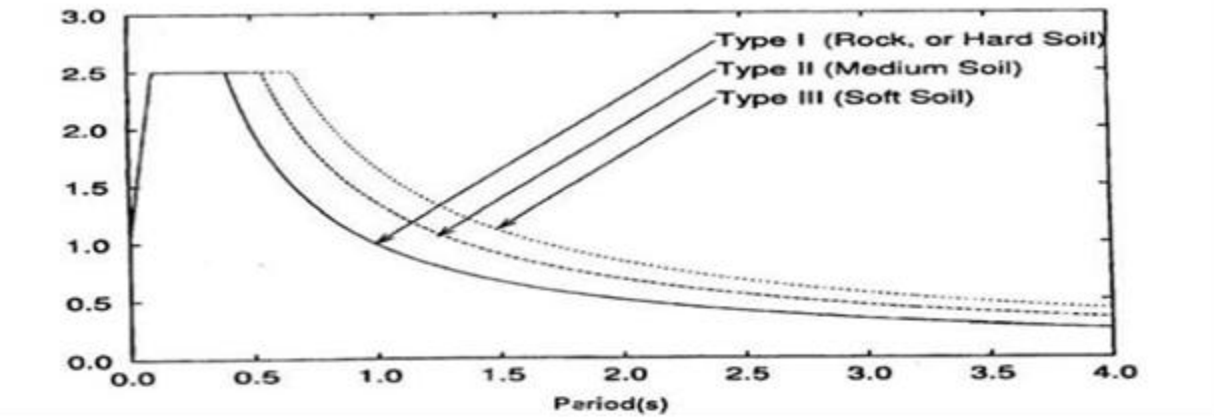

Fig.4: Response spectra

The R factor reflect the structure and their elastic properties and to provide the stiffness and evaluate those objectives and which is primarly defines the performance of the non-Structural elements.In these design process which it undergoes the seismic codes design allows the seismic design which is based on dynamic and static analysis of the structure using elastic Design Spectra.

3.3 EVALUATION OF R FACTOR USING MOMENT CURVATURE ANALYSIS

The moment and curveture is a reinforced section and it is valuable parameter to evaluate the strength, stiffness, ductility, energy dissipation capacity of structure.In these moment curvature analysis which is required to the moment It can be determined by obtaining the structural displacement and ductility factor μΔ which is related to member curveture ductility factor as shown in figure given below.

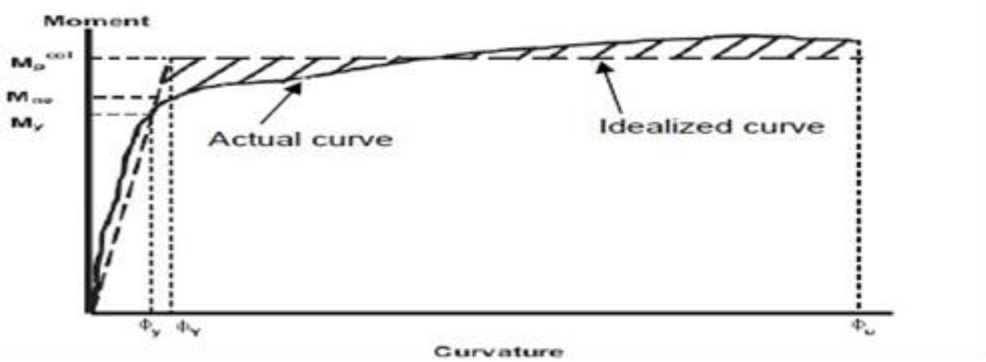

Fig.5: Moment curvature curve (Preistley et al. (1996))

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3.4 DESIGN OF PIER

Axial load P = 4441.19 Kn

Transverse moment on Pier M_{ll} = 1190 kN-m

Longitudinal moment on PierM_{tt} = 2351.7 kN-m

Factored moment M_u = 3953.53 kN-m

d' = 50 mm

d'/D = 0.04

$P_u/(f_{ck}D^2)$ = 0.11

$M_u/(f_{ck}D^3)$ = 0.05

From chart-55 SP-16 p/f_{ck} = 0.03

%of reinforcement, p = 0.9%

Areaof steel = 13847.4 mm2

Diaof longitudinal bar = 28mm

No. ofbars = 24

Transverse reinforcement—As perIS-456
Assuming12 mmdia. Bar
Spacings ≤ Dia. of pier
≤ 16xdia. ofmain reinforcement
≤ 300 mm
Provide12 mmcirculartie at 300 mm spacing

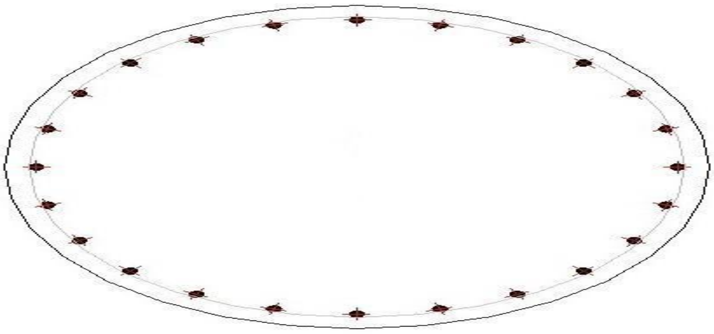

Fig.6: pier having 24 mm- 28mm dia reinforcement

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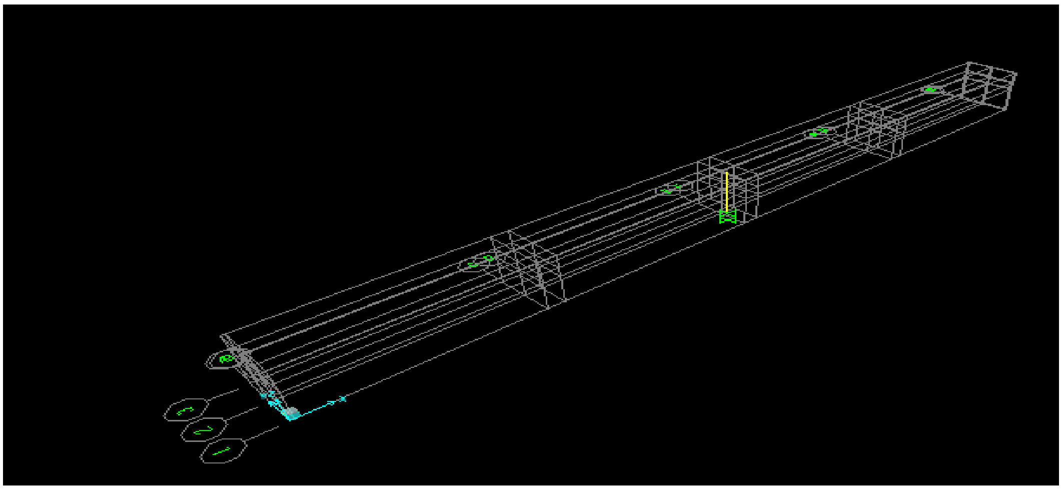

Fig.7: Model of 15m pier

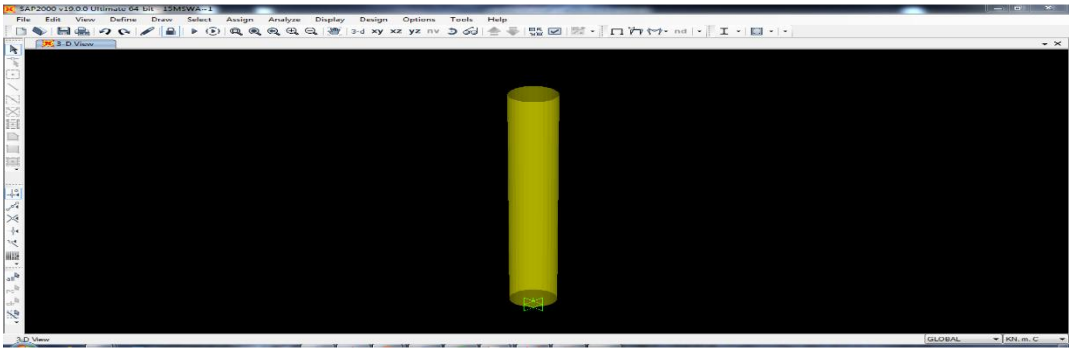

Fig.8: Peir and Pier Cap by using SAP Software

RESULTSAND DISCUSSIONS

Table.1: Comparision of transverse Reinforcement details obatained from different codes

CODES	Spacingin mm	Diameter ofCirculartieinmm
AASTHO	110	20
CALTRANS	120	20
RDSO-2010	150	20

- The study on the design of RC bridge pier using both conventional loading and seismic loading.
- It shows that different percentages of longitudinal reinforcement which is greater for the structuraln loading than conventional loading.
- Seismic response of bridges is critically dependent on the ductile characteristics of the pier.
- So, bridges should be designed such that under severe shaking plastic hinges form in the pier.
- Proper design of transverse reinforcement in plastic hinge region should be done.

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