IJIRSET
International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

e-ISSN: 2319-8753 | p-ISSN: 2347-6710

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 1, January 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.118

9940 572 462 | 6381 907 438 | ijirset@gmail.com | www.ijirset.com

International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)

|e-ISSN: 2319-8753, p-ISSN: 2347-6710| www.ijirset.com | Impact Factor: 8.118| A Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 1, January 2023 ||

| DOI:10.15680/IJIRSET.2023.1201037 |

Dynamic Analysis of Bridge with different Spans of Bridge Piers Applying Pushover

Mr. Mayur Madhav Shitre[1], Prof. V.V.Shelar[2]

Student, M.E, Dept. of Civil Engineering, Trinity College of Engineering and Research, Pune, India[1]

Professor, Dept. of Civil Engineering, Trinity College of Engineering and Research, Pune, India [2]

ABSTRACT*:* Bridges extends horizontally with its two ends restrained and that makes the dynamic characteristics of bridges different from building. Non-linear static procedures, such as pushover-based ones, have been continuously refined and improved along the past few years as a complement or even as an alternative to dynamic time-history analysis. The study addresses the issue of pushover analysis of bridges sensitive to torsion, using as a case-study a straight, overpass bridge with two equal spans, whose fundamental mode is purely torsional. This chapter presents a summary of various parameters defining the computational models, the basic assumptions and the bridge geometry considered for this study. The loads and load combinations on the bridge are studied and the same bridge in modeled in SAP 2000 and conducted Linear static, Modal and Seismic Analysis (Response Spectrum) to get the maximum bending moments and dynamic properties of the bridge.In the present study MPA is used for the study of nonlinear behavior of bridges with different span of pier.

KEYWORDS: RCC, Bridge, SAP2000, Pushover, Response Spectrum

I. INTRODUCTION

Modern transportation system has great influence on nation's economy and Bridges are an important component of all type of modern transport system. The various types of bridges have simple geometry, still they attract structural designer attentions to have various types of geometry and their type of constructions. It has been observed that bridges perform very poorly due to lack of attention in the design details. Numbers of bridges were designed around the world during the period, when there were no provisions for the seismic loads in the bridge codes or when these provisions were inadequate according to the present standards. The San Fernando Earthquake(1971), Loma Prieta Earthquake(1989), Northridge Earthquake(1994), Hanshin-Awaji Kobe Earthquake{1995) and Tohoku Earthquake (Japan)(2011), are few earthquake to name which caused drastic damage to a considerable number of bridges because of lack of design considerations to seismic counteraction forces.

The Bhuj Earthquake in India has been considered as most deadly earthquake. Recently, Nepal earthquake damaged several poorly built and weak masonry structures.

A large number of bridges are designed and constructed without considering seismic forces. Moreover, the linearly elastic procedures adopted for the analysis of bridges remain efficient as long as the structure behaves within elastic limit. If the structure response is beyond elastic limit, the elastic procedure is insufficient to perform assessment of the structures. This leads to an over estimating of structures thereby attracting more seismic forces. Presently there are no Comprehensive guidelines to assist the practicing structural engineer to evaluate existing bridges and their retrofitting. In order to address this problem, the present study aims to carry out a seismic evaluation for RC bridges having short and long piers using nonlinear (pushover) analysis.

II. STATE OF DEVELOPMENT

A. J. Kappos, et.al. the aim of this study is to investigate the extension of the modal pushover method to bridges, and the investigation of its applicability in the case of complex bridges. To this effect, a real, long and curved bridge is chosen, designed according to current seismic codes; this bridge is assessed using the aforementioned

|e-ISSN: 2319-8753, p-ISSN: 2347-6710| www.ijirset.com | Impact Factor: 8.118| A Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 1, January 2023 ||

| DOI:10.15680/IJIRSET.2023.1201037 |

three nonlinear analysis methods. Comparative evaluation of the calculated response of the bridge illustrates the applicability and potential of the modal pushover method for bridges, and quantifies its relative accuracy compared to that obtained through the 'standard' pushover approach.

TobiaZordana, Bruno Briseghella, Cheng Lan, et.al. In this paper, a 2D simplified finite-element model of a real 400-metre-long IAB, built in the Province of Verona-Italy, is implemented and used to perform nonlinear analyses on the bridge, the structural response of which is then examined in detail. A parametric study based on the variation of the soil properties behind the back-walls and around the piles is then performed. Furthermore, a temperature pushover analysis (nonlinear static analysis for positive and negative temperature variations) is carried out to assess the failure pattern of the bridge caused by a temperature change, considered as one of the key parameters in IAB design. Lastly, the effect of abutment stiffness is also discussed.

Yi Zheng, Tsutomu Usami, and HanbinGe, et.al. This study aims at investigating the applicability of pushover analysis to multi-span continuous bridge systems with thin walled steel piers. The focus is concentrated on the response demand predictions in longitudinal or transverse directions. The pushover analysis procedure for such structures is summarized and then parametric studies are carried out on bridges with different types of superstructure pier bearing connections. The considered parameters, such as piers' stiffness distribution and pier deck stiffness ratio, are varied to cover both regular and irregular structures. Finally, the relation of the applicability of pushover analysis to different structural formats is demonstrated and a criterion based on the higher modal contribution is proposed to quantitatively specify the applicable range.

R. Pinho1, C. Casarotti and S. Antoniou, et.al. such invariant force distributions cannot account for the redistribution of inertia forces caused by structural yielding and the associated changes in the vibration properties, including the increase of higher-mode participation. In order to overcome such drawbacks, but still keep the simplicity of using single-run pushover analysis, as opposed to multiple-analyses schemes, adaptive pushover techniques have recently been proposed. In order to investigate the effectiveness of such new pushover schemes in assessing bridges subjected to seismic action, so far object of only limited scrutiny, an analytical parametric study, conducted on a suite of continuous multi-span bridges, is carried out. The study seems to show that, with respect to conventional pushover methods, these novel single-run approaches can lead to the attainment of improved predictions.

III. PROBLEM STATEMENT

A parametric study of Bridges will be carried out by varying the height of piers and span length in different bridge models. Total 6 models of T Beam Bridge will model by considering the number of lanes, carriage way widths, span length, pier cap, abutments etc. Total length of bridge is 45 m. All Bridge models having 2 lanes (Total width 10m with 7.5m Carriageway). Slab thickness consider as 300 mm. Grade of Concrete – M40 and Grade of steel – Fe415.

Table 1 Bridge Configuration

Bridge Models	Type of Bridge	Height of Piers (m)	Span Length (m)
B-1	Long pier	16,16	15,15,15
B-2	Long pier	16,16	10,25,10
B-3	Short pier	8,8	15,15,15
B-4	Short pier	8,8	10,25,10

- Seismic Zone – Zone 4 (Seismic Coeff. Factor = 0.24)
- Poisson's ratio – 0.2
- Type of soil – Medium
- Importance Factor – 1
- Response Reduction Factor – 5
- Damping of Structure – 5%
- Clear width of roadway = 7.5mSpan of the bridge =16m
- Average thickness of the wearing coat = 80mmGrade of concrete= M25
- Grade of steel =Fe415

|e-ISSN: 2319-8753, p-ISSN: 2347-6710| www.ijirset.com | Impact Factor: 8.118| A Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 1, January 2023 ||

| DOI:10.15680/IJIRSET.2023.1201037 |

IV. MODELING AND RESULTS

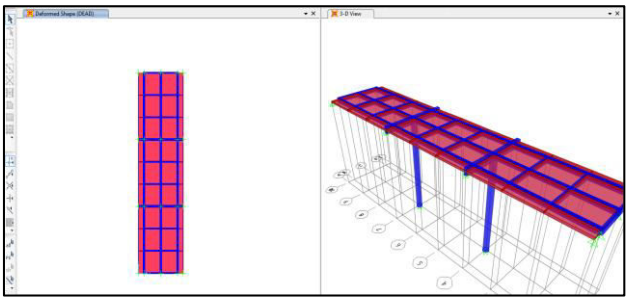


Fig. 1. Model B1

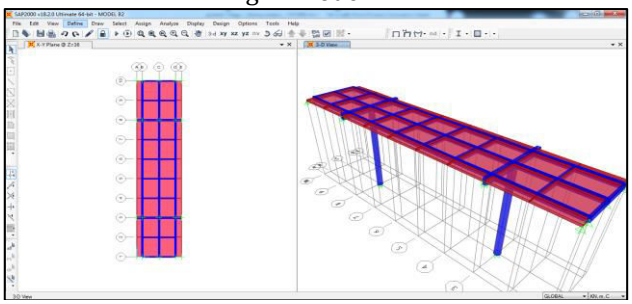


Fig. 2. Model B2

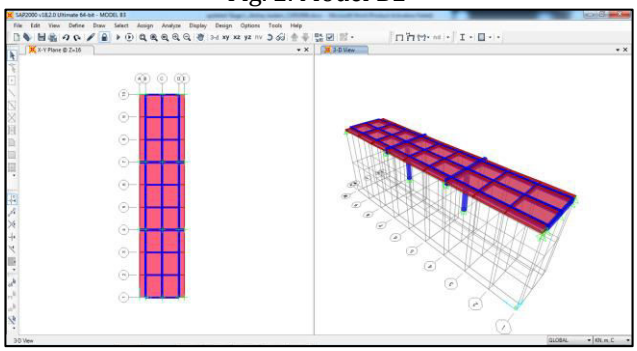


Fig. 3. Model B3

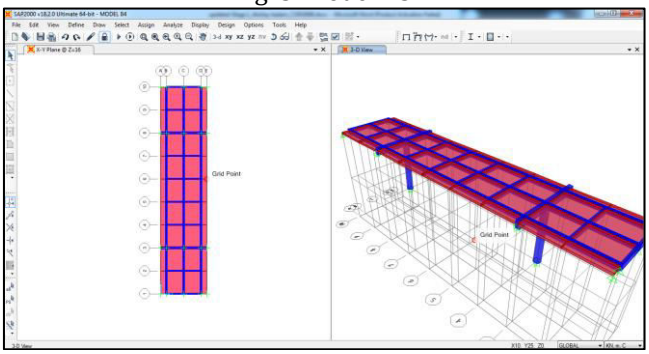


Fig. 4. Model B4

A. Response Spectrum

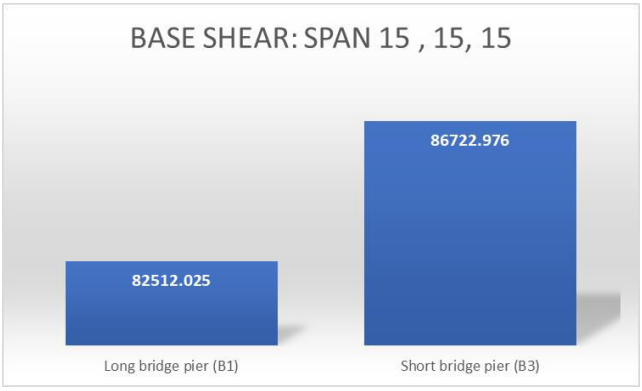
Table. 2 Base Shear (Span 15, 15, 15)

SPAN 15, 15, 15	
Long bridge pier (B1)	**Short bridge pier (B3)**
82512.025	86722.976

|e-ISSN: 2319-8753, p-ISSN: 2347-6710| www.ijirset.com | Impact Factor: 8.118| A Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 1, January 2023 ||

| DOI:10.15680/IJIRSET.2023.1201037 |

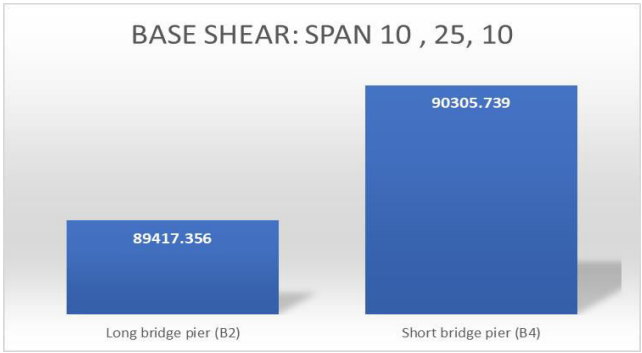


Graph 1. Base shear

As we see in the above graph, it shows about base shear of span 15,15,15 for long bridge pier (B1), short bridge pier (B3). The maximum base shear shows for short bridge prier (B3).

Table 3. Base Shear (Span 10, 25, 10)

SPAN 10, 25, 10	
Long bridge pier (B2)	**Short bridge pier (B4)**
89417.356	90305.739



Graph 2 Base shear

As we see in the above graph, it shows about base shear of span 10, 25,10 for long bridge pier (B2), short bridge pier (B4). The maximum base shear shows for short bridge prier (B4).

B. Time History: Displacement

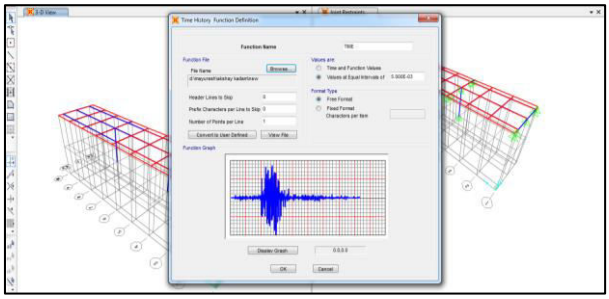


Fig 5Time history function

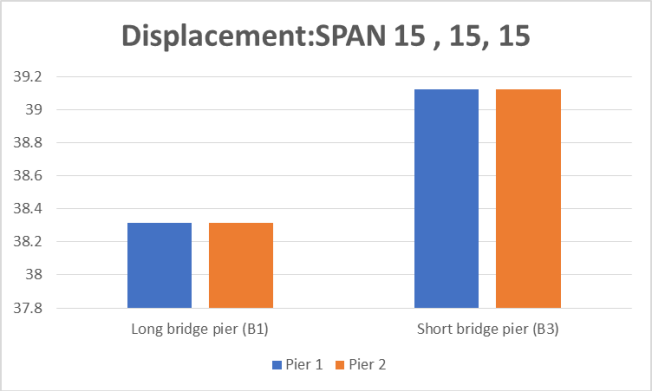
|e-ISSN: 2319-8753, p-ISSN: 2347-6710| www.ijirset.com | Impact Factor: 8.118| A Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 1, January 2023 ||

| DOI:10.15680/IJIRSET.2023.1201037 |

Table 4. Displacement (Span 15, 15, 15)

SPAN 15, 15, 15		
PIER	Long bridge pier (B1)	Short bridge pier (B3)
Pier 1	38.316	39.126
Pier 2	38.316	39.126

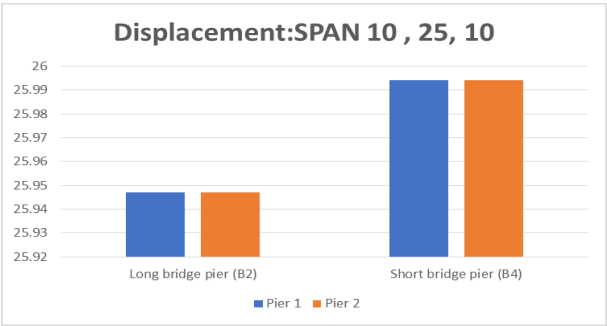


Graph. 3.Displacement (Span 15, 15, 15)

As we see in the above graph, it shows about displacement of span 15,15,15 for long bridge pier (B1), short bridge pier (B3). The maximum displacement shows for short bridge prier (B3) of prier 1 & 2.As well as irregular bridge of prier 1.

Table 5. Displacement (Span 10, 25, 10)

SPAN 15, 15, 15		
PIER	**Long bridge pier (B2)**	**Short bridge pier (B4)**
Pier 1	25.947	25.994
Pier 2	25.947	25.994



Graph. 4.Displacement (Span 10, 25, 10

As we see in the above graph, it shows about displacement of span 10, 25, 10 for long bridge pier (B2), short bridge pier (B4). The maximum displacement shows for irregular bridge prier (B4) of prier 1

V. CONCLUSION

A parametric study of Bridges carried out by varying the height of piers and span length in different bridge models. Total 6 models of T Beam Bridge with having bearing and the design of bridge and bearings are carried out analytically. Total Six models of Bridge model are consider with span of equal and unequal spans and pier heights and analyze this modes in FEM software SAP2000 for various seismic analysis methods such as, response spectrum, time history analysis etc.to investigate and measure the performance of the bridge with different span and pier conditions the analysis conclude that the Short pier height models are economic than the unequal and long pier model as compare, but as compare with Unequal pier models having equivalent results

|e-ISSN: 2319-8753, p-ISSN: 2347-6710| www.ijirset.com | Impact Factor: 8.118| A Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 1, January 2023 ||

| DOI:10.15680/IJIRSET.2023.1201037 |

with short pier model, so the bridge having unequal span and pier conditions are recommended for the seismic design purpose, the all final conclusions are carried out from the following results.

- **Response Spectrum Analysis**
  In the Response Spectrum analysis Method base shear of the bridge are compare, as compare with base shear results for equal and unequal spans, long span pier having less base shear than Short & Irregular piers, the Short & Irregular piers base shear difference are around 20-25%
- **Time History Analysis**
  In the Time History Analysis Method Displacement of the bridge are compare, as compare with Displacement results for equal and unequal spans, long span pier having less Displacement for both piers than Short & Irregular piers, the Short & Irregular piers Displacement difference are around 5-10%

REFERENCES

[1] *Ranjit S. Abeysinghe, EvgeniaGavaise, Marco Rosignoli, and TheodorosTzaveas, "PUSHOVER ANALYSIS OF INELASTIC SEISMIC BEHAVIOR OF*
[2] *GREVENIOTIKOS BRIDGE", American Society of Civil Engineers (ASCE), August 2002*
[3] *Mohammad Farhan and MohdTasleem, "PUSHOVER ANALYSIS OF REINFORCED*
[4] *CONCRETE BRIDGE PIER DESIGNED AS PER IRC-6 CODAL PROVISION",*
[5] *Journal of Civil & Environmental Engineering, August 2020*
[6] *AmitKatkar, P. M. Kulkarni, "PARAMETRIC STUDY OF BRIDGE PIERS",*
[7] *International Research Journal of Engineering and Technology (IRJET), Jan 2018*
[8] *NileshShadunkey, RashmiSakalle, "COMPARATIVE STUDY OF EFFECT OF*
[9] *VARYING SPAN LENGTH ON MAJOR ELEMENTS OF METRO BRIDGE",*
[10] *International Research Journal of Engineering and Technology (IRJET), Sept. 2019*
[11] *Chopra, A., Goel, R., and Chintanapakdee, C. (2003). "Statistics of Single-Degree-of-*
[12] *Freedom Estimate of Displacement for Pushover Analysis of Buildings." J. Struct. Eng., 129(4), 459–469.*
[13] *IS 1893 (Part 1)–2002, "Indian Standard Criteria for Earthquake Resistant Design of Structures, Part 1: General Provision and Buildings", Bureau of Indian Standards, New Delhi.*

IS CODES:

i. ***IS 456 : 2000*** *-Plain and Reinforced Concrete Code of Practice. - BUREAU OF INDIAN STANDARDS, NEW DELHI.*
ii. ***IS 1893 : 2000 -*** *Criteria For Earthquake Resistant Design Of Structures*

INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.118

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 6381 907 438 ijirset@gmail.com

Scan to save the contact details