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# Review Paper on Comparative Study of RCC Framed Building with and Without Expansion Joint at Different Location

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***Abstract:*** ***The pounding responses of the expansion joint in a curved ramp bridge under earthquake conditions. Long term effects of such seasonal temperature changes develop stresses and deformation in the building. Concrete creep and shrinkage increase the cracks widths and stresses. For elimination of this expansion joints are provided. The temperature expansion occurred most significantly during 20°C to 40°C and the optimised gradation could alleviate the arch expansion effectively, in the range of 20°C to 30°C.***
***An expansion joint is a gap provided in the structure to allow expansion and contraction of the building due to temperature changes. It absorbs the heat-induced by expansion and contraction of various construction materials. Two theoretical models were used under eight types of seismic conditions. Results indicate that a curved ramp bridge without an abutment expansion joint is a favorable structure for seismic design.***
***Keywords: Earthquake, pounding, Seismic Analysis, Expansion joints, Thermal stresses, Concrete Creep.***

## I. INTRODUCTION

Expansion joints are provided in a structure as they counter the adverse effects on structure due to temperature changes. An expansion joint may be defined as a mid-structure separation designed to relieve stress on a building material which are experienced during the life span of the structure.Due to creep, uneven settlement, temperature changes, expansion joints are essential, but under the action of earthquake, large-scale aqueduct's damage is often due to the collision of the adjacent groove in the position of the expansion joints . Influence of different factors on temperature expansion and also salt expansion of the cement stabilised base course through laboratory-scale slab tests and microscopic tests .Optimised gradation type of aggregate and other design indexes were proposed. The radial basis function network (RBFN) was used to establish a predication model of the amount of arch expansion. The micromechanism of arch expansion was further detailed by scanning images. Kelvin contact element was used to simulate the collision between expansion joints at the pier and the abutment. The purpose was to investigate the pounding responses of the expansion joint in a curved ramp bridge under earthquake conditions.

## II. OBJECTIVE

### *A. Objective of the Study*

The objectives of present study can be shortening as follows:

*1)* To study the effect of temperature load & earthquake load on the structure.
*2)* To study the variation in steel reinforcement in flat slab due to temperature loads.
*3)* To study the effect of temperature loads on member forces of beams.
*4)* Studying seismic gap between adjacent buildings by dynamic and pushover analysis.
*5)* To investigate seismic pounding between adjoining buildings.
*6)* To determine the minimum seismic gap between buildings.

### *B. Scope Of The Study*

*1)* Scope of the project work includes: Studying the seismic gap between adjacent buildings by dynamic and pushover analysis .
*2)* Evaluating the effects of structural pounding on the global response of building structures.

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## III. METHODOLOGY

*A.* A space dynamic model of a single curved ramp bridge was established, which includes the pier, the beam, the bearing, and the expansion joint.
*B.* Nonlinear time-history analysis helped compare the different pounding responses between expansion joints at the pier and the abutment in a curved ramp bridge.
*C.* A three-dimensional solid model is used to simulate the seismic collision of the aqueduct.
*D.* The radial basis function network (RBFN) was used to establish a predication model of the amount of arch expansion.
*E.* Two theoretical models were used under eight types of seismic conditions.
*F.* Understand the behavior of structure with and without expansion joints.

## IV. MODELLING

There are three models for the comparative study with variation in seismic gap. Modeling and analysis of structures are carried out using ETABS software.

### *A. Typical Models*

Model A – Adjacent structures with 0.3m gap
Model B – Adjacent structures with 0.4m gap
Model C – Adjacent structures with 0.5m gap

#### *1) Structural Details of Model*

| | |
|---|---|
| Number of models | 6 |
| Length | 90 m , 138 m , 180 m |
| Number of stories | G+9 |
| Height of each storey | 3m |
| Total height of building | 27m |
| Number of bay's along X | 6 |
| Number of bays along Y | 15(90m),23(138m),30(180m) |
| Columns | 600*600 |
| Beams | 450*600mm |
| Flat slab Thickness | 200mm |
| Flat drop | 350mm |
| Shear wall Thickness | 300mm |

Investigation of Flat Slab Structures with and Without Expansion Joints for Thermal Stresses

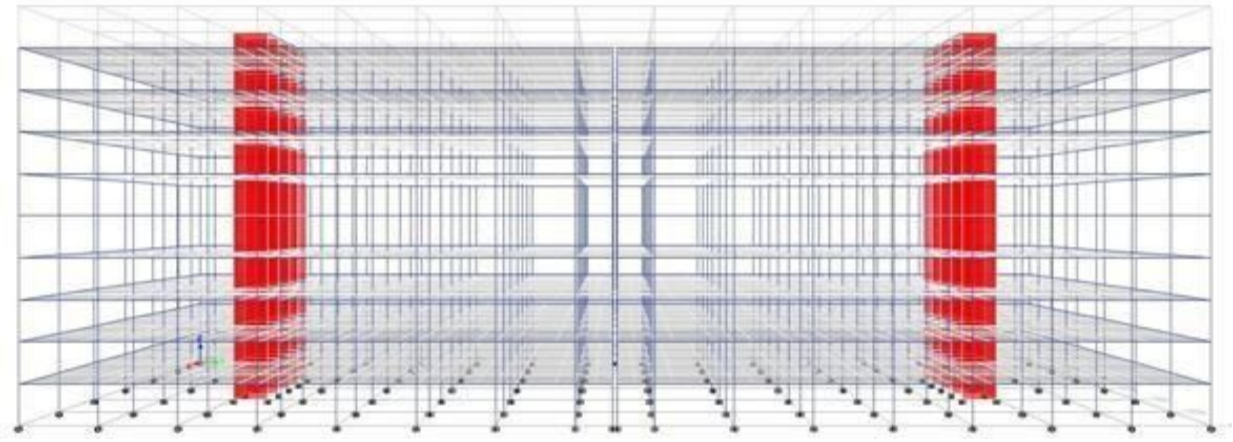


Figure: Elevation View of G+9 Structure of 90m slab length with expansion joint.

*2) Analysis*

*a)* All the six models i.e 90 m , 138 m , 180 m slab length with and without expansion joints are analysed using ETABS .

*b)* Corner displacements, Torsion on the peripheral beams are obtained.

*c)* Later the slabs at each level is exported to SAFE.

*d)* Results like stresses at each level and overall increase in steel reinforcement is obtained.

3) *Influencing Factors Analysis:* The expansion joint width of the aqueduct influences the collision effect. In order to investigate how different expansion joint width influences the collision effect, different calculation conditions are set for calculation and analysis. Since the aqueduct expansion joint width in the hydraulic engineering is mostly between 3 cm and 5 cm, the design width ranges from 1 cm to 8 cm. It is seen from Figure that as the width of the expansion joints increases, the number of collisions decreases. After the expansion joint width increases to 7.5 cm, the collision can be avoided. So, the expansion joint width is the key factor to suppress the collision. Besides, when the expansion joint width is small, the occurrence number of the collision force greater than 10 MN is relatively small and this is because a part of the energy is consumed by the frequent collisions.

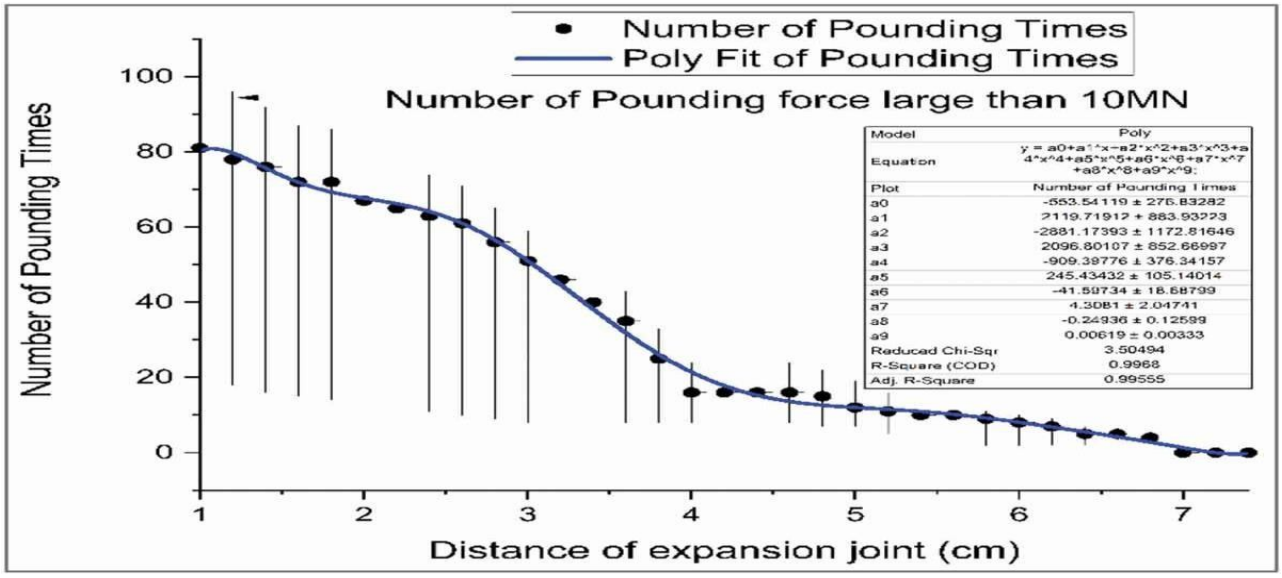



**Figure**. The relationship between collision times and the expansion joint width

## V. LITERATURE REVIEW

Liang Huang,Yujie Hou, (Volume 20, 2021) Collision in the expansion joint Effects on the seismic behavior of large-scale aqueduct . Present the three-dimensional contact analysis model has more collision times than that of the BSE-based model. Considering the shape of the crosssection in the three-dimensional contact analysis model, the contact between the two expansion joints is more frequent.

Shunji Jiang , Sivotha Hean,(Volume 21, 2020) Modelling structural response of flexible plug expansion joints under thermal movements. They presents the increase of joint width significantly reduces the stress at the interface between the mastic asphalt and APJ Thin joints generate lower stress levels in APJ under thermal condition.

Xuancang Wang , LongTing Ding, (02 Sep 2020), Characterisation of arch expansion of cement stabilised road bases. Temperature expansion occurred most significantly during 20°C to 40°C In the range of 20°C to 30°C, the arch expansion of cement stabilised materials was dominated by temperature expansion. The expansion was mainly salt expansion between −10°C and 0°C.

Pooja M & Dr. Karthiyaini S , (April 2017), This study mainly deals with design and analysis of structures of length 80m, 138m and 180m with and without expansion joints. Changes in stress at different levels, torsion on the exterior beam and overall increase in steel quantity on the structure after introducing temperature loads during the design of a structure.

Anjana C Jain, Ananya John, (Sep 2016), presents seismic Analysis of Expansion Gap for Multi-storeyed Buildings. Seismic performance of high rise buildings can be improved by providing links, bracings, shear walls, framed systems.

Anthony C. Jellen, and Ali M. Memari, (September 2018), in their paper they studied Residential Vertical Expansions Using Modular Construction. Matching the construction method to the proper application and diligent front-end planning, positive effect on the feasibility of multistory modular projects.

Zhengyu Liu, Brent M.Phares , (October 2016), Presents Use of Longitudinal Expansion Joints in Wide-Bridge Applications to Reduce Deck Cracking. This study indicate that the use of a longitudinal deck joint will not reduce deck-end cracks. Integral abutment combined with temperature and shrinkage differences between the abutment and the deck, and will occur for bridges of any width and any skew.

Wang Tian-li, Li Qing-ning,(March 2013) ,present Pounding Responses of an Expansion Joint in a Curved Ramp Bridge under Earthquake Conditions. Two theoretical models were used under eight types of seismic conditions. Indicate that a curved ramp bridge without an abutment expansion joint is a favorable structure for seismic design.

## VI. CONCLUSIONS

Based on the numerical study carried out in the present research work, following major conclusions can be drawn:

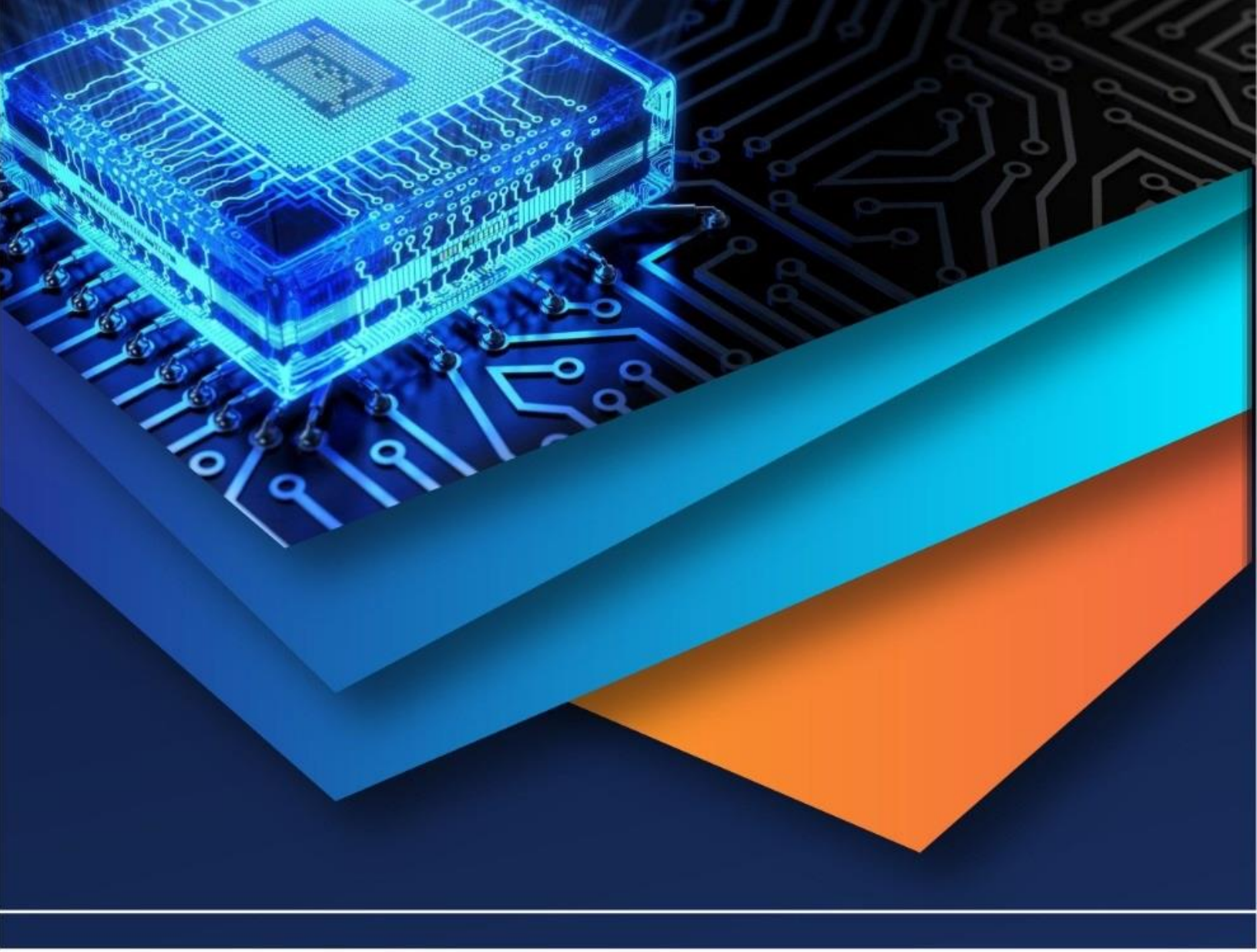
*1)* Building without expansion joint gives more stresses & moments than building with expansion joint.
*2)* Seismic performance of high rise buildings can be improved by providing links, bracings, shear walls, framed systems.
*3)* From the analysis of three models, a seismic gap in the range of 0.3m to 0.5m is quite effective for reducing pounding effect.
*4)* Steel consumption values are considerably reduced in presence of expansion joint & leads to economic structure.
*5)* It is observed that temperature stresses are reduced by application of expansion joint in the structure.
*6)* Based on results it concludes that provision of expansion joint is beneficial for structural stability & economical point of view.

## VII. SCOPE FOR FUTURE WORK

Further research can be carried out to study multi-storeyed R.C.C structures by placing expansion joints at different locations. A comparative study can be done to study the response of the structure under different seismic zones and different soil conditions. Effect of temperature variation in RCC structure can also be considered. Temperature effect on steel structure can be studied.

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