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Comparative Study of Conventional Bridge and Balance Centilever Bridge

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Abstract: The study compares balanced cantilever and conventional bridge designs, diving into their engineering details like how much weight they can bear, their cost-effectiveness, and their impact on the environment. It looks at real-life examples to give a thorough picture of how well each type of bridge holds up over time and how eco-friendly they are. It also considers things like how they look, how much maintenance they need, and how well they can handle earthquakes, providing a complete view for engineers, planners, and decision-makers in bridge construction. The paper even talks about how the bridges look and how they fit into their surroundings. Plus, it focuses on how well each design can handle earthquakes and heavy traffic. By putting all these aspects together, the report gives a detailed understanding of what each type of bridge does well and where it could use some improvement. Its goal is to help professionals make better choices when they're designing and building bridges.
Keywords: Balance Cantilever Bridge, Conventional bridge, Moving load, Seismic Load

I. INTRODUCTION

A. Balanced Cantilever Method

The balanced cantilever method for building bridges is like constructing a bridge from both ends and meeting in the middle, creating a structure that hangs gracefully in the air. Instead of relying on supports from below, this method uses a balanced approach, where each side supports the other as it extends outward. It's a bit like building a tower from the top down, with careful calculations and precision to ensure stability and strength. This technique allows engineers to span long distances without needing as many temporary supports, making it an efficient and elegant solution for constructing bridges over wide rivers or deep valleys.

The Balanced Cantilever Method refers to a construction method that does not install scaffolding systems under the bridge and completes the superstructure of the bridge by sequentially joining the segments to form a span by post-tensioning and balancing them left and right from each pier using special erection equipment. The balanced cantilever method can be largely classified as Cast-in-Place Cantilever Method and Precast Cantilever Method.

Balanced cantilever construction denotes building a bridge superstructure from both sides of the –pier table in a scales-like fashion. This erection method is also known under the name free cantilever construction. It is one of the most popular bridge construction methods used. When two opposing free cantilever structures are attached as a single structure and erected in the same step, it is known as ‘balanced cantilever’.

B. Conventional Method

A conventional method bridge, also known as a U girder bridge, is a type of bridge that is commonly used in civil engineering projects. The bridge is constructed using precast concrete U-shaped girders that are placed horizontally to support the bridge deck. These girders are typically made of reinforced concrete and are designed to withstand the weight of the bridge deck and the loads placed on it. The construction process for a U girder bridge involves several steps. First, the abutments and piers are constructed to support the girders. Then, the precast girders are placed on top of the supports and connected to each other to form the bridge deck. Finally, the deck is poured with concrete to create a smooth surface for vehicles to travel on.

U girder bridges are popular because they are cost-effective and relatively easy to construct compared to other types of bridges. They can be built quickly and are durable, making them a popular choice for many infrastructure projects. Additionally, U girder bridges can be designed to span long distances and carry heavy loads, making them suitable for a wide range of applications.

Overall, U girder bridges are a versatile and efficient solution for crossing rivers, highways, and other obstacles, making them an important part of our transportation infrastructure.

Dimensions and Specifications

	CONVENTIONAL BRIDGE	BALANCED CENTILEVER BRIDGE
SPAN LENGTH	28M	80M
WIDTH	10.5M	10.65M
PLATE THICKNESS TOP	-	0.20M
PLATE THICKNESS BOTTON	0.40M	0.70M
SURFACE THICKNESS 1	0.2M	0.70M
SURFACE THICKNESS 2	-	2M×8M
COLUMN	-	3.4M × 2.15m
Beam 1	0.20M × 0.20M	0.20M × 0.20M
BEAM 2	0.40M × 0.40M	-

Table – 1: Structure Dimensions

II. METHODS AND MATERIAL

The steps used for designing the Structure in STAAD Pro are as follows:

1) Provide the nodes with co-ordinates and connect them by using the command "ADD BEAM" to make the plan.
2) Assign properties to the structure i.e. giving dimension according to table no.1.
3) Assign supports to the structure.
4) Insert Load case details:
a) *Dead Load (DL):* The Self weight of the structure is taken as Dead load comprising the weight of the various structural components such as slab, beam and column.
b) *Seismic Load:* Earthquake load is taken as per zone category specified in the IS code 1893 (Part 1): 2002[ii] for the location where building is located.
c) *Moving Load:* A moving load refers to a dynamic force or weight that changes position or move along a structure such as a vehicle traveling on a bridge.

5) Assign loads to the structure.
6) Run Analysis and check for errors.
7) Make necessary changes in Design.
8) Run Analysis and check for errors.

Designing is done as per IS 875 (Part I for Dead Load), (Part II for Imposed Load), (Part V for Load Combinations).
IS 1893 (Part 1 for Earthquake resistant designing of Structure).

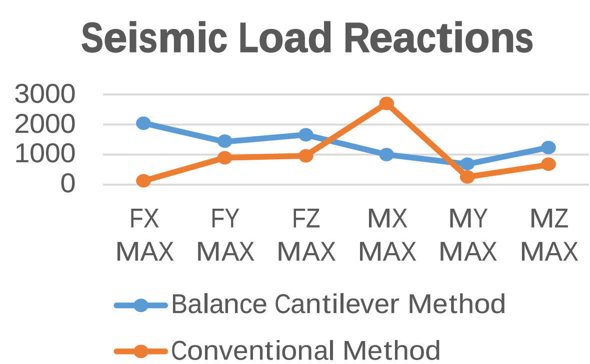
III. RESULTS AND DISCUSSION

	Balance Cantilever Method	Conventional Bridge
FX MAX	$2.05x10^3$	128.152
FY MAX	$14.4x10^3$	889.492
FZ MAX	$1.66\ x10^3$	958.449
MX MAX	$10.007x10^3$	2702.437
MY MAX	$0.686\ x10^3$	250.848
MZ MAX	$12.299\ x10^3$	667.120

Table – 2: Seismic Load Reactions

	Balance Cantilever Method	Conventional Bridge
FX MAX	$1.15\ x10^3$	75.157
FY MAX	$12.7\ x10^3$	1422.756
FZ MAX	$2.71\ x10^3$	567.013
MX MAX	$1.9\ x10^3$	3562.044
MY MAX	$4.42\ x10^3$	265.877
MZ MAX	$19.6\ x10^3$	1031.524

Table – 3: Moving Load Reactions



A. Title and Author Details

Title must be in 12 pt Times New Roman font. Author name must be in 11 pt Regular font. Author affiliation must be in 10 pt Italic. Email address must be in 9 pt Courier Regular font.

TABLE I
FONT SIZES FOR PAPERS

Font Size	I. Appearance (in Time New Roman or Times)		
	Regular	Bold	Italic
8	table caption (in Small Caps), figure caption, reference item		reference item (partial)
9	author email address (in Courier), cell in a table	abstract body	abstract heading (also in Bold)
11	level-1 heading (in Small Caps), paragraph		level-2 heading, level-3 heading, author affiliation
12	author name		
18	title		

B. Section Headings

No more than 3 levels of headings should be used. All headings must be in 10pt font. Every word in a heading must be capitalized except for short minor words as listed in Section III-B.

1) *Level-1 Heading:* A level-1 heading must be in Small Caps, cantered and numbered using uppercase Roman numerals. For example, see heading "III. Page Style" of this document. The two level-1 headings which must not be numbered are "Acknowledgment" and "References".A
2) *Level-2 Heading:* A level-2 heading must be in Italic, left-justified and numbered using an uppercase alphabetic letter followed by a period. For example, see heading "C. Section Headings" above.
3) *Level-3 Heading:* A level-3 heading must be indented, in Italic and numbered with an Arabic numeral followed by a right parenthesis. The level-3 heading must end with a colon. The body of the level-3 section immediately follows the level-3 heading in the same paragraph. For example, this paragraph begins with a level-3 heading.

C. Figures and Tables

Place figures and tables at the places where they needed. All tables should be in Classic 1 format with borders to heading and subheading columns. Large figures and tables may span across both columns. To do so select text above one column table and convert it in two column and then select text below one column table and convert it into two column. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig. 1", even at the beginning of a sentence. We suggest that you use border for graphic (ideally 300 dpi), with all fonts embedded) and try to reduce the size of figure to be adjust in one column. Figure and Table Labels: Use 8 point Times New Roman for Figure and Table labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader.

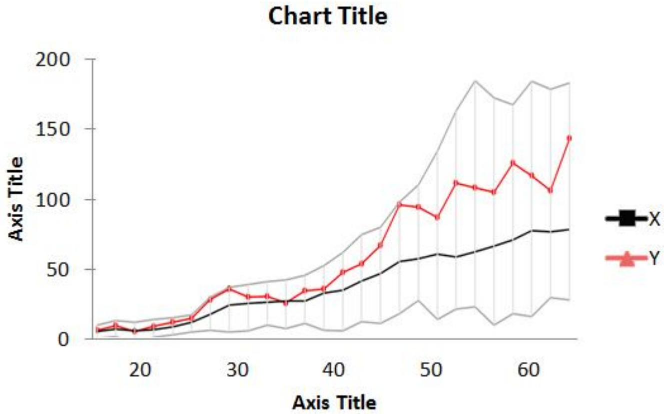


Figure 1: A sample line graph using colours which contrast well both on screen and on a black-and-white hardcopy

D. Page Numbers, Headers and Footers

Page numbers, headers and footers must not be used.

E. Links and Bookmarks

All hypertext links and section bookmarks will be removed from papers during the processing of papers for publication. If you need to refer to an Internet email address or URL in your paper, you must type out the address or URL fully in Regular font.

IV. CONCLUSION

Based on the findings presented above, after performing the analysis of the building frames using STAAD PRO software, and comparing the results, it is concluded that:

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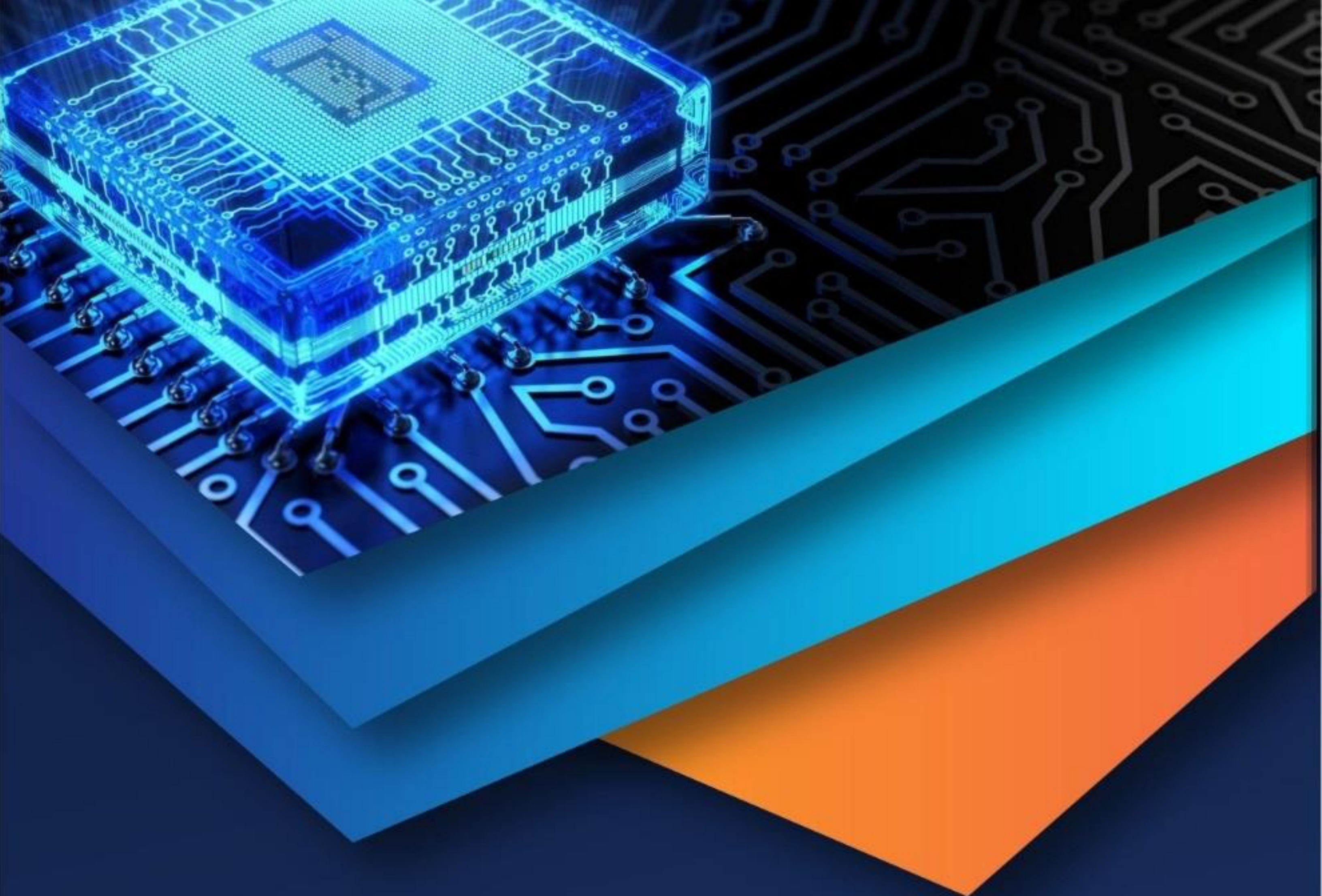

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