SEISMIC ANALYSIS OF BOX GIRDER BRIDGE

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ABSTRACT: Presently a day the Box girder is often utilized bridge framework in around the world. All things considered; the crate support connect is ordinarily utilized for the long range for the overlooking the substantial load as contrast with the other bridge framework. CSI Bridge v 20.0.0 is utilized for breaking down powerful reaction of box support connect.

The fundamental target of this examination is dissecting and exploring seismic execution of multi range with up to five traverses 92-meter-long box support connect. The seismic presentation of box support connect is mind boggling and execution relies upon the pinnacle ground movement and, ground movement increasing speed. It is finished by straight time history investigation strategy. In this investigation, the three-measurement model and the information of Kobe seismic tremor are utilized for dynamic attributes and demonstrating the greatest reaction of box support deck. Reaction results show regarding disfigured shape, total quickening, base shear, base response, absolute vitality segment and uprooting. Accordingly, the paper recommends that the development of scaffold dependent on time history examination will continue the quake up to 6.9 extent.

KEYWORDS: box girder, bridge model, ground motion, seismic response, Kobe earthquake.

1. INTRODUCTION

Box support connect is generally basic in worldwide and box brace connect is better steady, useful and affordable. Box support connect have extraordinary unbending nature bringing about better cross over burden dispersion. Box brace connect is an extremely unpredictable on the grounds that it is three-dimensional and cross over course. Generally, a few sorts of extension disappointment have been seen during seismic tremor and some deck, dock clasped some crumbled. There is a major issue. a typical disappointment deck slid off their base help because of solid ground movement as in SHOWA BRIDGE in the 1964 NIIGATA seismic tremor with greatness M=7.5 and the NISHINOMIYA BRIDGE in the 1995 KOBE quake with size M=6.9 in Japan. Thusly, need to plan powerful when instigated solid ground movement. As a matter of fact, some tremor greatness is anticipated in the different power accordingly it is must know to contemplate the different seismic conduct for various in term of different reaction. Most recent couple of years, hypothetical and exploratory work performed and researched seismic conduct utilizing time history examination technique and analyze the impact of seismic reaction.

In this examination, we have taken 92 m long extension deck with various ranges. The estimation of pinnacle ground quickening PGA, top ground speed PGV, top ground removal of deficiency ordinary and issue equal segment are analyzed for deciding of seismic reaction of box support connect. Non-straight time history examination strategy is utilized in current investigation to carryout seismic reaction of box support connect.

2. METHODS USED IN STUDY

There is different strategy to use to quantify seismic reaction of box girder structure. They are Equivalent static seismic power technique, reaction range strategy, time history examination strategy, and weakling investigation. We have utilized time history examination strategy in our investigation.

Time history examination strategy is extremely wide and complex field of study. There are two sorts of time history investigation technique for example limit non-direct time history investigation and inelastic time history examination. Time history examination is dynamic investigation which consider material non-linearity of the structure. Thinking about the productivity of the investigation, non-direct component is utilized to speak to significant pieces of the structure, and the rest of expected to carry on flexibly. Time history investigation technique is applied for the deciding the seismic conduct of extension structure under unique stacking of quake.

3. DATA ANALYSIS

Kobe tremor was one of the most damaging quakes in the japan with size of 6.9. The seismic tremor caused outrageous harm in Kobe city and its encompassing zone. The quake went on for around 20 second and the locus of seismic tremor was found 17 km underneath its focal point. Roughly 6434 individuals lost their lives in this calamity and around 4600 individuals there from Kobe city.

Characteristics of field ground motion which is used in analysis

earthquake- Kobe earthquake

station- Kakogawa japan

magnitude- 6.9

distance- 22.5 km

4. BRIDGE STRUCTURE MODEL AND ANALYSIS

Typical 3-dimensional concrete box girder bridge with up to five spans consist of a continuous 92-meter-long box girder deck with 1 intermediate girder are examine the different element of the bridge model and seismic loading. In this study the following parameter are considered.

Bridge geometry-

Bridge span - 92 m

Span ratio - 1.0

No. of girder - 4

Bridge width - 9.7 m

Bridge depth - 1.5 m

Concrete slab thickness - 225 mm

Diaphragm depth - 1.5 m

Abutment - 4 m depth and 1.5 m width

Pier cap - 1.5 m depth and 1.2 m width

Live load- IRC class A and IRC class70R two lane traffic

Regulations- IRC: 5, IRC: 6, IRC: 21 and IRC; 112

Materials- Un tensioned steel HYSD bars grade Fe415 conforming to IS;1786, controlled concrete M40 and M55.

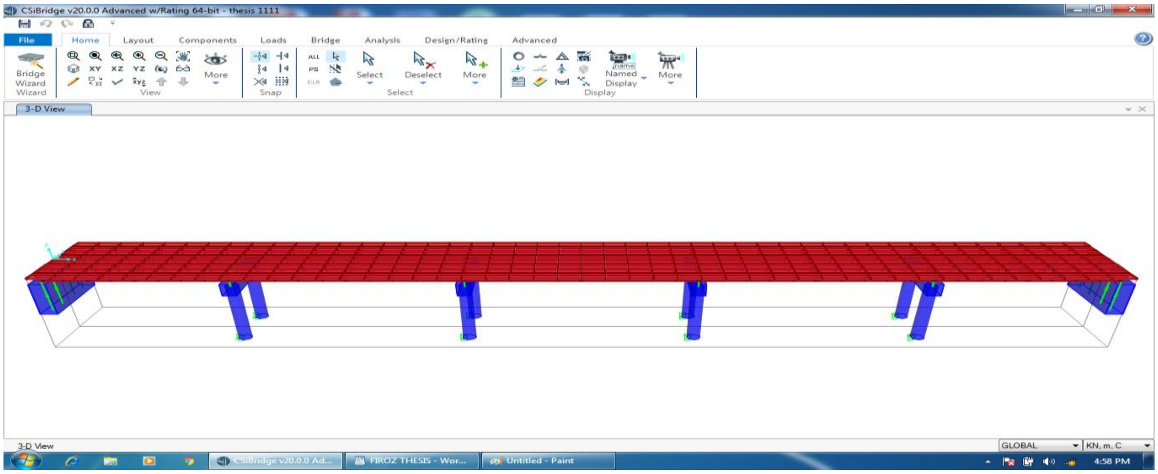


Fig: 1 3D Bridge model – CSI Bridge

5. Integrating of bridge-

Since all the bridge component has been defined step by step. The reference line defines the abutment and pier cap. Since the model has 5 spans, the reference lines have set to have 5 spans by modifying the value of the start and end station considering 92-m span length shown in figure.

We have assumed column bent with length 7.5m with circular column diameter of 1.5m and height 12m. For this study, vehicles loading is taken from IRC: 6 and geometry from IRC: 112. In this bridge we are analyzing for the maximum bending moment to loading AA and loading 70R. Seismic loading considered from IS:1893-2016 and the maximum normal and shear stresses for concrete box girder at the critical section. We have taken permissible stress as per section IRC:18. The time history technique is used for the parametric analysis and resulting higher seismic response.

6. SEISMIC ANALYSIS RESULTS

The seismic response of the multi span box girder bridge is discussed in the above study. The 92m long box girder bridge model using 3-dimensional and Kobe earthquake is used as dynamic input to calculate the maximum seismic response of the box girder deck. Non-linear time history analysis output is shown in the term of the displacement and base shear studies. Seismic response of the box girder in the term of acceleration, displacement, velocity and base shear shows in comparative diagram is given below.

Fig:1 table of base reaction

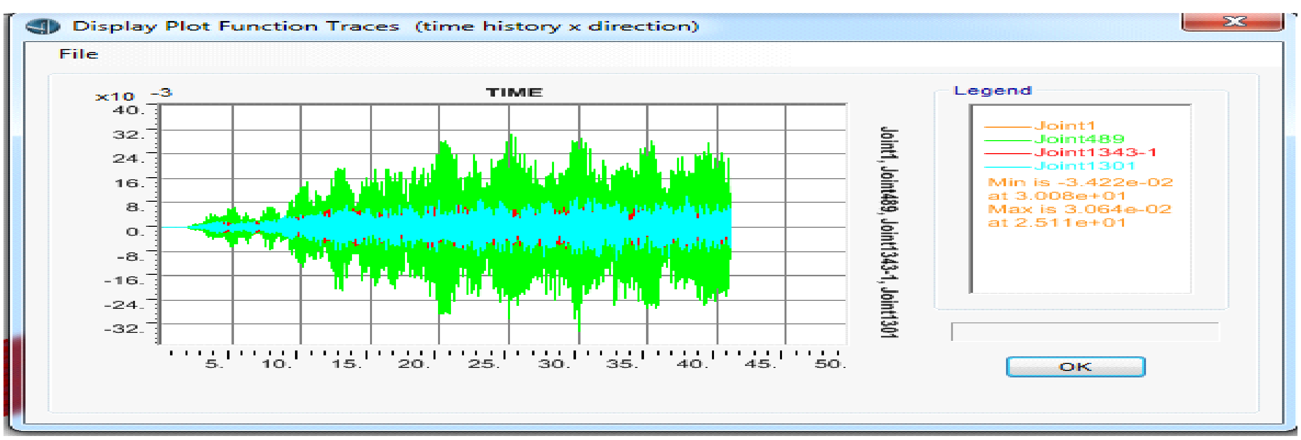
Case Type	Step	Global	Global	Global	Global	Global	Global
Text	Text	Fx (KN)	Fy (KN)	Fz (KN)	Mx (KN-m)	My (KN-m)	Mz (KN-m)
Combination	Max	3.30E-08	7.95E-09	31511.77	6619.4889	-128973015	-0.0000005
Combination	Min	-1.31E-08	-1.65E-08	27981.38	7.63E-08	-135492476	-0.0000032
Combination	Max	-1644.8	5.65E-09	31511.77	6619.488	-1288245	-0.0000025
Combination	Min	-1644.87	-1.88E-08	27981.38	7.37E-08	-135344016	-0.0000028

Fig: 2 Joint Reaction

Joint	Output Case	Step Type	F1 KN	F2 KN	F3 KN	M1 KN-M	M2 KN-M	M3 KN-M
58	basic combination	Max	1362.742	-217.376	1.25E+15	-5.723E+14	-1.23E+13	949.1579
58	basic combination	Min	453.275	-482.507	-2.766E+14	-1.268E+13	-2.68E+13	2102.8988
58	seismic combination	Max	1363.029	-217.647	-1.791	-5.73E+14	-1.23E+13	-950.3338
58	seismic combination	Min	453.563	-482.777	-1.791	-1.269E+13	-2.69E+13	-2104.074
1358	basic combination	Max	3240.345	26.645	1.927	3.7057	23.5233	-3.48E+17
1358	basic combination	Min	2731.595	23.419	1.927	-2.4621	-13.2912	-3.48E+17
1358	seismic combination	Max	3245.025	26.71	-256.15	2.6814	2102.5984	-3.48E+17
1358	seismic combination	Min	2736.274	23.484	-261.45	-3.4864	2065.7838	-3.48E+17

Fig: 3 Joint Displacement

Joint	Output Case	Step Type	U1 M	U2 M	U3 M	R1 Radians	R2 Radians
1	basic combination	Max	0.00054	0.000102	-0.000415	0.000397	0.001615
1	basic combination	Min	0.00014	0.000102	-0.000723	0.000322	0.000612
1	seismic combination	Max	0.0129	0.000102	-0.000415	0.000397	0.001614
1	seismic combination	min	0.01251	4.32E-06	-0.000723	0.000522	0.000614
1401	basic combination	Max	0.00006	-3.9E-05	0.003259	0.000442	-0.000166
1401	basic combination	Min	0.00014	-5.9E-05	0.004661	0.000392	-0.000266
1401	seismic combination	Max	0.01221	-3.7E-05	0.003259	0.000442	-0.0000166
1401	seismic combination	Min	0.01216	-0.00006	0.004662	0.000394	-0.000266



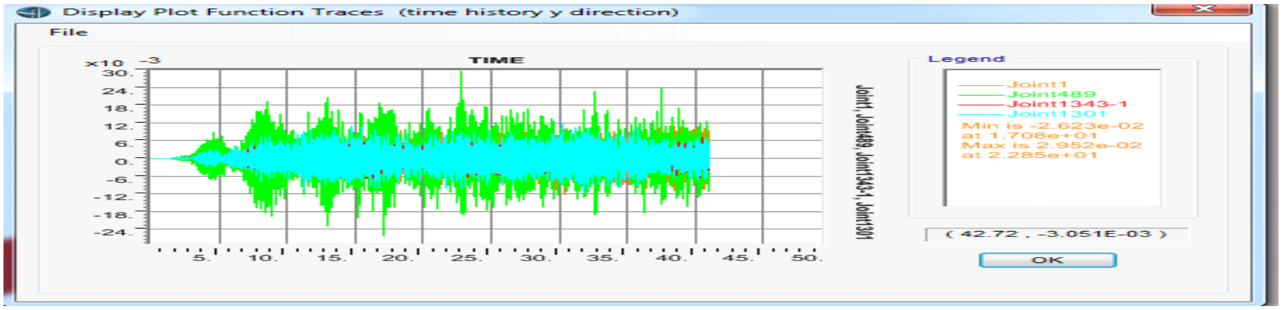


Fig: 7 Acceleration v/s time in X and Y direction

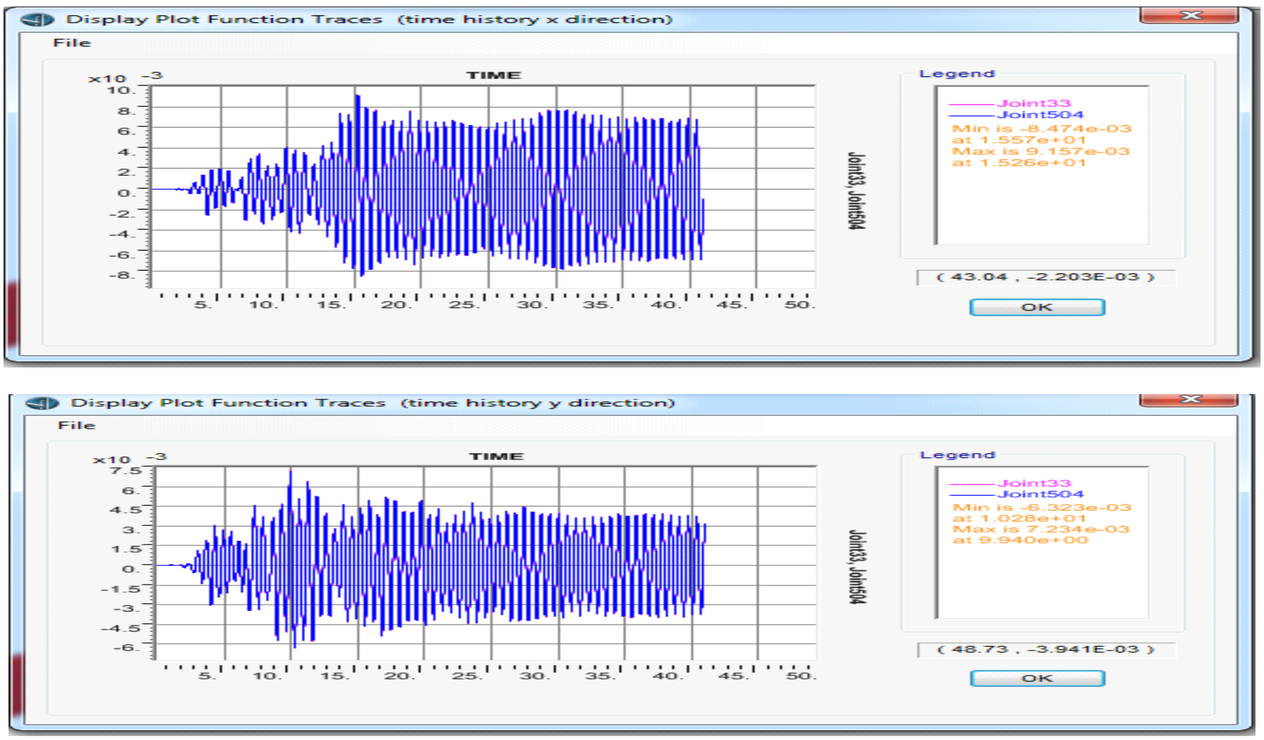


Fig: 8 Velocity v/s time in X and Y direction

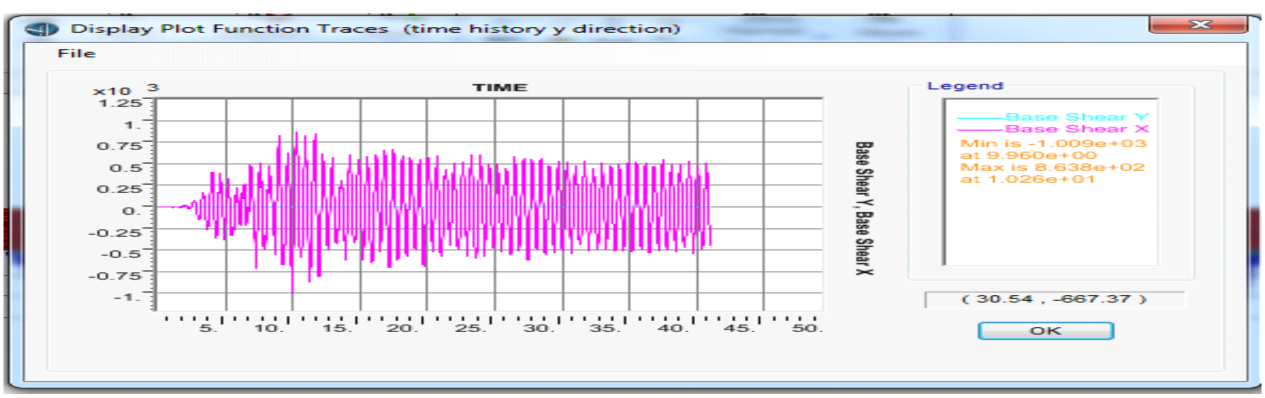


Fig: 9 Base shear v/s time in X and Y direction

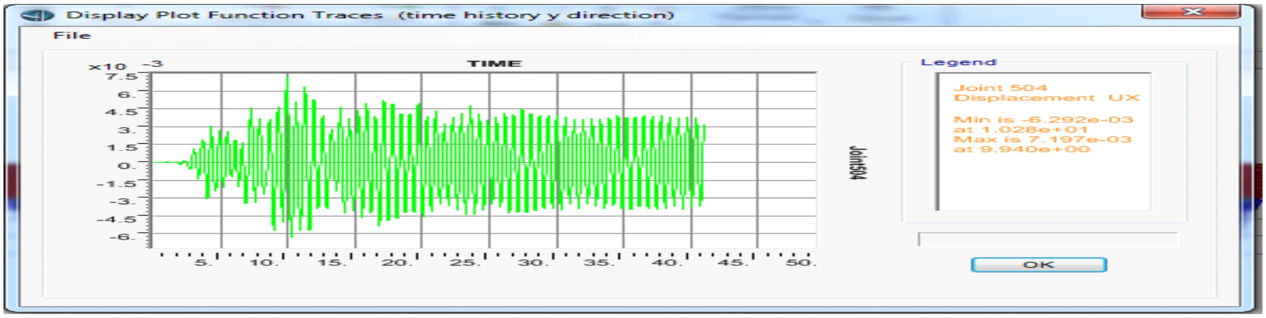


Fig: 10 Displacement v/s time in X and Y direction

CONCLUSIONS

From this study value of the acceleration, base shear, velocity and displacement have been determined for the both component at the same joints of the bridge structure. Above results shown in the form of comparative diagram. According to the results following conclusion can be drawn.

- According to the above results, the value of the acceleration, displacement, velocity and base shear with respect to the time in x direction is higher than acceleration, displacement, velocity and base shear with respect to the time in y direction.
- Acceleration response of the bridge deck depends on the characteristics of bridge and applied ground motion.
- Results shows that seismic response of the superstructure good agreements with recorded ground motion data in the term of the acceleration, base shear, velocity and displacement in the both directions.
- It also the indicate that the base shear has played important role on seismic response of the bridge deck. it is provided resistance to lateral load.

In seismic analysis, CSI Bridge v 20.0.0 is used for analyzing dynamic response of box girder bridge. Motion hazard is determined by the using bridge structure geometry with the help of time history analysis method, and shows seismic effects in both X and Y direction.

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