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Comparative Study of Conventional RCC Structure and Compression Spring based Isolated Structure Under Earthquake Effect

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***Abstract*— A new low-cost seismic isolation system based on spring tube bracing has been proposed and studied at the Structural and Earthquake Engineering Laboratory of Istanbul Technical University. Multiple compression-type springs are positioned in a special cylindrical tube to obtain a symmetrical response in tension and compression-type axial loading. Large amounts of energy, as much as 60-70% of the total cycle energy, may be absorbed in overcoming frictional forces and compassion forces. Ring springs have been identified as suitable devices for use in earthquake-resistant structures. A particularly attractive candidate for use of compression springs is in protecting columnar structures during earthquakes. Simulation of collapse procedure of a scaled reinforced concrete structure is carried out and compared with the results obtained by spring base isolation experiments.**

The experiment was performed using RC building model and analyzes the time of cracking under Magnified excitation. The experiment was performed using three storied RC building. Springs-with-damper base isolation installed under a three-store building. It is a base isolation device approximately similar to Lead Rubber Bearing. This experiment is totally based on frequency ranges. In this frequency of an earthquake and analyze the results ire. in which frequency, cracking starts in structure. The emphasis of this paper is on the application of passive seismic isolation for buildings primarily as practiced in the United States, though systems used in other countries will be discussed and from that we are going to compare conventional and isolated spring-based building. The transmitted acceleration to the floor levels is greatly diminished because of the isolation story, which effects longer period and higher damping. There are no stability and self-centering problems in the isolation floor. The spring-like isolation bearings with considerable lateral flexibility help in reducing the earthquake forces by changing the structure's fundamental period to avoid resonance with the predominant frequency contents of the earthquakes. Whereas the sliding-type isolation bearings filter out earthquake forces via the discontinuous sliding interfaces, between which the forces transmitted to the superstructure are limited by the maximum friction forces, regardless of earthquake intensity. The system incorporates spherical supports for the base, a specially designed spring-cam system to keep the base supported under normal conditions and moves for the duration of the earthquake under the constraint of a spring with optimized stiffness characteristics. The dynamic behavior of a three-story concrete structure with and without the base isolation subjected to the Centroid earthquake loads was investigated. The results indicated that the absolute peak acceleration and displacement as well as shear forces decreased significantly with the application of a base isolation system, and it is possible to achieve 87 to 94% reduction in the maximum accelerations and transmitted forces. The movement of the base relative to the ground was less than 0.15 m in the optimized system, and the springs were not fully compressed at any time during application of the earthquake loads. The maximum induced vertical forces as a result of the spherical base support were found to be less than 1.5 % of the weight of the structure. Since the system performance is highly dependent on the rapid unlocking of the cams in the event of a seismic disturbance, careful consideration should be given to the optimal design of the spring-cam system. The results which are especially compared to base isolated and fixed base building show that the displacements of base isolated is more than fixed base building but other seismic response such as acceleration of base isolated is significantly reduced compared to fixed base as well as base isolated building has capacity for reducing of member force of the structure with fixed base building. Then comparison of analysis results between fixed base condition and isolated condition of the building due to multi direction earthquake motions such as horizontal and vertical earthquake. Firstly, static analysis is used for fixed base condition due to gravity factored load to design the helical spring.

Keywords—Seismic Isolation, Spring Tube, Base Isolation, Low Cost Isolation.

I. INTRODUCTION

Seismic isolation reduces the response of a structure during an earthquake by introducing flexibility and energy dissipation capabilities. Generally, horizontal inertia forces cause the most damage to a structure during an earthquake.

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Since the magnitude of the vertical ground acceleration component is usually less than the horizontal ground acceleration component, vertical seismic loads are not considered in the design of most structures. The Earthquake resistant techniques are Base isolation, Energy dissipation device, Spring Base Isolation structure. For the protection of building from different magnitudes of an earthquake, use Spring Base Isolation Structure technique. Generally Spring Base Isolation is a base isolation device which is used for conservation of various building and non-building structures adjacent to potentially harm lateral impacts of strong earthquakes. Springs with base isolation installed beneath a two storied building. It is a base isolation device approximately equal to lead rubber bearing.

One of two to three storied buildings like which was well instrumented for the recording of both vertical and horizontal acceleration on their floors and ground has survived a cinched shaking during an earthquake. This compression spring are fitted in plinth of building with well compacted firm soil. So, these springs can easily sustain the loads in the form of absorbing property. The concept of base isolation as an application of the period shifting technique is now widely accepted in earthquake-prone areas of the world for protecting important structures from strong ground motions. One of the historical concepts to lengthen the fundamental period of a building is to use a flexible first storied (Kelly, 1986). The predicted response is good agreement with record data of first and third floor rubber base isolated.

II. OJECTIVES

1 Analysis of helical compression spring for building by analytical approach.

2.The experimental study of behavior of three storied building with and without spring base isolation system.

3.To compare the results with and without spring base isolation.

4.To know energy dissipation behavior under seismic effect.

III. SOLUTION

This study involves building bearing consist of helical spring to achieve a multi-directional seismic isolation system, which also provides controlled flexibility in the vertical direction. In the proposed configuration of the isolated building, the whole building system can be situated on the helical spring bearing. Helical springs, which have both vertical and shear stiffness, are designed to support vertical loads, including self-weight of the building, providing mechanism to accommodate moment in all directions. To protect the building from damage by earthquake in multi directions, helical spring are installed at the base of the building. The used helical spring isolation that is expected to provide an effective flexible seismic isolation that reduces the response of the system. From a numerical analysis study, how response of the building with proposed isolation system under multi-direction earthquakes is then presented followed by the conclusion.

I. SCOPE

1. From behavior between conventional and spring base isolation system can suggest the best method.
2. The compression spring stiffness and behavior under seismic effect.
3. The stability and flexibility of spring base isolation structure under seismic effect.
4. The spring base isolation increases natural period of structure by reducing acceleration.

II. METHODOLOGY

Data collection

Model planning.

Designing parameters of helical compression spring

Model making

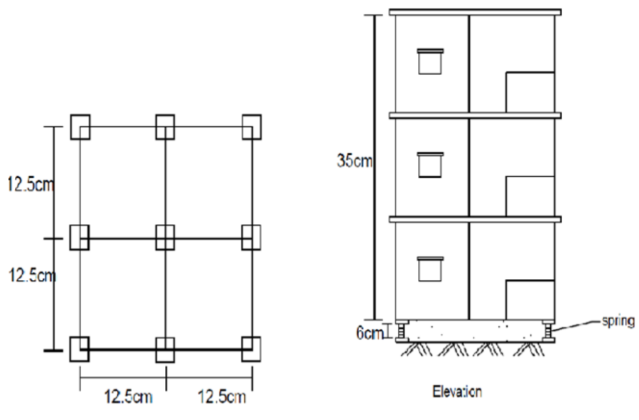
Test on model

Result analysis

Conclusion

References

III. PLAN



IV. DESIGN OF SPRING ACCORDING TO 7906-(PART 1): 1997 –

Considering maximum load on column = 98.1N

Given:

W = 98.1 N   G = 81,370 N/mm^2

$C = \frac{D}{d} = \frac{20\ mm}{5mm} = 4mm$

1. **K_S (Shear Stress Factor)** = $1+\frac{1}{2X4}$ = 1.12

2.**K (Cohal's Stress Concentration Factor)** = $\frac{4X4-1}{4x4-4}+\frac{0.615}{4}$ = 1.40 N/mm^2

3.**Resultant Shear Stress (** τ **)**

$\tau = \tau_1 + \tau_2$

= $\frac{8WD}{\pi d^3} + \frac{4W}{\pi d^2} = \frac{8WD}{\pi d^3}$ x (1+ $\frac{d}{20}$)

= $\frac{8WD}{\pi d^3}$ x (1+ $\frac{1}{2c}$)

= K_S X $\frac{8WD}{\pi d^3}$

=1.12 X $\frac{8X98.1X20}{\pi X 5^3}$ =44.76 N/mm^2

4. **Stress Due To Carvature of wire is too considered:**

τ = k x $\frac{8WD}{\pi d^3}$

= 1.40 x $\frac{8 X 98.1 X 20}{\pi X 5^3}$ = 55.95 N/mm^2

Cheak : We Considering Grade Steel Form Table t 30.1 Tensile Strength is given

V The Permissible Shear Stress for The Spring Wire Is 30% Of The Ultimate Tensile Strength 30.

G = 81370 N/mm^2

τ = 0.3 x S_ut

=0.3 x 1250

= τ < 375 N/mm^2 Hence ok …

5. Men Coil Diameter

D = c X d =20mm

6. Number of Active Coils Form Table (10.8)

$\delta = \frac{8 WD^3 N}{G d^4}$ --- 1.

$\frac{\delta}{N} = \frac{8 X 98.1 X20^3}{81370 X5^4}$

$\frac{\delta}{N}$ = 0.12 N/mm^2

Considering N = 10 ....Active no of coil

$\delta =$ 1.2 mm

7. The No. of Active Turns (N) :

$N_t - 2 = 10$|

8. Solid Length of Spring

(L) = N_t x d = 12 x 5 = 60mm

9.Free Length Of Spring Under Maximum Load Take axil gap 15% 0f δ

Free length = solid length + Total axil gaps + δ

= 60mm + $\frac{15}{100}$x1.2 + 1.2

= 61.38 mm

10. Pitch of Coil = $\frac{Free\ Length}{(Nt-1)}$ = $\frac{61.38}{(12-1)}$

= 5.58 mm.

V. EXPERIMENTS

LOAD (N)	DISPLACEMENT (MM)
9.81	0.02
19.62	0.025
29.43	0.033
39.24	0.04
49.05	0.055
58.86	0.06
68.67	0.074
78.48	0.08
88.29	0.093
98.1	1
107.91	1.3
117.72	1.4

VI. TEST OF MODEL ON SHAKE TABLE

The experimental setup consists of shake table, RPM machine, Accelerometer1 and Accelerometer 2, computer. When the shake table starts giving motion then displacement and acceleration waves are readings are automatically taken by software of computer. In this figure Accelerometer 1 is attached to spring base building and Accelerometer 2 is attached to fixed base building. The software gives accurate reading at small waves also.

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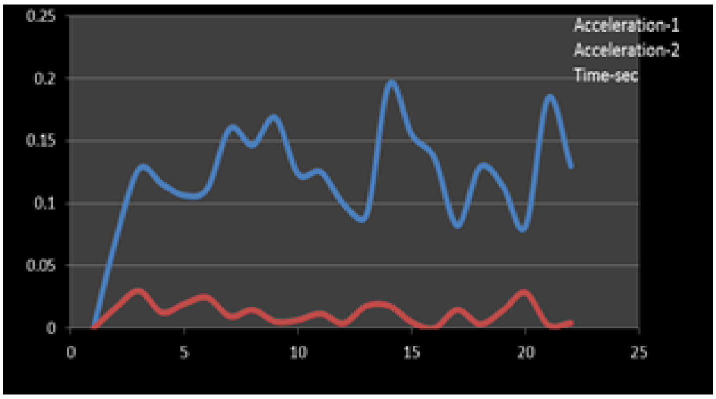
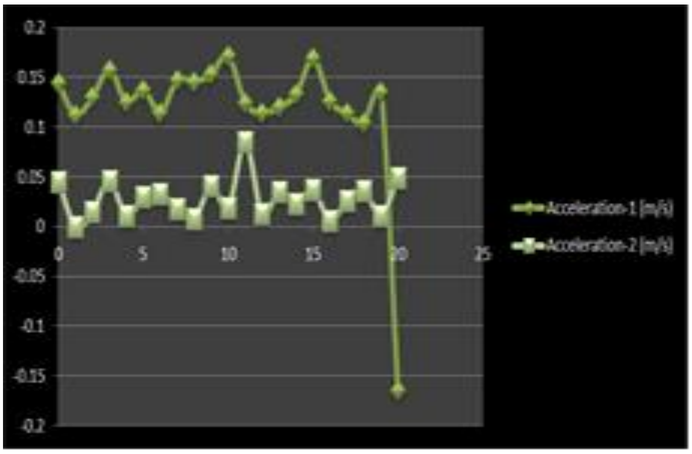
VII. RESULT

1. Acceleration Test-

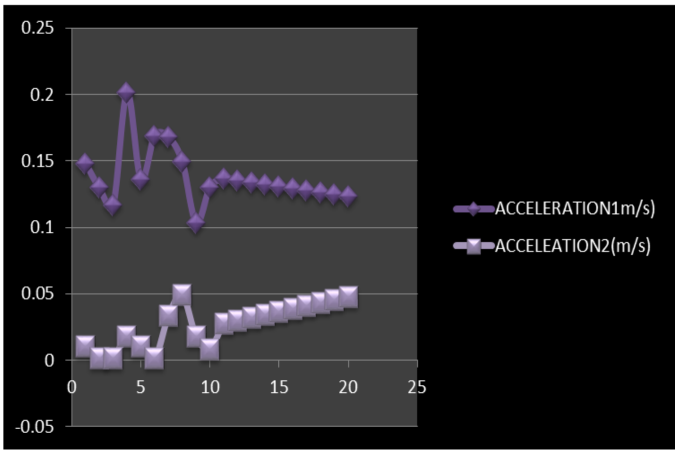
A. 100rpm



B. 150rpm

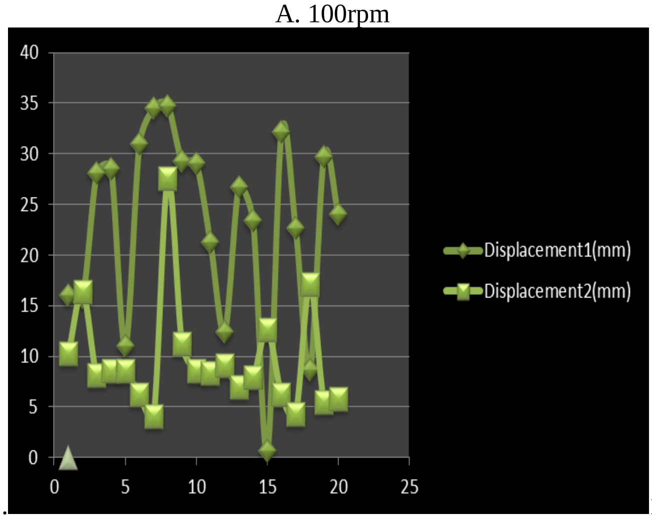


C. 200rpm



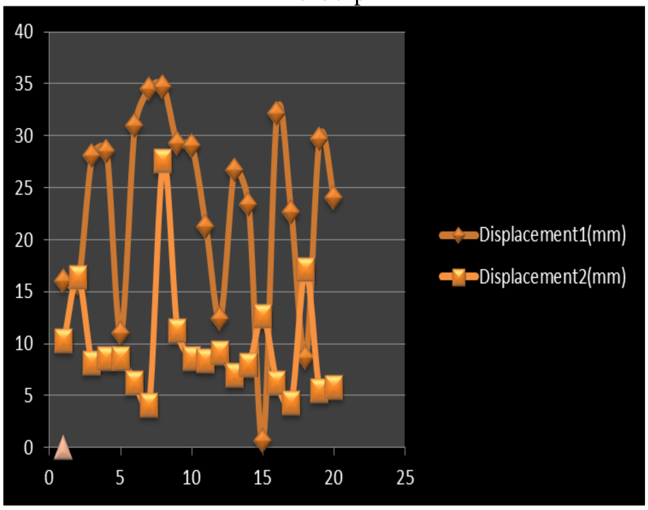
2.Displacement Test

A. 100rpm

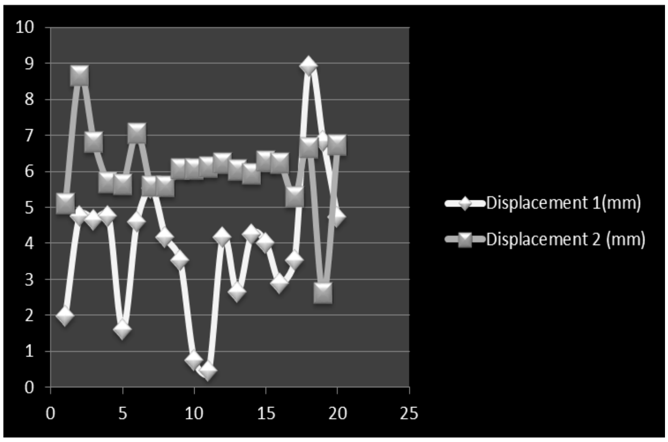


. 1

B.150rpm



C. 200rpm



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VIII. CONCLUSION

1. Displacement is more in helical spring-based structure than fixed base structure of building

due to this isolated structure releases the energy which resist the seismic effect.

2. The building is flexible, so it not collapses suddenly, and it gives warning before failure, but fixed base absorbs energy and may chances of sudden failure.

3. The acceleration is more in spring base isolation than fixed base under seismic effect which increases stability of isolated structure.

4. From the results Isolated shows more resistance against earthquake effect towards safer side.

IX. REFERENCES

1. Papazoglou, A.J., and Elnashai, A.S. 1996. Analytical and Field Evidence of the Damaging Effect of Vertical Earthquake Ground Motion. Earthquake Engineering and Structural Dynamics, 25: 1109-1137.
2. Button, M.R. Cronin, C.J., and Mayes, R.L. 1999. Effect of Vertical Ground Motions on the Structural Response of Highway Bridges. Multidisciplinary Center for Earthquake Engineering Research Report 99-0007, State University of New York at Buffalo, Buffalo, NY.
3. Waisman, F., and Grigoriu, M. 1994. Effectiveness of Vibration Isolation Systems for Bridges. Proceedings of the First World Conference on Structural Control. Los Angeles, CA, Vol.1, pp. 30-39.
4. Ministry of Construction of PRC., (2001), Code for seismic design of buildings (GB50011-2001) [S] Zhou Yun, An Yu, Liang Xingwen. (2002),
5. A displacement-based design method for base-isolated structures, Journal of Guangzhou university (Natural Science Edition), 1:1, 75-79. (in Chinese) CECS 126, (2001), Technical specification for seismic-isolation with laminated rubber bearing isolators[S]
6. Kelly, J. M. (1999). The role of damping in seismic isolation. Earthquake Engineering and Structural Dynamics, 28, 3-20.
7. Ryan, K. L., Morgan, T. A., & and Sayani, P. (2006). Consistent performance comparison of seismic-isolated and fixed-base buildings. 8th National Conference on Earthquake Engineering. San Francisco, CA: Earthquake Engineering Research Institute.
8. “Seism Isolation and Adaptive Systems of SeismicSafety”, Moscow, Nauka, edited by J.M.Aizenberg,1983.