

ANALYSIS OF SYSMIC RETROFITTING OF G+12 BUILDING

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ABSTRACT

The present work deals with a study on the improvement location of retrofitting buildings in symmetrical high rise building. Position of shear walls in symmetrical buildings has due considerations. The seismic retrofitting of reinforced concrete buildings not designed to withstand seismic action is considered. After briefly introducing how seismic action is described for design purposes, methods for assessing the seismic vulnerability of existing buildings are presented. The traditional methods of seismic retrofitting are reviewed and their weak points are identified. Modern methods and philosophies of seismic retrofitting, including base isolation and energy dissipation devices, are reviewed. The presentation is illustrated by case studies of actual buildings where traditional and innovative retrofitting methods have been applied.

KEYWORDS: Pushover Analyses, Seismic Vulnerability, Seismic Retrofitting, Base Isolation

1. INTRODUCTION:

1.1 INTRODUCTION OF RETROFITTING:

The Seismic retrofitting of constructions vulnerable to earthquakes is a current problem of great political and social relevance. Most of the Italian building stock is vulnerable to seismic action even if located in areas that have long been considered of high seismic hazard. During the past thirty years moderate to severe earthquakes have occurred in Italy at intervals of 5 to 10 years. Such events have clearly shown the vulnerability of the building stock in particular and of the built environment in general. The seismic

hazard in the areas, where those earthquakes have occurred, has been

known for a long time because of similar events that occurred in the past. It is therefore legitimate to ask why constructions vulnerable to earthquakes exist if people and institutions knew of the seismic hazard. Several causes may have contributed to the creation of such a situation. These are associated to historical events, fading memory, greed, avarice, poverty and ignorance. Second World War and similar situations have occurred in Italy many times in the past. In such a situation it is possible that the phenomenon of fading memory occurs and past memories are easily erased. In Italy commercial profits often result from the employment of poor material and workmanship rather than of the optimal utilization of the production factors..

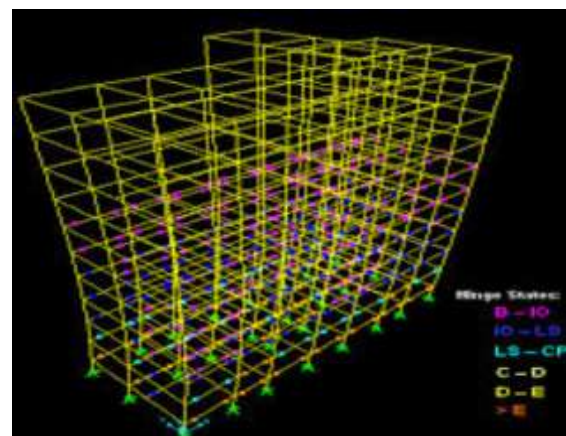


Figure 1.1 Retrofitting of g+12 building

A final cause of vulnerability is connected with the maintenance of constructions; it is obvious that if a construction is not regularly maintained, much as happens for a motorcar, the mechanical properties of the materials may undergo local and global degradation with a significant loss of resistance of the structural members and of the entire construction. Also, changes in service conditions, often made arbitrarily, may lead to substantial changes in the structural behavior resulting in a degradation of the structural response to the expected loading conditions. On the basis of what has been presented so far, it is not surprising that in areas long known to be subject to the seismic hazard it is not infrequent to find constructions vulnerable to earthquakes.

1.2 SEISMIC RESISTANCE AND VULNERABILITY

Because it is necessary to retrofit only constructions vulnerable to the design earthquake, a vulnerability evaluation is obviously needed before attempting any seismic retrofitting. As has been seen, the design earthquake is specified by means of a design spectrum which depends on the energy dissipation capacity through the structure behavior factor.

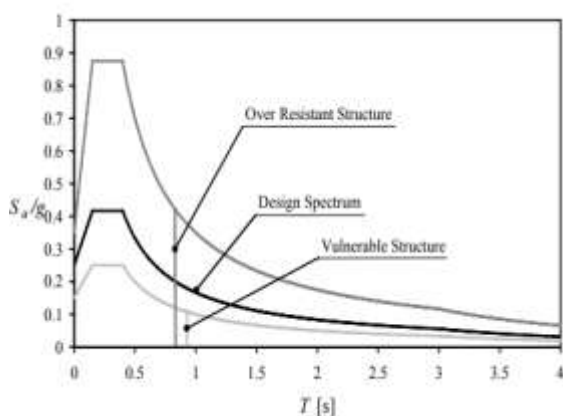


Figure 1.2 Comparison between seismic resistance and seismic demand

A structure with the resistance specified by such an ordinate is capable of withstanding an earthquake with an anchoring acceleration larger than that associated with the design earthquake. Instead if the seismic resistance of the structure corresponds to the shorter ordinate in Figure it is obvious that the resistance capacity is smaller than the demand that the earthquake places on it and the structure is vulnerable to the design earthquake. In this second case the structure can only withstand an earthquake with an anchoring acceleration smaller than the design one.

1.3 TRADITIONAL METHODS OF SEISMIC RETROFITTING

Traditional methods of seismic retrofitting fall essentially into two categories, one based on the classical principles of structural design which requires an increase of strength and stiffness, and the other based on mass reduction.

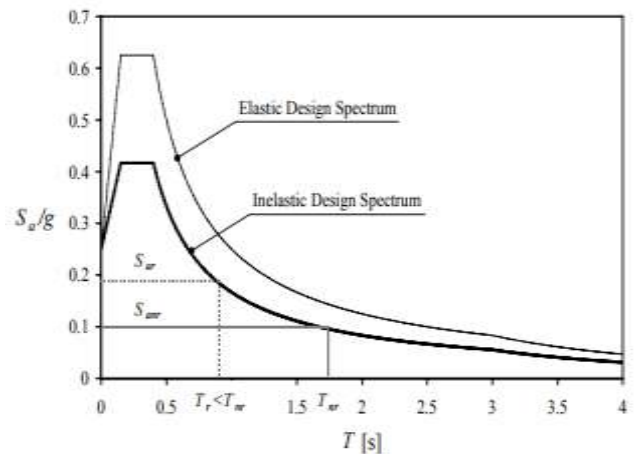


Fig. 1.3 Increase of the seismic demand following an increase of seismic resistance

Only after stiffness and strength have been increased up to a level where the fundamental period corresponds to the constant branch of the design spectrum, is it possible to achieve a condition where the

design inequality is satisfied. It is, therefore, evident that an attempt to increase the seismic resistance capacity in this way only results in an increase of the seismic demand. When, in the end, the procedure converges, it is at the expense of a considerable expenditure of resources.

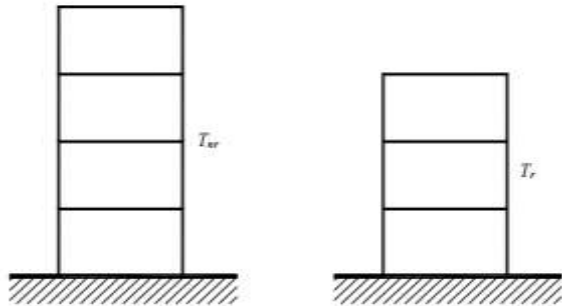


Fig. 1.4 Seismic retrofitting by mass reduction

In conclusion, both of the traditional methods of seismic retrofitting, although effective, are rather expensive. It must however be pointed out that, as in the case of low buildings, the fundamental period may already fall within the constant branch of the design spectrum and a period shortening may not result in an increase of the seismic action. Another situation when traditional methods of seismic retrofitting may be rather effective is in the case of soft soil conditions, where higher spectral ordinates occur at relatively longer periods, see for instance Clough and and the design spectra of Euro code

1.4 INNOVATIVE APPROACHES TO SEISMIC RETROFITTING

The main innovative methods of seismic retrofitting may be grouped into the following classes:

- Stiffness reduction
- Ductility increase
- Damage controlled structures
- Composite materials

- Any suitable combination of the above methods
- Active control.

For equal mass the ‘stiffness reduction’ produces a period elongation and a consequent reduction of the seismic action and therefore of the seismic strength demand. In general it may be assumed that base isolation is a special case of the stiffness reduction approach.

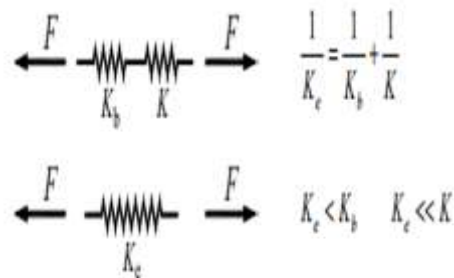


Figure 1.5 Stiffness reductions by the principle of springs in series

1.5 OBJECTIVE:

The objective of this thesis is to use FVT to determine what effect the retrofit has on the building dynamics. The results from the testing are then compared to computational model predictions to conclude whether the computational model correctly predicts the effect the retrofit has on the building. Through the testing, modal information is gathered that is then compared to computational model predictions. Currently, there is little research regarding the modal behavior of buildings with stiff shear walls and flexible diaphragms

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community participation in construction," at Cebu Philippines, in reference to 1992 Later earthquake. They have pointed out the fact of majority of houses collapsed, were from low cost category.

2) Joseph M. ,Barcci , Sashi K Kunnath(2010) Seismic Performance and Retrofit Evaluation of RCC Structures. The authors opine that, in high rise buildings, reliance only on the inertia force developed by roof or top stories, as design criteria will be underestimation.. A retrofitted model was tested with same parameters and results were tabulated.

3)Sekar T.;Ramaswamy S.N.;Nampootha ri(2011)

N.V.N. Study on Strengthening of Brick Masonry Structures in Fire Work Industry against Accidental Explosion. (AJCE, V.13, no.6.2012 p.743. Authors have published this paper with the aim to suggest retrofitting measures for safe guarding work force and explosives contents stored in single storied structures in explosive producing factories.

[4] Kevadkar M.D., Kodag P.B. (2007). The authors have stressed the need of "Lateral Load Analysis" as these loads can develop high stresses, produce sway movement or cause vibrations. It is therefore important for such structures as well as for new structures to possess strength for vertical and lateral forces. Further, they discuss the methods of strengthening like, provision of shear wall, steel bracing. They compared steel bracing to shear wall method and conclude as steel bracing is preferable to shear wall.

3. METHODOLOGY

3.1 PROCEDURE FOR SEISMIC OF RETROFITTING BULDINGS

The most suitable way to plot force displacement curve is by detecting the

base shear and roof displacement. The capacity curve is generally made to represent the initial mode response of the structure based on the postulation that the fundamental mode of motion is the major response of the taken structure. This is basically valid for buildings with the fundamental periods of vibration upto about 1 second limit. For more flexible buildings with the fundamental period > 1 second, the analyst should take into account addressing higher mode effects is the done analysis.

Classifying each element in model as either primary or secondary Apply lateral story forces to the structure in ratio to the product of the mass and fundamental mode shape.

3.2 RETROFIT AND VERIFICATION STAGE:

Identification of appropriate retrofitting techniques to correct the deficiencies. Evaluation of the new member sizes along with the additional Reinforcement required, and/or the new members need. Reanalysis of buildings to validate the adequacy with then anticipated retrofit techniques. If strength and stiffness necessities are satisfied then the proposed retrofits scheme may be taken, else other more suitable retrofit scheme may be acknowledged.

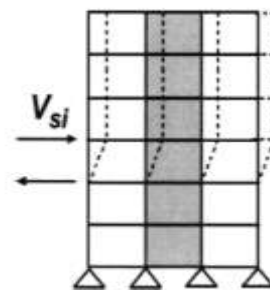


Figure 3.1 Forces causing a story mechanism

3.3 DESCRIPTION OF RETROFITTED FRAME MODEL BUILDING:

Following the series of damaged shaking table excitations on the original model structure, numerous seismic retrofit alternatives for GLD RC frame structure were investigated for improving their local and global response performance during low-to-moderate type earthquakes by comparing structural behavior from nonlinear dynamic analysis. These retrofit schemes were designed to distribute damage throughout the building with suitable control of story deformations by averting a terrible soft-story failure and enforcing a more ductile beam-sideway mechanism.

measured to provide a minimum seismic resistance satisfactory for low-to-moderate seismicity zones and was considered insufficient for high seismic zones.



Fig. 3.2 Deformability reduction by reinforced concrete thin walls; first story

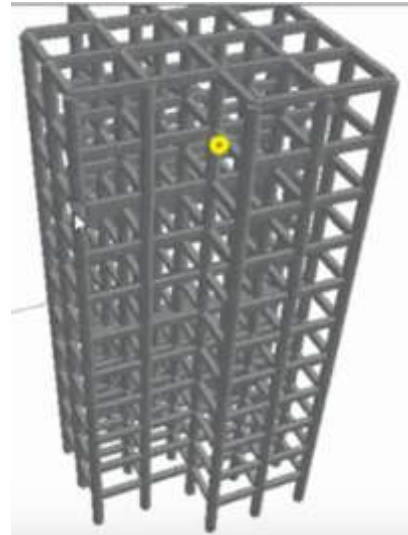
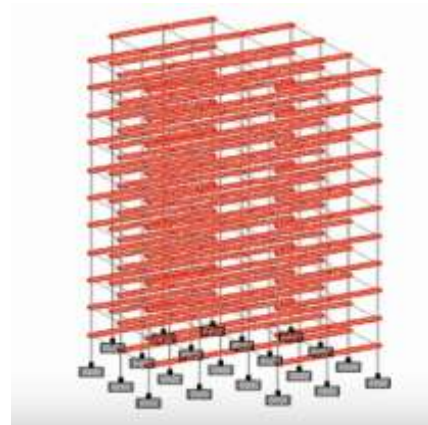


Figure 3.3 Equating retrofitting building.

4. RESULTS:



4.1 front view of the retrofitting building

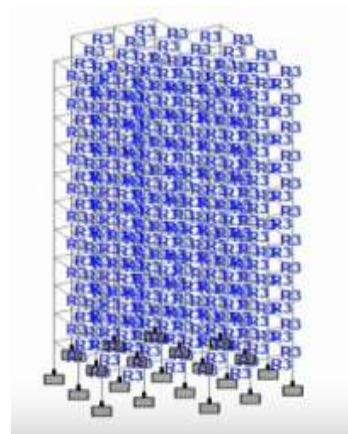


Figure 4.2 Live loads

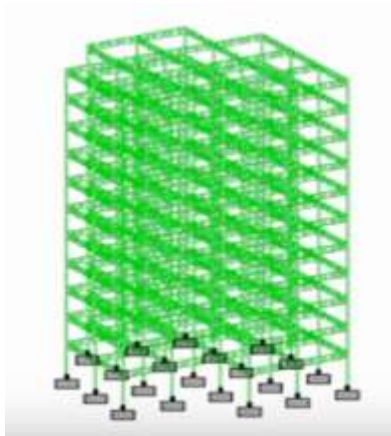


Figure 4.3 Live loads of the building

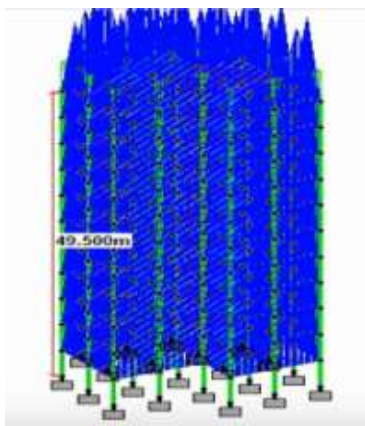
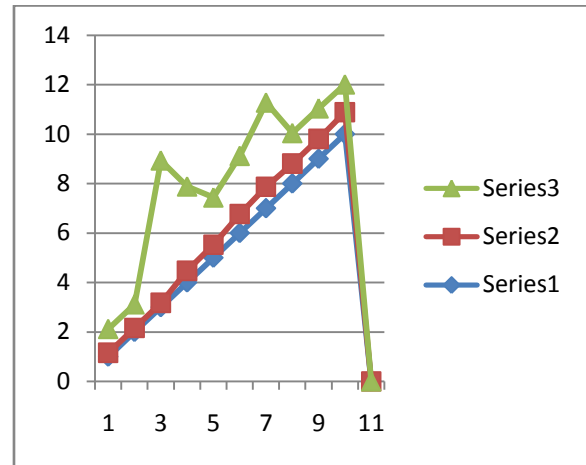


Figure 4.4 dead loads of retrofitting building

Table 4.1 Frequencies load case

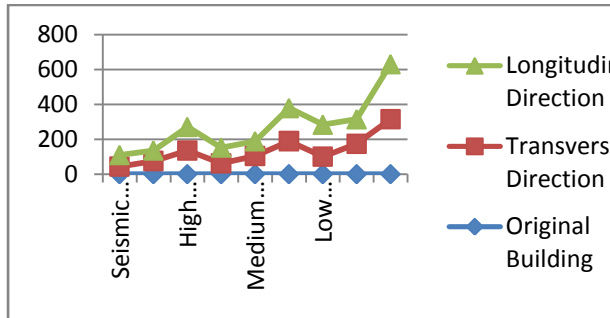
1	0.156	0.965546
2	0.156	0.963646
3	0.176	5.763682
4	0.473	3.414123
5	0.523	1.917784
6	0.769	2.354689
7	0.869	3.414123
8	0.806	1.240884
9	0.806	1.240884
10	0.884	1.13176



Graph 4.1 Different variations of load cases

Table 4:2 Relative Seismic Resistance R (%) of the Retrofitted Building

Seismic zone	Original Building	Transverse Direction	Longitudinal Direction
High Seismicity	Original Building	43	66
	Building + Walls	75	60
Medium Seismicity	Original Building	135	135
	Building + Walls	62	90
Low Seismicity	Original Building	189	189
	Building + Walls	100	183
	SR+W	174	140
		315	315



Graph 4.2 Seismic Resistance v (%) of the Retrofitted Building

5. CONCLUSIONS:

After an introduction which explains why there are so many vulnerable structures in areas of high or moderate seismic hazard around the world, the authors consider the specific case of Eastern Sicily. The paper proceeds with an illustrative description of the seismic action and then addresses the problem of evaluating the seismic resistance and vulnerability of engineering structures. This method is carried out in practice by application of the concept of springs in series, leading in fact to base isolation. One of the two springs in series represents the structure and the other represents the base isolation system. The application of the concept to two buildings in Eastern Sicily concludes the presentation. The enhanced resistance of the buildings to the design earthquake clearly shows the effectiveness of the method, while a generally improved seismic performance also emerges from the application

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