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RETROFITING OF STRUCTURE

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ABSTRACT

Buildings and other structures have a certain useful life, which depends on the specifications adopted. The large number of monuments, which are cherished heritage structures have stood well over a period of time. But some of these have shown signs of distress due to age, aggressive natural environment/industrial pollution etc. Further distress gets aggravated due to overloading misuse of buildings. A few buildings have also failed due to faulty design/construction. Thus, repairs and rehabilitation of buildings are of vital importance. In such cases or in such conditions of structure it will not be economical to reconstruct or renovate the structure therefore with proper retrofitting techniques retrofitting can be done to gain the structural stability and improve aesthetic appearance. Retrofitting of existing building is one of the challenging tasks the structural engineer face in the aftermath of earthquakes. The behaviour of masonry in reinforced concrete buildings in recent earthquakes in India and other countries have demonstrated that these structures are susceptible to damage due to lack of good design, poor quality of construction, lack of maintenance and inadequate earthquake resistance. There is need to examine reasons of failure and improve upon the existing design practice for better performance in future earthquakes. The seismic retrofitting of building is one of the most effective methods of mitigating seismic hazard in future.

KeyWords: - Retrofitting of building, base isolation, Column strengthening, Beam to column joint strengthening, Viscous dampers.

1. INTRODUCTION

This project gives a glance to retrofit the structures which are deteriorated and liable to retrofit. This project includes different techniques of retrofitting. On the behalf of these retrofitting techniques, we studied the approximate techniques which are used to retrofit the different structures. Using this study, the measures to retrofit the mosque and Elevated Storage Reservoir are suggested which are the part and parcel of our case study. Along with these buildings, Elevated Storage Reservoir, bridges, dams are retrofitted.

2. NEED OF STUDY

Buildings and other structures have a certain useful life, which depends on the specifications adopted. The large number of monuments, which are cherished heritage structures have stood well over a period of time. But some of these have shown signs of distress due to age, aggressive natural environment/industrial pollution etc. Further distress gets aggravated due to overloading misuse of buildings. A few buildings have also failed due to faulty design/construction. Thus, repairs and rehabilitation of buildings are of vital importance.

2.1 Causes of failure of RC buildings:-

1.Lack of good design in planning lateral load resisting system such as moment resistant frames, frames with shear walls or with infill walls, and the joints.

2.Poor quality of construction materials and technology.

Inadequate detailing of reinforcement in beams, columns, beam-column joints, particularly from ductility considerations.

3.Inadequate diaphragm action of roofs and floors.

4.Sudden reduction in all column reinforcements at some point along the height.

5.Inadequate treatment of non-structural components like infill masonry walls, staircases, water tanks on roofs, etc.

6.Inadequate anchorage of bars at the ends, particular those ordinarily in compression, but subject to tension under reversed earthquake force direction.

Different techniques of retrofitting:

1. Column strengthening
   - Concrete jacketing
   - Steel jacketing
   - Fiber reinforced polymer sheet wrapping
   - Prestressed wire wrapping
2. Beam strengthening
   - Addition of concrete
   - Steel plating
   - Fiber reinforced polymer wrapping
   - Use of Fiber reinforced polymer bars
   - External prestressing
3. Beam to column joint strengthening
   - Concrete jacketing
   - Steel fillet
   - Steel plating
   - Steel jacketing
   - Fiber reinforced polymer jacketing
4. Slab strengthening
   - Upper surface overlaying construction method
   - Lower surface overlaying construction method .
5. Wall strengthening
6. Foundation strengthening

2.2 System model of isolation:

The laminated rubber bearings (LRB) in most commonly used base isolation system. The basic components of LRB system are steel and rubber plates built in the alternatives layers as shown in fig.5. (Jangid, R. S., Datta, T. K. ,1995)

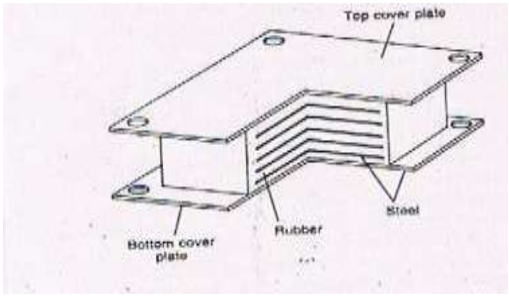

Fig.1 Laminated rubber bearing

The dominants features of LRB system are parallel action linear spring and damping generally LRB system exhibits high damping capacity, horizontal frequencies flexibility and high vertical stiffeners. The damping constant of the system varies considerably with the strains level of bearings (generally of order of 10%). The system operator by decoupling the structure from the horizontal compounds of earthquake ground motion by interposing layer of low horizontal stiffness between structure and foundation. The isolation effects in this type of system are produced not by absorbing the earthquake energy but by deflecting through the dynamics of system this device can be manufacture easily and are quite resistant to environmental effects.

Recent advances in retrofitting techniques: There have been developments in retrofitting using newer materials and innovative technology some developments include: seismic base isolation, structural control, smart materials and viscous dampers. These techniques are briefly described below:

Seismic base isolation: The seismic base isolation (SBI) method of retrofitting consists in replacement of conventional bearings by base isolation device. The isolation bearings elongate the natural period of bridge from a typical value of less than one second to 3 second or more. This will result in significant reduction of earthquake-induced response. The force reduction could be of the order of 3 to 8 from those of conventional fixed bearings.

The base-isolation devices will result in increase in displacement response. To counter this effect some kind of damping device is provided externally or internally within the bearing. The devices should be designed according to principles of isolation. The available options of isolation system are: elastomeric bearing with external damper, high damping rubber bearing, lead rubber bearing and friction pendulum system (FPS). A typical seismic base isolation system of bridge using lead rubber bearings. A judicious choice may be necessary based on the benefits of isolation and additional costs of such devices.

Viscous dampers: The viscous dampers are installed between deck and pier and function as an energy dissipating devices. These devices have been employed as retrofitting devices in bridges. Twelve bridges have been retrofitted in south Korea using this technology. A viscous fluid damper generally consists of a piston in a damper housing filled with a compound of silicone or oil. It dissipates energy through movement of the piston in the highly viscous fluid. If the fluid is purely viscous then damping force is directly proportional to the velocity of the piston. The device can cause significant dissipation of energy. The viscous dampers are reliable, easy in installation and efficient in operation.

Objectives of retrofit:-

1.Increasing the lateral strength and stiffness of the building as shown in fig.2.
2.Increasing the ductility and enhancing the energy dissipation capability.
3.Giving unity to the structure.
4.Eliminating sources of weakness or those produce concentration of stresses.
5.Enhancement of redundancy in the number of lateral load resisting elements.
6.The retrofit scheme should be cost effective.
7.Each retrofit strategy should consistently achieve the performance objective.

Fig.2 Damages of various buildings

Need of retrofitting of bridges:

1.The seismic retrofitting of bridges is required under following situations
2.Upgrading of seismic zones leading to upward revision of seismic coefficient.
3.Updating of design criteria and change in design philosophy as a result of revision codes.
4.Bridges not design for seismic forces particularly those constructed prior to existence of modern seismic codes.
5.Bridges that are damage in earthquake may need both repair and retrofitting.
6.Bridges known to posse¨s structural deficiency as a result of new experiences gained from recent seismic behavior.
7.Deterioration and aging

Fig.3 Damage of bridge pier

3. CONCLUSIONS

We were in search of the project topic which gives us brief knowledge ongoing project concern with existing structures. After taking a glance on many topic we chose the "retrofitting of structure" as a project topic as we have a case study on the same topic our guide has given us motivation for choosing this subject, as this subject has wide scope in field. In addition to this our friends from dhule told us about the mosque building , we told them to send us the detailed photographs of the building then we studied the condition of the structure, damages in the structure, required retrofitting techniques from the photographs . On the behalf of this report we suggest the measures to retrofitting the mosque building. Then we collected the data regarding to retrofitting the different structure like building, bridge, Elevated Storage Reservoir and dam. Then we worked on implementation of various techniques to number of structure like concrete jacketing, strengthening of footing Fiber reinforced polymer wrapping etc. Mean while Dr. S B Kharmale informed us about another case study concern with Elevated Storage Reservoir which is badly damaged.

Concluding summary:

- In general cement grouting method is adopted for retrofitting of structures.
- For the particular case study the suggestions are given, for retrofitting those suggestions are followed then the life of structure will increase for few years.
- Base isolation, Fiber reinforced plastic concrete and steel jacketing can be used for retrofitting of foundations of building, piers of bridges respectively.
- Poor quality of concrete creates problems like porosity cracking and degradation; to overcome such problems retrofitting is the one of the best solution by using cement slurry with admixtures.

In retrofitting of column there is no significant increase in the size. Fiber reinforced polymer has been used not only as sheets, but also as rebar. Fiber reinforced polymer bars can be attached to the web of a beam for shear strengthening. Fiber reinforced polymer bars can be used as tendons for external prestressing. The retrofitted portion by Fiber reinforced polymer jacketing exhibit better efficiency in terms of strength, energy dissipation, lesser rate of stiffness, degradation and ductility levels.

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