EFFECT OF DIFFERENT WRAPING TECHNIQUES ON RETROFITTING OF RCC BEAM COLUMN JOINTS USING FERROCEMENT

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ABSTRACT

Reinforced concrete structural components are found to exhibit distress, even before their service period is over due to several causes. Such unserviceable structures require immediate attention, enquiry into the cause of distress and suitable remedial measures, so as to bring the structures back to their functional use again.This strengthening and enhancement of the performance of such deficient structural elements in a structure or a structure as a whole is referred to as retrofitting. The all important issue to be addressed in retrofitting is life safety. What can be done to prevent collapse of the structure and prevent injury or death to occupants? Some retrofit requirements may try to address only the issue of life safety, while acknowledging that some structural damage may occur.

GRAPHICS

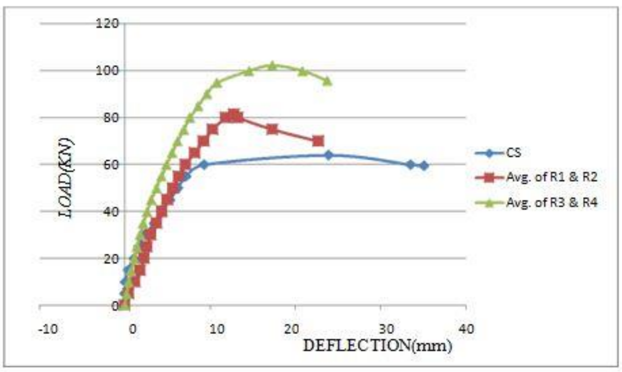

Figure 4.1 Average Values of Load and Deflection at 150mm From Fee end of Beam of Controlled and Retrofitted Specimens.

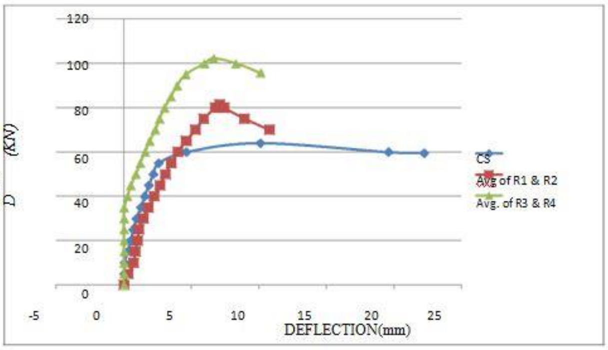

Figure 4.2 Average Values of Load and Deflection at 100mm From Column Face of Controlled and Retrofitted Specimens.

INTRODUCTION

In various parts of the world, Reinforced Concrete (RC) structures, even in seismic zones are still being designed only for gravity loads. Such structures, though performing well under conventional gravity load case, could lead to a questionable structural performance under seismic or wind loads. In most cases, those structures are highly vulnerable to any moderate or a major earthquake. Along with the seismic prone zones like Himalayan region in India, Iran, Turkey, New Zealand and fault regions in US etc., devastations from earthquake have also been seen at the places believed to be seismically not-so-active (as shown in Fig. 1.1) and hence, the existing structures need immediate assessment to avoid collapse which brings a huge loss of human lives and economy that the world has witnessed for several times. Moreover, for new structures, the specifications and detailing provisions, though available to a certain extent, have to be considered in such a way that the structure would be able to efficiently resist seismic actions. Generally, a three phase approach (*Sasmal; 2009)* is followed to describe a structure under seismic loading, as underlined below:-

1. The structure must have adequate lateral stiffness

to control the inter-story drifts such that no damage would occur to non- structural elements during minor but frequently occurring earthquakes,

2. During moderate earthquakes, some damage to non- structural elements is permitted, but the structural element must have adequate strength to remain elastic so that no damage would occur.

EXPERIMENTAL PROGRAM

The test program is so devised so as to study the behavior of retrofitted beam-column joints subjected to different ways of wrapping the retrofit material. The test program consists of:

1. First is the determination of basic properties of constituent materials namely cement, fine and coarse aggregates and steel bars as per relevant Indian standard specifications and designing the relevant concrete mix proportions.
2. Casting of five beam-column joints, with column rectangular shape of dimensions 225 mm x 150 mm and length of 1000 mm and the beam with dimensions 225mm x150 mm in all test specimens and length of 500 mm, using M 20 grade concrete.
3. One beam-column joint is considered as control beam. The remaining are stressed and retrofitted with ferrocement, in-order to find out the load carrying capacity. The stress levels maintained are 80% of the maximum load carrying found out by testing the control beam. The details of the test program are discussed in subsequent sub-sections.

MATERIALS USED

1. **Cement**
2. **Fine Aggregates**
3. **Coarse Aggregates**
4. **Water**

RESULTS AND DISCUSSIONS

In this chapter the load carrying capacity of different specimens are discussed. Initially the control specimen is loaded to ultimate load and other four beam-column joints are loaded up to 80% of the ultimate load obtained from testing of control specimen. Out of four, two beam-column joints are retrofitted with type one retrofitting and the other two are retrofitted with type two retrofitting with the help of mesh wire.

The testing of beam column joints are done with the help of a servo controlled hydraulically operated jack. With the help of the jack, point load is applied on the beam at a distance of 300mm from the face of the column and the value of load is read from the data acquisition system connected to the jack. Three LVDT's are placed at different locations.

Out of the five specimens cast, one specimen is taken as control specimen and is loaded to ultimate loading and the data corresponding to it is recorded through data acquisition system. The rest four specimens are loaded to 80% of the ultimate load and then are retrofitted using different wrapping techniques.

It is observed from the experimental data and the corresponding graph that retrofitting leads to increase in the ultimate load carrying capacity from 64.1 KN (control specimen) to 102.21 KN whereas the deflection corresponding to ultimate load of 102.21 KN is 20.31 mm as compared to 24.1 mm for the control specimen at 64.1 KN. Also there is a considerable increase in the yield load from55 KN (control specimen) to 95 KN for the retrofitted specimen. For the R4 specimen exactly similar trend is observed and increase in load is also of almost of the same order i.e. from 64.1 KN (control specimen) to 102.35 KN with deflection of about 20.35mm. The yield load increases from 55 KN (control specimen) to 95 KN. Thus, on an average for type two retrofitting with 80 % stress level beam-column joints, on retrofitting the ultimate load increase is of the order of 59.56% and yield load increases by 72.73 %

CONCLUSIONS

1. The load carrying capacity of retrofitted beam-column joints for both types of retrofitting techniques increases significantly as compared to control beam-column joint.
2. Specimens with mesh wire wrapped diagonally show maximum improvement in their ultimate load.
3. There is increase in the yield load also in both types of retrofitting; in case of specimens with mesh wire wrapped diagonally there is significant increase in the yield load.
4. There is decrease in the deflection in case of retrofitted specimens as compared to control specimen
5. The ductility ratio of retrofitted specimen is less than the ductility ratio of control specimen.
6. The ductility ratio of those specimens in which mesh wire is wrapped diagonally is more than those specimens in which mesh wire is wrapped in the shape of L.

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