A STUDY ON SEISMIC RESPONSE ESTIMATION USING MEASURED ACCELERATION DATA

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1. INTRODUCTION

In the field of structural health monitoring, there are different approaches for damage identification. Most of the traditional approaches use the acceleration measurement of the building to identify the changes in its dynamic properties [1]. Similarly, some use these dynamic properties to update the numerical model and then estimate the location and magnitude of damage [2]. This is a different approach of estimating the responses in the building to detect the damage by using the acceleration measured from a few floors of the building. An experimental study is carried out to test and validate this novel approach.

2. Modal Concept and Response Estimation

This method of estimating seismic responses is based on the modal concept. As per this, any structural responses can be considered as the sum of several modal responses. This is not only applicable to linear range but also works approximately for the non-linear range.

In each mode the modal responses are directly linked to the modal coordinates. This relationship between the modal coordinates and responses can be obtained through the cyclic modal pushover analysis even for the non-linear range. Thus, here the key is to initially obtain the modal coordinates and then compute the modal responses. The modal coordinates in various modes are obtained using the measured acceleration data. This modal decomposition is carried out using an orthogonal filter approach [3]. Thus, after computing all the modal responses, these are combined to obtain the overall seismic responses.

3. Experiment

In this study, shaking table tests were carried out simulating several earthquakes. An 8 DOF steel cantilever beam was constructed in the lab. First the modal identification test was performed. Then by attaching the accelerometers to a few of the floors, the structure was subjected to different real ground motions. To validate the results obtained, a few strain gauges were attached to the specimen to directly measure the bending and shear strain responses.

4. RESULT

From the acceleration data obtained, all the responses were computed. The bending and shear strain were also computed for each of the earthquake applied. This result was then compared to those directly obtained using the strain gauges. The comparison for one case is shown in Figure 1. Here, the Friuli earthquake is applied to the specimen and the responses are obtained.

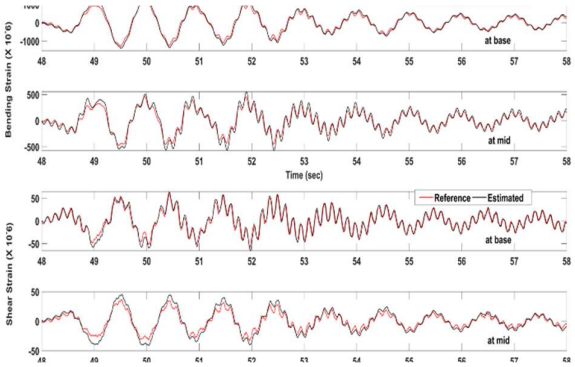

Figure 1. Comparison of strain responses for Friuli Earthquake (0.35X1.8 pga)

4. CONCLUSIONS

By this physical experiment, it was demonstrated that this approach of using few acceleration responses to estimate all the other types of seismic responses is feasible.

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