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Estimation of Dynamic Characteristics of a Middle Rise Steel Reinforced Concrete Building Using Long-Term

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Abstract : In earthquake resistant design of buildings, evaluation of vibration characteristics is important. In recent years, due to the increment of super high-rise buildings, the evaluation of response is important for not only the first mode but also higher modes. The knowledge of vibration characteristics in buildings is mostly limited to the first mode and the knowledge of higher modes is still insufficient. In this paper, using earthquake observation records of a SRC building by applying frequency filter to ARX model, characteristics of first and second modes were studied. First, we studied the change of the eigen frequency and the damping ratio during the 3.11 earthquake. The eigen frequency gradually decreases from the time of earthquake occurrence, and it is almost stable after about 150 seconds have passed. At this time, the decreasing rates of the 1st and 2nd eigen frequencies are both about 0.7. Although the damping ratio has more large error than the eigen frequency, both the 1st and 2nd damping ratio are 3 to 5%. Also, there is a strong correlation between the 1st and 2nd eigen frequency, and the regression line is y=3.17x. In the damping ratio, the regression line is y=0.90x. Therefore 1st and 2nd damping ratios are approximately the same degree. Next, we study the eigen frequency and damping ratio from 1998 after 3.11 earthquakes, the final year is 2014. In all the considered earthquakes, they are connected in order of occurrence respectively. The eigen frequency slowly declined from immediately after completion, and tend to stabilize after several years. Although it has declined greatly after the 3.11 earthquake. Both the decresing rate of the 1st and 2nd eigen frequencies until about 7 years later are about 0.8. For the damping ratio, both the 1st and 2nd are about 1 to 6%. After the 3.11 earthquake, the 1st increases by about 1% and the 2nd increases by less than 1%. For the eigen frequency, there is a strong correlation between the 1st and 2nd, and the regression line is y=3.17x. For the damping ratio, the regression line is y=1.01x. Therefore, it can be said that the 1st and 2nd damping ratio is approximately the same degree. Based on the above results, changes in eigen frequency and damping ratio are summarized as follows. In the long-term study of the eigen frequency, both the 1st and 2nd gradually declined from immediately after completion, and tended to stabilize after a few years. Further it declined after the 3.11 earthquake. In addition, there is a strong correlation between the 1st and 2nd, and the declining time and the decreasing rate are the same degree. In the long-term study of the damping ratio, both the 1st and 2nd are about 1 to 6%. After the 3.11 earthquake, the 1st increases by about 1%, the 2nd increases by less than 1%. Also, the 1st and 2nd are approximately the same degree.

Keywords : eigenfrequency, damping ratio, ARX model, earthquake observation records
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