別紙４－１（課程博士（英文））

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# Abstract（Doctor）

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| Title of Thesis | Damage Assessment of Conventional and Passively Controlled Buildings against Individual and Successive Earthquake and Wind Loads. |

Approx. 800 words


In the region where more than one type of natural disaster is probable, the possibility of progressive damage of buildings due to successive hazards is a concern. The demand loads recommend by design manuals and guidelines are based on the maximum probable disaster, while the contribution of multi-hazard events to the progressive damage is not considered. Under the maximum loads, the design provisions allow a certain amount of damage to the load-carrying members expecting to absorb the input energy by inelastic deformation. However, the damaged members must be required, while demolishing or rebuilding damaged buildings is not economically feasible. Therefore, it is necessary to identify the buildings that will be damaged under natural disasters and take countermeasures. To examine the seismic capacity of existing buildings in the building service periods, a practical damage assessment method is essentially required. Also, the occurrence scenario of multi-hazards in the building design life is necessary, especially for earthquakes and strong winds.

To reduce the damage to structural members under dynamic loads such as earthquake and wind loads, the application of response control devices is an excellent solution to absorb the induced energy. Unlike the general structural elements, the seismic response control device can be replaced after getting damaged. This unique feature makes the devices popular and to be manufactured with different characteristics and shapes. Under the design loads, the performance of different passive control devices is examined extensively by researchers to point out the pros and cons. Although the response control techniques could minimize the damage to buildings, they may increase the building cost, and uncertain about future benefits because of the fatigue and deterioration problem of response control devices. The literature review indicates the effectiveness of the response control techniques under the combined application of low-cycle of high-strain earthquake loads and high-cycle of low-strain wind loads is less explored. Although the high-cycle of low-strain wind loads do not cause significant damage to structural and non-structural elements, it may cause cumulative damage to response control devices and correspondingly progressive damage to buildings.

To encounter the stated problems, first, this study examined the seismic damage of low- and mid-rise conventional buildings located in Afghanistan. In this regard, as a practical damage assessment method, the Japanese screening procedure was practiced to examine the building's performance and it was found out that the screen method is capable to determine the vulnerable buildings in Afghanistan by adjusting the damage criteria. In the next step, a simplified procedure was introduced to evaluate the seismic performance of the passively controlled building under design loads. Since the main objective of the research is to measure the progressive damage in the building's lifetime, the study introduced a practical methodology to model the occurrence of natural disasters. The procedure is based on the Poisson process which is using the return period and intensity of earthquake and wind events. The proposed method enables the assessment of the building performance in the service period under possible successive earthquake and wind loads.

Then, under multi-hazard scenarios, the accumulative damage to high-rise buildings with passive control devices was examined in terms of the damage index, the plastic strain energy, the absorbed energy, and the maximum and accumulative ductility factors. It was revealed that under the successive analysis of multi-hazard events, the overall building damage was about 1.5~2.0 times larger than the damage under the individual design loads. Also, Moreover, it was found that the passive control device may reach its fatigue limit under multi-hazard scenarios.

Finally, the current research proposed a framework for the damage assessment of passive control buildings under multi-hazard scenarios.