Secondary Develiomeent And Application Of Bio-Inspired Isolation System

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Near-fault ground motion means that the motion data are collected in a seismostation which is close geographically to the fault, less than 10km in most cases. This kind of ground motion contains long-period displacement pulse and velocity pulse which will cause much larger dynamic responses of the superstructure than ordinary earthquake motion. For the isolated structures, the near-fault ground motion may cause excessive base displacement at each isolation bearing. The deformation capability of the bearing is limited and cannot keep in normal working state under excessive displacement. The damage of the bearing will further weaken the overall isolation effect of the whole structure. To control the base displacement subjected by near-fault ground motion, a new isolation system is proposed in this paper. The new isolation system is inspired by the "sacrificial bonds and hidden length" biomechanics of an abalone shell. The abalone shell contains a unique colloform that makes it possible to maintain its mechanical properties. In the process of stretching a molecule, a large amount of resistance entropy will increase, but almost no entropy increase will happen in the process of shrinking. A special negative stiffness energy absorption model (BIO model) is established from the process of stretching and shrinking. The BIO model indicates that the energy is only absorbed in the process of the mass point moving from the ends to the equilibrium position. The new isolation system, consists of the special negative stiffness mechanism and the traditional linear stiffness and linear damping combined parallel, can control the base displacement efficiently and reach almost the same vibration isolation efficiency as the semi-active control system. The current research on the new isolation system is still confined to the simplified lumped mass model and cannot uncover the exact performance of isolators and structures in practical applications. A user subroutine is developed based on the interface of UEL in Abaqus. The user subroutine can perform the properties of the new isolation system by user's definition and can be used in both 2D and 3D model. Subsequent verification has been done in both the simplified lumped mass model and 3D complex model with Abaqus, Matlab/Simulink, and SAP2000. It can be revealed from the comparative results that the calculation accuracy of the secondary developed user subroutine can meet the demand for further design and research in complex 3D models. The isolation effect of the new isolation system is also checked compared to that of the traditional isolation system. The results show that the new isolation system in practical application can reduce the dynamic response more effective than the traditional way.