京都大学 KYOTO UNIVERSITY
Graduate School of Engineering/Department of Civil and Earth Resources Engineering
Laboratory of Infrastructure Innovation Engineering

Performance Assessment in Concrete Structures

Oscar Sergio Luna Vera

Describing performance through vibrations

【Background】

The continuous recording of structural vibrations in structural health monitoring is widely used for detecting the existence of damage in a system or locating it in their components. Regardless, quantifying the severity of the damage, or predicting the remaining service life, is still debatable. In order to reach such detailed level of damage assessment, it's necessary to understand the change in the monitored parameters and its correlation with the structural performance.

【Objective】

The description of the variation in the first two natural bending mode frequencies of a Prestressed concrete beam when different phenomena are introduced. E.g. stiffness change due to cracks propagation, elastic or creep recovery after loading stages, and/or irreversible creep due to plastic deformations. Furthermore, observe the correlation with the loading performance.

【Approach】

Obtain experimentally the modal parameters of a concrete specimen (beam type structure) and analyze the variation of such when its intrinsic characteristics change along ten stages. These stages include incremental static loadings, cracks propagation and creep recovery after unloading the beam. Displacements in the bottom profile of the beam is monitored all the time, as well as compression strains in the top surface. The vibrations were recorded by exciting the structure with an impact hammer and deploying several piezoelectric accelerometers along the bottom of the beam.

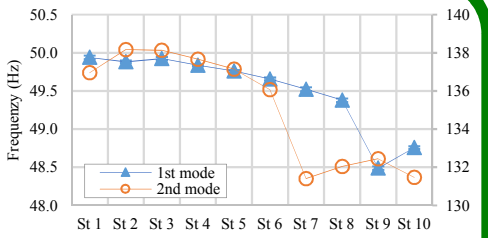
【Publication】

Performance variation influence on experimental modal parameters of a prestressed concrete beam, 20thApplied Mechanics Symposium JSCE, May 2017, Kyoto, Japan.

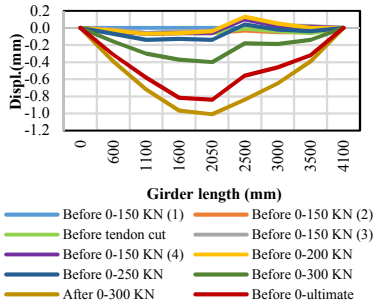
Modal Parameters Variation of PC beams and its influence on Failure Probability, The 8th International Conference on Structural Health Monitoring of Intelligent Infrastructure SHMII8, December 2017, Brisbane, Australia.

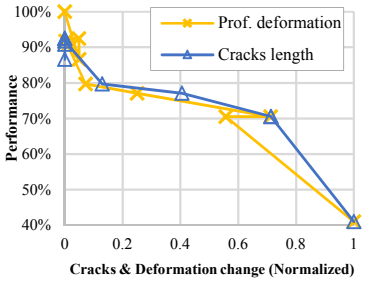
【Results】

The second natural modal frequency is clearly affected when cracks begin superficially(St.6-7).



This is because the modal mass is relatively small compared to the first bending mode and making it more stiffness sensitive. On the other hand, the first mode appears to be creep sensitive (St.9-10).





Performance is correlated to the cracks length and the profile deformations. Besides, each mode frequency seems to be more sensitive to different phenomena (stiffness, irreversible creep, etc.).