

Shaking of reinforced concrete structures induced by a transient dynamic load

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ABSTRACT

The purpose of our study consists in the research of new ways of designing reinforced concrete structures submitted to commercial aircraft impact. We will particularly focus on shaking resulting from such load case. The cutoff frequency of this kind of stress is within the range of 40 to 100 Hz which should correspond to medium frequency [1].

Therefore, industrial structure design implies dynamic studies. The response, especially during the transient stage, cannot be completely described using classical finite element method associated with explicit numerical schemes. Indeed, the medium frequency range is often ignored unless the calculation is carried out with a very refined mesh and consequently, a refined time discretization. This would lead to a prohibitive computation time.

The linear behaviour is not questioned outside the impact area, however, the non-linearity of the portion of the impacted structure can have a significant influence. A new multiscale computational strategy, the Variational Theory of Complex Rays [2], is developed for the analysis of the vibration of structures in the medium frequency regime. Using two-scale shape functions which verify the dynamic equation and the consecutive relation within each substructure, the VTCR can be viewed as a means of expressing the power balance at the different interfaces between substructures in variational form. The solution is searched as a combination of propagative and evanescent waves. Only the amplitude of these waves, which are slowly varying quantities of the solution, are discretized. This leads to a numerical model with few degrees of freedom in comparison with a Finite Element model.

The method consists in an initial decomposition FFT (Fast Fourier Transform) of the signal loading. The VTCR ensures the transfer of the decomposed signal into the structure. The obtained signals are then processed by inverse FFT (IFFT) to reconstruct a time signal and a response spectrum [3]. The aim is to develop a robust method to get mid-frequency spectra generated by an aircraft impact on a simplified containment [4].

References

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