GREEN'S FUNCTION METHOD FOR ANALYSING THE RESPONSE OF AN INFINITE EULER-BERNOULLI BEAM ON INHOMOGENEOUS ELASTIC FOUNDATION INTERACTING WITH A MOVING OSCILLATOR

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Transition zones in railway lines are areas between different track structures such as the transition from conventional track to slab track, tunnels or viaducts. The main feature of a transition zone is that it exhibits a dramatic change in structural behaviour to bridge the difference in the adjacent track parts. This change causes high dynamic loads which contribute to quality deterioration of the track. Two main factors influence the magnitude of the interaction forces between trains and track in transition zones. Firstly, the abrupt change in track stiffness. This stiffness is determined by the mechanical features of the entire track structure; the conventional track is a compliant structure, while slab track, tunnels and viaducts are relatively stiff. A train passing a stiffness change induces a variation of track deflection under the moving dead loads and, consequently, also a variation in the wheelset's vertical momentum leading to higher loads. Secondly, settlements of the backfill and its foundation are typically larger than those of stiff structures, leading to track unevenness.

This abstract deals with the issue of the dynamic analysis of an infinite Euler-Bernoulli beam on elastic foundation with transition in foundation stiffness, subjected to a moving oscillator. This model is one of the simplest ones for a vehicle passing a transition zone. The equations of motion are solved by means of the time-domain Green's function method using convolution integrals in terms of the unknown contact force. Considering the track as an aperiodic structure, the Green's functions are calculated in a stationary reference frame. Two methods of solution are investigated. The first one is based on the Laplace Transform, where the response consists of a contribution from the initial conditions and one from the moving contact force. By choosing the initial conditions in accordance with the steady-state response of a beam with homogenous foundation subjected to a moving load, the free vibrations and waves due to oscillator entrance are suppressed and steady-state behaviour is achieved before the oscillator reaches the transition zone. The second method is based on the Fourier Transform, which automatically ensures steady-state behaviour. The influence of the length of the transition zone and the speed of the moving oscillator on the contact force are analysed; both sub-critical and super-critical speeds are considered.

REFERENCES

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