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Random Vertical Seismic Vibrations of the Long Span Cantilever Beams

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Abstract : Seismic resistance norms require calculation of cantilevers on vertical components of the base seismic acceleration. Long span cantilevers, as a rule, must be calculated as a separate construction element. According to the architectural-planning solution, functional purposes and environmental condition of a designing buildings/structures, long span cantilever construction may be of very different types: both by main bearing element (beam, truss, slab), and by material (reinforced concrete, steel). A choice from these is always linked with bearing construction system of the building. Research of vertical seismic vibration of these constructions requires individual approach for each (which is not specified in the norms) in correlation with model of seismic load. The latest may be given both as deterministic load and as a random process. Loading model as a random process is more adequate to this problem. In presented paper, two types of long span (from 6m – up to 12m) reinforcement concrete cantilever beams have been considered: a) bearing elements of cantilevers, i.e., elements in which they fixed, have cross-sections with large sizes and cantilevers are made with haunch; b) cantilever beam with load-bearing rod element. Calculation models are suggested, separately for a) and b) types. They are presented as systems with finite quantity degree (concentrated masses) of freedom. Conditions for fixing ends are corresponding with its types. Vertical acceleration and vertical component of the angular acceleration affect masses. Model is based on assumption translator-rotational motion of the building in the vertical plane, caused by vertical seismic acceleration. Seismic accelerations are considered as random processes and presented by multiplication of the deterministic envelope function on stationary random process. Problem is solved within the framework of the correlation theory of random process. Solved numerical examples are given. The method is effective for solving the specific problems.

Keywords : cantilever, random process, seismic load, vertical acceleration
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