University of Bergamo, School of Engineering (Dalmine)

Course of COMPUTATIONAL MECHANICS OF SOLIDS AND STRUCTURES

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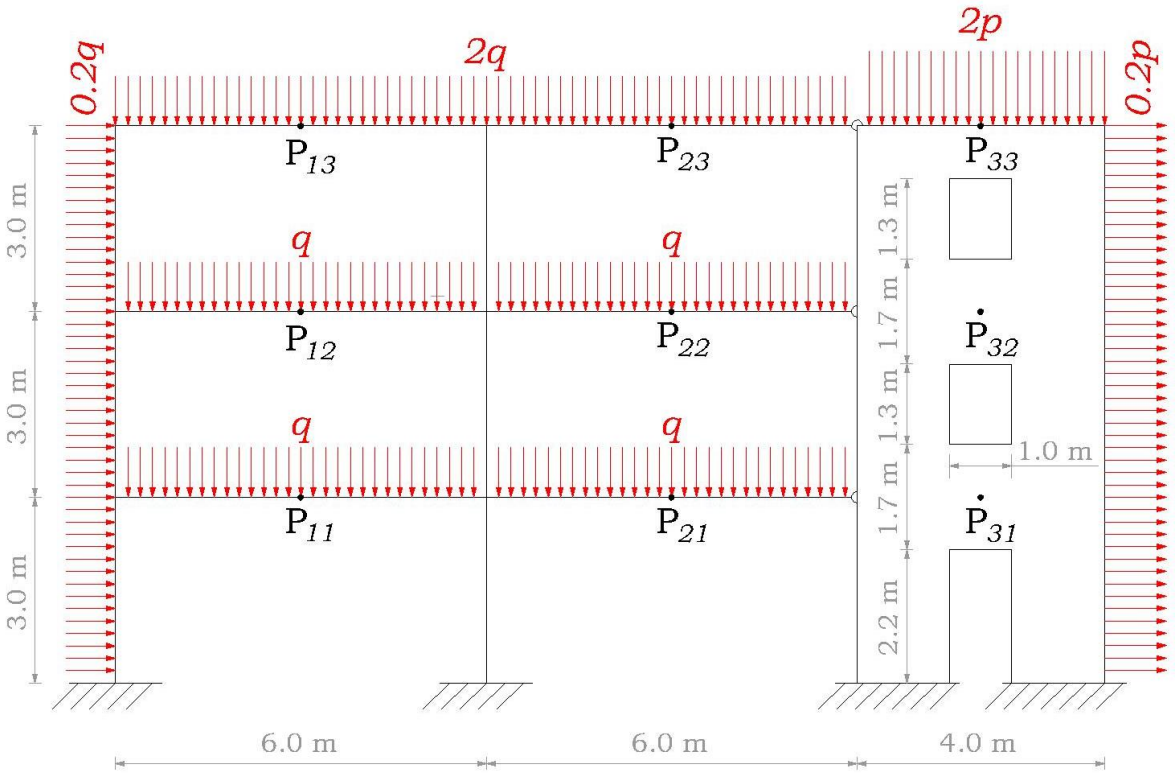
Consider the reinforced concrete structure portrayed in the figure below. Columns have a square-shaped cross-section of dimension 40.0 cm; horizontal girders have a rectangular-shaped cross-section, with a base of 40.0 cm and a height of 60.0 cm. The shear wall has an out-of-plane thickness of 40.0 cm. The reinforced concrete is assumed to behave as a linear elastic isotropic material with a Young modulus and a Poisson ratio of 30.0 GPa and 0.15, respectively. The frame is loaded as shown in the figure (q= 50 kN/m and p= 200 kN/m^2).



Assignment

After having defined an adequate finite element discretization of the structure

1) Calculate the static response of both the frame and the shear wall under the small displacement assumption (linearized kinematics) by using the following models of the frame:
   a) truss finite elements;
   b) Euler-Bernoulli beam finite elements;
   c) "Timoshenko" beam finite elements (shear factor equal to 1.2).

   The shear wall must be modelled through continuous finite elements under plane stress conditions.
2) Plot the deformed configuration of the structure.

3) Plot the diagrams of the internal actions of the frame.

4) Plot the maps of stress tensor components of the shear wall.

5) Calculate the values of the horizontal and vertical displacements of points P_{ij} given in the picture.

Comment and provide a critical interpretation of the obtained results.

Optional request

A rotating machine is constrained to the floor of the first level of the right span. The rotating machine generates a force (magnitude of F= 20 kN) rotating at a frequency of Ω= 15.0 Hz. Calculate the first three natural modes of vibration of the adopted FEM models and discuss qualitatively about the possibility that the rotating machine leads the structure to resonance (density of the concrete ρ= 2500 kg/m^3).