Static calculations and structural design with application of principle

of superposition

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Abstract

The paper presents selected examples of application of principle of superposition in definition of the structure of a method proposed for calculations of the statically indeterminate trusses and in process of design of the foundation structural system intended for heavily loaded objects, including tall buildings [1]. The proposed method makes possible the approximate calculation of the force values acting in members of the plane statically indeterminate trusses by means of e.g. the Cremona's method applied in two stages for suitable forms of statically determinate trusses strained by the half values of the load forces F, see Fig. 1a-c. Final values of forces are resultant of the force values calculated in both stages for the same truss members. The principle of superposition is also applied in design of structural system of the combined foundation, modular segment of which is presented in Fig. 1d-f. System of combined foundation consists of horizontal beams (1) located on a common slab (2), which are supplemented by intermediate system composed of the funicular components (3) and of the arch components (4). The system of combined foundation has theoretically unlimited surface and it can be applied for construction of very heavily objects on subsoil of very small load capacity. It has an inherent feature of damping of vibrations, what makes it very useful for buildings located in earthquake areas. Principle of superposition can be also applied in the design process of the whole structural system of the tall building, see Fig. 1g.



Figure 1. Schemes of plane tension-strut truss systems, a) basic configuration, b) configuration of overloaded structure

Keywords: Static calculation, Foundation structure, Earthquake area, Tall building.

References

[1] Rebielak, J. (2015) Examples of application of principle of superposition in the design of structural systems and in static analyses, *Journal of Mathematics and System Science* 5, 150-155.