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PhD thesis summary

The method of modelling of steel halls structures covered by trapezoidal sheeting

Steel structures of buildings mainly consists of beams and columns. These elements are usually supports for a machinery, walkaways or roofs and walls coverings. In general, static calculations of such buildings are made without using a stabilising effect of a sheeting. This effect is known as the "stressed skin diaphragm action". The design procedures are available to solve problems using it. However, these are difficult to implement in a practice and does not cover every possible geometry of buildings to be solved. Studies of existing methods possibilities leads to conclusions that a more universal and a practical approach is necessary to develop. The main scientific goal of the doctoral thesis is to propose the new method of modelling of steel halls structures covered by the trapezoidal sheeting.

The assumption to the proposed method is that a bearing steel structure is represented as a common static system. It can be done using chosen techniques (e.g. by working in 2D or 3D space). A sheeting (roofs and walls) can be attached to it, as an addition, according to the rules of the provided method. Such arrangement creates a complex assembly of a bearing structure with covering, which can be calculated together to obtain internal forces and deformations of a building structural elements. Research on alternatives to the analytical procedures proved that an appropriate direction for further studies are computational methods where complex structures can be solved efficiently. Bases of the new approach has been proposed taking into account this conclusion. The main idea is to take into account every single connector and trapezoidal sheet applied in a roof or wall covering. This approach may give the impression of highly complicated since hundreds of such connectors and sheets can be distributed over a simple roof. Solution for this disadvantage have been also proposed in the dissertation. Geometries of roofs and walls coverings made of trapezoidal plates are generally regular and have uniform distribution of their structural components. This

observation led to a programming techniques as a solution for building complex models like those resulting from the presented method. Such procedure has been written using the advanced programmable features available in the chosen static software. The program has been effectively used to generate almost all models calculated for the needs of doctoral thesis.

The method has been checked by the experimental and the analytical tests. Scope of the experimental tests are: the part of a roof (the archival laboratory tests), the steel hall (own fields tests of the real building) and the thin plates connections under shear (own laboratory tests). The most interesting and valuable tests is the 12 m wide, 20 m long and 4 m high building. The steel hall have been investigated three times (stages): the bearing structure only (steel skeleton), the structure with covered roof, the structure with covered roof and walls. Test were performed by applying a point load on a chosen column head, with horizontal force values up to 1,5 tons (15 kN).

Area of the analytical research cover all experimental cases in form of the calculations using the proposed method. As an addition to the experimental validation, there is a comparison to the typical roofs, estimated using known recommendations provided in European Standards. The results acquired from the simulations according to the developed method have been highly corresponding to those obtained from the experimental test. All observations and comparative studies proved that proposed method can be accurately used to model steel halls structures covered by trapezoidal sheeting. Further research and case studies are necessary e.g. to validate the method with more complex structures.