Summary

The development of the finite element method (FEM), commercial software and computer hardware enables an efficient in terms of quality and quantity analysis of bridge structures. Regardless of the degree of complexity of the numerical model, the problem of the adequacy of the FEM mapping to the behavior of the real structure always remains relevant. The study showed that there is an impact of the numerical model class adopted at the design calculations stage (complexity, discretization, model accuracy) on the global safety factor of the bridge structure, identified with its design load capacity margin.

In Chapter 2, the ambiguous concept of load-bearing capacity of bridge structures is formulated and systematized, highlighting differences in its popular perception, significance in the context of structural mechanics, understanding of design standards, requirements and dimensioning principles, as well as studies dealing with the problem of bridge structures in science.

Chapter 3 presents the state of knowledge concerning computer modeling of concrete bridge structures using the FEM, referring to the basic principles known from the theory of structures.

Chapter 4 presents examples of modeling concerning typical concrete bridge structures and their structural details using the FEM, as well as the impact of the model class on the labour consumption of its preparation, the risk of making mistakes, the form of presentation of calculation results and the possibility of their interpretation. In addition, recommendations and practical guidelines are developed for the selection of numerical models adequately for specific types of analyzed bridge structures. Comparative static calculations are carried out for 7 road viaducts, each of which is mapped using a few or a dozen or so models with different accuracy (49 models are made), and on this basis it was determined whether the impact of the model class is insignificant (discrepancies less than 15%), medium significant (differences 15 ÷ 25%) or significant (differences above 25%) on the estimated static quantities.

Conclusions and the fields of future research are given in the last Chapter 5. Based on the simulations carried out, it is shown that there is an implicit effect of the bridge numerical model class on its design load-bearing capacity, in relation to the global safety margin factor, recommended by design standards and regulations. Values of partial safety factors are proposed in relation to numerical models of some typical bridge structures.

Keywords: concrete bridge, computer modeling, numerical model, FEM, load-bearing capacity