SUMMARY OF PH.D. DISSERTATION

The work concerns the design, modelling and simulation of FRP composite footbridges. Chapter 1 presents state-of-the-art on structural solutions and design of FRP composite footbridges. Areas that require further research and development are indicated. The advantages and disadvantages of the superstructures of existing FRP composite footbridges are summarized. The origin of the Ph.D. dissertation is given. The series of FRP composite footbridges developed in this dissertation partly eliminates the unfavourable features of footbridges developed as part of the FOBRIDGE project and is technologically and cost-competitive in comparison with footbridges made of conventional materials (steel, reinforced concrete, steel-concrete). Chapter 2 sets out the objectives of the dissertation.

In Chapter 3, literature studies were conducted in the following areas:

- design basis for building/engineering structures according to Eurocodes,
- microstructure, constitutive equations and hypotheses of destruction of FRP composites,
- glue joints of FRP laminate shells,
- numerical modelling and simulation of FRP laminate shells and metal joints, loaded statically.

Issues 1, 2 form the theoretical basis for formulating and solving issues covered by this doctoral dissertation. Issues 3, 4 give the state-of-the-art which allows to assess the Ph.D. student's contribution to the disciplines of mechanical engineering and civil engineering and transport.

In chapter 4, the numerical modelling and simulation methodology of glued GFRP laminate shells was developed using MSC.Marc FE code. The test segment with a box cross-section, manufactured within the framework of project FOBRIDGE, was used for the experimental validation of the modelling and simulation. Testing of selected simulation parameters and tests of FE mesh density were carried out. In addition, the effect of ply sequence of reinforcing fabrics used in the footbridge construction was examined to determine the sequence leading to the highest load capacity of the test segment.

In chapter 5, the methodology for designing GFRP composite footbridges, compliant with the Eurocodes, has been developed. Preliminary design, global detailed design and local detailed design of footbridges were distinguished. The design criteria were defined in the
preliminary design as well as in the global detailed design. In the local detailed design, only the load capacity criterion imposed on the effort indices of the laminae is used.

Chapter 6 presents the structural concept of a series of FRP composite footbridges with a multi-box cross-section and the preliminary technological design for manufacturing these footbridges. Design assumptions were made in such a way that the footbridges could be used almost all over Poland, without the need to repeat the design calculations. The actions according to the Eurocodes were calculated and the preliminary design of the series of footbridges was carried out. Based on the preliminary design calculations, a structural design of a box footbridge with the code CBFB/16.00/2.56 (span $L=16.00$ m, usable width $B=2.56$ m) was developed. This project was verified by performing global and local detailed design calculations.

In Chapter 7, the global detailed design calculations for the footbridge CBFB/16.00/2.56 were carried out using MSC.Marc FE code. The design model of the footbridge was developed and the numerical modelling of the footbridge was carried out. Seven load capacity ultimate states and two serviceability ultimate states were formulated and the simulation results in graphical and numerical form were presented. Chapter 7 is a presentation of the developed methodology of global detailed design calculations.

In Chapter 8, the local detailed design calculations for the footbridge CBFB/16.00/2.56 were carried out using MSC.Marc FE code. The design and numerical models of two sub-areas of the footbridge have been developed, which require a detailed analysis of the effort, i.e.: a stabilizing system on the support and the area of the transport and assembly opening. The load capacity ultimate state in the abovementioned sub-areas was checked. The necessary local adjustments were made in these zones.

Chapter 9 is a summary of the results of the Ph.D. thesis and the contribution to the scientific disciplines. Appendix A contains the calculation of reactions on the supports and checking of stability for rotation of the CBFB/16.00/2.56 footbridge. The dissertation also contains a list of references and a summary in Polish and English.