KLOKNERŮV
ÚSTAV
ČVUT V PRAZE

Anotace

In my dissertation I focused on the numerical analysis of the shear notch coupling method for the combination of timber and ultra-high performance concrete (UHPC or UHPFRC) for composite bridge structures. This type of coupling allows to transfer the large loads that can be expected in bridge structures, yet it is a relatively simple method of connection to implement. In particular, the advantage of using UHPC instead of conventional strength concrete is the possibility of designing more subtle structures that can offer an efficient structural system due to the saving of dead weight while maintaining sufficient load carrying capacity. The use of a renewable material in the form of timber in combination with the modern cement composite UHPC can lead to the design and implementation of structures in line with the concept of sustainable construction. As UHPC is a relatively new material, the design of structures using it lacks the necessary standard regulations to encourage its wider use. Its combination with timber is a topic that has received little attention so far. Although the combination of conventional concrete with timber has been implemented for several decades and there is a wide range of possibilities to achieve the combination, there are still a number of shortcomings in the standards in some areas of their design. My work will involve the use of Atena 3D and Ansys nonlinear numerical computation programs. For the input data of the calculations I will use data obtained experimentally during the TAČR grant TH02020730. This grant project focused on the development of a coupling system for timber-UHPC composite bridge structures with emphasis on the prefabrication used, a number of necessary experimental tests were performed to validate the computational models I worked on in the grant project. On the basis of the validated models obtained, I was able to perform a detailed analysis of the functioning of the coupling system and to perform its optimization already in the framework of my work. The optimization of the coupling consisted in the use of UHPC material directly for the notch itself and thus took advantage of its excellent shear strength properties. In the next steps, I performed two parametric studies on the optimized coupling. The first one was aimed at obtaining the dependence of the shear notch depth on its length. This study helped me to derive analytical relationships that can be used to calculate the load capacity and stiffness of the joint. The second parametric study was the effect of temperature on the stresses in the structure. Through this study, I was able to establish at least approximate relationships to determine the effect of this loading condition. I evaluate the results of my work as an insight into the possibilities of using numerical nonlinear modeling in the design of coupled timber-UHPC structures. I believe that the findings from my work will make a difference in the design of this

composite structures. Another contribution of my work I see in the possibility of supplementing the standard regulations in case of thorough verification of the obtained results.