THE INTERREG “ATCZ190 SAFEBRIDGE” PROJECT ON ADVANCED ANALYSIS OF EXISTING REINFORCED AND PRE-STRESSED CONCRETE BRIDGES IN THE AUSTRIA-CZECH REPUBLIC REGION

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Summary

The European Project INTERREG AUSTRIA - CZECH REPUBLIC “ATCZ190 SAFEBRIDGE” targets to address issues concerning nonlinear modelling, reliability, safety formats and lifetime aspects of advanced analysis of existing reinforced and pre-stressed concrete bridges. In the framework of this project, a selection of bridges (5 from each country) is analysed through nonlinear finite element simulation methods (NLFEM) on deterministic and stochastic levels based on the upcoming Austrian standard ON B4008-2. The outcome of the analysis will lead to the development of a relevant guideline to assist the engineering community and the bridge owners to perform and assess the accuracy of NLFEM analyses. Additionaly, indicative statistical data about road/railway bridges within the program region are presented, along with the future steps of the project.

1 Introduction

The increasing need for assessment and evaluation of the existing railway and road bridge network in Europe is the motivation for the current research. Advanced bridge analysis for the realistic assessment of their structural condition is necessary and should take into account their increasing age, environmental decay and traffic volume, considering also the new relevant codes and standards. The “ATCZ190 SAFEBRIDGE” project targets to address the need of realistic assessment of bridges with the assistance of non-linear deterministic and stochastic methods and it is operated by two main partners, which are University of Natural Resources and Life Sciences, Institute of Structural Engineering, Vienna, Austria and the Brno University of Technology, Institute of Structural Mechanics, Brno, Czech Republic. The remaining project consortium consists of strategic partners, which are the main national and county road and railway bridge operators in Austria and the Czech Republic.

The bridge evaluation process is very similar in both countries and it can be divided in four levels, based on the new Austrian standard ON B4008-2 [1] for the assessment of the load bearing capacity of existing road and railway bridges. Recalculation of a bridge structure on Level 1 (assessment based on current design standards e.g. EN [2], [3], [4]) is applied by all engineering offices that specialise in bridge assessment. Some engineering offices proceed also on recalculation on Level 2 (assessment using updated information on the load, resistance and safety through the introduction of reduced partial factors). The remaining two levels (Level 3: assessment by probabilistic analysis determining the reliability level of the structure compared to the one of the current design standard and Level 4: acceptance of reduced reliability level and corresponding compensatory measurements, such as weight limits, reduced speed, etc.) take probabilistic aspects into consideration and therefore, they are not often addressed by engineering offices.

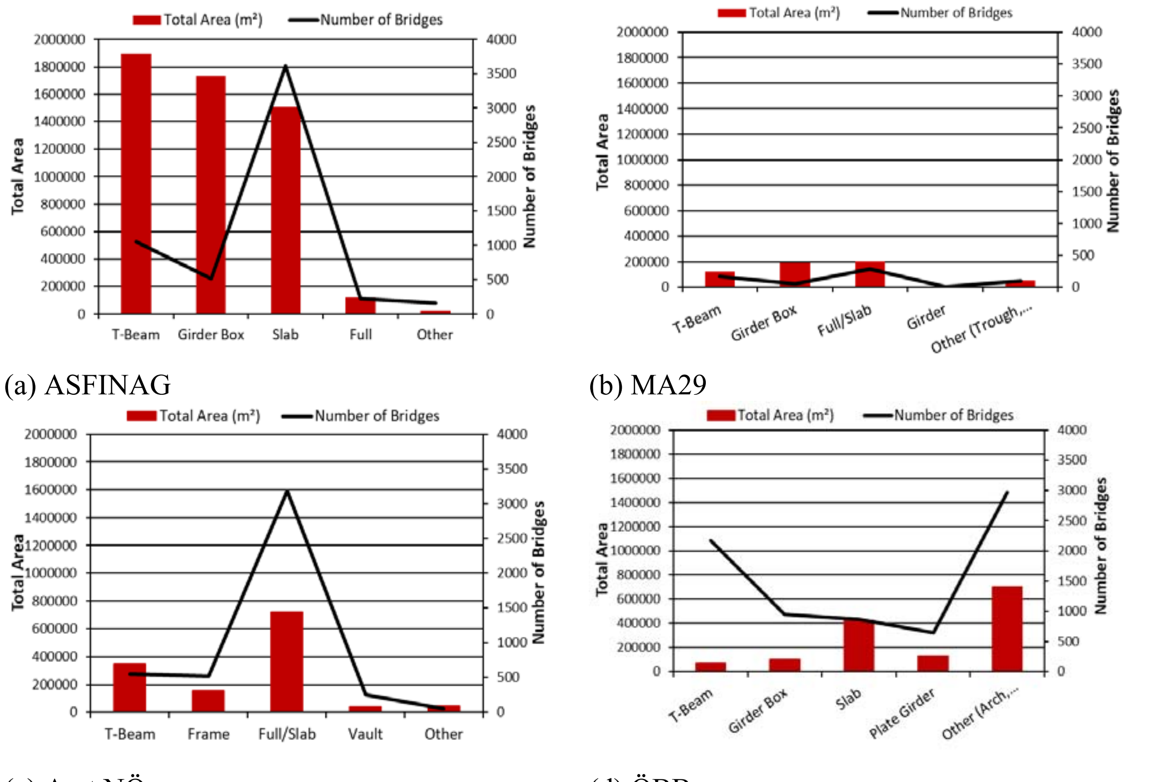
The process described above will be applied in ten selected case studies (five from each country) and the results will serve as background for the development of a relevant Guideline that will help the engineering community become familiar with stochastic methods. In this paper, the main target and objectives are presented, along with some indicative statistical data of bridges in the program region and the future steps of the project.

2 Statistics of Bridges within the Program Region

Bridge statistics mainly serve the selection process of the case studies for the current project and the information concern the border regions between Austria and Czech Republic, including Vienna, Lower Austria, South Moravia, South Bohemia and Vysočina. Strategic partners from both countries provided the statistics, as they are the main national and regional operators of road and railway bridges and have access on data concerning the full bridge stock in Austria and Czech Republic. The evaluation of the statistical data will facilitate the case study selection, because they will point out the most typical features of bridges in terms of cross-sectional type, material, size and age of brides. On the Czech side, the structural condition of the bridge is also taken into account.

2.1 Austria

The four main Austrian Road and Railway Bridge operators (ASFINAG, MA 29, Amt der NÖ Landesregierung and ÖBB) provided series of statistical data for the evaluation of bridge characteristics, such as: (a) cross-section structural type, (b) material type, (c) span length and (d) year of construction. Fig. 1 shows the statistics about the cross-sectional type for all four bridge operators in terms of total area and number of bridges.



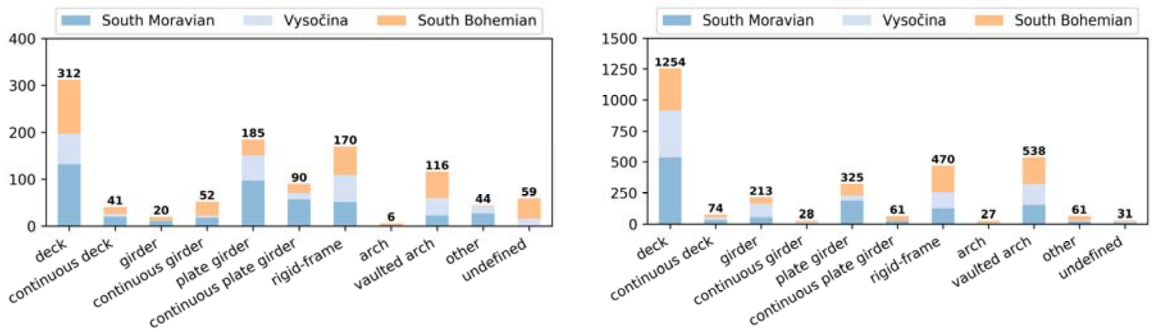
(a) ASFINAG (b) MA29

(c) Amt NÖ (d) ÖBB

Fig. 1 Bridge distribution in Austria based on the structural type of the cross-section

2.2 Czech Republic

In the Czech Republic, almost all railway bridges (with exception of railway bridges on siding rails) are operated by the Railway Infrastructure Administration, state organization (SŽDC). Bridges on motorways and 1st class roads are managed by the Road and Motorway Directorate of the Czech Republic (ŘSD ČR), bridges on 2nd and 3rd class roads are owned by regional institutions. Bridges on local roads are owned by towns and municipalities, or they have private owners. Series of statistical data are provided by the SŽDC (data on 31.12.2017) and ŘSD ČR (data on 01.07.2018) in terms of (a) structural condition (SC), (b) material and age of bridge superstructure, (c) structural type and length are evaluated in the following sub-sections [5], [6]. Fig 2 shows indicatively statistical data about bridges in Czech Republic categorised based on the bridge structural type.



(a) Motorways and 1st class roads (ŘSD ČR) (b) 2nd and 3rd class roads (ŘSD ČR)

Fig. 2 Number of bridges in Czech Republic based on structural type

3 Discussion and Future Research

Summarizing the statistical data of bridges in Austria, it was concluded and agreed that the bridges to be considered should have specific characteristics that could cover a large number of bridges within the program region. So, the selected bridges should be of reinforced or pre-stressed concrete, with a cross-section structural type being slab, T-beam or hollow box. The bridge spans should vary between 1 and 10 and the span length between 6 and 40 meters. One railway and four rad bridges were chosen.

Concerning the statistical data of bridges in the Czech Republic and based on the requirements and suggestions of Czech strategic partners, one railway bridge and four road slab bridges made of pre-stressed precast girders were selected for case studies. The most common bridge types and their structural condition were the crucial parameters in the decision making process.

The main outcome will be a Guideline on "Advanced analysis of existing reinforced and pre-stressed concrete bridges: Nonlinearity, reliability, safety formats, life-time aspects". This guideline will be communicated through a series of seminars and training schools that target engineering offices and includes the following parts, based on the analysis of the ten case studies: (A) Gathering and updating the existing information. (B) Advanced non-linear deterministic assessment on how to deterministically simulate the most important features of the examined object. (C) Advanced non-linear probabilistic assessment, involving stochastic material properties and constitutive models of concrete, steel reinforcement, etc. (D) Life cycle assessment models for the prediction of future behavior and remaining life, taking into account environmental factors and other processes that cause deterioration of the structure. (E) Performance indicators for the evaluation of the degradation processes, defining the critical indicators that have a significant impact on the remaining future lifetime of bridges.

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