Danube Bridges 2019

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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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INTRODUCTION. The existing European road and railway bridge network is being constantly evaluated in terms of road safety, durability and stability. The evaluation targets to support the decision making process on whether structures should be demolished and rebuilt or whether a strengthening/upgrading concept should be developed. Advanced analysis to assess the structural condition of concrete bridges is essential, as the bridge stock is constantly aging, the traffic volume increases and new codes and standards are developed with customized levels of security that have to be met by existing bridges.

The "ATCZ190 SAFEBRIDGE" project, financed by the European Union (INTERREG Austria-Czech Republic), aims to achieve a more realistic analytical modeling of bridges through the consideration of non-linear deterministic and stochastic aspects. The evaluation process is based on the new standard ON B4008-2 for the assessment of the load bearing capacity of existing road and railway bridges, which includes four levels of assessment for bridges: Level 1 - assessment based on current design standards, Level 2 - assessment using updated information on the load, resistance and safety through the introduction of reduced partial safety factors, 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.). Engineering offices mostly assess the load bearing capacity based on Level 1 using current design standards, i.e. deterministic calculation and partial safety factors method and aim of the project is to familiarize the engineering community with assessment levels 2-4. This can be achieved through a series of bridges that will be assessed and the current paper presents the selection process of the bridges to serve as case studies, based on statistical data provided by the strategic partners, aiming to focus on characteristic case studies that concern the majority of the structures within the program region. The most commonly addressed features of the bridges in terms of material, cross-section structural type, size and age of bridges will be finally summarized. Finally, the future steps of the project, leading to a general Guideline on the topic, will be briefly presented.

BRIDGE STATISTICS AUSTRIA. The four main Austrian road and railway bridge operators within the program region (ASFINAG, MA 29, Amt der NÖ Landesregierung and ÖBB) have provided a series of statistical data in terms of bridge number and total bridge area. The characteristics that are evaluated are:

(a) Structural type of the cross-section

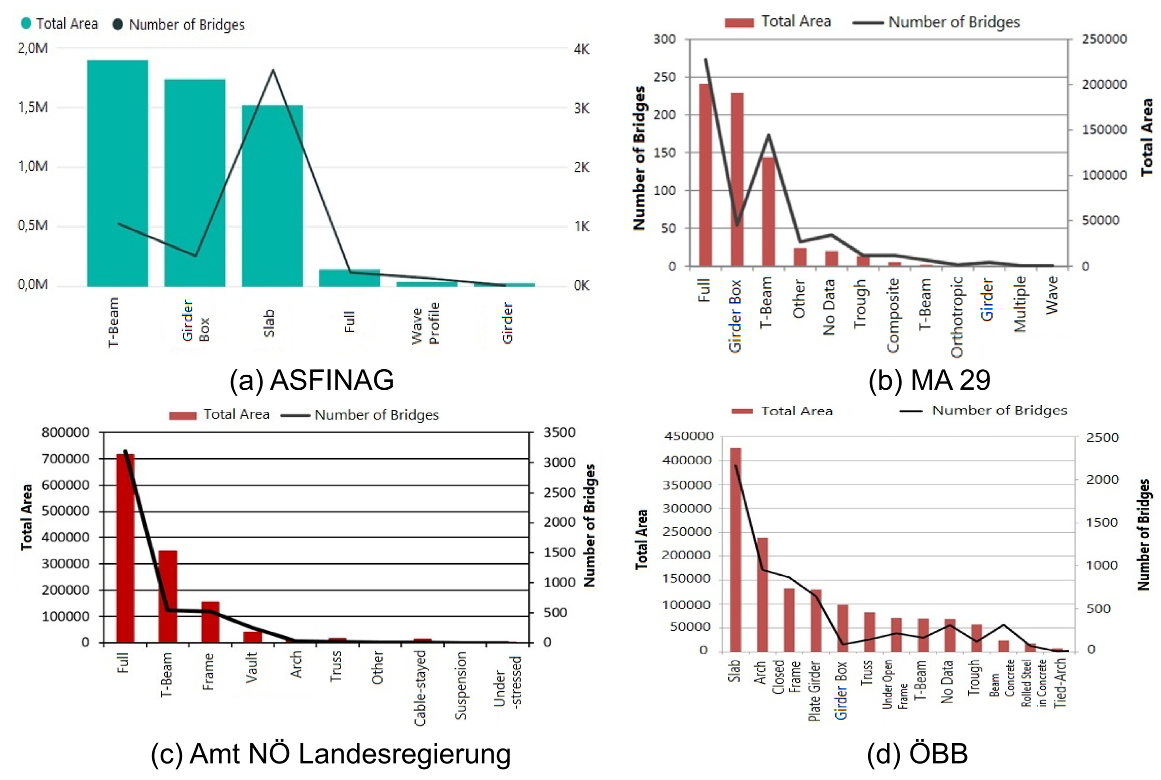

Figure 1: Bridge distribution according to the structural type of the cross-section

A wide variety in structural type of bridge cross-sections is addressed within the Austrian side of the program region (Figure 1). The most common cross-section types are full-slab, box girder, T-beam, etc.

(b) Structural material

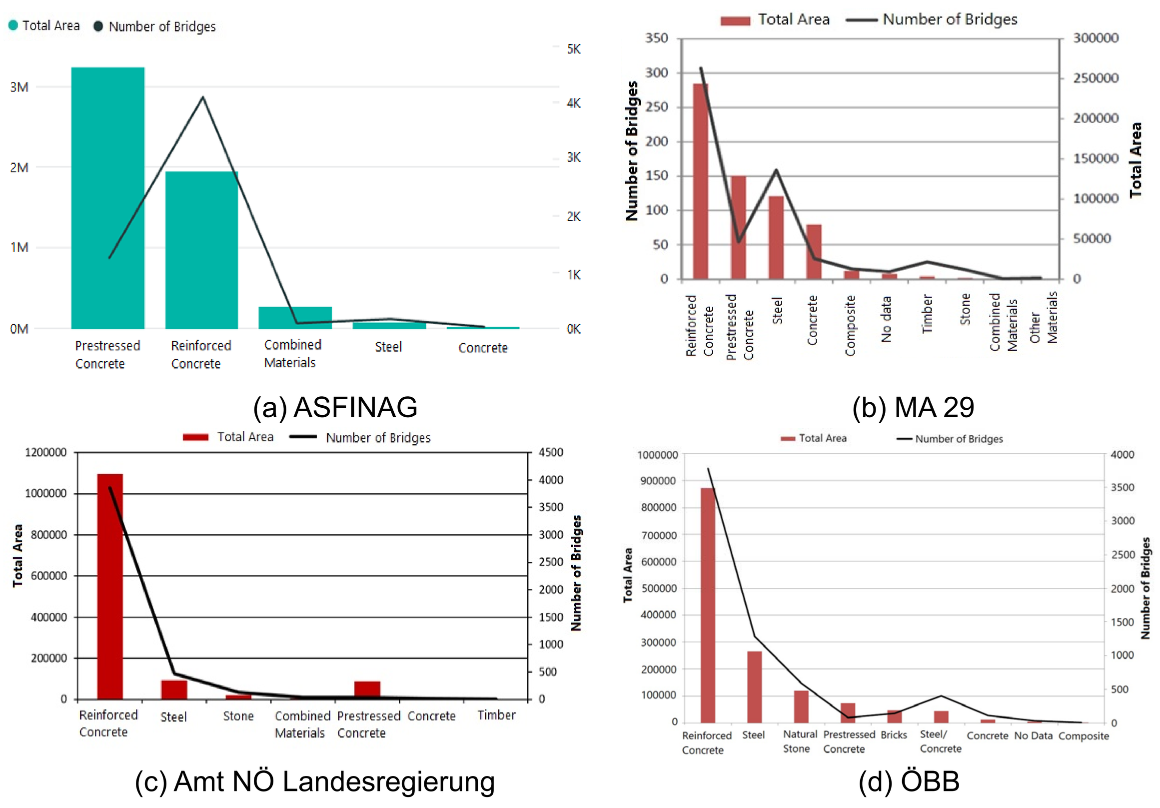

Figure 2: Bridge distribution based on material type

As far as the type of material used for the bridge construction is concerned, it can be noticed that regardless of the bridge operator the most commonly used materials are reinforced and pre-stressed concrete and this concerns both the total area and total number of bridges (Figure 2).

(c) Year of construction

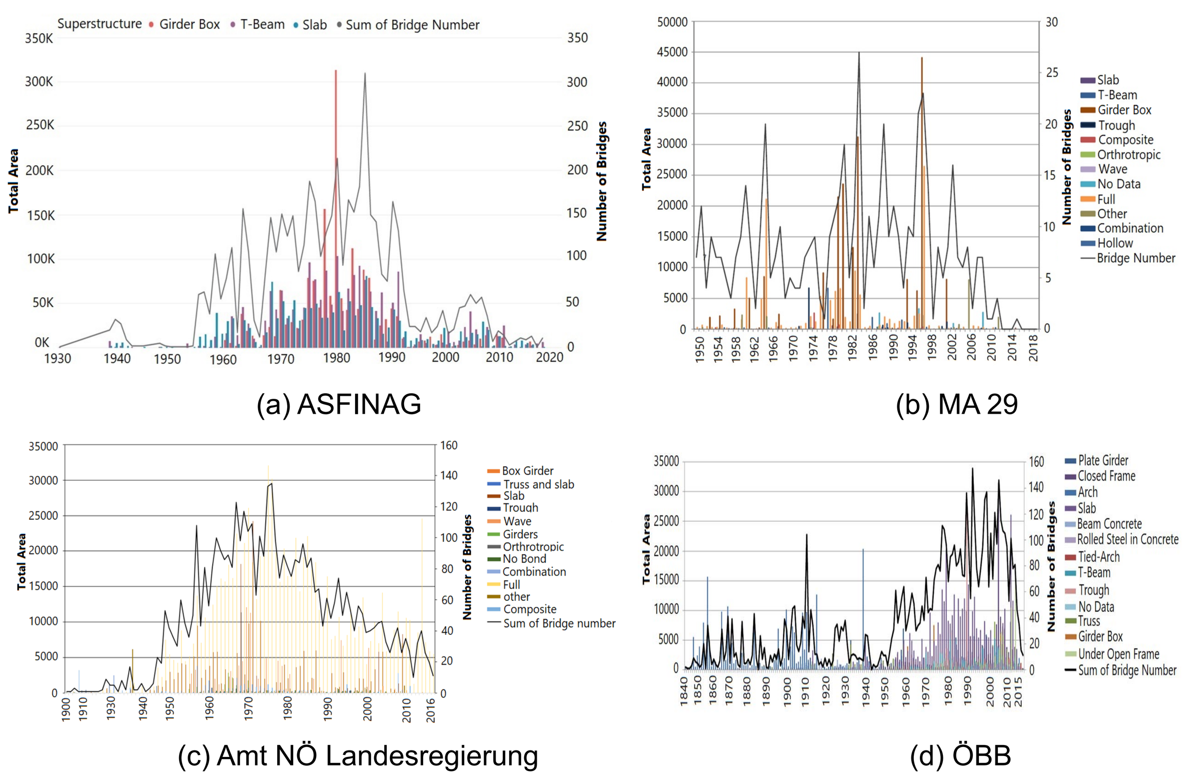

Figure 3: Bridge distribution based on construction year

The provided statistical data from the road bridge operators (ASFINAG, MA29 and Amt NÖ Landesregierung) in Figure 3 show that the majority of road bridges in Austria were built between 1965 and 1995. As far as the railway bridges are concerned, the statistics from ÖBB show that, apart from a peak around 1910, most railway bridges were constructed during the period 1975 to 2010. So, the road bridges in Austria are aging significantly and are in need of maintenance.

BRIDGE STATISTICS CZECH REPUBLIC. 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 regions. Series of statistical data provided by the SŽDC (data on 31.12.2017) and ŘSD ČR (data on 01.07.2018) in terms of:

(a) Structural condition (SC)

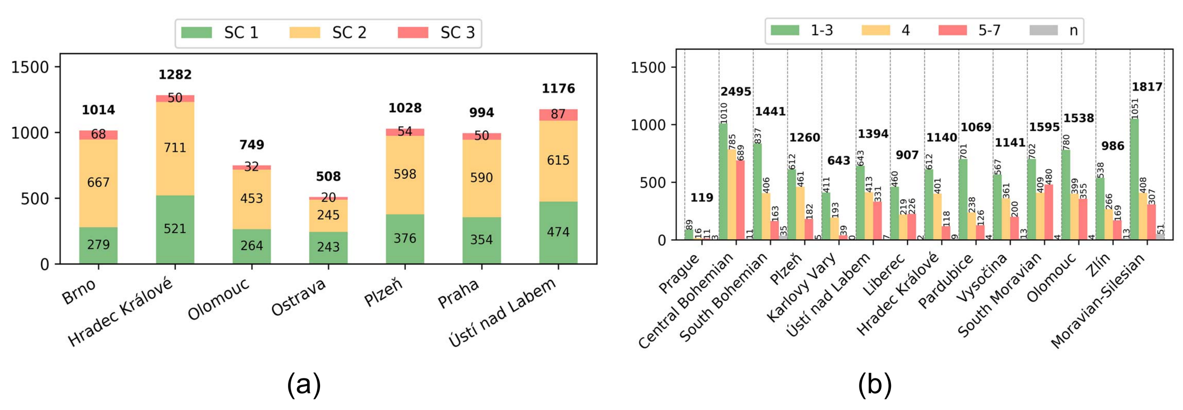

Figure 4: (a) Number of bridges with respect to the SC according to Regional Directorates (SŽDC), (b) Total number of bridges on motorways and roads considering SC and region (ŘSD ČR)

Three classes are defined for the condition of railway bridges (Figure 4(a)). Classification status of the state of the road bridges involves seven classes that are assigned according to Czech standard ČSN 73 6221 [5] (Figure 4(b)) ('n' states for undefined).

(b) Material and age of bridge superstructure

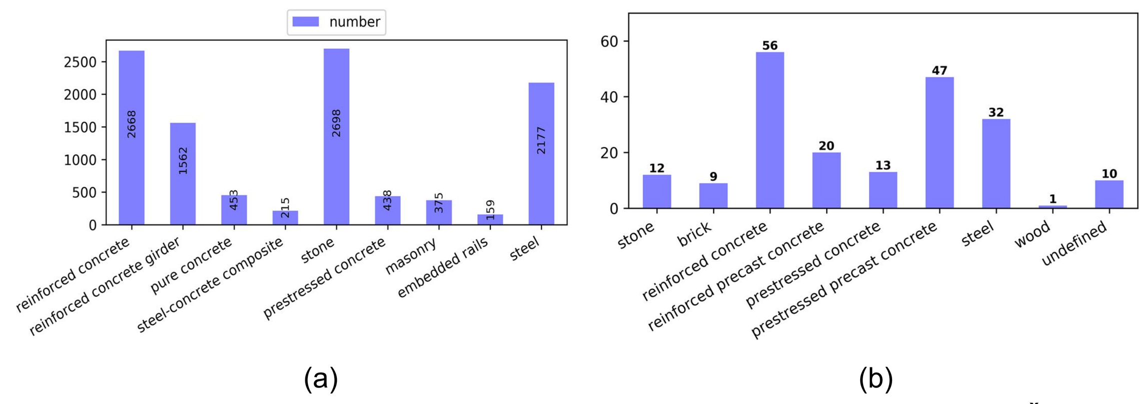

Figure 5: Number of superstructures considering material (a) railway bridges (SŽDC), (b) on local roads in SC 5–7

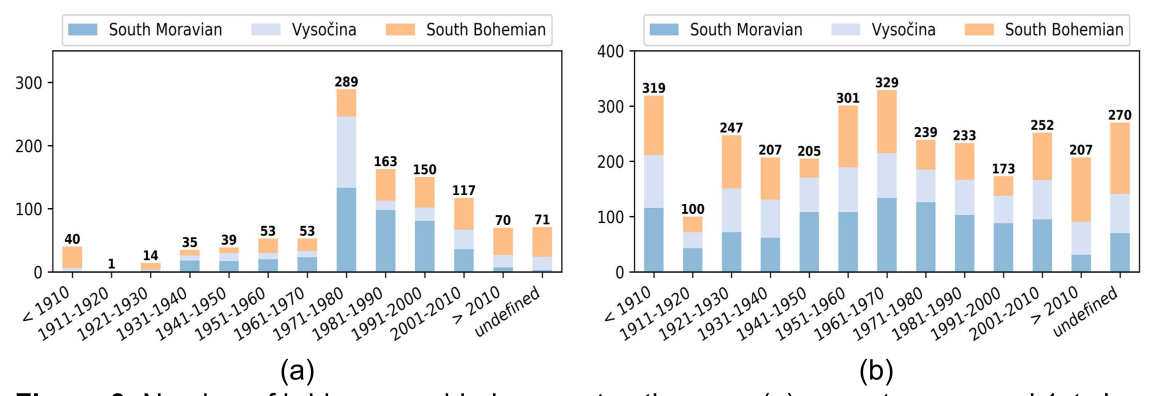

Figure 6: Number of bridges considering construction year (a) on motorways and 1st class roads, (b) on 2nd and 3rd class roads (ŘSD ČR)

Railway bridges with steel superstructure are the most problematic because of their high number and high average age (Figure 5). In case of road bridges, classes 5, 6 and 7 are the most critical, as for these bridges, the load should be significantly reduced to decrease the high risk of serious failure or accident. Within the program region a total of 461 road bridges were built until 1920 on motorways and 1st, 2nd and 3rd class roads (Figure 6). These bridges have already reached or exceeded their planned design lifetime and maintenance or rehabilitation is already uneconomic.

(c) Structural type and length

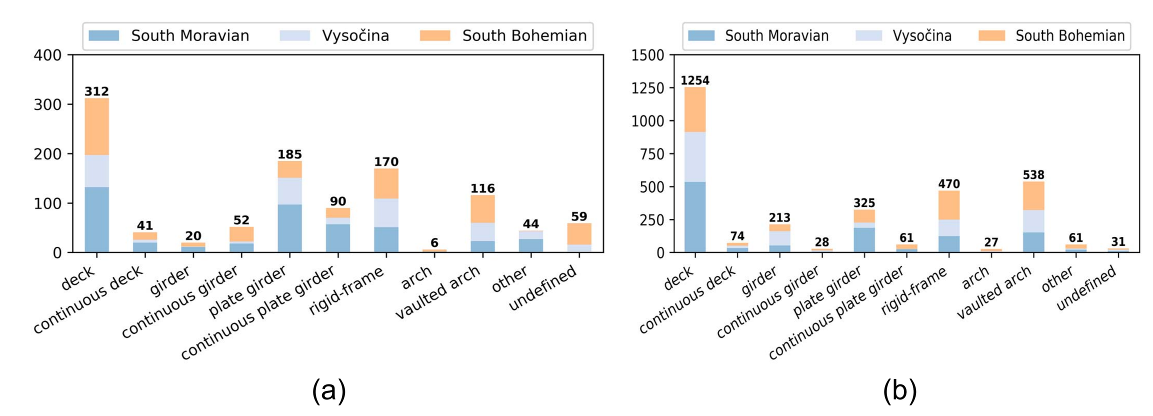

Figure 7: Number of bridges considering the structural type (a) on motorways and 1st class roads, (b) on 2nd and 3rd class roads (ŘSD ČR)

The most common types of road bridges' superstructure within the program region are a deck, a vaulted arch and a rigid-frame (Figure 7).

FUTURE WORK. As this is an ongoing project (Start: 01/09/2018, End: 31/08/2021), 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".

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