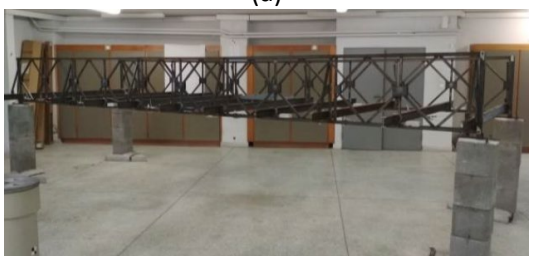
Realization of a laboratory scaled steel truss bridge (refer to Prof. A. Collina and Ing. L. Bernardini)

Structural Health Monitoring (SHM) is a well-known approach for ensuring civil infrastructure safety and integrity. It basically consists in tracing structural condition in the long period by means of measurements of meaningful variables (such as displacement, acceleration, strain etc.).
SHM is intended to support visual inspections, potentially making bridge and viaducts maintenance more cost-efficient. When developing damage detection algorithms, the impossibility to apply damages to the real bridge structure (e.g., (a)) under analysis may significantly hinder their effectiveness in real life scenarios. To overcome this issue, laboratory scaled version of real existing bridges can be beneficial in testing SHM algorithms, without applying damage to structures actually in service. In fact, it is possible to perform testing on experimental data acquired from the scaled structure, on which damages of known location and extension can be applied.

(a)



(b)

In this context, the aim of the present thesis work is to design and create a laboratory scaled model (e.g., (b)) of a real existing steel truss railway bridge. Many railway bridges have a life of more than 50 years, in some case even beyond their estimated life. The scaled bridge should present the following main features:

1) It must be dynamically scaled, i.e., able to reproduce the dynamic behaviour of the real system corresponding to the dimension reduction scale. One possibility is to adopt the scaling that corresponds to have the same accelerations as the real-existing bridge.
2) It should present a modular structural conformation with the possibility to easily apply damages, e.g., removing connection at nodes, or substituting truss elements with damaged ones.

The work will be developed along the following main points:

- theoretical analysis of the impact of the dynamical reduction hypotheses
- set up of a finite element model of the proposed dynamically scaled model, considering the range of possible materials to be used (in terms of stiffness and masses) and additional masses to be added locally
- practical realisation of the reduced scale model of a truss bridge
- dynamical testing to assess the influence of damage on the global and local behaviour of the bridge structure

The realized scaled bridge will be used to test the influence of damages of different type. This can help in advancing the exploration of SHM perspectives, both direct and indirect, and in the understanding of degradation phenomena typical of this bridge structure.