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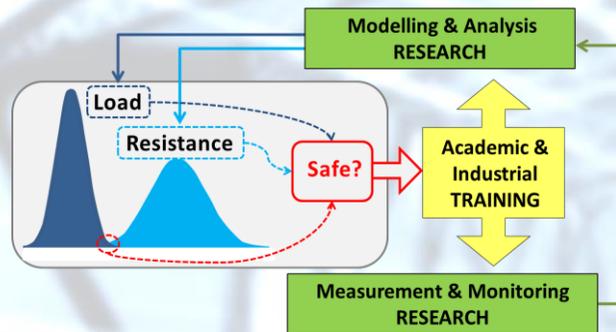


Training in Reducing Uncertainty  
in Structural Safety

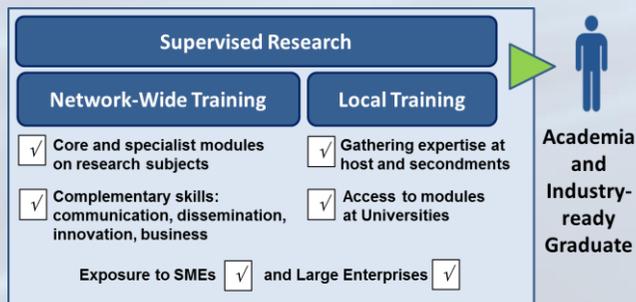
[www.trussitn.eu](http://www.trussitn.eu)

## ABOUT TRUSS

TRUSS (Training in Reducing Uncertainty in Structural Safety) is a Marie Skłodowska-Curie Innovative Training Network project funded by the European Union's Horizon 2020 Programme from January 2015. The network is composed of 4 Universities, 11 Industry participants and 1 research institute from 5 European countries. While developing tools that reduce uncertainty in structural safety and improve infrastructure management, TRUSS lays the basis for an advanced doctoral programme that will qualify 14 Early Stage Researchers (ESRs) for dealing with the challenges of an aging European infrastructure stock, thereby meeting a critical need whilst at the same time enhancing their career prospects.



During four years, original and impactful research supported by secondments are combined with local and network-wide training to give ESRs significant insights and exposure to research and innovation in both academia and industry. In addition to scientific and technological knowledge, complementary skills are key components of the training (i.e., entrepreneurship, communication and societal outreach).



The individual research projects extend over a wide range of infrastructure types with great potential for inter-sectoral application of results. They are grouped in two thematic clusters: building, energy and marine infrastructure (ESR1 to ESR6) and rail and road infrastructure (ESR7 to ESR14).

## ESR13: Using truck sensors for road pavement performance investigation

Host: University of Nottingham, United Kingdom

This project aims to assess the influence of road pavement condition on truck fleet fuel consumption. Using a "Big Data" approach, the correlation between truck fleet fuel consumption and road condition for a large number of vehicles is analysed across the strategic road network of England. Results can be used to include lifecycle carbon impacts of roads in improved maintenance planning strategies.



## ESR14: Reduction of uncertainty through regularized, automated road inspection

Host: University College Dublin, Ireland



A set of algorithms and Graphical User Interface that controls multiple Unmanned Aerial Vehicles are created to maximize efficient data capture enabling faster, cheaper, and more flexible visual options for road and bridge infrastructure inspection. Synchronization allows time-specific positioning and temporal-based change detection is employed as a means for automated defect identification of major infrastructure.

## CONTACT DETAILS

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**ESR10: Assessment of bridge condition and safety based on measured vibration level**  
Host: Universitat Politècnica de Catalunya, Spain

Bridge condition is commonly related to modal properties; however, these are heavily influenced by external conditions. The relationships between bridge condition and non-modal properties, attained from measured vibrations are examined. The accuracy and robustness of these vibration-based properties are assessed and compared to traditional modal-based methods under varying conditions.



**ESR11: Development of optical fibre distributed sensing for SHM of bridges and large scale structures.** Host: Universitat Politècnica de Catalunya, Spain



This project deals with the spatial resolution and strain measurement accuracy of distributed fiber optic sensors when applied to concrete elements and its potential for crack characterization and displacement calculation. Different adhesives and attachment techniques are investigated as well as their long-term reliability. Criteria for the deployment of a monitoring system based on these sensors are provided.

**ESR12: Bridge damage detection using an instrumented vehicle**  
Host: University College Dublin, Ireland

The Traffic Speed Deflectometer (TSD) vehicle from Greenwood Engineering is used as basis for developing a novel Structural Health Monitoring (SHM) system for bridges. The TSD uses lasers to very accurately measure the distance from the vehicle to the road. TSD data resulting from crossing a bridge are analysed to determine any change in the bridge's dynamic behaviour that might indicate damage.

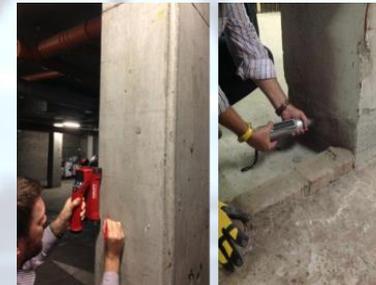


**ESR1: Reliability of concrete structures reinforced with braided FRP**  
Host: University College Dublin, Ireland

The design and structural reliability of BFRP as reinforcement for concrete structures is investigated. The BFRP is manufactured by braiding making it more flexible. Laboratory tests combined with statistical analysis are used to determine their properties and characterize the interactions at the concrete-rebar interface. The impact of deterioration mechanisms on long term performance is also explored.



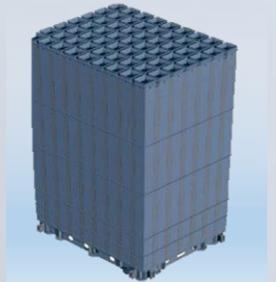
**ESR2: Reduction of uncertainty in assessing concrete strength of existing structures**  
Host: Ove Arup & Partners Ireland



A programme of non-destructive tests is designed to reduce uncertainty in assessing concrete strength. Tests are rebound hammer, cut and pull out, ultrasonic pulse velocity, and bond strength. These are carried out in the concrete laboratory at University College Dublin. Results are analysed to assess key influencing factors. These methods are then applied in the field to improve assessment of existing concrete structures.

**ESR3: Reduction of uncertainty in design of free standing nuclear spent fuel rack**  
Host: Equipos Nucleares SA, Spain

Racks are around 60 tons and 5 m high steel structures used to store Nuclear Spent Fuel. Numerous racks rest free-standing in the depths of the Spent Fuel Pool. The analysis of their response to seismic conditions is a fluid-structure interaction problem with a highly nonlinear transient dynamic response. Numerical results show some dispersion due to uncertainties related to the parameters involved and to the problem solving methodology. The latter are addressed via theoretical simulations and experimental tests.



#### **ESR4: Probabilistic optimisation of the design of offshore wind turbine towers**

**Host: Trinity College Dublin, Ireland**

This work proposes methodologies to assess the uncertainty associated with extreme events in Offshore Wind Turbines (OWT). Extreme events, usually of rare occurrence, are difficult to characterize with precision. Therefore, as a mechanism to unlock further competitiveness in the sector, this research aims at contributing to a better comprehension of their associated risks during an OWT life time.



#### **ESR5: Integrity management of ship structures**

**Host: Lloyd's Register EMEA, United Kingdom**



This project incorporates advances in the prediction of structural issues threatening the safe operation of ships into the management methodology. Inherent uncertainties associated to harsh operational conditions, corrosion and fatigue are addressed via probabilistic modelling techniques. Maintenance strategies are optimized to ensure target reliability levels while minimizing human intervention costs.

#### **ESR6: Residual life assessment and management of ship unloaders**

**Host: Lloyd's Register EMEA, United Kingdom**

Ship unloaders are subject to rapid rates of deterioration due to environmental factors and mechanisms such as corrosion, physical and chemical attack, bio-deterioration, as well as general wear, abrasion, fatigue and accidental damage. This project aims to improve the monitoring of the residual life of critical elements and to enhance the sustainability of this vital link in the transport infrastructure chain.



#### **ESR7: Railway bridge safety and condition assessment**

**Host: Full Scale Dynamics Ltd, United Kingdom**

There is a need for cost efficient and practically applicable Structural Performance Monitoring methods that reduce the uncertainties involved in bridge assessment and that quantitatively evaluate the condition of aging bridge structures. Theoretical studies in conjunction with laboratory and field tests are conducted to develop reliable techniques for determining bridge structural safety.



#### **ESR8: Probabilistic modelling of bridge damage based on damage indicators**

**Host: Phimeca Engineering, France**



Bridge safety assessment is performed via bridge resistance and load models based on probabilistic theory and Bayesian updating using damage indicator(s). The ultimate goal is to develop an advanced probabilistic methodology that can be used for life-cycle assessment and maintenance planning of bridges and to identify the most appropriate damage indicators for application to this purpose.

#### **ESR9: Railway bridge condition monitoring and fault diagnostics**

**Host: University of Nottingham, United Kingdom**

In this research project, due to the increased importance of railways in the transportation field and their exposure to various external factors that may increase the safety risk and the whole life cost of asset, automated fault detection methods, such as Bayesian Networks, are developed in order to assess health state of the railway bridges and to overcome the limitations of the traditional visual inspections.

