

Re-Gen

risk assessment of ageing infrastructure

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ABOUT THE Re-Gen PROJECT

Re-Gen is a research project funded under the CEDR programme. CEDR is an association of road directors from across Europe. One of the objectives of this association is to fund research projects in Europe. This is the second issue of the Re-Gen Newsletter and provides an update on the recent work that has been completed as part of the project and describes some of the future planned activities.

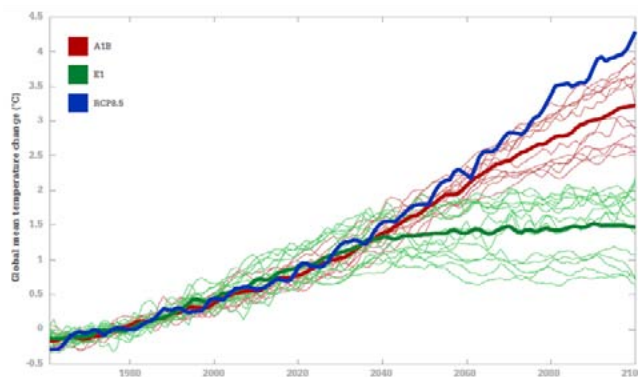
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Report of Climate Change Predictions

According to climate change predictions Europe will go through dramatic changes in the near future. More floods, drier summers and wetter winters are expected, along with the rise of sea levels and increase of winds. The operational issues imposed on road networks by the change in temperature, precipitation, sea level etc. are already recognised.

Deliverable 2.1 "Report of Climate Change Predictions" looks at these issues. Its goal is to summarise the current available data on climate change predictions and its reliability. More floods, drier summers and wetter winters are expected, along with the rise of sea levels and increase of winds. The operational issues imposed on road networks by the change in temperature, precipitation, sea level etc. are also discussed.



Projected change in global mean temperature (°C) for different scenarios, with respect to the 1961-1990 values taken from Summary of ClimateCost project results.



Example of retaining wall failure in Austria (photo taken from "oe24" newspaper website).

Guidelines on Collecting WIM Data and Forecasting of Traffic Load Effects on Bridges

One of the key parameters for the risk assessment of ageing bridge stock is traffic loading. In most European countries, the majority of the bridge stock was designed and built in times when traffic loading was considerably lower. When assessing these bridges, load models from bridge design or assessment codes can be used to assess the traffic loading but these can be overly conservative as they need to represent all cases. As a result, such load models may not be representative of the loading on the bridge in question. Weigh-in-motion (WIM) data can be used to develop a more appropriate load model. This involves installing sensors on the road which can weigh normal traffic as it passes along the road at highway speeds. This truck weight data can then be used to calculate the level of loading on the bridge.

Deliverable 3.1 "Guidelines on collecting WIM data and forecasting of traffic load effects on bridges" examines WIM data collection practices around Europe and presents best practice guidelines for collecting and using WIM data to accurately assess site specific loading on bridges. Case studies are also presented to show how WIM data is being used around Europe.



Examples of heavy vehicle images recorded at WIM sites



Layout of a Dutch WIM site



Case Study: WIM data was used to assess fatigue when designing of the Millau Viaduct in France.

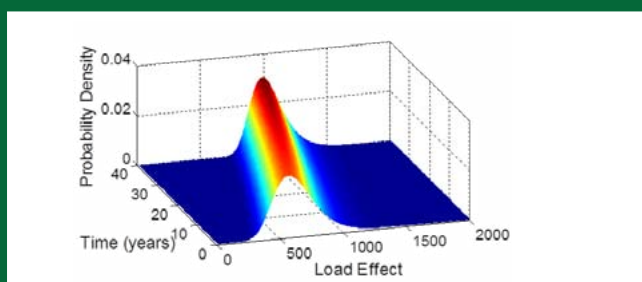
Review of The Most Critical Existing Structures Under Growing Traffic

Freight traffic within the European Union is constantly growing. Freight movements are increasing within member states but also between member states. It is predicted that freight traffic will grow at an annual rate of 1.8% until 2030. This may seem like a low rate of growth but over 30 years this compound growth would result in a total growth of 71%. As a result, traffic growth is an important consideration for road authorities when assessing bridges on their network as they must consider not only the current traffic conditions but how these conditions might change over the service life of the bridge, i.e. if an existing bridge passes assessment for current traffic conditions it may not necessarily pass later in its service life.

Re-Gen Deliverable 3.2, "Review of the most critical existing structures under growing traffic and advice for precise assessment", describes methods for simulating growth when assessing traffic loading on bridges. As the load distribution changes from year to year, a fixed statistical distribution cannot be used to model the loading. Therefore, a generalised extreme value distribution whose parameters vary with time is used.

Growth in both the volumes of trucks and the weights of trucks is modelled. It is shown that growth in truck weights has the most significant effect on bridge loading but that growth in flow is also an important consideration.

The work also identifies some bridge types which are particularly sensitive to traffic growth. These include arch bridges, steel orthotropic decks and prestressed beam and slab bridges. Techniques such as load tests can be used to assess the structural capacity of such bridge and if it is found not to be adequate, different options for strengthening the bridge are discussed. These approaches give road owners the tools to deal with traffic growth on their network.



A time-varying generalised extreme value distribution is used to model traffic growth.



A diagnostic load test.

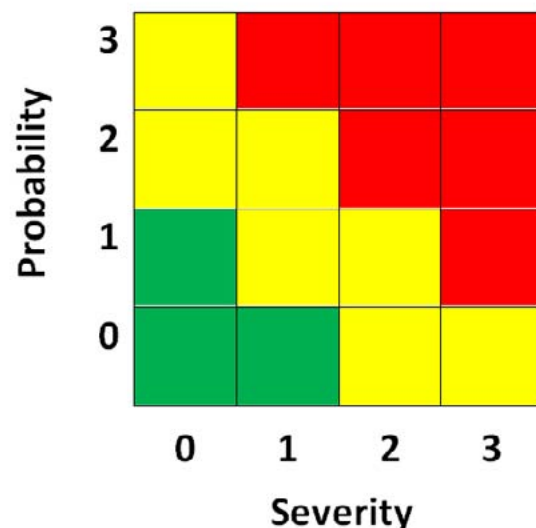
Report on the Literature Review on Risk Frameworks and Definition of Road Infrastructure Failure

The majority of infrastructure components for road transport systems were constructed during the 1960s and the 1970s in Europe. Many of the structures built during this period are now in need of repairs or can no longer adequately serve the road user. As infrastructure deterioration caused by heavy traffic and an aggressive environment becomes increasingly significant, this results in a higher frequency of repairs and higher costs to maintain the required service life performance of road infrastructure. Thus, the need for risk-based assessments to prioritise budgets/resources for maximized service life performance is increasingly urgent.

Deliverable 4.1 is titled "Report of the literature review on risk frameworks and definition of road infrastructure failure" and reviews relevant literature in order to address a number of key points for the Re-Gen project:

- What exactly constitutes failure of an infrastructure element? Failure can be structural but also functional failure (e.g. traffic jams).
- Qualitative and quantitative risk assessment models are examined to assess their appropriateness for Re-Gen.
- The most suitable risk assessment tool for Re-Gen is identified.

Risk Matrix



LATEST CONSORTIUM MEETINGS

- ZAG hosted a consortium meeting in Ljubljana on 12th of October 2015
- A productive consortium meeting was attended by all partners at Schipol airport on the 27th January 2015.
- IFSTTAR hosted a consortium meeting at their offices in Paris on 12th May 2015.

PLANNED EVENTS

TRA - APRIL 2016, WARSAW, POLAND

- ROD-IS will present a paper on their work on traffic growth at this conference next April.
- IFSTTAR and TU Delft will present a paper about their work on risk analysis for asset management considering climate change and traffic increase.

IABMAS - JUNE 2016, FOZ DO IGUAÇU, BRAZIL:

- ROD-IS plan to present a paper on the effect of traffic growth on bridge loading and IFSTTAR plan to present a paper on an asset management framework which considers this traffic growth as well as climate change.

IALCCE - OCTOBER 2016, DELFT NETHERLANDS:

- TU-Delft and IFSTTAR plan to present a joint paper on their use of nested sampling for prediction of infrastructure degradation under uncertainty.

DISSEMINATION

FIRM

- Eugene O'Brien, Director and Chairman of the Co-ordinator ROD-IS, presented the Re-Gen project at the FEHRL Infrastructure Research Meeting (FIRM) in Brussels in April 2015.



IABSE

- Re-Gen had a joint special session with the Xara CEDR project at the IABSE 2015 conference in Geneva in September 2015. The session was entitled "Infrastructure Asset Management". Donya Hajilzadeh presented a paper titled "Traffic Load Effect Forecasting for Bridges". This paper described the work that ROD-IS performed to model the effect of traffic growth on bridge loading of traffic growth. André Orcesi presented a paper on the work of IFSTTAR and TU Delft. The paper was titled "Multi-criteria optimization framework for road infrastructures under



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