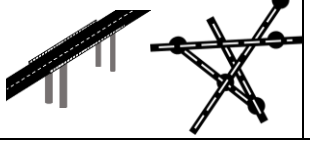
Stress-tests of Provincial Roads: Noord Holland

Context

Climate Region: NW Europe	**Location:** Netherlands	**Key Actors:** Infrastructure Owners, Consultants
Processes Covered: Risk assessment, Risk Evaluation, Resilience Assessment, Adaptation Solutions	**Scale:** Asset / network 	**Infrastructure Type:** Road, Rail, Ports, Utilities 

Outline

The motivation for conducting the stress-test and subsequent actions came internally from the Province's asset managers, who wanted to know how to conduct maintenance as efficiently as possible, keeping the effects of climate change in the back of their minds. Parallel to this question of the asset managers, the Dutch Delta Programma Ruimtelijke Adaptatie (Delta Program Spatial Adaptation) requires all Dutch governments (national, provincial and municipal) to periodically conduct a stress test. The project was conducted together with the Dutch National Road Authority (Rijkswaterstaat) and the Dutch railway authority (Prorail).

The goal was to understand the locations where potential bottlenecks will occur under various weather extremes and to discuss to the extent to which these bottlenecks will lead to such problems that measures need to be taken.

For the waterways, roads and engineering structures the impact of climate change has been mapped. Various themes within climate change were examined climate change being: flooding; drought and subsidence; heat, floods and storms. The results of this stress test were first discussed internally and then in two opportunity and risk dialogue sessions with external stakeholders (contractors, water boards and safety regions).

Analysis of climate hazards

The analyses considered the following hazards:

- Drought and subsidence,
- Heat stress,
- Pluvial flooding/ extreme precipitation
- Flooding,
- Storm.

Climate Hazards Considered:
Flooding Wind
Extreme Temperature
Drought Other

The project made use of existing data, that was collected on www.klimaateffectatlas.nl (subsidence, drought, heat). This website shows how climate is expected to change over time according to various climate change scenarios, as provided by the KNMI (Dutch Meteorological Office). It also shows what impacts can be expected on infrastructure. For flooding the analyses make use of information on Risicokaart.nl. The exposure to pluvial flooding is determined through (extensive) hydraulic and hydrological analyses. The probability of occurrence is not directly considered.

Resilience assessment

The resilience was assessed in Phase 1, by taking 3 main steps:

I. Inventory: kick-off and collect data and key figures

II. Bottleneck analysis: (qualitatively) visualizing climate effects, making climate maps

III. Quantification and qualification of bottlenecks: risk dialogue, opportunity dialogue, visualizing costs.

NRAs Process
- Planning
- Operation & maintenance
- Remediation & Rehabilitation

The project made use of existing information. During step I of the project, relevant data was gathered.

The Bottleneck analysis (step II) essentially is an exposure analysis, where for various hazards (drought and subsidence, heat stress, pluvial flooding/ heavy precipitation, flooding and storms (wind)) maps were made showing where these hazards could affect the province's infrastructure.

Subsequently, the resulting impacts were estimated. The estimated impacts were then discussed with relevant stakeholders, to further improve their reliability in step III.

In the second phase, the results will be further analysed to be used in a pilot at the regional level. Through this pilot, a proposal will be made to implement/secure climate adaptation in the provincial organisation.

How is increased resilience achieved?
- Prevent
- Prepare
- Respond

The goal of phase 2 was to come up with an implementation agenda and an implementation recommendation for the province. In phase 2 two workshops were held. These workshops used the results at the provincial level.

How are adaptation solutions considered?

A risk matrix (risico/kansen) was developed, comparing the potential impacts (various parameters: costs, availability, environmental impact, etc) against the determination of level of acceptable risk.

Following Phase 1 (stress-testing and risk dialogues), Phase 2 consisted of a deep dive into a specific region, as implementation of solutions was expected to require more regional input and a better understanding of the local situation. This was done via 2 workshops with local stakeholders.

The first workshop was used to prioritise locations based on bottlenecks and possible solutions. In the subsequent workshop, possible solutions were identified, including required cost, knowledge, capacity and cooperation with other stakeholders and a ballpark implementation planning was made. The results of this process were implementation tables showing an overview of the above-mentioned information.

Solution types considered:
- Hard measures
- Soft measures
- Nature Based Solutions

Solution types considered:
- Multi-criteria analysis
- Cost-effective analysis

In some cases, research and/ or monitoring were suggested to see if/ what kind of solution was required. For example, for a specific location where subsidence occurs, it was suggested to first find out the reason for the subsidence before implementing measures. Requirements for implementing measures often considered budget, more knowledge and cooperation between the relevant stakeholders.

How is the adaptation strategy implemented in practice?

Following the completion of both Phase 1 (Stress testing + dialogues) and Phase 2 (regional deep dive), the process has come to a halt, despite the Phase 2 report providing recommendations for moving forward. The recommendations focus on:

- people: front runners are needed to lead the way and set an example and inspire others to also take up climate change adaptation
- rules, laws and budgets: governance and budgets are needed to formally anchor climate change adaptation
- not everything can be organized formally, therefore climate change adaptation must also be made part of regular day-to-day processes.

Despite the above, actual implementation is currently lacking and renewed attention must be given to building resilience for climate change.

Lessons learned?

Undertaking a stress-test in and of itself is not complicated. The subsequent process of weighing alternatives and coming to an implementation plan requires time and attention. However, the main challenge is to justify additional costs and to underline the urgency for the implementation.