

Capability Assessment Tool for Tunnel Masonry Linings

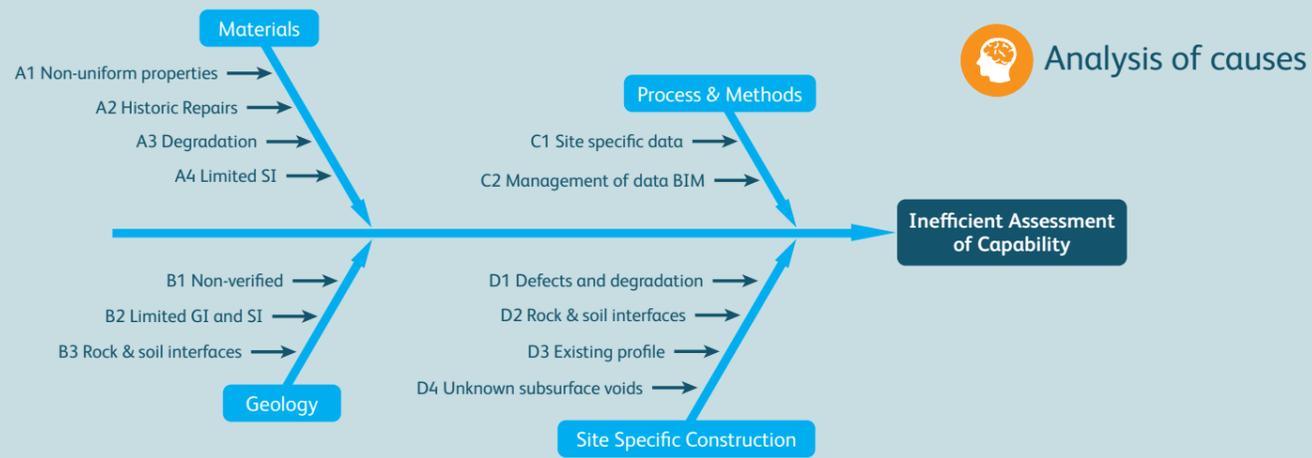
What is the situation?

We are responsible for 630 tunnels, stretching over 335 Km throughout the network. Currently, there is no prescribed method for assessing tunnel lining capacity. Interactions with geology, historic repairs and structurally significant defects are currently undetermined.

Track access availability is decreasing, meaning possessions to complete tunnel examination and maintenance is at a premium.

Furthermore, the quality of data collected during examinations and the presence of specific elements within each tunnel, make a universal assessment more complicated than just a data manipulation algorithm.

Achieving a detailed understanding of a tunnel lining capacity is necessary to better manage Network Rail's tunnel portfolio while meeting requirements of the 2030 railway and Digital Rail.



Priority problems

Specific priority problems

- Understanding the structural capacity of tunnel lining.
- Quantitative assessment of condition data.
- No prescribed method of tunnel lining capacity assessment.
- Interactions with geology, historic repairs and structurally significant defects are currently undetermined.
- There is a need to detail required on-site data collection to enable the appropriate level of capacity assessment.

Related goals

- A repeatable and reproducible methodology to accurately and objectively manipulate data to satisfactorily determine the capacity of a tunnel lining.
- An appraisal to determine whether action is required to ensure that the level of safety and serviceability of the tunnel remains acceptable.
- Inform and detail adequate intervention works that satisfactorily strengthen the lining capacity.
- Tunnel Information Modelling (BIM for Tunnels) : Shared and collaborative knowledge resource for information.

Benefits

- Facilitate informed asset management decision making.
- Less cost impact.
- Improved risk evaluation of serviceability and structural stability of operational tunnels.
- Less disruption for the TOCs.

Scope

We need to establish qualitative and quantitative assessment methods for masonry lined tunnel major elements.

To support this challenge and manage the risks associated with tunnel assets, it will be necessary to develop techniques to undertake tunnel 'assessments' and develop the tools to adequately analyse and assess lining capacity.

The chosen analysis methods must be partnered with 'big data' management system such as Building Information Modelling (BIM). This will enable the interpretation and analysis of the information which is generated to positively inform decisions in the ongoing management and optimise of tunnel assets.

This may go further and include organic architecture with computer systems utilised to interrogate the data.

Specific research needs

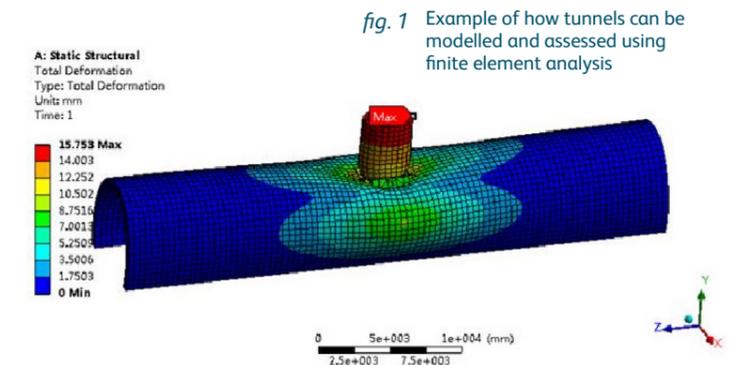
A quantitative assessment of the strength of tunnel linings and its adequacy to support neighbouring land is required.

Assess individual tunnel major elements for durability and capability. With full consideration given to permanent and transitory actions, principal dimensions, condition data, material properties and geotechnical parameters.

Furthermore, the tunnel assessment should inform the management of the structure by quantifying tolerable changes in the condition, in terms of the strength of the lining element; specifying sufficient strengthening works and determine the adequacy of the major element and structure as a whole.

Related data

Each tunnel asset is sub-divided into components such as bores and portals. Tunnel bores are broken down into lengths termed tunnel sections. Also termed major elements within the Tunnel Condition Marking Index (TCMI) scoring system. These are split horizontally to form smaller discrete areas known as minor elements for condition reporting at a higher resolution (Fig1).



Expected impact & benefits

Understanding the capacity of constitute minor elements is required to help determine integrity of the tunnel and whether a deterioration in condition is tolerable, or whether specific interventions are required to maintain the tunnels ongoing fitness for purpose.