

Aging tunnel networks, and how to deal with them

Sharing lessons learned from the Netherlands and Working group 6 of the ITA.

7 February 2023

Introduction

- Ir. Sallo van der Woude
 - President of the Royal Dutch Engineering Society for Tunnels and Underground works,
 - Working with Arcadis,
 - Project manager tunnels at the Blankenburg connection.
 - And consultant in old (rail)road tunnels
- I started my career in bored tunnelling projects.
- In 2015 I became project manager of a renovation project of an immersed tunnel built in the '60.
- My conclusion:

Renovation projects are interesting and often more challenging than green field tunnelling projects.









Content

- Introduction
- Aging tunnel Network, and how they are delt with in the Netherlands
- More European countries deal with the same problems, and found/find different solutions.
- Lessens learned in WG-6 and challenges to come.

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72 tunnels, 4 tunnels under construction, 0? planned



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72 tunnels, 18 refurbishments within a decade



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Followed strategy in the Netherlands

- Regular maintenance does not prevent that at a certain moment a tunnel is outdated or below a certain safety threshold!
- Since a decade we (tunnel owners, tunnelling society and the business) are focusing on our aging tunnels,
- Our Strategy;
 - Tunnel specific approach, in priority order.
 - Risk sharing conditions to deal with surprises,
 - Involve creativity of contractors in the tender stage to optimize working methods and minimum the down time.

Case history Velser tunnel

- Renovation of Cut and Cover Tunnel 1957
- Type: DBM contract
- Contract volume <u>+</u> 95 mln. €
 - Award 2014 opening 2017, 7 yr. maintenance
 - Altered ventilation concept & safety concept
 - All E&M system new
 - Major civil refurbishment: Increase the profile of free space with 12 cm, evacuation doors & rooms, water buffers increased, new portals, etc.
- Network philosophy: refurbishment in 9 months
 - High penalties on delay.

"Build it virtual prior to construction"





Case history Velser tunnel

- No proper as-built data. 1.5 yrs. of preparation and short construction time.
- The total scope was built virtual before it was realised to make sure the schedule was kept.

"Plan a military operation by using 3D BIM"







As-is survey by static laser scanning:

- accuracy \rightarrow 5 millimeters
- fast \rightarrow 2 night closures
- complete \rightarrow all details included
- flexible \rightarrow single survey, multi measure

Modelling in Civil3D & Revit:

- object-oriented model
- direct from point-cloud
- model on a need-to-know basis
- point-cloud always in background

NUMBER OF STREET, STREE

o3(-3)-Z(-970) : bk werk der (24) X: 105311,574 m X: 496927,442 m Z: 8,175 m

anna a

Case history Velser tunnel

Virtual construction results in; predictable construction, limits down time and failure costs







Case history Maas tunnel

- Renovation of an Immersed tunnel 1942
 - The tunnel is national heritage
- E&C type of contract, with elements of risk sharing,
- Contract volume <u>+</u> 265 mln. €
 - Awarded 2016, road tunnel finalised 2019
 - Altered ventilation concept.
 - New safety concept, altered operational concept
 - all E&M systems new.
 - Civil: concrete repair, new concrete floors, asbestos sanitation, etc. etc.
- Network philosophy>>>refurbishment in 2 x 12 moths
 - Closure of both tubes would mean blocking of the city
 - Unidirectional flow to the North (Hospital on Northern riverside

'Better do it together'





Case refurbishment Maas tunnel

- A national heritage monument
- The looks and feel had to be maintained





Case refurbishment Maas tunnel

- Interference of safe operation during construction
- Keeping budget & planning while maintaining the looks and feel of this National heritage tunnel
- Old tunnel are full of surprises, manage them in cooperation, flexibility in the contract.



Aging Networks

5 more tunnel refurbishment projects completed **We are on our way!**

How is Poland doing?

How are other countries doing?

I can tell a little about that from my role as vice animateur of WG-06 tunnel maintenance and repair Sport Uitzendingen

FLEIERS

'200 snelwegtunnels in Italië niet veilig'

Door achterstallig onderhoud zijn ongeveer 200 tunnels in de Italiaanse snelwegen niet veilig, melden Italiaanse media. Het zou gaan om 105 tunnels van de particuliere wegbeheerder Autostrade per l'Italia en 90 tunnels van andere beheerders.

Op 30 december kwam in een tunnel in de A26, niet ver van Genua, een deel van het plafond naar beneden. Wonder boven wonder gebeurden er geen ongelukken.



Autostrade, 200 gallerie a rischio sicurezza: Sono 105 sulla rete di Austostrade per l'Italia e 90 gestite da altri. È un primo censimento della Guardia di Finanza dopo il crollo nella galleria Bertè sulla A26 a dicembre https://t.co/LGPVMB0zxU

12 dagen geleden

Many European countries have aging tunnel networks ARCADIS

Many European countries experience similar problems.

In 2019 the EuTF was formed, with specific focus on:

- BIM & digital construction>>>SC formed
- Preventive maintenance and tunnel refurbishment>>>SC formed

This group of people is a sub-group of WG-6 since 2022

We started with sharing the major challenges and developments within the 9 countries



Austria • Belgium • France Germany • Italy • Portugal Netherlands • Spain • Switzerland



Sharing insights

- Some countries are in control, (they are doing it since a long time)
- Some countries are worried about the work to come.
- Some countries have acute problems (=tunnel closure)

The ambition should be....

Stay away from incident management and unpredicted tunnel closure

Tunnels must stay predictable

| Inspection code " | | DIN 1076" | every 2 yr | | | |
|-------------------|-----------|--------------------------|------------------|-----------|------------|------------------|
| Condition grade | Area/zone | Condition assessment | load capacity | usability | durability | damage |
| 1 | 1.0-1.4 | very good condition | + | + | + | none to small |
| | 1.5-1.9 | good condition | | | | none to small |
| 2 | 2.0-2.4 | satisfactory condition | + | + | 0 | none to small |
| | 2.5-2.9 | sufficient condition | | | | none to small |
| 3-4 | 3.0-3.4 | not sufficient condition | + | 0 | 0 | medium - serious |
| | 3.5-4.0 | inadequate condition | - | - | - | very serious |



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Sharing insight

- Different tunnels, different construction methods, different approach,
- But common ground on the goals of the WG and the priorities

Goal 1 : diagnosis failure mode identification and classification

- Goal 2 : Minimal inspection criteria and reporting
- Goal 3 : Life span predictions and increasing life span methods
- Goal 4 : Repair methods and implementation
- Goal 5 : Predictive maintenance programs and follow-up
- **Goal 6? : Inventory of tunnel refurbishment projects**



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Prio 1

Priority 1: minimal inspection criteria

Minimal inspection criteria and reporting

9 countries have shared how this is delt with in their country.

- Many countries have guidelines for the regular inspection of their aging tunnels, coupled to a classification method to assess the status of the tunnel.
- Some countries have tunnel specific maintenance in place, based on general asset management. This may not be efficient but is sufficient.
- Some countries are not in control, but are learning quickly.
- We all need development of automated inspection techniques to be able to do the work that needs to be done.
- We will share our common insight in Athens 2023.
- >>>> If Poland see's the need to joins usYou are Welcome!
- (please contact me or Ed Taylor if you want to place a representative) .

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Prio 1

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