Managing the integrity of the nation's lighting infrastructure, through an understanding of materials

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Background

- 7.5 M lighting columns in public ownership across the UK
- Not just highways
  - Rail sector
  - Retail
  - Industrial
  - Airports
  - Utilities
- Considered useful supports
- But are they ......
Current considered position

2017 NDT test houses report an average of 3.5% are red / critical columns.

They report a growing number of amber assessed columns (2010 11% / 2016 37%).

10% of amber columns have turned red over 3 years.

Understanding your asset has never been so important.
A few examples
So what is being done / is required?

- Good asset management & risk assessment approaches
- Highways Act
- New Highways Code of Practice
- ILP Asset management tool kit
  - Minor structures
  - Revised guidance
- Understanding the asset condition
Legal - Highways

- Infrastructure Act 2015
  - All reasonable steps should be taken to ensure the continued availability & resilience of the network

- Highways Act 1980
  - Section 41 (Duty to maintain)
    - Maintain public highways to a reasonable standard
  - Section 54 (Special defence in actions for damage for non-repair)
    - Provides a defence “the authority has taken such care as in all the circumstances was reasonably required to which the action relates was not dangerous for traffic”
Well managed highway infrastructure (CoP)

- To deliver a safe and well maintained highway network
- Good evidence and sound engineering judgement
- Applying the principle of risk-based management
- Implemented in accordance with local needs, priorities and affordability
- Code does not outline any minimum or default standards
Risk asset management based

- Understanding the asset
- If you don’t know what you have you can’t manage it
- What is needed
  - Evidence of process
  - Skills and competencies
  - Tailored service to suit local needs / requirements
- Opportunities
  - Tailored to local requirements
  - Strengthen asset management
  - Enables efficiencies
The approach

- Risk & asset management based
  - Reactive
  - Time based
  - Condition based
  - Risk based
- New Code
  - 36 recommendations
- Asset information
Managing a vital asset
Luminaire supports
Project brief

- Step-by-step guidance
- Life cycle assessment techniques
  - Inspection, assessment & testing
  - Interventions & timescales
  - Risk management strategy, including potential additional loads
  - Measurement matrix
  - Development of a robust condition index
  - Prioritisation and investment planning
The new document

- Background
  - Support as a structure
  - CDM / competency
- Columns
  - Inspection & testing
  - Degradation modelling
  - Risk management
- Wall mounted / catenary
- Appendices
  - Inspection & testing methods
  - Column design & construction
So the problem / opportunity?

- A range of designs
- Age anything up to 200+ years of age
- Lacking information
- Different materials brought together within different environments
- Realisation that we need to understand the interactions
- Mitigate these
- Understand residual life
Understanding the materials

- Column materials
  - Cast iron and bronze
  - Wooden / Engineered wood
  - Concrete
  - Mild steel (S275, S355, S235 ....)
  - Stainless steel
  - Aluminium
  - Composite

- Embellishments
- Load (aluminium, composite)
- Electrical connections
Protective coatings

- Exposed and buried parts
  - Shot blast and zinc spray
  - Bitumen
  - Painted
  - Galvanised
  - Galvanised and painted
The environment

- Weather
- Maintenance operations
  - Salting
  - Verge maintenance
- Coastal
- Soil conditions
- Wind
- Dog’s
So going forward

- Understanding the assets condition throughout its life cycle / serviceable life
- Provide the mid to long term strategy for maintaining the asset at the required level of service yet minimising whole life costs
- Justify expenditure based upon ‘need’ for both revenue and capital budgets
Inventory

- If you don’t know what you have and can’t measure it you can’t manage it
- Good inventory with the right data
- Inform analysis on the current condition and performance
  - Cause of deterioration
  - Rate of deterioration
  - Interventions
  - Maintenance efficiencies
  - Structural capacity
- Compile, verify and maintain the data at every opportunity
Lessons learnt

- Draws on past failures, testing & inspection
- Lessons learnt
Inspection & testing methods

- Inspection & testing
  - Expensive & time consuming
  - Targeted for cost effective inspection
  - Priority assessment
- Every opportunity to gain & record data
Data analysis

- Current approach – short term
- Looking at a mid to long term strategy
- Driven by a support behavioural model
- Support the repair & replacement strategy
Risk context

- Risk will differ between asset owners
  - Probability of failure x consequence of failure
  - Risk is within acceptable range
  - Residual risk to unacceptable risk understood
- Lighting a valuable highly visible asset
- Essential to the social & economic well-being
- Failure to maintain can result in serious injury or death, damage and civil claims
- Local characteristics
- Local priorities, finance & affordability influence risk appetite / tolerance
Risk profile

- **Unacceptable Region**: Risk cannot be tolerated (except in extraordinary circumstances).
- **Tolerable Region (ALARP)**: Risk tolerable only if reduction is impractical or cost is grossly disproportionate to the improvement gained.
- **Broadly Acceptable Region**: Risk tolerable if cost reduction would exceed the improvement gained.
- **Low Risk**: No additional measures are necessary except maintaining inspections & testing.

Graphs showing risk over age with predicted and updated scenarios.
Degradation Modelling
Degradation modelling

- Column Condition Index (CCI)
- Highway structures industry based approach
  - Structural loading
  - Materials
  - Geometry
  - Protective coating
  - Environmental factors
Approach for deterioration

Protection System life expectancy

Average Protection Life

Average Corrosion rate

PDF

PDF

Protection System life expectancy

Average Corrosion rate of Parent material

\[ p_j = P(R - S \leq 0) = \int_{-\infty}^{\infty} F_S(x)f_R(x)dx \]  

Eq. 1

Load Effect, \( S \)

Resistance, \( R \)
Approach for deteriorating column

Column life cycle analysis results*

* Based on WCC light column life cycle analysis (1990-2013)
Intervention strategy effects

- Do minimum
  - Maintenance only to keep assets at the Operational Threshold

- Corrective maintenance
  - Maintenance reinstating deteriorated elements

- Time base preventative maintenance
  - Planned column replacement

- Condition based preventative maintenance
  - Maintenance when the condition falls to a defined threshold
Intervention strategy effects
Summary

- Supports the identification, assessment & management of risks to safety. Risks have to be controlled so that residual risk exposure for any asset owner is tolerable
- Understanding the materials and their interactions
- Provides a robust auditable assurance
Thank you