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JBP Trenchless Training Course:

## **Sewer Pipeline Condition Assessment & Coding**

(in accordance with EN Standard: EN 13508-2:2003+A1)

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### Course Summary:

1. Introduction - History and Importance
2. General Purpose, Methods and use of codes, & Different systems
3. Coding Principles, Documentation & Reporting
4. Drains & Sewers
5. Manholes and Inspection Chambers
6. Coding practice
7. Course assessment
8. Questions, answers and feedback



### 1. Introduction - History and importance





## Sewers – Essential Infrastructure

- Historically settlements developed wherever migrant populations had safe access to fresh water and could dispose of human waste, usually into rivers or the sea
- As these communities grew they increasingly relied on transportation of foodstuffs, raw materials, fuel and finished goods. They built pipes, aqueducts and drainage conduits to sustain public health and well being
- These were the cornerstones of the ancient world and they remain vital to modern society



## Lessons from History

- Looking back over 6000 years of sewer history we find evidence that sustainable communities built and maintained remarkably sophisticated water and wastewater networks.
- Efficient gravity sewer systems are critical to human survival and may be seen as a hallmark of civilisation where they serve the needs of the wider population



## Introduction - History and importance



## Examples of Sewer Construction

- 4000-2500BCE – Jointed clay drains found at Ur and Babylon, domestic and rain water systems
- 3200BCE – two channel, stone, fresh and wastewater systems at Orkney in Scotland
- 3200-1800BCE – Stone and terracotta sewers found at Minoa and Mycenae in Greece
- 2600-1900BCE – brick sewers, cess pits and drains at Lothal and Harappa in the Indus Valley
- Since 2000BCE – many stone or brick conduits and clay pipes were built in China in the Shan, Han, Tang and Song dynasties, examples of many old structures are incorporated into modern drainage systems

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## Introduction - History and importance



## The Greco-Roman Empire

Aqueducts, wooden “trunk” mains, lead pipes, stone and concrete sewers serving forts and settlements throughout the Greek and Roman empires since 500BC



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## The Pioneer of Pipe Rehabilitation

Marcus Agrippa, Roman General and Civil Engineer designed and built the Pantheon, extended the aqueducts, restored the Cloaca Maxima which served Rome then and still does now!



## The Islamic World

- The Roman traditions survived in the Middle East. Many Byzantine cities maintained and improved on their good practices.
- Advanced sewer networks and water supply systems were built in Spain's Al Andalus region under Islamic rule. Many examples can be found in Cordoba, Fez and Fustat, dating from the 8<sup>th</sup> to 13<sup>th</sup> Centuries
- Islamic scholars published many documents on the control of water borne disease some of which can be found in historic library collections
- For example, Ibn Sina (1025AD) wrote a Canon of Medicine in 5 volumes which includes guidance on personal hygiene and public health

## Medieval Europe

- Only Castles, Palaces and Monastic houses were equipped with sewers. For most, open drains conducted their waste waters to the rivers,
- In the 14<sup>th</sup>C , closed sewers in Paris were built by Aubird and Laborde. In 18<sup>th</sup>C London the Walbrook, the Fleet and other sewers were paved over. In most places, even in the 19<sup>th</sup>C night soil collectors dealt with solid wastes



## Sewerage collection and treatment

- Early sewage plants are recorded in Silesia 1531, Edinburgh 1650, Paris 1868, Berlin 1876, Frankfurt 1887 and Melbourne 1897
- Europe moved into the Industrial Revolution in the 19<sup>th</sup> century with substantial growth in the number and size of cities which put huge pressure on sewer networks.
- Waterborne diseases were rampant until Cholera and Typhoid pandemics threatened civil society



## Sewers building in Europe and elsewhere

- From 1847 James Newlands built 480km of sewers in Liverpool raising life expectancy from 19 to 40.
- From 1859 to 1865 Joseph Bazalgette built 720km of interceptor sewers and 21000km of local sewers in London
- From 1860s sewers were built in Hamburg, Frankfurt, Berlin, Munich, Cologne in Germany, Chicago and Brooklyn in the USA
- 1858-75 William Clark built a network of brick egg shaped interceptor sewers in Kolkata, 27km of which were renovated 2007-13



## A change in direction

- Throughout the 20<sup>th</sup> C sewer networks grew steadily in Europe, US and Asia. Between 1960 and 1996 Japan installed more than 350000km of sewers.
- In the UK the 1973 Water Act consolidated more than 2000 local bodies involved in water supply and sewerage collection to form 10 Regional Water Authorities to harmonise practice and bring about efficiency gains, Over the next 15 years the RWA's adopted national policies but staffing levels fell from 80,000 to 50,000





## Sewer Dereliction – its official!

- In 1977 the National Water Council's Standing Technical Committee produces a National Assessment which identified a crisis underground. They highlighted the need to shift from a policy of network expansion to network renewal and identified problems including a lack of basic asset information, a lack of planned inspection, and a shortage of investment and qualified staff. Clearly time for the introduction of new strategies such as systematic asset inspection and the development of non disruptive replacement and renovation technologies.
- A step change in priorities and a challenge to the industry which would have worldwide implications given the leadership role of UK based engineering consultants



## Focus on the problems

- The 1981 ICE International Conference on Restoration of the Sewerage System reported aged and collapsing sewers and a shortfalls in sewer renewal and maintenance across the world. The UK was not alone....
- The BHRA 1984 Conference on Construction and Maintenance of the sewer system highlighted more international experience. It became obvious that we all share similar problems
- The IPHE 1985 Conference Trenchless Construction for Utilities reported significant progress on inspection methods and experience and emerging renovation and replacement techniques which involved much less excavation and disruption – the beginnings of trenchless technology







## UK Water Privatisation

The Water Act 1989 converted the 10 RWAs and smaller water only companies to private water companies licensed to operate water supply and sewerage services regulated by three new Agencies

- OFWAT to finance their activities and meet their obligations
- Environment Agency to regulate flood risk, sustainable development and environmental issues and social benefit
- Drinking Water Inspectorate to regulate water quality.



## The role of WRc

- In 1974 Government and the NWC had merged three water related research agencies to form the Water Research Centre
- It worked closely with the RWAs, developing studies on many aspects of the industry and publishing much useful research and operational guidance. In 1989 it too was privatised, its focus broadened, seeking international opportunities and a wider scope of activity
- It developed WRc Approved, a product and process evaluation facility and offered a range of training products
- In 2020 it was acquired by RSK and its direction of travel is currently a little uncertain



## Progress to date

- The Water Companies report that they have invested more than £160Bn in maintaining and improving assets
- Critics note that they are mostly owned by private equity firms, some with controversial tax avoidance strategies. Public opinion polling carried out in 2017 indicates that the 83% of UK water consumers favour renationalisation
- Historically more than 95% of profits has been paid out to shareholders, many feel that more should have been reinvested in the networks
- There remains much to do to reduce leakage and pollution incidents and the underground assets are ageing.

## CCTV introduction and use in sewers

- 1942 Developed by Walter Bruch to monitor German V rockets in WWII
- 1949 Vericon developed commercial CCTV cameras in the USA
- 1970 Widespread use of VCRs and miniature cameras
- 1983 WRc publish MSCC and SRM
- 1990 launch of Wincan sewer software
- 1999 Launch of commercial DVRs
- 2011 Launch of Apple iCloud data storage





## Emerging CCTV Capabilities

- Inspection of buried pipes and chambers which cannot be easily or safely explored by man entry
- Systems became available for pipes with a wide range of diameters
- Surveying long lengths
- Improved image resolution and recording – Zoom, Pan & Tilt and iCloud
- Additional capabilities such as Light Ring, Laser and Sonar



## Development of a survey strategy

### Background

NWC recorded 5000 collapses and 200,000 blockages every year, estimated cost £500M/year

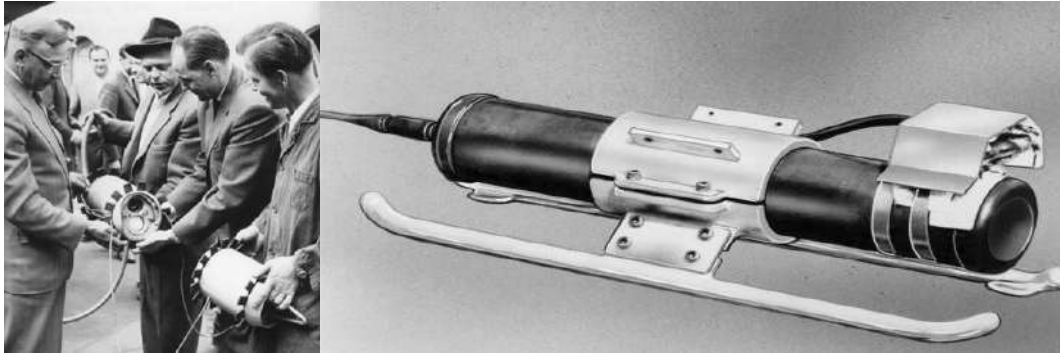
### Strategy

- Initially developed by Severn Trent Water Authority
- Rank failure risk - age, material, location
- Regularly inspect 5% most at risk
- Less frequent inspections for next 15%
- Inspection not justified for 80%

In 1970 there were 3-4 CCTV contractors, by 1984 >50



## Early Challenges



Pioneers included Telespec and Cues Inc

## Tasks for CCTV

- Identification of operational issues
  - Infiltration
  - Blockages
  - Odour
- Carry out periodic condition assessment and prioritisation
- Undertake initial acceptance of new pipe installations
- Inspection repair or renovation works before and after completion
- Re-inspect at end of warranty period



## Standard Reporting

- Consistency of reporting and description of defects
- Internationally recognised standard codes
- Suitable for state of the technology data processing, artificial intelligence based analysis and iCloud storage and data location
- Professionally trained and certified operators



- Sewerage is and always has been critically important
- Our sewers do not have infinite life, they need regular attention
- We must inspect, assess and maintain them
- The CCTV inspector is an important player in the team
- We must train to provide consistent skills and performance



## Introduction - History and importance



Before moving on, if you have any questions please take this opportunity to post them on the course Q&A platform and we aim to respond as soon as possible during the course.

