Towing Vehicle - V
Research Plan

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Contents

Importance Of Towing Vehicle - V

- Preservation of heritage - showcasing the industrial legacy of Zollverein’s coal mining era.
- Integral part of operations - reflecting the efficiency of industrial logistics at that time.
- Educational value - offers visitors a glimpse into historical coal transport methods.
- Cultural and historical significance - represents the economic and social impact of coal mining on the Ruhr region.
- Artistic inspiration - the design and functionality of towing vehicle inspires modern industrial aesthetics.

Location Of Towing Vehicle – V In Zollverein

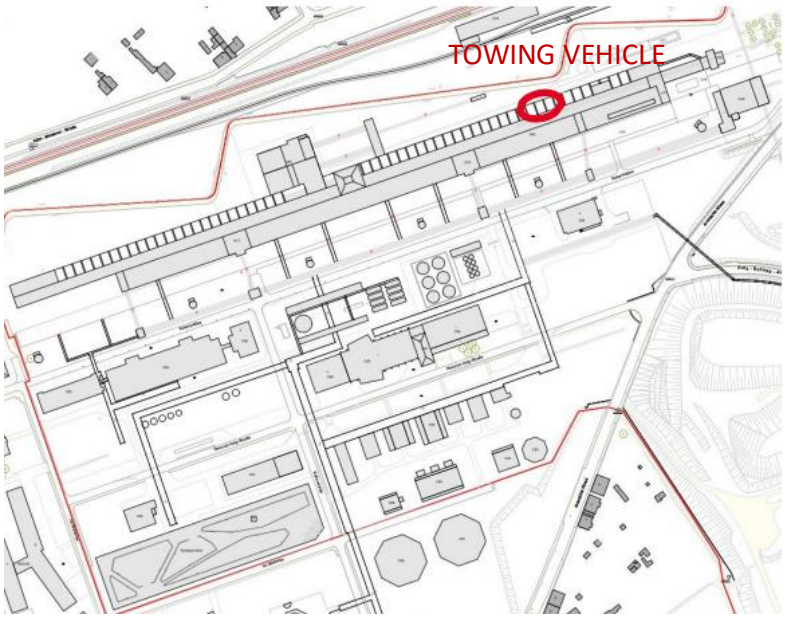

Fig 1 : Layout of coking plant ,Zollverein,Essen, Source: moodle

Towing Vehicle- V Location Overview

- Adjacent Structures
  - Quenching Car: Located to the West (back).
  - Towing Vehicle IV: Positioned to the East (front).
  - Oven Batteries: Found to the South.
  - Brick Wall: Situated to the North.

Condition Survey

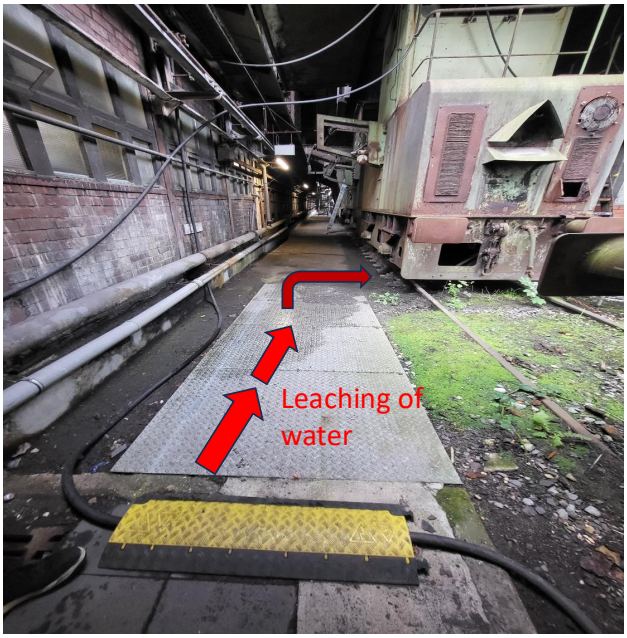

Fig 2: Water disposal way towards the towing vehicle IV and towing vehicle V.Photo captured by Sooraj Nair , October 2024

Fig 3: Water disposed around the towing vehicle IV, photo captured by Sooraj Nair, October 2024

Fig 4 and 5 : The bottom part of towing vehicle - V has more corrosion, photo captured by Sooraj Nair, 2024

Fig 6 and 7 : The top portion of towing vehicle - V have less corrosion, photo captured by Sooraj Nair, 2024.

Fig 8: Bricks spall off due to water absorption on north side of towing vehicles IV and V , photo captured by Sooraj Nair, 2024.

Quenching Car

Fig 9: Bottom side of the quenching car, photo captured by Sooraj Nair, 2024.

Fig 10: The floor adjacent to quenching car, photo captured by Sooraj Nair, 2024.

Research Question

- Investigating if nearby environmental conditions, surrounding structures and water dampness contribute to corrosion of towing vehicle V and recommending effective strategies to mitigate these effects.

Examination Methods And Sampling

Sampling 1

- Object: Masonry wall
- Location of the object : parallel to and north of the towing vehicle IV and V in coking plant Zollverein in Essen.
- Analysis : Measurement of moisture content in brick wall by dielectric moisture meter- Trotec T610.

- Sampling location: Five points in 60 cm height from the bottom edge of the brick wall. Each measuring point in the horizontal spaced 50 cm apart from each other, the starting point for testing will be 500 cm from the left corner of the brick wall, when facing the towing vehicle. The measuring points in brick wall is in 340 cm distance horizontally from the rail of towing vehicle V.
- Preparation: Surface is cleaned by a brush with soft bristles to avoid scratching and damaging of bricks. A non abrasive scrubbing pad for removing more stubborn dirt.
- Collection: The obtained data from T610 dielecteric meter will be documented.
- Equipment: T610 dielecteric meter, brush with soft bristles, non abrasive scrubbing pad,Laborjournal, photo camera via smartphone, scales 2m and colour card reference , flash light.

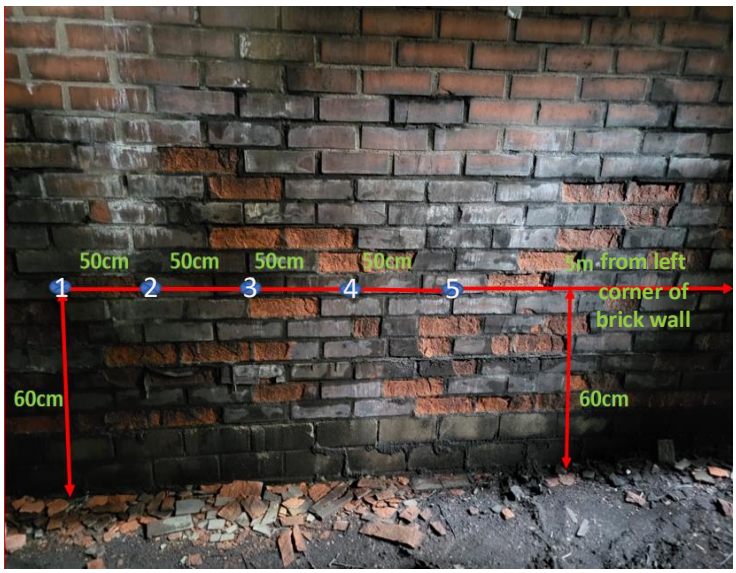

Fig 11: Points to be taken for measuring moisture content, photo captured by Sooraj Nair,October,2024.

Fig 12: Dielecteric meter, source: https://www.researchgate.net/publication/359750899_Diagnostics_and_Renovation_of_Moisture_Affected_Historic_Buildings .

Sampling 2

- Object: Soil
- Location of the object : North and South sides of towing vehicle.
- Analysis : Measurement of moisture content in soil by using gravimetric method.
- Sampling location : Soil weighing 50 to 100 g from two random points within a horizontal distance of 50 cm from north and south side of towing vehicle V from various depths (0 to 15 cm).
- Preparation : Clean and dry the containers to hold soil sample during weighing and drying. Ensure containers are pre- weighed and recorded. Clearly label each container with relevant information, such as location, depth, date and sample number.

- Collection : 50 to 100 g of soil from various depths of 0 to 15 cm. The obtained data is documented.
- Equipment : Precision balance, containers, oven set to a specified temperature (typically between 105°C and 110°C) , spatula or scoop , flashlight.

Sampling 3

- Object : Towing vehicle V
- Location of the object : North side of coke oven batteries, coking plant Zollverein in Essen.
- Analysis : SEM for examining surface morphology, EDX for elemental composition and XRD for identifying crystalline phases of corrosion products.
- Sampling location : South side 285 cm from the base of coke oven battery wall to center of the rail. 19 cm high from the bottom edge of the rail and 34 cm high from the ground. Labeled in Figure.

- Preparation : Clean the specimen with appropriate solvents (ethanol). The specimen should be small enough to fit inside the SEM chamber ≈ 2 * 2 cm. Properly label the specimen.
- Collection : A flat, rectangular specimen of ≈ 2 *2 cm in size and thickness of less than 10 mm. The obtained specimen will be properly labelled.
- Equipment : Hand held cutting tools, gloves, scalpel or razor blades, Dremel tool or rotary cutter, soft brushes, lint - free wipes, small container. Labelling material (permanent marker, labelling tape) sealable bag or aluminium foil, camera or smartphone, forceps , flashlight.

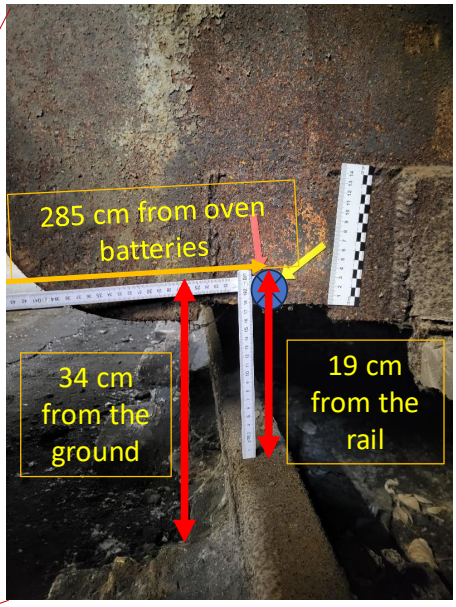

Fig 13 and 14: Points to be taken for conducting SEM,XRD etc, photo captured by Sooraj Nair,October,2024.

What Others Have Done In Similar Scenario ?

Problem	Solution
Moisture in walls	Masonry drying (natural & artificial), soft caping
Soil moisture	Redesigning ground drainage systems, improving sub-floor ventilation, electro-osmosis and electromagnetic systems
Salt weathering in building materials	Use of crystallization inhibitors
The rising moisture from the ground	Wall base ventilation system
Risk of waterlogging soil	Installation of a french drain
Capillary rise	Mechanical barriers, chemical barriers

Conclusion

- From our visual inspection, we identified water dampness as the major contributor to corrosion in the towing vehicle, as well as to damage in the nearby masonry structure. Immediate action like repair the drainage system, improve soil drainage, redirect water flow, repoint mortar joints is required to preserve the towing vehicle V.
- Further testing has to be conducted to identify specific issues before suggesting more permanent solutions.

THANK YOU