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THE GANTRY – REPAIR METHODOLOGY

1.0 ASSESSMENT

- 1.1 The Gantry situated at the north side of the Power Hall is a composite cast iron and steel structural frame comprising two rows of cast iron columns supporting low carbon steel compound girders atop which sit two travelling cranes. The cranes originally traversed the length of the Gantry on tracks fixed to the steel beams but they are no longer operational after many years of disuse. The cast iron columns are bolted at their bases to iron plinth castings bolted to stone pad foundations set below the surface of the Upper Yard.
- 1.2 Prior to our engagement the Gantry was inspected by Sutcliffe Civil & Structural Engineers in late 2013. Their observations are detailed in their *Structural Appraisal of Overhead Gantry* report which surprisingly claims that the structure has been regularly maintained and is in reasonable condition free from deterioration, corrosion or any significant effects of weathering. More concerningly the report also states that the Gantry could be returned to working order without any recommendation for further investigation, assessment or structural analysis.
- 1.3 Conisbee first investigated the Gantry in late 2018 at the request of The Science Museum Group with the aim of evaluating its condition and structural integrity coupled with the provision of outline repair recommendations. Our inspection was carried out via MEWP and our observations and recommendations are detailed in our *Gantry – Structural Appraisal & Feasibility Report* and accompanying drawing 180426-CON-GA-XX-DR-S-3200 which may be summarised as follows:
 - The Gantry has clearly suffered from a poor preventative maintenance regime over a substantial period of time, almost certainly pre-dating its ownership by the Science Museum Group. It is particularly important to regularly inspect and renew protective paint work on compound structures such as this which are vulnerable to moisture capture, retention and corrosion by their large number of components and connections.
 - The steel elements of the Gantry have suffered deterioration due to corrosion, significantly so at the relatively exposed fish bellied beams and bearings of the travelling cranes. The cast iron columns and their bases are in relatively good condition where visible.
 - The proximity of some elements of the Gantry to the Power Hall wall, notably the south girder, has amplified deterioration and complicates inspection, repair and protection from the elements. Parts of the Gantry are in direct physical contact with the Power Hall wall and may be engaged structurally in preventing its further outward movement.

- Loose corrosion product was removable by hand in selected locations, however this aided inspection of the underlying metalwork which was found to possess sufficient structural integrity in the short term.
- The Gantry is coated with several layers of thick paint thought to be micaceous iron oxide, potentially containing lead, which has reached the end of its life span. Patch overpainting of historic corrosion is present in several places which may also possibly obscure significant material loss, cracking or other structural defects. No cracking or structurally significant casting defects were evident at the time of inspection but the paint finish had failed in a number of locations and separated from the iron substrate, resulting in collection of water and surface corrosion.
- Generalised loss of structural stability was not observed but specific areas of corrosion were sufficiently advanced to warrant immediate protection and further detailed investigation.
- There was no sign of general structural distress or excessive distortion, however additional stresses may be applied in future should further movement of the Power Hall north wall occur. Whilst historic and forthcoming repairs to the Power Hall roof will serve to resolve any roof thrust onto the wall, the nature of the foundations and bearing strata/structures is unclear and a potential for rotational movement at foundation level remains. Specific periodic informal monitoring is recommended with any changes or new defects identified for further consideration.
- It is possible that structural strengthening of the Gantry may have been carried out previously by others to address apparent concerns, notably the introduction of a modern steel castellated transverse beam and modern steel cross bracing members between the columns at the westernmost bay.

- 1.4 Our report contained several recommendations for short, medium and long term actions.
- 1.5 Our recommendation to provide immediate protection to relevant areas was implemented in early 2019 when the south girder was fully netted in order to prevent corrosion product falling from height.
- 1.6 The Gantry was scaffolded and enclosed in 2019 as part of the Power Hall repair project. Following a pause in the progress of this project we completed a supplementary inspection of the structure from the scaffold in early 2020 in coordination with the implementation of our additional recommendation to undertake material sampling and testing of the structure to understand its material composition, to inform our subsequent structural analysis, and to inform potential repair techniques.
- 1.7 Our recommendation to remove the existing paintwork to facilitate a detailed inspection of hidden parts of the structure has not yet been implemented.

2.0 RECOMMENDED ACTIONS

- 2.1 Full assessment of the extent of corrosion and remaining sound metalwork is often difficult without mechanical removal of corrosion products and failed paint finishes. The full extent of condition and essential remedial works therefore cannot be determined until the failed paint finishes and corrosion products are removed as far as practicable.

- 2.2 If nothing is done corrosion will continue and the risk of further loss of historic fabric and disengagement of corrosion products at height will increase, requiring further netting and/or the creation of pedestrian exclusion zones at ground level below and around relevant areas of the Gantry, and the ultimate cost of remedial works and the risk of structural inadequacy will be proportionately greater.
- 2.3 Consequently the following actions are recommended:
- Representative scrapes of the existing paintwork should be obtained to understand the historic painting schemes and establish the composition of the various paints. Any hazardous components within (e.g. lead) will dictate the paint removal technique and control system to be used.
 - To expose the metalwork for detailed close-up inspection, to evaluate the full extent of deterioration and to allow the specification of appropriate repairs preparatory hand removal of corrosion product followed by light blast cleaning of the superstructure to remove existing paintwork should be carried out using a non-ferrous medium (e.g. glass bead or crushed garnet) to. Trial testing of the blast cleaning method at a small area of the Gantry should be undertaken to assess its effectiveness and evaluate any potential harm to the existing structure.
 - Location-specific cleaning at high risk areas should be prioritised e.g. the travelling crane bearings and the south girder. The existing scaffold enclosure will need be supplemented with necessary additional protection (a sealed enclosure and/or negative suction) to capture the dust generated by the cleaning process, and further protection may need to be provided to the Power Hall and other adjacent buildings.
 - Blast cleaning will prepare the surface of the metalwork to receive new protective paint finishes, the effectiveness, durability and longevity of which are highly dependent on adequate surface adhesion. Whilst future protective coatings may achieve durability in line with the manufacturer's expectations on plane surfaces a shorter lifespan at riveted joint connections should be anticipated and planned for in maintenance budgets.
 - The existing scaffold enclosure which has been installed for the upcoming works on the Power Hall will provide an easy means to facilitate temporary opening up works for inspection of inaccessible areas of the Gantry that abut the Power Hall (e.g. localised removal of bricks). If this proves unfeasible remote camera inspection in otherwise inaccessible areas will be carried out.
 - A numerical analysis of the residual structural capacity of the Gantry encompassing the worst affected areas of the structure will be undertaken. This will confirm whether the remaining capacity is sufficient assuming arrest of deterioration or whether more substantial interventions such as the introduction of additional plates or fixings are needed.
 - Following the implementation of essential repairs an appropriate program of protection and routine maintenance will be developed and implemented to mitigate further deterioration.

3.0 ANTICIPATED REPAIRS

- 3.1 The true condition of the Gantry and the full extent of essential repairs cannot be confirmed and specified until the existing paint finishes and corrosion products have been removed to expose the structure for detailed close-up inspection. However, the expected repair types can be predicted with a reasonable degree of confidence and provisional quantity allowances may be made for budgeting purposes.
- 3.2 Deconstruction of the Gantry is not an acceptable option from a conservation perspective so in-situ repairs will be undertaken. There are no plans to reinstate the Gantry to working order and based on the observed structural condition this is unlikely to be a viable option in any case.
- 3.3 As the Gantry is no longer in use as a working structure no significant live loading is currently applied. Wind and snow loads are negligible. The general structural requirement is therefore to support its self-weight only and to resist any lateral loads applied by the Power Hall north wall. The potential impact loading from accidental vehicle strikes should also be considered taking into account the known condition of the structure.
- 3.4 Non-structural repairs are primarily anticipated to comprise surface preparation and application of appropriate new paint finishes to improve the durability of the structure. It is recommended that a specialist paint consultant is employed to undertake an assessment of any historic paint layers present and provide recommendations for renewal of the finishes.
- 3.5 General structural repairs to corroded or otherwise defective areas of the Gantry followed by full re-application of appropriate protective finishes is required. Some repairs are anticipated to involve over-plating with new compatible material informed by the results of the metallurgical testing completed in 2020 which confirmed the composition and strength of the Gantry's structural elements.
- 3.6 Since the inherent geometry and construction of the Gantry structure has a propensity to retain moisture in crevices routine hands-on inspections and monitoring of the structure from below and above is recommended on a quinquennial (5 yearly) basis to identify any localised accelerated degradation of protective finishes and allow timely renewal.
- 3.7 In line with best conservation practice for a Grade II listed heritage asset such as this our approach will be one of minimal intervention. Where intrusive repairs are deemed necessary to maintain durability and structural performance they will be as sympathetic, transparent and honest as possible so as to allow the story of the Gantry and its relationship to the Power Hall and the wider site to be clearly read.
- 3.8 All specified remedial work will be developed in conjunction with the Science Museum Group and MCC's Conservation Officers recognising the listed status of this significant structure.

