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THE POWER HALL: WALLS – REPAIR METHODOLOGY

1.0 ASSESSMENT

1.1 Conisbee carried out a detailed inspection of the Power Hall walls in early 2019 at the request of The Science Museum Group with the aim of evaluating their condition and structural integrity coupled with the provision of outline repair recommendations. Our initial inspection was carried out from ground level with the aid of binoculars.

1.2 The Power Hall and Gantry were 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 Power Hall from the scaffold in early 2020.

1.3 Our observations and recommendations are detailed in our *Structural Appraisal and Feasibility Report* which may be summarised as follows:

- The Power Hall walls comprise red bricks laid in lime mortar in English Garden Wall bond. Relatively soft, low durability, high porosity red bricks are used in all areas and appear to be consistent through the walls which are ~600mm thick in most areas, increasing to ~750mm at piers and abutments. Bullnose profiled red bricks are provided at piers around structural openings and canted engineering bricks are provided at the plinth course.

- Sandstone and gritstone copings cap the parapets on all elevations, with further stone detailing provided at sills, carriage stones and bollards. Sandstone units form the upper part of the cornice at the south and east elevations, with profiled gault clay bricks forming the lower portion.

- The brickwork generally has suffered from a poor preventative maintenance regime over a substantial period of time, almost certainly pre-dating its ownership by the Science Museum Group. Although it remains in acceptable and serviceable condition in most areas, localised deterioration has occurred together with damage to isolated bricks on all external elevations, mainly spalling caused by successive wetting and freezing exacerbated by the application of cementitious pointing over the elevations. Localised leaking gutters has saturated the brickwork in some areas, increasing its susceptibility to frost damage and causing lime to leach from the mortar

- The worst areas of damage are concentrated at the west elevation and at low level on the south elevation, consistent with greater exposure to water run-off and driving rain. The apparently random location of other damaged bricks most probably relates to inconsistent manufacturing standards during firing with some bricks being exposed to higher temperatures (and therefore being more durable) than others.

- Localised cracking is evident which in some locations may have resulted from stresses in the brickwork arising from macro-structural movement of the walls discussed above together with thermal and moisture related expansion of the lengthy north and south elevations.

- The internal faces of the external walls generally remain in good condition having avoided exposure to weathering. However Isolated defects are present including loose bricks adjacent to former sliding door fixings and areas where saturation due to gutter leakage has caused localised brickwork deterioration.

1.4 Sampling and testing of mortar has subsequently been undertaken to understand its composition, to aid our subsequent structural analysis, and to inform repair specifications.

2.0 MONITORING & ONGOING ASSESSMENT

2.1 Global movement in the external brickwork envelope is readily apparent and a verticality survey has shown that both the north and walls lean northwards by approximately 140mm at their middles, decreasing to a negligible amount at their ends where they are restrained by the east and west walls of the building.

2.2 Chases have been cut in the external face of the north elevation to accommodate the Gantry which suggest that at least some of this movement occurred shortly after – or perhaps during – the Power Hall's construction, with further movement occurring subsequently. It is probable that the Gantry provides a degree of support to the Power Hall and that stresses arising in the north elevation are diffused into areas of the surrounding brickwork and absorbed by the relatively flexible lime mortar. The close proximity of some elements of the Gantry to the Power Hall north elevation, notably the south girder, may have amplified brickwork deterioration and has complicated inspection, repair and protection of the fabric from the elements.

2.3 Although much of the observed movement appears to be longstanding it is not yet known whether progressive movement is occurring, therefore live monitoring of the structure has been underway for several months and will remain ongoing until the refurbishment and repair works are complete. The movement monitoring data acquired to date will inform any recommendations for remedial measures to address the long-term macro-stability of the structure, however the data acquired to date indicates that movement is minor and additional structural interventions will be unnecessary.

2.4 The loading condition of the walls has remained unchanged for a considerable period of time and will not be significantly altered by the proposed permanent works. Temporary removal of the roof finishes will, however, significantly reduce the vertical loads and by implication the friction restraints at the roof truss bearings. Restraint to the wall will therefore be temporarily reduced until the finishes are reapplied, therefore live movement monitoring will continue during the construction phase.

3.0 RECOMMENDED ACTIONS & REPAIRS

3.1 The essential repair of localised defects to the Power Hall walls has been identified following our detailed inspection and assessment (see Conisbee drawings 180426-CON-PH-XX-DR-S-3100 to S-3105 which include a detailed conservation specification for each element of repair work required):

- The majority of fabric repairs comprise replacement of excessively decayed bricks with matching new or reclaimed bricks, indent repairs to deteriorated cornice stonework, crack repairs using stainless steel helical bars and repointing works. Agreement will need to be reached as to the extent of colour and texture match to be achieved.

- Diagonal cracking of brickwork was observed in a number of locations, most typically around structural openings where stress concentrations arising from thermal or structural movement tend to become concentrated. None of the cracking noted appeared to exceed 3 – 4 mm in width and localised repair and reinforcement should be sufficient to stabilise these areas.

- Cementitious pointing has failed in some areas and now requires replacement with a suitably specified lime-based mortar with compatible characteristics to the historic mortar. This specification has been closely informed by the mortar testing data which has been undertaken. The brickwork behind the south girder of the Gantry is deeply eroded and although access is somewhat difficult repointing should be attempted during the works programme.

- In other areas the cementitious pointing remains well bonded and is not causing damage to the fabric, therefore universal removal is not recommended so as to avoid further damage to the soft brickwork.

- A number of isolated bricks have previously been replaced, particularly on the north elevation. Little attempt has been made to achieve good colour and textural matches in the new materials and replacement might be considered, however further damage to surrounding bricks is possible during this process and we would not recommend proceeding in this way.

- We recommend reinstatement of the locally missing bricks in the north wall of the Power Hall which have been removed to accommodate M&E services penetrations with bricks matching the size, colour and texture of the existing brick as closely as possible. Any areas of brickwork that may be unavoidably damaged following the removal of redundant M&E equipment will be made good by plugging with a 1:3 lime:sharp sand mortar mix including an admixture of brick dust matching the colour of the existing brick as closely as possible and finished flush with the brick surface.

- Samples of each of the proposed masonry repairs, including the cornice and coping stone repairs, are to be completed for review and approval by Conisbee and the wider team before general repairs are carried out.

- Remedial works in relation to the macro-stability of the structure are not currently anticipated. In the event that further or progressive movement is identified during the monitoring period additional measures such as provision of a mechanical connection between the roof truss bearings and the brickwork may need to be considered. With reference to our companion report on the roof structure reinstatement of some lost connections between the roof trusses and the central column heads would also be needed to form a linkage between the north and south elevations.

- Parts of the above ground drainage system are in poor condition and wall dampness is evident in various areas. These defects will be addressed by renewal and upgrading of the entire system.

- 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 Power Hall and its relationship to the Gantry and the wider site to be clearly read.

- 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.

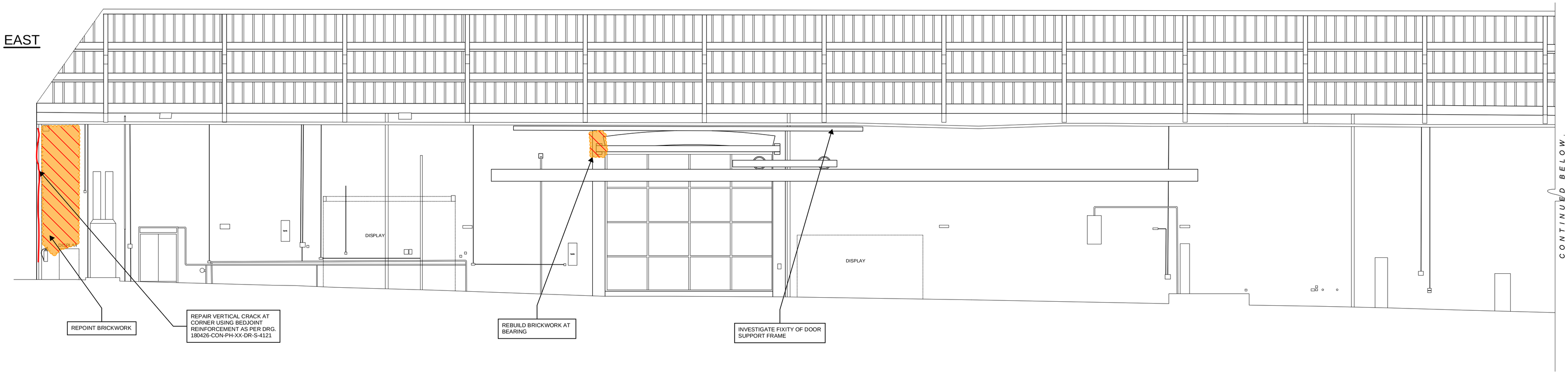
- Following the implementation of essential repairs an appropriate program of protection and routine maintenance will be developed and implemented to mitigate further deterioration.

GENERAL NOTES

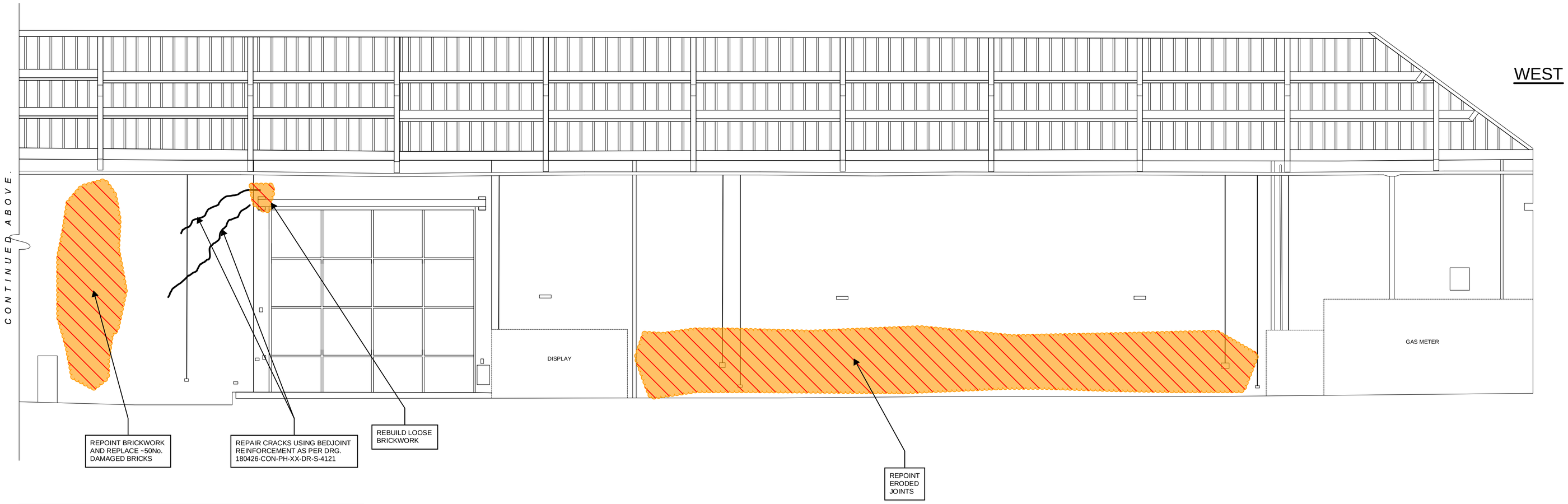
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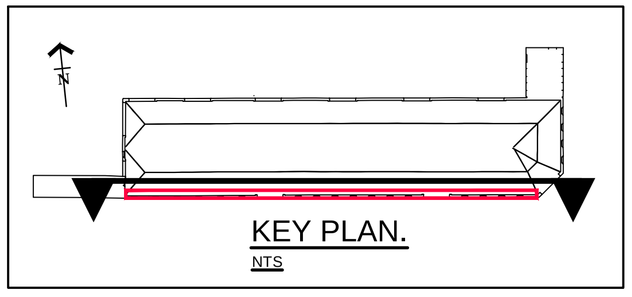
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EAST



WEST





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P1	06.12.19	STAGE 3 ISSUE	PM	SW

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Drawing Status
PRELIMINARY

Project
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Manchester

Title
Power Hall Repairs
South Elevation (Internal)

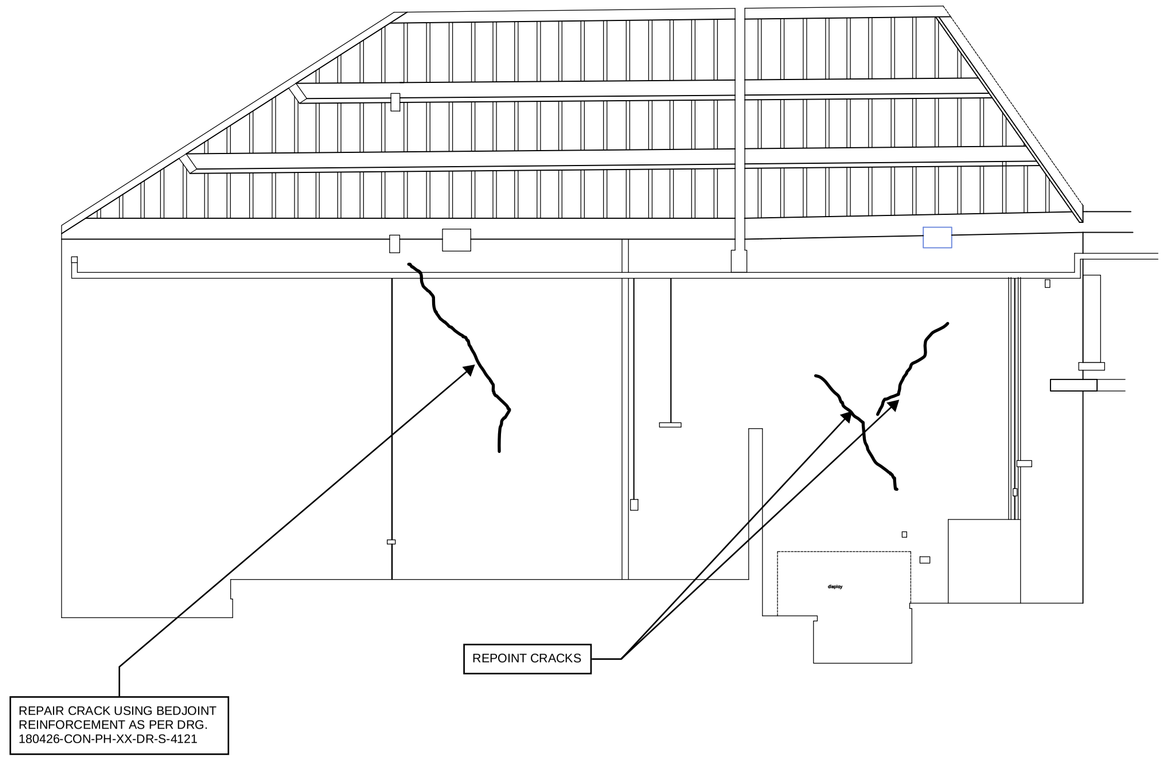
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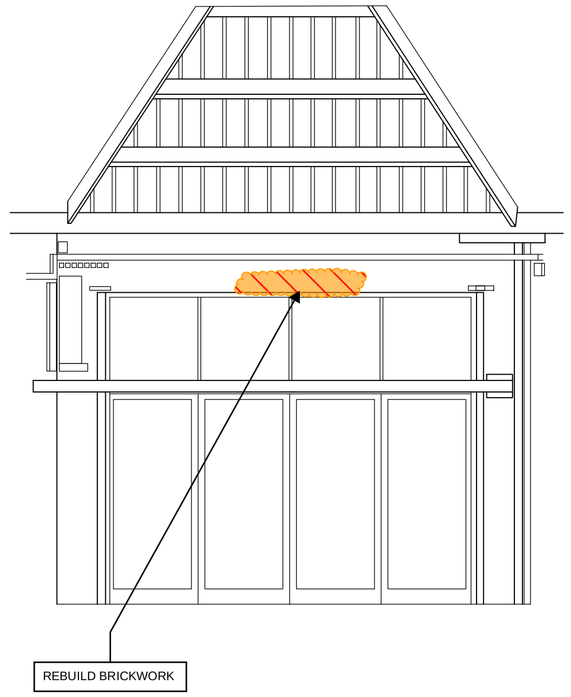
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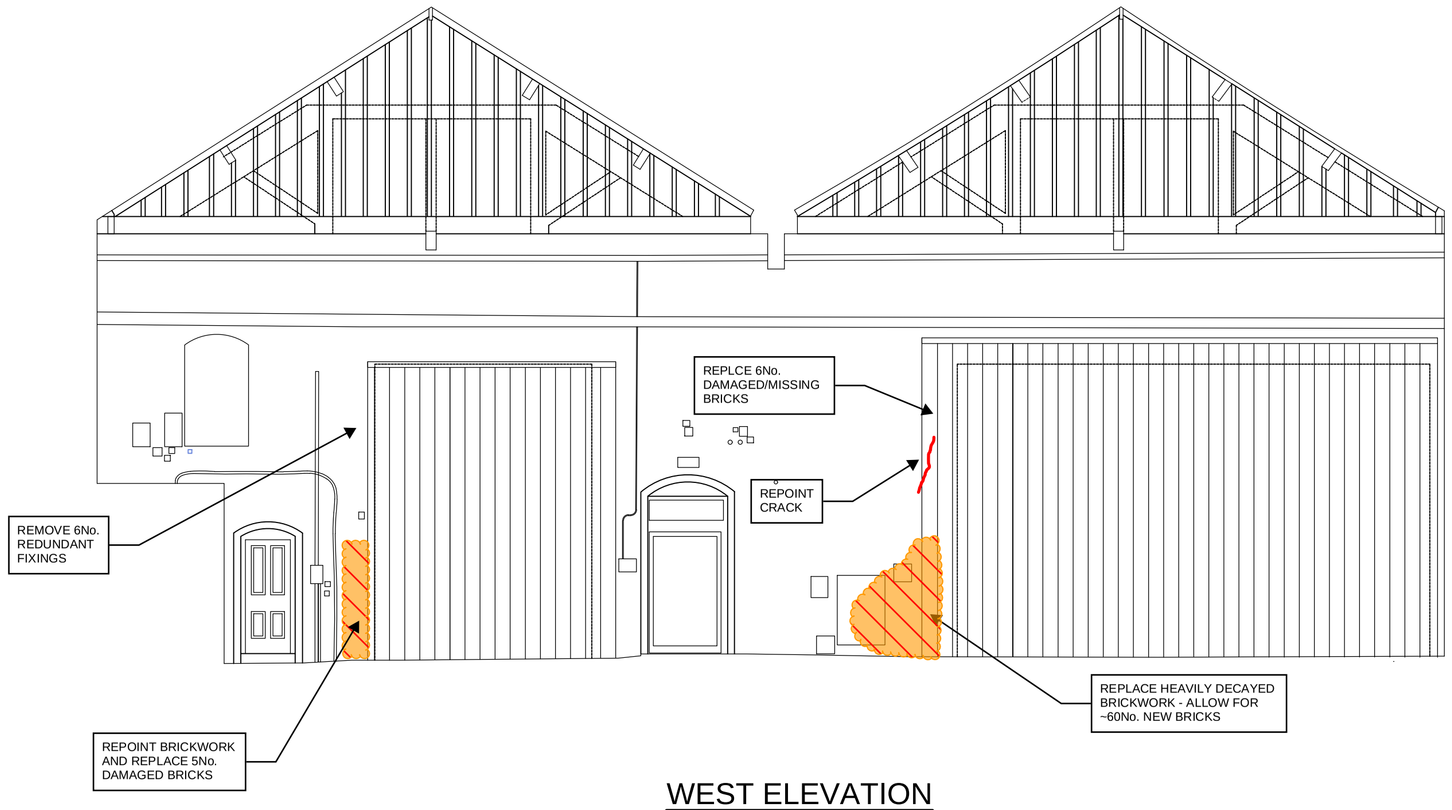
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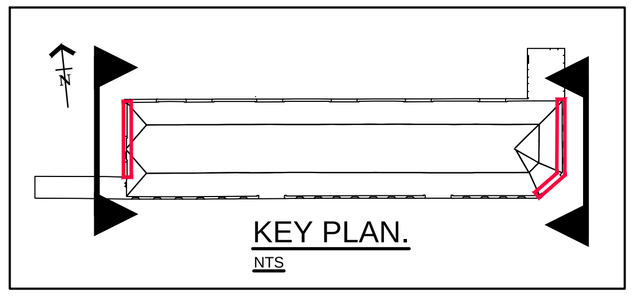
EAST ELEVATION

SCALE 1:75



WEST ELEVATION

SCALE 1:75



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Drawing Status
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Project
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Title
Power Hall Repairs
East and West Elevations (Internal)

Drawing No
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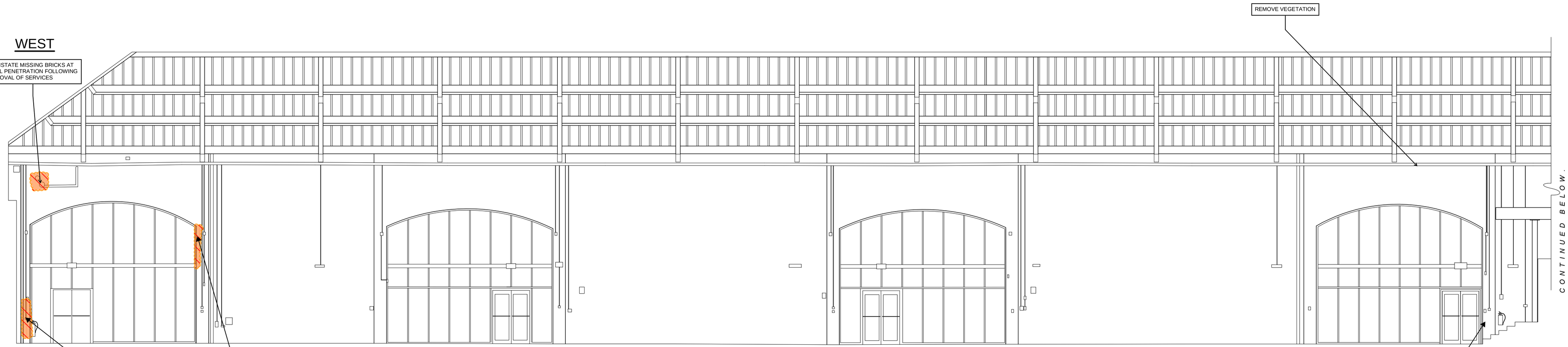
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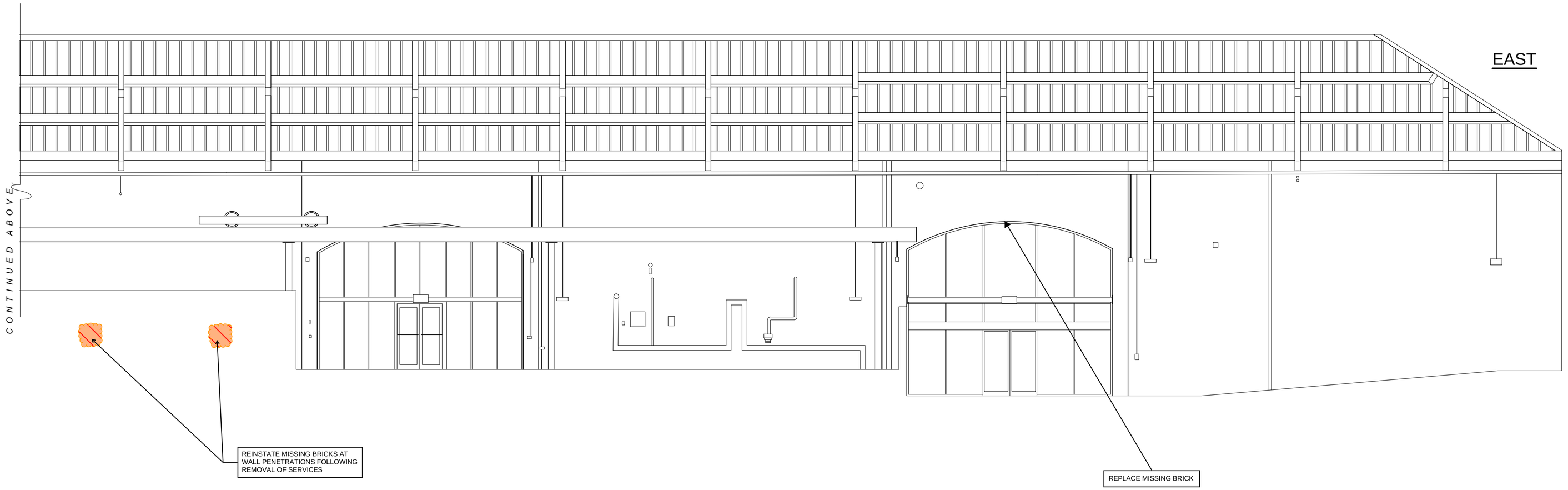
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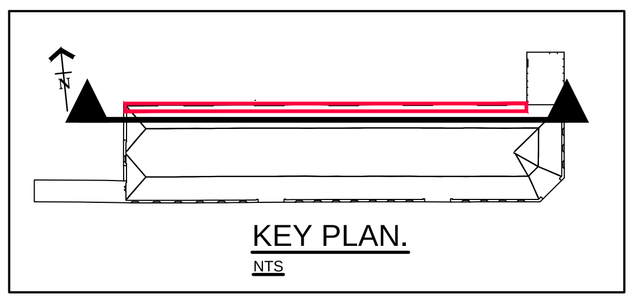
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WEST



EAST





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P2	18.08.21	REPAIRS ADDED	KC	KC
P1	06.12.19	STAGE 3 ISSUE	PM	SW

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Drawing Status
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Project
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Title
Power Hall Repairs
North Elevation (Internal)

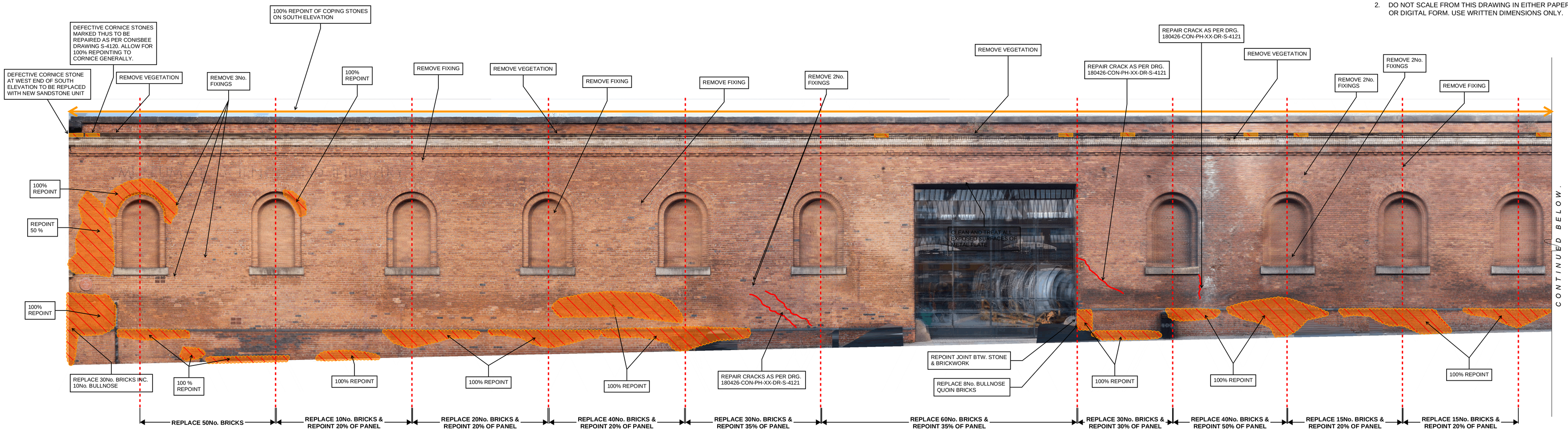
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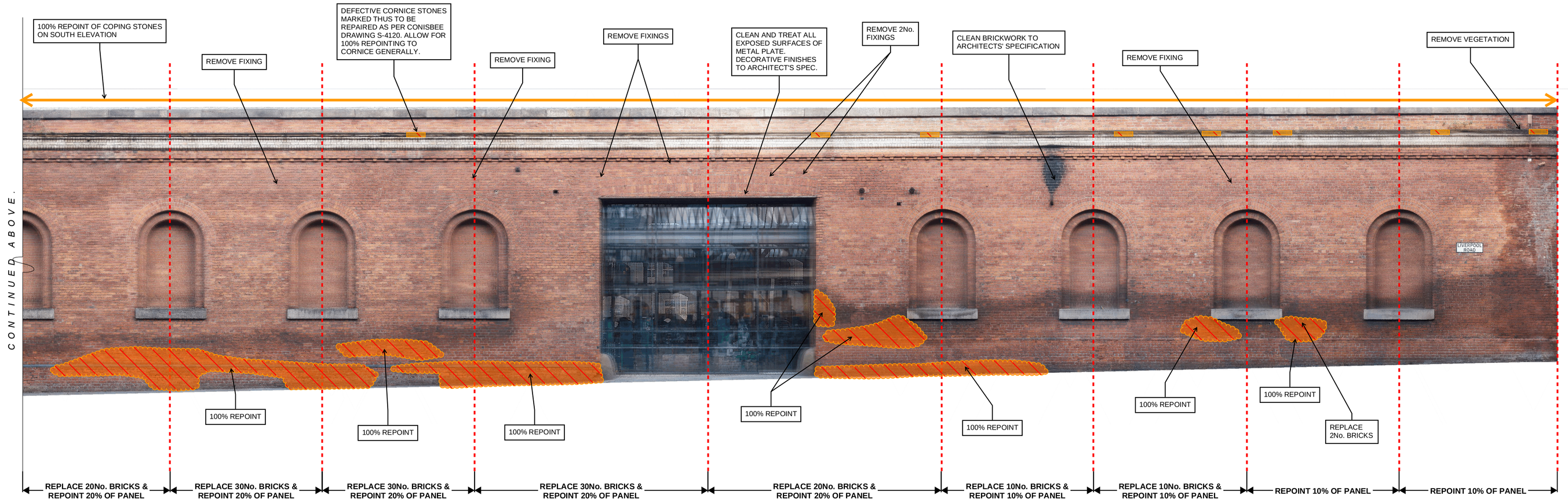
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Revision **P2**

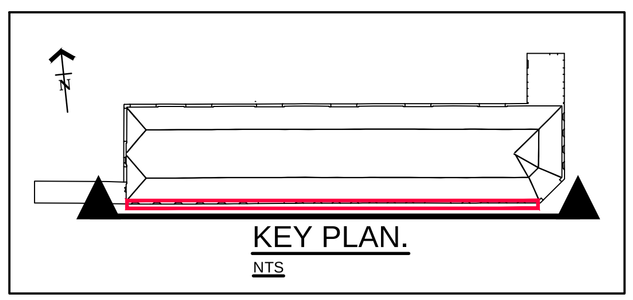
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P3	21.03.22	CORNICE REPAIRS ADDED	KC	KC
P2	18.08.21	REPAIRS ADDED	KC	KC
P1	06.12.19	STAGE 3 ISSUE	PM	SW

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Drawing Status
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Project
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Title
Power Hall Repairs
South Elevation (External)

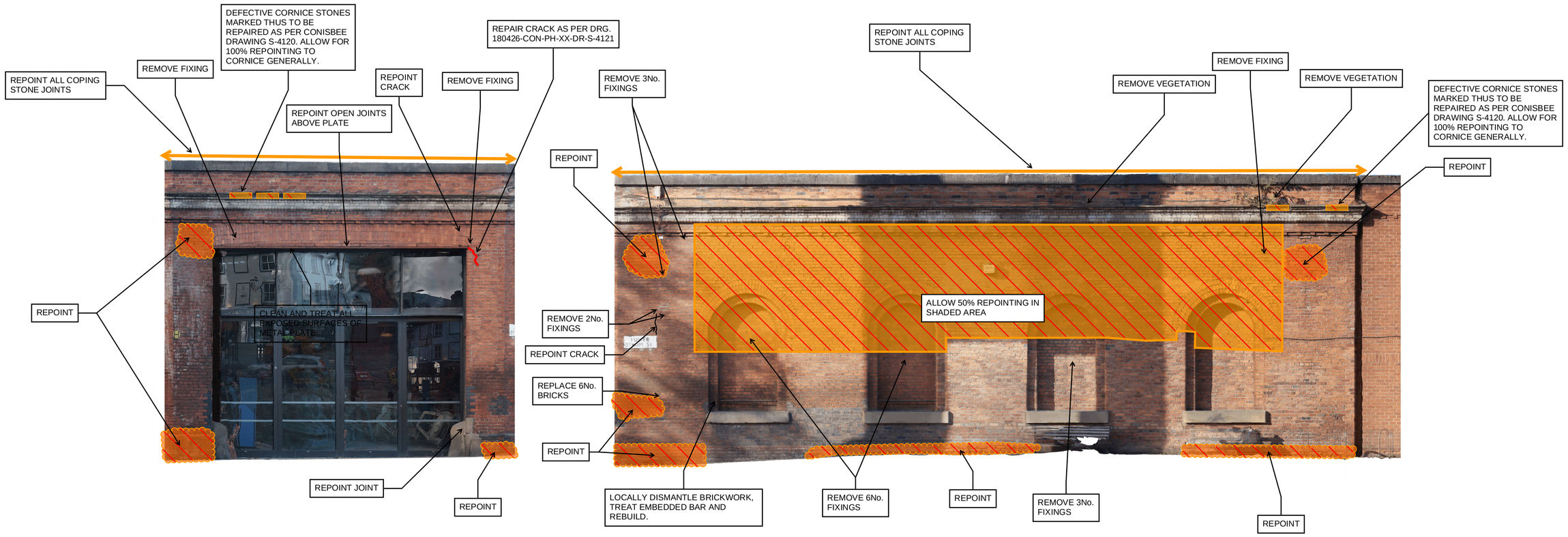
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Revision **P3**

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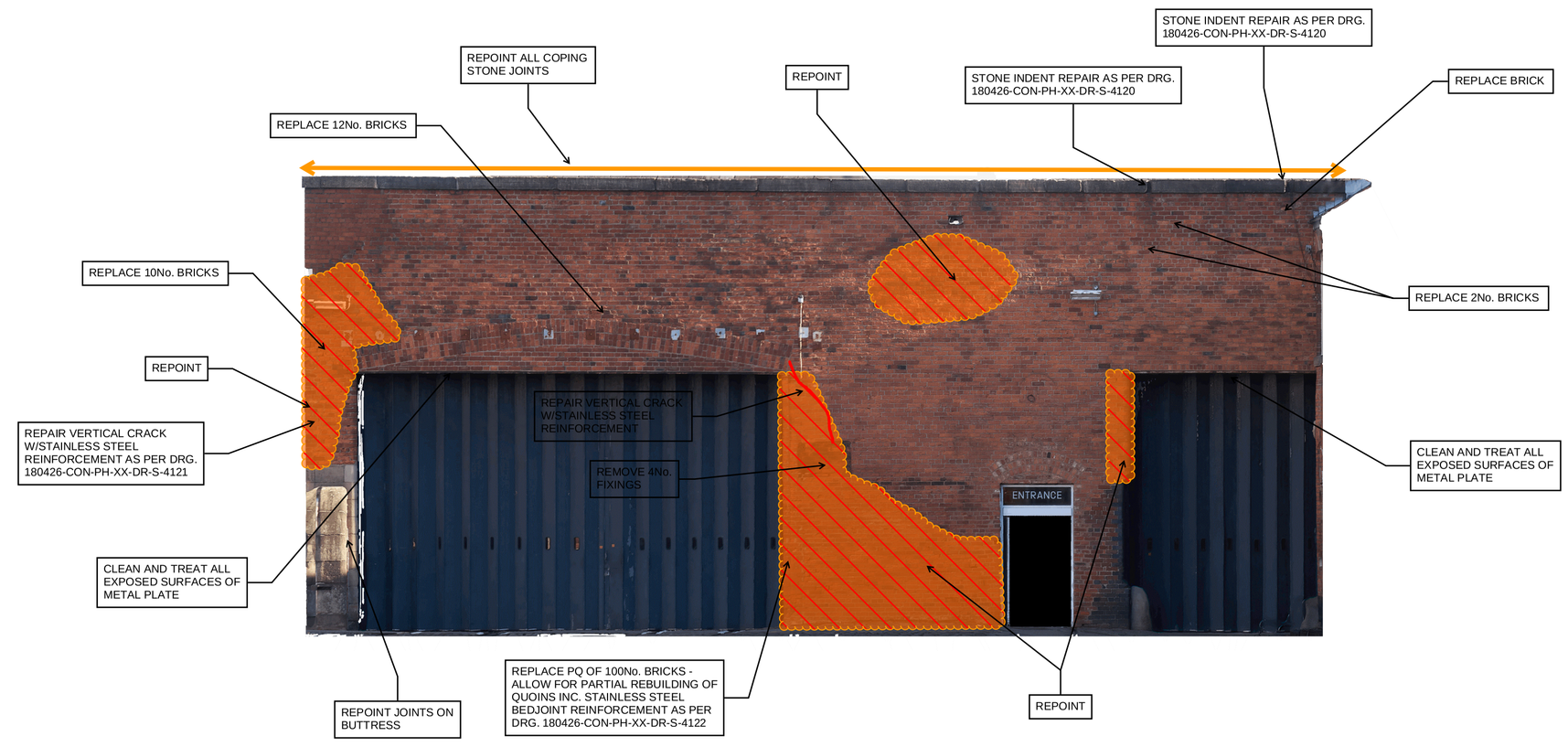
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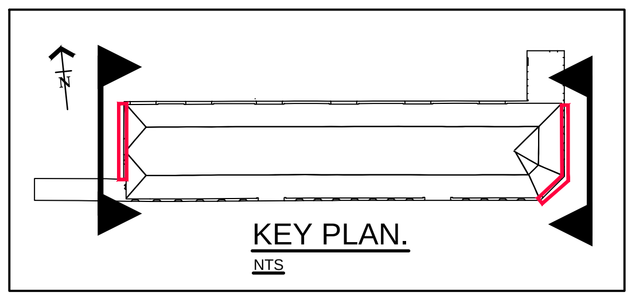
EAST ELEVATION

SCALE 1:75



WEST ELEVATION

SCALE 1:75



KEY PLAN.

NTS

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Rev	Date	Description	Drawn	Check
P3	21.03.22	CORNICE REPAIRS ADDED	KC	KC
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Project
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Title
Power Hall Repairs
East & West Elevations (External)

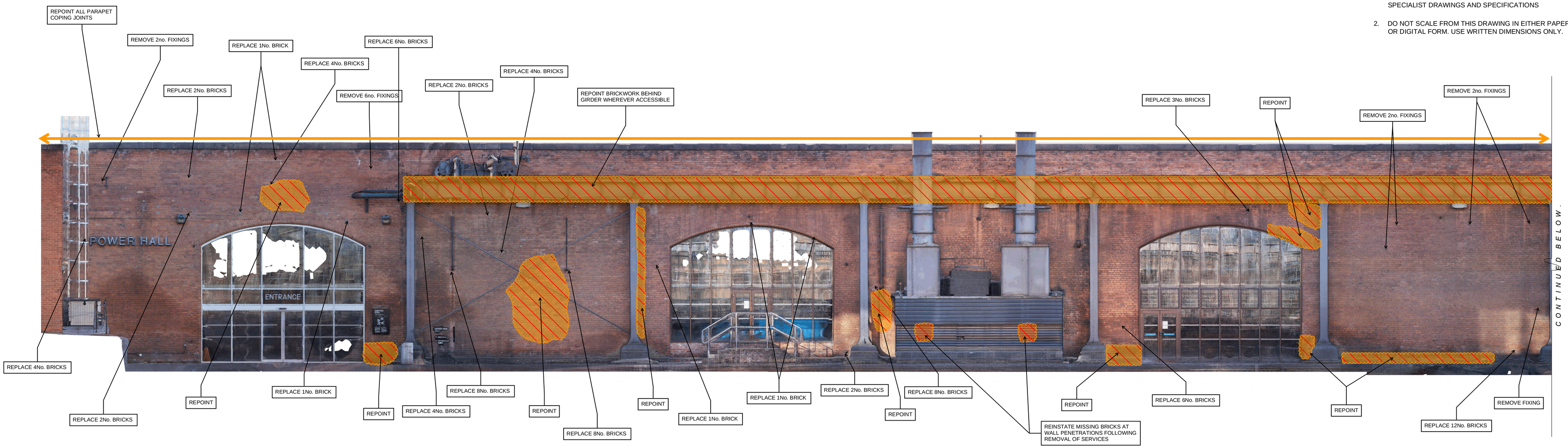
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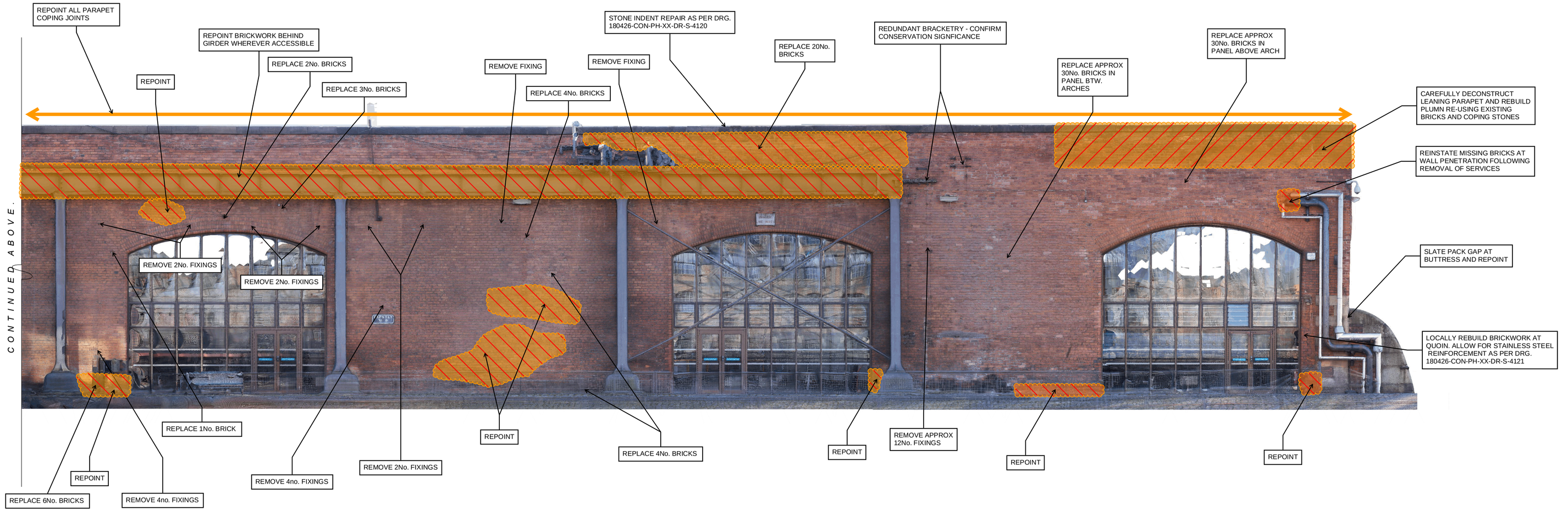
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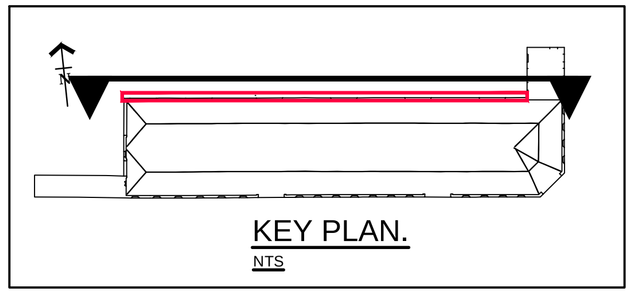
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P2	18.08.21	REPAIRS ADDED	KC	KC
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Project
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Title
Power Hall Repairs
North Elevation (External)

Drawing No
180426-CON-PH-XX-DR-S-3105

Date Dec 2019
Scale 1:75@A1
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Revision **P2**