Annex A

Development Projects/Cases related to Preservation of Historic Buildings
(Progress as at 15 November 2022)

Hong Kong Island

	Development Project/Case	Built Heritage at the Site	Latest Progress
1.	Revitalisation of Central Police Station (CPS) Compound	● The CPS Compound, i.e. the CPS, the Central Magistracy and the Victoria Prison, is a fine example of Victorian and Edwardian colonial architecture in Hong Kong and were declared monuments in 1995.	● The revitalised CPS Compound commenced operation as "Tai Kwun – Centre for Heritage and Arts" on 29 May 2018. ● As for the Married Inspectors' Quarters (Block 4), which partially collapsed on 29 May 2016, the Hong Kong Jockey Club (HKJC) briefed the Antiquities Advisory Board (the Board) on the updated recovery plan on 12 December 2019. ● HKJC announced on 9 July 2021 that their reappraisal found that Block 4 was weaker than previously anticipated in 2019. For the sake of public safety, HKJC decided to terminate the implementation of the updated recovery plan and revisit the eight initial recovery options presented to the Board in 2016. ● HKJC is exploring possible heritage conservation arrangements and plans for Block 4 on the premise of safeguarding public safety as the top priority. In HKJC's latest technical update, the unsafe portion of Block 4 will be removed, while the recovery plan will be further explored and developed during the removal works. Please refer to the attached HKJC's technical update for details.
2.	Peel Street/Graham Street Development (H18) of Urban Renewal Authority (URA)	● The shophouses at No. 118 and No. 120 Wellington Street are Grade 3 and Grade 1 historic buildings respectively.	● URA plans to preserve the two terrazzo signs with the calligraphy of Su Shi-jie (蘇世傑) at No. 118 Wellington Street and incorporate them in the public open space at the same site in future.

Annex A

	Development Project/Case	Built Heritage at the Site	Latest Progress
		● Nos. 26A-C Graham Street are a row of three pre-war buildings, with Grade 3 status. ● The building remains at the site of Cochrane Street has not been given any grading by the Board.	● URA will preserve *in-situ* the shophouse at No. 120 Wellington Street and the main façade of the shophouses at Nos. 26A-C Graham Street.
3.	Renovation works for the West Wing of the former Central Government Offices (CGO West Wing)	● The former CGO (including the three buildings) have been accorded Grade 1 status by the Board. The West Wing, completed in 1959, was used as government offices for over 50 years until 2011.	● Subsequent to the endorsement of the Heritage Impact Assessment (HIA) report on the renovation of CGO West Wing by the Board on 4 March 2015, the conservation works to convert the building into the offices of the Department of Justice and law-related organisations had commenced in October 2016 and substantially completed, with the heritage interpretation works targeting for completion in 2023-24.

Kowloon

	Development Project/Case	Built Heritage at the Site	Latest Progress
4.	Development at Diamond Hill Comprehensive Development Area (CDA) and construction of Diamond Hill Stabling Sidings of Shatin-to-Central Link	● The old Pillbox and former Royal Air Force Hangar are Grade 2 and Grade 3 historic buildings respectively.	● Pursuant to the approved Environmental Impact Assessment (EIA) report, portions of the Hangar were disassembled and stored for future display together with a model of the Hangar whereas the Pillbox was lifted up in one piece and stored for future reinstatement. Both the Hangar and Pillbox were relocated to the construction site by MTR Corporation Limited in July and August 2018 respectively.

Annex A

	Development Project/Case	Built Heritage at the Site	Latest Progress
			● The planning of the water feature park was entrusted to the Housing Department (HD). HD proposed to reinstate the Hangar and Pillbox within the water feature park in the western part of the Diamond Hill CDA (not at the original locations). HD proposed adaptive reuse of the Hangar and the Pillbox which would be on display with interpretation in the park after completion. ● Under the requirements of the approved EIA, AMO continues to provide technical advice from the heritage conservation perspective. ● HD submitted a restoration proposal of the Old Pillbox on 16 May 2022. AMO provided comment and replied to HD on 22 July 2022. HD re-submitted a restoration proposal of the Old Pillbox on 28 October 2022.
5.	Redevelopment of Kwong Wah Hospital incorporating a Chinese Medicine Wing	● The original hospital, with the present Tung Wah Museum (TWM) as its Main Hall, was built in 1911 and extended in 1923. The hospital was completely reconstructed in 1958 as Kwong Wah Hospital with the Main Hall preserved. ● The Main Hall, which houses TWM currently, was declared a monument in 2010.	● The Main Hall has been properly protected in accordance with the HIA report endorsed by the Board on 4 June 2015 before commencement of construction works. ● Phase 1 of the redevelopment commenced in June 2016. Works were suspended by the Hospital Authority due to settlement of TWM found on 26 November 2018. With the implementation of the remedial works, the settlement of TWM has been stabilised. Works were resumed in February 2019. ● The whole redevelopment (Phases 1 and 2) is targeted for completion by 2025.

Annex

LATEST TECHNICAL APPRAISAL FOR BLOCK 4 THE CENTRAL POLICE STATION COMPOUND

ABSTRACT

1. This Paper relates to the Married Inspectors' Quarters ("Block 4") located at the Former Central Police Station Compound ("CPS Compound"). The context for the preparation of the Paper is that safety concerns emerged during the preparatory work for the 2019 Updated Recovery Plan[1] ("Updated Recovery Plan") for Block 4, which triggered a re-appraisal of the building's condition. The re-appraisal was conducted by a series of reviews carried out by an expert team including Purcell, Arup and PAYE[2] ("expert team"). The team advised that Block 4 cannot be revitalised according to the Updated Recovery Plan in a safe manner within acceptable levels of risk, and there would be an undue risk of sudden collapse during the recovery work, which would place an unacceptable level of danger on the operatives undertaking the works and on the public, both within the site and immediately outside it. As the condition of Block 4 has continued to deteriorate, despite careful protection, the expert team advised that the parts of the extant building fabric that cannot be retained safely must be removed as soon as practicable. This paper explains the findings of the re-appraisal and inform the Antiquities Advisory Board ("AAB"/"Board") on the proposed schedule of removing the unsafe building fabric of Block 4.

PURPOSE OF PAPER

2. This Paper explains the latest development of the Updated Recovery Plan for Block 4, which suffered a partial collapse (Figure 1) on 29 May 2016. Specifically, AAB members are invited to note the following, which is explained later in detail.

- It was revealed during the preparatory work[3] (see Figure 1 for location) for the Updated Recovery Plan that the building was in worse condition than was previously known (see paragraphs 8 to 11).
- Safety concerns emerged during the preparatory work, which triggered a re-appraisal of the building's condition in 2020–21 by the expert team. It revealed that previous assumptions about the inherent strength characteristics of the masonry (which were already low) were too optimistic (see paragraphs 12 and 13).
- The strength of the masonry is derived from two factors: the quality of materials and the quality of workmanship used to construct the building. Both have been found to be poor. In this case, another important factor is the uncertain load paths down through the building, as more temporary propping has been installed to counter

[1] Details of the Updated Recovery Plan can be found in the board paper (ref. AAB/11/2019-20) for the AAB meeting on 12 December 2019. This proposal comprised retention of the external envelope of the building and some rearrangement of the interiors to meet statutory and operational demands, including changes to the façade design of the rebuilt part at the west end.

[2] The expert team comprises:
- Purcell Asia Pacific Limited, Architects and Heritage Consultants ("Purcell")
- Ove Arup & Partners Hong Kong Limited, Structural Engineers ("Arup"); also the project Registered Structural Engineer ("RSE")
- PAYE Stonework and Restoration Limited, Masonry Contractors ("PAYE"), United Kingdom

[3] The preparatory work refers to the removal in 2020 of the extant portion adjacent to the collapsed part, referred to as the "West Room".

building movements. Considering the inherent weakness in the structure and uncertain load paths, it was concluded that robust methods of undertaking the recovery work cannot be developed with sufficient confidence in the safety of the operations necessary to carry them out (see paragraphs 14 to 20). Taking account of the expert team's advice and, being mindful that safety must be the top priority, The Hong Kong Jockey Club (the "Club") concluded in July 2021 that it had to terminate the implementation of the Updated Recovery Plan (see paragraphs 21 and 22).

- Given the grave circumstances of the situation, the Club and its consultants revisited the original eight recovery options[4] (Figure 2) with a view to identifying whether any alternative approaches could be applied to mitigate risk to within acceptable limits. However, exhaustive reviews have confirmed that there would be an undue risk of sudden collapse during the recovery work.

- As a result, the Club and its consultants are now in the process of pursuing an optimal solution that reconciles the retention of heritage value with the over-riding need to achieve an assured level of safety. It is therefore essential to arrive at the optimal solution by a process that is based in fact – a process that is particularly challenging when there are many unknowns regarding inherent weaknesses of the building. The aim is to identify and adopt a recovery scheme once the range of unknowns is within reasonable limits. To do this, it is first necessary to remove the historic fabric sufficiently to make the building safe and to retain what remains as a relic (see paragraphs 23 to 25). Detailed design work on the recovery schemes can then proceed, which will be shared with the Board as soon as sufficient information is available.

- As the condition of Block 4 has continued to deteriorate despite careful protection, the expert team advised that the parts of the extant building fabric that are unsafe to retain must be removed as soon as practicable before ongoing dilapidation further weakens the building fabric, which would make it more hazardous to handle. A plan for removal of unsafe fabric is proposed, and the rationale is explained (see paragraphs 26 and 27).

BACKGROUND

3. The CPS Revitalisation Project is a large-scale heritage conservation scheme aimed at conserving one of Hong Kong's most distinguished heritage assets for adaptive reuse. The Club has been leading the Project since 2008. Its objective was, and remains, to conserve safely as many heritage features as possible while sensitively adding compatible new elements to revitalise the site to create a heritage and arts centre for public enjoyment. This approach has earned the accolade of the UNESCO Asia Pacific Award of Excellence[5].

4. Of the sixteen historical buildings that were retained, fifteen have been meticulously conserved. The policy framework that has guided the Project is set out in the

[4] Original eight recovery options presented in the board paper (ref. AAB/33/2015-16) for the AAB meeting on 8 September 2016: (A) Restoration, (B) Reconstruction, (C) Adaptation, (D) Preservation, (E) Façade Retention, (F) Façade and Interior Retention, (G) Total Reconstruction and (H) Demolition

[5] UNESCO Award of Excellence October 2019. The citation reads: "The technical quality of the restoration work is standard-setting on an international level, ensuring the authenticity and integrity of the historic fabric. Innovative architectural and engineering solutions are underpinned by meticulous investigation and rigorous conservation principles."

Conservation Management Plan ("CMP") and the project vision statement. The revitalised CPS Compound operates as Tai Kwun – Centre for Heritage and Arts ("Tai Kwun"), which commenced operations on 29 May 2018. Block 4 has remained out of use owing to the partial collapse in May 2016 whilst much effort has been spent planning for its recovery.

5. Block 4 was constructed in 1862–64. Its construction form followed that of traditional British architectural styles but was modified to suit Hong Kong's sub-tropical climate. On the north and east façades (Figure 3), there are large arched openings between brick piers, and high ceilings, all intended to aid ventilation in the hot and humid weather. The building is roofed in Chinese clay tiles that are heavier than British tiles or slates.

6. As a result of the construction form of tall and slender piers, using low-strength materials and poor workmanship, the brick piers are more highly loaded yet weaker than those in British buildings of a similar date. Hence, Block 4 has inherent structural weaknesses and a lower safety factor than other buildings in the CPS Compound. Whilst other buildings were safely restored for adaptive reuse and have remained stable, Block 4 suffered a partial collapse during construction works whilst undergoing similar works.

7. The partial collapse and the further surveys and data gathering that have occurred since 2016 have presented a considerable challenge: on the one hand, Block 4 was, and remains, a key building on the site, in both the context of the former Central Police Station and now as Tai Kwun. Its close proximity to the primary entrance to the site and to the Parade Ground, its spatial relationship with the former Central Magistracy and being among the first substantial group of buildings built in the 1860s, all combine to place this building among the surviving principal group of buildings on the site. On the other hand, its building form, the materials used (Figure 4; Paragraph 11) and the poor workmanship (Figure 5) have rendered the building very fragile, and therefore vulnerable to local failure or even progressive collapse.

PREPARATORY WORK / BUILDING MOVEMENTS

8. Preparatory work necessary to enable the Updated Recovery Plan to proceed was carried out in 2020. It comprised the removal of roof tiles, roof timber trusses, brick walls and timber floors (Figure 6). It was carried out by a Registered General Building Contractor ("RGBC"), with qualified workers using hand tools in accordance with the industry best practice and work processes approved by government authorities.

9. During the removal of the West Room, four movement incidents were detected during daily inspections (Table 1). These building movements included enlargement of existing cracks in both vertical and horizontal directions (Figure 7), tilting, and settlement. Whilst small movements are not uncommon during construction works, in view of the 2016 partial collapse, these movements caused considerable alarm because they also included slight but unexpected movements of the east façade facing Arbuthnot Road, some twenty metres away from the West Room where the removal work was being carried out.

10. Another movement incident was detected more recently, on 3 November 2022, after typhoon 'Nalgae' (Table 1). Since there was no construction work going on at Block 4 at that time, the movement detected would likely have been caused by the environmental effects of wind and rain induced by typhoon Nalgae, and despite the extensive

temporary propping that was, and remains, in place. This is a clear sign of the building's fragility.

11. For each of the movement incidents, the RGBC prepared an incident report. Arup, the project RSE, then prepared and submitted the respective investigation reports to the Buildings Department, detailing the investigation and conclusion. Possible causes for each movement incident were identified but the root cause(s) could not be confirmed.

RE-APPRAISAL OF BUILDING CONDITION

12. The safety concerns that emerged during removal of the West Room triggered a re-appraisal in 2020–21 of the building's condition and design parameters. Its findings revealed that the building was in worse condition than was previously known. The basis for the change of view about the robustness of Block 4 lies in the widespread and very poor quality of materials discovered during the removal of the West Room where the expert team was provided with the opportunity to inspect a very large sample of the existing brickwork (approximately 57,000 bricks). The inspections revealed the weakness of many of the bricks exposed as explained below:

- *Visual Inspection* – The mortar in the West Room construction would have been prepared locally. Inspections revealed that large areas of the mortar have a powdery composition, with very little cohesion. It is so weak that it is possible to separate the bricks by hand easily (Figure 8). Thus the brick walls should be described as a loose assembly of low-strength bricks in a matrix of weakly-bound sand (Figure 9) rather than a cohesive structural unit.
- *In-Situ Assessment of Brick Hardness* – Inspections of various brick layers, assisted by the use of hand-tools, in the walls of the West Room (Figure 10) revealed that approximately 75% of the bricks are very soft (Figure 11). The distribution of these bricks is random.
- *Brick Compression Tests* – Compression tests on 40 brick samples were conducted (Figure 12). The test results show that the characteristic strength of the bricks is 4.32 N/mm^2, some 28 – 44% lower than the results of the previous comparable tests carried out in 2009 and 2016 (Table 2).

13. The above results were unexpected and not in line with the strength characteristics that had been established when the Updated Recovery Plan was prepared[6]. In summary, the new findings showed that the brickwork superstructure is more variable in strength and therefore has less predictable performance characteristics. Whilst the most recent tests apply to the bricks from the West Room only, it is reasonable to expect that the bricks

[6] It should be noted that the scale of the inspection conducted during the removal of the West Room was unique, and such an opportunity was not possible before because most of the brickwork was concealed under plaster or render of heritage value, and the previous investigations were limited to small, discrete areas.

extracted from the West Room walls are representative of the materials in the remainder of the building[7,8].

STRUCTURAL ENGINEERING RISKS

14. Most of the construction operations necessary to complete the Updated Recovery Plan are now considered to be unduly hazardous and are not capable of being mitigated. This stems from the use of relatively weak materials, generally not well built, in a multi-storey building with unduly large openings and tall, slender piers. The outcome of these factors is that the brickwork is excessively stressed but more significant is the fact that the areas of particular weakness cannot be identified with certainty. This makes the structural performance unfeasible to predict with sufficient certainty to mitigate risk to within acceptable limits.

15. *Hazards owing to Low Vertical Strength of Existing Brickwork under Gravity Loads*. The recent testing shows that some of the brickwork is very weak. Back-calculations suggest that the ground floor piers could be close to failure due to the self-weight of the brickwork alone. This would explain the compression failure cracks found in some of the piers (Figures 13, 14 and 15). As the ground floor piers could be close to failure due to the self-weight of the brickwork, even a very small change, for example owing to construction variations, could result in a collapse.

16. *Highest Hazard Operations*. The Updated Recovery Plan requires many operations, some of which are hazardous and invasive structural interventions. The highest hazard operations are considered to be:

- Removing the internal walls and floors, because these tie together the outer walls that were to be retained;
- Underpinning the existing walls (if required owing to excessive settlement on sheet pile installation), because this relies on the existing walls being able to temporarily arch between the pins which are constructed in a hit and miss pattern;
- Excavating for the new foundations because this is likely to result in some settlement of the foundations of the existing walls, even though they have been underpinned;
- Replacing the temporary props supporting the projecting bay on the north façade with permanent support (Figure 16);
- Replacing the temporary timber frames in each opening with new permanent steel brackets. (Figure 17);

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[7] *Brick Sampling*. The removal of the West Room walls provided an opportunity to extract a large number of grey brick samples, which would otherwise have been impossible to extract in significant numbers from within the existing walls. These samples provided a larger quantum of bricks available for testing than would ordinarily have been possible. The brick samples for compression tests were selected randomly from the bricks removed from the West Room walls in all three storeys, and grouped in two broad types: (i) 20 nos. whole bricks (10 nos. 'soft' whole bricks; 10 nos. 'not soft' whole bricks) and (ii) 20 nos. broken bricks (10 nos. 'soft' broken bricks; 10 nos. 'not soft' broken bricks).

[8] *Brick Sample Representativeness*. Whilst the most recent tests apply to the bricks from the West Room only, it should be noted that it was not constructed in isolation. Rather, it was built at the same time as the remainder of the building with the brickwork progressing vertically upward, course by course, as in a typical masonry construction method. It is therefore reasonable to expect that the bricks extracted from the West Room walls are representative of the materials in the remainder of the building.

- Repairing and, if necessary, rebuilding the slender piers (Figure 18). Given the poor condition of the brickwork, there is no certainty that a viable temporary works scheme can be developed for this operation;
- Temporary removal of the roof timber trusses, which are acting as ties between the outer walls, to facilitate the construction works owing to restricted site work area.

CONSTRUCTION HAZARDS

17. To retain the masonry fabric safely, the building first needs to be stabilised. To do this, four phases of work are required as outlined below. However, there is an underlying risk attached to this task because the masonry walls have limited structural integrity, which prevents educated judgements to be made in advance of and during the works.

    - Provide temporary vertical support to the structural arches and floors;
    - Restrain the external fabric (entailing invasive structural interventions which are themselves hazardous, Figure 19);
    - Remove the existing floors; and
    - Infill masonry voids by grouting and making good arches, etc, progressively with the removal work.

    These tasks rely upon the ability of the existing structure to bear short-term additional loads. A problem therefore arises when the structure is barely able to support its own weight, and the material strength is very weak, as in this case, which inhibits the ability to install temporary support safely.

18. The success of grouting of voids in masonry walls is based upon the three main factors below.

    - Extent of voids and ability to accommodate a flowable grout;
    - Grout injection pressure; and
    - Integrity of the wall to be grouted.

    The extent of voids and limited bonding arrangement / integrity within the walls of Block 4 is a concern when applying a pressurised grout[9]. Such increase in internal pressure could cause bulging of the weak masonry walls (Figure 20). When the weaknesses are random in location and widespread, it is not feasible to confirm the long-term integrity of the wall because of the inability to guarantee the extent of grouting or bonded masonry undertaken.

19. PAYE has assessed the risks associated with the building operations required to restore the building, which shows that:

    - Of the twelve operations evaluated (Figure 21), all are considered High Risk in the initial risk rating;
    - After introducing mitigation measures, the risk level of three items can be reduced to Medium Risk; and

[9] For example, the preferred grout is St Pauls Lime Grout which requires an increased grouting pressure to penetrate masonry voids

- The remaining nine items remain at High Risk.

20. The risk assessment raises major concerns about the health and safety risks of the Updated Recovery Plan, to the extent that there is undue risk of sudden collapse during the recovery work. PAYE's conclusion is that it is unfeasible to deliver the Updated Recovery Plan safely given the scale of invasive structural interventions required in light of the poor building condition and construction hazards identified (Figure 22).

TERMINATION OF UPDATED RECOVERY PLAN

21. Given the new findings and the construction hazards identified, the expert team believes that the recovery structural interventions will be far more hazardous than was initially anticipated. The low strength brickwork might not survive the structural interventions required. Local failure or partial collapse, similar to the partial collapse in 2016, may occur suddenly without warning, posing severe concern for the safety of workers, staff and visitors in the CPS Compound, as well as road users on Arbuthnot Road. The expert team therefore strongly advised against proceeding with the Updated Recovery Plan.

22. The control of risks to the health and safety of construction workers and the public, not least the adjacent public highway, Arbuthnot Road, is the highest priority of the Club. Ordinarily, such risks are manageable but in this case the expert team concluded, regrettably, that this was not practicable. Looking ahead with public safety as the principal consideration, the Club accepted the findings and advice of the expert team, and concluded in July 2021 that it had to terminate the implementation of the Updated Recovery Plan[10] and to seek an alternative recovery option.

DEVELOPMENT OF RECOVERY SCHEME

23. Since Block 4 has experienced a partial collapse, the recovery work must therefore be based on an approach that has sufficient certainty in construction safety to ensure building operatives, and ultimately members of the public, future users of the building facilities, visitors to Tai Kwun, and staff, tenants and programme partners who work there, will have full confidence in its safety. The Club and its consultants revisited the original recovery options in order to see whether any alternative approaches could be applied to mitigate risk to within acceptable limits, but arrived at the conclusion that, regrettably, there is no feasible method of undertaking the works that would provide sufficient confidence of avoiding a serious incident, such as further collapse and/or serious injury to operatives.

24. Given the outcomes of the re-appraisal and Block 4's status as a Declared Monument, the optimal recovery scheme is likely to be one that retains heritage fabric where it is feasible to do so whilst ensuring safety and sustainability[11]. In broad terms, the Club and its consultants are exploring two recovery options, i.e. (i) conserve-as-found[12] and

[10] "Update on the Married Inspectors' Quarters (Block 4) of the Central Police Station Compound", 9 July 2021, https://www.taikwun.hk/en/taikwun/press/press_release/update-on-the-married-inspectors-quarters-block-4-of-the-central-police-station-compound/117

[11] "Sustainability" here means that the recovery scheme should facilitate a new use that is sustainable in the long term.

[12] Conserve-as-Found option – This option seeks to remove the historical fabric that is strictly necessary to make Block 4 safe and to retain what remains as a relic. The aim would be to convey some tangible sense of the building after removal of the unsafe building fabric.

(ii) new building[13], which are basically derived from the original eight recovery options (see Footnote 4). Working out what this means in detail is ongoing. As soon as sufficient details are available, the recovery schemes will be shared with the Board.

25. In the meantime the Club seeks to remove only the historical fabric that is strictly necessary to make the building safe and to retain what remains as a relic. The precise extent of retained fabric will be subject to the structural expert's advice and permitted limits under the Building Regulations. What can be said at this stage is that the granite retaining walls facing Arbuthnot Road and the Sergeant's Yard (Figure 23) would be capable of retention. As to the superstructure and masonry wall foundations, it is envisaged that a series of defined stages of removal works will be completed, followed by inspections and testing to confirm the extent of historic fabric that could be safely retained. With public safety being the most important principle, the long-term safety performance of the masonry structure must be the primary criterion to determine the extent of building fabric that can be kept.

PROPOSED SCHEDULING OF BLOCK 4'S REMOVAL WORKS

26. As the condition of Block 4 has continued to deteriorate despite careful protection, the expert team advised that the parts of the extant building fabric that are unsafe to retain must be removed as soon as practicable before ongoing dilapidation further weakens the building fabric, making it more hazardous to handle. The Club therefore proposes to submit an application for a permit under section 6 of the Antiquities and Monuments Ordinance ("Section 6 permit") to the Antiquities Authority (i.e. Secretary for Development) to enable commencement of Block 4's preparation for the removal works (i.e. site hoardings, catch fans, working platforms, etc) to start in June 2023, with physical removal works starting in November 2023.

27. Scheduling the physical removal works to start in November 2023 is to ensure that all risky removal works at height (e.g. removing roof clay tiles and timber roof trusses, taking down fragile masonry arches and piers, particularly those facing Arbuthnot Road and the Sergeant's Yard) can be completed before the next typhoon season in May 2024. Failing to commence in June 2023 would mean deferring the removal works for another year and prolonging the deterioration of Block 4 in what is a live, publicly-accessible site.

CONCLUDING REMARKS

28. Block 4's partial collapse was a most unfortunate incident that has damaged the heritage value of the building and the site. Six years on, the detailed studies and lengthy deliberations on Block 4 demonstrate the Club's commitment to facing substantial technical, practical and engineering challenges necessary to recover the building for adaptive reuse. Despite the unfortunate situation concerning Block 4, the Club remains committed to achieving an optimal solution that reconciles the need to retain heritage value whilst achieving a sustainable long-term future and to do so safely.

[13] New Building option – This option is a wholly new building that would replace the extant building in a form similar to the present building and thus reinstate the spatial relationship between the extant Block 4 and its neighbours, including the Parade Ground.

29. The findings of the re-appraisal in 2020–21 have clearly shown that the weaknesses of the building are random in location and widespread, which means they cannot be pinpointed and the likelihood of failure quantified. Test results obtained from the re-appraisal show that the estimate of the brickwork compressive strength is some 28 – 44% lower than the previous comparable tests carried out in 2009 and 2016, which reduces the strength to a level below the acceptable limit stipulated by the current masonry code of practice. Given these new findings and the construction hazards identified, the expert team believes that the structural interventions necessary to carry out the recovery operations will be far more hazardous than was initially anticipated. As there is an undue risk of sudden collapse during the recovery work that cannot be mitigated, the expert team strongly advised against proceeding with the Updated Recovery Plan.

30. In the short term, Block 4 has been kept in a stable condition by extensive temporary support (Figure 24; Table 3). The building condition is also monitored daily by detection devices and by the inspection of a care and maintenance contractor. It is however necessary to acknowledge that, according to the expert team, the condition of Block 4 has continued to deteriorate despite careful protection. Hence, the parts of the extant building fabric that are unsafe to retain must be removed as soon as practicable before the ongoing dilapidation further weakens the building fabric, making it more hazardous to handle. A removal work schedule is thus proposed in that the preparation for the removal works will start in June 2023, with physical removal works starting in the non-typhoon season in November 2023. **To enable this, a Section 6 permit application will be made in early 2023 for approval**.

31. The Club and its consultants are now pursuing a solution as a result of the above outcomes. At present, the recovery schemes are in the early development stage, which are expected to be shared with the Board as soon as sufficient details are available.

32. Members of the AAB are invited to note the latest development on the recovery of Block 4 and to offer views on the content of this Paper.

The Hong Kong Jockey Club
December 2022

Tables and Figures

Table 1 – Summary of four movement incidents during preparatory work of Block 4

Date	Number of Monitoring Devices Detecting Movements	Location(s) of Building Movements
22 Jun 2020	13	Ground floor west corbel and brick pier on east façade; Second floor arch portal
29 Sep 2020	1	Ground floor west corbel
29 Oct 2020	2	Second floor arch portal
2 Dec 2020	1	Second floor arch portal
3 Nov 2022	1	Ground floor west corbel

Table 2 – Summary of brick compression test results

Brick Compression Tests	2009	2016	2021
No of bricks tested	5	10	40
Mean compressive strength	11.42 MPa	13.54 MPa	8.35 MPa
5% Characteristic strength	5.97 MPa	7.72 MPa	4.32 MPa

Coupled with the weak and powdery mortar, the low brick compressive strength means the brickwork (i.e. the combined strength of bricks and mortar) would likely be weaker than the lowest characteristic value of 2.2 N/mm^2 (▭) as recommended in Table 2 of BS 5628 – *Code of practice for use of masonry* (see extract below).

Table 2 — Characteristic compressive strength of masonry, f_k, in N/mm^2

a) — Constructed with standard format bricks of clay and calcium silicate having no more than 25% of formed voids, or 20% frogs											
Mortar strength Class/Designation	Compressive strength of unit (N/mm^2)[a]										
	5	10	15	20	30	40	50	75	100	125	150
M12 / (i)	2.5	4.0	5.3	6.4	8.3	10.0	11.6	15.2	18.3	21.2	23.9
M6 / (ii)	2.5	3.8	4.8	5.6	7.1	8.4	9.5	12.0	14.2	16.1	17.9
M4 / (iii)	2.5	3.4	4.3	5.0	6.3	7.4	8.4	10.5	12.3	14.0	15.4
M2 / (iv)	2.2	2.8	3.6	4.1	5.1	6.1	7.1	9.0	10.5	11.6	12.7

Notes to Table 2, BS 5628:

- As shown in the second column of the table above, the lowest compressive strength of bricks allowed by the code is 5 N/mm^2 (▭). The Block 4's brick compressive strength of 4.32 N/mm^2 is even lower than the lowest required by the code.

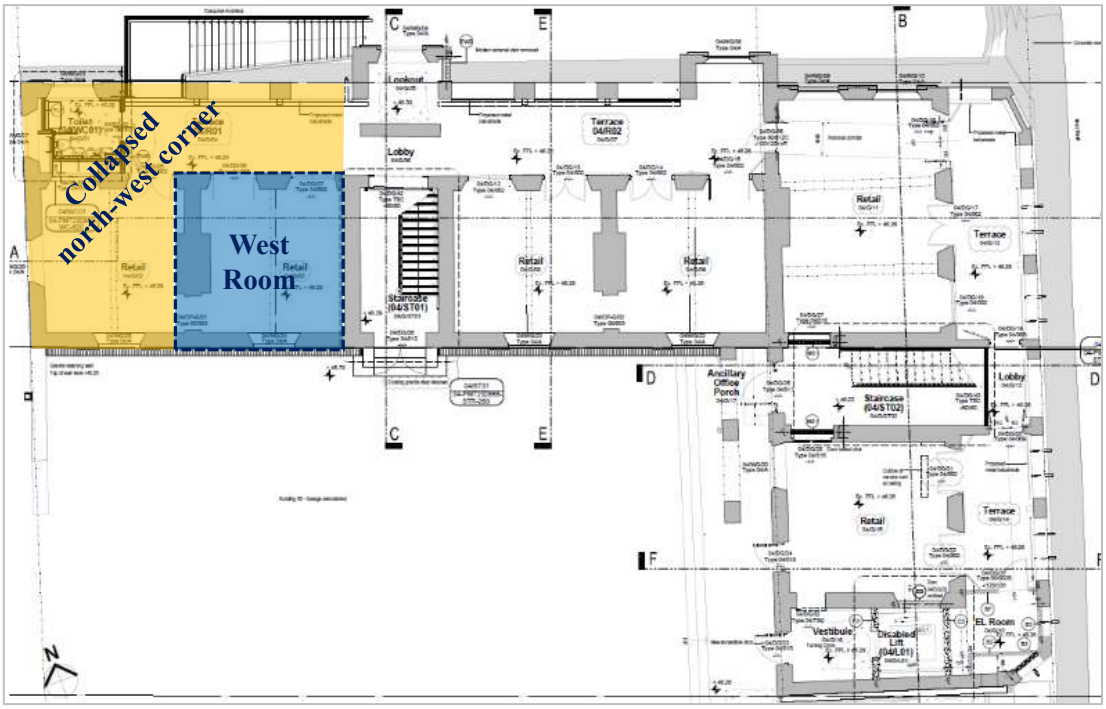
- Block 4's mortar strength is considered worse than Class M2 / (iv) ( ) because of its low 'cementitious material'-to-sand ratio. Therefore, the characteristic strength of masonry (bricks + mortar) would be lower than 2.2 N/mm^2.
- The code requires the above value to be further divided by a material factor of 3.5 to obtain a design strength (i.e. 2.2÷3.5), meaning that the design strength of the masonry will be less than 0.63 N/mm^2. In practice, the actual strength will be even lower owing to the voids and poor bonding observed and also to the slenderness of the piers.

Table 3 – Summary of temporary support to Block 4

Date	Locations / Nos of Props		Remarks
	Floors	Internal & External Arched Openings	
May 2016	**336**	–	Immediately after the partial collapse
April 2019	–	**272**	Upon recommendation by the UK experts
May 2020	+ 60 = **396**	–	Before the preparatory work (i.e. West Room removal)
Aug 2020	+ 406 = **802**	–	After detection of building movements during the West Room removal

Note – For a total floor area of approximately 790 square metres, there are some 802 props for the floors and 272 props for both internal and external arches

(a)



(b)

Figure 1 – (a) Aerial views of partially collapsed Block 4 (North Wing) with extent of West Room indicated diagrammatically in broken lines;
(b) Ground floor plan indicating location of partially collapsed portion and West Room

(A) Restoration

(B) Reconstruction

(C) Adaptation

(D) Preservation

(E) Facade Retention

(F) Facade and Interior Retention

(G) Total Reconstruction

(H) Demolition

Figure 2 – Original eight recovery options presented in the AAB meeting on in September 2016

Figure 3 – Block 4 before partial collapse. The design provides relatively tall ceiling heights and large window openings to aid ventilation in the hot and humid climate of Hong Kong, resulting in large arched openings with brick piers in between on the north and east façades

(a)   (b)

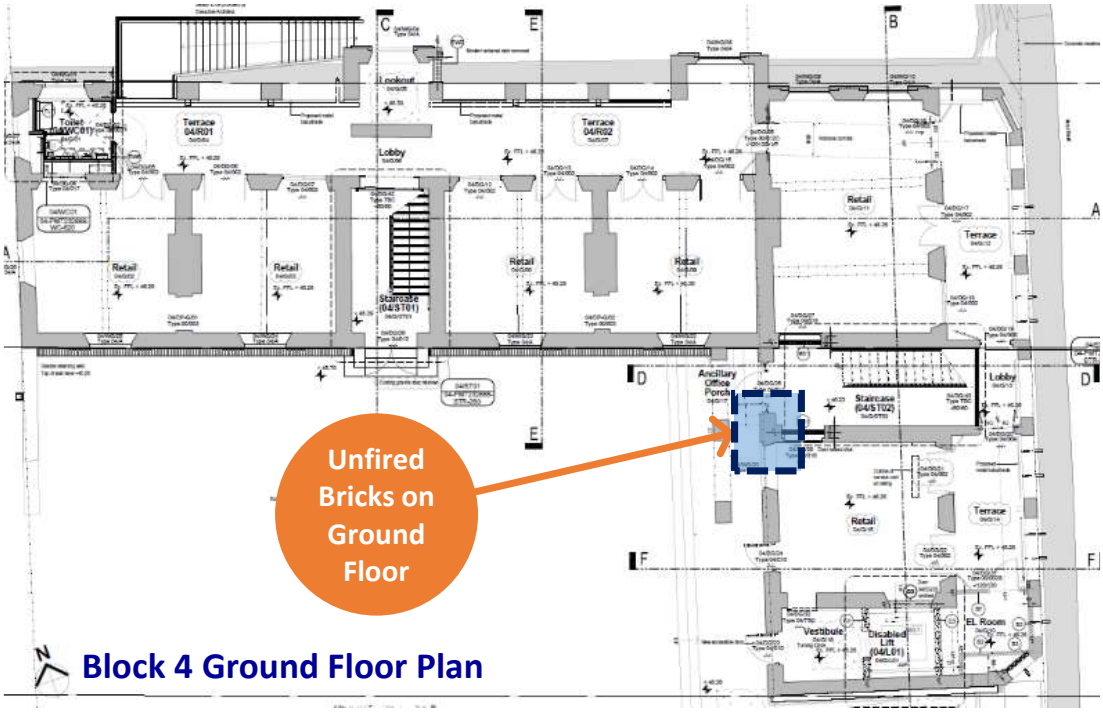


Figure 4 – (a) & (b) Views of brickwork after removal of plaster. Some bricks appeared to be unfired and could be rubbed away by hand;
Ground floor plan indicating location of unfired bricks (one of many locations)

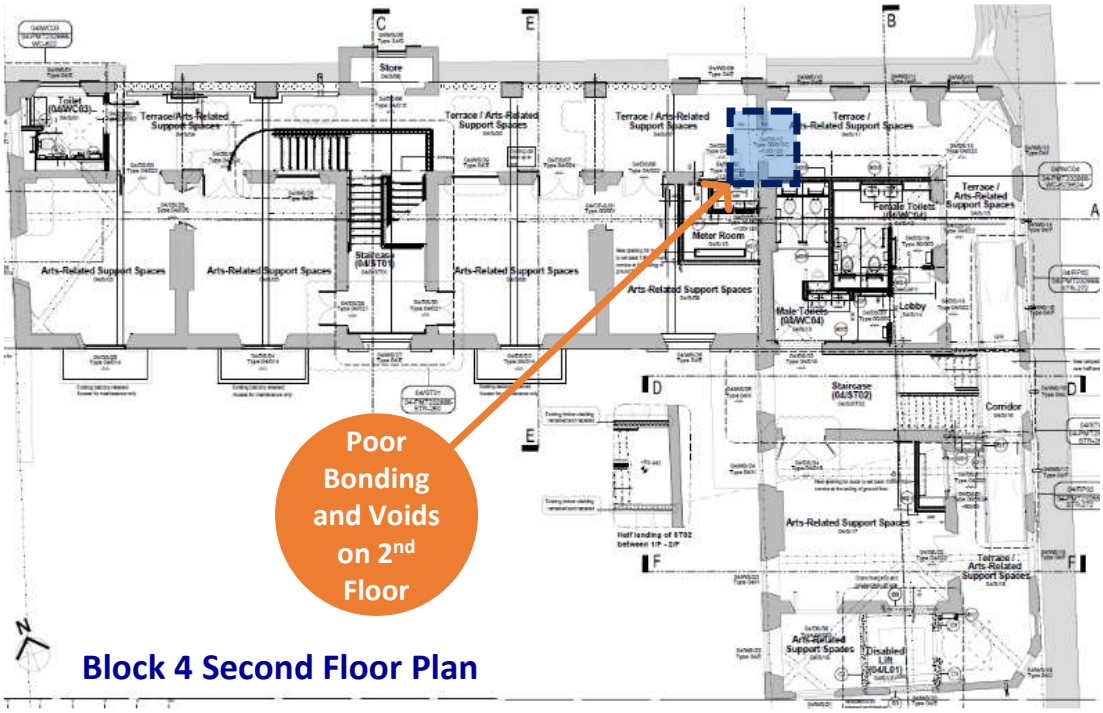
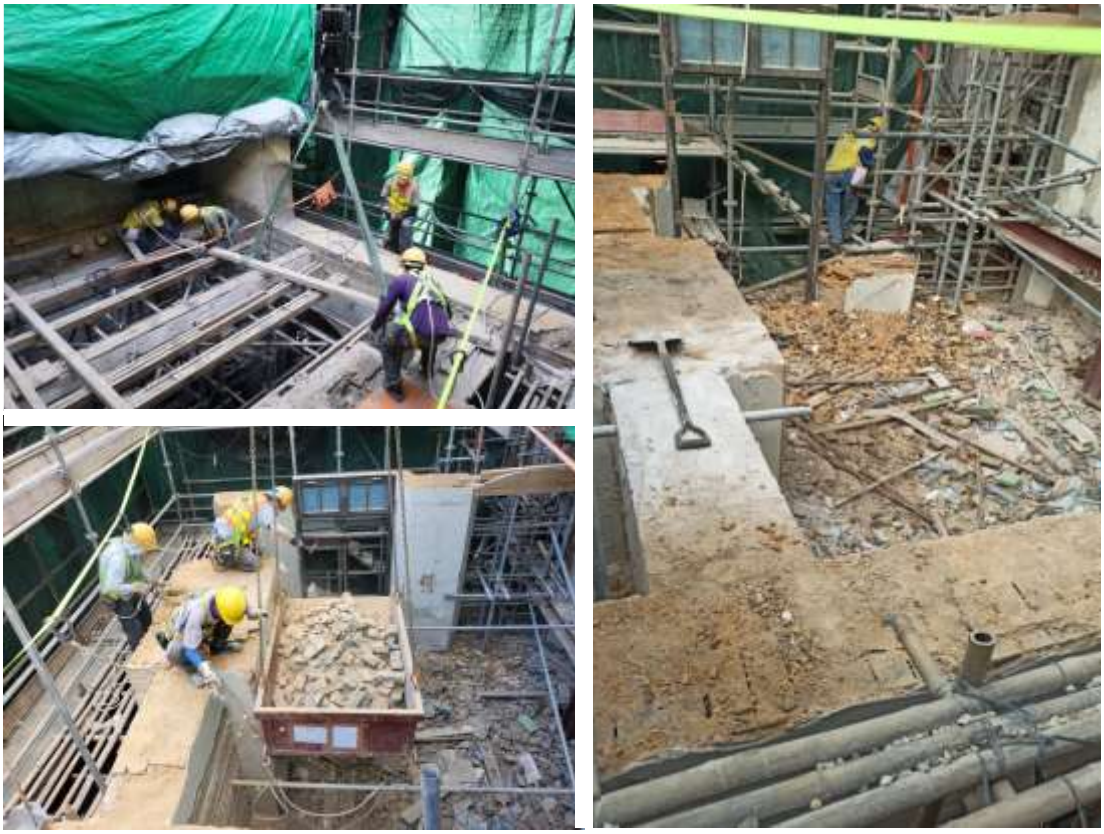


Figure 5 – Views of brickwork showing poor bonding and voids in the centre of the walls whilst cutting new door openings;
Second floor plan indicating location of walls with poor bonding and voids



(a)

(b)

Figure 6 – (a) Work-in-progress views of preparatory work (West Room removal)
(b) Completed preparatory work (West Room removal) in December 2020

(a)   (b)

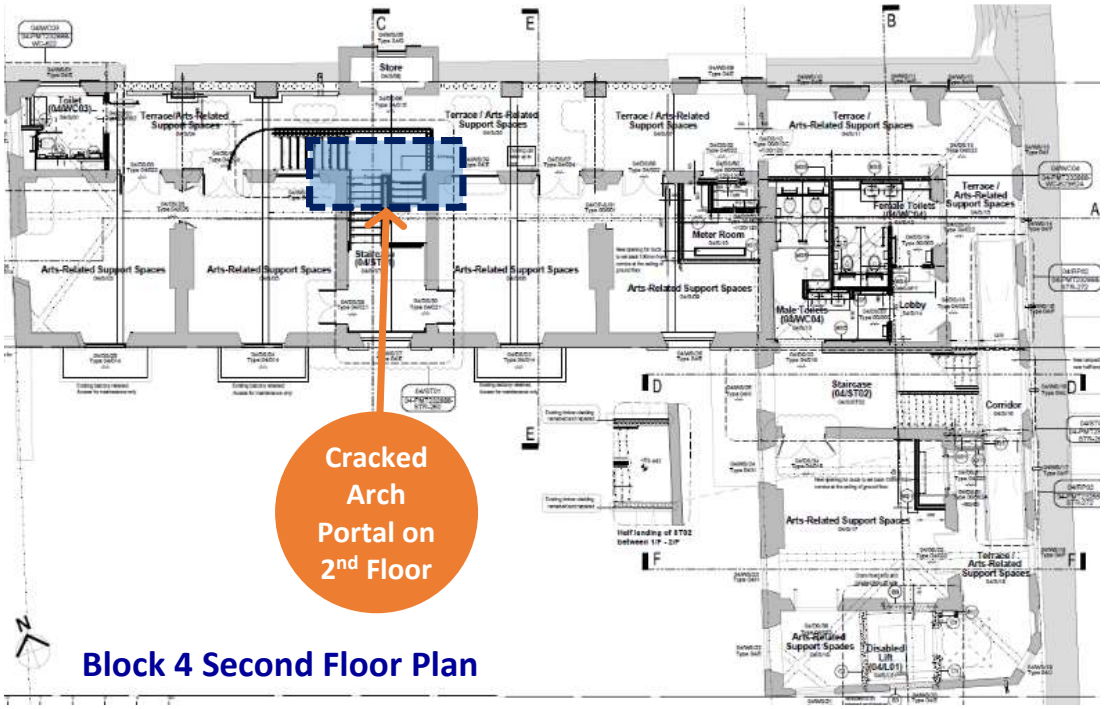


Figure 7 – (a) Overview of second floor arch portal;
(b) Close-up view of second floor arch portal showing enlargement of exiting crack;
Second floor plan indicating location of arch portal

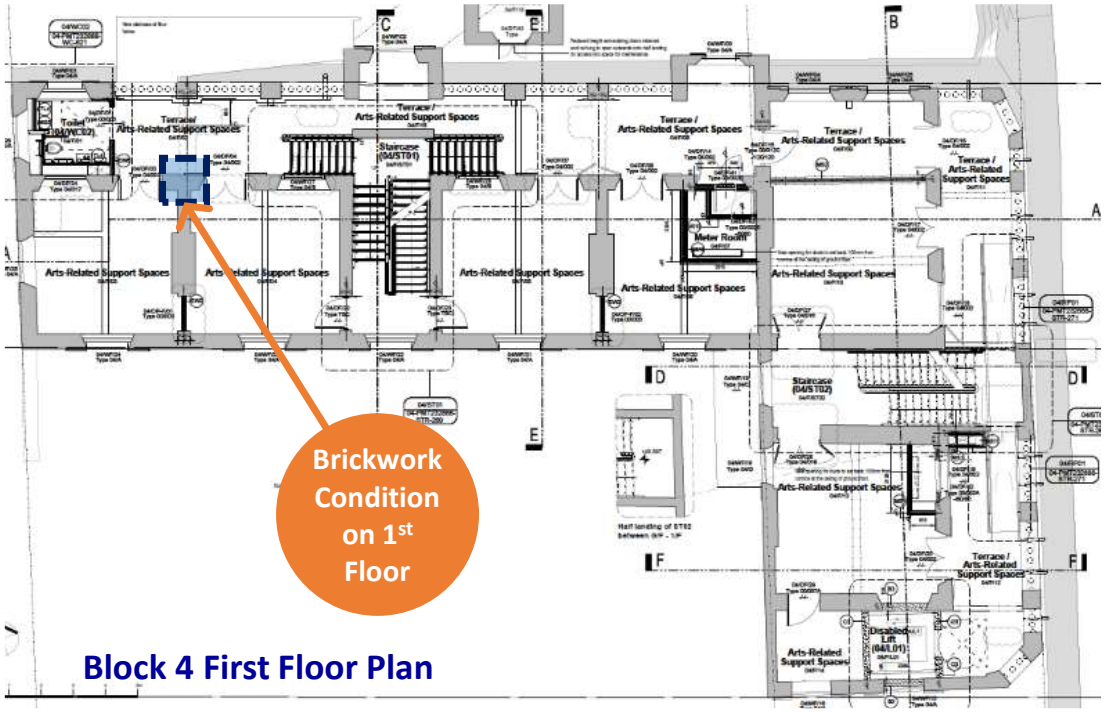


Figure 8 – Mortar is weak and powdery with little cohesion, and it is possible to separate bricks by hand easily
First floor plan indicating location of poor brick condition

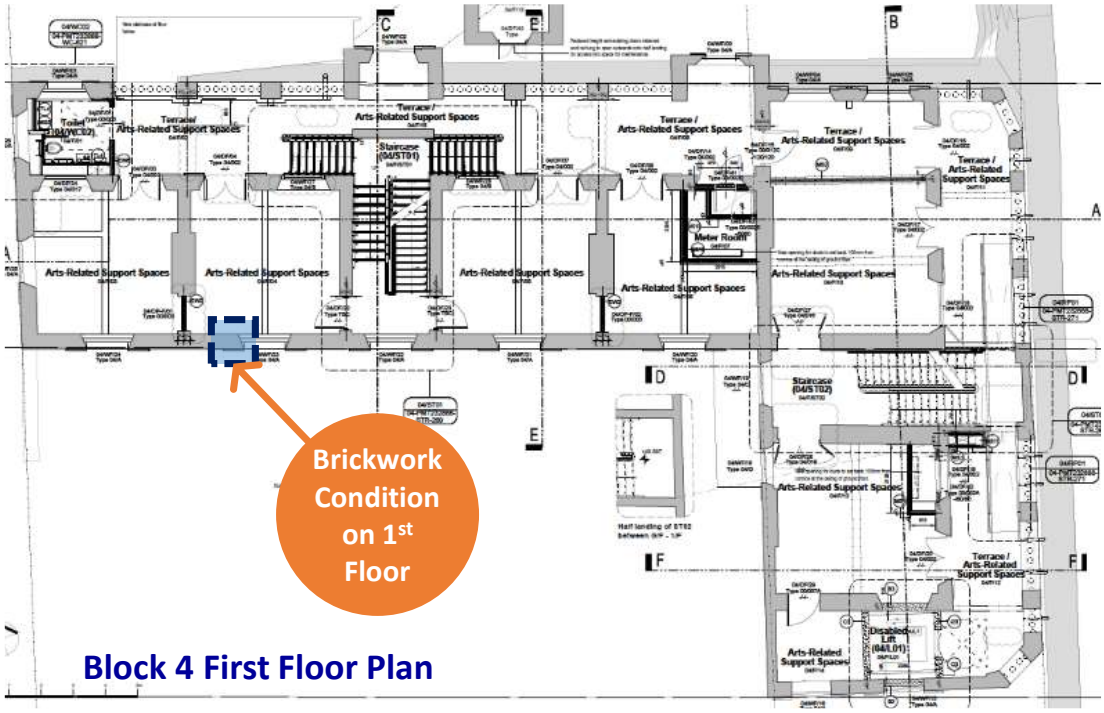
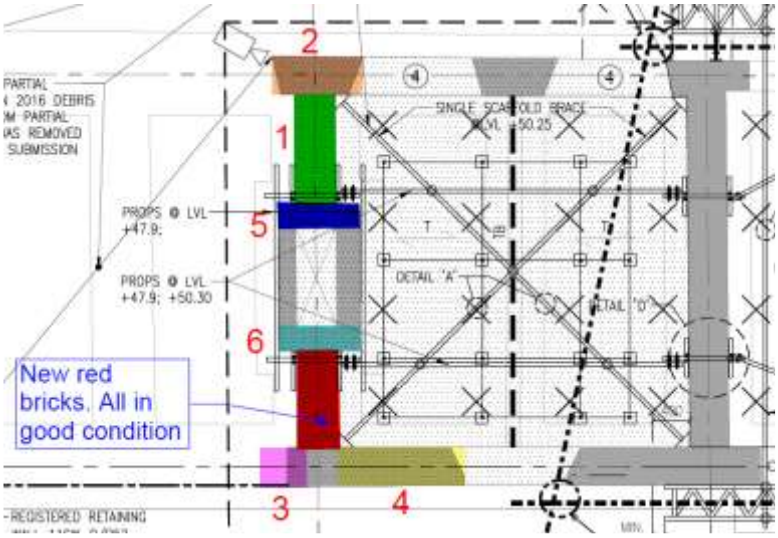


Figure 9 – View of brickwork during removal of the West Room, showing powdery mortar with very little cohesion. Brick walls are more an assembly of weak bricks in a matrix of sand than a cohesive structural units
First floor plan indicating location of poor brick condition

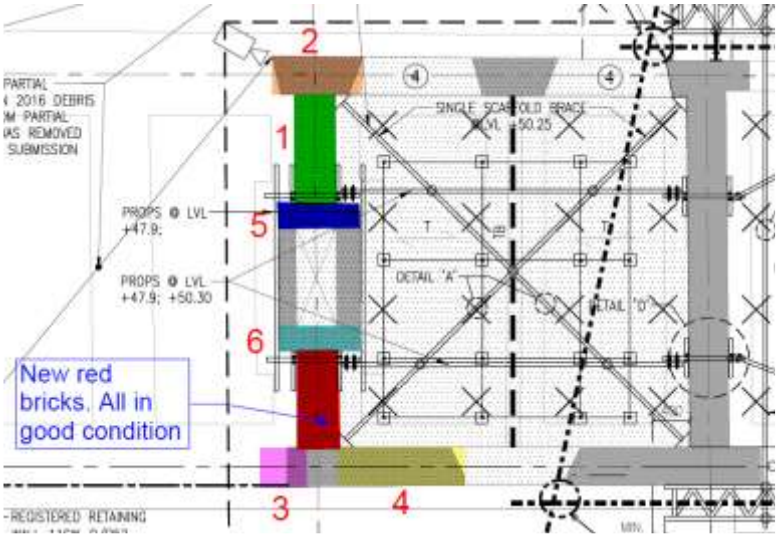
Figure 10 – Layer-by-layer inspection of brickwork during removal of the West Room by Purcell and Arup



Wall layout plan of West Room.

The two images below show brick inspection findings (soft and non-soft bricks) at wall locations **[1]** and **[6]**

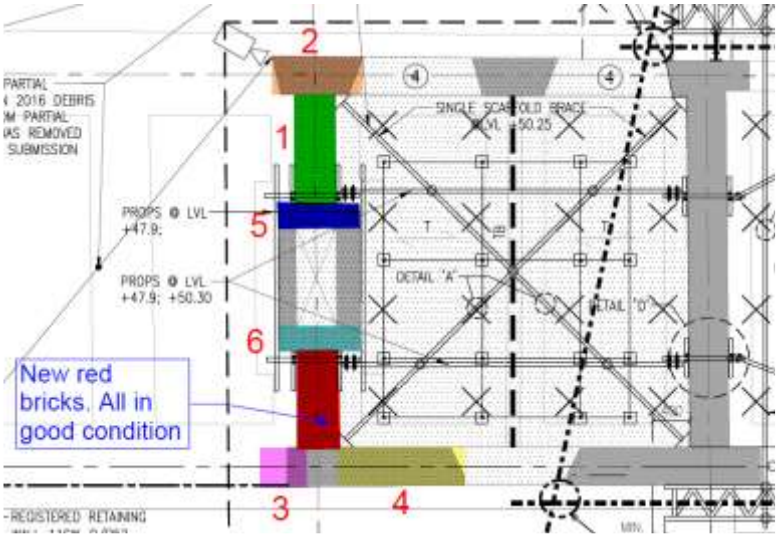
Figure 11 – (a) Approximately 75% of the bricks in random locations were considered soft ("X" Soft brick; "O" Not soft brick)



Wall layout plan of West Room.

The two images below show brick inspection findings (soft and non-soft bricks) at wall locations **[2]** and **[3]**

Figure 11 – (b) Approximately 75% of the bricks in random locations were considered soft ("X" Soft brick; "O" Not soft brick)



Wall layout plan of West Room.

The two images below show brick inspection findings (soft and non-soft bricks) at wall locations **[4]** and **[5]**

Figure 11 – (c) Approximately 75% of the bricks in random locations were considered soft ("X" Soft brick; "O" Not soft brick)

Figure 12 – Forty brick samples were collected for compression tests with results showing that the characteristic compressive strength of the bricks was only 4.32 N/mm^2

Defect No **DB-19**, Photo Ref. **P4163120**

Defect No **DB-20**, Photo Ref. **P4163123**

Extract from Appendix C4 of Structural Condition Survey – Volume 3, Final Report 2009 – Defect Photographic Record for Dormitory A and B

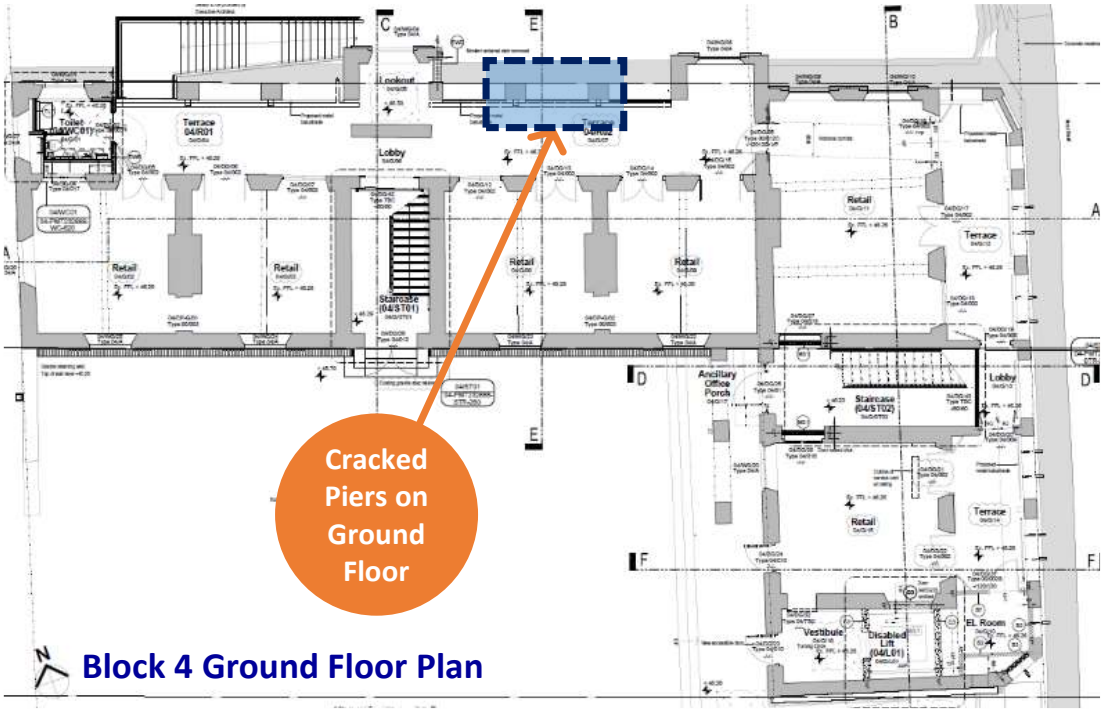


Figure 13 – 2009 structural survey identified cracked piers in the north façade which would require further investigation and structural repair;
Ground floor plan indicating location of cracked piers

Before rebuilding (discovered on 27 September 2014)
Extract from Appendix D2, 214A Repair Survey Report Revised, Building 04 – Married Inspectors, North Elevation, Central Police Station Hong Kong, Stonewest (HK)

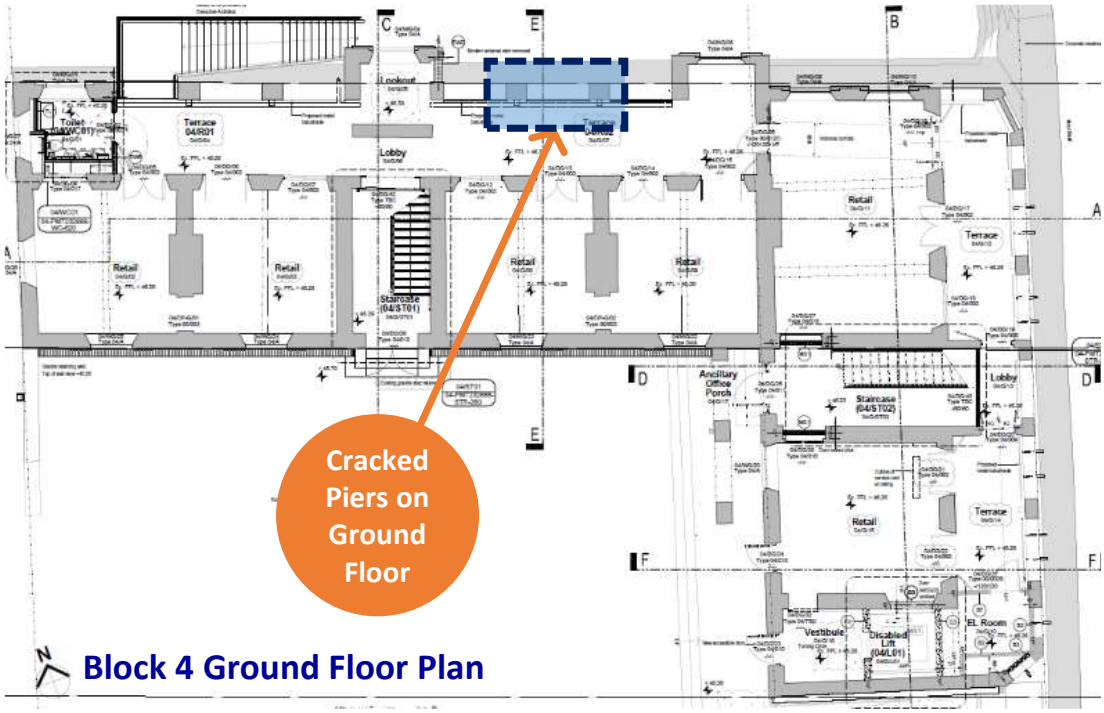


Figure 14 – 2014 repair works, major cracks in two brick piers on north facade discovered (Note – These two brick piers were repaired);
Ground floor plan indicating location of cracked piers

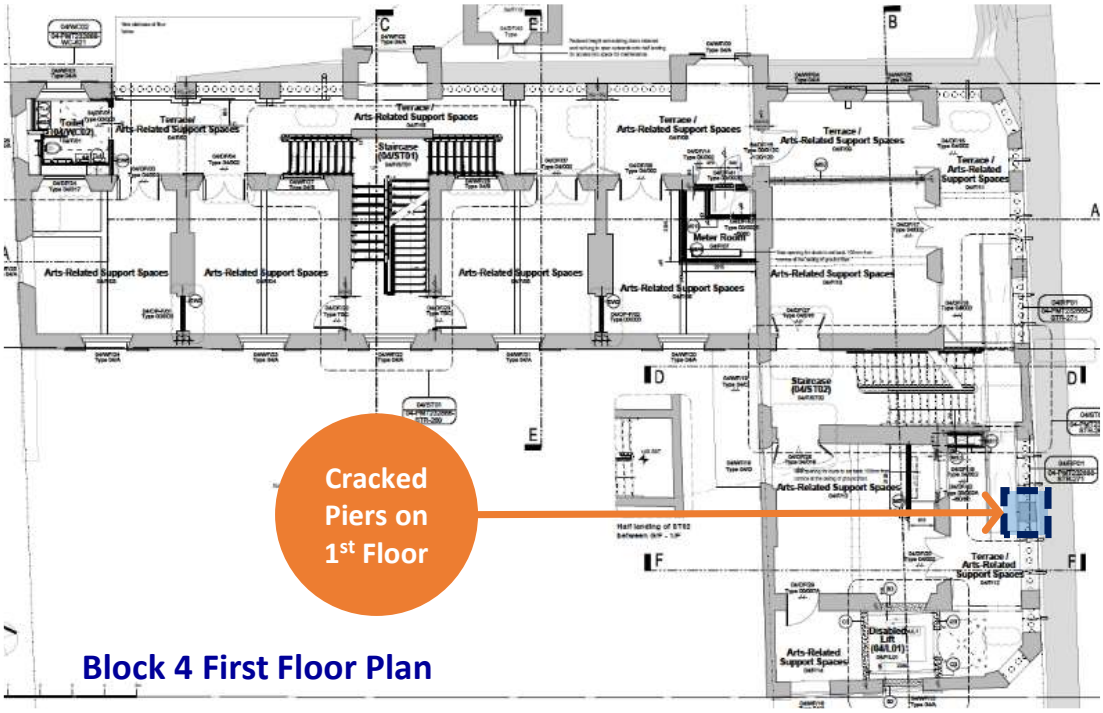


Figure 15 – Hidden cracks in brick piers which were revealed after removal of window frames on ground floor and first floor;
First floor plan indicating location of cracked piers

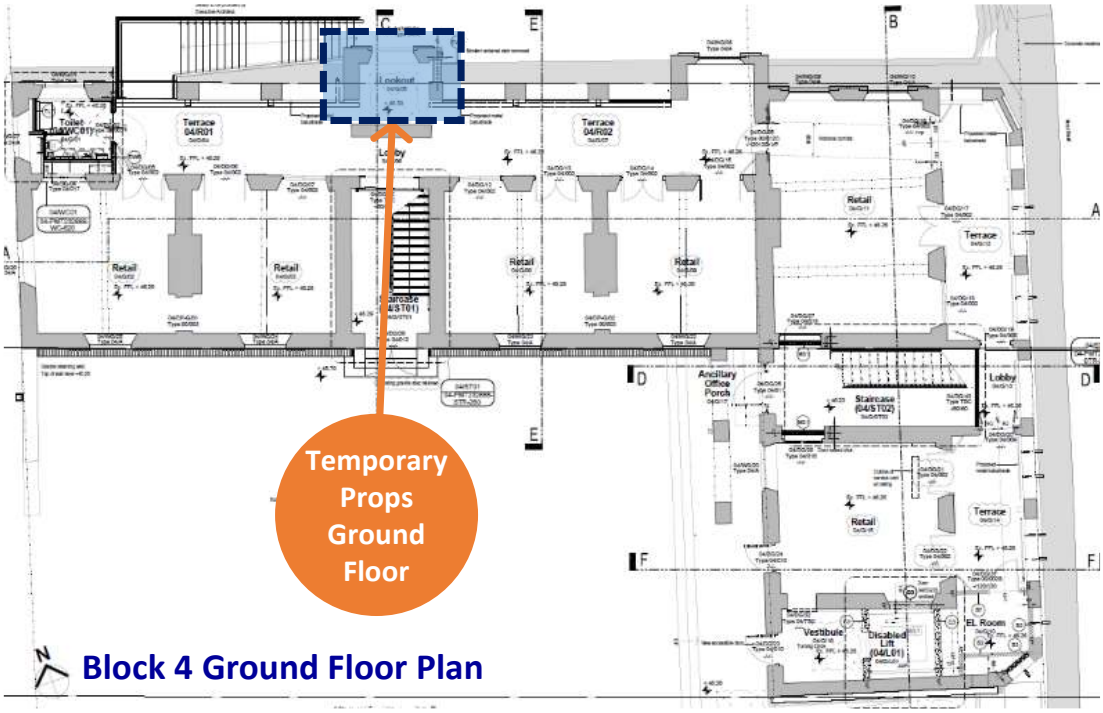
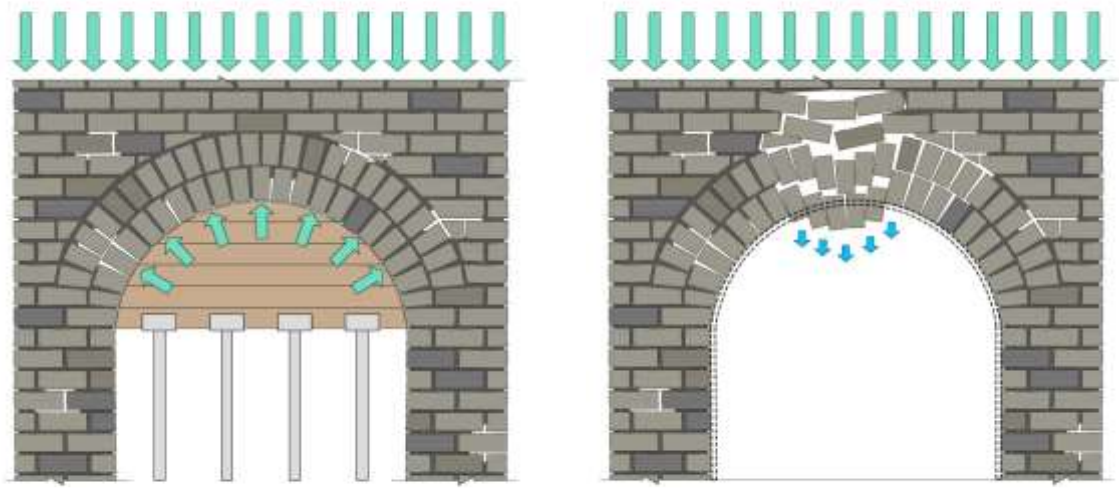


Figure 16 – Temporary props to projecting bay on north facade (needs to be replaced by permanent supports which is a high hazard operation)
Ground floor plan indicating location of temporary props to projecting bay

(a)



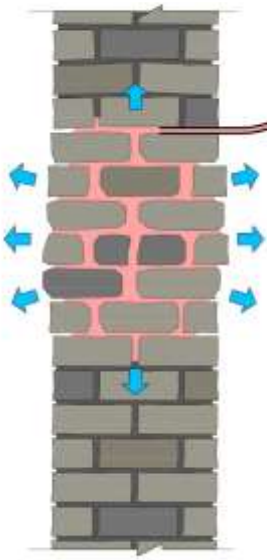
(b)

Figure 17 – Replacing temporary timber pack (supported by steel props) by permanent steel brackets, inducing hazards as it is difficult to envisage a sequence where brick arches are not left unsupported

Figure 18 – Slender and cracked brick piers in poor condition remain standing (supported by temporary works), and substantial repairs will be required in recovery work

Given the hidden weaknesses within the masonry, the technically feasible design / interventions are now considered particularly ambitious. As recent testing in 2020–21 has reduced confidence in the masonry, the construction will be more hazardous than was the case when the **Updated Recovery Plan** was developed.

Figure 19 – Hole-drilling through masonry facade, several hundred in quantity, is required to restrain the facade to a shoring system; this type of structural interventions are now considered ambitious as recent testing had reduced confidence in the masonry



Voids Grouting – Pressure grouting to penetrate masonry

Given the hidden weaknesses within the masonry, the technically feasible design / interventions are now considered particularly ambitious. As recent testing in 2020–21 has reduced confidence in the masonry, the construction will be more hazardous than was the case when the **Updated Recovery Plan** was developed.

Figure 20 – Grouting of voids in masonry walls is required to restore integrity. However, the increase in grout pressure could cause sudden bulging of weak brick walls; this type of structural interventions are now considered ambitious as recent testing had reduced confidence in the masonry

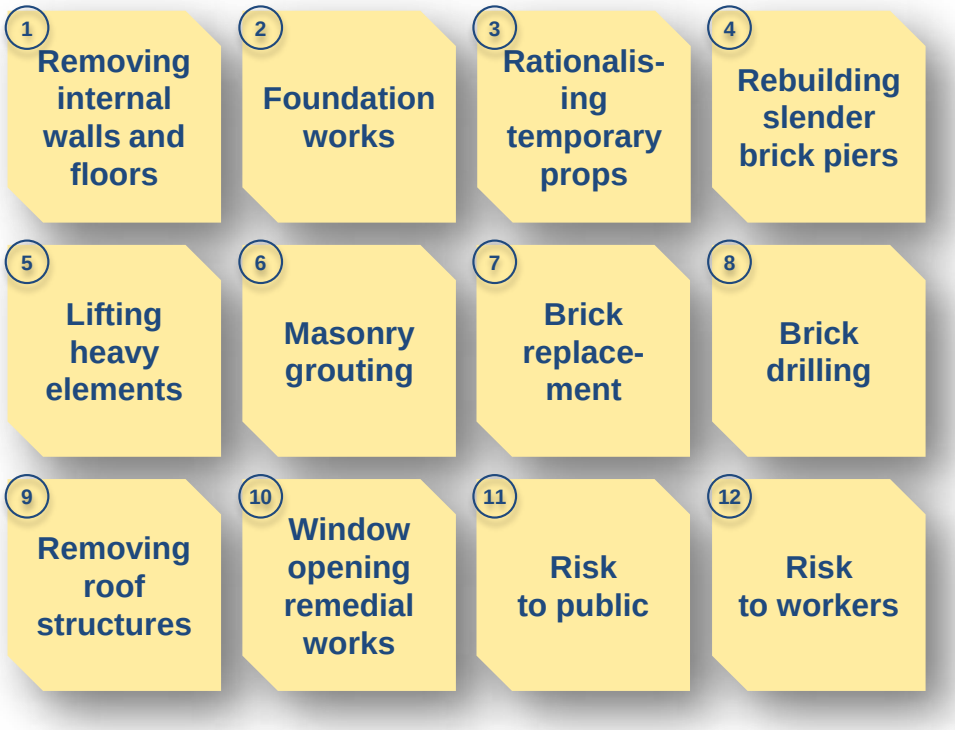


Figure 21 – Twelves operations considered in PAYE's standardised risk assessment

	Heritage Risk	Risk Rating (Pre-Controls)			Assessed risks and concerns	Residual Risk Rating		
		S	L	R		S	L	R
1	Removing internal walls and floors	5	5	25	Walls are providing stiffness and restraint of the facades through creating the thrust block to flat arches. Window propping removal will be protracted.	5	3	15
2	Foundation works	5	5	25	Confined working space. Risk that any vibratory works will dislodge the fragile masonry components.	5	4	20
3	Rationalising temporary props	5	5	25	Unable to determine which of the props within the 3 phases of installation are providing the primary support. Unable to determine the loadpath vertically and laterally.	5	5	25
4	Rebuilding slender piers	5	4	20	Difficulty in achieving temporary support. Mortar specification and setting times will prolong the process. Masonry panel above is fragile and the risk of collapse remains a constant concern.	5	4	20
5	Lifting heavy elements	5	3	15	Strict lifting plan in place. Design to reduce number of lifts required. Protect lifting areas with scaffold as a buffer zone. Lift away from fragile masonry	5	3	15
6	Masonry grouting	3	5	15	Weakness of masonry to resist hydrostatic pressure. Clamp façade but masonry bond remains questionable.	3	3	9
7	Brick replacement	5	4	20	Fragility of masonry and loss of mortar bond is a constant problem. Sudden collapse will undertaking the works is a constant concern.			
8	Brick drilling	5	5	25	Weakness of masonry and risk of bursting through compounded by limitations in bracing/clamping façade because of existing temporary props. Diamond drill.	5	3	15
9	Removing roof structure	5	3	15	Roof is providing some strength to the building and temporary restraint will be required.	3	3	9
10	Window opening remedial works	5	3	15	The requirement to transfer support safely from temporary frame to permanent condition needs to be developed.	4	3	12
11	Risk to public	5	4	20	Risk to public from sudden collapse remains a constant concern even with FRS in place.	5	3	15
12	Risk to workers	5	5	25	Risk to workers from sudden collapse.	5	4	20

KEY	PARTY (P)	SEVERITY (S)	LIKELIHOOD (L)	RISK (R) = (S) x (L)
	M = Management S = Supervisor O = Operative T = Third Party C = Client	1 = Trivial damage to historic fabric 2 = Minor damage to historic fabric 3 = Major damage to historic fabric 4 = Major damage / injury 5 = Collapse / risk to life	1 = Improbable occurrence 2 = Remote occurrence 3 = Possible occurrence 4 = Probable occurrence 5 = Likely occurrence	13–25 = HIGH RISK 6 –12 = MEDIUM RISK 1 – 5 = LOW RISK

The high scores within the risk assessment and predominantly red colour coding raises some major concerns regarding the health and safety risks associated with the 2019 Updated Recovery Plan and constant risk of sudden collapse during the works

Figure 22 – PAYE's standardised risk assessment of twelves items of the Updated Recovery Plan. Results show that the remaining nine items are High Risk still, including risk to public and workers

(a) Granite retaining wall on Arbuthnot Road

(b) Granite retaining wall facing Blocks 6 and 7; granite retaining wall on Pottinger Ramp

Figure 23 – Granite retaining walls being retained in both recovery options in "Ruins Approach"

Figure 24 – Presence of densely installed propping (making it harder to undertake follow-on works safely)