Shatin to Central Link – Contract 1109

Incident Report on the Construction of the Internal and Parapet Walls at TKW Station

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1. Executive summary

Upon receipt of a media enquiry on 5 June 2018 regarding the construction defects at an internal wall and the adjacent parapet wall at To Kwa Wan Station ("**TKW**") under construction as part of Shatin to Central Link ("**SCL**") Contract 1109, MTRCL took immediate action.

The responsibility for the construction rests with the Contract 1109 contractor Samsung Hsin Chong Joint Venture ("**Contractor**") and on 7 June 2018, MTRCL met with the Contractor to investigate the issue. On 8 June 2018, the Contractor confirmed in writing that part of the completed works were not in accordance with the approved drawings. On the same day, MTRCL immediately requested from the Contractor (i) a remedial plan; and (ii) further information including as to whether there were similar issues elsewhere in Contract 1109. On 15 June 2018, the Contractor submitted a report to MTRCL which included the remedial plan as well as confirming 2 other "suspected areas" with similar deviation from approved drawings.

Concurrent with our requests for information from the Contractor, we have conducted our own investigation into this matter which included interviewing 9 members of our staff. In this investigation the Contractor has declined the requests from MTRCL to interview its staff.

The construction subject to this investigation is a completed 200mm thick internal wall located adjacent to Staircase ST-03 and ST-04 near the upper platform level (the "**Internal Wall**") in TKW. Our investigation and the report by the Contractor indicate that the Internal Wall and the Parapet Wall were constructed in accordance with the approved drawings and followed the same quality control procedures as in all MTRCL projects using our Project Implementation Management System ("**PIMS**'), where "Hold Points" are specified and relevant forms (Request for Inspection/Survey Checks ("**RISC**") Forms) were in place, inspected and signed off by both the Contractor and MTRCL engineers / inspectors as appropriate.

Following construction, part of the front face of the Internal Wall was found to have slightly shifted toward the public area of the station due to bulging of formwork during the concreting process, resulting in over-casting of concrete in uneven thickness at

different areas of the wall surface. To remedy this bulging the process is a straight forward concrete trimming and repair for which there is a clear approved method statement. However, during the subsequent remedial trimming of the over-cast concrete to achieve a smooth surface for tiling, some of the reinforcement bars at a localized area (which the Contractor estimates at approximately 18m^2) were removed from one face of the Internal Wall. This is an unauthorised deviation from the approved method statement. The Contractor reported on 15 June 2018 that similar situations are suspected to have occurred at two other localized areas (which the Contractor estimates at approximately 8m^2 and 33m^2) of the same Internal Wall adjacent to Staircase ST-04. It should also be noted that the average thickness of the internal wall after trimming ranges from 175mm to 180mm respectively at staircases ST-03 and ST-04.

The total area of the Internal Wall adjacent to each Staircase (i.e. ST-03 and ST-04) is approximately 350m^2 (i.e. 700 m^2 in total for both staircases) and the area of concrete trimming for each Staircase estimated by the Contractor was approximately 160 m^2 (i.e. 320 m^2 in total for both staircases). The Contractor has advised that it has carried out extensive review of the "suspected areas" requiring further investigation and has employed a specialist to conduct non-destructive testing over these areas. The Contractor's estimate is that of the approximately 320 m^2 concrete trimmed area a total area of approximately 60 m^2 may not have been in accordance with approved drawings. Contrary to media reports, there is no evidence suggesting reinforcement bars were removed from the 250mm thick parapet wall (the "**Parapet Wall**").

The Contractor has confirmed that removal of the reinforcement bars means the works were not in accordance with the approved drawings. Such work would also not be in accordance with the approved method statement for such remedial work and the Contractor did not seek MTRCL's approval to deviate from the approved method statement for remedial works. In our interview of MTRCL's staff we were made aware of one instance when an MTRCL inspector had noticed, en route to checking other matters, an area with some horizontal reinforcement bars removed adjacent to staircase ST-03 but had not reported such issue. We are seriously concerned about this omission to report.

The Contractor has further confirmed, and MTRCL's initial checking concurs that based on the known and suspected areas, the deviation of the completed works of the Internal Wall from the approved design does **NOT** create any safety impact to the Internal Wall and to the adjacent staircases and escalators.

MTRCL is very concerned with this matter and requested the Contractor to provide all relevant information relating to the matter to assist with the investigation and to submit a remedial plan for rectification of the works. MTRCL has now received the Contractor's investigation report and remedial proposal. Although the Contractor has stated that it suspects that the affected area is limited to the areas described above, as a matter of prudence and to address public concerns we have instructed the Contractor to open up the whole area that was previously trimmed (i.e. 320 m^2 in total for staircases ST-03 and ST-04) to ensure that either the works are in accordance with the approved drawings or to undertake remedial works in accordance with the approved method statement.

We will submit the remedial proposal to the Government and MTRCL will supervise all remedial works undertaken by the Contractor. We will take action against the Contractor in accordance with the Contract and also commence disciplinary processes relating to staff not complying with our processes and procedures.

2. SCL Contract 1109

2.1 Scope of Contract 1109

Contract 1109 ("Sung Wong Toi and To Kwa Wan Stations and Tunnels") is one of the major civil contracts of the SCL Project. Contract 1109 involves the construction of Sung Wong Toi Station, To Kwa Wan Station, the tunnels between Sung Wong Toi Station and Ho Man Tin Station, ancillary railway facilities and modification of the SCL platforms at Ho Man Tin Station. The contract commenced in August 2012, and is anticipated to complete in September 2018.

The Contract was awarded to Samsung Hsin Chong Joint Venture ("**SSHCJV**" or the "**Contractor**"). Samsung is the lead partner of and is an internationally recognized contractor established in Korea. Contract 1109 is its first major civil construction project in Hong Kong. Hsin Chong is a Registered General Building Contractor under the Buildings Ordinance of Hong Kong and an approved "Contractor" on the Development Bureau's Approved List of Contractors for Public Works.

2.2 Construction Works Packaging and Sub-letting

The packages of works involved in the civil construction and architectural finishes of the Internal Wall and the Parapet Wall include the following sub-contractors:

Item	Activity	Subcontractor
1	Reinforcement fixing	Tin Wo
2	Formworking	Ming Tai
3	Concrete pouring	Wai Wah
4	Concrete trimming	Ming Tai Top Famous Lingma
5	Plastering and mosaic tiling	Top Famous

3. Structural design of To Kwa Wan Station and the walls in question

3.1 To Kwa Wan Station

TKW is a 3-level (concourse, upper track and lower track) station located beneath Ma Tau Wai Road. The main station structure typically comprises 1.2m thick diaphragm walls along the station perimeter, 1.2 to 1.5m thick roof slab, 1 to 1.5m thick concourse slab, 1.2m thick upper track slab and 2m thick lower track slab. The global structural stability of TKW is provided by the main station structure described above. The diaphragm walls of the main station were completed in March 2015 to facilitate subsequent excavation of the station cofferdam using the top-down approach. The roof slab, concourse slab, upper track slab and lower track slab were completed in July 2015, November 2015, March 2016 and December 2016 respectively.

A typical cross section showing the main station structure of TKW is shown in **Figure 1** below.

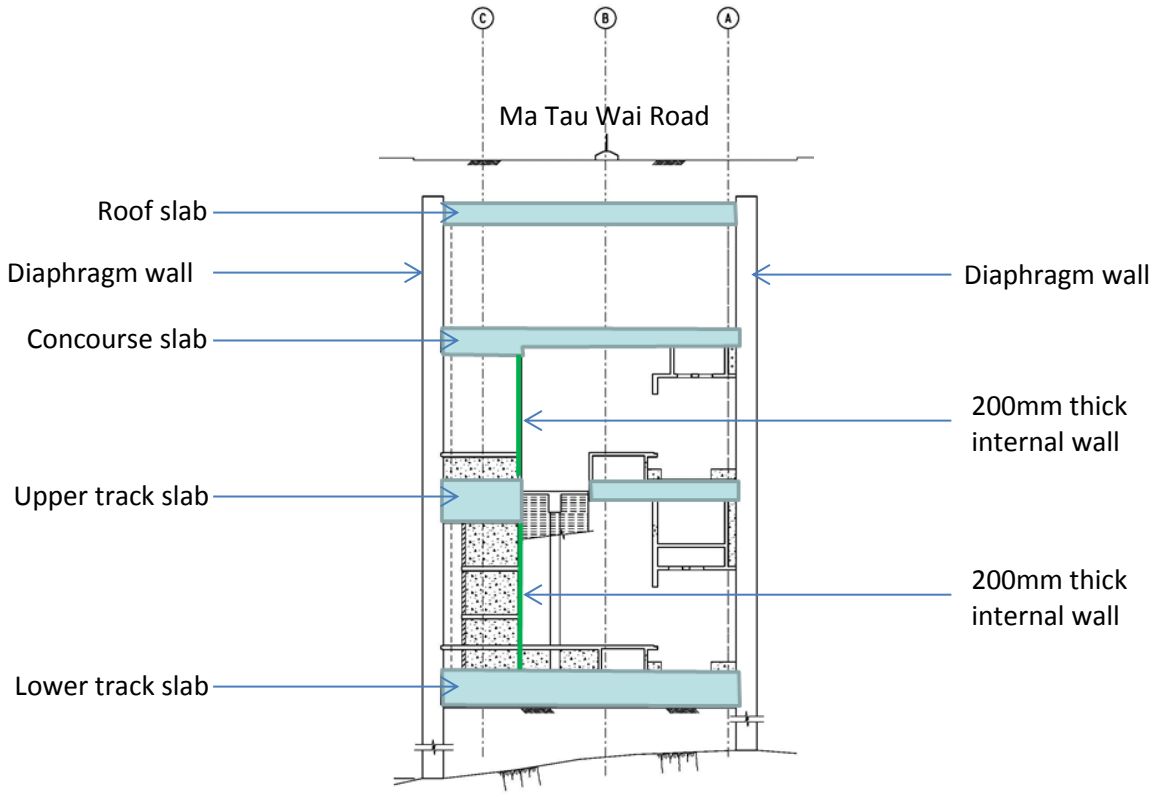


Figure 1 – Typical Cross section of To Kwa Wan Station

3.2 The 200mm thick internal wall (Internal Wall)

The Internal Wall runs longitudinally along the station at lower and upper track levels separating the Front of House platform and Back of House plantrooms. It is designed as a structural wall to resist the vertical live load acting on the slab above, the crowd load from the adjacent staircases and the nominal lateral load inside an underground station. It also supports the mezzanine slab in the Back of House area.

The Internal Wall was constructed after completion of the main station structure.

Due to the insignificant loading, the Internal Wall is designed as a reinforced concrete structure with T16-150mm (i.e. 16mm diameter bars at 150mm spacing) main vertical reinforcement bars and T10-150mm (i.e. 10mm diameter bars at 150mm spacing) horizontal reinforcement bars at both faces of the Internal Wall. The vertical reinforcement bars are for load resisting while the horizontal reinforcement bars are provided generally for crack control requirements. The concrete cover to the reinforcement bars is 40mm as per the approved design.

The Internal Wall adjacent to Staircase ST-03 and ST-04 is shown in **Figure 2** below.

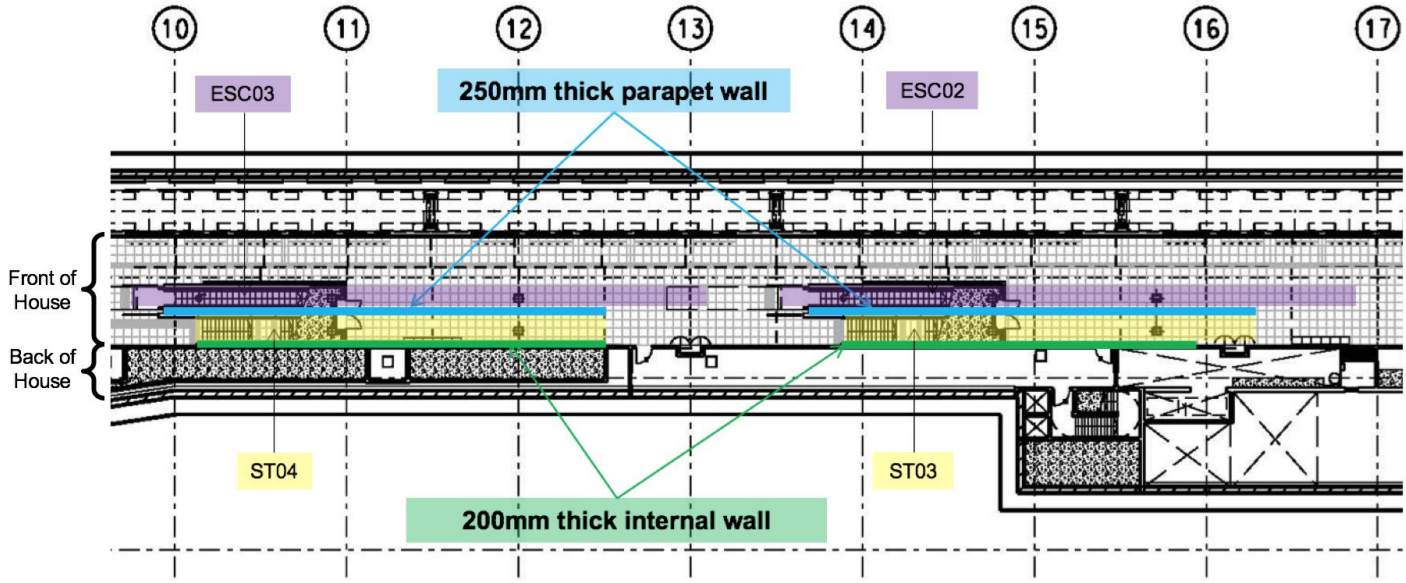


Figure 2 – Layout plan of the Internal Wall and Parapet Wall (lower platform level)

3.3 The 250mm thick parapet wall (Parapet Wall)

The Parapet Wall is to separate the staircase and the adjacent escalator. It is designed to be supported by the staircase slab. For aesthetic reason, the surface of the Parapet Wall is laid with mosaic tiles except for the section of the wall directly facing the escalator truss where no architectural finishes are applied.

The Parapet Wall is designed to take lateral load such as crowd load. The reinforcement is T16-150mm (i.e. 16mm diameter bars at 150mm spacing) vertically and T10-150mm horizontally at both faces of the parapet wall.

The Parapet Wall adjacent to Staircase ST-03 and ST-04 is also shown in **Figure 2** above.

3.4 The internal staircases ST-03 and ST-04

The Staircases ST-03 and ST-04 connect the lower and upper platforms. They are designed as a 175mm thick reinforced concrete slab supported on a spine beam of 450mm wide by 750mm deep. Each of the staircases is supported by the lower and upper track slab with 2 intermediate reinforced concrete columns sized 550mm x 450mm.

The reinforcement bars of the staircases are not physically connected to the adjacent Internal Wall and no loading of the staircases would be supported by the Internal Wall.

3.5 The escalators ESC02 and ESC03

The escalators ESC02 and ESC03 connect the lower platform and concourse. The truss of each escalator is supported by the lower and concourse slab with 2 intermediate reinforced concrete columns sized 550mm x 450mm. The 200mm thick reinforced concrete slab underneath the escalators is for fire separation purpose and does not contribute to the structural support of the escalators.

The location of Escalators ESC02 and ESC03 is shown in **Figure 2** above.

4. Concrete trimming and Repair Works for the Internal Wall and Parapet Wall

4.1 Completion of the Internal Wall and Parapet Wall

Following the completion of the main station structure around December 2016, the Contractor commenced construction of the Internal Wall. The Internal Wall adjacent to Staircases ST-03 and ST-04 was completed in March 2017 and May 2017 respectively followed by the relevant Parapet Wall between the staircases and the escalator well. According to the inspection records, the Internal Wall and Parapet Wall were constructed in accordance with the approved design.

4.2 Identification of misalignment of the Internal Wall

During the site survey of the completed Internal Wall between August and September 2017, some of the front face of the Internal Wall was found to have shifted toward the Front of House area, mostly between 20mm and 50mm, (except at a few small localized areas where the shift was 110mm) due to bulging of formwork during the concreting process, resulting in over-casting of concrete in uneven thickness at different locations on the wall surface. The Front of House wall surface was to be laid with mosaic tiles as architectural finishes at a later stage. Upon commencement of the mosaic tiling work in early 2018, the mosaic tiling subcontractor (Top Famous) reported to the Contractor that trimming of the overcast concrete at the wall surface would be required in order to achieve a flat surface for mosaic tiling.

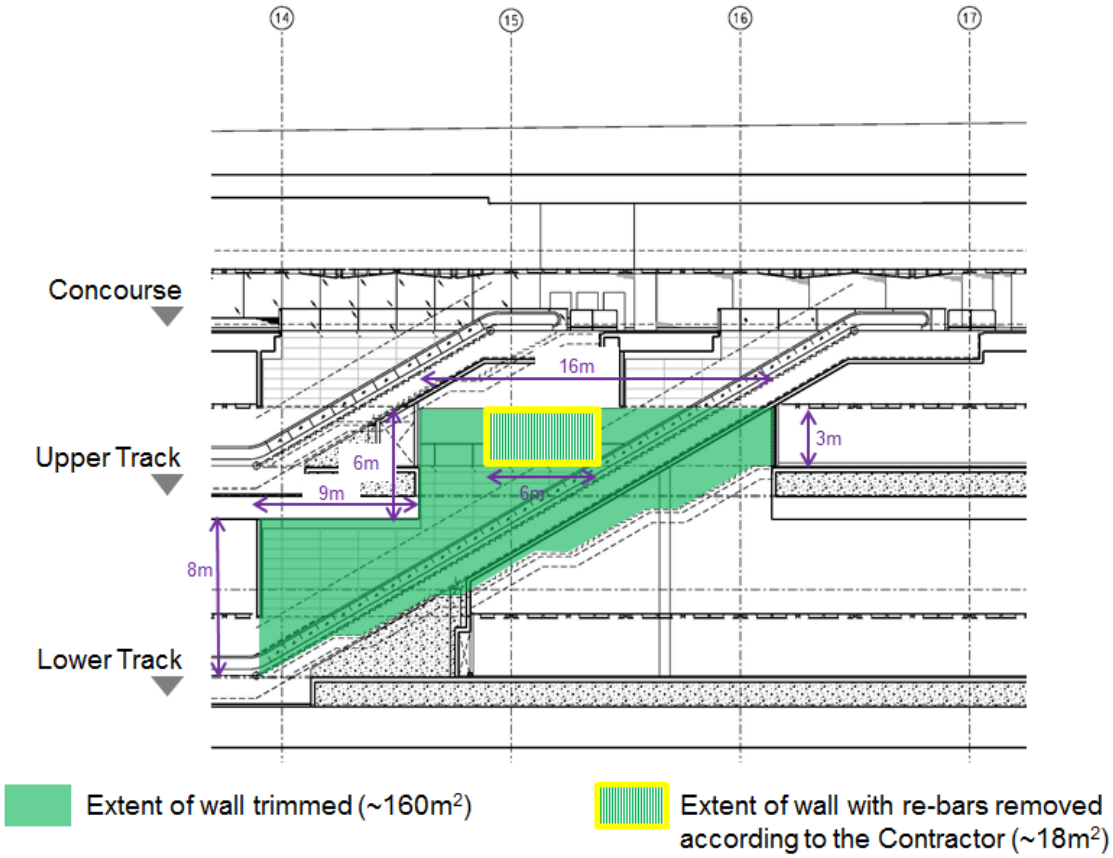
For the Parapet Wall, minor misalignment of the completed internal wall surface was found and only localized trimming of the overcast concrete was carried out. No reinforcement bars were exposed from evidence collected at the time of this report.

4.3 Carrying out of concrete trimming and repair work

The trimming and repair of the overcast concrete was carried out between February and April 2018 at the Internal Wall adjacent to Staircase ST-03 and between January and March 2018 at the Internal Wall adjacent to Staircase ST-04 by subcontractor Lingma. The work was to be carried out in accordance with the general concrete repair method statement CSF No. 1109-CSF-SCJ-CS-005783 approved by the MTRCL Engineer, which generally involves trimming of concrete surface and repairing with an approved non-shrink mortar. In the event that reinforcement bars are exposed, the method statement requires that any rust on the reinforcement bars are to be removed prior to the application of bonding agent and repair mortar. The method statement does not permit removal of any reinforcement bars. The concrete repair method statement can be found in **Appendix A** of this report. The Contractor did not make any submission seeking a variation to the approved method statement.

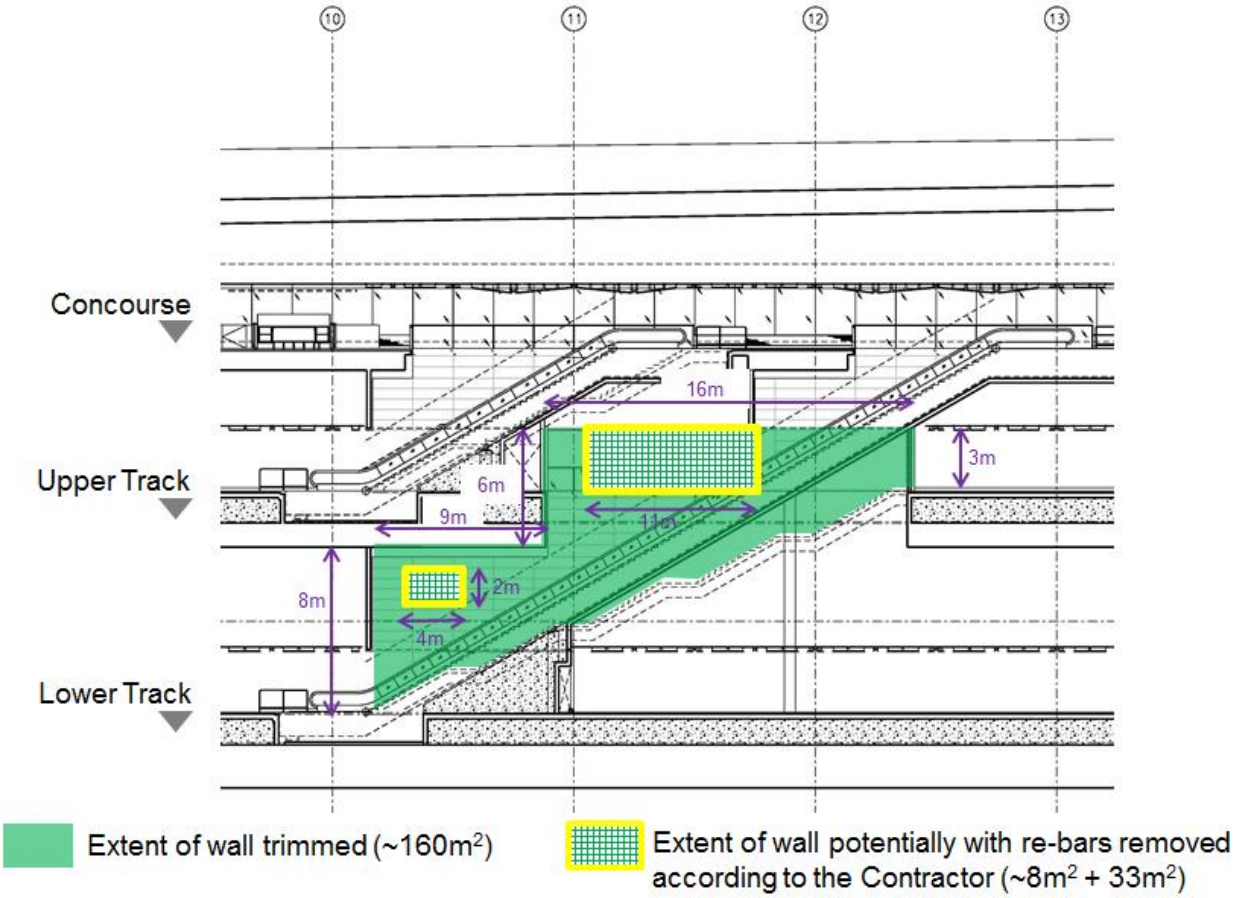
4.4 Extent of defect at the Internal Wall adjacent to ST-03

Based on the advice from the Contractor, the extent of the concrete trimming and repair work carried out at the Internal Wall adjacent to Staircase ST-03 was above the staircase level measuring approximately 160m^2. The thickness of the Internal Wall was trimmed from 200mm to an average of 175mm. The area with reinforcement bars removed from one face of the Internal Wall is advised by the Contractor as approximately 18m^2. The extent of defect at the Internal Wall adjacent to ST-03 is shown in **Figure 3** below.



4.5 Extent of defect at Internal Wall adjacent to ST-04

Based on the advice from the Contractor, the extent of the concrete trimming and repair work carried out at the Internal Wall adjacent to Staircase ST-04 was similar to that adjacent to ST-03. The area was also approximately 160m^2, above the staircase level. The thickness of the wall was trimmed from 200mm to an average of 180mm. As advised by the Contractor, reinforcement bars were removed from one face of the Internal Wall at two locations measuring approximately 8m^2 and 33m^2. The extent of defect at the Internal Wall adjacent to ST-04 is shown in **Figure 4** below.


10
11
12
13
Concourse
Upper Track
Lower Track
16m
6m
9m
11m
3m
8m
2m
4m
Extent of wall trimmed (~160m²)
Extent of wall potentially with re-bars removed according to the Contractor (~8m² + 33m²)

5. Chronology of events after the media enquiry

5.1 Receipt of the media enquiry

On 5 June 2018, the Contractor received an email enquiry from Apple Daily regarding construction defect at the Internal Wall and the adjacent Parapet Wall between staircases and escalators at TKW. On the same day, MTRCL received a similar enquiry from Apple Daily.

5.2 Immediate actions by MTRCL

Upon receipt of the media enquiry, MTRCL made an enquiry to the Contractor and set up an independent panel to examine our records and interview the relevant members of the Projects team to collect information relating to the matter. On 7 June 2018, MTRCL met with the Contractor relating to this issue.

5.3 Confirmation of defect at the Internal Wall by the Contractor

On 8 June 2018, the Contractor formally notified MTRCL that the part of the completed works of the Internal Wall adjacent to internal staircases ST-03 and ST-04 of TKW have deviated from the approved drawings. Upon receipt of the notification from the Contractor, MTRCL immediately requested the Contractor to provide all relevant information relating to the matter and to submit a remedial plan for rectification of the works.

By written response, the Contractor undertook to prepare a remedial works proposal for MTRCL's approval and to carry out all necessary rectification works in accordance with the approved method statement.

5.4 Confirmation of no safety concern by the Contractor

On 11 June 2018, the Contractor further confirmed that the defect does not affect safety of the Internal Wall. The Contractor has further confirmed that based on the designed loading, the Internal Wall will provide sufficient structural strength even with one layer of vertical reinforcement and a minimum wall thickness of 150mm (the Internal Wall is designed with 2 layers of vertical and horizontal reinforcement).

5.5 Report by MTRCL to RDO

On 8 June 2018, MTRCL reported the matter to RDO and issued a response to Apple Daily subsequently on 11 June 2018.

5.6 RDO requested for a report from MTRCL

On 12 June 2018, RDO requested MTRCL to provide RDO with a report by 18 June 2018.

5.7 Report received from the Contractor

On 15 June 2018, the Contractor submitted a report to MTRCL which stated that 2 similar situations are suspected to have occurred at two other localized areas (estimated by the Contractor to be approximately $8m^2$ and $33m^2$) of the same Internal Wall adjacent to Staircase ST-04.

The Contractor advised in its report that it has carried out extensive review of the "suspected areas" requiring further investigation and has employed a specialist contractor to undertake non-destructive testing over these other areas.

6. Level of site supervision by MTRCL

6.1 Construction of the Internal Wall and Parapet Wall

The construction of the Internal Wall and the Parapet Wall followed the same quality control procedures as in all MTRCL projects using our Project Implementation Management System (**PIMS**), where "Hold Points" are specified and each of them requires a notice of permission, consent or no objection from an MTRCL engineer/inspector or consent by a Relevant Authority or Utility Undertaker before the contractor can commence, proceed with or terminate an activity. It has been checked that relevant forms (Request for Inspection/Survey Checks (RISC) Form) for the construction of the walls in questions were in place, inspected and signed off by both the Contractor as well as MTRCL engineers / inspectors as appropriate.

6.2 Carrying out of the concrete trimming and repair work

After completion of the Internal Wall and the Parapet Wall, for the subsequent concrete trimming and repair work, there is no “Hold Point” specified in the Contract or the approved concrete repair method statement submitted by the Contractor. This means that there is no requirement on when and where the Contractor should notify or seek consent from the MTRCL engineer or inspector during the concrete trimming and repair process, although generally MTRCL inspectors are expected to inspect the surface preparation and, in the case where reinforcement bars are exposed, whether the reinforcement bars have been cleaned and properly treated with bonding agent as stated in Sections 2.3 and 2.4 of the concrete repair proposal. In the case of the Internal Wall rectification works, the Contractor did not formally submit to MTRCL for approval a proposal of removing reinforcement bars during the concrete trimming and repair work.

From the evidence collected at the time of this report, it is noted that an MTRCL inspector did observe some horizontal reinforcement bars were missing while walking by the area adjacent to Staircase ST-03 to carry out other duties. However, he did not take any action against the Contractor or report this to his superior. The Contractor subsequently applied the repair mortar and finished the wall with mosaic tile.

There is no evidence collected at the time of this report that suggests that any MTRCL staff saw, or was made aware of, the removal of any reinforcement bars in the Internal Wall adjacent to Staircase ST-04.

There is also no evidence collected at the time of this report to suggest that reinforcement bars were removed from the Parapet Wall.

The Contractor will continue to investigate to confirm that no other reinforcement bars have been removed in the Internal Wall or Parapet Wall. MTRCL will notify RDO immediately if the Contractor reports any deviation from what it has identified to date.

MTRCL is now in receipt of the Contractor's remedial proposal and investigation report and will submit the remedial proposal to the Government. MTRCL will supervise any remedial works undertaken by the Contractor. Upon completion of our investigation, we will commence our disciplinary processes if any MTRCL staff is found not to have complied with our processes and procedures. We will also consider all possible actions available against the Contractor.

7. Structural stability and safety

7.1 Global structural stability of TKW

As described in Section 3.1 of this report, the global structural stability of TKW is provided by the main station structure that comprises the diaphragm walls, roof slab, concourse slab, upper track slab and lower track slab. The Internal Wall and Parapet Wall do not contribute to the global stability of the station. Therefore the global structural stability of TKW is **NOT** affected by the reported defect at the Internal Wall.

7.2 Structural safety of the Internal Wall

The Contractor confirmed to MTRCL that the safety of the Internal Wall is **NOT** affected by the reported defect.

Review of the original design of the Internal Wall by the Contractor confirmed that the wall structurally only requires 1 layer of vertical reinforcement bars and a minimum wall thickness of 150mm under the same loading condition and hence even if the entire outer layer of reinforcement bars is removed, it will not affect the structural safety of the Internal Wall.

7.3 Structural safety of the Parapet Wall

From the evidence collected at the time of this report and based on advice from the Contractor, no reinforcement bars were removed from the Parapet Wall. Therefore their structural safety is **NOT** affected.

7.4 Structural safety of the staircases and escalators

As described in Section 3.4 and 3.5 of this report, staircases and escalators are not structurally supported by the Internal Wall and the parapet wall. Therefore their structural safety is **NOT** affected.

8. Remedial proposal by the Contractor

8.1 Investigation to ascertain the extent of defect at the Internal Wall

The Contractor has commenced work to ascertain the extent of defect at 3 identified locations at the Internal Wall adjacent to Staircases ST-03 and ST-04 by using non-destructive testing method. The result will provide information on the presence of reinforcement bars, diameter of the reinforcement bars and cover of the reinforcement bars from the surface of the mosaic tiles.

Further testing will be requested at the other area of the Internal Wall with concrete trimming and repair work carried out to confirm there is no similar defect.

8.2 Remedial proposal

The Contractor has proposed two options to rectify the defect in case reinforcement bars are found missing from the Internal Wall in question.

Option 1 involves thickening of the Internal Wall from the Back of House face of the wall. A layer of vertical reinforcement bars and horizontal reinforcement bars will be fixed in front of the Back of House face of the defective section of the Internal Wall. The Back of House face of the defective wall will be roughened and installed with shear connectors to ensure a proper load transfer from the affected portion of the wall to the thickened section of the wall. Concrete will be poured to form the thickened wall. This option will not be possible where the existing wall is backed with infill concrete.

Option 2 involves removing the architectural finishes and opening up the concrete from the Front of House face of the defective section of the wall. The concrete will be over-broken to provide enough physical room to install the missing reinforcement bars. Temporary supports to maintain stability will be installed if required during this stage. In order to achieve the required concrete cover, the horizontal bars will be inserted behind the vertical bars. The opened up area will be repaired by the approved method statement referred to in Section 5.3 above.

The preliminary remedial proposal can be found in **Appendix B** of this report.

Although the Contractor has stated that it suspects that the affected area is limited to the areas described above, as a matter of prudence and to address public concerns about safety we will instruct the Contractor to open up the whole area that was previously trimmed (i.e. 320 m^2 in total for both staircases) to ensure that the works are in accordance with the approved drawings (i.e. Option 2). We will submit the remedial proposal to the Government and MTRCL will supervise any remedial works undertaken by the Contractor.

For the Parapet Wall, subject to the further investigation, no reinforcement bars were found missing, therefore no remedial works will be required.

We will take action against the Contractor in line with the contract and also commence disciplinary processes relating to staff not complying with our processes and procedures.