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REPORT

Method Statement for Roof Repairs

Client: Cervejas De Moçambique

Reference: KA1831-RHD-ZZ-XX-RP-Z-0002

Status: S0/P01.01

Date: 4/12/2021

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1 Introduction

This report is a method statement which refers to the roof repairs/replacements to be executed at Cervejas de Moçambique in Beira, as well as repairs of some damaged structural concrete elements observed during the site visit. It follows the conclusions and recommendations of roof assessment done in the brewery (see report KA1831-RHD-ZZ-XX-RP-Z-0001).

2 Scope of Work

The purpose of this report is to provide a method statement for the repairs/replacement of the roof elements of the following buildings:

1. Brew House
2. Canteen and Filtration
3. Laboratory / Technical Building
4. Pack Hall
5. Finished Goods Warehouse
6. Un/Loading Bay (North)
7. Un/Loading Bay (South)
8. Silos Building
9. CO_2 Plant
10. Malt intake

The selection of the buildings to rehabilitate was made by CDM/ABInBev after the submission of the CDM Roof Assessment Report by RHDHV.

3 Method Statements

3.1 Brew House

Anomalies:

The following anomalies were observed during the site visit:

- Infiltration on the staircase.
- Water dripping from the ceiling on rainy days in one office.
- Movement of concrete columns causing concrete detachment.

Rehabilitation:

The rehabilitation will be focused on the damaged concrete columns.

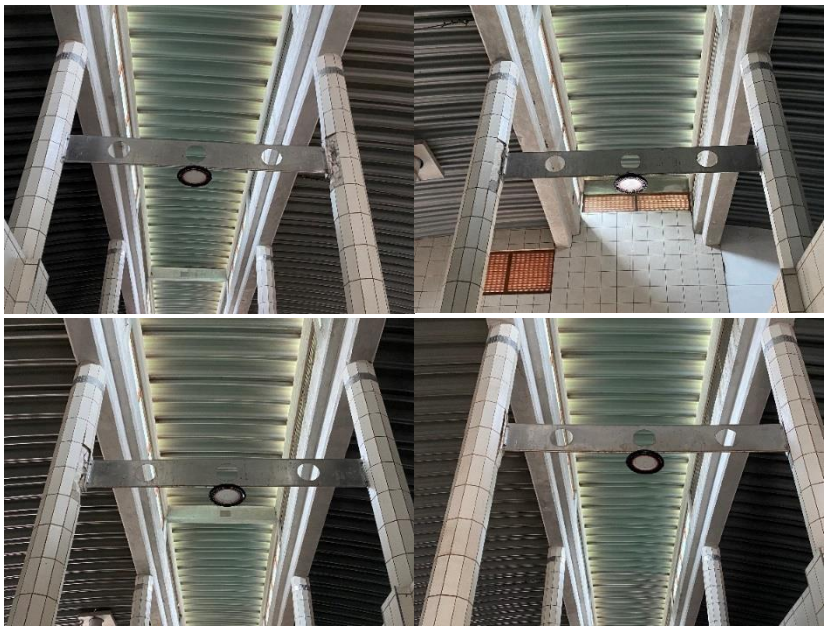

Figure 1: Brew House - Damaged concrete columns

Proceedings:

1. Behavioural tests shall be performed to determine the causes of the damage (it is difficult to establish it from a visual inspection only), whether the concrete columns have shifted, or the beams are pulling out and if the integrity of the structure has been compromised.
2. Monitoring tests shall be perfumed to indicate the extent of the damage and if there is still movement in the structural elements.
3. Based on the results obtained from the tests above, a contractor shall be appointed to execute the repairs to the damaged elements using structural repair mortar and reinforce the connections. In case of a compromised structural integrity, reinforcing elements shall be added to the structure.
4. When repairing the concrete, these steps should be followed:
    i. Select the repair method and material
    ii. Prepare the existing concrete for repair
    iii. Implement the repair method
    iv. Cure the repaired area properly

Recommendations:

It is recommended to use an experienced laboratory to perform the tests for structural integrity (concrete resistance and movement monitoring), such as LEM, or similar approved by the structural engineer.

The contractor shall submit technical specifications of the material to be used for structural repair, for approval. In the case where additional reinforcing elements are required, carbon strips may be an option.

3.2 Canteen and Filtration

Anomalies:

The following anomalies were observed during the site visit:

- Gutters lacking maintenance.
- 3 whirlybirds misplaced.
- Worn waterproofing membrane.
- Infiltration on the slab soffit.

Rehabilitation:

All anomalies listed above will be addressed as part of the rehabilitation.

Figure 2: Canteen and Filtration – Anomalies

Proceedings:

1. The gutters and down pipes should be accessed and cleaned. Any obstructions and vegetation found must be removed.
2. 2 of the 3 whirlybirds have the covers misplaced but there are on the roof, therefore it only needs to be accessed and put in place.
3. The third and large whirlybird is uncovered. After accessing the roof, the technician shall determine what is missing from the cover to replace it.
4. The waterproofing membrane on the Filtration roof slab is worn and should be replaced. A Contractor shall be appointed to remove the existing waterproofing membrane and install a new waterproofing system. The contractor must present beforehand the technical specifications of the waterproofing material they intend to use, for approval.
5. The slab soffit with signs of water infiltration must be cleaned and were necessary, repaired. In places with severe signs of damage due to water infiltration, the integrity of the concrete shall be determined by testing the degree of corrosion of the steel reinforcement in the slab.

Recommendations:

It is recommended that maintenance of the gutters is done at regular intervals. A map can be drawn to schedule the dates for the maintenance.

It is recommended that the areas with visible signs of water infiltration are examined to determine if there are other causes for water infiltration besides the poorly maintained gutters and the worn waterproofing membrane, like leaking pipes.

3.3 Laboratory / Technical Building

Anomalies:

The following anomalies were observed during the site visit:

- Infiltration on the slab soffit and walls.
- Missing lateral roof flashing.
- worn waterproofing membrane on the roof slab.
- Poor sealing between the wall of the technical building and the roof of the pack hall.
- Cracks on the 1st floor slab.
- Large cracks along the walls.

Rehabilitation:

All anomalies listed above will be addressed as part of the rehabilitation.

Figure 3: Laboratory / Technical Building – Anomalies

Proceedings:

1. The waterproofing membrane on the roof slab should be replaced. The Contractor must remove the existing waterproofing membrane and replace it with a new waterproofing system. The contractor must present beforehand the technical specifications of the waterproofing material he intends to use, for approval.

2. The slab soffit and walls with signs of water infiltration are to be cleaned and were necessary, repaired. In places with severe signs of damage due to water infiltration, the integrity of the concrete shall be determined by testing the degree of corrosion of the steel reinforcement in the slab.
3. A new lateral roof flashing must be installed where it is missing.
4. The joint between the wall of the technical building and the roof of the pack hall allows the rainwater through therefore must be sealed with a proper sealant to be proposed by the Contractor. The affected wall is to be cleaned, possibly scarified and a new plaster and paint applied.
5. From the visual inspection it is difficult to establish the exact cause of the cracking therefore a qualified laboratory should be appointed to perform tests such as soil compaction and concrete resistance to further investigate. This will allow for a more qualified opinion of the structural integrity and safety of the structure and the method of repair.

Recommendations:

It is recommended the use of an experienced laboratory to perform the tests such as LEM or similar approved by the structural engineer. The testing should be done as soon as possible to determine whether it is safe to keep using the space while the rehabilitation work do not start.

3.4 Pack Hall

Anomalies:

The following anomalies were observed during the site visit:

- Missing part of the roof, leaving it open and exposed to all weather conditions.
- Corrosion of roof steel elements.
- Infiltration on the ceiling and walls.
- Gutters in poor condition causing the water to pour inside the building on rainy days.
- Large cracks on the walls.
- Floor settlement.
- Detachment of the walls.
- Broken windows

Rehabilitation:

All anomalies listed above will be addressed as part of the rehabilitation.

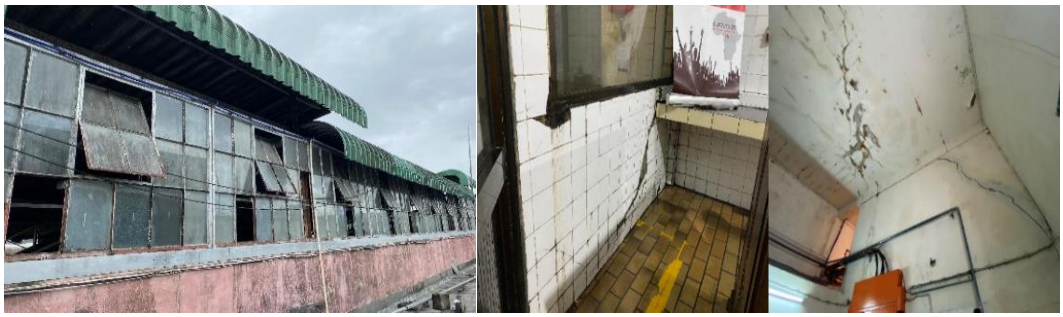

Figure 4: Pack Hall – Anomalies

Proceedings:

1. The entire roof should be replaced. A sturctural engineer should design a new roof structure able to withstand the winds of a cyclone.
2. New gutters must be designed to replace all the existing gutters.
3. The broken windows must be replaced.
4. A qualified laboratory must be appointed to material tests on the concrete to determine the extent of the damage of the roof slabs caused by water infiltration. It is likely that the roof slab needs to be repaired and reinforced as it shows signs of corrosion of the steel reinforcement inside the slab.
5. The laboratory must perform soil compaction tests to determine the cause of the cracks on the walls and the floor, as it is difficult to establish this only by visual inspection. The walls are severely damaged and detached from the structural elements therefore they must be demolished.
6. After the cause of the damage to the walls have been identified it must be addressed and resolved. In case of differential settlement, it can be fixed by concrete underpinning, jet grouting or extended geopolymers.

Recommendations:

The area around the detached wall presents a risk to people therefore it is recommended that this area is isolated until it can be repaired.

It is recommended that the rehabilitation works are executed in phases to minimize the negative effect on the operations.

3.5 Finished Goods Warehouse

Anomalies:

The following anomalies were observed during the site visit:

- Corrosion of the roof sheets.
- Damaged concrete beam and cracked wall.
- The roof between the empty bottles warehouse and the logistics meeting room shows signs of corrosion and has a portion of the roof missing, leaving an open space subject to all weather conditions.

Anomalies to address for the rehabilitation:

All anomalies listed above will be addressed as part of the rehabilitation.

Figure 5: Finished Goods Warehouse – Anomalies

Proceedings:

1. The entire roof should be replaced. A Consultant, structural enginner should design a new roof structure able to withstand the winds of a cyclone.

Recommendations:

It is recommended that the damaged beam and the wall inside that frame are demolished, leaving an open span.

3.6 Un/Loading Bay (North)

Anomalies:

The following anomalies were observed during the site visit:

- Missing last portion of the ridge cap.
- Torn and detached end roof sheets.

Anomalies to address for the rehabilitation:

All anomalies listed above will be addressed as part of the rehabilitation.

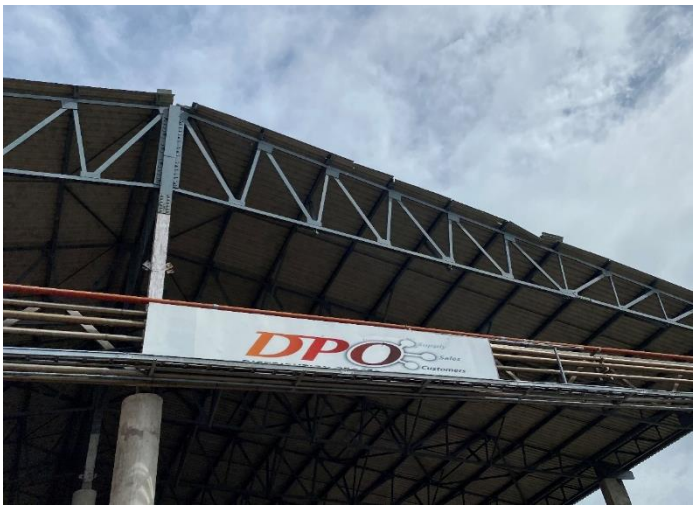

Figure 6: Un/Loading Bay (North) – Anomalies

Proceedings:

1. The damaged roof sheets should be replaced with new sheeting.
2. The end portion of the ridge cap must be installed.

3.7 Un/Loading Bay (South)

Anomalies:

The following anomalies were observed during the site visit:

- Missing the whole ridge cap.
- Corrosion of all steel elements (holes in the roof).
- Gutters in degrading condition

Anomalies to address for the rehabilitation:

The rehabilitation will focus on the gutters and the missing ridge cap. The roof structure and roof sheets are not a priority at the moment and will be replaced gradually at a later stage.

Figure 7: Un/Loading Bay (South) – Anomalies

Proceedings:

1. A contractor must be appointed to supply and install the ridge cap.
2. A Consultant must design new gutters to replace the existing gutters.

Recommendations:

Although a new roof structure is not urgent, it can be designed by the Consultant and reserved for when the time is appropriate to replace the existing one.

3.8 Silos Building

Anomalies:

The following anomalies were observed during the site visit:

- Waterproofing of the roof slab in poor condition.
- Infiltration on the slab soffits.
- One lateral roof sheet missing in the adjacent building.

Anomalies to address for the rehabilitation:

All anomalies listed above will be addressed as part of the rehabilitation.

Figure 8: Silos Building – Anomalies

Proceedings:

1. Material tests must be performed to determine the extent of the damage the water infiltration has caused in the slabs as it is difficult to establish this only by visual inspection. Repairs must be done according to the results obtained.
2. The building must be examined to determine the cause of the infiltration in the slabs.
3. The waterproofing membrane of the roof slab must be replaced with a new waterproofing system. The appointed Contractor must present beforehand, the technical specifications of the waterproofing material they intend to use, for approval.
4. The lateral roof sheeting of the adjacent building (malt crane area) must be replaced with a new one.

Recommendations:

It is recommended that the gutter downpipes are inspected to identify any faults that might be causing the infiltration in the building.

3.9 CO_2 Plant

Anomalies:

No anomalies found but there is a gap between the roof cover and the walls that allow the rainwater to pour in.

Rehabilitation:

The gap mentioned above must be addressed.

Figure 9: CO_2 Plant – Gap

Proceedings:

1. CDM must determine whether this opening is a requisite for the operations taking place at the CO_2 Plant.
2. Glass shutters can be placed if the opening is indispensable.

3.10 Malt intake

Anomalies observed during the site visit:

- Corrosion on the roof.
- Missing a portion of the roof.

Anomalies to address for the rehabilitation:

All anomalies listed above will be addressed as part of the rehabilitation.

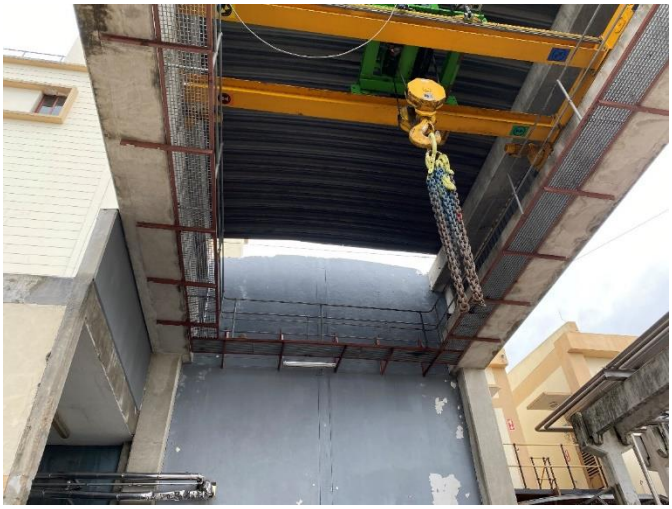

Figure 10: Malt Intake – Anomalies

Proceedings:

1. The roof supporting steel structure could not be inspected during the site visit due to inaccessibility, therefore it couldn't be determined whether it requires only treatment or replacement. It must be safely accessed using cherry picker for a proper inspection to determine whether it can be treated for corrosion protection or must be replaced.
2. The missing roof sheet must be replaced with a new one.

4 Conclusion

The method statements presented in this report are consequence of the previous roof assessment done at CDM. The buildings listed are the ones CDM has determined as priority following the anomalies identified on site.

The appointed Contractor will need to submit a step-by-step method statement on how the execution of the works will be done.