

Structural Reinforcement of the STS Panamax Container Cranes



Technical Description of the Scope of Works

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1. Introduction

There are three “S.T.S. Panamax Container Cranes” located at Pier I Container Terminal of the Piraeus Port Authority S.A.

It has been noted that the structure of the three S.T.S. Container Cranes is failing locally.

In addition, a preliminary strength assessment has proved that exceedance of the allowable stress limits is obtained at the areas which are represented in chapter 3.1 and 3.2.

Based on the conclusion of the calculation report of the preliminary strength assessment, Piraeus Port Authority wish is to structurally reinforce the areas which are represented in chapter 3.1.

Based on the proposed reinforcements, it is requested that the remaining operational lifespan of the STS Container cranes, shall be estimated.

Also, local structural improvement shall apply for the areas which are represented in chapter 3.2.

Finally, it is requested that:

- An Access Platform will be designed and installed on top of the “Waterside Pylon” of the main crane structure. For more details, please refer to chapter 3.3.
- At Boom-girder short rails, the type, quantity and location of the clamps should be redesigned and to suggest an adequate raw material for the short rails, please refer to chapter 3.4.
- Replacement of the four (4) pins that fixed the “Connect seat” at the Trolley with appropriate silent blocks. Also, a check should be performed on the bolts that connect the “Seat” with the “Connect Seat” due to often failures of the bolts please refer to chapter 3.5.
- Replacement, at the Trolley shafts, of the metallic Sleeve with a sealant. Modification on the axles may be required, please refer to chapter 3.6.
- Main Hoist roller N°1 & N°2 wears very quickly, a modification is required, please refer to chapter 3.7.
- At the portal beam (right side) handrails should be installed for safety reasons, please refer to chapter 3.8.
- The four existing tie downs the “Tie rails” should be replaced by wire ropes, please refer to chapter 3.9.

2. Reference Documents

The naming and numbering of structural areas/items are described in the documents which are as represented in the below table.

| Ref No | Document Number | Revision | Document Title |
|--------|------------------------------------------|----------|---------------------------------------------------------------------------------|
| 1 | Part 2 Results of Beam Model Calculation | 0 | 17212-STC-Crane-Piraeus-Part2-Results-of-Beam-model-calculation-Rev-00 |
| 2 | Part 3 FE-Models | 0 | 17212-STC-Crane-Piraeus-Part3-FE-Models-Rev-00 |
| 3 | Part 7 Trolley Calculation | 0 | 17212-STC-Crane-Piraeus-Part7-Trolley-calculation-Rev-00 |
| 4 | Part 0 List of documents | 1 | 17212-STC-Crane-Piraeus-Part0-List-of-documents-Rev-01 |
| 5 | Part 1 Basis of calculation | 0 | 17212-STC-Crane-Piraeus-Part1-Basis-of-Calculation-Rev-00 |
| 6 | Part 4 Parts subject for repair | 0 | 17212-STC-Crane-Piraeus-Part4-Repair-Parts-Rev-00 |
| 7 | Inspection report on 3 STS cranes | 3 | Inspection report on 3 STS cranes 2018.03.05 REV03 |
| 8 | Supplement 01 | 0 | 17212-STC-Crane-Piraeus-Supplement-01-Rev-00 |
| 9 | Appendix 1 to structural calculation | 0 | 17212-STC-Crane-Piraeus-Appendix-1-Weights-origin-calculation |
| 10 | Appendix 2 to structural calculation | 0 | 17212-STC-Crane-Piraeus-Appendix-2-Weights-part-lists |
| 11 | Appendix 3 for structural calculation | 0 | 17212-STC-Crane-Piraeus-Appendix-3-Contents-Krasta-Documentation-Rev-00 |
| 12 | Appendix 4 Krasta input data | 0 | 17212-STC-Crane-Piraeus-appendix-4-Krasta-input-data-Rev-00 |
| 13 | Appendix 5 Krasta results data | 0 | 17212-STC-Crane-Piraeus-appendix-5-Krasta-results-data-Rev-00 |
| 14 | Appendix 6 Krasta documentation trolley | 0 | 17212-STC-Crane-Piraeus-appendix-6-Contents-Krasta-Documentation-Trolley-Rev-00 |

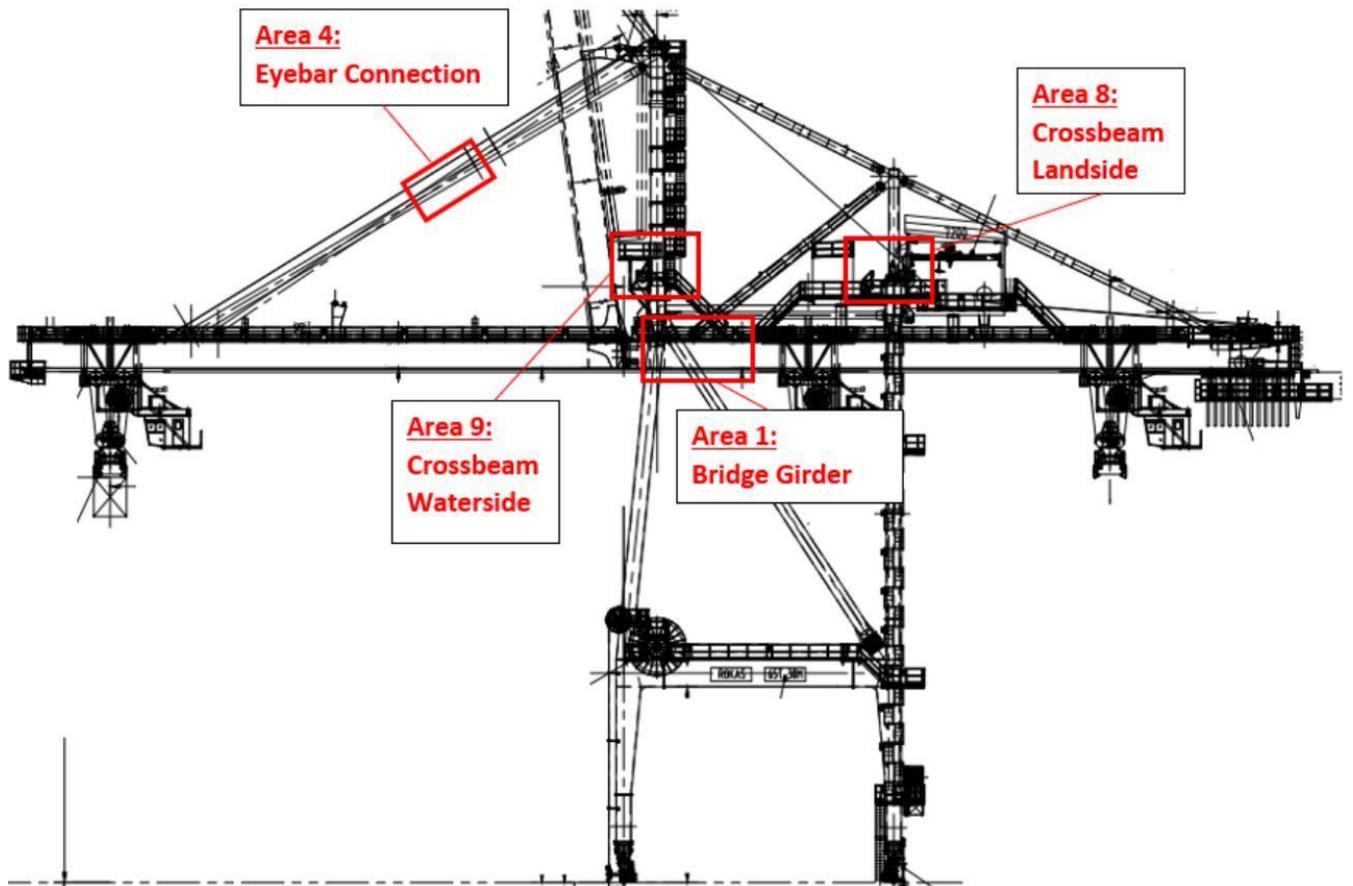
3. Scope of Works

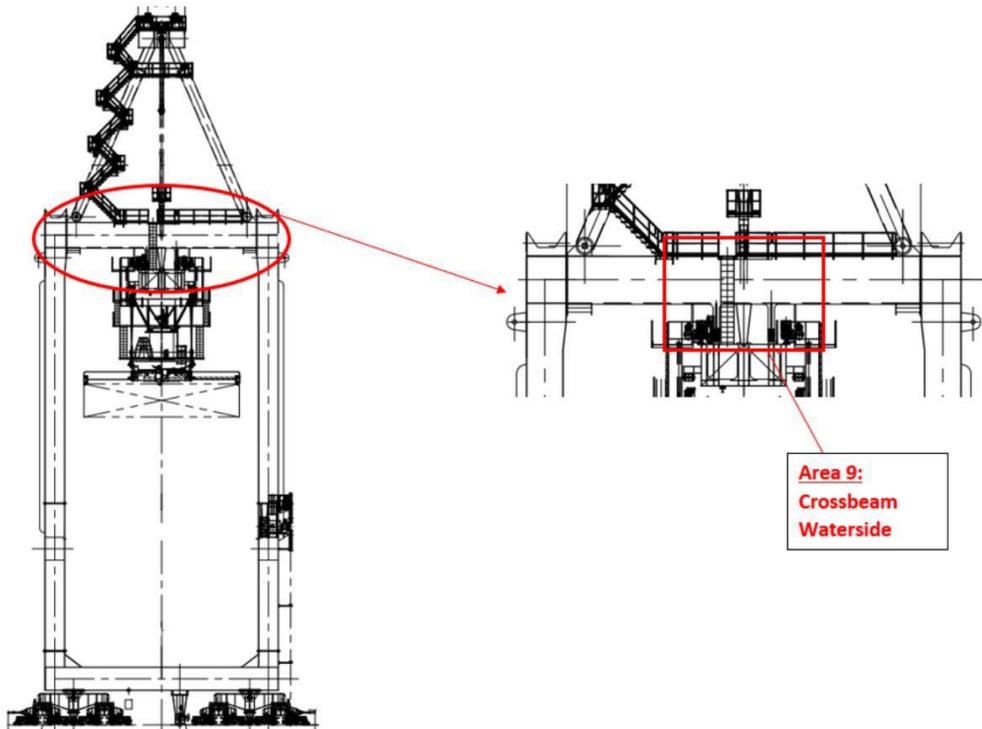
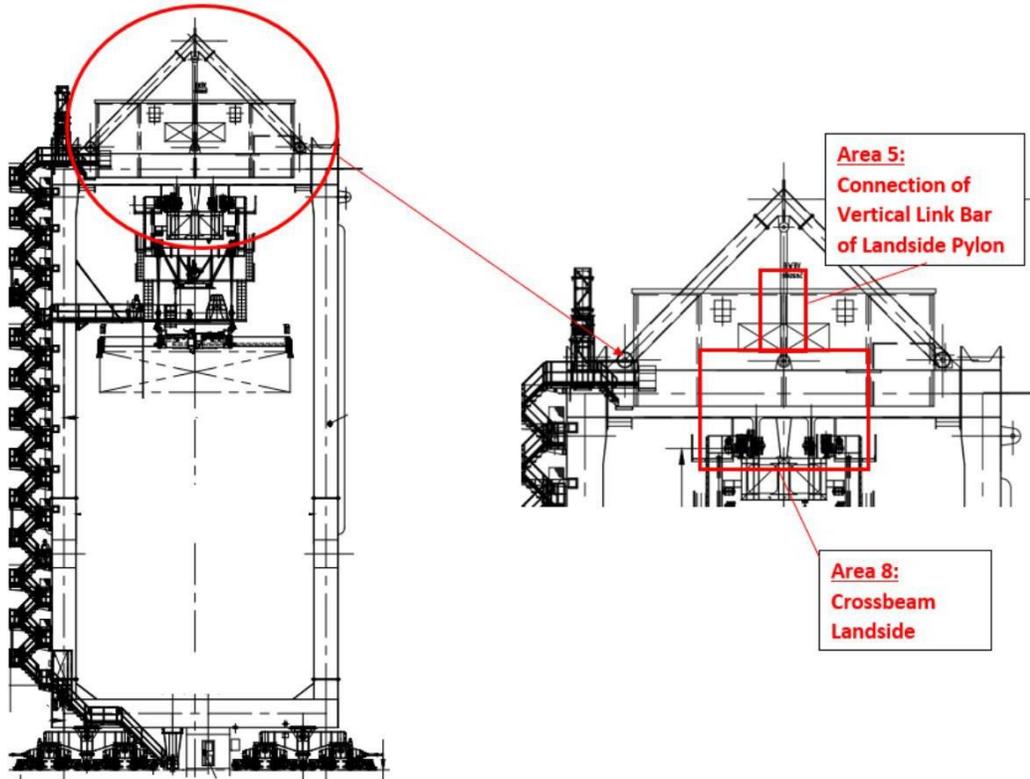
3.1. Local Structural Reinforcement of the Main Crane and Trolley Structure

During the preliminary strength assessment of the STS Container Cranes, two beam models for the Global Crane and Trolley structure have been created and analyzed, in KRASTA calculation software.

3.1.1. STS Panamax Container Crane - Main Structure

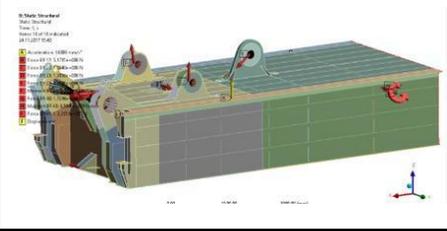
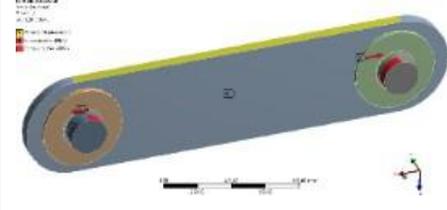
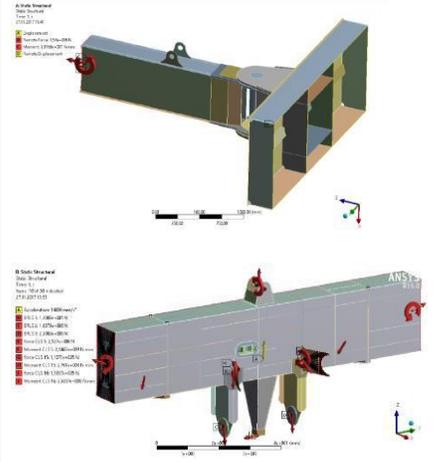
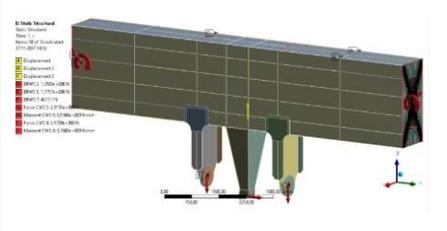
The below figures represent the structural areas/items of the STS Container Cranes - Main structure, which need to be reinforced.





The below table represents the scope of works for each structural item.

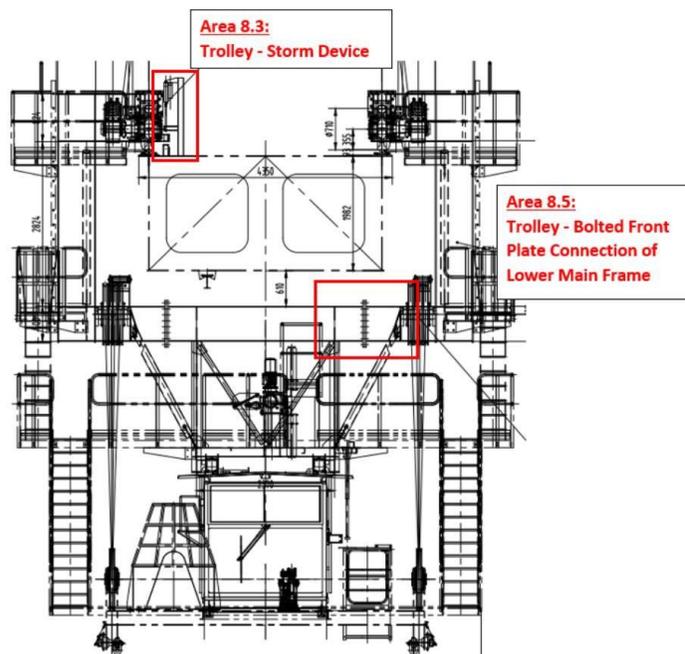
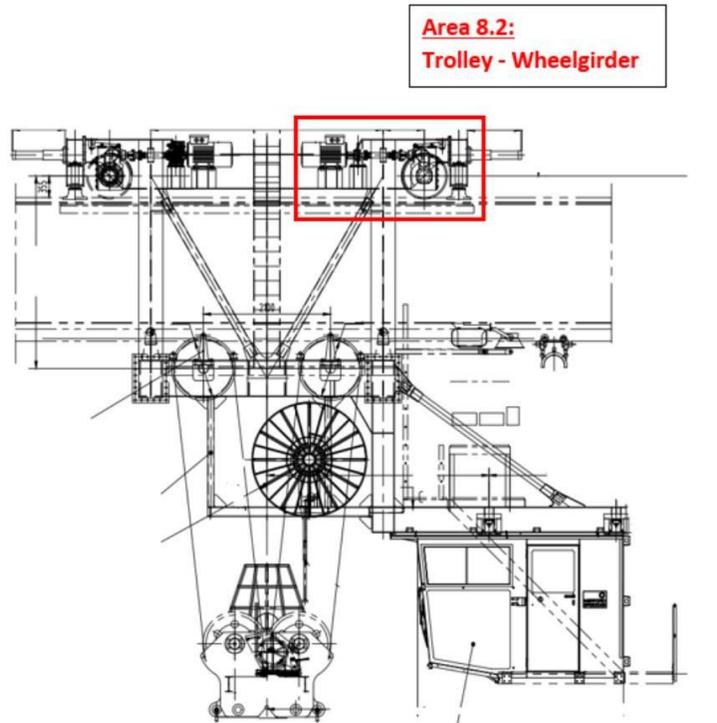
Table 1: Scope of Works for the strength assessment and reinforcement of the STS Container Crane - Main Structure

| Area / Item No | Description | Action | Remarks | Area Detail |
|----------------|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------------------------------------------------------------------------------------|
| 1 | Bridge girder connection to Backstay 2 (Ref. 2) | <ul style="list-style-type: none"> a. Yield Check b. Fatigue Check c. Calculation Report d. Structural Drawings of the Proposed Reinforcements e. Repair Procedures Report | N/A |  |
| 4 | Eyebar connection of link bar of forestay (Ref. 2) | <ul style="list-style-type: none"> a. Yield Check b. Calculation Report c. Structural Drawings of the Proposed Reinforcements d. Repair Procedures Report | N/A |  |
| 5 & 8 | Connection of vertical link bar of landside pylon to Crossbeam & Crossbeam landside (Ref. 2) | <ul style="list-style-type: none"> a. Yield Check b. Fatigue Check c. Calculation Report d. Structural Drawings of the Proposed Reinforcements e. Repair Procedures Report | N/A |  |
| 9 | Crossbeam waterside (Ref. 2) | <ul style="list-style-type: none"> a. Yield Check b. Fatigue Check c. Calculation Report d. Structural Drawings of the Proposed Reinforcements e. Repair Procedures Report | N/A |  |
| - | Global Crane Model | a. Fatigue Check and proposal of reinforcements for the areas in | N/A | |

| Area / Item No | Description | Action | Remarks | Area Detail |
|-------------------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------|
| | (Excluding Trolley Structure) (Ref. 1) | which fatigue limit is exceeded as per Ref. 1, Ch. 2.2, 2.6, 2.9, 2.11. b. Calculation Report c. Structural Drawings of the Proposed Reinforcements d. Repair Procedures Report | | |

3.1.2. STS Container Crane - Trolley Structure

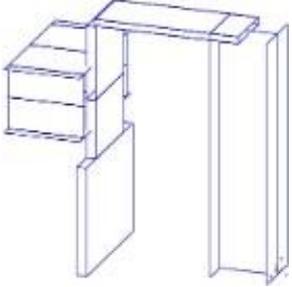
The below figures represent the structural items of the Trolley structure of the STS Panamax Container Cranes, which need to be reinforced.



The below table represents the scope of works for each structural area / item.

Table 2: Scope of Works for the strength assessment of the STS Panamax Container Crane - Trolley Structure

| Area / Item No | Description | Action | Remarks | Area Detail |
|----------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------|
| 10 | Trolley Model (Ref. 3) | <ul style="list-style-type: none"> a. Reduction of the Transverse Deflection of the vertical trolley beams b. Calculation Report c. Structural Drawings of the Proposed Reinforcements d. Repair Procedures | N/A | |
| 8.2 | Wheel Girder (Ref. 3) | <ul style="list-style-type: none"> a. Yield Check b. Fatigue Check c. Calculation Report d. Structural Drawings of the Proposed Reinforcements e. Repair Procedures Report | N/A | |
| 8.5 | Bolted Front Plate Connection of Lower Main Frame (Ref. 3) | <ul style="list-style-type: none"> a. Yield Check b. Fatigue Check c. Calculation Report d. Structural Drawings of the Proposed Reinforcements e. Repair Procedures Report | N/A | |
| 8.3 | Storm Anchor Device (Ref. 3) | <ul style="list-style-type: none"> a. Yield Check b. Calculation Report c. Structural Drawings of the Proposed Reinforcements d. Repair Procedures Report | N/A | |

| Area / Item No | Description | Action | Remarks | Area Detail |
|-------------------|-------------|--------|---------|-------------------------------------------------------------------------------------|
| | | | |  |

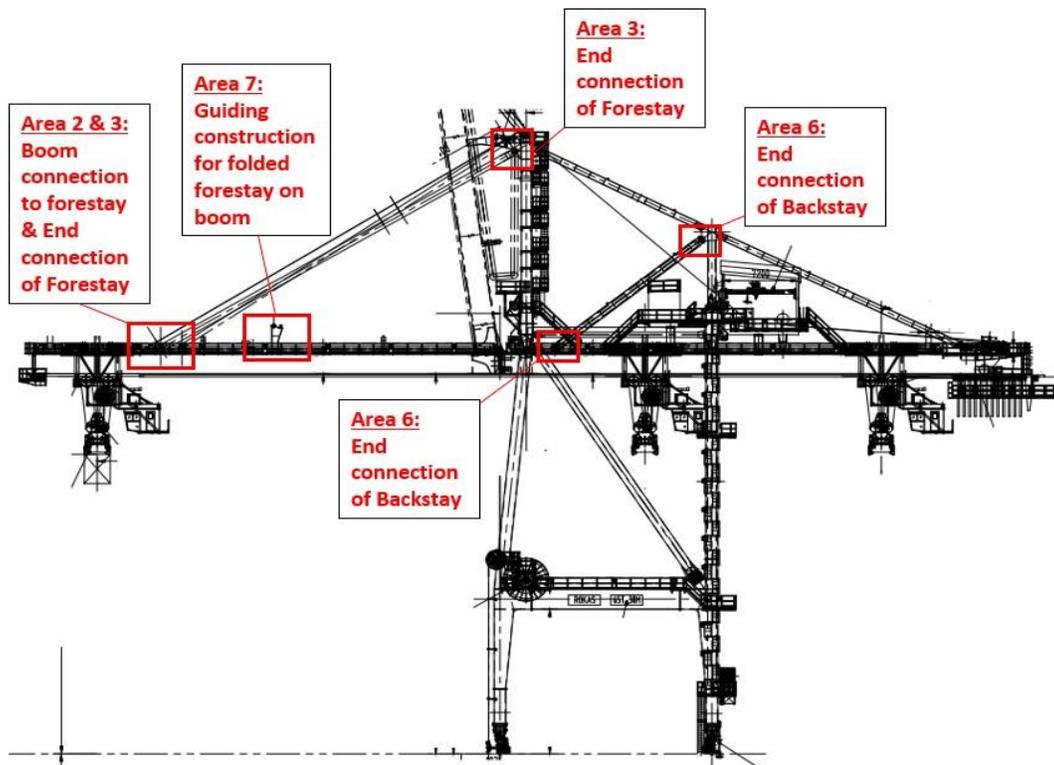
3.2. Local Structural Improvement of the Main Crane Structure

Based on the preliminary calculation report (Ref. 2), no structural reinforcement is required for items 2, 3, 6 and 7.

In that respect, for the above-mentioned areas a local structural improvement is requested by PPA S.A. The structural improvement shall be implemented based on the recommendations which are indicated in the preliminary calculation report (Ref. 2) and as per the FEM 1.001.

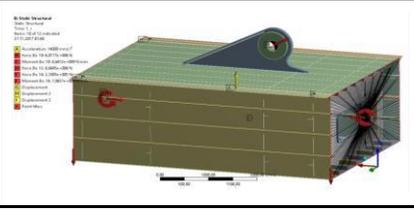
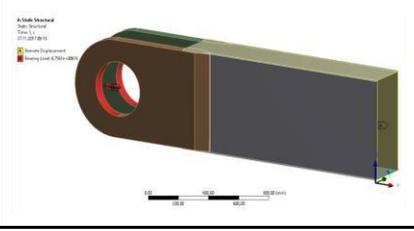
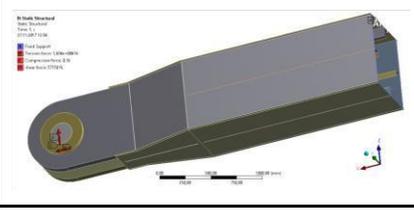
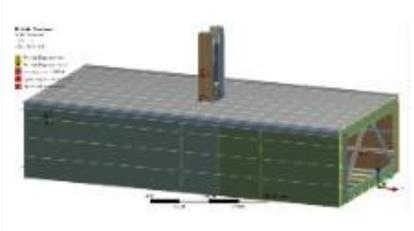
The structural improvements shall be represented by means of structural drawings and repair procedure reports as described in the Tender document.

The below figures represent the structural areas of the STS Container Cranes, for which local structural improvement is requested.



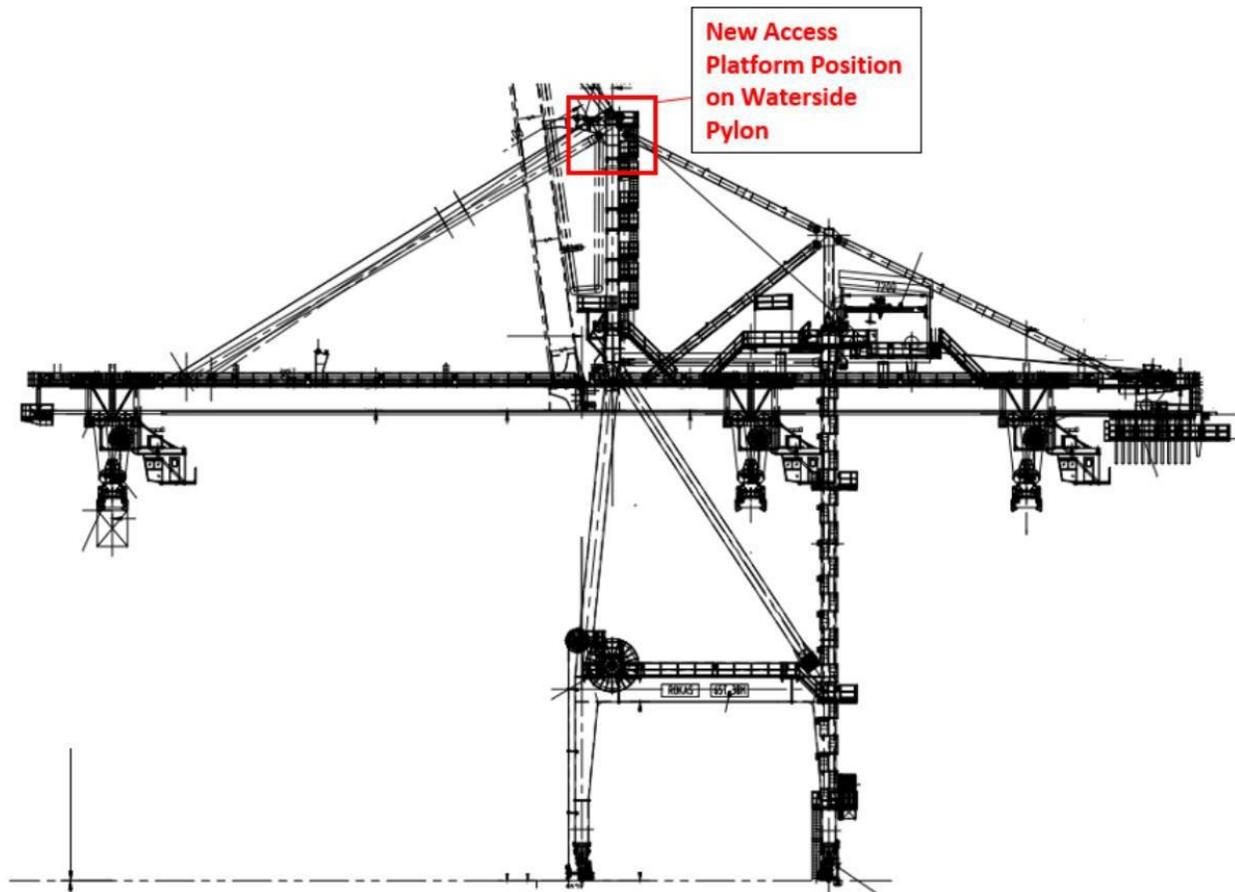
The below table represents the scope of works for each structural item.

Table 3: Repair Procedures for STS Container Crane - Main Structure

| Area / Item No | Description | Action | Area Detail |
|----------------|-----------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------|
| 2 | Boom connection to forestay (Ref. 2) | a. Repair Procedures Report b. Structural Drawings |  |
| 3 | End connection of Forestay 1 (Ref. 2) | a. Repair Procedures Report b. Structural Drawings |  |
| 6 | End connection of Backstay 2 (Ref. 2) | a. Repair Procedures Report b. Structural Drawings |  |
| 7 | Guiding construction for folded forestay on boom (Ref. 2) | a. Repair Procedures Report b. Structural Drawings |  |

3.3. Access Platform Design

A new Access Platform is requested to be designed and installed on top of the Waterside Pylon. The position of the new Access Platform is presented in the following figure.



The below table represents the scope of works for the Design of the Access Platform

Table 4: Scope of Works for the Design of Access Platform

| Item No | Description | Action | Remarks |
|---------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 11 | Design of Access Platform | <ul style="list-style-type: none"> a. Arrangement Drawings and BOM. b. Drawings which are indicating the Structure of the Access Platform. | |

3.4. Boom-Girder Short rails

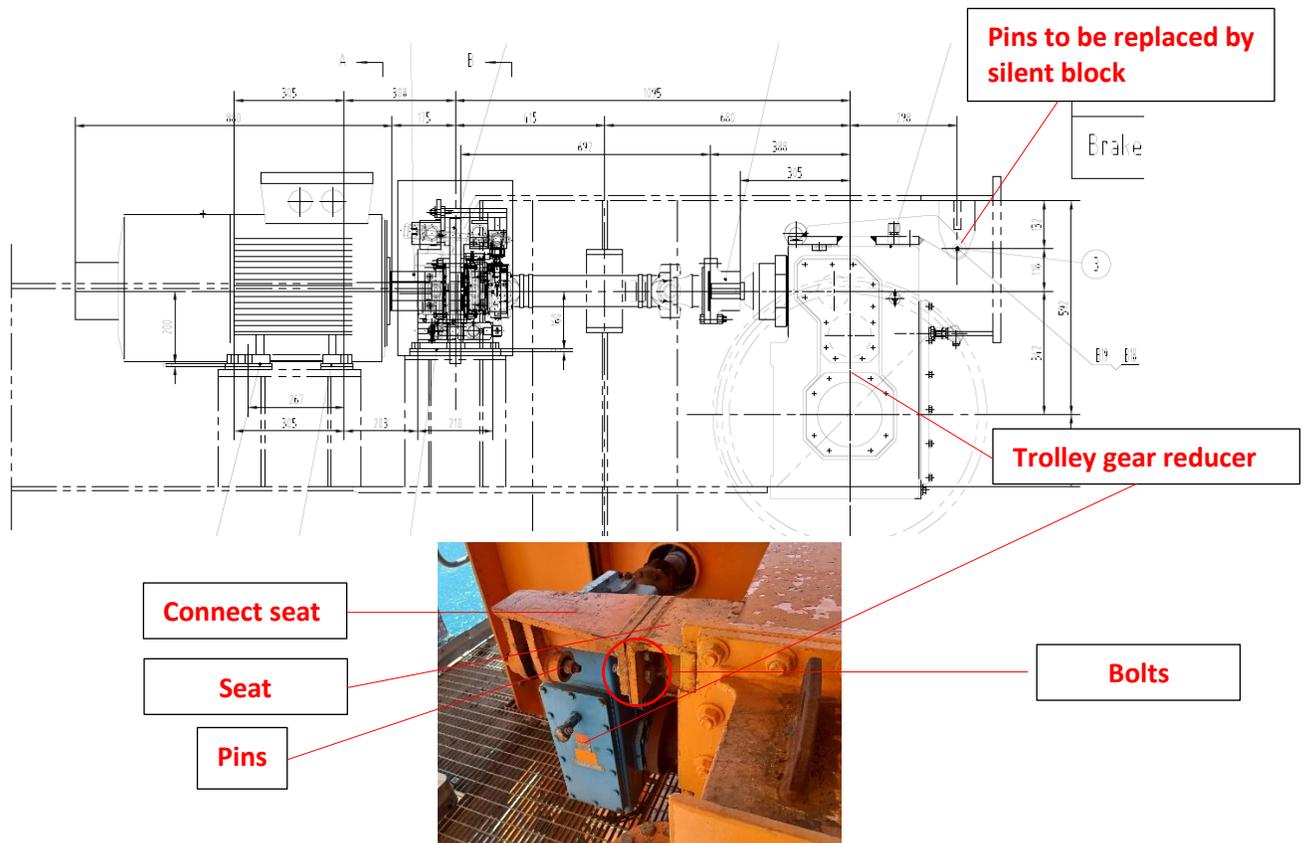
At Boom-girder short rails, the type, quantity and location of the clamps should be redesigned and to suggest an adequate raw material.



Table 5: Scope of Works for Boom-Girder short rails

| Item No | Description | Action | Remarks |
|---------|-------------------------|----------------------------------------------------------------------------------------------------|---------|
| 12 | Boom-girder short rails | a. Drawings and BOM with the new clamps. b. Suggestion for the raw material of the short rails. | |

3.5. Replacement of Trolley pins with silent block

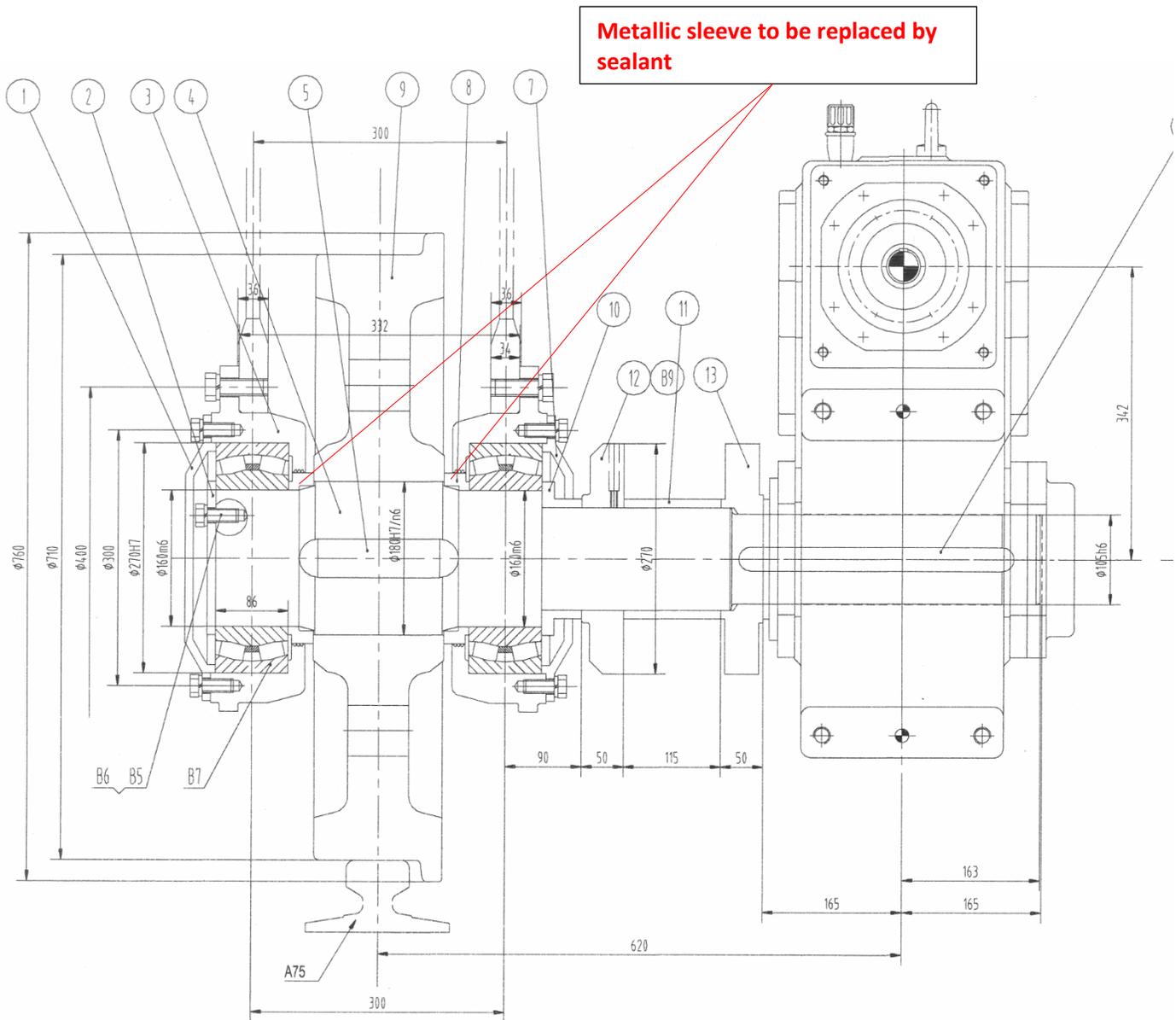


Replacement of the four (4) pins that fixed the “Connect seat” at the Trolley with appropriate silent blocks. Also, a check should be performed on the bolts that connect the “Seat” with the “Connect Seat” due to often failures of the bolts.

Table 6: Scope of Works for replacement Trolley pins & bolts

| Item No | Description | Action | Remarks |
|---------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 13 | Trolley pins for fixing the “Connect seat” | <ul style="list-style-type: none"> a. Drawings and BOM with the new silent blocks. b. Proposal for corrective actions for the failure of bolts. If required new design for the “Seat” and “Connection seat” drawings and BOM should be delivered. | |

3.6. Trolley shafts modification for installation of a sealant

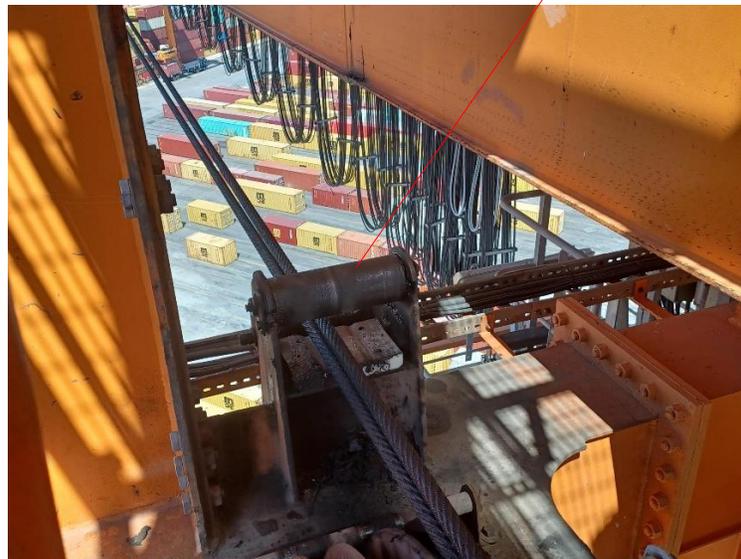
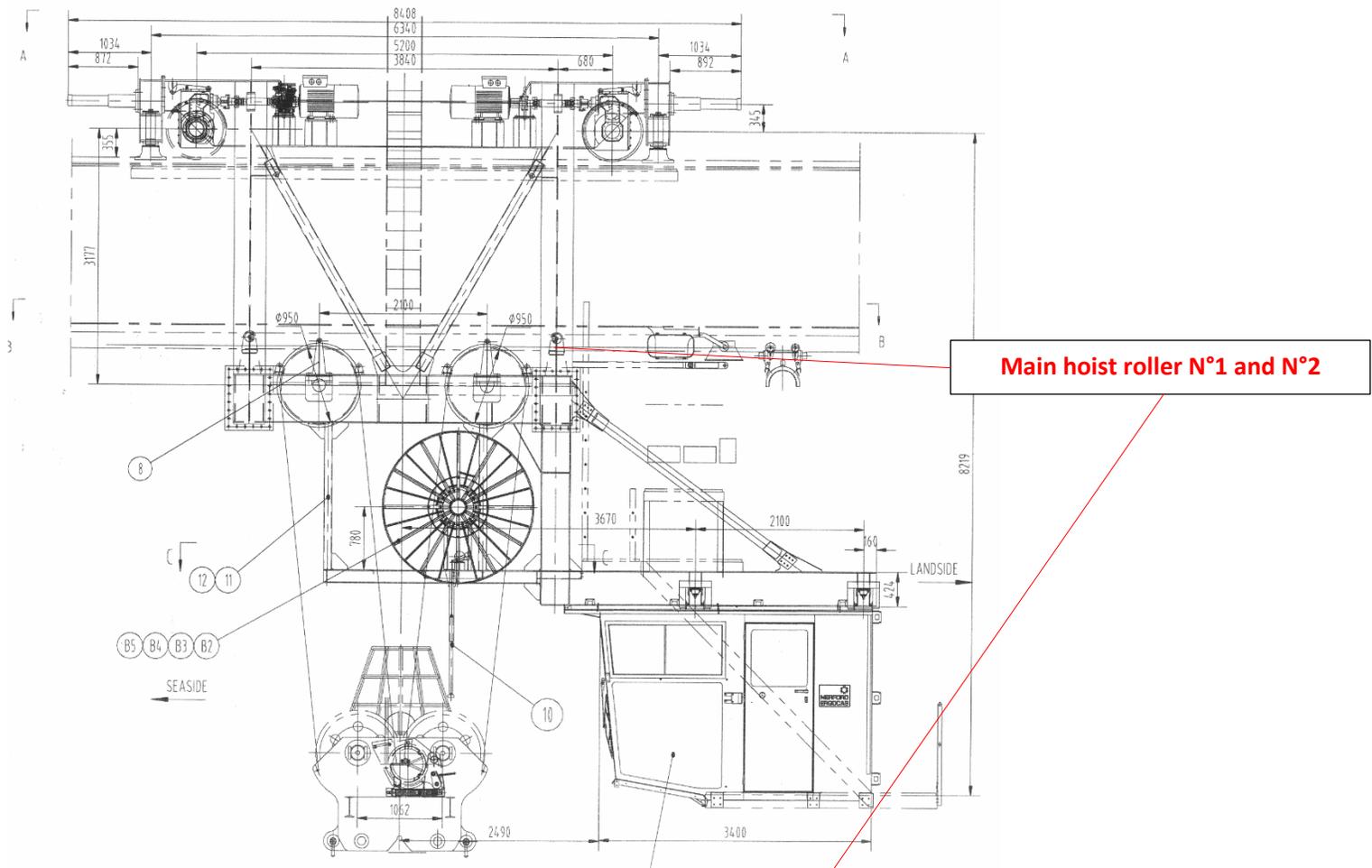


Replacement, at the Trolley shafts, of the metallic Sleeve with a sealant. Modification on the axles may be required.

Table 7: Scope of Works for sealant at Trolley shaft

| Item No | Description | Action | Remarks |
|---------|---------------------------|----------------------|---------|
| 14 | Sealant for Trolley shaft | a. Drawings and BOM. | |

3.7. Wear of Main Hoist roller

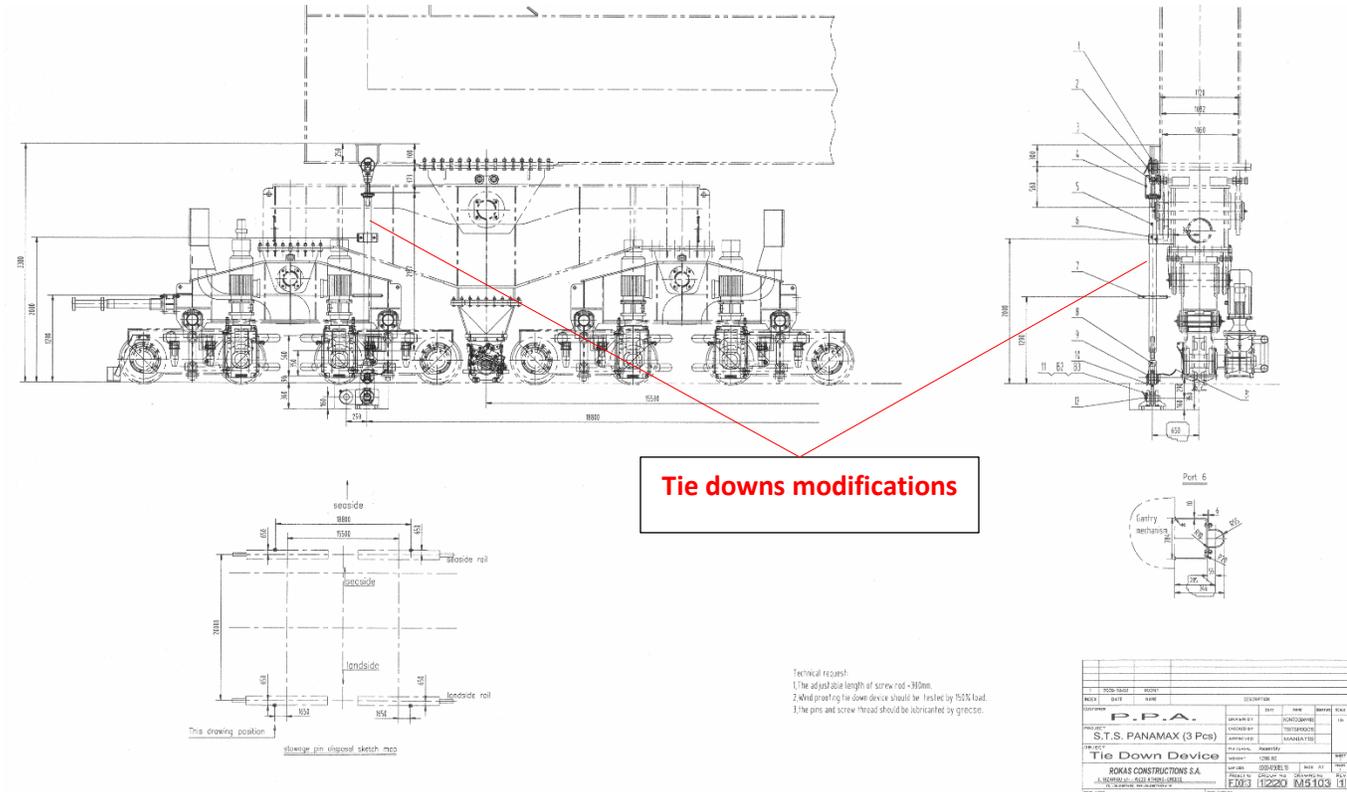


Main Hoist roller N°1 & N°2 due to wire rope wears very quickly, a modification is required.

Table 8: Scope of Works for installation hand rails at the Portal Beam

| Item No | Description | Action | Remarks |
|---------|--------------------------------------------|----------------------|----------------------------------------------------------------|
| 16 | Hand rails installation at the Portal Beam | a. Drawings and BOM. | Size of hand rails should be in accordance with European norm. |

3.9. Tie down modification



The four existing tie downs the “Tie down” should be replaced by wire ropes.

Table 9: Scope of Works for the modification of the Tie down.

| Item No | Description | Action | Remarks |
|---------|------------------------------|-------------------------------------------------------------------|---------|
| 17 | Modification of the Tie down | a. Drawings and BOM. b. Calculation of the wire rope diameter. | |