**Invitation for pre-bids**

**For participation in the process of execution of works of rehabilitation and strengthening of Pier I South quay structure in Bar port**

PORT OF ADRIA JSC BAR is financing the execution of works on rehabilitation and strengthening of Pier I South quay structure from its own funds.

Pre-bids are open for the companies meeting the conditions stated within this Invitation.

Having completed the pre-bids, the Employer shall forward tender documents only to qualified Bidders. Works execution shall be contracted in accordance with the General Conditions – Short Contract Agreement Form- Red book (edition published in International Federation of Consulting Engineers (FIDIC), First edition 1999 ISBN 2-88432-024-5.

In order to participate in pre-qualifications, Bidders must to prove that they meet the following minimum requirements:

- Average annual turnover – financial realization in the last five (5) years -4 million the minimum (4,000,000) EUR. In case that Bidders form Joint Venture/ Consortium of Bidders, turnover of all companies shall be regarded jointly.
- General experience of a Bidder, pursuant to requirements enclosed to this invitation, which the Bidder is obliged to meet and submit.

Number of pre-bid companies shall be limited to five (5) the maximum. If the number of submitters is higher than five (5), the choice shall be made on the grounds of quality and extent of submitted references.

Bidders must submit sealed pre-qualification documents in one original and one copy in Montenegrin and one original in English language.

Enclosed to this Invitation for Bidders the following is being submitted:

1. Technical description of works
2. Forms necessary to be filled confirming general experience of the Bidder

Bidders are herewith informed that execution of all works shall be wholly conceded.

Prior to signing the Contract, selected Bidder must secure licences for the firm and responsible persons from Engineers Chamber of Montenegro.

Bidders can obtain  additional information on the address stated below:

PORT OF ADRIA JSC BAR

(Attn. Mrs. Olga Luković, Business Development Department Chief)

Obala 13.jula bb

Bar

Montenegro

Tel:    + 382 (0)30 301 149

Fax:    + 382 (0)30 301 105

E-mail: olga.lukovic@portofadria.me.

All pre – qualification documents must be submitted to below stated address on the day or before the final deadline for submitting, the 23.03.2017. the latest (by local time). Late pre-qualification documents shall be rejected and returned to Bidders. Pre-qualification documents shall be opened in the presence of Bidder's representatives interested in attending Bids' opening.

Address for submitting pre-qualification documents is as follows:

PORT OF ADRIA JSC BAR

(Attn. Mrs. Olga Luković, Business Development Department Chief)

Obala 13.jula bb

Bar

Montenegro

Opening of pre-qualification documents shall take place on the above stated address on 23.04.2017. at 10:05 by local time.

# 1.TECHNICAL DESCRIPTION

## 1/1 .TECHNICAL DESCRIPTION

### 1.1.1 INTRODUCTION

On the basis of the contract signed with Port Adria JSC Bar, this Institute has made Main Project Design of rehabilitation and strengthening of Pier 1 south quay structure. This reinforced concrete structure was constructed in 1977. After the catastrophic earthquake in 1979, the Pier was damaged and its rehabilitation was completed in 1981. In 1999, Civil Engineering Faculty of University of Montenegro analyzed the current condition with detailed survey of damaged RC structure of the Pier and made Project design of rehabilitation.

During its utilisation period, this structure has sustained large damages and therefore its structural safety is at risk. In comparison to its condition in 1999, it worsened significantly. The objective of the rehabilitation is to secure adequate safety for utilisation load and in particular the durability of the structure. Additionally, apart from rehabilitation, the objective is to strengthen Pier structure so it can support increased load requested by new utilisation conditions because new cranes of larger capacity and individual weight shall be used in future.

As part of preparation of this Main Project Design of rehabilitation and strengthening of the Pier, following activities were carried out:

- Detailed survey of damages of all RC structure elements with appropriate documentation: damage description and photos with the categorization of the damages;
- Detailed underwater survey of piles structure;
- Concrete sampling and testing (concrete cylinder samples, diameter of 100 mm), from the RC structure of the Pier;
- Structural and dynamic analysis of the Pier structure in current and projected, i. e. rehabilitated and strengthened state;
- Current state structural analysis of the Pier;
- Preparation of Main Project Design of rehabilitation and strengthening of the Pier with adequate descriptions and graphic appendices.

### 1.1.2. AVAILABLE PROJECT DOCUMENTS

For the purpose of this Project, we had the following documents available:

1. Terms of reference
2. Urban and technical specifications
3. Water condition
4. Technical specifications of Pier 1 south quay
5. Existing state analysis, volume 1.1. – Civil Engineering Faculty Podgorica, 1999
6. Damage survey, volume 1.2. – Civil Engineering Faculty Podgorica, 1999
7. Rehabilitation project design, volume 1.3. – Civil Engineering Faculty 1999
8. Pier 1 – Port of Bar, Geotechnical survey, PIM Project Ivan Milutinović 1981

9. Main project design of rehabilitiation of Pier 1 in Bar after the earthquare, PIM Project Ivan Milutinović
10. Pier 1 Quay – appendix, volume IX, modifications of RC slab, Port of Koper Project Office, 1977
11. Pier 1 Quay, Main project design, volume II, Port of Koper Project Office, 1976
12. Pier 1 Quay, Main Project Design, structural analysis volume II/1, Port of Koper Project Office, 1976
13. Pier 1 Quay, Main Project Design, volume III, Port of Koper Project Office, 1976
14. Contract documents for the execution of works on facilities: earthworks and quays, volume III.2.2., prestressed concrete, Belgrade, 1975
15. Pier 1 Quay, construction design, volume V, Port of Koper Project Office, 1976
16. Pier 1 Quay, construction design, volume VI, Port of Koper Project Office 1976
17. Pier 1 Quay, construction design, volume VII, Port of Koper Project Office, 1977
18. Pier 1 Quay – appendix, volume IX, modification of RC slab, Port of Koper Project Office, 1977
19. Geotechnical project evaluation of Pier 1 quay Port of Bar in Bar, IMFM – University of Ljubljana, 1972
20. Pier 1 Quay, Details, Port of Koper Project Office, 1976
21. Pier 1 Quay, Drawings, Port of Koper Project Office, 1976
22. Study on geodetic works and coastal hydrography of the south side and head of Pier 1, Institute for studies and nautical design– Split
23. Records on driving piles, 1977

### 1.1.3 DESIGN STATE

Pier 1 south quay structure is made from reinforced concrete in 1976. The structure is immediately above sea level with the distance varying from 35cm to 85 cm (depending on the tide). High and low tide cycles rotate every 6 hours. High and low tide pattern varies and it depends on lunar phases.

Pier structure is 360 m long and 19.50 m wide, it consists of four sections (plates), each 90 m long, which are dilated. Width of the dilatation is 2 cm. RC struxture of the Pier is grille system with longitudinal and transverse girder, with a slab on top. Transverse girders are the main structural elements and their axial distance is 4.60 m. These girders are 80 cm wide and 197 cm high, including the additional slab. Longitudinal girders are placed asymmetrically in order to satisfy the need of the crane rails. They are 60 cm wide, 142 cm high, i. e. 146 cm including the additional slab. Margin (rim) longitudinal girders are 40 cm wide, 215 cm high seaward side and 197 cm landward side. Between first and second longitudinal girder seaward side, a box was formed, with the opening of 130x115 cm. RC slab is 28 cm thick. For the need of special forklifts, in the construction phase, on top of the designed slab, a new one was cast, 22 cm thick.

By means of transverse girders, RC grille rests on four rows of piles made of steel pipes Ø 508/8 m and filled with reinforced concrete. Designed length of piles was 29,50 m. According to the report on driving piles, it was 19.70 m – 42.27 m. Axial distance (center-to-center spacing) of the piles, from the seaside, is 4.00 m, 6.60 m and 5.54 m. Free length of the piles differs and is biggest for the first row piled seaward, 9.75m and linearly shortens landward, so that the last row of piles is completely buried in the ground.

Immediately below the resting place of transverse girder onto the pile, in the zone of high and low tide, the pile is encased in reinforced concrete, for the length of 185 cm and thickness of 10 cm.

This casing's purpose is to protect the pile head in this zone where sea level changes. The rigid joint is establihed between transverse girder and pile head by countersinking pipes and pile reinforcement by 77 cm. For the execution of works on section (plate) 4, a supporting wall was made from Larsen sheet piles TYPE 1II, 36.80 m long, extending from the head of the section landwards.

In section (plate) 4, in fields **g, h, i, j** and **k**, between existing transverse girders, new transverse girders with same cross section, but different length, have been built.

In section (plate) 4, in field **k**, between crown bars **V** and **VI**, there is a wooden grille (grating) made of plywood. In field **r**, in section (plate) 4, between crown bars **V** and **VI**, two steel grilles have been placed with boarding on them.

For these elements there is no data in existing project documents, nor could the representative of the Investor procure the information on their purpose.

Finishing of the RC slab is layer of asphalt, 16-22 cm thick.

After the catastrophic earthquake on Montenegrin coast in 1979, the Pier was damaged and its rehabilitation was carried out.

During the quake, there was subsidence(settlement) and translational motion of the rockfill that was used for pier's construction. Rockfill slid 17-18 m from the structure. There are no major damages noted on reinforced concrete structuree. During the subsidence (settlement)of the ground, a reinforced concrete supporting wall, L shaped, slid under the structure. Existing tie beams have deformed and lost the capability to receive horizontal forces from the ship.

Basic rehabilitation was carried out to enable acceptance of horizontal forces of the ship. This was achieved byusing steel tie beams Ø 85 mm, connected to the structure by steel plates. Tie beams were placed with all pile rows at the distance of 4.60m. Tie beams are 20 m long, so that the anchor block would be outside slip circle in stable zone.

Foundation engineering of pile strucure was done according to the Study on geologic survey of the ground for preparation of the Main project. Geological composition of the ground consists of quaternary deposits as the result of alluvial deposits both from the surface and sea bottom.. Following lithological components have been noted:

- silty close-grained sand (1).
- Sandy silt and seaweed (2).
- Clay slightly silty (3).
- Gravel, silty or with slight clay (4).
- Calcareous debris(4a).
- Gravel, sandy (5).
- Pulverised calcareous debris (6).
- Calcareous debris with clay (7).

- Clay (8).

In the geological study, deep foundation engineering of the structure on driven piles is recommended, with absolute elevation of driving -29.50 m. It was also recommended to remove surface mud layers by dredging up to the elevation of -12.00 m.

Projected concrete class of all structural elements of the Pier is M30 (M300). Reinforcement was done with deformed (ribbed) bars DA 400/500. Regarding the resistance of the concrete to the influence of the sea salt, no specific conditions have been prescribed by the project documentation, except for having thicker protection layer in comparison to structure located in non aggressive environment.

### 1.1.4. EXISTING CONCRETE QUALITY

#### *1.1.4.a. Sampling*

For the purpose of determining the quality of concrete in Pier structure, sampling and testing was carried out on cylindrical shaped concrete samples, 100 mm long, taken out from the Pier structure.

Sampling of kerns was carried out on nine different places, six on transverse girders and three from slabs. Three most damaged transverse girders from sections (plates) 1, 2 and 3 (survey category of damage TYPE 1) were selected for sampling. One kern each is extracted from the most damaged lower zone, immediately above the main reinforcement. Drilling depth was 30 cm in order to assess the concrete quality along the girder. Second kern was extracted from the middle zone of the transverse girder which did not sustain major damage. Drilling depth was 30 cm in order to determined the quality of concrete along the girder. Out of sound kern parts of all 6 kerns, additional two kerns, diameter and height of 100 mm, were made and these were used for testing. From the girder from section (plate) 3, three kerns were taken.

Kern extraction from slab was done on three locations in sections 1, 2 and 3. On all locations, drilling was done through the asphalt and then through the concrete slab for the depth of cca 40 cm. Drilling depth was conditioned with taking samples form newer slab, thickness of 22 cm and the main slab, thickness of 28 cm. Out of all kerns, two, i.e. three samples were taken, diameter and height 100 mm. In this manner, seven samples were acquired, which were used to establish the quality of concrete per slab thickness.

From the taken kerns, samples were taken for the analysis of chloride and sulfate amounts in pier concrete structure. Samples were taken from the surface and from the depth of 12-15 cm to determine the presence of chloride and sulfate along concrete sections of girders and slab. In total, four samples were taken, two from girders and two from slabs.

#### *1.1.4.b. Testing results*

*1.1.4.a.1. Compressive strength and density*

On the selected samples, analysis of the compressive strength and density was carried out. Results are provided in tables 1 and 2. Table 1 shows results from the samples, taken from the transverse girders, while table 2 shows results from samples taken from the slab. Also, in this report, photos (pic. 1 and 2) of the samples are attached, after the extraction, processing for testing and after testing, for samples taken from girders and slabs separately.

*Table 1. TESTING RESULTS OF CONCRETE SAMPLES TAKEN FROM TRANSVERSE GIRDERS*

| No. | LABEL | DATE OF MAKING | DATE OF TESTING | STRUCTURAL ELEMENT | HEIGHT (mm) | COMPRESSIVE STRENGTH | DENSITY | m(g) | Pl(kN) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1.a | | 20.07.2016. | SECTION 1 | 92 | 33.07 | 2255 | 1440 | 225 |
| 2 | 1.1.b | | 20.07.2016. | SECTION 1 | 92 | 36.74 | 2255 | 1440 | 250 |
| 3 | 1.2.a | | 20.07.2016. | SECTION 1 | 106 | 38.21 | 2406 | 1770 | 260 |
| 4 | 1.2.b | | 20.07.2016. | SECTION 1 | 104 | 38.21 | 2272 | 1640 | 260 |
| 5 | 2.1.a | | 20.07.2016. | SECTION 2 | 108 | 41.15 | 2322 | 1740 | 280 |
| 6 | 2.1.b | | 20.07.2016. | SECTION 2 | 108 | 38.95 | 2322 | 1740 | 265 |
| 7 | 2.2.a | | 20.07.2016. | SECTION 2 | 108 | 38.21 | 2282 | 1710 | 260 |
| 8 | 2.2.b | | 20.07.2016. | SECTION 2 | 108 | 36.01 | 2215 | 1660 | 245 |
| 9 | 3.1.a | | 20.07.2016. | SECTION 3 | 108 | 41.89 | 2455 | 1840 | 285 |
| 10 | 3.1.b | | 20.07.2016. | SECTION 3 | 105 | 30.87 | 2182 | 1590 | 210 |
| 11 | 3.1.c | | 20.07.2016. | SECTION 3 | 104 | 44.09 | 2286 | 1650 | 300 |
| 12 | 3.2.a | | 20.07.2016. | SECTION 3 | 104 | 47.77 | 2314 | 1670 | 325 |
| 13 | 3.2.b | | 20.07.2016. | SECTION 3 | 104 | 52.91 | 2328 | 1680 | 360 |
| | | | | | AVERAGE: | 39.85 | 2299.50 | | |

*Table 2. TESTING RESULTS OF CONCRETE SAMPLES TAKEN FROM SLABS*

| No. | LABEL | DATE OF MAKING | DATE OF TESTING | STRUCTURAL ELEMENT | HEIGHT (mm) | COMPRESSIVE STRENGTH | DENSITY | m(g) | Pl(kN) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | | 20.07.2016. | SECTION 1 | 103 | 25.22 | 2341 | 2048 | 210 |
| 2 | 1.2 | | 20.07.2016. | SECTION 1 | 102 | 24.01 | 2311 | 2002 | 200 |
| 3 | 2.1 | | 20.07.2016. | SECTION 2 | 102 | 36.02 | 2320 | 2010 | 300 |
| 4 | 2.2 | | 20.07.2016. | SECTION 2 | 106 | 31.22 | 2299 | 2070 | 260 |
| 5 | 2.3 | | 20.07.2016. | SECTION 2 | 106 | 34.82 | 2454 | 2210 | 290 |
| 6 | 3.1 | | 20.07.2016. | SECTION 3 | 104 | 33.62 | 2298 | 2030 | 280 |
| 7 | 3.2 | | 20.07.2016. | SECTION 3 | 104 | 36.02 | 2388 | 2110 | 300 |
| | | | | | AVERAGE: | 31.56 | 2344.30 | | |

***Picture 1. Samples from RC slabs of Pier 1 prepared for testing***

***Picture 2. Samples from transverse girders of Pier 1 prepared for testing***

Labels in Table 1, mean the following: first represents sections 1, 2 and 3, second represents location of sampling (1 – lower part of girder, 2 – middle part of girder and 3 – extraction depth (a – up to 15 cm, b – up to 30 cm and c – up to 40 cm)). Labels in Table 2, mean the following: first represents sections 1, 2 and 3 and the other, depth at which the sample was taken (1 – up to 15 cm, 2 – up to 30 cm and 3 – up to 40 cm).

Through the analysis of the compressive strength, average concrete girder compressive strenghts have been determined, 39.85 MP for the girders and 31.56 MP for the slab. Results have shown that, currently, this structure satisfies the designed concrete quality of C30. Through observing the thickness of the structural elements (transverse girders and slabs), there is no noticeable difference in compressive strength. In comparison to the analysis carried out by Materials and Structure Institute of Civil Engineering Faculty, Belgrade in 1996, there are some differences, because the Institute from Belgrade determined that concrete quality was not C30, but C20.

*1.1.4.a.2. Amounts of chloride and sulphate*

Percentage of chloride and sulphate are shown in ***Table 3***.

***Table 3. PERCENTAGE OF CHLORIDE AND SULPHATE***

| **Structural element** | **Location of sampling** | **Chloride (%)** | | **Sulphate (%)** | |
|---|---|---|---|---|---|
| | | **In concrete** | **as per cement quantity** | **In concrete** | **as per cement quantity** |
| **Transverse girder** | On the surface of the girder | 0.14 | 0.92 | 1.38 | 2.5 |
| | At depth (12-15) cm | 0.08 | 0.53 | 0.19 | 1.25 |
| **RC slab** | On the surface of the girder | 0.04 | 0.27 | 0.37 | 2.48 |
| | At depth (12-15) cm | 0.04 | 0.27 | 0.19 | 1.27 |

In Table 3, results of chloride and sulphate contents analysis are shown. Percentages in concrete and percentages for the amount of cement in concrete are given, with the assumptionthat the amount of cement in the concrete is 350 kg/m3. The percentage of chloride for the amount of cement is from 0.27% to 0.92%. Significantly higher percentage of chloride is in transverse girders in comparison to slabs, which is to be expected, because transverse girders are located immediately above the sea level. Going deeper, the percentage of the chloride is notably reduced. Percentage of sulphate for the amount of cement is significantly higher, from 1.25% to 2.5%. Percentage of sulphate is notably lower down cross section girder and slab.

Percentage of chloride and sulphate is higher than allowed values. Allowed values of chloride are from 0.2% to 0.4% for the amount of cement.

### 1.1.5 CURRENT STRUCTURE CONDITION

For the purpose of overview of current condition of damaged of reinforced concrete Pier structure, from June to July 2016, all structural elements were visually surveyed in detail. During the survey, every structural element was photographed from both sides, description of the damage was made as well as damage degree evaluation. This was done separately for transverse girders, longitudinal girders and slabs.

Depending on the damage sustained, all structural elements have been classified in two categories, i. e. types:

Type 1 - elements with major damage sustained.

Type 2 - elements with minor damage sustained.

**<u>Damage Type 1</u>**

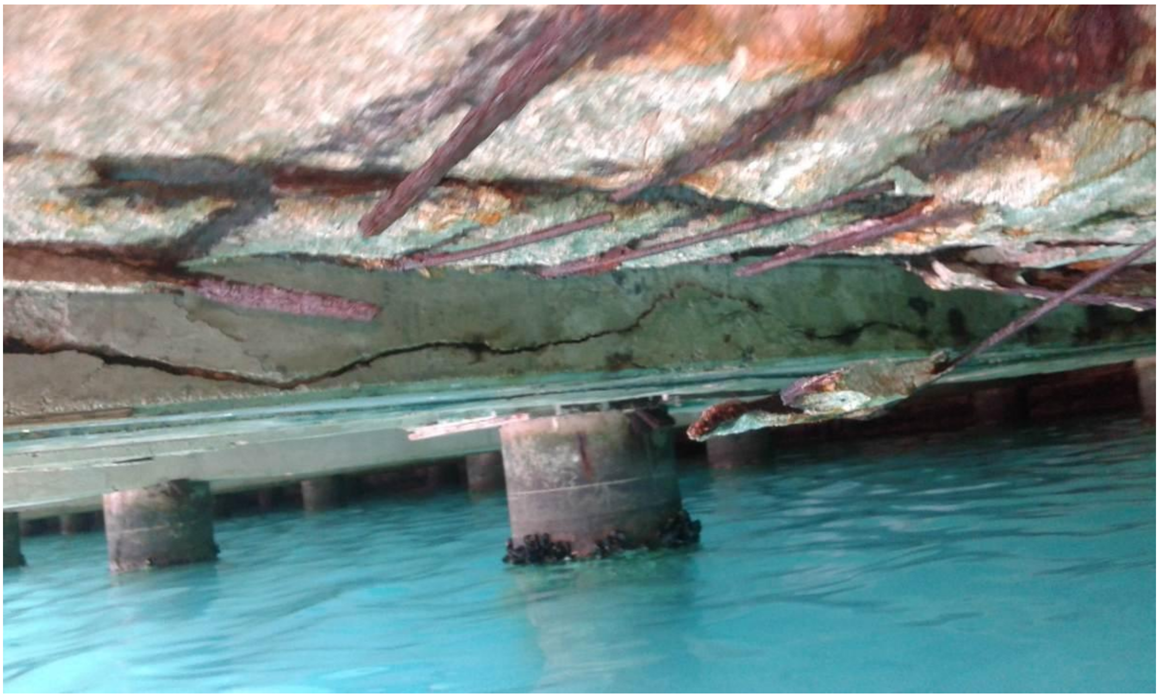
Elements with major damages with concrete parts fallen off or prone to fall off are listed in this category. Reinforcement can be seen and is severely corroded. Transversal section of the main bars has been noticeably reduced, while certain bars have completely cracked. Stirrups are mostly cracked, separated from the concrete and are hanging. In Picture 3, units of cracked stirrups are shown, while in Picture 4, units of the fallen concrete with traces of reinforcement corrosion, are shown.

***Picture 3.a) pieces of cracked stirrups from transverse girder***

***Picture 3.b) pieces of cracked stirrups from transverse girder***

***Picture 4. pieces of fallen-off concrete with traces of reinforcement corrosion***

In this category, there are also elements which have, partially this type of damage and partially TYPE 2, or are not damaged at all. These elements are marked with red color on the disposition of the sections. Typical damage of this type is shown on pictures 5, 6 and 7. In picture 5, transverse girders are shown, in picture 6, longitudinal girders and in picture 7, slabs.



***Picture 5.a) Damage TYPE 1 – Forming of unstable block in transverse beam which tends to fall out***

***Picture 5.b) Damage TYPE 1 – longitudinal and transverse reinforcement of transverse beams has completely corroded and prolapsed from the original position. Diameter of the reinforcement is significantly reduced***

***Picture 5.c) Damage TYPE 1 – longitudinal and transverse reinforcement of transversal beams has completely corroded and prolapsed from the original position. Diameter of the reinforcement is significantly reduced***

***Picture 5.d) Damage TYPE 1 – Detail of breaking by hand of part of transversal reinforcement from transverse beam***


***Picture 6. Damage TYPE 1 –Damage of longitudinal beam in the form of block falling off, up to visible transversal reinforcement and one row of longitudinal reinforcement***

***Picture 7. Damage TYPE 1 – RC slab damaged in the form of concrete falling off up to visible reinforcement and peeling off concrete in layers***

***Damage Type 2***

Elements with minor damages, like falling off the concrete in few places or cracking of the concrete protective layer, is listed in this category. Reinforcement can be seen and has corroded on the surface. In RC slabs, cracks, 0.3 mm wide, are visible and filled with carbon products. These elements are marked with blue color on the disposition of the sections. Typical damage of this type is shown in pictures 8, 9 and 10. In picture 8, transversal girders are shown, in picture 9 longitudinal girders and in picture 10, slabs.

***Picture 8. Damage TYPE 2 – cracks are starting to appear in the lower part of the transverse girders in the zone of lower main reinforcement***

***Picture 9. Damage TYPE 2 – Damage of lower slab of boxed girder and longitudinal beams in the form of concrete husking, peeling and falling off in thin layers***

***Picture 10. Damage TYPE 2 – Damage of the slab in the form of concrete falling off in thin layers and surface damage due to carbonization***

*In tables 8, 9 and 10, in item 3.2* ***Proof of quantities in Bill of quantities****, damage of the transversal and longitudinal girders and slabs are shown separately. Summary of all elements which sustained TYPE 1 damage, TYPE 2 damage or have no sustained damage as well as total number is provided.*

*Elements lengths as per damage types have been given as well as surfaces of elements parts damaged are given in the summary as well.*

*In graphical documentation (appendix 3.2.1, page 17 – appendix 3.2.4, page 20), damage for all structural elements in all sections is shown, where damage TYPE 1 is marked with red and damage TYPE 2 is marked with blue color.*

*In graphic documentation (appendix 3.2.5, page 21 – appendix 3.2.6, page 22), given in the Project, overveiw of existing damages and damages surveyed in 1999, is shown on all dispositions of sections 1,2,3,4, as per damage type.*

*According to the presented survey of the current condition (Book 1), it can be seen that the most damaged elements are the transverse girders, which are at the same time the main structural elements of Pier 1. Damage of the beams that are dilated, are inaccessible and they could not be surveyed.*

*Longitudinal girders are significantly less damaged, compared to the transversal girders. RC slabs sustained least damages. Damage TYPE 1 on slabs in section 2, according to Pier users, was caused by the impact from cargo falling, during handling. Manner of damage of all structural elements, their numbers and respective percentages are shown in the following tables (Table 4 – Table 7):*

| ***Table 4.*** ***DAMAGE TYPE OF TRANSVERSAL BEAMS*** | ***NO. OF UNITS*** | ***%*** |
|---|---|---|
| TRANSVERSAL BEAMS WITHOUT ANY DAMAGE | 0 | 0 |
| TRANSVERSAL BEAMS DAMAGED COMPLETELY - TYPE 1 | 29 | 36.25 |
| TRANSVERSAL BEAMS DAMAGED COMPLETELY - TYPE 2 | 0 | 0 |
| TRANSVERSAL BEAMS PARTIALLY DAMAGED - TYPE 1 | 3 | 3.75 |
| TRANSVERSAL BEAMS PARTIALLY DAMAGED - TYPE 2 | 2 | 2.5 |

| | | |
|---|---|---|
| TRANSVERSAL BEAMS PARTIALLY DAMAGED - TYPE 1 AND TYPE 2 | 46 | 57.5 |
| ***TOTAL BEAMS*** | ***80*** | ***100*** |

| ***Table 5.*** ***DAMAGE OF LONGITUDINAL BEAMS*** | ***NO. OF UNITS*** | ***%*** |
|---|---|---|
| LONGITUDINAL BEAMS WITHOUT DAMAGE | 156 | 33.6 |
| LONGITUDINAL BEAMS DAMAGED COMPLETELY - TYPE 1 | 187 | 40.3 |
| LONGITUDINAL BEAMS DAMAGED COMPLETELY - TYPE 2 | 121 | 26.1 |
| ***TOTAL BEAMS*** | ***464*** | ***100.0*** |

| ***Table 6.*** ***DAMAGE OF LOWER SLAB OF BOXED GIRDERS*** | ***NO. OF UNITS*** | ***%*** |
|---|---|---|
| SLABS WITHOUT DAMAGE | 6 | 7.9 |
| DAMAGED SLABS - TYPE 1 | 0 | 0.0 |
| DAMAGED SLABS - TYPE 2 | 70 | 92.1 |
| ***TOTAL SLABS*** | ***76*** | ***100.0*** |

| ***Table 7.*** ***DAMAGE OF RC SLABS BETWEEN LONGITUDINAL AXES II, III, IV, V and VI*** | ***NO. OF UNITS*** | ***%*** |
|---|---|---|
| SLABS WITHOUT DAMAGE | 268 | 88.2 |
| DAMAGED SLABS - TYPE 1 | 3 | 1.0 |

| | | |
|---|---|---|
| DAMAGED SLABS - TYPE 2 | 33 | 10.9 |
| ***TOTAL SLABS*** | ***304*** | ***100.0*** |

Compared to the condition in 1999, damage on the transversal beams progressed significantly in terms of intensity and number of damaged beams. The situation is similar with the longitudinal beams, while on slabs, difference is minimum, compared to the survey done in 1999.

According to the stated facts, it can be concluded that RC structure of the Pier has suffered serious damage. Comparing the condition from 1999 with the current condition (2016), it can be seen that the damage is progressing. The degree of damage of this structure is such that its safety is significantly endangered and some parts of RC structure may collapse in the nearest future. Because of stated reasons, rehabilitation of Pier RC structure is urgently needed. Pier users are particularly warned not to use cranes with greater individual weight and carrying capacity than the existing cranes considering the current condition of Pier structure.

A diver was employed for surveying the current condition of the piles, which carry RC structure of the Pier, with following instructions in terms of underwater surveying:

- To carry out underwater survey of three piles in each section randomly selected (one from each of the first three rows of piles from seaside). Piles were not selected from the fourth row, because the piles are driven into the causeway and only the pile head is visible, which is protected with a concrete layer. In total, twelve piles were selected for the survey. As appendix, there is disposition of sections where positions of piles surveyed visually and filmed are marked.
- To remove shells, algae and other sea flora from the steel pipe of the pile, on three locations on the pile (first: 1 m length from the sea level, second: 1 m lenght of pile in the middle from the wet bottom to sea surface and third: 1 m lenght of the pile from the sea bottom).
- After cleaning specific positions along pile lengtj, to record with a camera then take samples from the pile by cutting a corroded piece.
- While recording RC structure of the Pier, a detailed survey ofvisible parts of piles (parts above the sea level) was carried out, as well as taking photos and writing a description of damages.

Underwater survey, cleaning and sampling was done by the diver Aleksa Junković. After the survey, based on the video documentation, analysis of the samples taken from the piles surface and visual survey of visible parts of piles, following was concluded:

- Body of the piles has corroded, but the thickness of the corroded area does not exceed 1mm, although cathodic protection does not function for the past 3 to 4 years.
- Concrete protection of the piles, in the zone of high and low tide, has suffered certain damages. On certain number of piles heads (approx. 30%), cracks are visible. On few piles in fourth (last) row, dents, in the concrete layer, are visible, where clams settled.

Part of this report is the photo documentation of typical damages on the piles. Separately, there are video recordings.

On the basis of above-given, the following can be concluded:

- Even though the cathodic protection does function for the last 3 to 4 years, generally speaking, piles structure of Pier 1 south quay is in good condition and its carrying capacity is not endangered.
- Rehabilitation of the protective concrete layer of piles head, in the zone of high and low tide, is recommended.
- Rehabilitation of the cathodic protection is also recommended, to extend the exploitation period of this very important infrastructure.

### 1.1.6. CAUSES OF DAMAGES

The main cause for the damage of the reinforced concrete structure of the Pier is extremely aggressive environment, because this structure is immediately above the sea level and is exposed to constant impact of sea salt. Particular problem is permanent wetting and drying of the lowest parts of concrete structure of transversal girders and end longitudinal girders closest to sea water and mostly damaged.

Structure main designer has, to some extent, taken into the account the aggressiveness of the environment when determining the protective concrete layer. For slabs, the protective layers of reinforcement are 2.5 cm in the lower zone and 2 cm in the upper zone. For transversal beams, protective layer was 4, cm in the lower and 2.5 cm in the upper zone, while for longitudinal beams it was 4 cm in the lower and 2.5 cm in the upper zone. Adopted protective layers of the reinforcement are greater than layers in non-aggressive environments, but certainly are not enough for this kind of exploitation conditions.

Regarding the basic concrete components and their resistance to the aggressive influence of the sea, the designer did not prescribe any conditions nor restrictions.

Apart from the aggressive environment, this relatively fast decline of the structure came to be because of the oversight made during the execution of reinforced-concrete construction. The biggest oversight was embedding of the reinforcement without the designed protective layer. Through the visual survey, it was ascertained that on all damaged locations, the protective layer was smaller than designed and in some places, reinforcement was placed next to the framework, i. e. it practically lost all protective concrete layer. Also, by extracting of cylindrical concrete samples, unsatisfactory completeness of concrete in structure was determined. Unsatisfactory concrete compactness is confirmed by low density, which was determined by analysis.

Structural analysis on more realistic model determined certain deviations in reference to the influence from basic project. The reason for this is that the piles were considered as immovable at the time of analysis, which is not realisticbecause they are slender and deformable elements.

The largest deviations appear in supporting zones where for specific positions of movable loads, positive moments of relatively high intensity appear. Ultimate bearing capacity is not complied with in certain sections. This is especially notable in certain slabs, where in certain sections, safety coefficient is slightly higher than 1.0.

By analyzing cracks limit state, it was determined that their width is larger than the allowed for this degree of aggressiveness in all structural elements. The analysis was carried out for all the specific cross-sections and the following results were obtained: for slabs au=0.12 – 0.49 mm, for longitudinal beams au=013 – 0.20 mm and for transversal beams au=0.06 – 0.17 mm. According to **RULEBOOK FOR CONCRETE** for this degree of aggressiveness allowed width of the cracks is au,max=0.1 mm. Such cracks condition with small protective layer significantly accelerated reinforcement corrosion.

Biggest damages of end longitudinal beam in axis I can be explained by its direct exposure to constant weather changes with periodical wetting and drying as well as with slightest distance from sea surface, because the height of other longitudinal beams is lesser.

Greater damages of longitudinal girders in comparison to middle transverse girders can be explained by their smaller distance from sea level. This probably resulted in more often wetting of these girders by sea water.

Violating the ultimate limit state for certain cross-sections and limit state of cracks is also caused by increase of useful load caused by new cranes which will be used on the pier. However, the slab is not satisfactory even for the existing container crane CERETTI TIFANY 40t.

### 1.1.7. STRUCTURAL ANALYSIS

Structural analysis was carried out by using computer software TOWER. Structure was modelled in 3D with real dimensions and geometric specifications.

By structural analysis on this significantly more realistic model, some deviations from the original project have been determined. Namely, reinforced concrete structure of the Pier is founded on relatively slender piles which deform under the influence of imposed loads, so that analytical assumptions from the original project by which these points are immovable support for RC structure of the Pier are not valid. Besides, this structure is located on the edge between linear and deep beams span- height ratio from 2 to 5, which is categorized as high beams. Thus, RC structure is very rigid and sensitive to minor movements.

At the time of modeling of structure of Pier 1, only tie beams placed after the earthquake in 1979 were taken into consideration, i.e. tie beams with anchor blocks placed in stable zone. Tie beams placed at the time of construction of Pier 1, i.e. before the earthquake, were not taken into consideration during seismic design, because after the earthquake anchor block of these tie beams were in the landslide area.

Pier structure was calculated for the following loads:

1) Dead load:

1.1) Weight of the structure,
1.2) Asphalt 22 cm thick.

2) Live load
   2.1) Container crane CERETTI TIFANI 40t. This is the only of the existing cranes that shall be used even after rehabilitation and strengthening of the Pier
   2.2) Container crane LIEBHERR P13J (WS) L-super,
   2.3) Mobile crane GOTTWALD HMK 260 E,
   2.4) Reach stacker HYSTER RS 45-31,
   2.5) Truck MAFI T 225/ T230 with trailer.

### 1.2.3 SEISMIC LOAD

Analysis of the seismic forces was carried out with computer software TOWER6. The analysis was done for two, perpendicular directions X and Y. By modal analysis, first ten tones of oscillations of the structure were calculated, whereby the mass of the structure was adopted as mass of combination of the load (1.0 dead load + 0.5 live load). For the current state, it was determined that the first tone of the oscillation for the Y direction is T1Y = 0.851s and for X direction, T1X = 0.8406s. For the rehabilitated state, oscillation of the first tone for the Y direction is T1Y = 0.8511s and for X direction, T1X = 0.8403s. Calculation of the seismic forces was carried out, according to the current regulations (Rulebook on technical norms for drafting and analyzing constructions in seismic areas), with the method of spectral analysis. This structure belongs to structure category I, it is located in IX seismic zone (sf = 0.1), with foundations in the ground category III and belongs to framed structure types.

Influence of imposed loads listed item 2, are of various magnitudes. Biggest magnitude is caused by Reach stacker HYSTER RS 45-31, as the magnitude it causes is approx. twice in comparison to other imposed loads, with the exception of container crane LIEBHERR P13J (WS) L-super, which magnitude is approx. half of the reach stacker. The existing container crane, CERETTI TIFANI 40t, has the lowest impact, immediately after the truck MAFI T 225/ T230 with trailer.

Structural analysis was calculated for the current state, design state and rehabilitiated and strengthened state. In book 3, individual results for dead loads, imposed loads and design combinations for dimensioning including seismic influences.

Obtained structural influences differ from the ones in the original project, in magnitude and in location. The largest deviations are found in supporting zones, where, for certain locations of live load, positive moments of relatively big magnitude occur and which were not included in the original project.

The result of the structural analysis have shown that all structural elements, apart from the piles and transverse girders, do not have satisfactory carrying capacity for all new loads. RC slab III (slab between axes III and IV) in the lower zone for X direction was exceptionally poorly reinforced, with Ø10/15, and this is why it needs to be strengthened.

Also, first four fields of the longitudinal girders (span of 4.6m) with dilatations do not have adequaty carrying capacity and they need to be strengthened.

At the request of the Investor, although not requested by Terms of reference, additional structural analysis was made for the following influcences:

1. useful load of 40kN/m2 including influence of cargo placed on the pier during handling
2. railways train which can move along the existing rails on the pier

Mentioned loads are realistic on the pier and this is why additional structural analysis was carried out.

On the basis of executed structural analyses, it was determined that these loads have minor influence on structural elements of the pier in comparison of the influence of handling equipment for which dimensioning was carried out.

### 1.1.8. EVALUATION OF THE CURRENT CONDITION

Reinforced concrete structure of the Pier 1 is located in extremely exploitation conditionsimmediately above the sea level. Transverse girders and external longitudinal girderss are exposed to most agressive sea water impace due to being immediately above sea surface and they are exposed to constant wetting and drying, which is the reason why they have sustained damages the most. Flaws in designing, and particularly in execution of works, contributed greatly to RC structure damages. Designer flaws are reflected in inadequate protective layers of the reinforcement, particularly for not designing any additional conditions for the protection of RC structure from the sea salt impact. Also, the designer did not check the limit state of cracks. Through the control executed within this project, is was determined that the width of cracks is many times wider then it is allowed for this degree of aggressiveness.

Main cause for the damage of RC structure of the Pier was during the execution of works, when, on most structural elements, not even the minimum thickness of the protective layers of reinforcement was provided. At some places, the protective layer of reinforcement was less than 1 cm thick.

In such conditions, the extremely aggressive environment, humidity, chloride and inadequate protective layer of concrete have led to reinforcement corrosion which damaged the protective concrete layer even further, leading to progressive structure damages.

In its exploitation period, RC structure of the Pier has sustained major damages.Damage degree is such that its safety is largely endangered, i.e. there is no adequate safety in the existing exploitation state. Protective concrete layer has fallen of completely on some transverse girders. Most of the main reinforcement has corroded and its diameter is significantly reduced, while the stirrups have cracked due to corrosion and lost their function. It is surprising that some parts of RC structure have not collapsed. Taking into account aforementioned, usage of the Pier in its current condition is not safe, especially not with cranes which are of greater load than the existing ones, and therefore its urgent rehabilitation is needed.

In its exploatation period until now, Pier user did not carry out any maintenance of the Pier which would have lowered the degree of the structural damage.

Steel revetment (lining) of the piles is affected by corrosion the thickness of which does not exceed 1mm, although cathodic protection of the piles does not function for the last 3 to 4 years. Concrete revetment (lining) of the piles heads, in high and low tide zone has sustained certain damages.

Piles structure of this Pier is in relatively good condition and its carrying capacity is not endangered. In order to extend the exploitation period ofthis structure, it is necessary to renew its cathodic protection and rehabilitate damaged concrete revetment (lining) of piles heads.

### 1.1.9. REHABILITATION DESIGN

Choice of the rehabilitation design was based on the following assumptions, i.e. conditions:

- RC structure of the Pier has sustained major damage and its safety is at risk,
- Exploitation conditions are extemely unfabourable, i.e. the environment is aggressive,
- appropriate structural safety of the Pier must be secured,
- longevity of the structure must be obtained, i.e. structure life span must be extended as much as possible,
- the structure must be strengthened for increased useful loads,
- rehabilitation design solution should be acceptable from economic point of view.

The designer of the project has opted for rehabilitation and strengthening of all sections (plates) in the same way, considering the needs and the usage of the pier. Through different degrees of strengthening, small savings could be achieved in reinforcement and carbon strips, but this strengthening cannot be completely avoided.

**Rehabilitation preparations**

Regardless of the damage type, for the execution of works, the contractor is obliged to carry out the following preparations:

1) before the commencement of execution works, to prepare THE STUDY ON LAYOUT OF THE CONSTRUCTION SITE with detailed schedule of works execution and planned execution phases,
2) to prepare CONCRETE PROJECT AND TECHNOLOGY OF EXECUTING THE WORKS ON REHABILITATION AND STRENGTHENING OF PIER,
3) previous testing of concrete and mortarto be used for the rehabilitation,
4) to prepare control testing programme of execution of works and used materials in accordance with the conditions provided in the project,
5) to make an appropriate scaffold under the existing RC structure which shall be used for the works on rehabilitation. Contractor is obliged to make suspended scaffold (cradle) project

6) to propose rehabilitation materials, with adequate valid certifications, to be used for the rehabilitation,
7) to make openings in RC slabs (plates), dimensions 60x60 cm for execution of rehabilitation works, i.e. to approach the damaged elements, according to the graphic documentation (appendix 4.4, page 101). Openings to be made with diamond blades,
8) to remove all loose parts of damaged concrete elements (concrete and reinforcement) by hand while securing that all waste is collected on the scaffold, take out from under the structure and transported to the dump,
9) to carry out sandblasting of concrete surfaces with high-pressure water to remove all loose parts of concrete from the damaged parts of the structure, until only clean and firm concrete remains. Whole concrete surfaces must be sandblasted, because it is planned to protect all concrete surfaces from corrosion after the rehabilitation, i.e, both rehabilitated and non-rehabilitated. Special attention must be paid to sandblasting, i.e., cleaning of corroded reinforcement until returning itsshine, according to the standard ISO 8.501-1.

For the preparatory works from 1 to 6, the Contractor is obliged to get consent from Supervisor (Engineer) and Designer.

**Rehabilitation of the damage TYPE 1**

For this damage type of the girder, two rehabilitation designs have been chosen. First design consists of expanding cross-section in zones of registered damage. Thickness of the new concrete (concrete jacketing) is 10 cm on the bottom side and 8 cm on the lateral sides. This thickness was chosen to accommodate the reinforcement and provide appropriate protective layer. The height of the expansion depends on the height of the damage, which for transverse girders is from 20 cm to max 55 cm and for longitudinal girders is 25 cm. Execution of the rehabilitation must be carried out according to details in the project (appendix 4.3.2). This rehabilitation design refers to all damaged transverse girders (except for the ones with dilatations and ones on the edge) and longitudinal girders in axes III, IV and V.

Second design is executed within the existing dimensions of girders, according to details provided in the project (appendix 4.3.3). This rehabilitation design applies to transverse girders with dilatations, external transverse girders (girders defined in zones A and E) and longitudinal girders in axes I, II and VI.

The procedure of the rehabilitation is as follows:

- Checking the preparation of concrete base for the rehabilitation as well as preparation of reinforcement. All corroded reinforcement bars must be separated from concrete and cleaned from corrosion. Free gap, between concrete and the bars, must be at least 15 mm.
- Depending on the height of damaged part of the girder, the height of the concrete jacket is defined for every girder and additional finishing of girders is carried out for the execution of rehabilitation, according to the detail provided in the project.
- Removing all reinforcement bars or their parts with damaged cross-section of more than 20%.

- Protecting properly cleaned reinforcement with anticorrosion coating, by using adequate anticorrosion agent indented for this type of protection and aggressive environment.
- Embedding additional reinforcement according to the details provided in the project. Replacing removed bars with new bars of appropriate diameter, which need to be lap welded to the existing reinforcement in the length of at least 10∅. Stirrups have completely cracked and need special attention. New stirrups, of same diameter, need to be lap splice welded to the sound parts of existing stirrups in the length of at least 10 cm. Additional reinforcement also needs anti-corrosion coating. This reinforcement is butt welded.
- After placing all necessary reinforcement for TYPE 1 rehabilitiation with expansion to carry out erecting shutter of reinforced concrete jacket, to carry out concrete works with fine grained self-leveling concrete (aggregates at most Ø16 mm), concrete class M40 with water resistant mark of W-12. Conditions for these types of concrete are defined separately. Prior to concrete works, coat the surface with appropriate coating for enhancing the connection of old and new concrete.
- For rehabilitation desing without expansions of cross-section after placing the reinforcement, polymer primer, and after that polymer mortar in layers 3 cm thick is placed, according to the instructions from the manufacturers of rehabilitation materials.

Based on the survey of the current condition, the exact number of bars that need to be replaced could not be determined, because that would require chase cuttling of the damaged girders and that was not possible in this phase. Due to this, during the execution of works, for each structural element, after sandblasting, the exact number of bars that need to be replaced shall be determined, which shall be defined together by Contractor and Supervisor. In this project, on the basis of detailed survey, the number of bars that need to be replaced is an assumption, while the number of bars that need strengthening is determined by structural analysis.

**Rehabilitation of the damage TYPE 2**

This damage TYPE, as already mentioned, includes local concrete damage of all structural elements with different depth, surface corrosion of concrete and reinforcement and cracks.

Rehabilitation bases for preparations are same as for damage TYPE 1. In the same manner, adding and anti-corrosion protection of reinforcement are carried out.

Details of the rehabilitation execution are provided according to the depth of the damage, i.e., for depth up to 3 cm and for depth above 3 cm.

After preparation for rehabilitation and anti-corrosion coating of reinforcement are carried out, polymer cement primer is applied. Preparation and appliance of the primer is carried out according to the instructions of the manufacturer. After applying the primer, appliance of the polymer mortar is carried out in one or more layers, depending on the size of damage. Thickness of one layer is approx. 3 cm.

**Grouting of the cracks**

Grouting is carried out onto cracks more than 3 mm. Cracks grouting procedure is as follows:

- Form a slit at least 1 cm deep and wide above the cracks.
- In formed slit, place grouting tubes, diameter of 10 mm at the distance of 25 cm fixed with rapid-hardening mortar.
- Filing the slit with polymer cement mortar.
- Grouting with grouting mass, based on cement or epoxide resin. Grouting process to be performed pressurized from 0.5 to 2.0 bar, depending on the width of the crack.
- Removing tubes after completed grouting.

**Rehabilitation of damaged slabs**

**<u>Damage TYPE 1</u>**

Due to the characteristics of TYPE 1 damage on slabs, a separate detail and description of the rehabilitation is given. Rehabilitation of these slabs is done by their thickening in fields, by adding a new layer of concrete 10 cm thick, below the existing slabs. Preparation of concrete surface and reinforcement is done in the same manner as fo girders.

For the additional slab, support is formed by drilling anchors in nearby transverse and longitudinal girders. Layout of anchors and needed reinforcement are provided in graphic documentation.

Openings of Ø10 cm need to be drilled for placing the concrete. Layout of openings is provided in graphic documentation (appendix 4.3.4 – plans of reinforcement of longitudinal and transverse girders and slabs and plans of openings in slabs). Note that in all slabs between axes III i IV, openings of 60 cm x 60 cm shall be made to be also used for this rehabilitation.

**Rehabilitation of the piles heads**

Rehabilitation of piles heads should be carried out according to details provided in the project (appendix 4.3.5), in following order:

- Removing damaged lining.
- Cleaning pile's steel pipe, until it is shining, in accordance with standard ISO 8.501.-1, and then applying anti-corrosion coating.
- Making formwork (shutters) out of plastic salt resistant pipes.
- Placing reinforcement (with previously anti-corrosion coating applied) and formwork (shutters) and completing concrete works with self-leveling concrete. Formwork of plastic pipes keep as protection.

**Strengthening slabs with carbon strips**

Because of inadequate carrying capacity, it is designed to strengthen slabs III in X direction in the lower part, which is located between transverse girders in axes III and IV, with carbon strips. The field is reinforced with Ø10/15 cm (Ao = 5.23 $cm^2/m$), which is inadequate to absorb static equillibrium. Needed reinforcement is significantly larger (Ao = 8.67 $cm^2/m$). Designed strengthening is with strips SIKA CARBODUR S512, area A = 60 $mm^2$, with five straps per metre, 2.5 m long. The detail of strengthening with strips layout is provided in the graphic documents (appendix 4.3.5).

**Strengthening crown bars with carbon strips**

Longitudinal girders in axis I in four last fields of the section do not have adequate carrying capacity in the lower zone. The existing reinforcement is 18.28 $cm^2$, but it needs to be 32.88 $cm^2$. Designed strengthening is with eight strips SIKA CARBODUR S626, A = 156 $mm^2$, which are continuously placed for the length of 20 m. Preparation of the surface for the placement of the strips, method of the placement, method of applying glue and gluing of the strips should be carried out completely according to the manufacturer's instructions.

### 1.1.10. EXECUTION PHASES

This Pier consists of four sections, which are dilated between them and represent individual structural entities. The execution of the rehabilitation can be done in phases, i.e., individually for every section. Method and dynamics of the execution can be adjusted to the conditions of the use of Pier, i. e. according to the request of the Investor.

### 1.1.11. HANDLING EQUIPMENT WORK REGIME

While handling cargo, the following combination of handling equipment and cargo is allowed:

Container crane CERETTI TIFANY 40t, container crane LIEBHERRP 13J (WS) L-SUPER, mobile harbour crane GOTTWALD HMK 260E and forklift HYSTER REACH STACKER RS 43-31 cannot be on the same section at the same time.

Handling equipment from point 2 can be individually combined with MAFI TRUCK T225/T230 with trailer or train composotion or any other cargo whose individual weight is not more than $40kN/m^2$.

### 1.1.12. REHABILITIATION MATERIAL AND QUALITY CONTROL

***GENERAL***

During the preparation period, the Contractor is obliged to suggest the materials needed for the rehabilitation. For suggested materials, the Contractor is obliged to deliver appropriate certifications. Approval for the suggested materials is needed from the Supervisor and Project Designer. During the execution of the rehabilitation works, the Contractor is obliged to control the execution of works and analyze every material which is used according to the previously suggested control programme and approved from the Supervisor and Project Designer.

Each used rehabilitation material needs to meet prescribed quality regulations and conditions defined by current norms and standards for this type of rehabilitation works.

During the execution of works, the Contractor is obliged to keep Building book and Building log, in which all phases of works shall be precisely recorded. Upon the completion of works, the Contractor is obliged to design project of as-built state with all needed details and descriptions.

### *CONCRETE*

Concrete qualitty conditions are prescribed with the aim to ensure the required concrete resistance to the aggressiveness of sea water. Before concrete works, concrete needs to be previously analyzed which shall define the concrete meeting prescribed conditions.

### *QUALITY CONCRETE REQUIREMENTS*

Concrete class: M 40 self-leveling

Concrete waterproofing degree: W 12

#### *BASE INGREDIENTS*

#### *Aggregate*

In accordance with the Rulebook for concrete and reinforced concrete from 1987, for this kind and level of aggressiveness.

#### *Cement*

Due to the aggressiveness of sea water, for the concrete preparation, sulphate resistant cement, class 45, to be used. Or if the procurement of this cement is made difficult, Portland-blast furnace cement of 30%, class 45, can be used.

#### *Concrete additives*

Super plasticizers which reduce the need for water, favorably affect workability, increase waterproofing and compactness of concrete, should be used.

On the construction site, concrete and its base ingredients need to be checked constantly, according to concrete project.

#### *Repair mortar*

Repair mortar, which has valid certificates and meet prescribed quality conditions, should be used for the rehabilitation. For the rehabilitation, the following polymer cement mortars should be used:

- Compressive strength:
  - After 24h – 17 MPa
  - After 28 days – 58 MPa
- Flexural strength:
  - After 24h – 4 MPa
  - After 28 days – 9 MPa
- Adhesion: 2.4 MPa

Polymer cement primer should be used before repair mortar.

Appliance of the primer and mortar should be according to the manufacturer's instructions.

### *ANTI-CORROSION REINFORCEMENT PROTECTION*

Before applying anti-corrosion protection, reinforcement needs to be cleaned, according to the standard ISO 8.501.-1. Anti-corrosion protection should be applied with polymer cement primer, which is applied in two layers, at 24 h intervals. Polymer cement primer has to meet the following conditions:

- Adhesion for the surface 0.68 MPa,
- pH mixture 13,
- Density 1.8 g/cm3,

Anti-corrosion coating should be applied according to the manufacturer's instructions.

During the execution of works, it is necessary to perform regular checks of mortar characteristics according to the control analysis program.

### *FINISHING AND ANTI-CORROSION PROTECTION OF CONCRETE SURFACES*

All open concrete surfaces need to be protected with anti-corrosion coating. For this protection, the following is used:

- Agent for leveling concrete surfaces
- Agent for impregnation
- Agent for protection

Agent for leveling should be polymer of the following specifications:

- Compressive strength:
  - After 24h – 25 MPa
  - After 28 days – 35 MPa
- Flexural strength:
  - After 24h – 4.5 MPa
  - After 28 days – 9 MPa
- Adhesion 1.65 MPa

Agent for impregnation should be primers which reduce the surface porosity and make concrete more compact, filling capillaries and pores, forming thin layer on concrete surface and is resistant to the influence of sea salt.

Agent for the finishing should be product which forms continuous layer along the concrete surface, of required thickness and is resistant to the influence of sea salt. Following agents can be used: epoxy polyurethane, polymer enhanced cement, etc.

Agents for the finishing and anti-corrosion should be applied according to the manufacturer's instructions. During the execution of works, it is necessary to perform regular checks of all material, according to control analysis program.

***INJECTION/GROUTING***

For the injection/grouting of cracks, epoxy based agents should be used, according to the manufacturers instructions with regular control.

# 2.QUALIFICATIONS REQUIREMENTS

# Qualifications requirements

The Bidder must fulfil the following minimum criteria:

1. **a) General experience** of main Contractor in the execution of works on reconstruction and rehabilitation of structures of at least 3 projects with similar works complexity;

   **b) Current successful experience** of main Contractor in the execution of mentioned works in meeting the conditions to have at least five projects of similar size and complexity in the past five years;

2. **Qualified personnel.** The Bidder must secure adequate qualified personnel in order to cover the following positions. For each position , the Bidder shall provide information (in the form enclosed in Section 0, Part 2, Appendix 02-4) on key personnel whose experience shall meet the following criteria:

| *Position* | *Total years of experience (years)* | *On similar works (years)* | *As manager on similar works (years)* |
|---|---|---|---|
| *Project manager* | 15 | 10 | 5 |
| *Civil engineer* | 10 | 7 | |
| *Civil engineer – support* | 5 | 5 | |
| *Health and Safety Engineer* | 10 | 5 | |

3. **Equipment.** The Bidder must submit the list of the equipment for the execution of works proposed to be used for the contract. The Bidder shall give the numbers, types, brands and adequate age for each piece of equipment.

# 02-4 References

## Records on special experience

On separate page, using the format on the other side, the Bidder is requested to list all contracts of similar size and complexity as the Contract the Bidder wants to qualify for and on which it worked in the last five years. Partners of proposed Consortium of Bidders must give details on similar contracts proportional to their role in the Consortium. Value should be given in Euros on the Completion date or for current contracts in the period of awarding. Information is summarised, for each completed contract or in execution phase by the Bidder or each partner in the Consortium.

Where the Bidder proposes to engage sub-contractor for critical components of the works or for part of the works surpassing 10 % of total works value, information must be provided for each specialist /sub-contractor in the following forms.

## Contract details of equivalent of similar nature and complexity

*Use separate sheets for each contract.*

1. Contract number
2. Contract Title
3. Country
4. Name of the Employer
5. Employer's address
6. Nature of works and special characteristics relevant to the Contract for which the Bidder wants to qualify.
7. Role in the Contract (check/circle)

   a) Exclusively Contractor    b) Sub-contractor    c) Partner in the Consortium

8. Value of the total Contract /sub-contract /partner participation (on the day of awarding current Contracts)
9. Award date
10. Completion date
11. Duration of contract / sub-contract
12. Particular requirements

Signature .......................................................
(person or persons authorised to sign on behalf of the Bidder)

Date ....................................

## Personnel qualification

The bidder should enter the number of people necessary execution of works in the table below, and if necessary, fill the table by entry of the additional personnel, significant for works realization, that has not been stated. Data referring to their experience should be on separate sheets of paper for each candidate, by using the form given on the following page.

PERSONNEL:

1. Project manager …………………........................
2. Civil engineers ……………………........................
3. Occupational health and safety engineers ............
. Technicians……………………….............................
5. Other trained personnel ………….............……….

## Professional experience of key personnel (CVs)

| Name, Surname, Age | Professional qualifications | Current employment | Current job position | Professional experience years of service | Key qualifications | Main works that the person is responsible for (project/value) | Role in the team |
|---|---|---|---|---|---|---|---|
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Sum the professional experience in the last ten years in inverse order. Emphasize special technical and managerial experience relevant for the Contract.

| From | To | Company/ Project/ Job position/ relevant technical and managerial experience |
|---|---|---|
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Signature
...............................................
(Person or persons authorized to sign on behalf of the Bidder)

Date .....................................

## FINANCIAL STATEMENTS

Please provide the balance sheet and profit and loss statement for the last five (5) years. In case of forming Consortium of Bidders/Joint Venture, please submit respective documents for all consortium members.