Case of study : Review of the existing rail condition and re-alignment of rail in container terminal port of Makassar - Indonesia.

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Summary

To optimize the performance of the jetty/wharf and efficiency cost for operations, maintenance and repair of the Rail Mounted Gantry Crane (RMGC) or the Ship To Shore Crane (STSC) to be installed in container terminal port of Makassar-Indonesia, a review and opinion about alignment of STSC's rail is required.

This review is very critical considering the technical condition of the rail, because this rail has already been installed two years ago. This condition demands necessary corrections/revisions in order to achieve the level of performance and efficiency targeted.

To make sure the existing condition of rail before mounting STS Crane, the rails must be checked concerning *straightness, distance/span and levelness.* Besides that, it also improves civil work between the upper concrete surface of the jetty/wharf and the lower side of rails with grouting method. The grouting method will perhaps use the KRUPP MX System because this system has already used at the other Port in Indonesia (Port of Tanjung Perak-Surabaya).

Resumé

Afin d'optimises les performances des quais et des embarcadères ainsi que l'efficacité en terme de coût pour les opérations, la maintenance et la reparation des grues à portique sur rails ou des grues pouvons roulants doivent être monteés au terminal-conteneurs au port de Makassar. Un état des lieux doit être dressé et des avis sur l'alignement des rails des grues sont necessaires.

Cet état des lieux apparaît critique sur les conditions techniques d'installation des rails, déjà en place depuis deux ans. Des modifications sont necessaires pour atteindre le degré de performance attendu.

Pour ce faire, avant de monter les grues de type STS, les rails doivent être verifiés, en particulier : rectitude, espacement, et niveau.

Il convient aussi d'améliorer le génie civil entre le béton de la partie supérieure des quais et des embarcadères at le niveau inférieur des rails avec des méthodes d'injection. Il peut être utilisé une injection coulis de type KRUPP MX, déjà testé sur le port de Tanjung Perak à Surabaya.

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1. Introduction

The infra structure development such as the Container Wharf, the Container Yard (CY) and the Container Freight Station (CFS) at the container terminal port of Makassar-Indonesia has already been built in 1998.

And for the next the Port is procuring the Container Handling Equipment. One of this equipment is Rail Mounted Gantry Crane (RMGC) or Ship To Shore Crane (STSC) *(Figure 1)*. Its function is to load/unload of container from/to the vessel. This equipment is moving on the rail like a train and now it's still in the fabrication process for structure components and to procure of Mechanical/Electrical components.

Before installed on the rail as long as about 500 meters, the technical conditions of rail must be inspected. The inspections consist of *straightness, distance/span and levelness of rail*. The purpose of this inspection is to know what the rail fulfill the technical requirement for supports of this crane.

In this article, it will be explained about the comparisons between measurement results of rail and standard tolerance, and the re-alignment method of rails which has been already installed before by the civil contractor from Japan (Nippon Koei Co., Ltd.). Besides that, it was also used crane makers' data (Noell Germany) and Consultant (Sucofindo-Indonesia & Casper Associated USA).

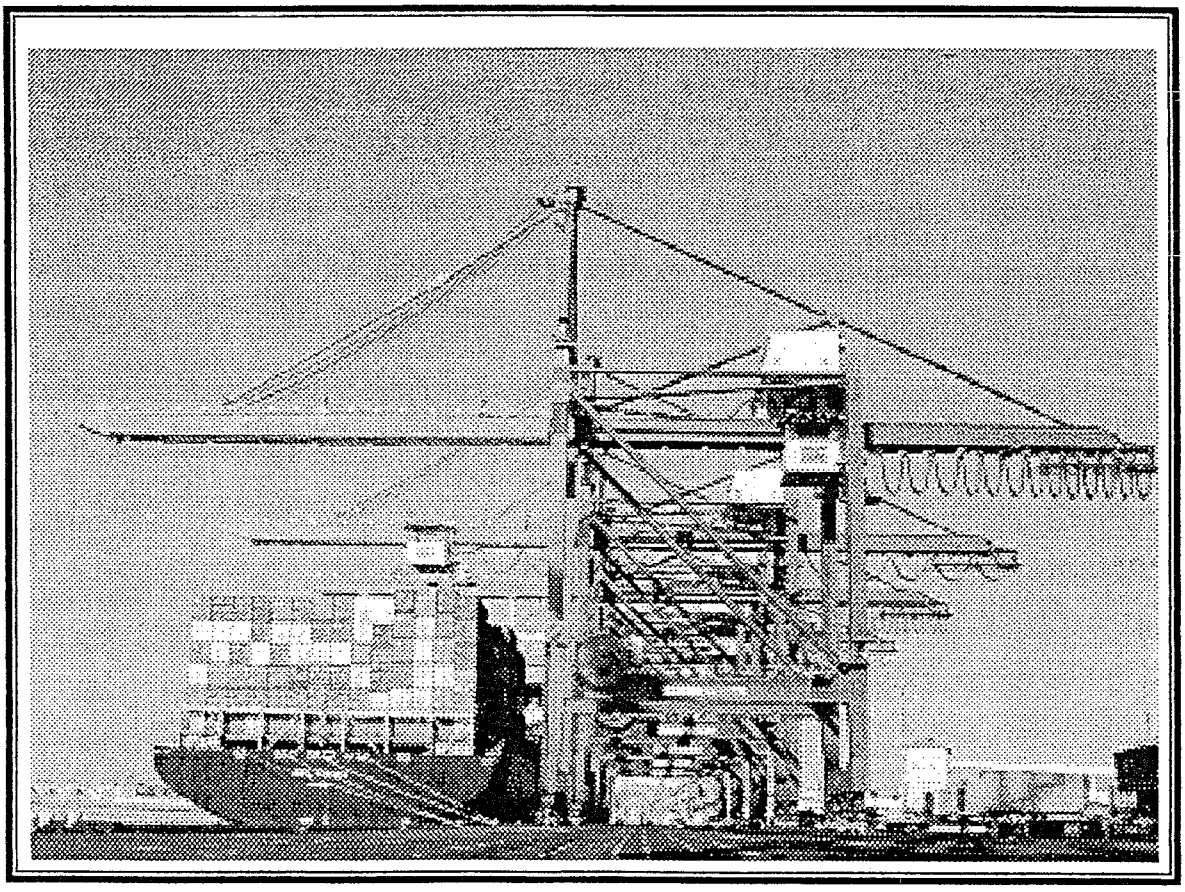

Figure 1. Ship To Shore Crane (STSC)

2. *Review of the rail conditions*

2.1 Technical specification of rails

Rail being installed is of the type CR73 and produced by Nippon Steel Japan. This rail is designed for the STS Crane. The rail maker confirmed that allowable wheel loads is as follows :

- 36 Ton/Wheel for normal working condition
- 40 Ton/wheel for seismic condition

Whereas the others data of rail are :

- Length : 498 meters
- Rail span/Track gauge : 15.24 meters

The installation of rail shows below in *Figure 2.*

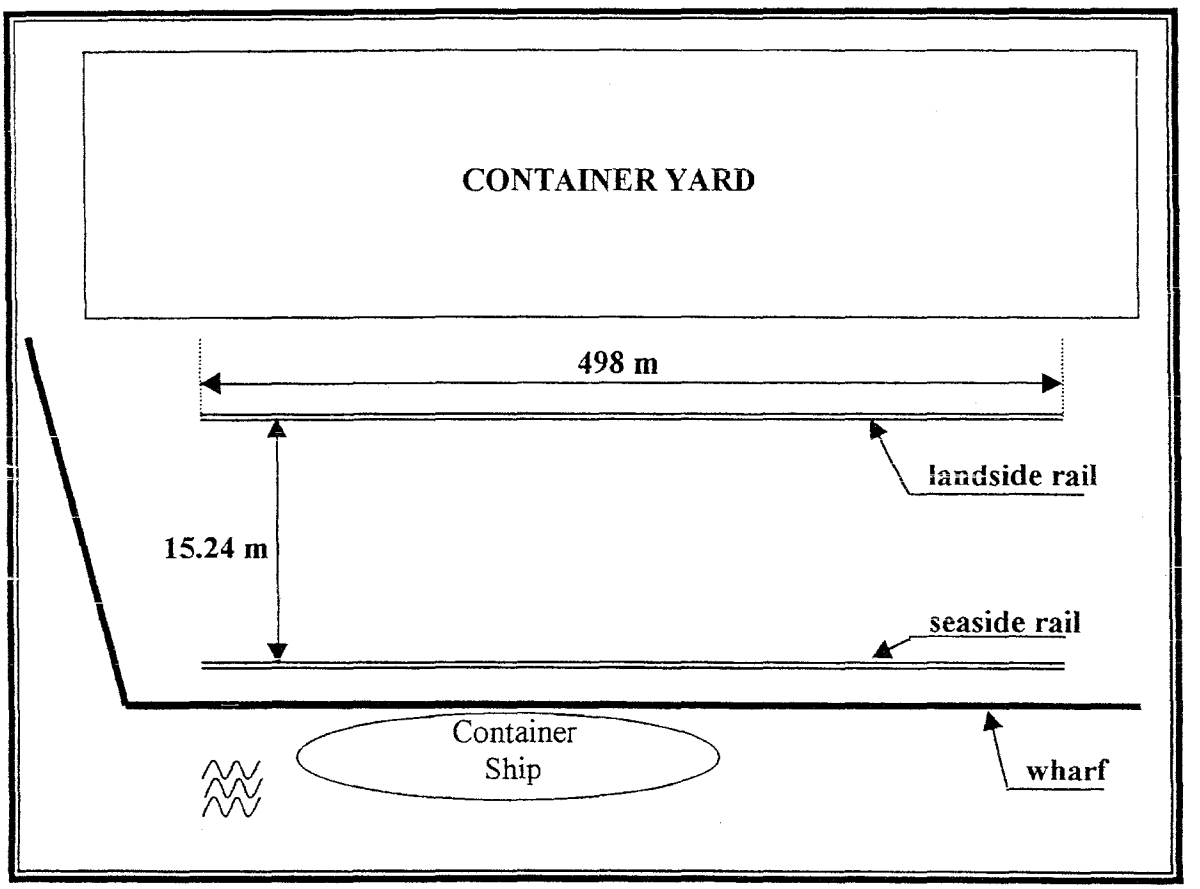

Figure 2. The dimension and installation of rails

2.2 Measurement of existing rail

Measurement being done are against :

- Track gauge centre
- Height of the rail to each other (lateral slope)
- Height of a rail (axial slope)

The measurement results of existing rail as follows :

a. Track gauge centre
The measurement has been done at three points (left side, centre and right side of rail). The distance is about 15.2 meters.

b. Height of the rail to each other (lateral slope)
Height difference (elevation) between landside rail and seaside rail has ranged near 16.5 up to 18.3 cm where landside rail higher than seaside rail.

c. Height of a rail (axial slope)

1) Landside rail
There is settlement about – 8.0 mm at 410 up to 450 meters from right side of rail (North) and also about + 3.0 mm at 50 meter from right side of rail (North).

2) Seaside rail
The settlement is about – 6.0 mm at 420 meters from right side of rail (North) and about + 2.0 mm at 140 meters from right side of rail (North).

2.3 Rail Tolerance

Tolerance for the position of rails is according to DIN 15018 class 2 standard. Based on this standard, we found tolerance results as below :

a. Track gauge centre
For rail span (l) > 15 meter : Tolerance (A) = $\pm$ [5 + (l – 15)] ; l in meter
If we have l = 15.24 meters,
So A = $\pm$ [5 + (15.24 – 15)] = $\pm$ 5.06 mm

b. Height of the rail to each other (lateral slope)
B = $\pm$ 0.001 of l
If we have l = 15.24 meters,
B = $\pm$ 0.001 x 15.24 = $\pm$ 0.01524 m = $\pm$ 15.24 mm

c. Height of a rail (axial slope)
C = $\pm$ 10 mm with the test length of rail is not exceeded of 2.0 meters.

d. Position of a rail in ground plan
D = ± 10 mm with the test length of rail is not exceeded of 2.0 meters.

e. Inclination of the rail to each other
E = ± 0.05 %.

f. Deviation of the rail head from the horizontal
F = ± 0.8 % of the width of the rail head (w)
If we have w = 100.625 mm,
F = ± 0.8 % x 100.625 mm = ± 0.805 mm

2.4 Compares between measurement of existing rail and rail tolerance

NO.	DESCRIPTION	DIN 15018 Class 2	MEASUREMENT OF RAIL	REMARKS
1.	Track gauge centre	max. 15.245 m min. 15.235 m	15.20 meters	Must be repaired
2.	Height of the rail to each other (lateral slope)	max. + 15.24 mm min. - 15.24 mm	16.5 cm up to 18.3 cm	Must be repaired
3.	Height of a rail (axial slope)	max. + 10 mm min. – 10 mm	max. + 3 mm min. - 8 mm	Meet requirement
4.	Position of a rail in ground plan	max. + 10 mm min. – 10 mm	Not yet measured	-
5.	Inclination of the rail to each other	max. + 0.05 % min. – 0.05 %	Not yet measured	-
6.	Deviation of the rail head from the horizontal	max. + 0.805 mm min. – 0.805 mm	Not yet measured	-

Based on the result above, the existing rail must be repaired concerning the leveling and alignment. Therefore the grouting is needed for re-alignment of rail.

3 Grouting System

3.1 System

The system is consisting in :

No.	SECTION	PARTS
1.	Crane rails	Rail CR73
2.	Continuous rails support	• Minex grout foundation • Base plate & Resilient pad • Anchor bolt & Adjusting bolt • Jacket tube
3.	Rail fasteners	• Clip MX 15 & Clip bolt • Plastic caps

The drawing of system above can be shown in *Figure 3*.

3.2 Installation

There are five stages as follows :

1) Trench and base plate preparation
2) Grouting zone preparation
3) Crane rails setting
4) Grouting process
5) Completion

3.2.1 Trench and base plate preparation (Figure 4)

a. Trench

The preparations of trench are as follows :

- Provide unreinforced zones for anchor bolts by jacket tube (or other materials approved such as spiral water pipe or wooden stick coated by styrofoam)
- Jacket tube should be installed to the reinforcement bars of cement concrete trench by surrounding galvanised wire. Ensure that the jacket tube positions were accordance with the base plates predrilled holes for anchor bolt.
- Trench cement concrete process and then after concrete dried up, remove all the jacket tube and ensure that its holes should be cleaned well.

b. Even though for preparation of base plate are :

- Tag welding for nuts
- Ensure that the nuts welded is correct as specification required and at correct position
- Check carefully that for all bolt could be inserted in the pre-drilled holes.
- If necessary, the base plate lifting tools could be installed.

3.2.2 Grouting zone preparation (Figure 5)

It should be done as follows :

- The casing frame for grout foundation must be of rigid construction and free of leakage, therefore fix well and sealed a long side of the base of casing frame.
- Clean up all surfaces of grouting zone and any sticky pieces, residues, oil, unsound material, dust etc should be removed. The surface should be cleaned well and free of loose with using compressed air.
- All surfaces of grouting zone including any casing frame to be thoroughly and continually wetted (watering) for a period of 8 hours by fresh water (clean). Any surplus to be removed prior to placing. This is ensuring the surfaces were saturated with water.
- After fully 8-eight hours, the water should be moved out
- Once again ensure that the grouting zone still in clean conditions.

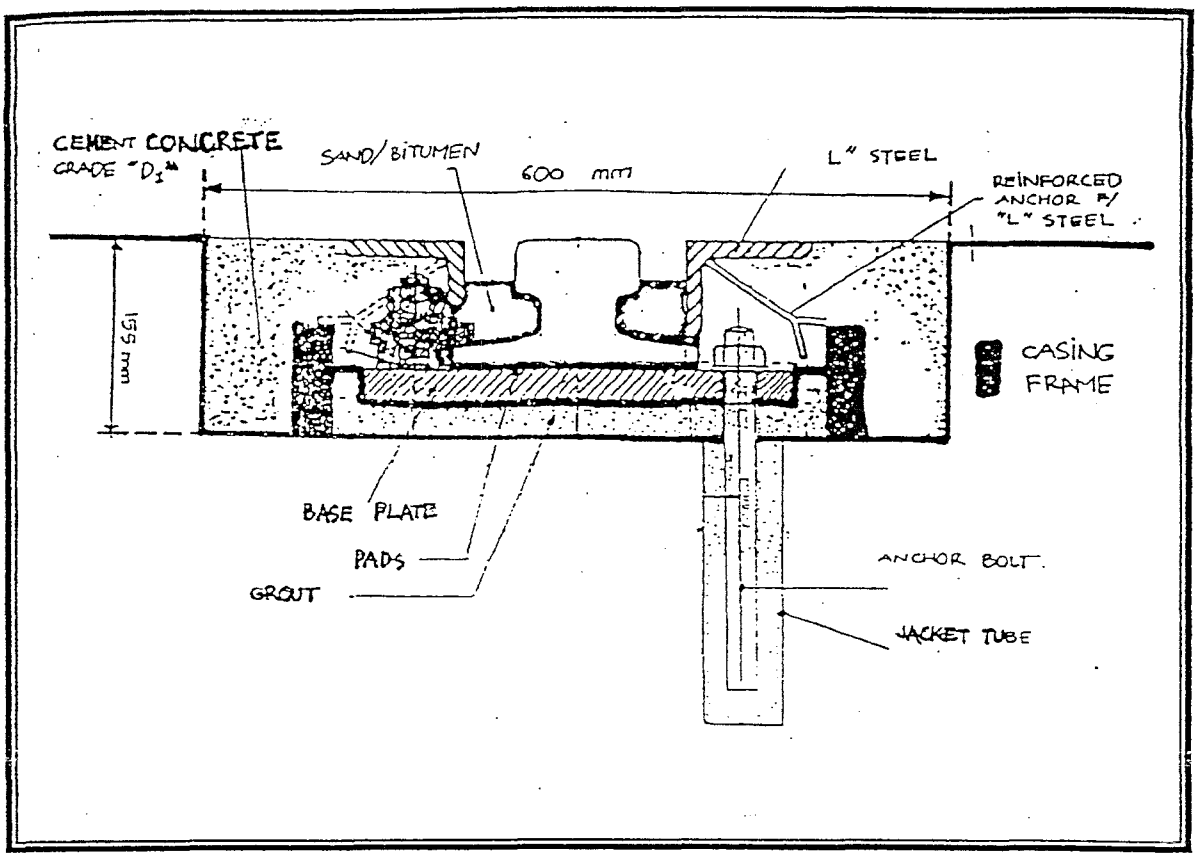

Figure 3. Grouting system of rails

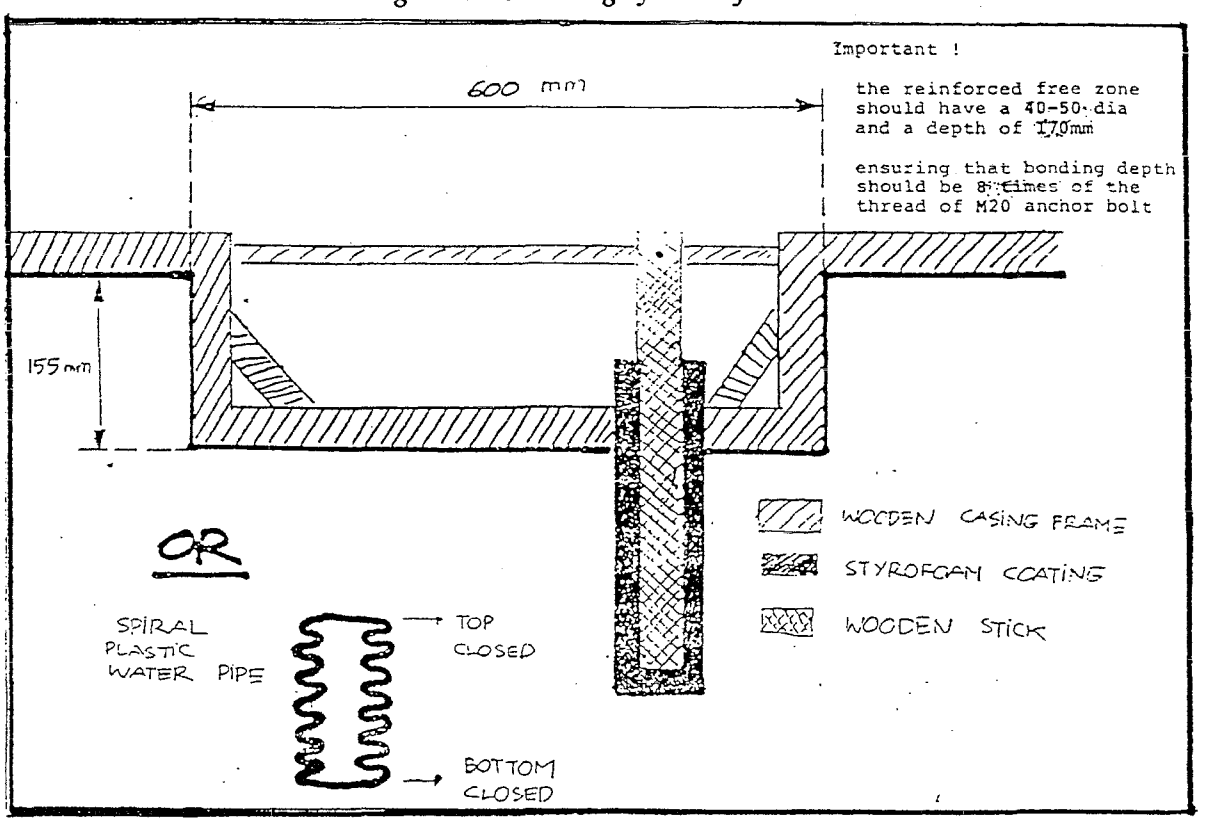

Figure 4. Trench and base plate preparations

3.2.3 *Crane rails setting (Figure 6)*

- Lit the base plate into grouting zone and put in the adjusting bolts to its position and adjust it (by turning) in order to have 35 up to 40 mm height of the grout foundation. As far as possible, maintain the interval gap between base plate of 10 mm. Then put off the lifting tools
- Roll out the resilient pads and place centrally on base plate at the joints without gap and no glue. Then check position of the drilled holes or jacket tubes in relation to the anchor holes in the base plate.
- Put the rails on the pad and leaving space between rails if welding required.
- Align the rail that it lied centrally between the holes of the base plate.
- Put the rail fasteners in zero position and screw on the plastic caps onto the clip bolts beneath the base plate. Then fastened sufficiently.
- Finally set the rail final height by turning the adjusting bolts.

3.2.4 *Grouting process (Figure 7)*

- Place the mixing grout from one side or corner in one continuous pour without any interruption
- When grouting large areas, pour from the middle through a pipe or tunnel
- Then the anchor bolts could be inserted and moved it up and down to compact with the grout.

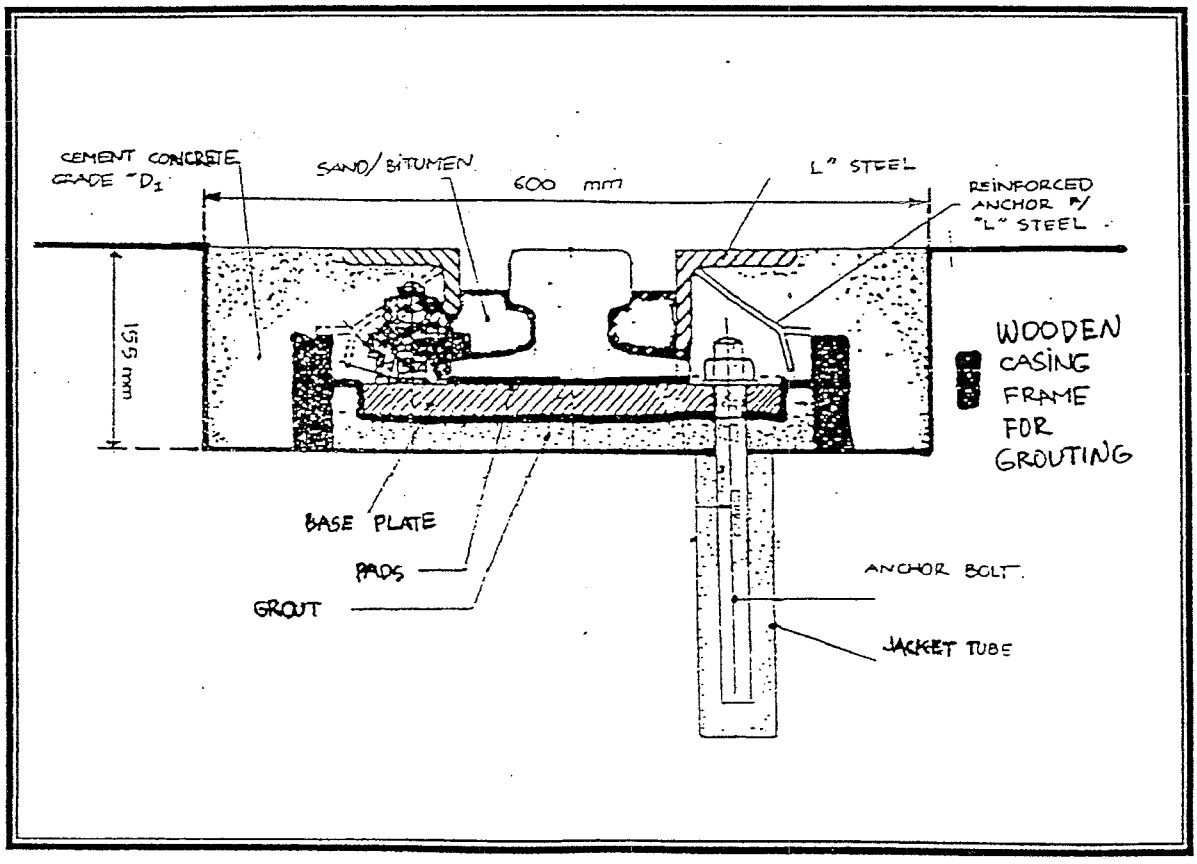

Figure 5. Grouting zone preparation

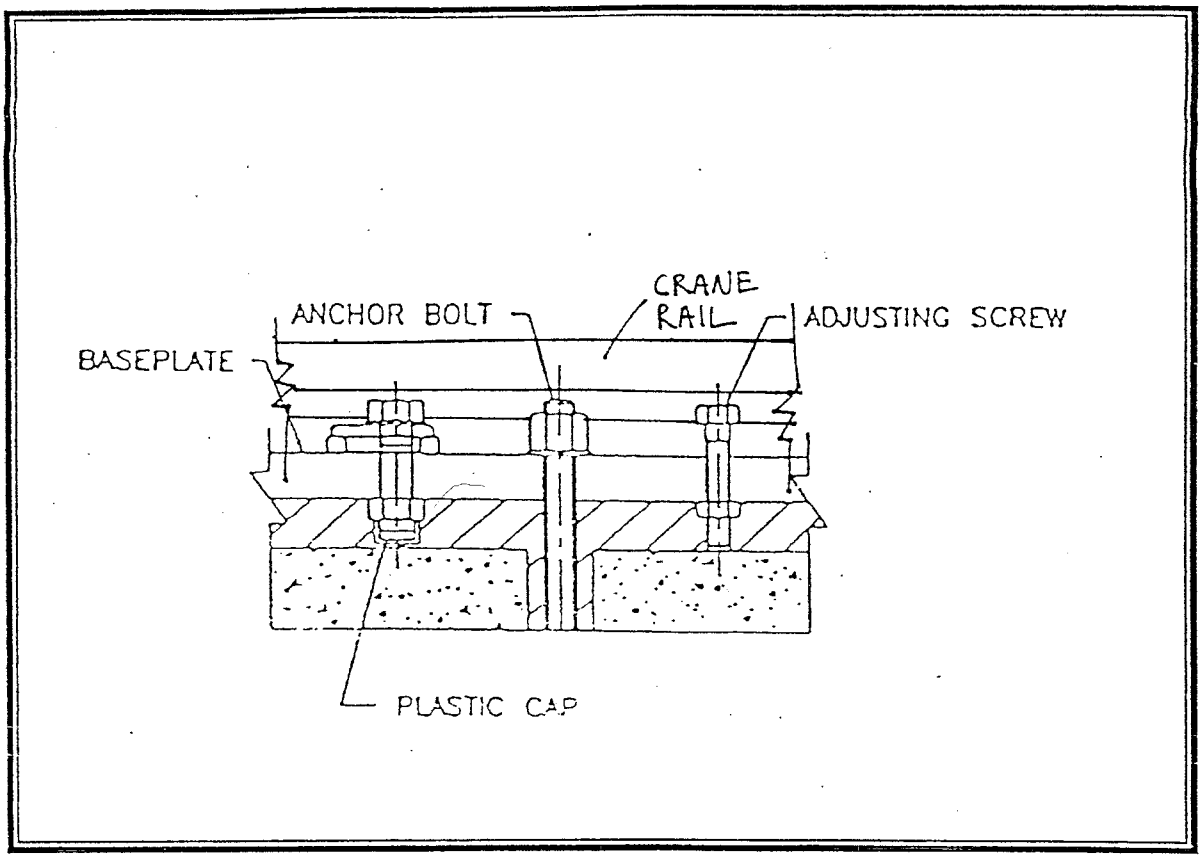

Figure 6. Crane rail settings

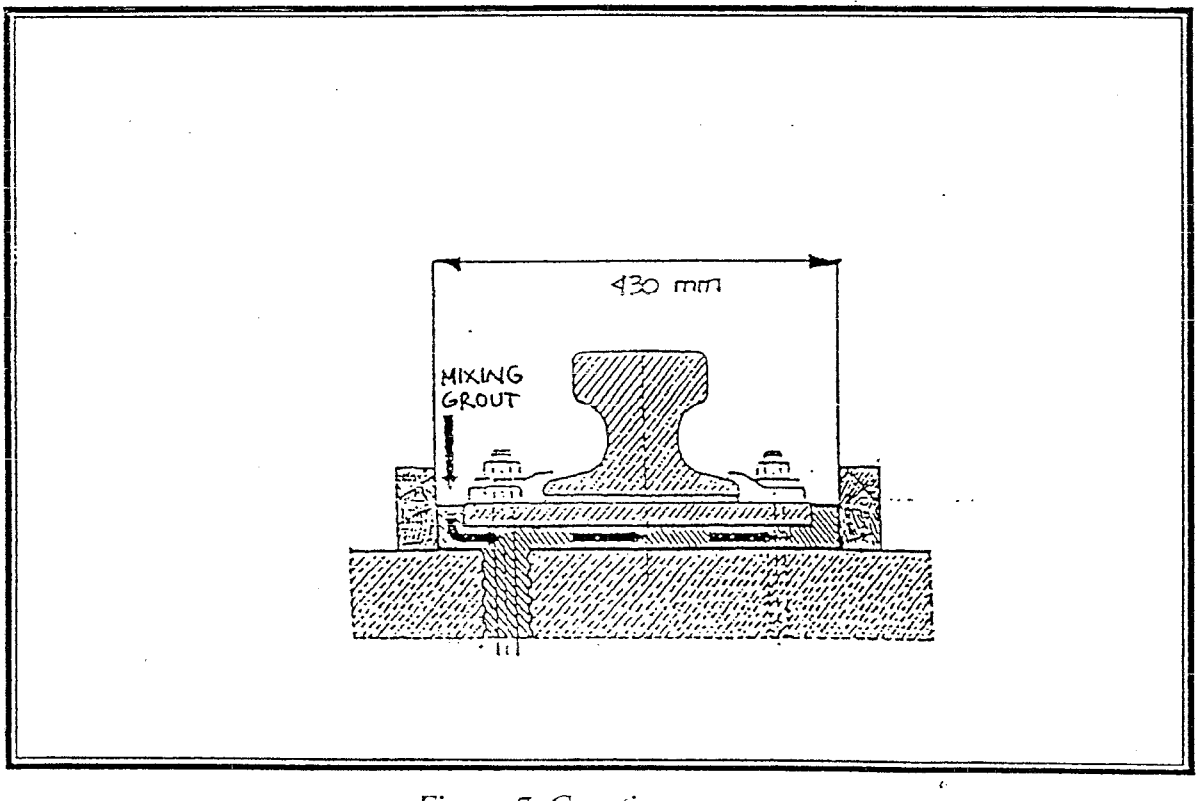

Figure 7. Grouting process

3.2.5 *Completion*

- The cast grout has to be kept wet or covered by plastic sheet and after setting approximately 24 hours, the casing frame and the cover sheet could be removed.
- Screw out the adjusting bolts and fill its holes with Mixing Grout again
- Pre-tension the anchor bolts as per specification and to do the rail joint with welding.
- Measure and align the rails in axial position
- Pre-tension bolts as specification and slightly lubricated.

4 Conclusion

The measurement result of existing rail shows that it doesn't meet requirement or exceeds the tolerance, which has stipulated i.e. accordance to DIN 15018 Class 2 standard. Therefore the existing rail should be done re-alignment and re-leveling with using the grouting method.

The grouting method uses KRUPP MX System because this system has already established at the other Port in Indonesia and nothing problem in so far.