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VISUAL ASSESSMENTS OF CURRENT PAVEMENT CONDITIONS IN THE STACK AREAS OF BERTH 203-205 AT THE DURBAN CONTAINER TERMINAL – PIER 2

Rowen Naicker and Dhiren Allopi

Department of Civil Engineering and Surveying, Durban University of Technology, P O Box 1334, Durban, 4000, South Africa

ABSTRACT

The Durban Container Terminal is currently the biggest and busiest container terminal in Africa and handles about 2.7-million TEUs a year. DCT handles approx. 70% of South Africa's containers and generates 60% of South Africa's revenue (Port of Durban, 2014).

The Port of Durban is currently assessing and introducing infrastructure to accommodate the rapid increase in export and import in the container terminal. The concern is whether or not current pavements will accommodate the weight of the new infrastructure without failing.

Assessment of the current pavement condition in the container stack areas of Berth 203-205 at Pier 2 at the Durban Container Terminal was carried out and is presented in this paper. The results were analyzed and conclusions, as well as recommendations were made.

Keyword:

INTRODUCTION

Background of the study

Pier 2 in DCT is divided into North, East and South Quays. The Pier 2 container terminal was constructed around 1970. Originally the pavement was designed to accommodate one over two straddle carriers and two high stacking. After an in-depth evaluation of other methods of construction, the Council for Scientific and Industrial Research (CSIR) decided the most suitable paving system to adapt was in-situ concrete rather than asphalt and concrete block paving. The type of straddle to be used was unknown when the pavement design was carried out, so to be on the safe side the paving was designed for 8 wheeled machinery. This overdesign was a good investment as the pavement is still in a fair condition approximately 35 years after construction with relatively low maintenance. Presently the pavement has exceeded its design life and more intense maintenance will be required. However the current pavement is not capable of withstanding the loading that new container handling infrastructure like Rubber Tyred Gantry's and Twin lift straddle carriers carry (Transnet National Ports Authority, 2013).

***Corresponding Author**
Email: Naicker@transnet.net

OBJECTIVES OF THE STUDY

The main purpose of this study was:

1) To identify the current conditions of paving areas in the container stacks and straddle ways.
2) To make recommendations on repair methods based on the findings.

Study limitations

This study is based on concrete pavement panels at berth 203-205, Pier 2, Durban Container Terminal. Pier 2 focuses on container handling cargo. The following Figure1 shows the locality map of the area covered by this study and Figure 2 shows the stacks and straddle ways covered in detail displaying the stack numbers that were assessed.

Figure 1: Layout map for Port of Durban

VISUAL CONDITION CRITERIA (Transnet National Ports Authority, 2011).

GOOD: No visible cracks or cracks less than 2 mm aperture. No, or minor spalling along panel edges not affecting the riding surface. Joint seal in good condition.

FAIR: Cracks with aperture between 2 and 10 mm. Spalling along panel edges to a depth in the order of 50 to 100 mm resulting in a locally uneven riding surface. Joint seal either damage or non-existent. *Condition suggests localised repairs/partial slab replacement and/or routine maintenance.*

POOR: Cracks with aperture greater than 10 mm and panels with a general appearance of being completely broken into independent pieces (shattered slabs). Spalling to a depth greater than 100 mm. *Condition suggests slab replacement.*

VISUAL CONDITION SUMMARY

Section	Good	Fair	Poor	Total slots	% Good	% Fair	% Poor	**Result**
RR1	400	98	24	522	76	19	5	**Good**
AA1	417	41	10	468	89	9	2	**Good**
AA2	418	150	26	594	71	25	4	**Good**
AA3	143	25	0	168	85	15	0	**Good**
BB1	444	22	2	468	95	5	0	**Good**
BB2	414	150	30	594	70	25	5	**Good**
CC1	493	23	4	520	95	4	1	**Good**
AA2	448	180	32	660	68	27	5	**Good**
DD1	402	14	0	416	97	3	0	**Good**
M01-M03	394	149	35	578	68	26	6	**Good**
EE1	552	18	2	572	97	3	0	**Good**
EE2	379	49	20	448	85	11	4	**Good**
FF1	390	20	6	416	94	5	1	**Good**
FF2	326	62	30	418	78	15	7	**Good**
GG1	453	15	0	468	97	3	0	**Good**
HH1	190	20	3	213	90	9	1	**Good**
				TOTAL	1355	204	41	**Good**
				% TOTAL	84	13	3	**Good**

SITE OBSERVATIONS

<u>The following observations were made during the site visit:</u>

1) Some of the pavement in the paths used by the straddle carriers were cracked and showed signs of differential vertical movement between concrete on either side of the cracks

2) Slot drains were filled with debris, thus not allowing proper drainage through slot drains

3) Comments made by straddle carrier drivers met on site indicated that the cracks had reached a stage where it detrimentally affected the riding quality

4) Most concrete pavement panels in the terminal were not cleaned and the presence of thick grease from the straddle carriers were visible on the panels

5) Signs of spalling at the corners where the joint meets,

6) Extensive shrinkage cracks

Factors that could be contributing to the above observations

1) Not cleaning the slot drains,
2) Lifespan is exceeded,
3) Lack of maintenance (joint sealing repairs etc.),
4) Panels cannot withstand the weight of new infrastructure e.g. twin lift straddle carriers,
5) Improper construction methods.

CONCLUSIONS AND RECOMMENDATIONS

The following could be rehabilitation options:

1) Do nothing (not recommended)

If the terminal decides to allow operation to continue the following implications could result:

- Implementation of heavier straddle carriers or RTG's could result in rapid deterioration of the pavement
- Operating speeds would be decreased which in turn would result in a negative impact on the efficiency of operations
- The wear and tear of equipment would increase

2) Minimal Repair

This option would reinstate the riding quality of the existing pavement and extend its life to what that pavement was originally designed for. However, when heavier container handling equipment is implemented by the terminal this could pose a problem. The remaining operational life of the slab after minimal repair is extended slightly.

3) Reconstruction of panels that are severely damaged

The cost of this option is quite substantial as it will also affect terminal operations over long periods. However the reconstruction of the pavement to a higher load specification would restore operational efficiency for present infrastructure equipment as well as future.

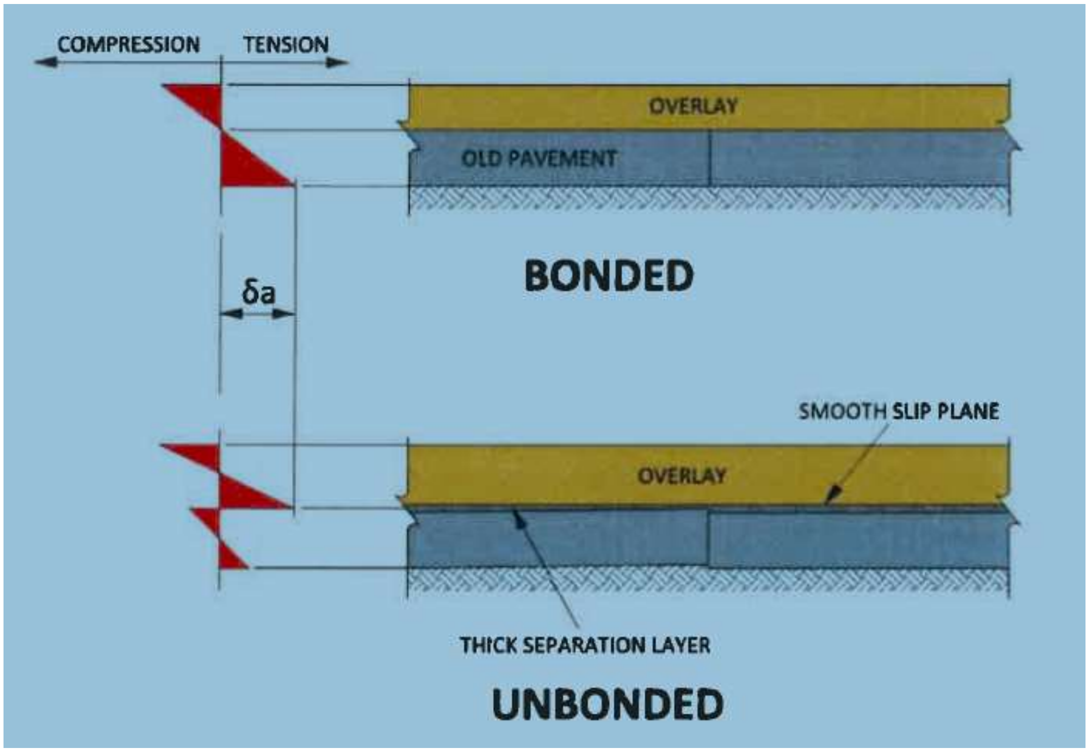
The following operations would need to be implemented:

- Demolish and remove existing pavement
- Demolish and remove the existing cement treated base (CTB) as generally the existing base would need to be reconstructed after the slab demolition
- Demolish the slot drains

- Repair and re-compact the subgrade
- Construct a new base, slot drains and concrete paving.

4) Structural overlay

After site observations, it has been concluded that much of the terminal is in a good condition therefore construction overlay is an option. Concrete overlays may either be bonded or un-bonded. In the case of bonded overlays the existing slab has to be free of defects whereas in the case of un-bonded overlays it is more tolerant of defects in the existing slab. It has been concluded that in the case of structural overlays the un-bonded option will be more suitable.



The advantages of structural overlay include the following:

- Construction time is minimized and will reduce terminal disruption
- The construction cost is lower than the alternative of reconstruction
- The remaining capacity of the existing pavement is utilized
- This option is more environmentally friendly as demolition and disposing large volumes of rubble is avoided

As this option has the benefit of utilizing the remaining pavement capacity, increasing the load capacity, causing the least operational disruption and having a modest construction cost, this option is the recommended alternative in preference to reconstruction.

REFERENCES

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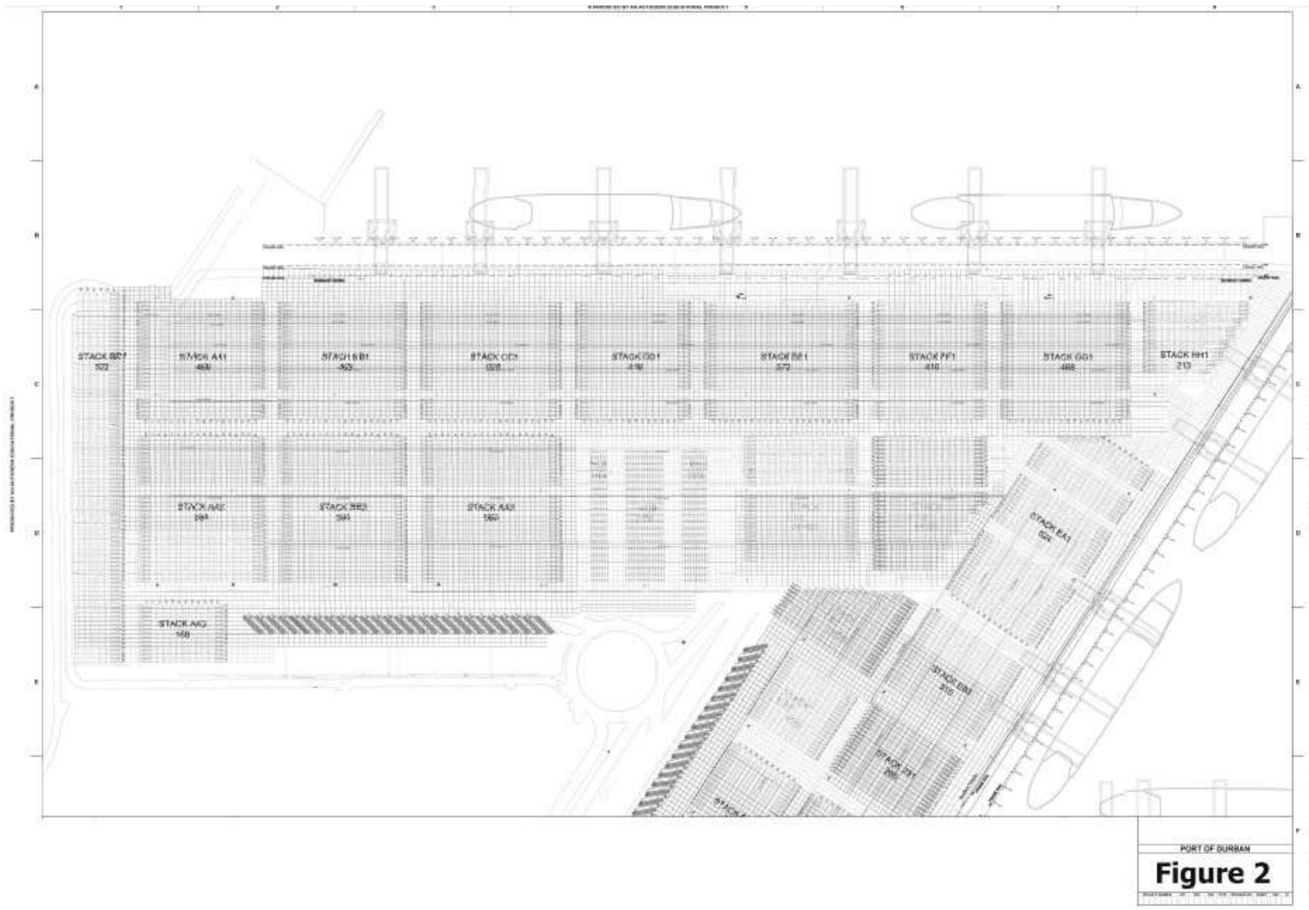

Figure 2