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

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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.

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 adopt 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).

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.
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

<table>
<thead>
<tr>
<th>Section</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Total slots</th>
<th>% Good</th>
<th>% Fair</th>
<th>% Poor</th>
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<td>41</td>
<td>10</td>
<td>468</td>
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<td>150</td>
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<tr>
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<td>22</td>
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<td>41</td>
<td></td>
<td>84</td>
<td>13</td>
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SITE OBSERVATIONS
The following observations were made during the site visit:
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**