Transport World Africa
April 2011

TRANSPORT WORLD AFRICA
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TRANSPORT ENGINEERING

Maintaining flight

Africa's busiest airport, Johannesburg's OR Tambo International Airport, ranks among the best in the world. This is all thanks to the Airports Company South Africa and the engineers involved.

ONE THING the Airports Company South Africa (ACSA) does well is plan ahead. The second thing ACSA does well is implement those plans, effectively. Over the last decade, a number of significant projects have been completed. These include the new Central Terminal building (R2 billion), the Terminal A Departures upgrade and relocation of the upper roadway (R76 million), a new multi-storey parkade (R470 million), the new Echo Apron (R219 million) the new International Pier (R535 million) and, last but not least, the ORTIA Gautrain Station. Now geared to handle 25 million passengers a year, it won't be long before the new mid-field terminal project takes off. However, in the meantime a more mundane and less glamorous, yet critical, project is underway.

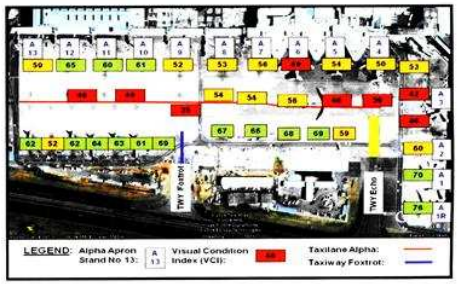
The Alpha Apron area and its related taxi lane on the southern side of the airport terminal area, which are used mainly by passenger aircraft, are in urgent need of refurbishment. Most of the concrete slabs in the aircraft bays and taxi lane have suffered, and show significant distress owing to aircraft loading and moisture-weakened pavement structures. The distress has resulted in increased maintenance requirements and the related risk of foreign object debris (FOD). Given that a section of the current apron area was built in 1952, and was last refurbished and extended in the mid-1970s, this is understandable.

Most of the aircraft movement areas on the Alpha Apron and the taxi lane have some distress in the form of cracking. The extent and severity, however, varies. A pavement assessment, based on a visual condition survey conducted by Arcus GIBB in April 2010, provides the following findings:

Group 1 stands (red): Poorly performing stands with low visual condition indices (VCIs) and/or high deflection values. These include stands A2, A3, A4, A5, A6 and A13, which are in need of urgent repairs to accommodate current traffic safely.

FIGURE 1 (Left) The locality of the assessed Alpha Apron area at the airport

FIGURE 2 (Below) The aircraft bays A1 to A13, the latter being the oldest, and the taxi lane



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Group 2 stands (orange): Stands with a lower intensity of distress (more sporadic) and medium deflection. The visual condition index for stands A7, A8 and A9 are not promising and, in addition, it has been found that for stand A9, a remaining structural capacity of not more than eight years should be expected.

Group 3 stands (green): Stands with only isolated distress. These include stands A10, A11 and A12, which do not indicate a risk of FOD at the moment, and deflection tests indicate a possible remaining capacity of more than 10 years.

Insufficient drainage and failing joint seals (which happen over time) are the main problems identified. Large areas of pavement subbase become saturated with water as a result of surface water crossing the pavement to points where it finds its way into the joints, entering the subgrade to weaken the subbase and substantially reduce the support value of the lower pavement layers. Subsurface and storm water drains need to be located strategically as a preventative maintenance measure. Joint seals need to be maintained preventively. Restoration measures will include:

- replacing the current (failed or weak) concrete slabs (and support layers) in areas affected by aircraft loading
- crack sealing and/or partial slab reconstruction for minor pavement damage
- sub-sealing of concrete pavements (identify and fill erosion voids where concrete panels have as yet not failed)
- providing surface and subsoil drainage systems to remove subsurface moisture and prevent surface water from crossing trafficked areas
- repairing joints, including partial depth concrete repairs and sealing of all joints on the apron, to reduce the ingress of water into the concrete support layers.

ABOVE
Some of the predominant types of distress, which include structural cracking, surface cracking possibly owing to alkali-silica reaction (ASR), as well as pumping of fines and edge spalling

Managing the project

From an operational point of view it is understood that:

1. Work on the taxi lane is regarded as the critical path. The duration of the total construction period will be based on the time necessary to restore the serviceability of the apron taxi lane.
2. No more than two adjacent parking bays will be allowed to be non-operational at any specific time. This will mean that the opposite Apron B parking bays will also be closed.
3. The contractor will have to allow for more than two construction teams working simultaneously.
4. To control the completion date, and specifically to achieve the objectives mentioned in point 2, a performance-driven contract will be negotiated with the contractor specifying specific milestone interim completion dates.
5. A parking bay will only be released for construction once another parking bay has been fully constructed. This will mean that the full scope of works for each work area needs to be completed before it is handed back to ACSA as fit for operations.
6. The length of any taxi lane work area will allow for full operational conditions on either side of the closed parking bays. Operational procedures will have to be included for towing aircraft in and out of the parking bays to prevent jet engine blast damage to construction areas.
7. The expected construction programme is based on experience gained on Delta Apron where on average 360 m² of concrete pavement was reconstructed per week. For the Alpha Apron, the construction rate would have to be increased by 20% to 430 m² per week.

The construction rate will also be improved through the use of construction materials that are not very susceptible to adverse climatic conditions and by allowing the contractor to have a dedicated batch plant on site. This not only reduces the risk of delivery delays owing to external factors, but also provides flexibility in construction hours and possible extended working hours. This measure will be factored in to enhance the rate of construction and reduce expected operational disruptions.

Priority	Element	Restoration measure	Approximate area (m²)
1	Routine maintenance, i.e. sealing of joints and cracks	Joint repair and crack sealing: ± 780 m x 220 m excluding reconstruction area (± 34 600 m²)	133 400
2	Alpha/Bravo Apron taxi lane north	Reconstruct concrete pavement with increased thickness: ± 100 m x 33 m	3 300
3	Alpha/Bravo Apron taxi lane middle	Reconstruct concrete pavement with increased thickness: ± 480 m x 18 m	8 640
4	Taxiway F concrete pavement	Sub-sealing or reconstruction of concrete pavement: ± 70 m x 18 m	1 260
5	Subsurface drains	Install additional subsurface drains in strategic locations: estimate 300 m long	300
6	Alpha stands 2, 3, 4, 5, 6 and 13 (red)	Reconstruct loaded pavement area: ± 2 660 m² per stand including taxi lane entrance	15 945
7	Storm water drain	Construct additional storm water drain: ± 300 m long	300
8	Alpha stands 7, 8 and 9 (orange)	Partially reconstruct loaded pavement area: ± 1 850 m² per stand including taxi lane entrance	5 550

TABLE 1
Summary of proposed restoration works

Project team

The project team for the preliminary scoping report included ACSA, as the client, and SSI, as the principal consulting engineers. As already mentioned, Arcus GIBB was called in to perform the visual condition survey. 35