

Investigation of Spray Seal Pavement Failure at Caloundra Tennis Centre

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ABSTRACT

Built Environment Collective was commissioned to provide Civil consulting services for the Caloundra Tennis Centre Redevelopment. The project involved a 580 square metre car park extension. A two-coat spray seal pavement was determined appropriate with respect to budget requirements and infrequent light vehicle usage.

Three months into the on-maintenance period the new car park pavement exhibited significant aggregate stripping. The performance of the two-coat spray seal as-constructed was reviewed to determine suitability and method of failure. Response was also provided to the sub-contractor's claims that:

1. 2-coat seal should not be employed for use in a carpark
2. The pavement performance (and failure) was indicative of a two-coat seal application

This paper compares the as-constructed two-coat spray seal with:

1. the nominated Sunshine Coast Regional Council Specification,
2. Austroads Guidelines,
3. Industry best-practice.

The two-coat seal pavement was designed according to Austroads and Sunshine Coast specifications. It was noted in Austroads AP-T236-13 and the AAPA Sprayed Sealing Practice in Australia that the use of a two-coat spray seal is suitable for high stress areas with low volumes of heavy vehicles.

The sub-contractor's proposed two-coat spray seal application rates/quantities were provided and reviewed after failure. As interpreted the binder application rate was too low, and the proportion of aggregate too high compared to Austroads specifications. Choice of aggregate sizes was also non-compliant. The AAPA '*Work Tip No.38; Sprayed Sealing – Surface Enrichment*', was referenced and nominated as a rectification method for providing enhanced binding and extended design life.

In this instance deviation from best practice specification requirements has resulted in a poorly finished surface and inadequate aggregate binding. Despite a variety of industry opinions, a number of guidelines and literature sources identify that spray-seal can be effectively utilised as a carpark pavement surface for light vehicle use, hence providing an economical and appropriately durable asset.

Keywords: Double/Double, Pavement, Seal, Austroads

1. INTRODUCTION

Built Environment Collective was commissioned in November 2013 to provide civil services for Caloundra Tennis Centre redevelopment. The project involved nine new tennis courts, eight 'hot shots' mini-courts and the rehabilitation of seven of the existing tennis courts to clay. This report focuses on the design, construction and consequent issues relating to a double/double spray seal (otherwise known as a two coat seal) utilised for extension of an existing carpark associated with the tennis court facility. The scope of works to be

undertaken included a new bitumen pavement, concrete kerbs and footpaths, stormwater drainage and bulk earthworks whilst leaving the existing car park untouched.

2. DESIGN

The carpark extension was scoped as a low use area with no heavy vehicle use, to be designed with cost effectiveness in mind. The carpark extension was to cover a new 580m² area and tie in to the existing carpark. Geotechnical Investigations and reports done by others found a subgrade California Bearing Ratio (CBR) of 3% existed in the area of interest. The final pavement design consisted of two base layers with a two-coat spray seal. A 150mm sub base or TMR type SB2 was specified with a minimum CBR of 35%. Above this a 100mm unbound granular base with a minimum CBR of 80% was specified with a two-coat seal to seal the pavement. The car park base design can be seen in Figure 1.

Tying into the existing carpark pavement was specified with the granular base overlapping the existing pavement by 300mm and the spray seal overlapping the existing pavement by an extra 300mm with a total of 600mm overlap. Carpark drainage was accomplished with a 100mm slotted agg pipe and sock at 1:200 fall behind the kerb and channel surrounding the pavement. The pipe is situated in a trench of 10mm single size aggregate at the edge of the pavement layer.

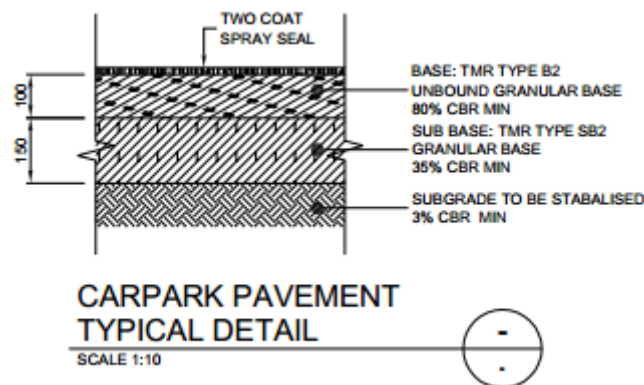


FIGURE 1 Car Park Base Design

3. DESIGN VALIDATION

Research was undertaken in support of Built Environment Collective's design specification encompassing existing specifications through AustRoads, AAPA Pavement Guidelines as well as other example applications to ensure the appropriate sealing method was used for the appropriate situation, in this case; a low use, light duty carpark area.

1.1 Specifications

Several specifications were referenced in the documentation of the two-coat seal pavement. Austroads states that its technical report, AP-T236-13, is an 'update of the design procedure for double/double sprayed seal surfacing. The information supersedes that in *Update of the Austroads Sprayed Seal Design Method* (Austroads 200), and replaces Sections 6, 7 and 8 in that document.' The Austroads Technical Report AP-T236-13, *Update of Double/Double Design for Austroads Sprayed Seal Design Methods* is considered an industry standard for specifications and procedures in Australia when it comes to sprayed seal design. The Australian Asphalt Pavement Association Australia also provides a quick guide to selection of suitable seal treatments with reference to the Austroads seal design method.

Although not specifically for car parks, Schedule 6 of the Sunshine Coast Planning Scheme nominates the requirements of road surfacing. In particular it nominated a double/double

application with all aggregate to be pre-coated. The two-cat bitumen seal is recommended for low volume roads used by light weight vehicles, similar to the requirement outlined for the car park at the tennis centre.

Refer US Spec

1.2 Example Applications

Two-coat spray seals are commonly utilised for low-traffic, low-budget carpark environments. Two similar projects in Queensland where two-coat seal has been utilised are outlined below:

- Brown Contractors have successfully installed a two-coat seal car park at the Art Gallery Moore, QLD.
- RMS Engineering have installed 4500m² of two coat seal pavement throughout the Bowen region in North QLD to Main Roads Specifications

4. CONSTRUCTION

Geotechnical testing of the base for the carpark was undertaken to ensure the correct compaction was obtained prior to the laying of the seal. A proof roll test was also undertaken to ensure there were no areas of weakness in the base layer. Both tests corroborated the strength of the base prior to laying of the two coat seal.

Contractors records, provided only after failure, indicated an AMC7 type binder was used with application of sealing immediately after laying of the binder. The rate at which the binder was applied was 1.2L/m². The top layer was a 7mm aggregate that was spread at a rate of 180m²/m³. A 10mm aggregate based was set down with an unknown compaction rate.

5. FAILURE

The pavement was deemed ineffective by the client, in this case Sunshine Coast Council, within 3 months of the two-coat seal being laid. The failure was documented and photographed as having excess loose gravel material on the surface with an ineffective binding layer. Failure of the pavement can be seen in Figure 2 and 2. Figure 3 shows a close up of loose gravel formulating in piles, particularly around the turning lines of vehicles. Although excess gravel is expected on a two-coat seal pavement, the volume of gravel is expected to be minimal and this far exceeds the expected amount. The contractor criticised the design of the pavement, stating that a two-coat seal should not be used in car parking situations.



Figure 2 Pavement Failure at Caloundra Tennis Centre



Figure 3 Pavement Aggregate Pooling around Turning Circles and Easily Removed

6. COMPARISON – DESIGN VS CONSTRUCTION

The aggregate sizes utilised in the construction was a 10/7, which differs from the preferred combinations of 10/5 or 14/7 as nominated in Austroads AP-T236-13 Section 1.5. Austroads recommends the secondary layer of aggregate should have a size no more than half the size

used in the first layer. Using a secondary aggregate size of more than half the primary size can lead to an inadequate binding of aggregate. The top layer aggregate was spread at a rate of $180\text{m}^2/\text{m}^3$ which is much less than the $250\text{m}^2/\text{m}^3$ set out in Section 2.3 of Austroads AP-T236-13.

The binder utilised was an AMC7 which requires a minimum 3 days of curing prior to sealing of the road per Austroads AP-T236-13 Section 2.2.7. The sealing was completed immediately after the binding layer was put down which diminished the binding of the aggregate.

The binder was laid at an application rate of $1.2\text{L}/\text{m}^2$ which is slightly less than the recommended $1.3\text{--}1.5\text{L}/\text{m}^2$ for 'cutback' bitumen binder covered in section 2.2 of Austroads AP-T236-13.

All of the elements of construction that differ to the required specification can contribute to an inadequate binding of the aggregate. Although each individual element may not have caused failure by itself, each difference between the construction method and the required specification contributed to the overall loss of bonding between the binder and the aggregate resulting in an excess of loose aggregate and a seemingly brittle pavement.

After the pavement was laid and it was noticed that the pavement was not performing as expected, it was suggested by Be Collective that a light sweep was undertaken to remove any excess gravel and an additional roll be carried out to further compress the layers per *AAPA Pavement Work Tips: Sprayed Sealing – Surface Enrichment*. The sweeping was not carried out by the contractor as they believed that sweeping the loose aggregate would expose the bituminous layer underneath and compromise the surface.

7. OUTCOME & RECOMMENDATIONS

There are several outcomes to be considered from the failure of the pavement design at the Caloundra Tennis Centre. By reflecting and reviewing projects that have not met the desired standards, engineers can improve not only their own practices and knowledge base, but also that of people they work with. It is with that acknowledgment that this report was written.

With respect to the Caloundra Tennis Centre, several design aspects could have been done better including but not limited to:

- The specification of the double/double spray seal needed to be confirmed between the Civil Engineer and the On-Site Contractor prior to the construction of the surface. It is not enough to assume the contractor will be knowledgeable in the appropriate Australian specifications and further communication is required. This would have ensured a collaborative approach to construction and a more exact construction methodology being utilised.
- Ensuring an appropriate supervising engineer is present on site can aid in preventing inappropriate methodologies and/or materials being used. Although it is not cost efficient for a site engineer to be present on some jobs, particularly smaller jobs, it can save money over an extended period of time having that expertise on site, to notice the inconsistencies between the design and the construction methods.
- A review of the construction materials should take place before construction of any surface or structure.

A checklist for future engineers to work by can then be developed based on aspects that could be done better and implemented to ensure a quality structure is installed. The following checklist is now in place with Built Environment Collective to ensure future pavements will not fail because of previous mistakes.

- 1) Confirm pavement characteristics required for the project i.e. heavy duty/light duty
- 2) Confirm pavement design utilising available council specifications or if none exist, the relevant Engineering best Practice Manual, i.e. Austroads in Australia

- 3) Confirm the aggregate size available from suppliers with the contractor
- 4) Confirm the spread rate to be adhered to during the separate stages of the pavement pour
- 5) Confirm curing time requirements between seal layers.

8. ACKNOWLEDGEMENTS

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9. REFERENCES

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Worktips may be downloaded free from the AAPA website at www.aapa.asn.au