

# LOW NOISE CONCRETE PAVEMENTS

## SMOOTH, SAFE, DURABLE AND COST-EFFECTIVE TEXTURING (LNDG)

### WHAT IS LNDG?

- > produces surface grooves to provide a low noise surface similar in acoustic performance to asphalt pavements
- > referred to as “Next Generation Concrete Surfacing” (NGCS)

### KEY FINDINGS

- > consistently demonstrated LNDG surfacing provides equivalent low noise performance to that of asphalt
- > retains a consistent performance much longer
- > ride quality showed an average IRI of 0.61 for three passes which is one of the lowest achieved in Australia for any pavement

### KEY OUTCOMES

Concrete pavements with the LNDG surfacing treatment provide a quiet, smooth, safe, cost-effective and durable pavement texture which meets (or surpasses) the noise performance of asphalt, with lower life cycle costs.

### BENEFITS OF LOW NOISE DIAMOND GRINDING (LNDG) FOR CONCRETE PAVEMENTS

Asset owners want a pavement with low initial cost <sup>16</sup>, low maintenance cost <sup>26</sup>, good skid resistance especially in wet weather <sup>1</sup>, good ride quality <sup>2</sup> and low noise <sup>13 4 6 7</sup>. LNDG delivers on every one of these criteria.

### CONVENTIONAL DIAMOND GRINDING (CDG)

Conventional Diamond Grinding (CDG<sup>9</sup>) is typically used to improve ride quality, skid resistance, delineation and extend service life by renewal of positive surface texture. CDG usually comprises a single diamond grinder pass to remove steps at joints, resulting in a corduroy type appearance as shown in the photograph on the right (top). A single pass of CDG can reduce the roughness (IRI) by 50%. This treatment removes heavy vehicle dynamic loading of joints and thus increases pavement life and improves driver comfort and safety <sup>6</sup>.



CDG SURFACE

### LOW NOISE DIAMOND GRINDING (LNDG)

Referred to as “Next Generation Concrete Surfacing” (NGCS) outside of Australia <sup>7</sup>, LNDG provides a low noise surface similar in acoustic performance to asphalt pavements <sup>8</sup>. In contrast to CDG, an LNDG surface provides a negative texture characterised by deep grooves and may be achieved in a single pass (on a newly constructed pavement), whilst for the rehabilitation of aged pavements, typically a three-pass method is employed as follows: (Pass 1) joint stepping is removed, (Pass 2) surface is ground flush, and (Pass 3) grooves are cut at 14.5 mm centres. The texture resulting from each of the three passes is shown in photos on the right.



FLUSH GRIND



LNDG SURFACE

### LNDG PERFORMANCE AND DURABILITY

LNDG was used on trials at the Hunter Expressway <sup>1</sup> 2012–2014 and at the Pacific Highway Upgrade at Valla <sup>3</sup> (Nambucca Heads to Urunga) in 2018. Extensive acoustic testing was undertaken using the Statistical Passby Method (SPB) which measures roadside noise levels

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from passing vehicles, Controlled Passby (CPB) which measures noise using a standardised car and On-Board Sound Intensity (OBSI), which measures surface noise at the interface of the road and vehicle tyre. The results have consistently demonstrated LNDG surfacing provides equivalent low noise performance to that of asphalt<sup>13 45</sup>. Asset owners and noise modellers want a high level of confidence for noise outcome. An LNDG surfacing is created in such a uniform manner that it reliably provides consistent texture and has been shown to have a lower standard deviation in noise outcome than any other pavement<sup>3</sup>, whereas the random matrix of asphalt is affected by variable binder contents, voids, stone size and roller compaction process, all resulting in texture variability. Concrete is not subject to the environmental degradation that asphalt is (oxidation causing fretting and loss of performance). LNDG retains a consistent performance much longer. These attributes are recognised in the NSW Government's Noise Model Policy Guideline<sup>8</sup> which models the best performing asphalt (open grade) as varying up to 7 dBA over time, whereas LNDG is modelled at a set value.

The ride quality or smoothness of LNDG achieved on the Pacific Highway at Valla showed some of the lowest (smoothest) IRI values achieved in Australia for any pavement, averaging IRI 0.61 (equivalent to NAASRA 15) for 3 passes and IRI 0.79 (equivalent to NAASRA 20) for 2 passes.



PENDULUM TESTING ON HUNTER EXPRESSWAY



TFSW SCRIM TRUCK



DIAMOND GRINDING PLANT

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### TfNSW NOISE MODELLING GUIDELINES<sup>8</sup> (EXTRACT)

Pavement Type	Noise Level
Concrete (LNDG)	0.0
Asphalt (SMA14)	+1.0
Asphalt (OGA14)	-4.5 to +2.5
Sprayed Seal	+4.0

For the trials on the Hunter Expressway, skid resistance was measured by both pendulum and the NSW SCRIM machine. Both methods demonstrated that LNDG provides similar skid resistance to transversely-tined concrete and typically 10-15% greater than asphalt pavements<sup>1, 2, 12</sup>. Skid resistance measurements for LNDG varied between 60 and 79 (SCRIM).

### COST CONSIDERATIONS

When considering noise sensitive pavements, LNDG surfacing on Plain Concrete Pavement (PCP) is considered the cheapest pavement where long runs of machine placed concrete can be achieved. The most cost-efficient alternative most often used for highways in NSW is Continuously Reinforced Concrete Pavement (CRCP) with Stone Mastic Asphalt (SMA) wearing course. Savings accrue by the absence of reinforcement in PCP, absence of asphalt wearing course and elimination of periodic asphalt wearing course replacement. On the Hunter Expressway in 2013, the construction saving was estimated to be \$0.7 M/km<sup>1</sup>.

### ENVIRONMENTAL CONSIDERATIONS

Disposal of slurry generated by diamond grinding is an area for ongoing development. Some highly innovative cost saving methods were utilised on the Kariong to Somersby project.

### REFERENCES

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SLURRY SETTLING BASINS

### SUMMARY

Concrete pavements with the LNDG surfacing treatment provide a quiet, smooth, safe, cost-effective and durable pavement texture which meets (or surpasses) the noise performance of asphalt, with lower life cycle costs.