Investigating and Comparing Different Methods of Line Marking Removal

Lauren Collins
The Issue

Road Scarring:
• reduces the service life of the road
• can lead to visibility of removed lines
Standards in New Zealand

- There are only Standards dedicated to road marking application
- New Zealand Standards provide no constraints or guidelines on how to remove road marking
Standards in New Zealand

Required Preview Distance for the Speed Environment

- Edgeline
- Centre Line and Lane Lines – Divided carriageways

Preview Distance (m)

<table>
<thead>
<tr>
<th>Posted Speed Limit (Km/h)</th>
<th>Above 70</th>
<th>Below 70</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
<td>10</td>
</tr>
</tbody>
</table>
The Goal of Our Research

Our Goal was to:

• see if there is a correlation between percentage of paint retained and preview distance
• understand the operators control of the water blaster
Three methods along each section of line:
• Varying pressure
• Varying operator speed
• Operators attempt at reaching required percentage of paint retained
Modified Sand Circle

Modified Sand Circle Depth vs Sand Circle Depth

\[ R^2 = 0.9369 \]

Sand Circle Equation

\[ D = \frac{57300}{d^2} \]

Modified Sand Circle Equation

\[ D = \frac{45000}{80 \times L} \]
Paint Retention
Test Results – Operators Control

Paint Retention with Varying Pressure

\[ y = -1.9016x + 85.465 \]

\[ R^2 = 0.8877 \]

Paint Retention with Varying Time Period

\[ R^2 = 0.0219 \]
Test Results – Operators Control

Paint Retention Corresponding to Percentage Retention Goal

Paint Retention for Markings initially at 100%

\[ R^2 = 0.3518 \]
Test Results – Preview Distance

Preview Distance vs Paint Retention

R² = 0.4108
Test Results – Preview Distance

Preview Distance v Paint Retention for Varying Pressure

% Paint Retained

Preview Distance (m)
## Test Results – Line Removal Guide

<table>
<thead>
<tr>
<th>Line Type</th>
<th>Posted Speed Limit (kph)</th>
<th>Viewing Direction</th>
<th>Viewing Point Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edgeline</td>
<td>Above 70</td>
<td>With travel</td>
<td>50</td>
</tr>
<tr>
<td>Centre Line and Lane Lines</td>
<td>Above 70</td>
<td>Both</td>
<td>30</td>
</tr>
<tr>
<td>Centre Line and Lane Lines - Divided carriageways</td>
<td>Above 70</td>
<td>With travel</td>
<td>30</td>
</tr>
<tr>
<td>Edgeline</td>
<td>Below 70</td>
<td>With travel</td>
<td>20</td>
</tr>
<tr>
<td>Centre Line and Lane Lines</td>
<td>Below 70</td>
<td>Both</td>
<td>20</td>
</tr>
<tr>
<td>Centre Line and Lane Lines - Divided carriageways</td>
<td>Below 70</td>
<td>With travel</td>
<td>20</td>
</tr>
<tr>
<td>Intersection Markings</td>
<td>Rural</td>
<td>With travel</td>
<td>10</td>
</tr>
<tr>
<td>Intersection Markings</td>
<td>Urban</td>
<td>Both</td>
<td>10</td>
</tr>
</tbody>
</table>

### Preview Distance

<table>
<thead>
<tr>
<th>Preview Distance</th>
<th>Percentage Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>20m</td>
<td>10</td>
</tr>
<tr>
<td>30m</td>
<td>17</td>
</tr>
<tr>
<td>50m</td>
<td>30</td>
</tr>
</tbody>
</table>
Test Results - Photos

- 10% Line Marking Retention
- 17% Line Marking Retention
- 30% Line Marking Retention
Day & Night Time Visibility

**Luminance (Day)**

<table>
<thead>
<tr>
<th></th>
<th>P-15</th>
<th>P-16</th>
<th>P-17</th>
<th>P-18</th>
<th>P-19</th>
<th>P-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Pre w T</td>
<td>62</td>
<td>60</td>
<td>59</td>
<td>56</td>
<td>54</td>
<td>59</td>
</tr>
<tr>
<td>Post w T</td>
<td>50</td>
<td>46</td>
<td>47</td>
<td>46</td>
<td>40</td>
<td>33</td>
</tr>
</tbody>
</table>

**Retroreflectivity (Night)**

<table>
<thead>
<tr>
<th></th>
<th>P-15</th>
<th>P-16</th>
<th>P-17</th>
<th>P-18</th>
<th>P-19</th>
<th>P-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Pre w T</td>
<td>33</td>
<td>36</td>
<td>34</td>
<td>28</td>
<td>28</td>
<td>41</td>
</tr>
<tr>
<td>Post w T</td>
<td>21</td>
<td>19</td>
<td>21</td>
<td>19</td>
<td>17</td>
<td>13</td>
</tr>
</tbody>
</table>

Required: 100 mcd/m^2/lux

Required: 150 mcd/m^2/lux
Modified Sand Circle

Greatest Variance in Macro Texture

Depth Before 2.9mm

Depth After 4.3 mm
Conclusions

- There is a correlation between road preview distances and paint retention and therefore paint retention can be used as a reference for different speed environments.
- The operator found it hard to achieve a required percentage of paint retention based on verbal prompts.

<table>
<thead>
<tr>
<th>Preview Distance</th>
<th>Percentage Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>20m</td>
<td>10</td>
</tr>
<tr>
<td>30m</td>
<td>17</td>
</tr>
<tr>
<td>50m</td>
<td>30</td>
</tr>
</tbody>
</table>
Recommendations

Future research:
• Further testing to validate the relationship between paint retention and preview distances.
• A more reliable photo analysis should be used to achieve the true paint retention value.
• Further testing using more mechanically operated controls.
• Further testing on roads which meet the minimum visibility standards
• Further testing to be done on wet nights where ghostmarking is more visible.
Acknowledgements

A big thank you to:
• Our supervisors Bevan Clement and Doug Wilson
• Alister Harlow and Ross Ridings from NZRF
• Chris Mackenzie and the team from Aquamax
• Barbara Howarth, Navtoj Buall and the team from Downers Group ITS
• GHD