TRAFFIC MANAGEMENT IN CONSTRUCTION ZONES

Randall Cable Pr Eng
16 October 2014
Overview of Presentation

1. Work Zone Road Safety
2. Management of Road Works
3. Traffic Accommodation for
   - Two Lane Roads
   - Freeways
4. Conclusions/ Recommendations
Road Safety in South Africa

2012/13:
- 13 802 Fatalities
  - Drivers: 3 983
  - Passengers: 5 205
  - Pedestrians: 4 614
  - 27 fatalities per 100 000 popu.

SADC Region : +/- 63 000 Road Fatalities per year
South African Road Safety Trend

Source: Road Traffic Management Corporation
Global Comparison

Figure 6. Road fatalities per 100 000 population in 2011

IRTAD Road Annual Safety Report 2013
1. Work Zone Road Safety

- Department of Labour does not distinguish between road work zone injuries & deaths and other construction related statistics
  - Challenge to understand the extent of the work zone road crashes in South Africa (no stats)
- Local and International Research (Sinclair)*
  - Road work zones pose higher risks than other construction sites
  - Higher fatality rates in work zones than in general traffic
    - USA – Road work zone deaths (32 per 100 000 workers), 3 times higher than road death rate

*Prof Marion Sinclair, University of Stellenbosch, Vulnerability at Road Construction Sites, South Africa
Figure 6. Road fatalities per 100,000 population in 2011

IRTAD Road Annual Safety Report 2013
1. Work Zone Road Safety

- SA incidents of accidents in general traffic is higher than most countries
  - Inevitable that accident rates on road work zones would be higher as well
- Local and International Research (Sinclair)*
  - Three main causes categories
    - Physical characteristics of road works environment
    - Road worker vigilance and behaviour
    - Behaviour of the traffic that passes through the work zone
  - All three are inter-dependant
    - One of the causes most relevant to all themes are Speed

*Prof Marion Sinclair, University of Stellenbosch, Vulnerability at Road Construction Sites, South Africa
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2. Management of Road works in SA

- Paradox of making roads safer, need to subject them to construction first.
- At any given time a significant proportion of the SANRAL network is under some form of construction.
- Minimise construction costs with maximising safety
South Africa has the 10\textsuperscript{th} Longest Total Network in the World.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Road length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>6,506,204</td>
</tr>
<tr>
<td>2</td>
<td>China</td>
<td>4,008,200</td>
</tr>
<tr>
<td>3</td>
<td>India</td>
<td>3,320,410</td>
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<tr>
<td>4</td>
<td>Brazil</td>
<td>1,751,868</td>
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<tr>
<td>5</td>
<td>Japan</td>
<td>1,203,777</td>
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<tr>
<td>6</td>
<td>Canada</td>
<td>1,042,300</td>
</tr>
<tr>
<td>7</td>
<td>France</td>
<td>1,027,183</td>
</tr>
<tr>
<td>8</td>
<td>Russia</td>
<td>982,000</td>
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<tr>
<td>9</td>
<td>Australia</td>
<td>812,972</td>
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<tr>
<td>10</td>
<td>South Africa</td>
<td>746,978</td>
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<tr>
<td>11</td>
<td>Spain</td>
<td>681,298</td>
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<tr>
<td>12</td>
<td>Germany</td>
<td>644,480</td>
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<td>13</td>
<td>Italy</td>
<td>487,700</td>
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<td>14</td>
<td>Turkey</td>
<td>352,046</td>
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<tr>
<td>15</td>
<td>Sweden</td>
<td>425,300</td>
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<td>34</td>
<td>Dem Rep of Congo</td>
<td>153,497</td>
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<td>46</td>
<td>Zimbabwe</td>
<td>97,267</td>
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<td>55</td>
<td>Zambia</td>
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<td>61</td>
<td>Tanzania</td>
<td>78,891</td>
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<td>70</td>
<td>Madagascar</td>
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<td>79</td>
<td>Angola</td>
<td>51,429</td>
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<td>87</td>
<td>Namibia</td>
<td>42,237</td>
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<td>96</td>
<td>Mozambique</td>
<td>30,400</td>
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<td>102</td>
<td>Botswana</td>
<td>25,798</td>
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<td>121</td>
<td>Malawi</td>
<td>15,451</td>
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<tr>
<td>146</td>
<td>Lesotho</td>
<td>7,091</td>
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<tr>
<td>157</td>
<td>Swaziland</td>
<td>3,594</td>
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<tr>
<td>168</td>
<td>Mauritius</td>
<td>2,028</td>
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<tr>
<td>181</td>
<td>Seychelles</td>
<td>458</td>
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</tbody>
</table>

SADC Total 1,412,222

Roads represents one of the largest public infrastructure investments in most countries.
## South African Road Network

<table>
<thead>
<tr>
<th>Authority</th>
<th>Paved</th>
<th>Gravel</th>
<th>Total</th>
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<tbody>
<tr>
<td>SANRAL</td>
<td>21,403</td>
<td>0</td>
<td>21,403</td>
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<tr>
<td>Provinces - 9</td>
<td>44,400</td>
<td>136,640</td>
<td>181,040</td>
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<tr>
<td>Metros - 8</td>
<td>51,682</td>
<td>14,461</td>
<td>66,143</td>
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<tr>
<td>Municipalities</td>
<td>37,691</td>
<td>302,158</td>
<td>339,849</td>
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<tr>
<td><strong>Total</strong></td>
<td>153,719</td>
<td>453,259</td>
<td>606,978</td>
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<tr>
<td>Un-Proclaimed (Estimate)</td>
<td></td>
<td>140,000</td>
<td></td>
</tr>
<tr>
<td><strong>Estimated Total</strong></td>
<td>153,719</td>
<td>593,259</td>
<td>746,978</td>
</tr>
</tbody>
</table>

**Un-Proclaimed Roads** = Public roads not formally gazetted by any Authority
SANRAL Road Network

* The SANRAL road network has grown
  - 7 200 km in 1998
  - 21 403 km in 2014
* The 21 403 km represents only **2.8 %** of the 750 000 km of RSA network
  - but carries **26.6%** of all traffic, and
  - **70%** of all long distance road freight.
SANRAL Road Network

- Continue to invest in our national road asset
  - **2009/10 to 2013/14**
    - SANRAL awarded **921 contracts** worth **R61.9 billion** for new works, rehabilitation and improvement, and various maintenance cycles
  - **2013/14**
    - SANRAL awarded **175 contracts** worth **R8.9 billion**
    - SANRAL spent **R9.9 billion**
## SANRAL National Road Network (km)

<table>
<thead>
<tr>
<th>Description</th>
<th>Non Toll</th>
<th>Agency Toll</th>
<th>BOT</th>
<th>Total</th>
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<tbody>
<tr>
<td>Dual Carriageway</td>
<td>610</td>
<td>520</td>
<td>443</td>
<td>1 573</td>
</tr>
<tr>
<td>4-Lane Undivided Single</td>
<td>11</td>
<td>299</td>
<td>240</td>
<td>550</td>
</tr>
<tr>
<td>2-Lane Single</td>
<td>17 662</td>
<td>1013</td>
<td>605</td>
<td>19 280</td>
</tr>
<tr>
<td>Total</td>
<td>18 283</td>
<td>1 832</td>
<td>1 288</td>
<td>21 403</td>
</tr>
<tr>
<td>% of SANRAL Network</td>
<td>85%</td>
<td>9%</td>
<td>6%</td>
<td>100%</td>
</tr>
</tbody>
</table>
21 403 km
## Network Summary Per Province

<table>
<thead>
<tr>
<th>Province</th>
<th>SANRAL Current</th>
<th>Strategic Network</th>
<th>Primary Network</th>
<th>Total</th>
<th>Surfaced</th>
<th>Gravel</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>4 510</td>
<td>0</td>
<td>518</td>
<td>5 028</td>
<td>3 285</td>
<td>26 340</td>
<td>29 625</td>
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<tr>
<td>FS</td>
<td>1 592</td>
<td>479</td>
<td>2 460</td>
<td>4 531</td>
<td>3 385</td>
<td>21 325</td>
<td>24 710</td>
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<tr>
<td>GP</td>
<td>617</td>
<td>249</td>
<td>840</td>
<td>1 706</td>
<td>2 360</td>
<td>1 895</td>
<td>4 255</td>
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<tr>
<td>KZN</td>
<td>1 422</td>
<td>804</td>
<td>1 405</td>
<td>3 631</td>
<td>4 540</td>
<td>14 437</td>
<td>18 977</td>
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<tr>
<td>LP</td>
<td>1 922</td>
<td>158</td>
<td>963</td>
<td>3 043</td>
<td>5 518</td>
<td>15 396</td>
<td>20 914</td>
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<tr>
<td>MP</td>
<td>4 016</td>
<td>59</td>
<td>1 535</td>
<td>5 610</td>
<td>3 341</td>
<td>8 887</td>
<td>12 229</td>
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<tr>
<td>NC</td>
<td>3 114</td>
<td>12</td>
<td>0</td>
<td>3 126</td>
<td>1 308</td>
<td>23 205</td>
<td>24 513</td>
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<tr>
<td>NW</td>
<td>2 743</td>
<td>0</td>
<td>133</td>
<td>2 876</td>
<td>3 978</td>
<td>14 961</td>
<td>18 939</td>
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<tr>
<td>WC</td>
<td>1 467</td>
<td>599</td>
<td>1 748</td>
<td>3 814</td>
<td>3 759</td>
<td>10 194</td>
<td>13 953</td>
</tr>
<tr>
<td>Totals</td>
<td>21 403</td>
<td>2 360</td>
<td>9 602</td>
<td>33 365</td>
<td>31 474</td>
<td>136 640</td>
<td>168 114</td>
</tr>
</tbody>
</table>
2. Management of Road works in SA

- **Legal Framework**
  - The Road Traffic Act of 1966 (RTA)
    - Including Road Traffic Regulations 2000
    - Spells out obligation of road authorities
    - Recognises the risks for road workers and road users through work zones and lays down in some detail *procedures* and *guidelines* to mitigate such risk
2. Management of Roadworks in SA

SARTSM: Vol 2: Chapter 13: Road works Signing

- Temporary Signs
  - Regulatory, Warning, Guidance, Information, Other
- Traffic Management
- Setting Speed Limits in Work Zones
- Some Contract Specification Guidelines
- Typical Signing Applications
  - Short Term Works,
  - Rural Roads,
  - Urban Roads
  - Freeways and Dual Carriageways
2. Management of Road works in SA

- Setting of Speed Limits in Work Zones (Chap. 13.6)
  - SARTSM highlights that work zones are more hazardous
    - Road environment is temporary and variable nature
    - Driver familiar with route cannot rely on knowledge of predicted conditions
      - Need to create an environment and that is obvious and predictable
  - SARTSM highlights the need to select appropriate speed limit for work zones
    - “Speed limits should be applied realistically and should, where appropriate, be capable of being altered to suit changing local conditions and/or time of day”
    - “It is essential that speed limits are realistic and that the public can learn to respect and rely on them”
2. Management of Roadworks in SA

- **Setting of Speed Limits in Work Zones (Chap. 13.6)**
  - How often do we see 60 km/h or even 40 km/h being used, for all road types, for all conditions?
  - Speed limits that are too low are potentially dangerous
    - Not realistic
    - Ignored,
    - High speed differentials

- **Speed limits should be designed as part of Traffic Accommodation Designs**
  - Certified by Professional
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3. Traffic Accommodation: Two Lane Roads

**DEVIAATION TYPES**

- The following options are available when deviations are considered on two-lane roads:
  - Single lane on half-width of existing or new road (Stop/Go)
  - Two lanes on half-width of existing or new road (with standard or narrow lanes)
  - Two-lane gravel/surfaced deviation separated from the road under construction.
3. Traffic Accommodation: Two Lane Roads

- BASIC EVALUATION APPROACHES
  - There are two basic approaches that can be followed in the evaluation of alternatives at construction zone deviations:
    - **Cost-benefit analysis** in which the cost of traffic accommodation is compared to the road-user cost.
    - **Level-of-Service** approach in which use is made of minimum level-of-service norms to determine whether the traffic accommodation is acceptable.
3. Traffic Accommodation: Two Lane Roads

- *Cost-benefit* analysis in which the cost of traffic accommodation is compared to the road-user cost for each of the deviation types
  - Cost to road user (additional costs associated with delay and accidents) influenced by various factors, such as lane width, speed, etc.

<table>
<thead>
<tr>
<th>Veh.km per km of deviation over duration of construction</th>
<th>Deviation Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 15 000</td>
<td>Single lane on half width</td>
</tr>
<tr>
<td>15 000 – 250 000</td>
<td>Two lanes on half width</td>
</tr>
<tr>
<td>&gt;250 000</td>
<td>Two-lane deviation</td>
</tr>
</tbody>
</table>

- E.g ADT 1000 x (3 x 4km deviations) = 12 000

*Professor Christo van As, University of Pretoria*
3. Traffic Accommodation: Two Lane Roads

*Cost-benefit analysis in which the cost of traffic accommodation is compared to the road-user cost for each of the deviation types.*

- Cost to road user (additional costs associated with delay and accidents) influenced by various factors, such as lane width, speed, etc.
3. Traffic Accommodation: Two Lane Roads

- **Level-of-Service** approach in which use is made of minimum level-of-service norms to determine whether the traffic accommodation is acceptable.
  - Assume vehicles will travel at 60 km/h or 80 km/h over the length of the deviation
  - Assume *average* waiting time at stop/go
    - 10 min acceptable,
    - 15 min still okay,
    - 20 min not acceptable

*Professor Christo van As, University of Pretoria*
3. Traffic Accommodation: Two Lane Roads

- **Level-of-Service**
- **Coordinated Traffic Signals**
  - Law Abiding road users
  - 60 km/h
  - Maximum 3 km spacing

*Professor Christo van As, University of Pretoria*
3. Traffic Accommodation: Two Lane Roads

- SANRAL Typical Traffic Accommodation Layout Plan
  - Flag persons
3. Traffic Accommodation: Two Lane Roads

- Good/Bad Practices
  - Location of Flag-persons
3. Traffic Accommodation: Two Lane Roads

- Good/Bad Practices
  - *Majority of Work Zone Accidents occur in the Advance Warning Area, specifically at the Stop Sign / Signal

*Petronella Theron, University of Stellenbosch, 2006
3. Traffic Accommodation: Two Lane Roads

- Good / Bad Practices
  - Signage on both sides of the road
3. Traffic Accommodation: Two Lane Roads

- Good / Bad Practices
  - Temporary marking
Traffic Accommodation: Two Lane Roads

- Good / Bad Practices
  - Flag person in the construction zone
3. Traffic Accommodation: Two Lane Roads

- **Good/Bad Practices**
  - Use of sandbags
  - No rocks, drums
3. Traffic Accommodation: Two Lane Roads

- Good / Bad Practices
  - Delineators facing incorrect direction
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- Traffic Accommodation on Freeways
  - Advance Warning Area
  - The Transition Area
  - The Stabilizing Area
  - The Buffer Zone
  - The Work Area
  - The Termination Area
3. Traffic Accommodation: Freeways

Cape Town Freeway Management System (CT FMS)
3. Traffic Accommodation: Freeways
3. Traffic Accommodation: Freeways

Cape Town FMS

155 km
How does FMS works?

Real-time traffic data
CCTV Surveillance

Information Dissemination

Information is processed
FMS Operations Centre
Real Time Information Dissemination

http://twitter.com/CapeTownFreeway
240 CCTV Cameras
52 Variable Message Signs
3. Traffic Accommodation: Freeways

Detection of Incidents

Figure 13: Detection Methods over Time
3. Traffic Accommodation: Freeways

- CT FMS used extensively for traffic management including for road works or maintenance
- Protocol in place to notify operators of construction/maintenance activities
- Can vary from simple activation or event plan
3. Traffic Accommodation: Freeways

- Advanced Traffic Management System (ATMS)
www.i-traffic.co.za

- Advanced Traffic Information System (ATIS)
www.i-traffic.co.za
3. Traffic Accommodation: Freeways

- CT FMS CCTV FOOTAGE

Flagman in Transition Area

Flagman in Transition Area + No Advance Warning
3. Traffic Accommodation: Freeways

- **CT FMS CCTV FOOTAGE**

Flagman Exposed + Signage
3. Traffic Accommodation: Freeways

- CT FMS CCTV FOOTAGE

Lane Closures: Setting out (1)

Lane Closures: Setting out (2)
Traffic Accommodation: Freeways

- CT FMS CCTV FOOTAGE
  - When things go wrong !!!
Conclusions

- Setting of Speed Limits in Work Zones requires Special Attention
  - Consideration to varying speed limits in closures

- Traffic Accommodation should be designed and managed as part of Engineer’s Design
  - Type of Deviation for Two Lane Roads could be evaluated by means of Cost-Benefit or LOS analysis.
  - More Research required

- CT FMS is a useful tool to create road user and roadworker road safety awareness
  - Debriefing
THANK YOU FOR YOUR ATTENTION!