Grass channel for road drainage

Steven Wade, HR Wallingford
Grassed channels for road drainage

Background

• Need to ensure safe (fast and effective) drainage of road runoff

• Preferred method: Surface water channels with triangular cross-section built along the edge of the road (or carriageway) receiving flow along their length
Grassed channels for road drainage

Background (cont.)

There is recognition that changing from concrete to grass-lined earth channels could provide:

- **Environmental benefits**
  - Natural material
  - Greener, more attractive appearance
  - Some pollution control (retention of fine solids and pollutants)

- **Hydraulic benefits**
  - Grass is a very effective soil protection material against water induced erosion (almost 4m/s for 1 hour, 3m/s for 2 hours)
  - Capacity to slow down the flow, thus reducing the quantitative and qualitative impacts on the receiving water
Research has been carried out on the following:

**Review study**
- Selection of appropriate grass types, construction constraints

**Laboratory study and safety trials**
- Experimental determination of the channels’ hydraulic resistance and safety aspects
- Adaptation of the existing design method for concrete channels to grassed channels
- Guidance on construction and maintenance

**Site trials**
- Selection of trial sites
- Development and installation of monitoring instrumentation
- Analysis of results

**Development of advice note**
Selection of appropriate grass types – Criteria

- Slow growing grass (to reduce maintenance requirements)
- Fast establishment rates, native seeds and suitability for many locations
- Tolerance of wet conditions (wetter conditions may affect balance and density of the grass types)
- Quick recovery from damage (by vehicles parking or accidentally running off the road)
Grasses chosen were:

- Perennial Ryegrass Mixture
  (speed of establishment, high recovery rate from damage, tolerance to wet conditions)

- Red Fescue Mixture
  (good salt tolerance, slower growth rate)
Laboratory study - hydraulic capacity

- Experimental study to determine resistance of grassed channels
- Limitations on capacity imposed by:
  - safety considerations: depth < 150 to 200mm
  - verge width.

Testing in PRG channel; Q = 50.8 l/s; grass height = 100mm
Grassed channels for road drainage

**Test facility**
14m long, 3.6m wide
Two half triangular channels were reproduced with two types of turf (Perennial Ryegrass and Fescues)

**Design formulae**
Based on Manning’s equation - relationship between $n$ and $VR$, dependent on grass height

$$n = 0.05 + 0.0048 \left(1 + \alpha\right) \frac{H}{VR}$$

with $\alpha = 0$ for Perennial Ryegrass
$\alpha = 1$ for Fescues

where $n$ is Manning’s coefficient, $H$ is the height of grass, $V$ is the mean cross-sectional velocity and $R$ is the hydraulic radius
Safety and resilience tests at Transport Research Laboratory (TRL)

- Full-scale grass channel, approx. 50m in length, 2m in width, max. depth 150mm
- Vehicles used: small car, van, rigid flat bed lorry and a loaded 38T HGV
- Conditions: driven through at increasing speeds, braking and acceleration from rest.
- Safety risk was not significant
- Braking of heaviest vehicles caused deep ruts

TRL channel
Grassed channels for road drainage

Vehicle trials
Grassed channels for road drainage

**Site trials**

**Sites**

- Three sites on a motorway in UK - a total of 500m of grassed channel were built
- Monitoring period: from early 2003 to mid 2004
- Triangular cross-section; turf (60% Fescue; 40% Bent)
- Impermeable liner

<table>
<thead>
<tr>
<th>Site</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44m</td>
<td>2m</td>
<td>150mm</td>
<td>1/75</td>
</tr>
<tr>
<td>2</td>
<td>97.5m</td>
<td>3m</td>
<td>150mm</td>
<td>1/66</td>
</tr>
<tr>
<td>3</td>
<td>147m</td>
<td>2m</td>
<td>150mm</td>
<td>1/35</td>
</tr>
</tbody>
</table>
Grassed channels for road drainage

Site 1
A2-M2
Junction 1
Site 2
A2-M2
Junction 1

Grassed channels for road drainage
Grassed channels for road drainage

Site 3
A2-M2
Nashenden Valley
Construction

- Need to consult the environmental regulatory authority regarding location of aquifers

- If aquifers are present an impermeable liner may need to be provided

- Need to consider hard areas around outlets and for emergency stoppage on verge (but maintain greenness)

- Avoid positioning safety fences in the channels; signage and ducts away from the channels, etc
Grassed channels for road drainage

Initial recommendations on establishment and maintenance of grassed channels

- For channels built in summer months, water for establishment of grass during first two weeks for one hour every day. Water in dry periods.
- Grass height to be kept at **50mm** (max 70mm)
- Grass cuttings do not need to be collected
- Weed killer can be applied but no fertiliser is needed.
Grassed channels for road drainage

Monitoring

- Continuous monitoring of rainfall and water depths in the channels
- Raingauges and dataloggers
- Ultrasonic probes for water depth reading (triggered by raingauge)
  Back-up system using water sensitive tape to measure maximum water levels
- Permeability tests
- Monitoring of grass condition

Installing instrumentation
Grassed channels for road drainage

A120 Reinforced grassed channel
Grassed channels for road drainage

Conclusions:

- Grassed channels are an environmentally improved means of safely disposing of runoff
  - Sustainable drainage system but requires maintenance
  - Minimal use of non-sustainable materials
  - Provide “greening” of the road (reduced impermeable area) but this also attracts litter!
  - Flow attenuation: flow vel. in grassed channels are 25% of velocity concrete channels
Conclusion (cont):

- Safety aspects have been addressed – grassed channels do not impose greater risks to drivers but prompt remedial action is needed if damage is caused to the channel.

- Quantification of pollution control properties of grassed channels requires research.
Grassed channels – a good idea for road drainage
Any questions?

HR Wallingford
Howbery Park, Wallingford, Oxfordshire OX10 8BA, United Kingdom
tel +44 (0)1491 835381 fax +44 (0)1491 832233 email info@hrwallingford.com