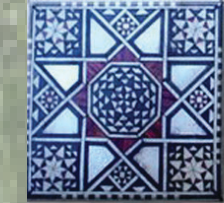




THE WORLD BANK
IBRD - IDA



GFDNR
Global Facility for Disaster Reduction and Recovery



META
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Road embankments

HEIGHT OF EMBANKMENT: Key Points

- 1 Height based on maximum flood level plus additional provision for wave action – in particular at sea fronts and river banks.
- 2 For roads close to rivers and sea, close coordination is needed with BWDB, to ensure road maintain width and height and are paved before the maximum height of the flood embankment has been achieved.
- 3 Inside low-lying flood prone area the height of roads may be increased so as to provide shelter and evacuation routes for people and livestock.
- 4 Also in areas prone to water logging road embankment must be raised with adequate drainage so that nearby houses are not inundated
- 5 Raising the height of these roads may be done with excavated material from khals and drains that is often easily available
- 6 In the haor areas road embankments may be made with appropriate heights that support water management and all-weather access – e.g. slightly elevated in order to influence the retreating inundation and to control soil moisture in the recession areas. Care should be taken not to interfere with the flooding patterns and deploy overflow structures, flood causeways or adequate cross drainage. When this is not possible or feasible, submersible roads may be made

SIDE SLOPE: Key Points

- 1 Road shoulders and embankments should follow recommended side slopes for road stability and safety and to accommodate roadside vegetation (see table). For higher embankments (4-5 mtr) more gentle side slopes apply.
- 2 Ownership issues of roadside side slopes should be addressed: this requires consultation and time, so as to agree on ownership by LGED and/or land use by communities of the side slopes.
- 3 Where it is not possible to ensure the proper side slopes, alternative reinforcement arrangement should be deployed such as (1) retaining walls properly anchored and backfilled; (2) face geotextile face wraps or geogrid bamboo mattresses with vegetation; (3) armouring with concrete block (with weepholes) or riprap with graded filter; (4) bio-engineering for short slopes, with native grasses, vertiver, creeper mats, especially on lower part of the slope; (5) toe drains.
- 4 One should prioritize slide slope protection by timely repair and building back better of the road embankments in case of erosion or flood damage.
- 5 Multi-purpose roadside ponds/trenches can be used to collect access drainage water and serve as a water storage – preferably at 3 meter from side slope. Deeper ponds/ trenches can be used for fish cultivation or aquatic crops.

Some practices



Grasses protecting side slope



Timely repair is important



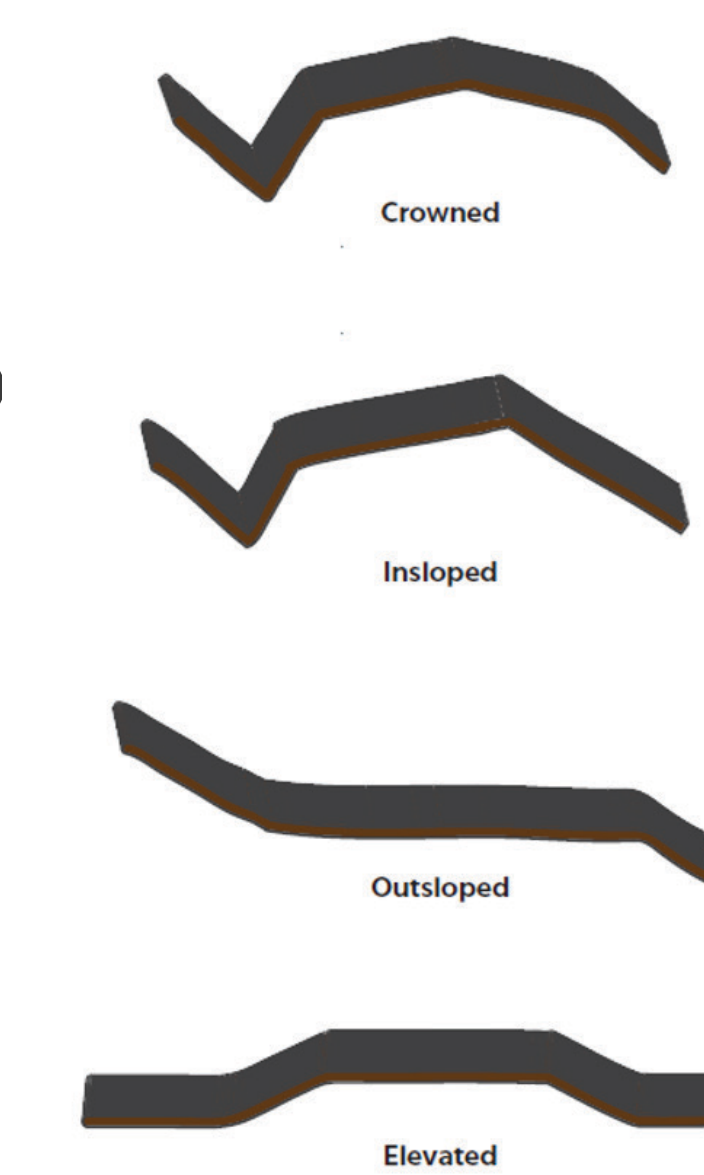
Retaining wall to be anchored (1/3) and backfilled



Damage to sideslope to be not just restored but be 'build back better'

CAMBER: Key Points

- 1 The road camber is important to remove standing water from road surface
- 2 CRELIC advises that with climate change the camber should have
 - a minimum of 3.0 % on carriageways, with increased cross falls of up to 5.0% on hard shoulders draining to filter drains.
 - longitudinal gradients should be at least 0.5% on curbed roads.
 - flat areas should be avoided, and consideration of surface water drainage is critical at rollovers, roundabouts, and junctions.
- 3 There are several shapes of camber. Crowned or in sloped surfaces are preferred to connect to side drains. Out sloped may discharge direct in adjacent land but should be provided by grass or dense stones to reduce erosion and facilitate infiltration of the road based on presence of roadside drain.



Source: MetaAria, (www.audiblewater.org).



Increasing Resilience of Rural Infrastructure and Local Communities through Green Roads Concept