

A list of countries for the principle projects for embankment and slopes includes:

- # *United Kingdom: M1-M62 Motorway Interchange,, A40 Oxford By-Pass, A36 Salisbury By-Pass, Shrewsbury By-Pass, Royal Portbury Docks Quay Walls and Coal Store, Portishead Power Station Redevelopment, Plymouth Shell Oil Store, Greenways Waste Management Consultancy*
- # *Denmark: Dyke Investigation*
- # *Malaysia: Bakun Dam Access Road rock and soil slope design reviews*
- # *Pakistan: Swabi Scarp access road rock slopes.*
- # *Hong Kong: Ting Kau rock slopes*

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# Embankments and Slopes

Vertical alignment for highways, railways and water systems inevitably require cuttings and embankment structures to bring the natural topography onto an acceptable design grade.

Embankments and excavations are also required for quarry excavations and containment sites as in landfill.

An embankment design must address:

- # *the in-situ and as-placed character of the material to be used for construction,*
- # *character of foundation materials,*
- # *the local hydrological regime,*
- # *strength and consolidation characteristics of filling and foundation soils,*
- # *safe slope angles for construction.*



For cuttings, the natural geological profile must be excavated to a safe angle. Whether in soil or rock, an engineering geological assessment of the natural ground must be made which demands an understanding of:

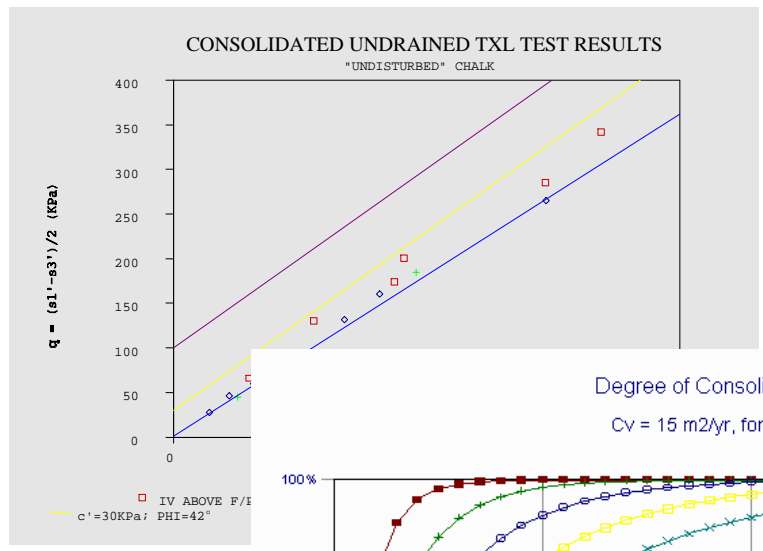
- # *the geological history and the local processes of weathering and erosion,*
- # *the local hydrological regime,*
- # *soil moisture state and strength,*
- # *safe slope angles for construction.*

For embankments, the behavior of the natural materials must be understood at the time of placement and compaction, taking into account the changes that may occur to source materials after excavation. The foundations of the embankment are also a consideration.

Creating a cutting or embankment imposes changes to the original site-and most importantly to the local in-situ stress and hydrological regime.

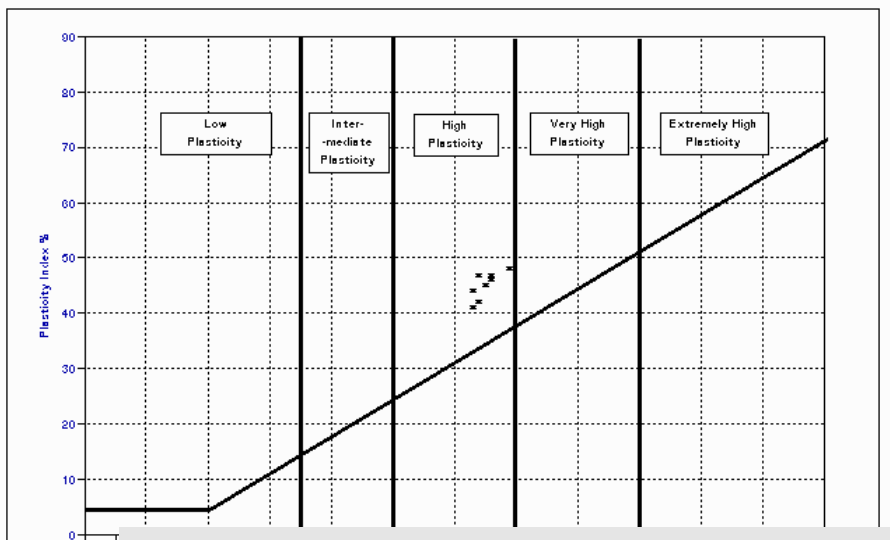
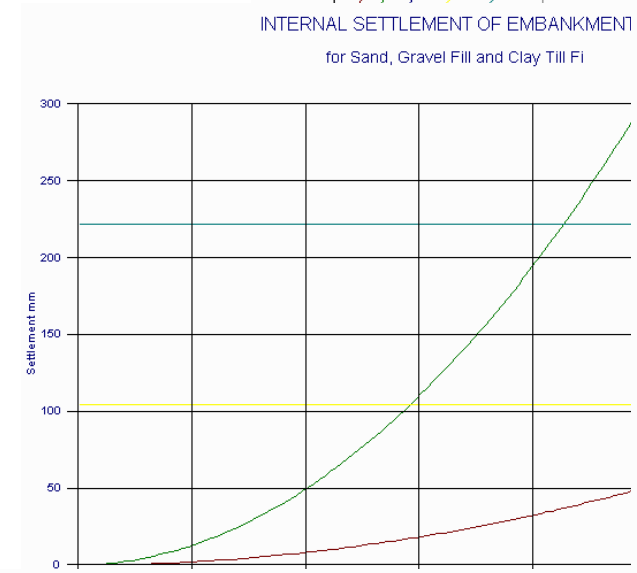
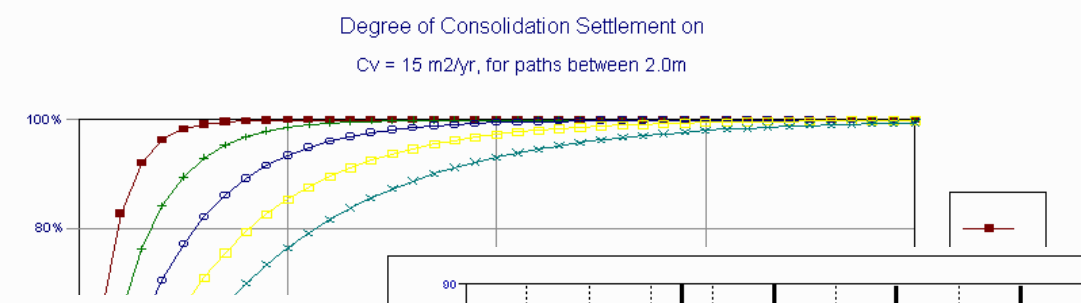
Embankments and cuttings have been investigated and designed by Antonio Associates for highway, landfill and water supply projects.

Cuttings in soil, in tropical residual soils, in fresh and weathered rock masses, have been designed, as well as embankments from soil, chalk, strong rock on competent and weak ground and with impermeable materials for landfill linings.

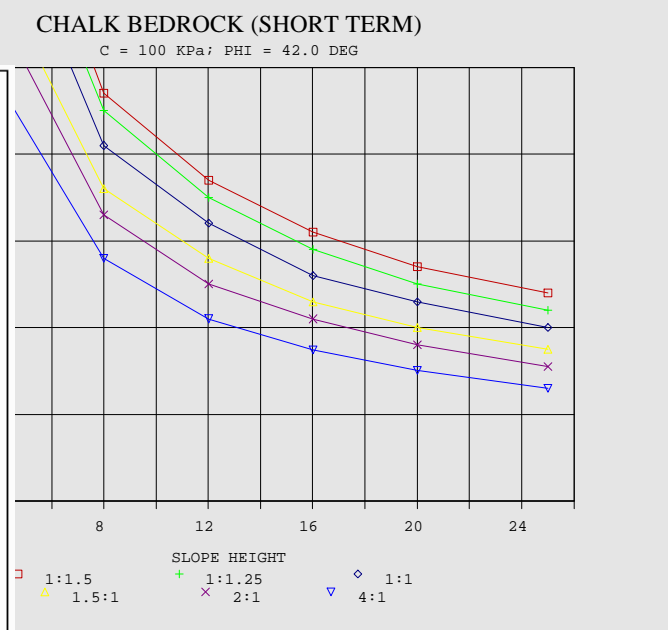
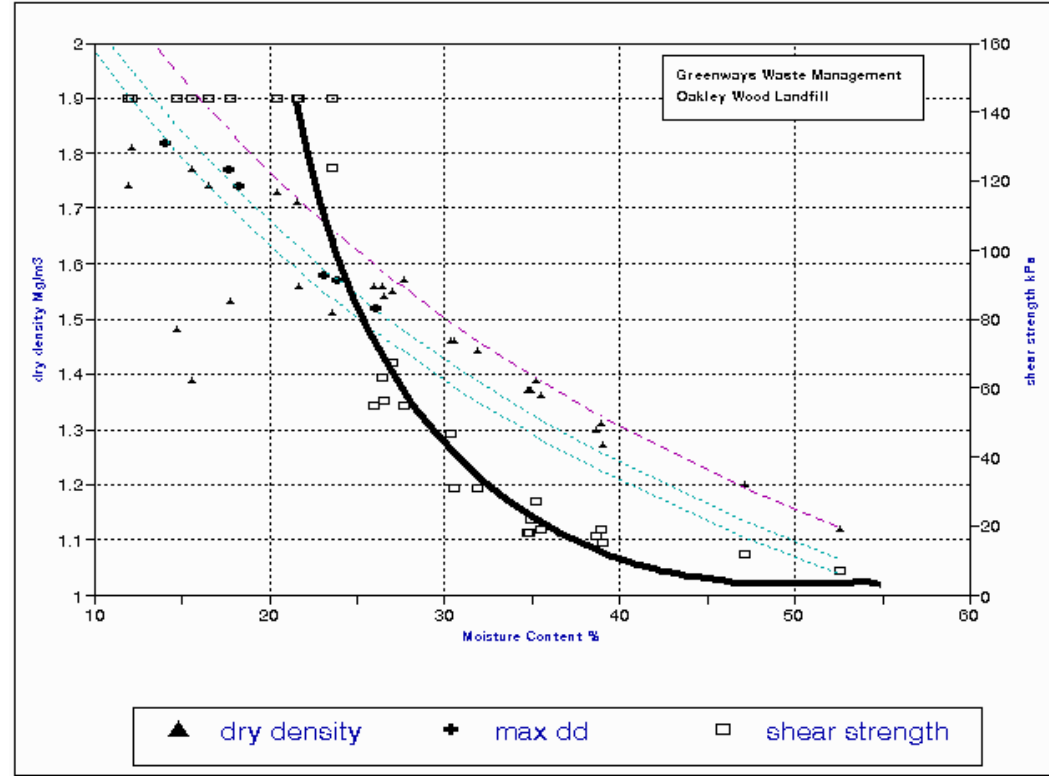


The design of slopes and embankments is controlled by the materials available to build them-there is usually no choice as to which material must be used for construction ...

hence, an inevitable compromise must be made between the uniformity or reliability of those materials and the contractors ability to build.



Special control is required for retaining structures such as dams or landfill liners. Permeability of the material is another attribute to be considered during placement and compaction.



In difficult ground (weak rock or particularly weathered slopes) or on poor foundation soils, a good understanding of the geological processes enables a sensible line to be drawn about the theoretical slope angle and the ease of build and maintenance.

Antonio Associates can investigate, plan and design embankments and cuttings in soil or rock.