

# ROAD CONSTRUCTION

## CASE STUDY: ROADS AND LANDSLIPS

The A2 is a major road in Northern Ireland, a considerable length of which is often referred to the Antrim Coast Road because much of it follows the scenic coastline of County Antrim.

The structure of the scenic Antrim Coast road is constantly under threat of landslips, rock falls and erosion by the sea. The road is confined to a narrow coastal strip and when constructed, undercut the cliffs, destabilizing the rock above. The initial problem was solved by moving the road onto an artificial causeway made of boulders and other debris.



The road is still affected by landslips since the cliffs consist of clays overlaid by chalks and basalts. The clay forms an impermeable barrier to percolating rainwater. The bedding plane becomes waterlogged and acts as a slip plane for the rocks above.

Moreover the clay is squeezed by the downwards force of the rocks above, it becomes semi fluid and results in a mud flow when water logged. IT flows down gullies into the road.



## CONSTRUCTION CONSIDERATIONS

- a) **Rocks underlying** roads need to have a **high load-bearing strength**.
- b) **Foundations must be stable** and so **can't have faults, caves or underground mine workings/hidden river channels**. **Good drainage is necessary to control surface water**.
- c) **A local supply of aggregate for road stone** is needed.
- d) **A road cutting or embankment** may be required to ensure the road stays at a **maintained / suitable gradient**.

### Road cuttings

In civil engineering, a cutting is where soil or rock material from a hill or mountain is **cut out to make way for a canal, road or railway line**.

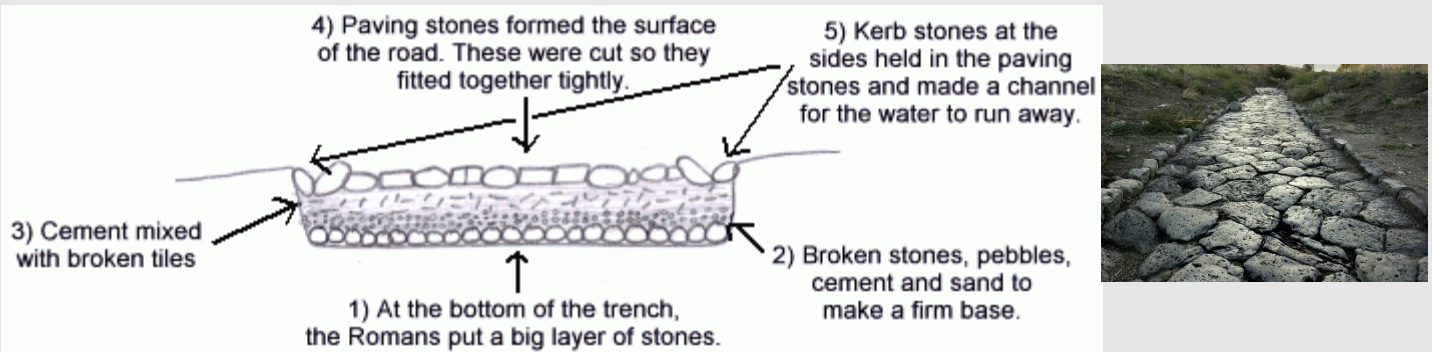
1. Road cutting through **strong, competent rock may allow for steeper sides**, whereas cuttings through incompetent or weaker rock must have a low-angled slope. A suitable angle for **clay is 6 to 8 degrees**.
2. The dip of the beds must be considered too. **Beds that dip away from the road or are horizontal are acceptable**.
3. Jointed rock surfaces should not be in close proximity to a road cutting since they are vulnerable to **freeze thaw and rock fall**.

These measures are to ensure landslips, rock falls and slumping chances are reduced.

## Embankments

Embankments are constructed where the road has to be built over low lying areas. An embankment must be stable and strong enough to carry the load. A large amount of material is required for the construction and the angle of slope must be calculated accurately with consideration that accounts for possible slip failure.

Cut and fill techniques are often used where material is removed from a cutting and used to build an embankment. This provides a local resource of aggregate.



## CONSTRUCTION CONSIDERATIONS

1. Slope modification = The slope angle is reduced to increase stability/shear strength.
2. Retaining wall = Usually constructed of concrete and used to support the sides of road cuttings.
3. Gabions = Wire mesh boxes filled with rocks and placed as a lateral toe support at the bottom of slopes to prevent failure by slumping.
4. Rock bolts = Steel rods that are several meters long are drilled and cemented into rock faces. They pin loose rocks to sound rocks behind to prevent rock falls. Rock bolts are only effective on competent rock faces.
5. Wire netting = This will fix surfaces in place and catch small rock falls.
6. Shotcrete = Concrete is sprayed on rock faces and slopes at a high pressure and hardens rapidly. This reduces permeability, increases strength and protects the surface from weathering.
7. Vegetation = Plants fix soil in place, binding unconsolidated material. They also transpire so reduced groundwater infiltration. Planting shrubs and grass is one of the few effective strategies to stabilize incompetent material.

Shotcrete was invented in the early 1900's by Carl Akeley, an American taxidermist. He initially intended it to fill plaster models of animals. Later shotcrete was used to patch up weak parts of buildings and finally for stabilization of slopes.

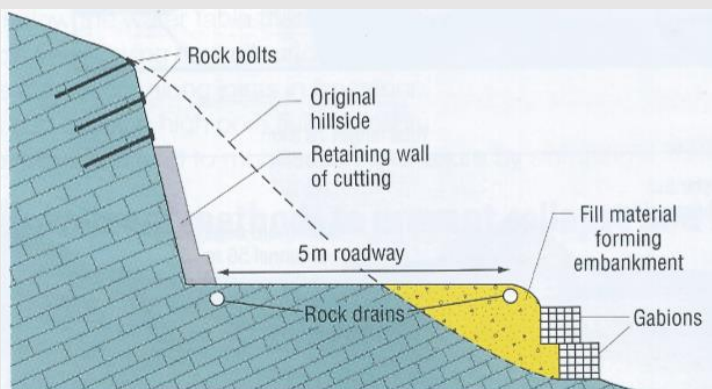


Figure 3 Ground improvement strategies used to stabilise cuttings and embankments.



Figure 1 Gabions along the side of a road



Figure 2 Rock bolts and wire netting