A number of methods have been used to stabilize slopes, each of them found to be appropriate for a particular set of conditions:

- Application of Slope
- Purpose of stabilizing
- Time available
- Accessibility of the site
- Types of construction equipment, and
- The cost of repair

These methods can be classified into three categories:

- Removal and Protection
- Drainage of water
- Reinforcement
Removal and Protection

Excavation & repair
Catchment & Wire Netting
Grading & Serrating
Benching
Resloping and unloading
Lightweight Fill
Counterberms
Trimming
Shear Keys
Scaling
stabilization of slope by removal and repairing the potential unstable blocks (Hoek and Bray)
Catchment & Wire Netting

catchment of a rock fall in hill terrains
Grading & Serrating

Grading of slope
Benching

benching of slope
Resloping and unloading

- Foundation overstress reduce load

Reduce driving weight
Application of lightweight fill
Counterberm to provide weight at toe of embankment.
Counterberms

Application of berm to increase slope stability
working mechanism of shear keys.
making of shear key by replacing loose soil with strong and resists soil
Rock buttress used to control unstable slope (Schuster and Krizek, 1978).
Drainage of water is an effective method of increasing the stability of a slope. Water in a slope may come from two primary sources: surface water and groundwater. Water control is generally maintained through installation of surface and subsurface drainage devices within and adjacent to potentially unstable slopes. Runoff and infiltration of water along a slope or over a bluff face can often be reduced by planting vegetation on top of the slope or bluff to reduce erosion.

**Surface Drainage Systems:** Surface drains and landscape design are used to direct water away from the head and toe of cut slopes and potential landslides and to reduce infiltration and erosion in and along a potentially unstable mass.

**Subsurface Drainage Systems:** The main functions of subdrains are to remove subsurface water directly from an unstable slope, to redirect adjacent groundwater sources away from the subject property and to reduce hydrostatic pressure beneath and adjacent to engineered structures. Control of subsurface drainage is generally attained by installing a network of horizontal and/or vertical subdrains.
Surface Drainage

Network of ditches which converge to carry surface waters away from the instable slope
surface and subsurface drainage in the slope.
Subsurface Drainage

- Subsurface Drainage Blankets
- Trenches
- Horizontal Drains
- Relief Wells
- Drain Wells and Stone Columns
- Well points and Deep Wells
- Drainage Galleries
Horizontal Drains

Sub-horizontal drainage to lower groundwater levels for slope stabilization
(http://www.sigra.com.au)
STABILIZATION THROUGH SUPPORT

- Steel reinforcement
- Rock anchor
- Rock Bolts
- Rock Dowels
- Soil Nailing
- Piles
Rock anchor

Polyester Resin Rock Anchor System (http://www.williamsform.com)
Rock or Earth Anchors (http://www.williamsform.com)
Rock bolting is using to transfer loads from the unstable zone at the rock face to the stronger interior mass (http://www.moretrench.com)
Application of rock bolt to prevent the rock fall (http://www.dywidag-systems.com)
Rock Dowels

Standard rock bolt and cable bolts
Types of rock bolt and dowels
Soil Nailing

application of soil nail for reinforcing the slope
Application of soil nailing in the field
Common Terminology

- Ground Level
- Back Fill
- Construction Joint
- Stem
- Key
- Drainage
- Base Slab, Footing

Typical View of Retaining Wall
Gravity walls Made of Different Materials
Gravity wall

Show force act on gravity wall
Cantilever Retaining Walls

Cantilever wall

Mechanics of cantilever wall in the soil
Sheet Piling Retaining Walls

Piling wall

Sheet piling in the soil
Anchored retaining wall

Anchored wall in the soil
Application of tieback on the piles through competent layer of rock
Gabions

Application of Gabions wall near hilly roadway.
Application of shortcut in the loose rock(a) with wire mesh (6).
Mechanisms of root reinforcement of grass plants and tree
application of various slope stabilising measures