

Chapter 1

Introduction

Soil from rock ?

or

Rock from soil ?

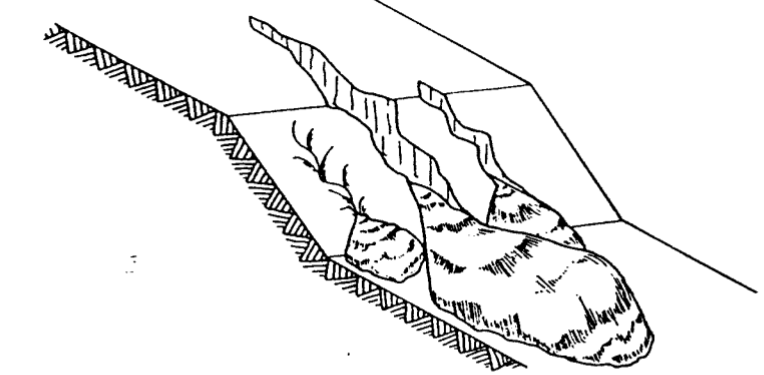
- Soil was made primarily from rock and partly from animals and vegetables.
- Human body < soil < rock
- Used rock for (building) house, mine, tunnel, work of art, etc.
- © Rock is a very intimate material to human beings.

**Why is rock, however, hard
to deal with from an
engineering point of view?**

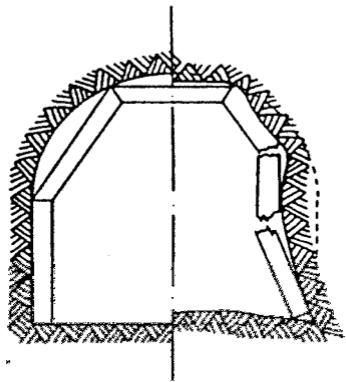
- Rock consists of various minerals having different properties.
- It possesses numerous flaws and weakness making itself called discontinuous rock or rock mass.
- Behavior of rock mass mainly depends on the aspect of discontinuities within it.

What is block theory ?

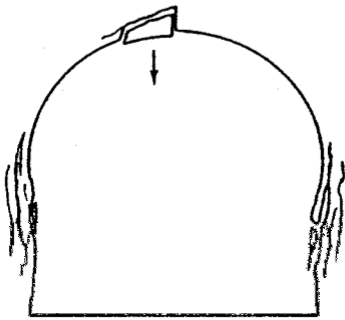
- Block theory is about stability analysis of rock blocks created by intersection of discontinuities in rock (mass).
- Moving of a block from its hosting rock mass is called failure (Fig. 1.3).



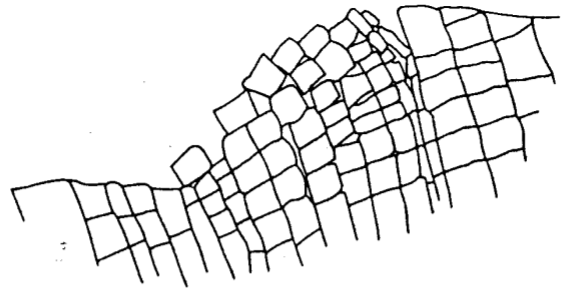
(a)



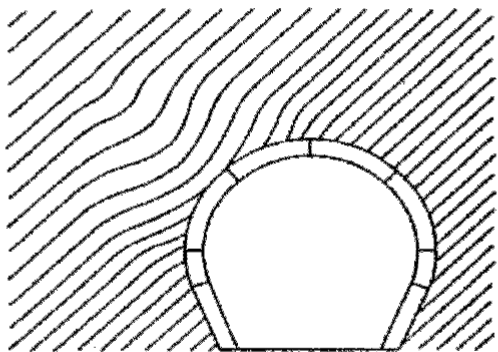
(b)



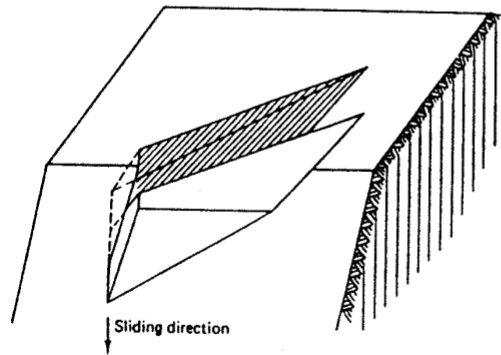
(c)



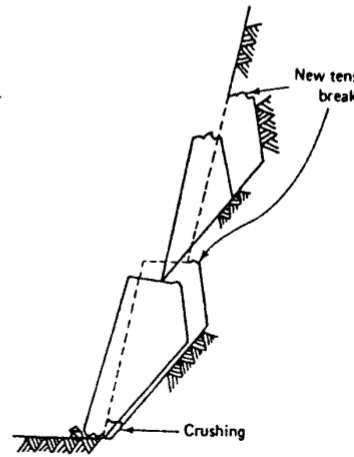
(e)



(d)



(f)



(g)

Figure 1.3 Modes of failure of rock excavations: (a) erosion, (b) squeezing, (c) slabbing, (d) buckling, (e) toppling, (f) wedge sliding, (g) tension cracking and sluffing of rock excavation.

Figure 1.3 (Continued)

**Assumptions of block
theory ?**

- Joint surfaces are perfectly planar.
- Joints are extended enough through the rock mass of interest.
- Rock/joints are rigid.
- Discontinuities are determined.

Difference between Block theory and FEM?

- FEM shows strain and displacement, while BT shows which block (potentially) fails/moves.
- FEM shows stress (distribution) whereas BT does not.
- FEM requires much time and effort to compare different shape (layout) of models, while BT can do it quickly/efficiently. (Fig. 1.12)
- FEM generally requires more time and computation than BT does. BT even can be applied manually by using graphical technique.

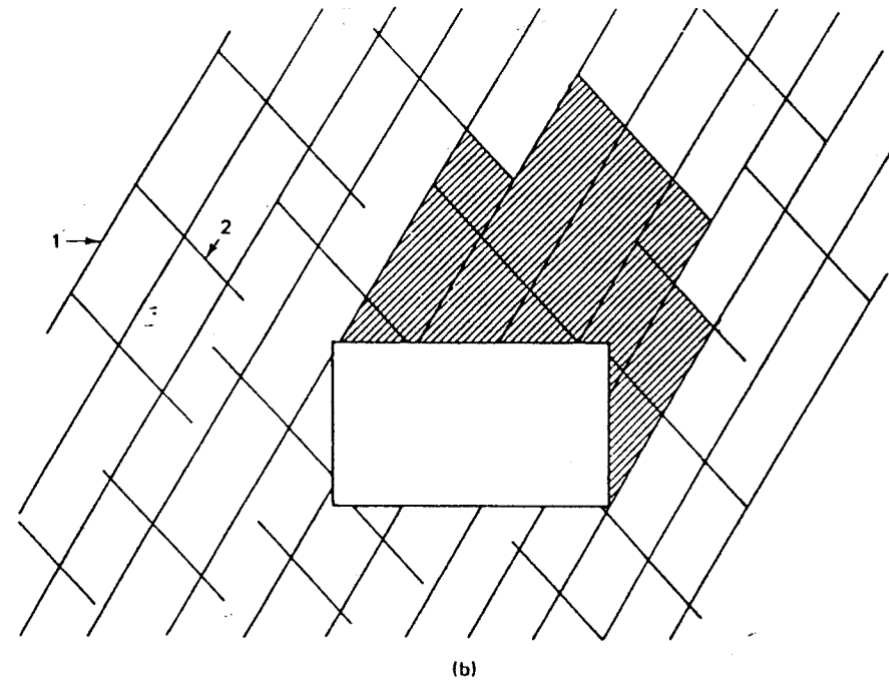
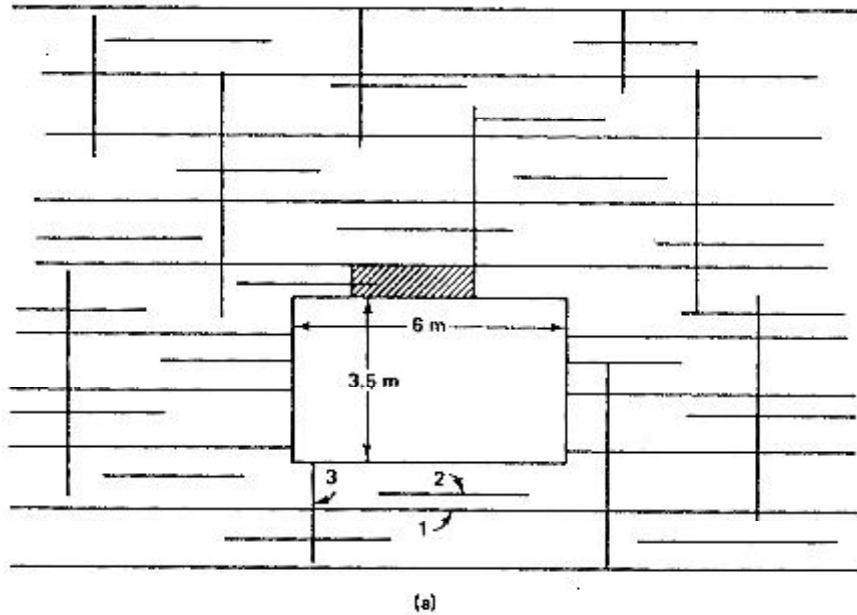


Figure 1.12 Influence of the direction of a tunnel on the extent and nature of rock falls. The dips and dip directions of the joints in the rock are as follows: set (1) 60° and 285° ; set (2) 48° and 105° ; set (3) 90° and 15° . In (a), the tunnel azimuth is 105° ; in (b) the tunnel azimuth is 15° .

Figure 1.12 (Continued)

**Difference between
Block theory and DEM?
Engineering judgment?
Limit Equilibrium analysis?
Physical models?**

- Refer to the text book, summarize them, and submit your report in next class (Sep.18).

What is a key block?

- Generally the key block means a critical block which triggers adjacent blocks to move out subsequently when it is pulled out. (Fig. 1.11)
- The key block, however, technically (in block theory) means a block whose safety factor is less than 1.

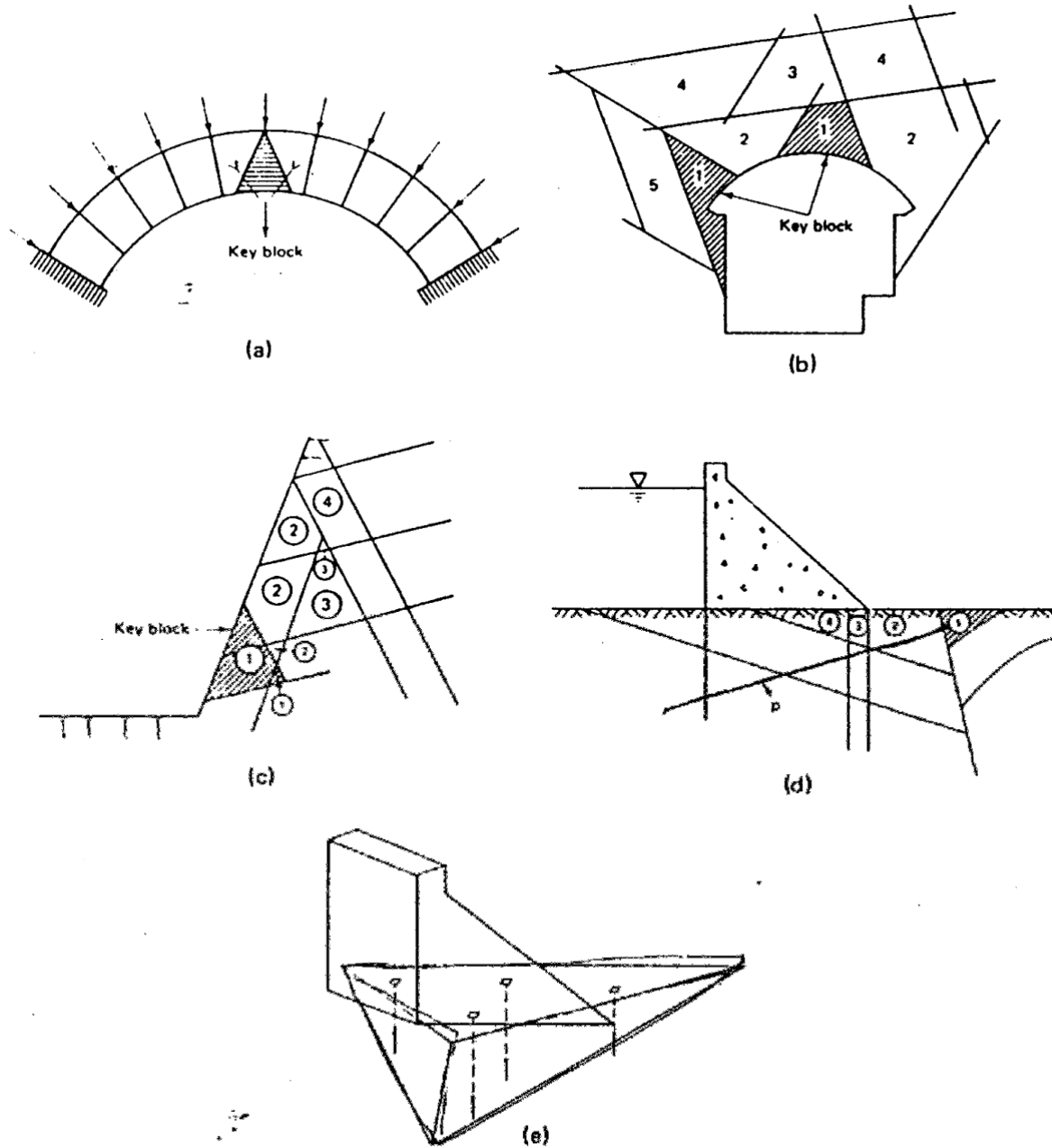


Figure 1.11 Key blocks in: (a) an arch; (b) an underground chamber; (c) a surface cut; (d) and (e) dam foundations.