SITE INVESTIGATIONS

Introduction

Site investigation:

- refers to the methodology of determining surface and subsurface features of the proposed area.
- consists of determining the profile of natural soils/rocks at the site, taking samples and determining their properties.

Introduction…..contd.

Knowledge of fractures in rocks is important in engg practice because they:

- control transport & circulation of various fluids thru rocks.
- determine movement & storage of groundwater & penetration of surface water into rocks.
  - *Well jointed rocks, which are otherwise impermeable, may form important water reservoirs.*

Introduction…..contd.

Geologic features & info of importance to foundations on rock include:

- Faults, joints, shear zones, stratigraphy.
- Groundwater levels, springs, surface water or other evidence of groundwater regimes.
- Potential cavities due to karstic formations, mines, and tunnels

Introduction…..contd.

Other important features include:

- Potential problem rocks subject to **dissolving, swelling, shrinking,** and/or **erosion.**

Joints under foundations:

- should be treated/sealed to;
  - prevent water circulation that may lead to erosion of rock, leading to their enlargement of joints into caverns.

Site Investigations

Process by which

- Geologic
- geotechnical
- other relevant data/information

that may affect construction and/or performance of an engineering or building project – are acquired.

Objectives of Site Investigations

- To assess suitability of a site & its environs for proposed project – geological condition of rock & soil formation – in order to:
  - Determine type & depth of suitable foundation – in terms of load-bearing capacity – for a given structure.
  - Estimation of probable settlement of a structure, e.g immediate settlement;

$$\rho_i = \frac{p * B\,(1 - \mu^2) * I_p}{E}$$

Wherein:

p ≡ uniform contact pressure; B ≡ Width of foundation;

μ≡ Poisson‘s ratio of the soil; E ≡ Modulus of elasticity of the soil

Ip ≡ Influence factor depending upon dimensions of foundation, i.e. length (L) & width (B).

- Determine potential foundation problems (e.g., *expansive soil, collapsible soil, sanitary landfill, and so on*

Objectives of Site Investigations…..contd.

- To provide data for effects of proposed project on its environment → distress to neighbouring structures resulting from loss of ground &/or lowering of groundwater table (which would lead to legal action).
- To observe & record any conditions that may have led to failure of existing or former structures
- To explore & locate sources of construction materials.
- Where alternatives exist, to advise on suitability of alternative sites

Organisation of Site Investigations

For an investigation to be successful, it must be:

- Well planned / organised
- Undertaken in an orderly manner using appropriate & well maintained field & lab equipment.

$\Rightarrow$ Investigations are carried out in STAGES.

1. Project Conception Stage

After decision to initiate project → need for desk study, involving:

- Topographic, Geological, and Geotechnical data, incorporating;
  - All topographic maps
  - Aerial photographs
  - Geologic & hydrogeologic maps of site
  - Site investigation & construction reports for adjacent engineering projects.

1. *Project Conception Stage.....contd.*

Main idea for this phase is:

- To produce sufficient evidence to allow for formation regarding
  - Geologic structure
  - Nature of sedimentary deposits, if any, @ site
  - Location & type of likely engg. problems which may arise as a result of prevailing ground conditions.

1. *Project Conception Stage.....contd.*

To achieve that, the following need to be investigated:

- History and previous use of site (was there a gas station, a railway line, a dumpsite?)

- Any defects /failures of existing or former buildings attributable to foundation conditions

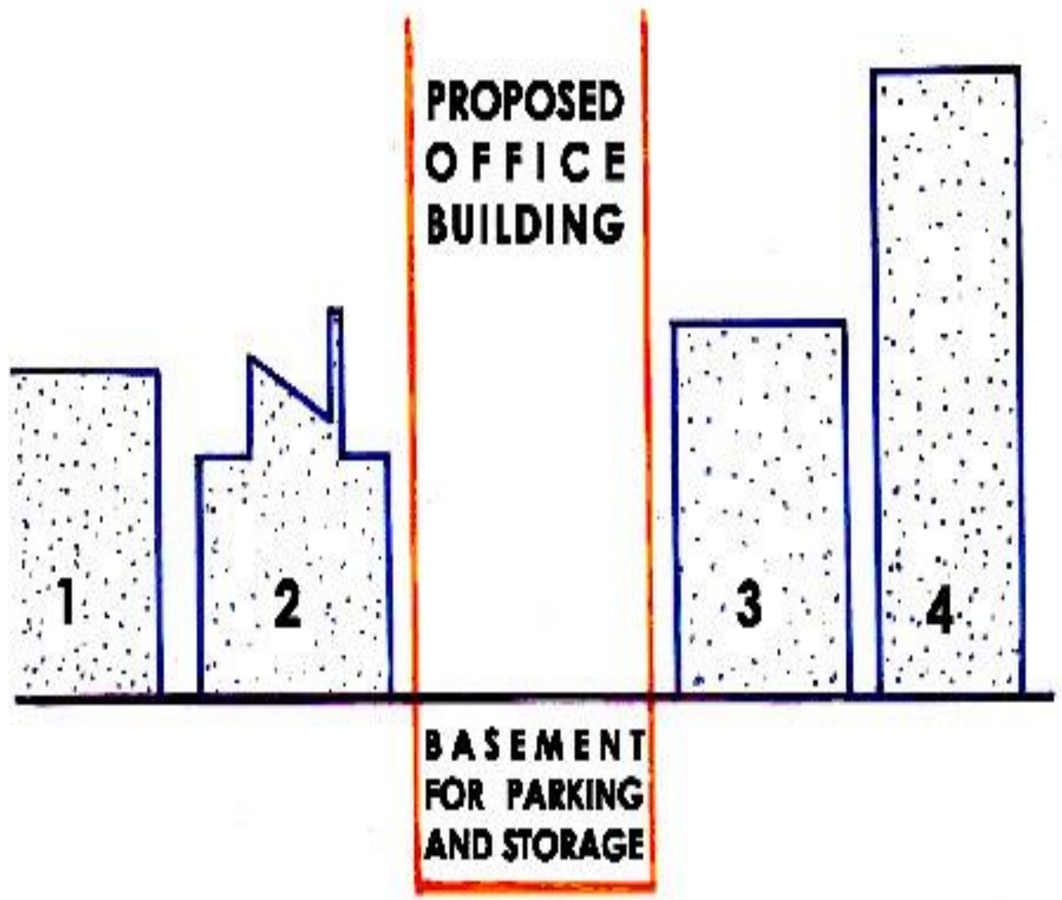
- Any special features – possibility of earthquakes, flooding, seasonal swelling & shrinkage of ground.

1. Project Conception Stage.....contd.

Example:

Tall office block in built-up area, incorporates basement for storage or car park:

- Buildings on both sides are of varying age
- Building 2 is very old and of antique design
- Building 4 is modern, but old
- Buildings 1 & 3 are modern and new.



1. *Project Conception Stage.....contd.*

Example.....contd.

In addition, the following is known of this site:

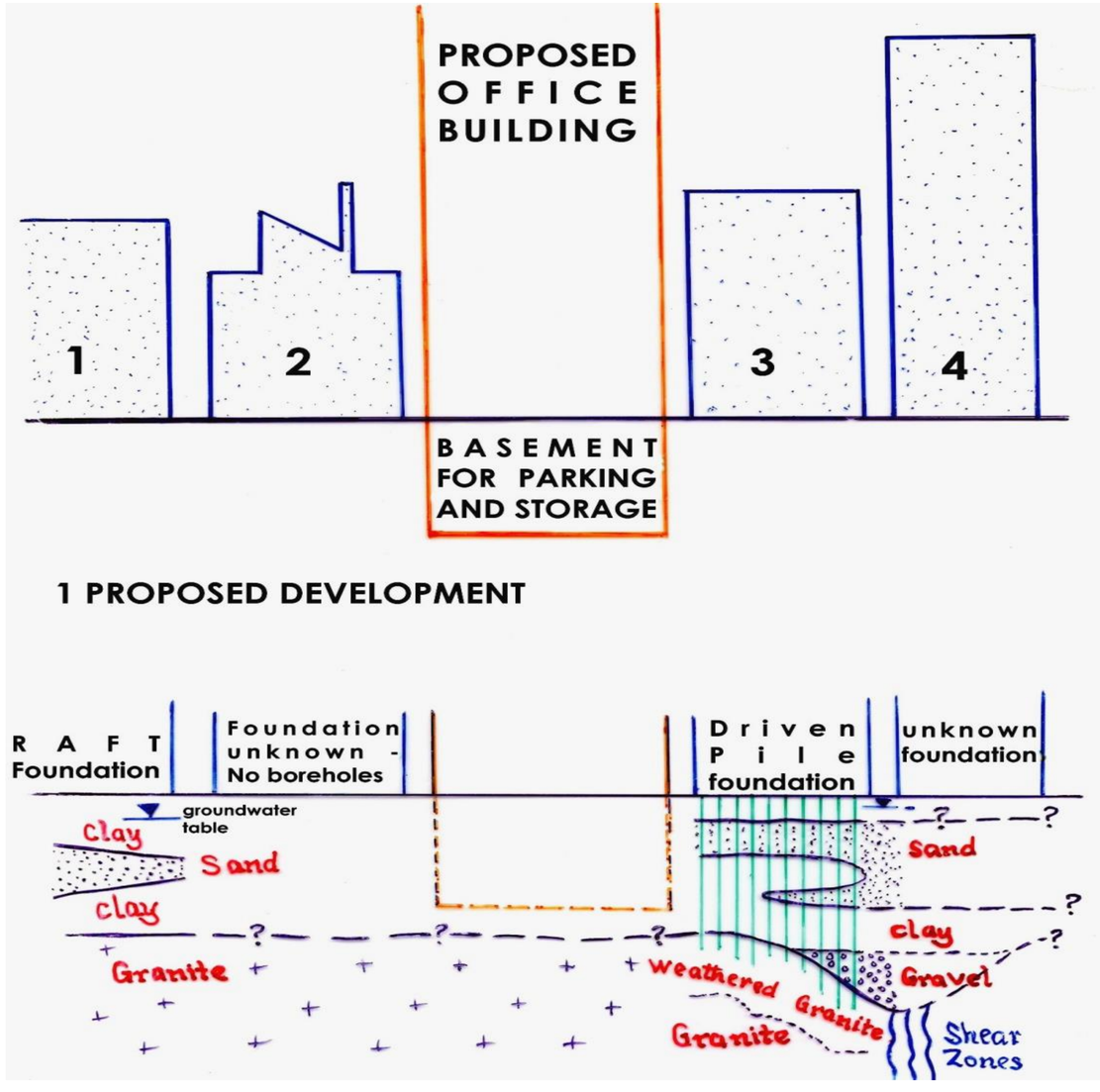
- Records of an old borehole @ 1
- Investigations records & foundation drawings for 1 & 3
- No geologic conditions are known @ 4

1. Project Conception Stage.....contd.

Example.....contd.

⇒Site geology & hydrogeology can be deduced....

- Granite most probably underlies proposed block and would seem likely to be deeper than bottom of proposed basement.
- If work must go on, it should begin with excavation of b/m ⇒ withdrawal of support from surrounding ground.



1. Project Conception Stage…..contd.

Example…..contd.

Consequence of excavation:

- might create problems with stability of excavated slope.

To determine this problem, requires knowledge of geotech. props. of soil/rock mass in the slope.

Unfortunately, because of presence of adjacent buildings, slope must be near vertical…..

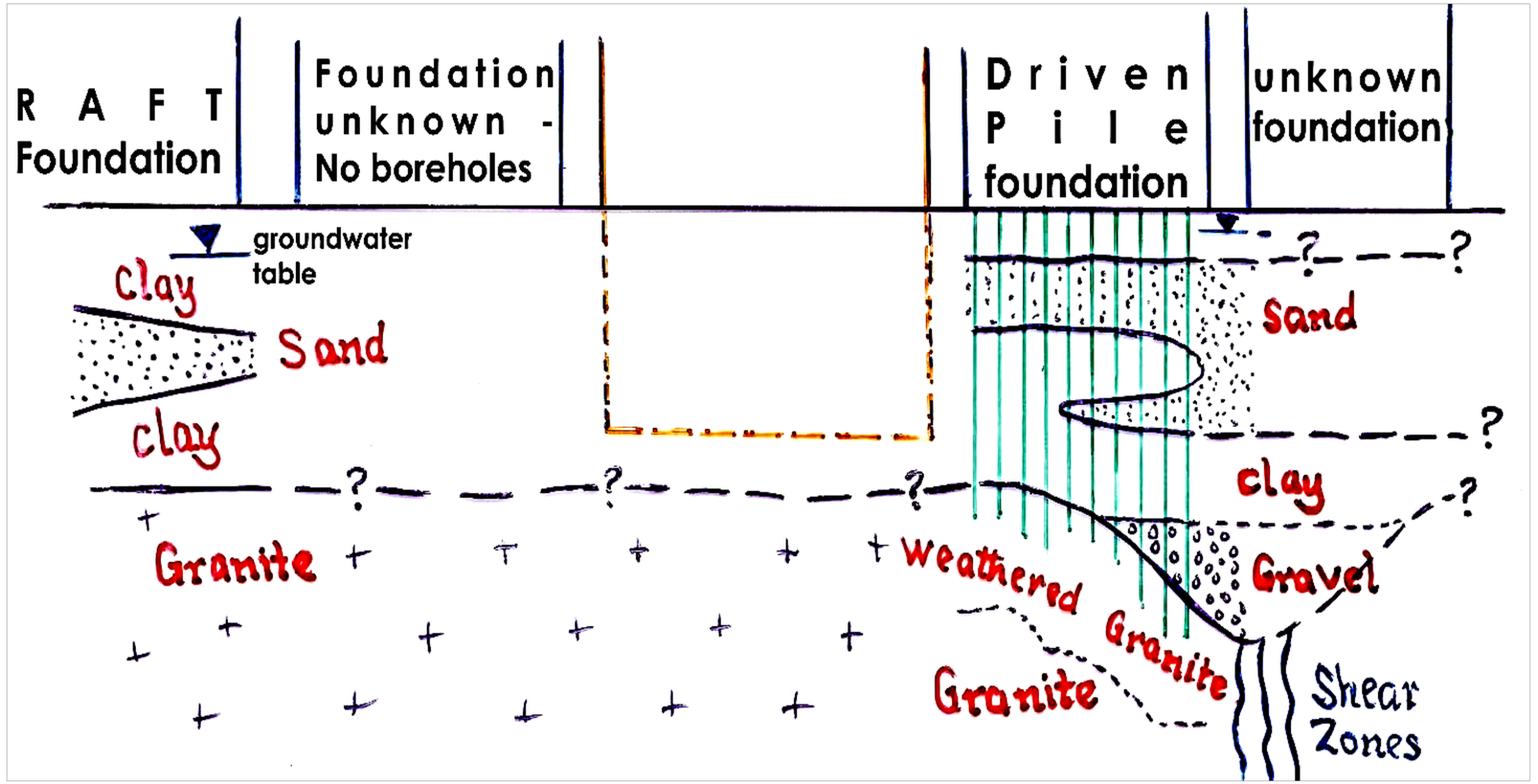
…and may thus, subsequently need some support. To achieve this, it will require knowledge of:

- Geotechnical properties of groundmass.
- Foundation loads imposed by nearby buildings (+ their types, depth & conditions).

1. Project Conception Stage.....contd.

Example.....contd.

Assuming foundation excavation can be made, *depth to top of granite will need to be known.*



If granite is deep, & alluvium too weak to support building load, *foundation may need to extend below bottom of basement to reach it.*

1. *Project Conception Stage…..contd.*

Example…..contd.

Possible problems:

- Higher slope will be created $\Rightarrow$ *need for support*
- If water table is high in alluvium, water will flow into excavation & influence stability of slope…….

Having assessed some likely problems that'd affect project, basic practicability of project should be established!

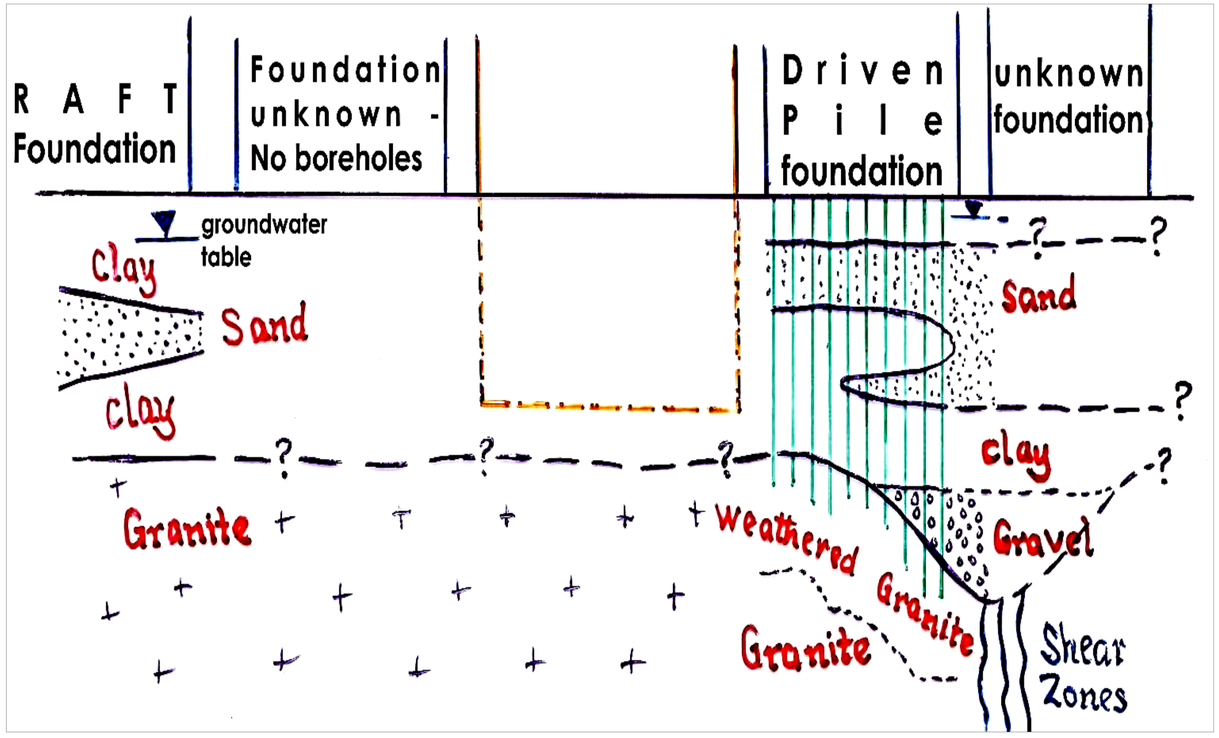
2. Preliminary Investigation Stage

Foregoing will reveal gaps in basic knowledge of site. In this stage, limited exploration is carried out using relatively simple & inexpensive techniques to:

- Establish basic knowledge, and
- Define the main factors that'd influence feasibility, cost & safety of project.

2. Preliminary Investigation Stage.....contd.

If granite is too deep, alluvium too weak, & adjacent foundations of uncertain nature & quality, design may need to be modified:



- Do without basement
- Move to alternative site, if available.

If from this stage design seems possible → next stage.

3. Main Investigation Stage

Work done in this stage is to get detailed & appropriate parameters for foundation design*:*

- Geotechnical props of groundmass thru extensive lab & in situ testing – permeability, shear strength,.. etc.
- Distribution of alluvium
- Ground conditions within zone affected by foundation pressures – geophysical surveys, etc.
- Ground water levels in various strata
- Nature, depth & conditions of foundations of adjacent buildings.
- Distribution & character of strata on/in under foundations.

3. *Main Investigation Stage.....contd.*

- Any environmental hazards & how they'd affect determined parameters.

Subsequently, behaviour of ground to proposed engg. work → determined by CALCULATION & JUDGEMENT

4. Construction Investigation Stage

Results of MIS are rarely absolutely correct. Construction of project often reveals DISCREPANCIES between forecast GRD CONDNS & those encountered.

⇒ Sometimes need for project re-design

All ground conditions encountered during construction must be monitored, recorded & assessed.

5. Post-Construction Investigation Stage

- Monitors behaviour of completed engg work computed on basis of data acquired in earlier stages & comparing with predicted performance:
  - If behaviour of structure is not same as anticipated,… need for further investigations.
    - If there are anomalies, their cause must be established & remedial measures undertaken before severe damage/failure can occur.
- Reveals discrepancies between forecast and actual conditions &
  - establishes causes of these discrepancies so that appropriate remedial measures can be undertaken before severe damage / failure occurs.

Summary

In most civil engg and building works worth of their name:

- the unexpected will ALWAYS happen.

To:

- be prepared for such eventualities, and
- forestall their effects,

is the test of good construction practice.

"Self-discipline is like a muscle; the more you exercise it, the stronger it gets."
(Anonymous)

End of lecture