ENGINEERING GEOLOGY GLY 363

SEMESTER TEST

13 March 2009

TIME: 50 min
MARKS: 50
ANSWER ALL THE QUESTIONS IN THE ANSWER BOOK PROVIDED

Question 1 [15]

The geological model is important to understand the behaviour of Earth materials under changed conditions. Explain the concepts of the geological model, engineering geological model and geotechnical model and the interaction between these models.
Emphasize specifically the geological input and importance of geology in the models.

Material & mass properties *Ground behaviour*

Observation/experience *precedent/experience*
Intuition/synthesis *intuition/risk assessment*

Geol process *Geol model* *ground model* *geotech numeric model*

Input: composition, material, structure, groundwater, processes, hazards, soil profile, lab tests, observation, geol knowledge, site description, conceptual model

Strength + deformation + permeability + durability = material properties
Material properties + mass fabric = mass properties
Mass properties + environment = ground regime
Ground regime + imposed change = ground response

Question 2 [10]

The Post-Gondwana geomorphological history of the southern part of Africa has a significant influence on the present day geotechnical constraints in a number of lithostratigraphic units. Discuss three stratigraphic formations in which the engineering geological behaviour of the residual soil and/or bedrock can be directly linked to the recent geological processes.

Chuniespoort Group – dolomite – African Surface & Post African = tectonic uplift
Expose submerged horizontal cave systems – act as receptacles
Sinkholes & subsidences

Basement Granite – above 1 500 m contour
Exposed to long period of weathering – feldspar change to kaolinite, quartz stay sand grains
Leaching of profile remove kaolin particles – open structure = collapsible grain structure

Cape Supergroup sandstone – uplift along eastern coastline – new base level
Deep vertical incision of larger river valleys.

Kalahari Group – accumulation of thick Aeolian sand deposits inland. Loose and collapsible, mobile.
Climate change along western coast cause dry and windy conditions.

Question 3 [25]

Describe the following geologic phenomena, the processes leading to their development, their influence on foundations, measures that can be employed to create safe construction conditions and in which stratigraphic units/rock types these phenomena may typically be expected:

3.1 Expansive residual soil (8)

3.2 Corestones in soil profile (7)

3.3 Deeply incised river valleys (5)

3.4 Dipping strata leading to unstable slopes (5)

Phenomenon	Description	Development process	Influence on foundations	Remedial measures	Occurrence
3.1 Expansive residual soil (8)	Moisture changes induce soil volume change	Chemical weathering of mafic minerals.	Differential volume change cause cracking	Remove clay horizon, pre-wet clay, reinforced strip foundations, raft, piles.	Basic igneous rocks; e.g. norite, dolerite, andesite Argillaceous rocks.
3.2 Corestones in soil profile (7)	Hard unweathered rock boulders in residual soil	Decomposition along joints, intersections larger surface area more pronounced weathering, joint spacing determines size of corestones	Differential movement across hard rock and soft soil parts; excavation difficulty	Excavate, soil mattress,	Igneous rocks, jointed, N < 5
3.3 Deeply incised river valleys (5)	Deep near vertical side slopes down to river – no floodplain.	Tectonic uplift lowered erosion base with renewed vertical down cut at coast	Steep sides – not suitable for foundations	Anchoring of foundations into rock mass, cut platforms	South-eastern coastline; Cape Supergroup sandstones
3.4 Dipping strata leading to unstable slopes (5)	Different rock types or bedded rocks at dip angle,	Tectonic processes disturbed original horizontally bedded sedimentary rocks	Movement of material down slope; destroy structures	Dewater slope, slope anchoring	WWR; Pretoria Group; Cape S-group & Natal Group;