CIE 444 – SOIL MECHANICS

Lebanese American University – Fall 2010
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HOMEWORK#3

Out Friday Oct. 29, 2010
Due Friday Nov 5, 2010, IN CLASS

In 1978 near Rissa, Norway, a landslide devastated an area of 0.127 sq miles, which included 7 farms. The slide contained about 7 to 8 million cubic yards of debris - the biggest slide in Norway in the past century. Of the 40 people caught in the slide area, only 1 died.

The cause of this landslide was later determined to be the failure of a quick clay (marine clay) that was triggered by the excavation and stockpiling of 900 cu yards of soil placed by the shore of Lake Botnen. The stock-piled soil was generated by excavation work from the construction of a new wing being added to an existing barn. Note the relationship between the volume of the slide (~7.5 million yards) to the volume of the excavation that triggered it (~900 yards) - a ratio of over 8,000.

The slide started at the lake shoreline and developed retrogressively landward, occurring over a period of 6 minutes. About 70-90 m of shore slid into the lake.

After watching the movie, briefly answer the following questions:

1- What was the triggering mechanism of the devastating landslide? Explain in you're an own words.

The landslide was triggered by the excavation and stockpiling of 690m3 of soil placed by the shore of Lake Botnen. The stockpiled soil was generated by excavation work from the construction of a new wing being added to an existing barn.

2- What were the damages that resulted from this failure?

A slide area of 330,000 m^2 and a volume of 566 million m^3. Seven farms and 5 houses were taken by the slide. Only 1 person died out of 44 residents of the area.

3- How did the volume of the slide affect the neighboring villages? Could the damage incurred in these villages be minimized had there been a warning?

The slide volume created large water waves that propagated along the lake (a 5km distance) to reach the other side and affect the neighboring village called LIERA.

A warning system could have mitigated the damages to a certain extent but property damage would not be reduced.

4- How was the cause of the landslide determined? What was the role of the geotechnical engineer?

Geotechnical investigations were carried out to determine the shear properties of the soil. Site investigations included rotation soundings and soil sampling. Disturbed and undisturbed samples were tested to identify the Atterberg limits and the engineering properties of the soil. Lab tests also included: cone test, triaxial test, and direct shear tests.

The cause of the landslide was determined to be the complete loss of strength of quick clay. Quick clay was identified when the LL was found to be larger than the normal range by 5 to 10%. The clay was determined to be too wet and thus highly sensitive to change of conditions. Sensitive clays have a very high potential for failure upon a slight disturbance.

5- How was the slide area treated?

Stabilization works were done by removing the remaining quick clay. Dynamite was used to explode these sensitive areas. The remolded clay reached a more stable condition and thus the area was rehabilitated by planting it again and creating a new road in the village.

6- What are the important lessons of this case history?

Before any construction, field studies must be done to check the strength properties of the underlying soil in order to have a proper foundation design. Understanding the geology of the area is also important in order to identify the historical deposition background of the site.