ANALYSIS OF GROUNDWATER FLOW IN THE CENTRAL YANGON AREA

KUNIO WATANABE SAITAMA UNIVERSITY
HTIKE HTIKE SAITAMA UNIVERSITY
HIDEHIKO KAZAMA SAITAMA UNIVERSITY

1. Introduction

Ground water as well as river water has been used in Yangon area for domestic and industrial use. The daily amount of water supplied from the groundwater sources is approximately 15 million gallons for all purposes. During the rainy season, the replenishment of groundwater is very significant because rainfall exceeds evapotranspiration and raises the groundwater levels in wells. After the rainy season, the groundwater level start to decline and levels are reached to the lowest level at the end of the dry season (mid May). The usage of ground water resource will be much more increased in near future for the development of industrial work. Management system of groundwater resource should be constructed to avoid the severe environmental problems that will be induced by the excess pumping in a near future. As a first step to construct the system, groundwater flow in the center part of Yangon City was 3-dimensionally simulated with changing pumping rates at choosed pumping locations.

2. Geology of Yangon Area

Fig-1 illustrates the calculated area and also shows the area of Myanmar Maritime University (MMU).In recent geological research works were performed in MMU campus and Fig- 2 shows an example of geological condition obtained by Standard Penetration Test. The geological of this area is mostly composed of silt and clay layer. Also grain size distribution of typical silt is shown in figure. The geological condition of calculated data was assumed as the same as MMU campus.

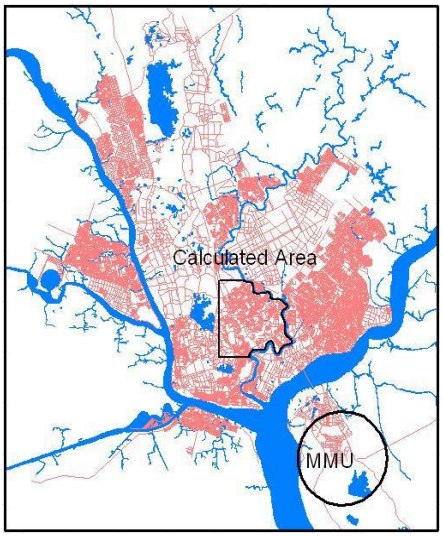

Fig-1 YANGON AREA MAP

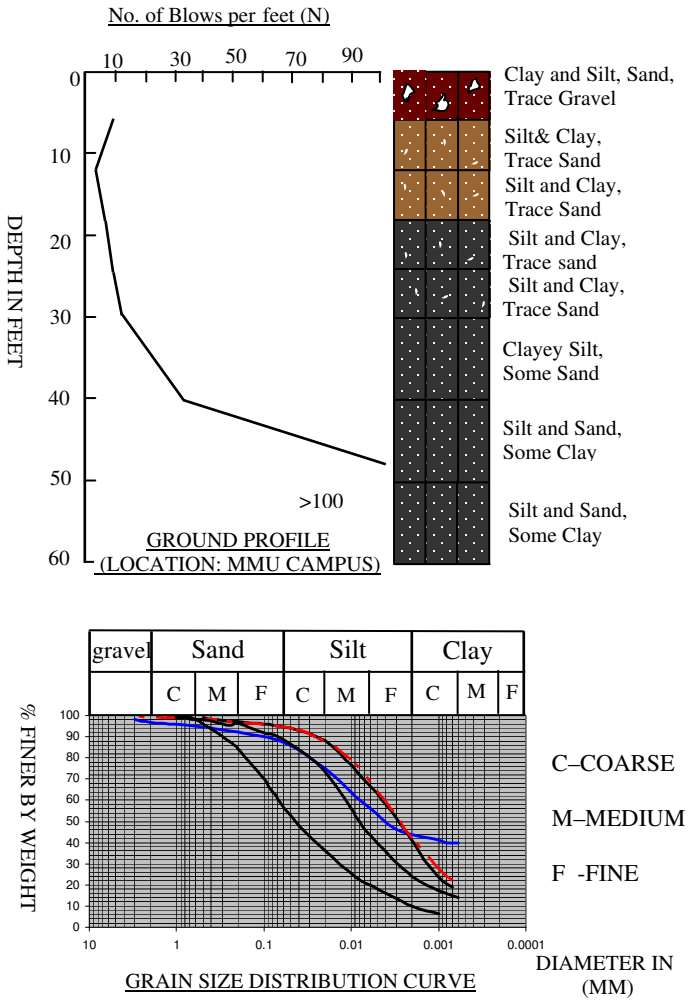

Fig-2 Geological condition in MMU

3. Consideration Domain of Numerical Model

Fig-3 illustrates the area conducted and the mesh division. 3D FEM was used for the groundwater analysis. The area is about 25 km^2 (2500 ha) and it covers the 1/14 of the whole Yangon area. The requirement of ground water supply is mainly for domestic and groundwater demand of this area is higher than the other part. The effect of pumping rate on groundwater table is analyzed to maintain the ground water table in high level and avoid the severe land subsidence. The depth for this modal is fixed as 30m and under this depth assumed as impervious layer. In research area, although the geological properties do not change differently, I considered the depth where the ground water can meet as possible and is divided into 11 layers of each 3m depth, to analyse details. The boundary condition of the flow on the right hand side is

Keywords: Pumping Rate , Piezometric Head Distribution of Groundwater Flow
Address : Department of Civil & Environmental Engineering, Geosphere Research Institute, Saitama University
255, Shimo-Okubo, Urawa- Shi, Saitama ken, 338-8570

fixed as 27 m and for the left hand side is 24 m, as shown in Fig 3. No flow boundaries were adopted in the top and bottom side of the domain. The initial condition of piezometric head is 27 m and the model was run for 1440 times with time interval 60 sec. Then, the groundwater flow reached a steady condition. In this study based on dry condition and will not be effect from rainfall. 10 pumping wells are choosed and calculated the pressure head values with various pumping rate which pump from the bottom layer (i.e. 30 m depth from the top layer of the domain). The saturated hydraulic conductivities in x, y and z directions were assumed as 0.00055 cm/sec. Although there is no special research work for geological data, all of these assumed values are empirically reasonable.

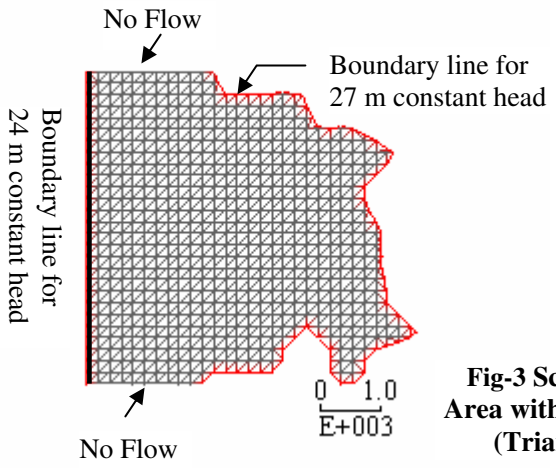

Fig-3 Schematic of Domain Area with Finite Element Grid (Triangular Elements)

4. Results and Discussion

The piezometric head values were calculated with changing pumping rate. Fig-4 and Fig-5 are two examples of the result. Piezometric head distribution on surface layer, 15 m depth and the pumping layer(at 30 m depth) are displayed in these figures. Fig-4 shows the ground water flow under no pumping rate. The value of piezometric head in most part of the area is 27 m in this condition. When it starts pumping the piezometric head is changed and for higher value of pumping rate, the piezometric head values at considered pumping points tend to much decrease value as shown in Fig-5. The results illustrated in Fig-5 are the distribution under the pumping rate 0.01 m^3/sec (0.23 million gal/day) from each well. Now groundwater table depth is not regulated in the Yangon City area. However proper regulation of groundwater pumping should be constructed on the basis of groundwater simulation.

5. Conclusion

As the first step to construct groundwater management system for the Yangon area, Myanmar, the effect of pumping rates on piezometric head was analyzed. The pumping rate should be carefully regulated to maintain groundwater table in high level.

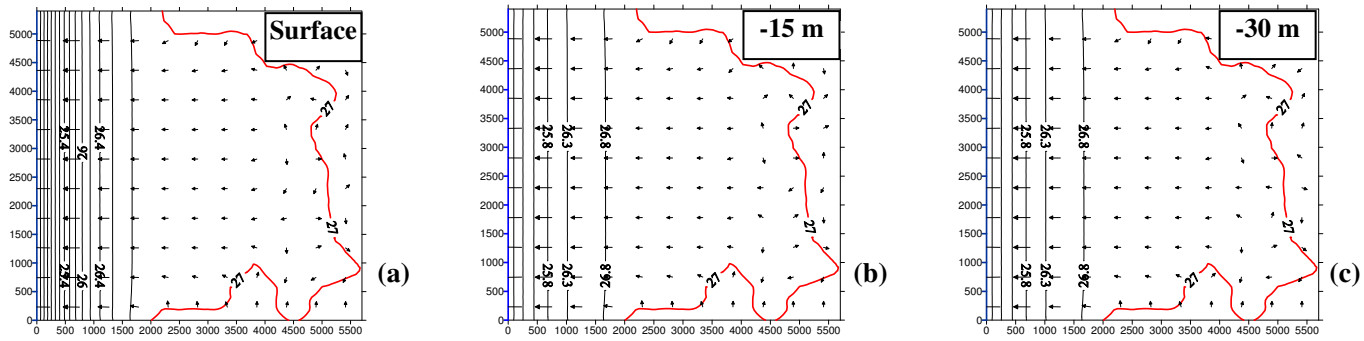

Fig-4 Piezometric Head Distribution of Groundwater Flow under no pumping condition

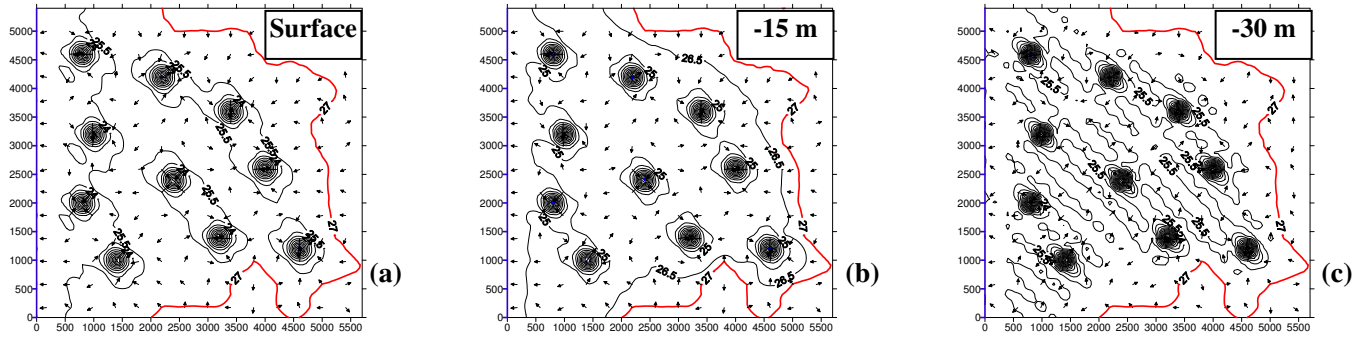

Fig-5 Piezometric Head Distribution of Groundwater Flow under pumping rate 0.01 m^3/sec from each well