`the importance of community service learning in engineering

Community Development
Community based Learning and Outreach

[1]Nowbuth, M. D., [2]Gunness, S. & [1]Moonshiram-Baguant, Y.

1 – Faculty of Engineering, University of Mauritius
2 – Virtual Centre for Innovative Learning & Technology, University of Mauritius

INTRODUCTION

Community service learning (CSL) is gradually shaping up the way of applying the design tools and techniques which students learn during their undergraduate courses in Engineering in Mauritius. A case study was carried out to evaluate the extent to which CSL could be applied in the field assignments so as to help students better understand the practical and social aspects of a problem. The course BEng(Hons) Civil Engineering is of 4 years duration, with 3½ years being full time courses at the University of Mauritius and the remaining half year being spent as industrial training in either a consultancy or a contracting firm. During the time spent at the University, the students are assignments different types of assignments, with the objectives of enabling them to take their own initiatives, to work in teams, to organise themselves as they work in groups and to get better understanding of the social aspects of engineering problems and practical acceptable solutions. However, over the years it was noted that though several of the objectives are actually met successfully, the appreciation of the social aspects was not always successful. Students tend to fail to understand that some practical economical solutions were not always the ones that the society would accept and trust. With a view of remedying this issue, the structure of an assignment was modified. Third year students were given this assignment and were asked to liaise with the public to find the socially acceptable solution.

STRUCTURE OF THE ASSIGNMENT

The assignment under study was carried out linked to the field of Water Resources. The structure was as follows: Students were requested to first visit ongoing major projects in the field of Civil Engineering that had a major component on water resources. In the next stage, the students had to discuss with the people living in the neighbourhood where the major water resource project was being implemented to identify and assess their problem. From there, the students would have to identify possible solutions and then find the socially acceptable solution to the problem. Students also had to keep a diary so as to document their approach towards identifying real case problem and proposing a solution.

The assessment criteria used by the tutor was based on the nature of the problem identified, the discussions held with the inhabitants, the engineering problem and the engineering solutions, and finally the socially acceptable solution, and its justifications.

For this assignment third year semester one students were used, and these students had not yet undergone industrial training. The reason for which this target group was chosen for this assignment was to test the appreciation of the engineering and environmental modules that had been conducted in the past two years and also to evaluate their approach to solving an engineering problem in the local context. During their industrial training these same students would then be in a better position to observe and learn from the behaviour of practising engineers towards problems encountered in engineering projects.

Engineering Problem – The Sea-Level Rise/Groundwater

The engineering problem identified was one where sewer pipelines were being located along a coastal zone in the north west of the area. The major water works projects ongoing in that region, was the laying of a wastewater network, consisting of the pipe network and the treatment plant. During the pipelaying phase it was noted that water was always present in the trenches even during long stretch of dry periods. One possible reason was that the site was located along the coast and sealevel rise could be responsible for the water problem. This situation was not convenient for the engineering team and this was also costly as such a problem had not been foreseen before, while quoting for the work. While the engineering team carrying out the work had to deal with this problem, they could not invest time to identify the problem. The students therefore had an important role to play here. Not only would they help to solve this problem which was being costly, but they would also help the engineering team better organise themselves as the site stretched a long way from the collection point to the treatment plant.

Solving Engineering Problem

Solving the problem was carried out in two stages, the first stage was to dewater the trench and the second stage was to find out the cause of the problem. The engineering team working on the site had to dewater the trench whenever needed and from there they could carry on with the bedding materials for the pipes. The students on the other hand tried to first identify the reason for this problem.

The students interviewed the inhabitants living along the coastal region to have a feel of the impacts of sea level rise. The inhabitants confirmed that sea level rise did have some impacts, for they could often find water in their yard, even though it was not raining. However, some more experienced adults indicated that they believed that the water was not coming from the sea only, but from inland also. The reason for this assumption was that at times water was also found in their yard even when it was low tide periods. At this stage it was clear that the water could either be due to sea level movements or it could also be due to movement of groundwater from inland towards the coast.

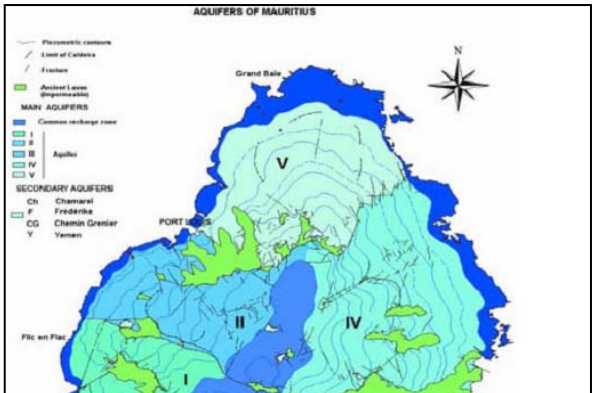

Figure 1 – Aquifers of Mauritius

The aquifers of the island are all in hydraulic contact with the sea. The aquifers receive their recharge from the Central Plateau, which is a very wet humid zone, and groundwater moves slowly towards the sea. The hydraulic gradient with which the groundwater moves differs from aquifer to aquifer, as the topography varies accordingly. The Northern Aquifer is characterised by preferential pathways (Nowbuth, 1999 & Giorgi et al., 1999). Two major flow paths govern the groundwater flow pattern, one lying along the North West region, and the second one lying along the North East region (Figure 1). The region directly north is not connected to the major recharge zone owing to the presence of lava flows, from a volcanic vent, Forbach. The study area is located along the north west region and groundwater flow from inland would be taking this path to reach the sea.

Laboratory simulations of the Engineering Problem

The laboratory physical equipment, Hydrology Apparatus (TecEquipment) was used to simulate the field conditions. The Hydrology Apparatus allowed a user to simulate a catchment, its physical property such as elevation, its landuse together with the groundwater level and rainfall prevailing over the catchment. Before using this physical model, the students had to undertake a conceptual model of the Northern Plains Aquifer.

The conceptual model Northern Plains Aquifer was taken from the research work of Nowbuth (1999). The nature of the subsurface of the North Plains Aquifer is basaltic, having been formed from lava flows of the most recent volcanic activities which prevailed over the island. The lava flows of this particular volcanic activity period, is characterised by fractured basalt, lava tunnels and highly vesicular basalts. The Northern Plains Aquifer was characterised by a major recharge area, occurring at the high elevation region of La Nicolière Reservoir (Figure 2). The surface elevation then dips towards the sea over a horizontal distance of 15km, varying from about 400m to 0m, over that

distance. Major groundwater flows occurred along the North Eastern and North Western zones. The coastal zone acted as a constant zero head boundary. The aquifer was in constant hydraulic contact with the sea.

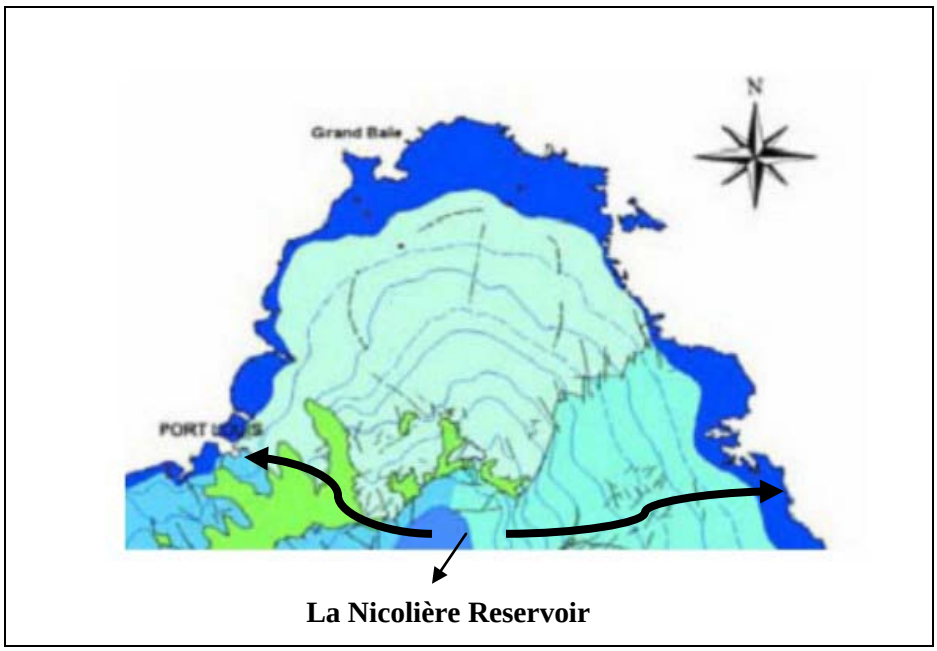

Figure 2 – The study area – the Northern Plains Aquifer

The sea was simulated as a constant head level, using a continuous water supply from a tap to keep the height of water constant. Using the Principles of Dimensional Analysis, the catchment was scaled down to match the geometrical similarity between the catchment and its model. Coarse sand was used to match the kinematic similarity between the catchment and its model, since the aquifer is known to be characterised by lava tunnels, fractured basalt, vesicular basalt, all these contributing to an overall high coefficient of hydraulic conductivity. The basement of the aquifer is known to change steeply from the high elevation region towards the sea, and the base of the Hydrological model was inclined to simulate the steepness of the base elevation of the aquifer. The landuse which is made up of agricultural zones and residential zones, were simulated with zones covered with grass and zones covered with plastics to simulate the impermeable surfaces.

RESULTS

The physical model was simulated in 3 stages:

1. Rainfall events occurring over the catchment
2. No rainfall event

3. High and Low tide level

When rainfall events which produced runoff were simulated, it was noted that water accumulated at the zones that were representing the coastal zone, and this was independent of whether there was high or low tide. During periods when there was no rainfall event, water did not accumulate along the simulated coastal zones regions again independent of tides level. It was also interestingly noted that water did not accumulate when the tide level was raised significantly.

The physical model of the Northern Plains Aquifer, was illustrating that the water that was accumulating along the coastal zone, was in fact coming from inland. The conceptual model of the Northern Aquifers had already noted that there was a major flow path along the Northern Aquifer and in addition the hydraulic gradient along this path was quite steep. During periods of high rainfall events which tended to occur during the summer period, the recharge to the aquifer significantly increased and this in turn increased the hydraulic gradient of the groundwater flow towards the sea. This situation resulted in water accumulation along the coastal zones of the aquifer. The water was in fact not due to tide levels as the inhabitants had rightly observed.

DISCUSSIONS

Once the results of the physical model supported the observations of the inhabitants, the next stage was to meet them and the engineering team to present to them the findings of the study. The inhabitants wanted a solution to this problem while the engineering team had only a temporary solution to their problem of water filled trenches. The problem of the engineering team was being solved by dewatering process while the problem of the inhabitants could not be solved right away. One possible solution was to increase groundwater abstractions in strategic points upstream so as to lower the hydraulic gradient that was the cause of the water accumulation problem.

The inhabitants were given simplified explanations as to how the water was getting accumulated in their yards. Though most laymen do not fully understand the concept of groundwater flow and hydraulic gradient, with simplified diagrams the inhabitants could visualise the cause of their problem. They also very much appreciated that the research study had rightly confirm what they had been observing as inhabitants of this area. They were always convinced that tides had nothing to do with the water which tended to accumulate in their back yard and, because the recharge zone was located at least 15km from their place, they could not associate the problem with rainfall events also. However, they wanted a solution to this problem, for it was not convenient to walk around in water clogged areas. So the proposal of abstracting water to relieve the problem was seen as an effort to help them.

CONCLUSION

Engineers always have to work in teams and nowadays community participation is given its due in almost all engineering projects. The present research study firstly helped third

year students to not only learn about practical problems encountered in engineering projects during their implementation stage. The study also helped the students in appreciating how the community of an area where an engineering project is being undertaken, can collaborate to find solutions to a problem, given that they stay in the area and have a feel of the environmental problems related to the area. This research work significantly helped the students in interacting with the community while being trained to become good engineers in the near future. Such types of assignments give students a good level of maturity before they go for industrial training, where they can make the most of the training by observing how the engineering teams have to interact with communities to get the work done to the satisfaction of each and everyone.

LIST OF REFEFRENCES

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