

Physical Model Approach in Developing and Creating Critical Thinking Skills for Engineering Hydrology (CEW541) Students

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Engineering hydrology (CEW541) subject consist of several chapters including urban storm-water system design (7th Chapter). Students were introduced with the design of flow and mitigation measures for stormwater control mainly in the urban area. In conducting the urban stormwater design, students are required to refer to the specific guideline namely Manual Saliran Mesra Alam (MASMA 2012). One of the main concerns for the urban stormwater system is the workability and functionality of the proposed system in controlling the after-development flow (Q_{Post}) in each of the development projects. This control is one of the keys to combat with the flooding problems that occurred frequently throughout the year due to the urbanization impacts.

During the lecture session, student had been taught with the theoretical design procedure and how to solve the problem based on the case study and listed manual. Since this subject have been offered for the Year three (3) students, it is necessary for the students to be exposed with the hands-on practice to catch up with the current industrial needs or trends and in creating the critical thinking skills for knowledge enhancement among the students. In addition, by going through the process they will be pushed to learn before proceeding with action. Hence, they will be able to understand the whole process from inception to completion and thinking on the realistic problem solving with a proper system or method.



Figure 1: Rainwater Harvesting System (Building)

A specific task related to the selection of the available mitigation measures for Q_{Post} control and construction of the physical model such as rainwater harvesting unit, piping distribution system, water filtration unit, water storage system and other control structures has been given to the students and need to be completed within the allocated time (Week 13 and Week 14). The given task was aligned mainly with the Course Outcome No. 3 (CO3), Program Outcome No. 3 (PO3) and Program Educational Outcome No. 1 (PEO) for CEW541 (Engineering Hydrology) and Bachelor of Civil Engineering with Honours (Infrastructure) (EC221). The given task also indirectly aligned with other POs and PEOs for EC221.

Students are expected to come up with their individual or group models (up to two (2) members in a group) in accomplishing the task (preparation of model and recorded video). Students have been suggested to consider the usage of low cost or recycle materials for instance water bottle, glass bottle, plastic wrap, cotton wool, cardboard and plasticine for physical model construction for the sustainable environmental promotion and due to the limited accessibility cause by Covid-19. Furthermore, students are required to create a cooperative working environment with their partners by planning their work properly and dividing the work equally. There are expected to have online mutual understanding between partners towards the completion of the task. On the other hand, the cooperation or mutual understanding between partners are essential in contributing to a proper and correct selection of the online material (completed projects).



Figure 2: Dry Detention Pond Model with Landscaping

Once completion of the physical model construction, students are required to prepare at least three (3) minutes recorded video to explain about the chosen mitigation stormwater model, including step by step process in relation to the stormwater-controlled features and benefit of the chosen system. By conducting the allocated task, students able to understand the estimation of the design flow, ($Q_{Pre-dev}$) and Q_{Post} by applying either Rational Method or Time Area Hydrograph Method, able to identify the different types of flow control measures based on the specific technical factors (location, amount of Q_{Post} , period, Manning's coefficient, permeability and etc) and able to relate the water storage concept with the lagging time or longer time of concentration for the reduction of Q_{Post} .

Interestingly, after completion of the task, students able to understand the proper stormwater control system (step by step procedure and its impacts on controlling the stormwater flow) and contribute to the understanding and thinking skills improvement on the applied system. Figures 1, 2, and 3 show the sample of the constructed physical model for stormwater control system prepared by the students.

In conclusion, the conducted task is vital in achieving the specific PO and PEO listed under EC221. Furthermore, students are required to have a wide picture of what they had learnt during their undergraduate study for them to be able to perform their work when they embark into the industry and working as an engineer either in the consultant or contractor firms. They should be equipped with an interpersonal skill together with the academic



Figure 3: Rainwater Harvesting System (Single Residential Unit)