Construction of BIOECODS for a Government Complex: A Case Study

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ABSTRACT

This paper presents the construction of Bio-ecological drainage system (BIOECODS) for the proposed forensic wad of Tanjung Rambutan Hospital. BIOECODS is consistent with objectives of new storm water management approach that focus on the control of both the quantity and quality of urban runoff. This has been embodied in the concept of an ecologically sustainable development, which is aimed at ensuring that development can occur without long-term degradation of natural resources and the environment. By integrating storm water management planning with landscape and environmental planning, it will add aesthetic and recreational values to the water amenities.

This new environmental-friendly drainage system adopts "control at source" principle to simulate the natural hydrological cycle in urban areas by combining infiltration, detention storage, delayed flow as well as runoff treatment techniques. BIOECODS comprises grassed swale, detention storage and dry pond components.

The construction of this drainage system is a simple construction method that uses minimum numbers of laborer and machineries. The minimum usage of resources leads to cost effective of construction in this drainage system in the future. What is being concern is that the authorities and contractors that involves in this field can accept this drainage system and its requirement. It is also hope that the relevant authorities could understand the Urban Stormwater Management Manual for Malaysia or MSMA so that the drainage system in this country can be change and be more environmental friendly.

The proposed BIOECODS is an applicable concept as new storm water management approach to minimize the impact of urbanization on the environment. It adopts an integrated approach to obtain both practical and cost effective solutions for drainage system.

2 Project Background

This project consists of the construction of a single building, which includes administration unit, clinical unit, forensic block and wad. The project covers a catchment area of 1.51 hectares on medium soil type. More than 60 % of the total area has been developed into impervious area such as paved road and car park, sheltered walkway, and utilities other than the building. The origin of this area was cultivated field. The pre-development runoff was catered by roadside drain and other existing secondary drains before discharging to the nearest receiving water which is located at 200 meters at the downstream.

Generally, the duration of this construction project is about 76 weeks where it started on 24 June 2002. For the drainage system, the construction started in early of January 2004 and ended on June 2004.

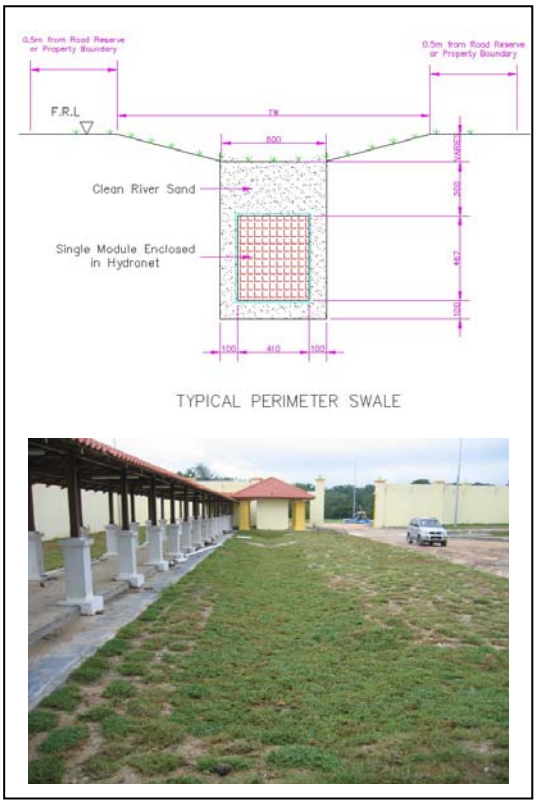

Figure 2 Perimeter Swale.

3 Proposed Drainage System

The proposed drainage system which is known as Bio-ecological Drainage System (BIOECODS) for this project is consistent with objectives of new stormwater management approach which focus on the control of both the quantity and quality of urban runoff. This has been embodied in the concept of ecologically sustainable development which is aimed at ensuring that development can occur without long-term degradation of natural resources and the environment. The component of BIOECODS consists of grassed swale, i.e. perimeter swale (figure 2) and ecological swale (figure 3), subsurface detention storage, i.e. Type A and Type B (figure 4) and also Dry Pond as the detention basin (figure 5)

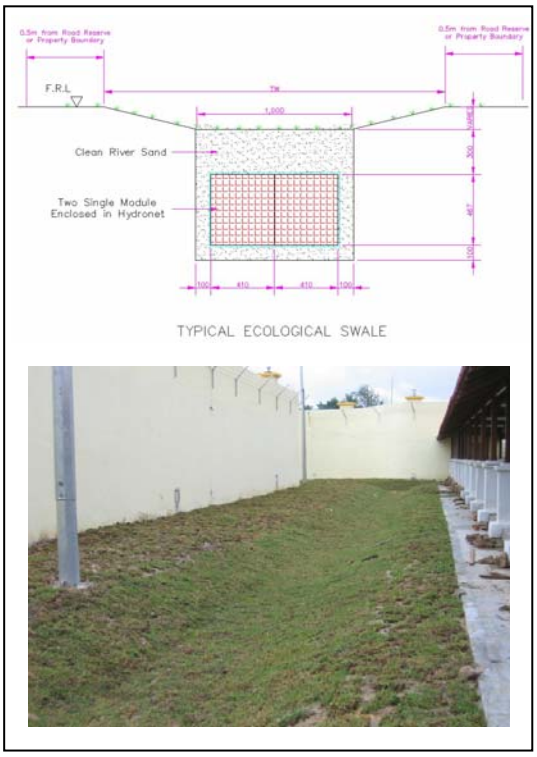

Figure 3 Ecological Swale.

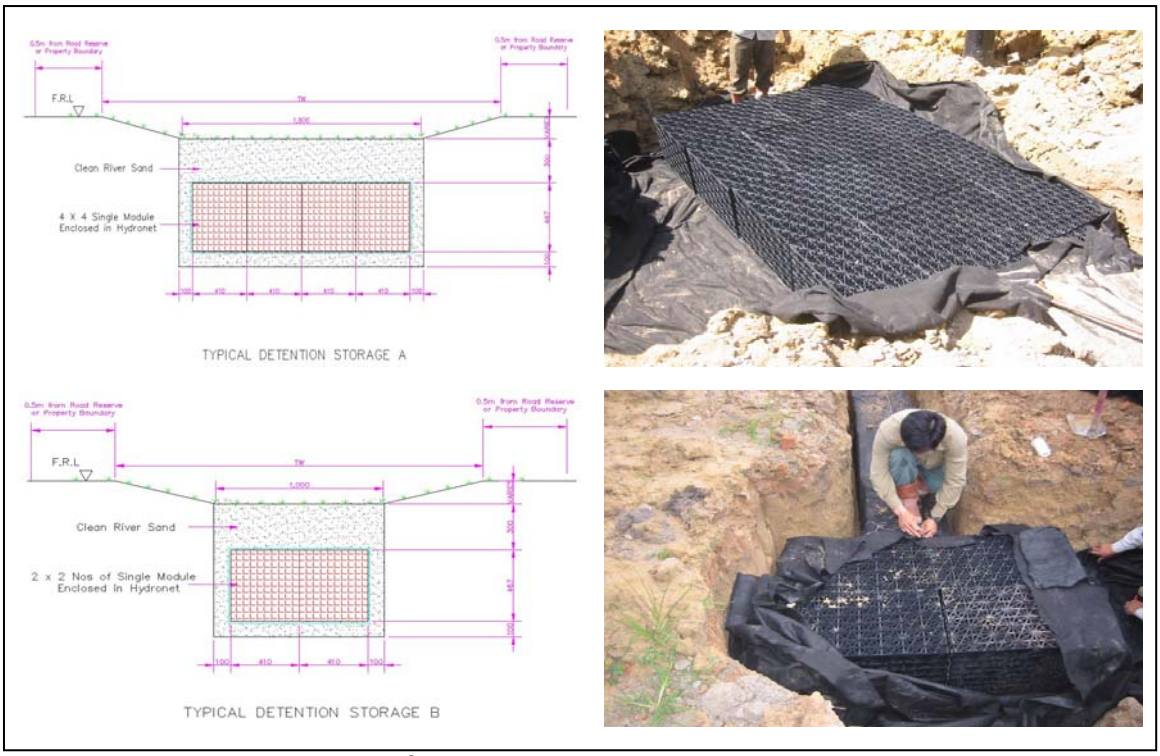

Figure 4 Subsurface detention storage, Type A and Type B.

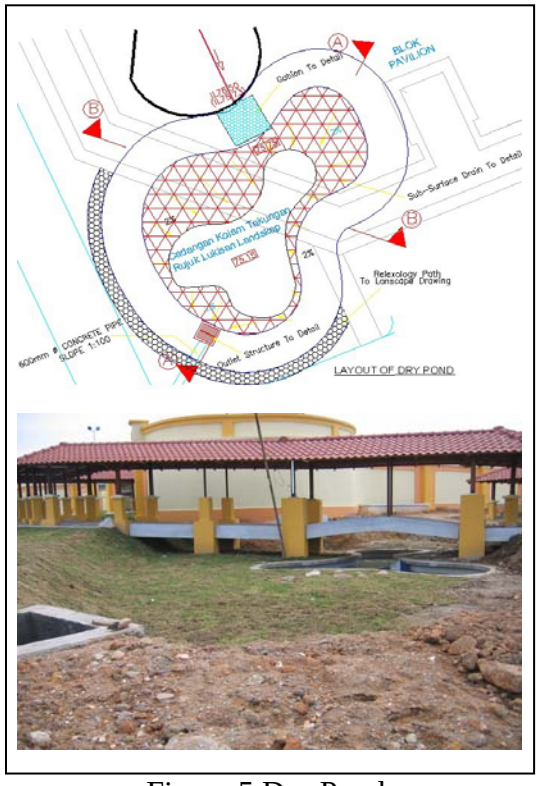

Figure 5 Dry Pond.

4 Materials of Construction

Material that are used in this drainage system mostly are environmental-friendly. Some of the material are from the recycle material and can long about 100 years. For the finishes part, the usage of natural resources gives greeneries view for the constructed area. The material that is being used in this BIOECODS construction (figure 3) are:

a. *Module* – size of 410mm x 467mm x 610mm
b. *Hydronet Filter Fabric* – permeability capacity of 9.30mm/s
c. Clean/washed river sand – passed sieving test of BS 1377 (0.5mm-0.2mm)
d. Topsoil – thickness of 25mm-50mm
e. Cowgrass

Figure 6 The material of construction of BIOECODS.

5 Construction Technique

Generally the construction technique of this drainage system is mainly the same as the construction of conventional drain. Among the works that involved are setting out, excavation works, level checking, sand bedding laying, installation of module, sand backfilling and also turfing work. The simple construction method and minimum usage of laborer and machineries makes this drainage system easy to be managed and lead to cost effectives in the construction.

5.1 Setting out works.

This is the first work to be take place in the construction of BIOECODS. In this work, the location or the alignments of the drainage will be determined. After the alignments had been determine, leveling survey will follow. In this stage of work the indication of invert level of the drainage will be marked on the drainage location so that the excavation work will be easy. Figure 7 shows the setting out work.

Figure 7 Setting out works.

Figure 8 Excavation works and invert level checking.

5.2 Excavation and Sand Bedding works

The excavation works will start after the setting out finished. This works use only one back hoe and during excavation there will be one labor observe and control the level of the excavation (figure 8). This is to make sure that the level of the drainage is being followed and the flow direction is accordingly. After the excavation, sand layer of about 100mm thick were placed. This works use only one laborer to be accomplished (figure 9).

Figure 9 Sand bedding laying.

5.3 Installation of subsurface module

This subsurface module is installed accordingly to the drainage type. Before the arranging the module, the geotextile must be first placed. The sizes of the geotextile must be according to the size of the drainage type so that it can be enclosed properly. The arrangement of the module must be much closed and tights. During this work, only 3 to 4 laborers are involved. Figure 10 shows the installation works.

Figure 10 Installation works of subsurface module.

5.4 Sand Backfilling and Turfing Works

After the module had been enclosed with the geotextile, it will be filling with river sand on the top (figure 11) and the thickness will be about 250mm to 300mm. This sand layer will be flattening up to get the shape of the swale and also to make turfing works be easy. This works is done by 1 or 2 laborer. Before cowgrass is planted, topsoil will be lay and distribute on the top of the sand layer. The thickness of the topsoil will be around 50mm. This topsoil consist of good soil and also organic soil so it can allow the grass to grow. Turfing work (figure 12) is the final work in the construction of BIOECODS. During this stage of work, the cowgrass is closely turf as being required by the designer and this work used only 4 to 5 laborers. For maintaining the growth of the grass, it should be watered twice a day.

Figure 11 Sand Backfilling works.

Figure 12 Turfing Works.

6 Conclusion

The proposed BIOECODS is an applicable concept as new storm water management approach to minimize the impact of urbanization on the environment. The simple construction and easy to manage gives some advantages to this drainage system to be apply or use in the future. The minimum usage of resources makes BIOECODS competitive to the conventional system. It also adopts an integrated approach to obtain both practical and cost effective solutions for drainage system.

Acknowledgements

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