



**6th UNDERGRADUATE
SEMINAR ON BUILT
ENVIRONMENT
AND TECHNOLOGY
(USBET) 2023**

**SUSTAINABLE BUILT
ENVIRONMENT**

25 - 27 SEPTEMBER 2023

E-PROCEEDING



USBET 2023



e-Proceeding

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Published by,

Department Of Built Environment Studies And Technology
Faculty Of Architecture, Planning & Surveying
Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus
usbet.fspuperak@gmail.com

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eISSN 2821-3076



9 772821307002

02 October 2023 | Perak, Malaysia
Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus

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6th Undergraduate Seminar on Built Environment and Technology 2023

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Flash Flood Counter: Smart Eco Drain Cover

Muhammad Amirul Faiz B. Nordin¹, Hasni Suryani Bt. Mat Hasan^{1*}

¹Department of Built Environment Studies and Technology, College of Built Environment, University Technology MARA, Perak Branch, Seri Iskandar, 32610 Seri Iskandar, Perak, Malaysia

m.amirulfaiz1998@gmail.com, *hasnisuryaniuitm@gmail.com

ABSTRACT

In Malaysia, flash floods are familiar issue and always occur especially in residential areas, this can be related to the drain cover system that contributes to the occurrence of flash floods because most drains are blocked and filled with garbage and effect the drainage system become improper. The flood that hit this nation in the late 2021 and early 2022 had caused damage to living quarter, vehicles, business premises, manufacturing and agriculture sector as well as public assets and infrastructure. There are many flash floods incidents which happen due to the poor maintenance of the drainage system which is filled with garbage which obstructs the rainwater from flowing away quickly and easily. Silt, garbage and other obstructions are reducing the carrying capacity of the drainage system by up to 50 percent and thus causing flash floods. Besides, theft of metal drain cover also contribute to the flash flood issue. This is related to irresponsible of people's attitude, corresponding to the high price of iron. Drain covers made of iron are one of the things that are potential to be stolen, this caused drains that should be covered become open drain then it causes garbage to easily enter and fill the space in the drain and finally close the water channel resulting in clogged drains and causing the occurrence of flood. Thus, the aim of this study is to develop smart eco drain cover, to assemble their prototype, to demonstrates the performance and also to market the product using. This research are using innovation framework as a methodology of the research.

Keywords: *floods, clogged drainage, drain cover, smart eco drain, theft.*

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INTRODUCTION

The term 'innovation' can be defined as new idea, design, product, or the development from existing product to new products, designs, or ideas with upgraded function, performance and also their characteristic (Cambridge Dictionary, 2020). Every innovation has pros and cons. For example, discussing construction material, the advantages of innovation of construction material includes, easy to recycle, help business remain competitive, reduce cost, quick installation and also stronger than existing material.

Innovation also has drawbacks, such as the risk of businesses running out of money if they invest too much and don't get products to market quickly enough, the waste of resources when developing a product that won't sell, the inability of businesses to produce new products on a large scale at an affordable price with a guaranteed return on investment, and the reputational risk of producing subpar goods. The aim of this research is to develop smart eco drain cover which is innovation from existing drain cover to counter lack of existing drain cover with upgraded drain cover in terms of function, performance, design etc. Thus, the aim of this research is to develop smart eco drain covers, to assemble their prototype, to demonstrates the performance and also to market the product using.

Development Of Smart Eco Drain Cover

Designing a smart eco drain cover to effectively reduce flash floods requires careful consideration of various characteristics of flash floods and the drainage system. Here are some important characteristics to consider when conceptualizing the design which is Rainfall Intensity and Duration. Flash floods often occur due to heavy rainfall in a short period. The drain cover should be equipped to handle sudden influxes of water and be able to manage varying rainfall intensities and durations. Water Flow Capacity. The drain cover should have a high water flow capacity to quickly drain away large volumes of water. It should prevent water accumulation on roads and streets, reducing the risk of flooding. Besides, debris management. Flash floods can carry debris such as leaves, branches, and litter into the drainage system, causing clogs and reduced drainage efficiency. The drain cover should have features to prevent debris from clogging the drainage system. Other than that, Aesthetics and Safety. The drain cover should not pose a safety hazard to pedestrians, cyclists, or vehicles. It should also be designed in a way that integrates aesthetically with the surrounding environment. By addressing these flash flood characteristics, the smart eco drain cover can be designed to effectively reduce the impact of flash floods and enhance overall urban resilience to extreme weather events.

METHODOLOGY

The researcher analyzed floods caused by drainage system in urban area using a descriptive methodology with qualitative techniques. Multimethod in nature, qualitative research takes an interpretative, naturalistic approach to its subject. This ensures that the problem isn't viewed through a single lens, but rather via a multitude of lenses, allowing for the understanding of the phenomenon's numerous facets (Baxter & Jack, 2010).

LITERATURE REVIEW

The information gathered via research and examination of previous studies of literature reviews to accomplish the first objective. The literature review is conducted on the relevant topics of flash floods, the causes of flash flood and also the impact of flash flood. This may also include the first objective, which is critical review of current issues and problems, as well as to assemble the prototype from improvised smart eco drain cover as the innovation to counter or minimizing the problem the current issues. Journal articles and other published materials related to the development of the innovation idea were collected, filtered, and reviewed. Based on the literature review, all of the materials that going to be used to proposed the smart eco drain cover was identified. To create this smart eco drain cover composed of a terminated coconut husk and concrete mix, the required materials and equipment may be different from those used to produce the conventional drain cover. The technique of creating this new product is limited and conducted at home. Therefore, the following is a list of the material and equipment that were utilised in this smart eco drain cover innovation.

- **Cement**

Any substance that binds other materials together through a series of chemical reactions known as setting is cement. While not to be mistaken with concrete or mortar, which are all dry powders, cement is an essential component of both, acting as the "glue" that gives structures their strength. Cement is a crucial building ingredient since it is a key component of both mortar, which is made of cement and sand, and concrete, which also contains coarse aggregates (Mohsen, 2015). Figure 1 below shows the cement.



Figure 1 : Cement

- **Sand**

Sand is a type of fine aggregate that can be made from natural sand, crushed stone, or crushed gravel. Natural Sand is formed naturally from rock. Figure 2 below shows the sand.



Figure 2 : Sand

- **Water**

Water is a substance that exists in gaseous, liquid, and solid phases and is made up of the chemical elements' hydrogen and oxygen. One of the most prevalent and necessary substances is it. At normal temperature, it is a flavourless, odourless liquid with the crucial property of dissolving numerous other compounds. Figure 3 below shows the water.



Figure 3 : Water

- **Coconut husk**

The dried coconut fruit is gathered to extract the coir fibre from the coconut, which is found on the coconut's outer layer and will be the main source of fibre for this inquiry. Coconut husk is the longest and most important natural fibre in terms of its resistance to twisting. As they are in tropical regions, coconuts are widespread, particularly in communities. Figure 4 shows the coconut husk.



Figure 4 : Coconut husk

In this study, the coconut husk is taken, divided into strips, flattened, and compressed before being added to the mould. However, only realistic, in-home equipment was used to compress the fibre in this study due to the equipment and machine constraints in terms of accurately extracting coconut and compressing the fibre. Illustrated breakdown of the steps involved in making coconut husks are shown in figure 5 below.



Figure 5: Extraction process of coconut husk

The coconuts waste that had been collected from local market were put together and ready to be extract. The extraction process was done by hands where the husks are pull separated from the shell. The process done with precaution step using gloves and mask to avoid any small husk particles in the air when the process is undergoing. Next all the extracted coconut coir will undergo water treatment. The coconut husks were put inside a bucket and then submerged by water. Make sure the coconut husk was fully submerged under the water. Keep it for a few days. Then rinse the water and set the husk on clean surface and let it dry. After the dry process is complete, we can proceed to the next step.

- **Wire mesh**

Wires of different thicknesses are intertwined, woven, or joined to form parallel rows and intersecting columns that are proportionately equal in size. The process of creating wire mesh, sometimes referred to as wire fabric, wire cloth, or hardware mesh, entails weaving wire on commercial looms while leaving square or rectangular gaps between the wires. An electric welder is used to join parallel longitudinal wires where they intersect to create welded wire mesh or cloth.

Figure 3.8 below shows the wire mesh that will be used in developing this prototype.

Figure 6: Wire mesh



- **Unplasticized Polyvinyl Chloride (UPVC)**

UPVC stands for unplasticized polyvinyl chloride, which is a type of piping that is made from PVC plastic. It is becoming an increasingly popular choice for water and wastewater systems because of its many advantages over traditional materials like metal and concrete. Figure 7 below shows the UPVC pipe with 4-inch diameter that will be used in developing this prototype.



Figure 7: UPVC Pipe

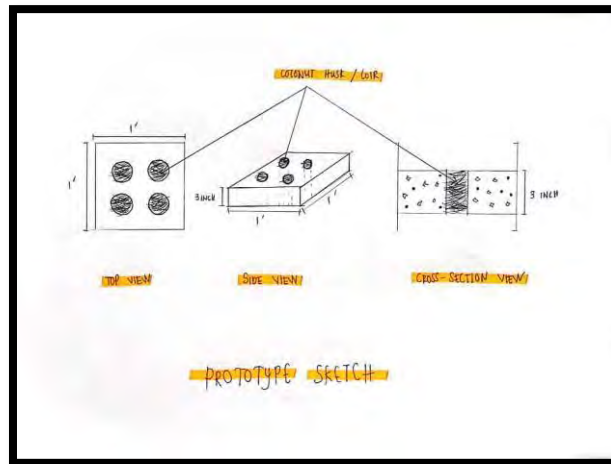
Design Thinking

Design thinking is the alternative to accomplish the second objective. It offers a clear approach for invention, which is its main advantage. Trial and error can be a useful method for determining what works and what doesn't, but it is frequently time-consuming, expensive, and ultimately useless (Han, 2022). On the other hand, adhering to the specific processes of design thinking is a productive technique to create fresh, creative ideas (Han, 2022). As a result, there was a sharp rise in traffic to these pillars. By expressing that initial voyage of discovery in language that were easy to understand at the time of encounter and need, it had made it more understandable (Cote, 2022).

In this section, innovation project was designed using ideation, prototype and testing as mentioned in research process. Research on prototype model was used to achieve the second objective, to

assemble the prototype by creating smart eco drain cover. The idea for smart eco drain prototype was designed with coconut coir that works as filter to this drain cover and automatically make this innovation product looks differ to existing drain covers. The design idea on how the prototype may look are shown below.

Figure 8 : Prototype sketch



Based on the early sketch for prototype design, a mould was purposed to made the prototype. The sketch for the mould is shown below.

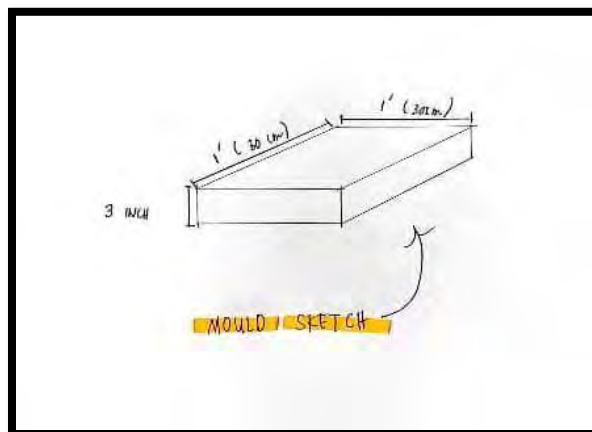


Figure 9 : Mould sketch



The idea to make the prototype in size of 1'x 1' with thickness of 3 inches is to make sure that it appears in the standard size of already commercialize concrete drain cover.




Procedure For Develop the Mould

The process to create the product by propose of making suitable mould. With commercial drain

cover variety of size of, in this project it was decided to use 30cm x 30cm (1'x 1') with 3 inch thickness. The suitable mould is made at the wood workshop, and details are shown in table 3.1 below.





Table 1 : Procedure For Develop The Mould

No.	Description	Figure
a	<p>The first step is to find suitable plywood as the base components for the mould.</p> <p>All the plywood are taken from wood workshop at UiTM Seri Iskandar</p>	
b	<p>Next, the plywood will be measure according to the sketch</p>	

	<p>c After that, the plywood is cut according to the measured line using jigsaw machine.</p> <p>Table saw also been used for place that jigsaw machine can't reach</p>	
	<p>d After cutting process is done, the mould is assemble using nails.</p>	
	<p>e The mould with dimension 1' x 1' x 3 inch are ready to the next process of casting the smart eco drain cover.</p>	

Other Equipment and Apparatus

Table 2: Other equipment and apparatus

a	Glove (for safety in workshop)	
b	Oil/grease/lubricant (As separator when dissembling the product from mould)	
c	Weighing Scale (to measure the weight of cement, sand and water)	
d	Cutter (to cut the wire mesh)	

Procedure for casting the Smart Eco Drain Cover

The procedure of casting the smart eco drain cover are divided into two (2) section in this chapter, its includes the ratio, the design mixing of the end product also the calculation of the material to be use, all of this section will further elaborated in section 3.4.4.1. Besides, the process of casting the end product will be explained step by step in section 3.4.4.2.

Ratio, Design Mix and The Calculation Of The Casting

The cement ratio that has been used for the prototype is 1 : 2 : 4, however the casting for smart eco drain cover are not using the aggregates in the concrete mix, only cement and sand that being used with 1 : 2 including the water. For design mix, coconut coir were added with 5

% into the mixing of the concrete. All of the materials are calculated to find the total quantity for each material cement, sand, water, and coconut coir needed to proposed 1 unit of smart eco drain cover. The calculations for the casting are as following;.

1 unit of Smart Eco Drain Cover

Size of the end product :-

$$0.3 \times 0.3 \times 0.02 \quad ; \quad 0.007 \text{ m}^3$$
$$5\% \text{ wastage} \quad ; \quad 0.00025 \text{ m}^3$$
$$0.007 + 0.00025 \quad ; \quad 0.00725 \text{ m}^3$$

① cement : $320 \text{ kg/m}^3 \times 0.007 = 2.24 \text{ kg/m}^3$



② Sand : $700 \text{ kg/m}^3 \times 0.007 = 4.9 \text{ kg/m}^3$



③ Water : $145 \text{ kg/m}^3 \times 0.007 = 1.015 \text{ kg/m}^3$


Figure 10 : Calculation Of Material For Casting Process

Process of Casting



Table 3 : Process of casting

<p>a</p>	<p>Cut the UPVC pipe into 3 inch length, cut and form a wire mesh as same as the diameter of UPVC pipe, and moved formed wire mesh into the UPVC pipe.</p>	
<p>b</p>	<p>Arrange the UPVC pipe into 4 point in the mould.</p>	



<p>c</p>	<p>Apply the oil to the mould with brush.</p>	 A person wearing a grey t-shirt and a white cap is kneeling on a concrete floor. They are using a brush to apply oil to the interior of a rectangular wooden mould. A tray with more oil is visible next to them.
<p>d</p>	<p>Prepare all the material by measuring it using scale as per calculation to get the concrete mix.</p>	 Three yellow buckets are placed on a platform scale. The scale's display is visible at the top. The buckets contain different materials, likely cement, sand, and aggregate, used for measuring concrete mix components.
<p>e</p>	<p>Sieve the sand using sand siever.</p>	 A person wearing a grey t-shirt and a white cap is kneeling on a concrete floor. They are using a circular sieve to separate sand. The sand is being poured from a bucket into the sieve, and the finer sand is falling through onto a tray below.

	<p>f Mix together all those cement, sand, water, and coconut husk manually.</p>	
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	<p>g Pour the concrete mix into the mould.</p>	
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<p>h</p>	<p>Compacting the concrete using vibrator.</p>	
<p>i</p>	<p>Keep for curing process.</p>	

<p>j</p>	<p>Disassembled the mould.</p>	
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	<p>k Insert the coconut husk into the UPVC pipe as prepared.</p>	
	<p>l Cut the wire mesh as cover to the drain water points.</p>	

m	Smart eco drain cover ready.	
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Lab Experimental

This study requires a lab experiment to be completed. In essence, the experiment will look into the flow of surface water being discharged without allows any debris or garbage from entering the drainage system and interrupt the surface water to be discharge. Furthermore, its demonstrates the performance of smart eco drain cover compares to competing products, with a focus on coir that works as a filter in this smart eco drain cover to improve the flow of discharge surface water. This lab experimental is conducted in a controlled environment, which is crucial. The type of development techniques used in assembling this innovation product, like the concrete specimen of smart eco drain cover made with additional coir which contributes as a filter, made it possible to conduct testing to accomplish the third objective.

Desk Study

Before more information is gathered from the field, a desk study is a preliminary analysis of the hydrogeology utilising all the information already available. It is the first step in creating the conceptual model, and any hydrogeological assessment is likely to start with the procedures presented in this chapter. A desk study is a very helpful technique of designing a fieldwork programme by describing what is already known about a place and selecting which questions need to be answered. It is important to finish the desk study since it is crucial to organising what may be a lengthy field research (Brassington,2017). Desk study also one of the method that has been used to accomplish the fourth objective.

FINDINGS

As for the findings, smart eco drain cover has been successfully developed throughout the methodology, research process and research design. All those four (4) objectives has been achieved which are to develop smart eco drain cover, to assemble the prototype of smart eco drain cover, to demonstrates the performance and also to test the marketability of the product. Smart eco drain cover that has been developed is shown below.



Figure 11 : Smart eco drain cover



Comparison Between Previous Innovation and Smart Eco Drain Cover

There are a few comparisons in terms of function, performance of the existing drain cover and smart eco drain. All of the comparison are as table 4 at below

Table 4: Comparison Between Previous Innovation and Smart Eco Drain Cover

Previous Innovation	Smart Eco Drain Cover
	
Flows of water are so slow.	Flows of water are very fast.
Cannot be maintained.	Easy to maintain.
Long time taken of water to be discharge.	Short time taken of water to be discharge.

CONCLUSION

Alternatively, 'smart eco drain cover' might promise the best solution to improve the drainage system in term of workability and efficiency on flow of surface water and indirectly solve the problem of flash floods.

ACKNOWLEDGEMENT

Alhamdulillah, first and foremost, I am thankful to Allah SWT for his blessing giving me opportunity, strength and ability to complete this Innovation Project II (BCT654) in my last year of degree despite the fact I had a lot of difficulties while working on this project. I would like to express my appreciation to my supervisor, Dr. Hasni Suryani, as well as the lecturer who were involved, Dr. Asmat, for the support and guidance while I completed my research project, which was a mentally and physically challenging for me. I would want to convey my gratitude to my parents and family, who have never stopped providing me their encouragement and dedication in order to lift my spirits not just while accomplishing this project but throughout my whole studies to seeing I succeed in life.

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