



NATIONAL HYDRAULIC RESEARCH INSTITUTE OF
MALAYSIA
(NAHRIM)

Hydraulics Physical Model Testing for Mobile Flood Wall Barrier

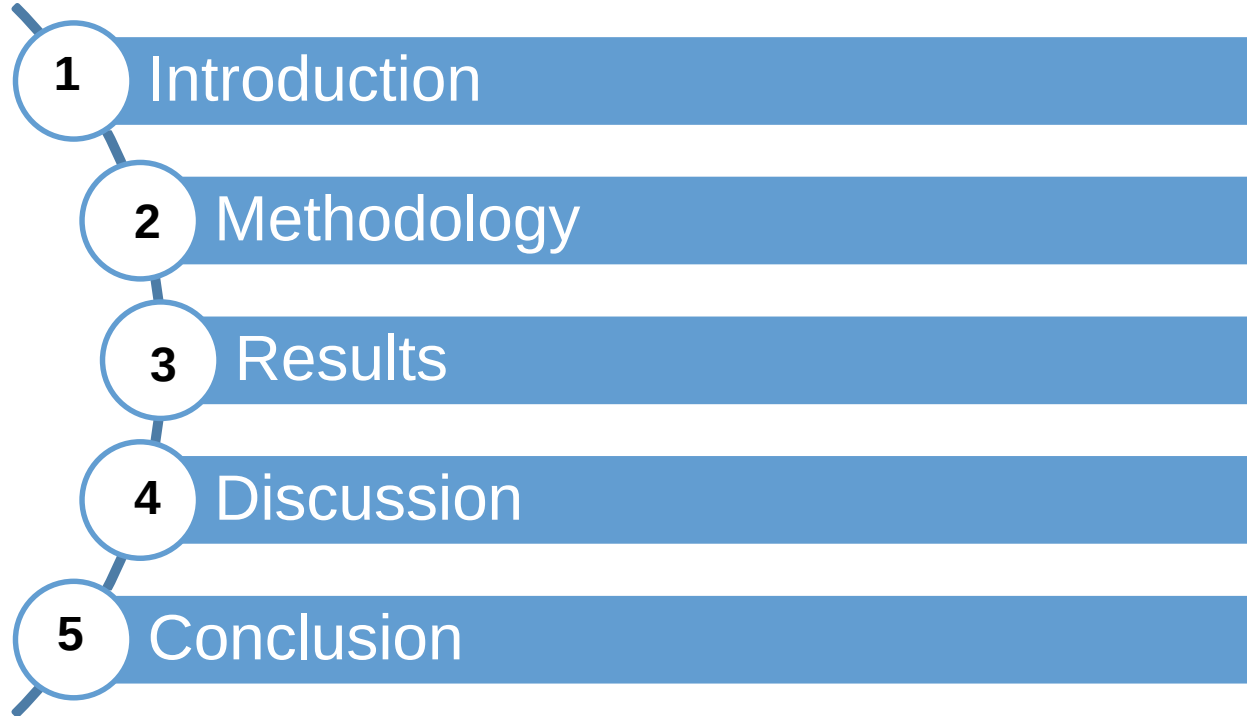
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OUTLINE





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1.0: INTRODUCTION

Floods and Its impact



Properties



Human



Animals



Industries



History

Type of Flood Walls

PERMANENT

Fixed, hard structure, long lasting, attached to building, view blocked, need space



Floodwall in Sunbury, Pennsylvania

Source: https://commons.wikimedia.org/wiki/File:Floodwall_in_Sunbury_Pennsylvania.JPG



Glass wall barrier, Shoreham, UK

Source: https://www.kiteglass.co.uk/portfolio_page/flood-barrier-shoreham-by-sea/



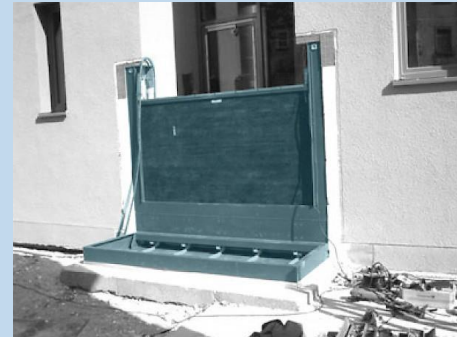
Brick floodwall, England

Source: <https://floodquiz.savingplaces.org/permanent-floodwalls/#.XkzcjmgaUk>



Mobile Floodwall, Austria

Source: <https://interestingengineering.com/mobile-flood-walls-keeps-austrian-town-safe>



HydroBeam, German

Source : Steinhardt Water Technology System

MOBILE

Easy and quick installation, lightweight and take little storage



Metal Floodwall, China

Source: <https://www.made-in-china.com/showroom/cecilia0139/product-detailMvomhgCKGXWZ/China-Metal-Flood-Barrier.html>

Advantages of Mobile Flood Wall Barriers



Light in weight



Easy to transport



Less storage use



Easy to install



Less Maintenance



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2.0: METHODOLOGY

THE DEVELOPMENT OF MOBILE FLOOD WALL BARRIER

- According to Bramley, for majority of houses and premises, 0.9 m of wall height is sufficient enough to retain the flood from entering.

1

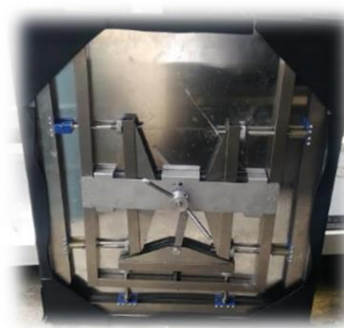
- Flood depths greater than 1 meter above flood level are likely to result in structural damage of buildings (Keeble, 2002)

2

1. Bramley, M. E., & Bowker, P. M. (2002). Improving local flood protection. *Proceedings of ICE*, (pp. 49–54).
2. Keeble, S. (2003). Interim Guidance for Improving the Flood Resistance of Domestic and Small Business Properties. Office of the Deputy Prime Minister.

Design

1.0 meter in height



MFWB NADI 1



MFWB NADI 2



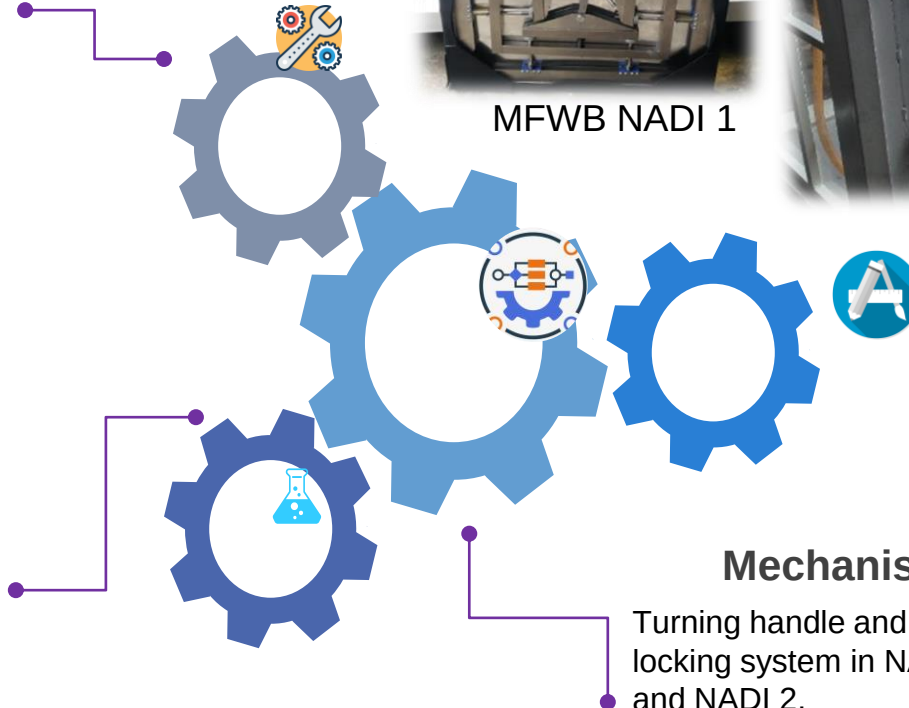
MFWB NADI 3

Material

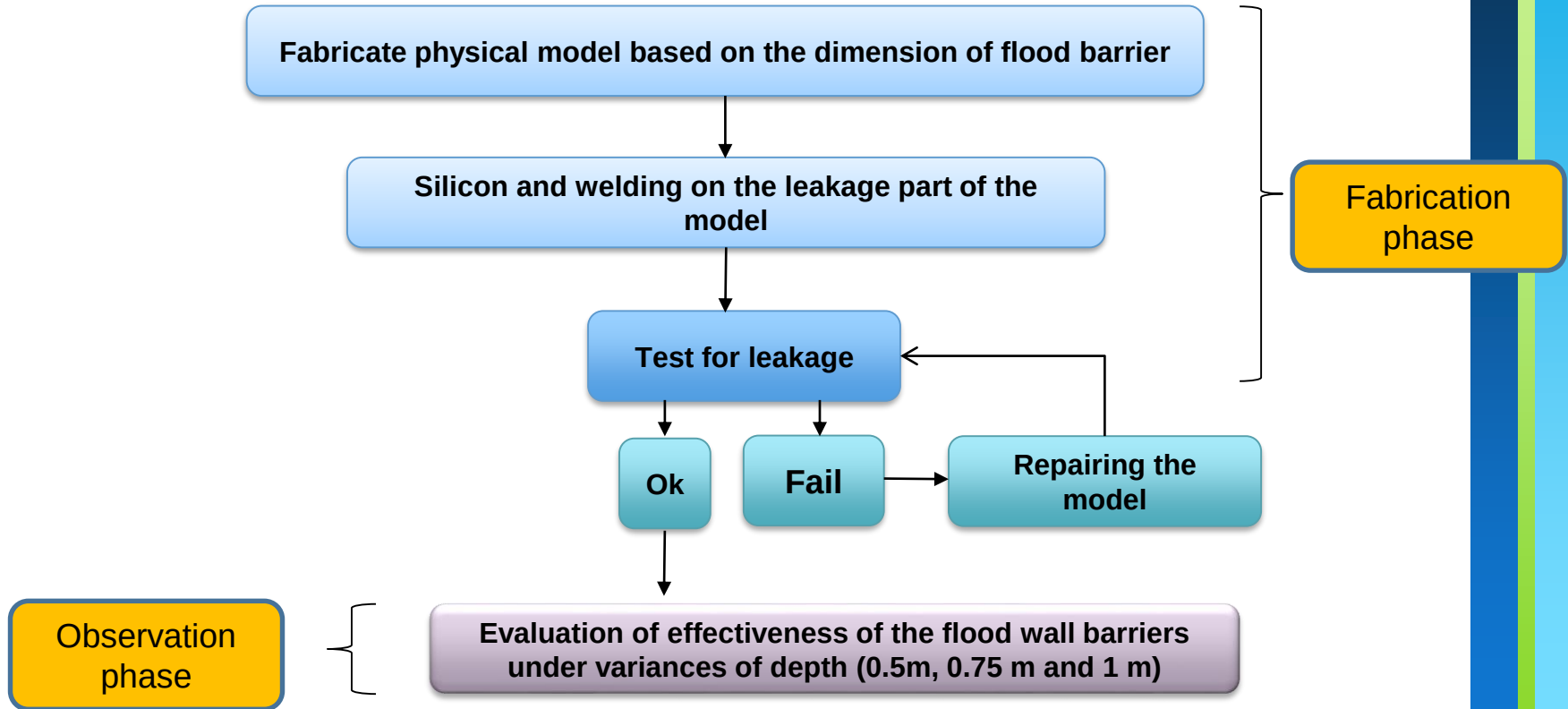
Stainless steel,
neoprene and
Ethylene
Propylene Diene
Monomer (EPDM)
rubber

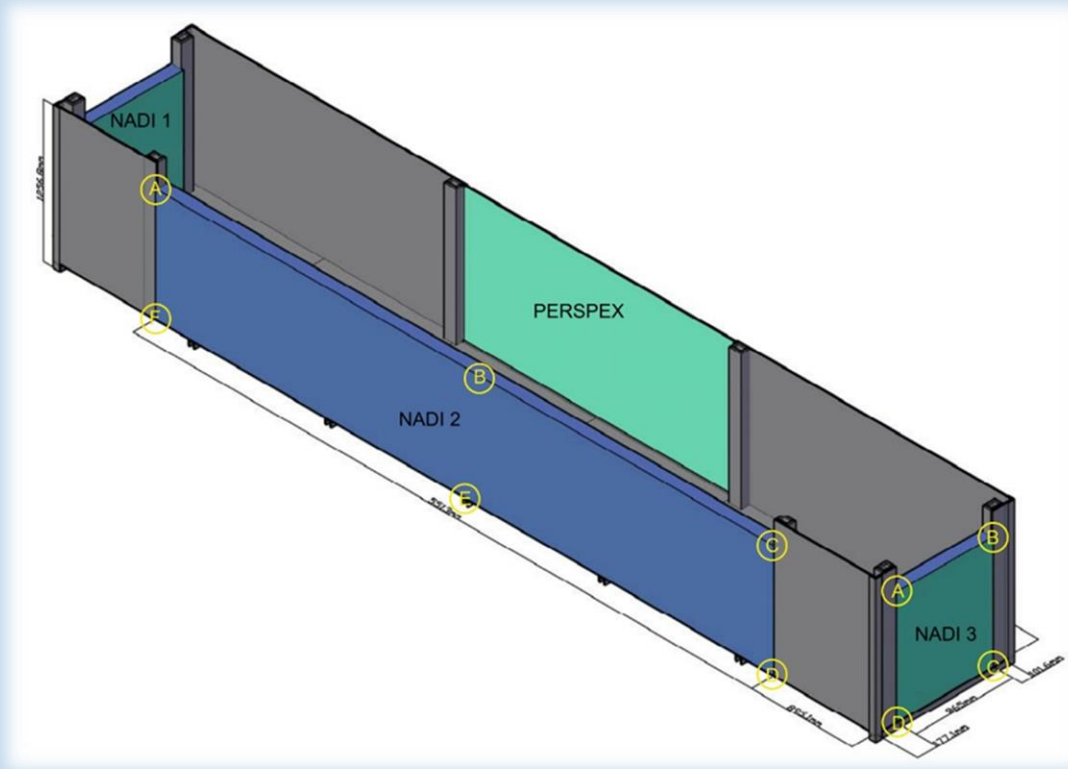
Mechanism

Turning handle and knob
locking system in NADI 1
and NADI 2.
Clamping system in NADI
3.



HYDRAULIC PHYSICAL TESTING WORK FLOW





Detail dimension of the constructed physical model for MFWB NADI 1, NADI 2 and NADI 3

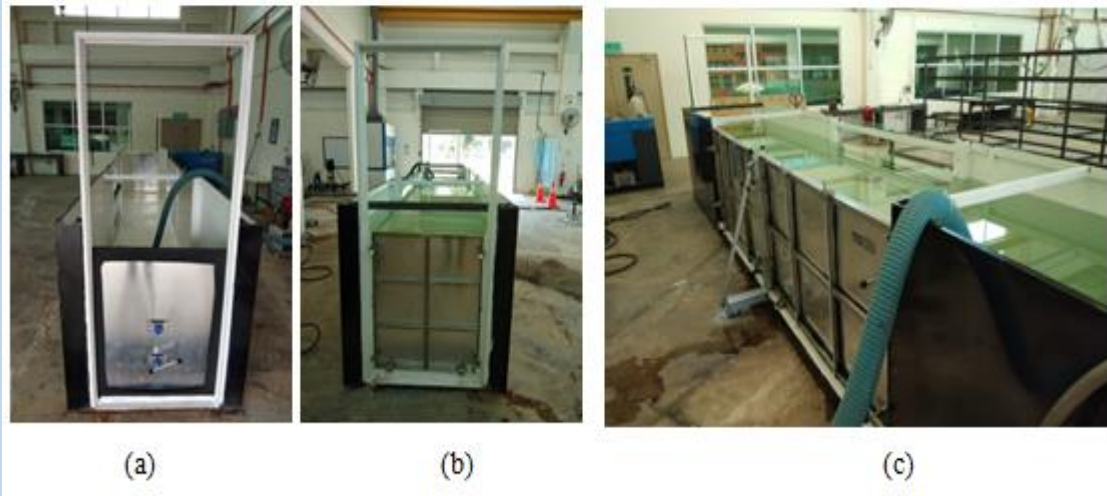
Measurement of Water Leakage

Water Leakage

MASS (kg) = Weight after absorption (kg) – Weight before absorption (kg)

Spill Water

Mass (kilogram) = volume (m³) x density (kg/m³)



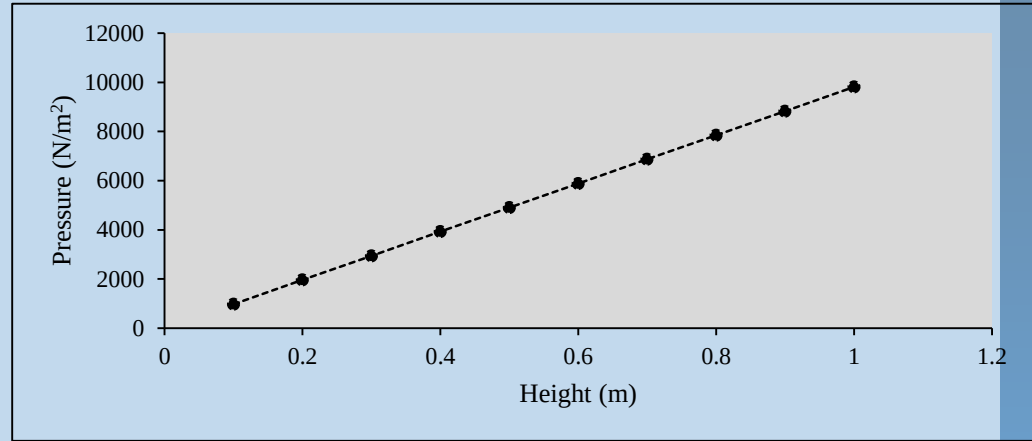
Water tightness test on final constructed hydraulic physical model-(a) NADI 1,
(b) NADI 3 and (c) NADI 2



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3.0: RESULTS

HYDROSTATIC PRESSURE



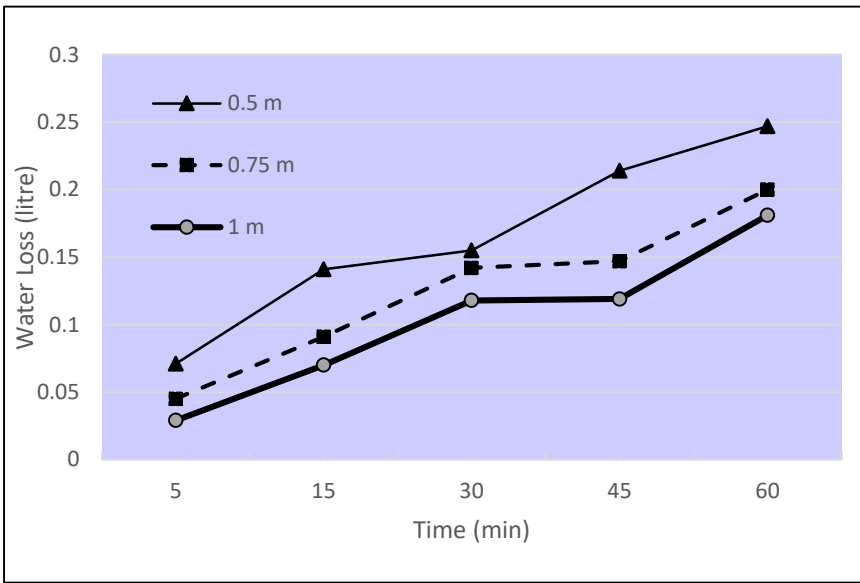
Graph of hydrostatics pressure acting on NADI 1, 2 and 3

- i. The hydrostatic pressure is the pressure that exerted by a fluid at equilibrium at a given point within the fluid, due to force by gravity.
- ii. Pascal's principle states that the pressure at a point in a fluid at rest is the same in all directions.
- iii. Higher depth will give high hydrostatic pressure due to increasing weight of the fluid.
- iv. As the height of water increases by time, the pressure will increase too.

WATER LEAKAGE

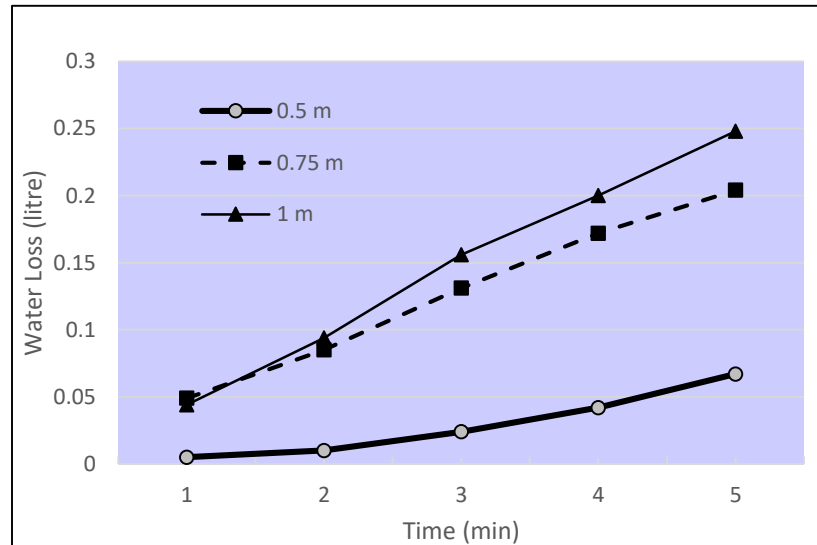
Water level (m) Time (min)	Water leakage (gram)			Water loss (liter)			Rate , Q (l/min)		
	0.5	0.75	1.0	0.5	0.75	1.0	0.5	0.75	1.0
NADI 1									
5	71	45	29	0.071	0.045	0.029	0.014	0.009	0.058
15	141	91	70	0.141	0.091	0.070	0.009	0.006	0.004
30	155	142	118	0.155	0.142	0.118	0.005	0.005	0.003
45	214	147	119	0.214	0.147	0.119	0.004	0.003	0.002
60	247	200	181	0.247	0.200	0.181	0.004	0.003	0.003
NADI 2									
5	5	49	44	0.005	0.049	0.044	0.0010	0.009	0.009
15	10	85	94	0.010	0.085	0.094	0.0007	0.006	0.006
30	24	131	156	0.024	0.131	0.156	0.0008	0.004	0.005
45	42	172	200	0.042	0.172	0.200	0.0009	0.004	0.004
60	67	204	248	0.067	0.204	0.248	0.0010	0.003	0.004

Detail of water Leakage Test of NADI 1 and NADI 2 at 0.5, 0.75 and 1.0 m of water depth



The overall water leakage at MFWB NADI 1 due to time and pressure

The overall water leakage at MFWB NADI 2 due to time and pressure





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4.0: DISCUSSION

HYDROSTATIC PRESSURE

1. When the water level raised at 0.5 m, the original setup of NADI 2 deformed on the top part due as NADI 2 is unable to resist high pressure of 4.90 kN/m^2 . NADI 2 was bent and deflected because of the hydrostatic pressure acting against its lengthy barrier wall.
2. This probably due to the structure of NADI 2 which did not have enough overall strength in order to support or withstand the exerted water pressure.
3. A simple solution was to create an external support structure and the middle span section of NADI 2 which can withstand more than 9.81 kN/m^2 of static water pressure.

WATER LEAKAGE

1

- Nadi 1- as the time increased, water pressure (water level) is also increased and lead the amount of water leakage to increase. It can be inferred that the longer and the higher of flood inundation, the more water will leak through the flood barrier, however, these amount can be considered small and can be mitigate by mopping the floor.

2

- Nadi 2- the amount of water loss increase as the time increase at all different water level and spilled larger amount of water due to higher pressure and time. This happened due to the pressure exerted to the flood barrier increase at higher water level and NADI 2 is lengthier in size than NADI 1.

3

- Nadi 3- there was no leakage observed during the testing because the clamping mechanism is rigid enough to ensure that there is no gap between the door frame and the flood wall. The small structure of the barrier as well as the additional support at the middle of the barrier enables it to withstand high pressure as compared to NADI 1 and 2.



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5.0: CONCLUSION

CONCLUSION



The experiment was successful to prove the effectiveness of flood wall in blocking and preventing the seepage of water during flood. The wall can endure water with minimum leakage at 0.5 m to 1.0 m of height.



The most efficient MFWB is NADI 3 that is capable of preventing any leakages.



Although there are some leakages for other MFWB, it is around acceptable range and still performed to avoid overflow of water.



ACHIEVEMENTS OF MFWB NADI

i) INSTALLATION OF MFWB NADI
AT INDIVIDUAL RESIDENCE AND
GOVERNMENT PREMISE
(SCHOOL)

INDIVIDUAL RESIDENCE AT KG MERU, KLANG



GOVERNMENT PREMISE: SEK. KEB. KAJANG



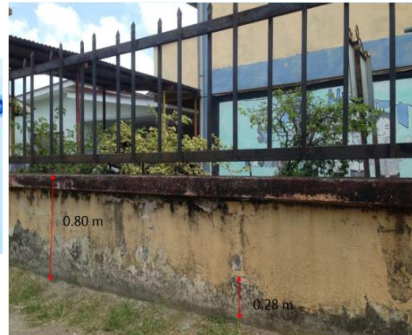
Individual residential

Single storey
Jalan Meru,
Klang



Government premises

Sekolah
Kebangsaan
Kajang



Klinik Kesihatan
Kajang



Products- NADI 1, NADI 2 dan NADI 3 participated in ISIF, Turkey from 27-30 September 2018 and successfully won Gold Medal for NADI 2 and Bronze Medal for NADI 1 and NADI 3.



Success Stories Shared during *Slot Rancangan Selamat Pagi Malaysia* at RTM on 12 October 2018



Soft Launching for MFWB NADI 2 by Datuk Dr. Tan Yew Chong, KSU KATS on 13 October 2018.

Public Service Innovation Awards 2019 in celebration of 10th Anniversary Malaysia-Croatia Technology Exchange at Malaysia Technology Expo 2019 (21-23 Feb 2019)





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Thank You