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# Topmix Permeable : An eco-friendly Innovation to tackle Flooding in Urban Areas

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## ABSTRACT

Flooding is a natural disaster that has occurred most often in indonesia since long ago, especially in the rainy season. the consequences of this flood can be a disaster that causes risks that adversely affect the community. Therefore as one of the solutions to water absorption on a small amount of land and high rainfall resulting in flooding, an innovation in manufacturing in the field of environmentally friendly construction was developed, namely Topmix Permeable asphalt. topmix permeable asphalt is called porous asphalt. This porous asphalt has larger pores than normal asphalt. with a porous surface, it allows water to flow and dissipate naturally into the soil. this research method is obtained from literature studies, data analysis so that the conclusion is obtained from the innovation of environmentally friendly permeable topmix asphalt to prevent flooding. porous asphalt innovations that are effective and efficient in workmanship and cost, make environmentally friendly asphalt that can store water in the ground and reduce the risk of flooding, especially in urban areas.

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## 1. INTRODUCTION

Flooding is a natural disaster that has long occurred in Indonesia, especially during the rainy season considering that there are so many watersheds in the Indonesian region (Rizkiah, 2015). Flooding is the inundation of land that is usually dry, occurs because the volume of water in a body of water increases. Floods can occur due to the overabundance of water in a place due to heavy rains, the equalling of land with rivers, the breaking of river dams, rising water at sea level or melting ice. Flooding can be a disaster when it occurs in areas where human activities take place. This flood can also cause risks that adversely affect the community (Bradford, et al., 2012).

Disaster risk is an event that is likely to occur and is designed to manage events whose countermeasures are not appropriate. This provides learning for the community to change the mindset of the importance of disaster management before the disaster occurs. Disaster management is a form of government responsibility in protecting each of its citizens as a form of human security for each individual in a country (Cesarec, et al., 2020).

Permeable topmix is also known as porous concrete. The function of Permeable Topmix can play a fundamental role in most sustainable urban drainage designs. Providing an easy, long term, answer to surface flooding that can be implemented quickly and cost effectively. A new solution for draining and paving concrete quickly and cost effectively. This permeable topmix can quickly direct excess water away from roads, parking surfaces and footpaths. Unlike conventional concrete, it has a high void ratio of between 20%-35%. This allows the risk of surface flooding and contamination of watercourses to be eliminated (Zhang et al., 2018).

In recent years, there has been an increasing recognition of the importance of implementing sustainable measures to mitigate the impact of flooding in Indonesia. One such approach is the implementation of green infrastructure, which involves the use of natural systems and materials to manage stormwater and reduce flood risks. Green infrastructure strategies include the establishment of green roofs, rain gardens, and urban wetlands, which can absorb and store excess water during heavy rainfall. These strategies not only help in flood control but also provide additional benefits such as improved air quality, enhanced biodiversity, and aesthetic appeal to urban areas (Fennessy and Cronk, 1997).

Furthermore, community engagement and public awareness play a crucial role in effective flood management. It is important to educate and empower individuals and communities to understand the risks associated with flooding and to take proactive measures to protect themselves and their properties. This can be achieved through the dissemination of information about flood-prone areas, early warning systems, and emergency preparedness plans (Gwimbi, 2007). Additionally, promoting sustainable land use practices and zoning regulations that consider flood hazards can help in minimizing the exposure of vulnerable populations to flood risks.

Overall, a comprehensive approach to flood management in Indonesia should incorporate a combination of structural and non-structural measures. While infrastructure solutions like permeable topmix can be effective in reducing surface flooding, they should be integrated with other strategies such as green infrastructure and community engagement to create a holistic and sustainable approach (Kambites and Owen, 2006). By prioritizing flood prevention, early warning systems, and community resilience, Indonesia can better adapt to its natural conditions and mitigate the adverse effects of flooding, ultimately protecting its citizens and promoting sustainable development.

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## 2. METHODS

The research method used is data collection with literature studies. literature study is a search for theoretical references used in research that can be found in books, journals, research report articles, and trusted sites on the internet (Dewantoro, 2016). The output of the literature study is the collection of references that are relevant to the topic discussed. literature study also serves as support in problem solving (Saputra, et al., 2021).

This literature study was conducted to compile this report and data analysis provides an idea of innovation in geoporous asphalt. discussion and conclusions are based on an idea of technological innovation in the field of infrastructure by creating water-absorbing asphalt innovations so that flooding can be avoided. writing is done in stages in several work steps. the following is a flow chart used in the research on topmix permeable asphalt innovation shown (Sukontasukkul and Chaikaew, 2006) in **Figure 1.**

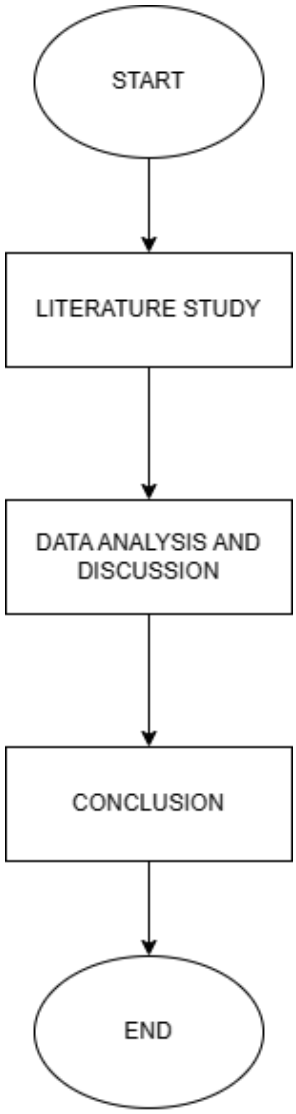


**Figure 1.** Flowchart of the topmix permeable asphalt innovation research.

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## 3. RESULT AND DISCUSSION

Flooding in Indonesia is not an uncommon occurrence, in fact, flooding is very common in major cities in Indonesia. This happens because the land surface is lower than sea level and the lack of large water catchment (Koster, et al., 2000). Floods can also hit residential areas and not a few victims. Reporting from detik.com according to Aqueduct Global Flood Analyser analysis, Indonesia is the sixth country with 80 per cent of the total population affected by floods every year and the diagram is depicted (Measey, 2010) in **Figure 2.**


**Figure 2.** Diagram of Disasters by Time

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One of the factors that cause flooding is the lack of water infiltration that guarantees to absorb a lot of water in a short time. Therefore, one of the solutions that can be applied is to replace asphalt in areas that are often affected by flooding.

Topmix Permeable is a hollow concrete that can absorb water at 2000 litres/minute. This Permeable Topmix uses Fly Ash base material which can be obtained from the waste of Steam Power Plant (PLTU) (Savioz, et al., 2009) and is depicted in **Figure 3**.

**Figure 3.** Asphalt with infiltration

The difference between geoporous asphalt and ordinary asphalt is that geoporous asphalt uses a base material that can absorb water faster because it has pores where the absorption capacity can be much greater according to construction needs (Pan, et al., 2004). If this asphalt is applied, problems caused by drainage and culverts that are clogged with garbage will be solved, because garbage will not be an obstacle to this asphalt in absorbing water.

In addition, this asphalt is also environmentally friendly and can also last for approximately 40 years (Duncan, 2000) as shown in **Figure 4**.

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**Figure 4.** Asphalt Infiltration Capability Experiment.

The price of making the construction is generally not much different from conventional road construction. But in terms of durability, the use of geopore construction is much more durable. Meanwhile, if the production is done industrially, the price can be much cheaper because the materials used for its manufacture are local (Sun et al., 2020).

According to ITB lecturer Prof. Bambang, currently a rough calculation of making a road with geopore construction for a size of 1 Kilometre and a width of 4 metres, costs around Rp1.3 billion. "The price is not much different, but the function is more effective.

Topmix Permeable, which is a hollow concrete that can absorb water at 2000 litres/minute, will be targeted for marketing to the government and communities in Indonesia. The government needs to be aware of the floods that always exist in Indonesia, especially in areas that are often affected by floods such as Jakarta, Bandung and others (Imansyah, 2012). Therefore, it is necessary to come up with solutions so that flooding can be controlled, and the Indonesian people to be able to support solutions that can prevent flooding and know how the performance of this permeable asphalt to be applied.

It uses a system commonly used for water recycling, where the water may be contaminated, or where the subsoil is impermeable. An impermeable membrane is installed over an underground pipe and an outlet pipe installed within the subsoil. Water can be captured and harvested for needs such as irrigation, toilet flushing and so on and is shown (Ward et al., 2012) in **Figure 5**.

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**Figure 5.** Asphalt Coating.

On this asphalt there are also advantages and disadvantages including:

● Advantages

- Some of the advantages of permeable topmix are Rapid water absorption ensures more effective management of large volumes of water
- Safer roads are created as there is less ponding of water thereby reducing the risk of hydroplaning,
- Reduced risk of flash flooding,
- Reduced impact on the natural water cycle,
- Reduced cost of managing large volumes of water,
- Low surface maintenance costs,
- No planning permission required in domestic applications such as driveways (Marenco and Seidl, 2021).

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- Disadvantages

The disadvantage of permeable topmix is that the pores of the concrete can be clogged with dirt such as dust, soil, dry leaves. Another disadvantage is that when the temperature is very cold, the incoming water will crystallise and freeze which of course will damage the concrete structure directly (Harty, 2005). But in Indonesia, you don't have to worry about that problem, because the tropics only have summer and rainy season.

## 4. CONCLUSION

In the research conducted, which discusses innovations in the field of construction technology based on environmentally friendly by innovating a permeable topmix, namely porous asphalt. this permeable topmix makes a solution in Indonesia to overcome the problem of flooding that has long existed, especially in urban areas because this asphalt can absorb water and the water is channeled into the soil below the surface of the porous asphalt. The advantages of this permeable topmix in addition to being environmentally friendly are more effective rainwater management, reduced rainwater management and less complex porous asphalt maintenance. although there are drawbacks, this permeable topmix or geoporous asphalt experiment is good for Indonesia's flood-prone conditions during the rainy season.

## 5. AUTHOR'S NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

## 6. REFERENCES

Bradford, R. A., O'Sullivan, J. J., Van der Craats, I. M., Krywkow, J., Rotko, P., Aaltonen, J., ... and Schelfaut, K. (2012). Risk perception–issues for flood management in Europe. *Natural hazards and earth system sciences, 12*(7), 2299-2309.

Cesarec, I., Mikac, R., and Spevec, D. (2020). The concept of human security as a basis for the application of big data concept in establishment of early warning system for crisis management in the republic of Croatia. *Croatian international relations review, 26*(86), 72-95.

Dewantoro, A. Y. U. (2016). Perilaku penggunaan teknologi informasi dalam pencarian referensi pada penulisan ilmiah di fakultas ilmu budaya Universitas Diponegoro (studi kasus skripsi di fakultas ilmu budaya Universitas Diponegoro). *Jurnal ilmu perpustakaan, 5*(1), 311-320.

DOI: https://doi.org/10.17509/seict.v4i1.47106
p-ISSN:2744-1656 e-ISSN:2774-1699

Duncan, J. M. (2000). Factors of safety and reliability in geotechnical engineering. *Journal of Geotechnical and Geoenvironmental Engineering, 126*(4), 307-316.

Fennessy, M. S., and Cronk, J. K. (1997). The effectiveness and restoration potential of riparian ecotones for the management of nonpoint source pollution, particularly nitrate. *Critical reviews in environmental science and technology, 27*(4), 285-317.

Gwimbi, P. (2007). The effectiveness of early warning systems for the reduction of flood disasters: some experiences from cyclone induced floods in Zimbabwe. *Journal of Sustainable Development in Africa, 9*(4), 152-169.

Harty, C. (2005). Innovation in construction: a sociology of technology approach. *Building Research and Information, 33*(6), 512-522.

Imansyah, M. F. (2012). Studi umum permasalahan dan solusi das Citarum serta analisis kebijakan pemerintah. *Jurnal Sosioteknologi, 11*(25), 18-33.

Kambites, C., and Owen, S. (2006). Renewed prospects for green infrastructure planning in the UK. *Planning, practice & research, 21*(4), 483-496.

Koster, R. D., Suarez, M. J., Ducharne, A., Stieglitz, M., and Kumar, P. (2000). A catchment-based approach to modeling land surface processes in a general circulation model: 1. model structure. *Journal of Geophysical Research: Atmospheres, 105*(D20), 24809-24822.

Marenco, M., and Seidl, T. (2021). The discursive construction of digitalization: a comparative analysis of national discourses on the digital future of work. *European Political Science Review, 13*(3), 391-409.

Measey, M. (2010). Indonesia: a vulnerable country in the face of climate change. *Global Majority E-Journal, 1*(1), 31-45.

Pan, L., Sander, M. B., Huang, X., Li, J., Smith, M., Bittner, E., ... and Johnson, J. K. (2004). Microporous metal organic materials: promising candidates as sorbents for hydrogen storage. *Journal of the American Chemical Society, 126*(5), 1308-1309.

Rizkiah, R. (2015). Analisis faktor-faktor penyebab banjir di kecamatan tikala kota Manado. *Spasial, 1*(1), 105-112.

Saputra, R. F. A., Pranoto, C. S., and Ali, H. (2021). Faktor pengembangan organisasi profesional: leadership/kepemimpinan, budaya, dan iklim organisasi (suatu kajian studi literatur manajemen pendidikan dan ilmu sosial). *Jurnal Manajemen Pendidikan dan Ilmu Sosial, 2*(2), 629-639.

Savioz, A., Leuba, G., Vallet, P. G., and Walzer, C. (2009). Contribution of neural networks to alzheimer disease's progression. *Brain Research Bulletin, 80*(4-5), 309-314.

Sukontasukkul, P., and Chaikaew, C. (2006). Properties of concrete pedestrian block mixed with crumb rubber. *Construction and Building Materials, 20*(7), 450-457.

Sun, Y., Li, L., Shi, H., and Chong, D. (2020). The transformation and upgrade of China's manufacturing industry in industry 4.0 era. *Systems Research and Behavioral Science, 37*(4), 734-740.

DOI: https://doi.org/10.17509/seict.v4i1.47106
p- ISSN 2774-1656 e- ISSN 2774-1699

Ward, S., Memon, F. A., and Butler, D. (2012). Performance of a large building rainwater harvesting system. *Water Research, 46*(16), 5127-5134.

Zhang, C., Hu, M., Dong, L., Xiang, P., Zhang, Q., Wu, J., ... and Shi, S. (2018). Co-benefits of urban concrete recycling on the mitigation of greenhouse gas emissions and land use change: a case in chongqing metropolis, China. *Journal of Cleaner Production, 201*, 481-498.

DOI: https://doi.org/10.17509/seict.v4i1.47106
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