UNIVERSITI TEKNOLOGI MARA

The 11th International, Invention, Innovation & Design 2022

INDES 2022

Ushering in the Age of Endemic

THE 11TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION INDES 2022

EXTENDED ABSTRACTS BOOK

e ISSN 2756-8733

9 772756 873009

Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e-ISSN: e-ISSN 2756-8733

Cover Design : Nazirul Mubin Mohd Nor
Typesetting : Wan Nurul Fatihah binti Wan Ismail

The 11th International Innovation, Invention and Design Competition 2022

Organised by

Office of Research, Industrial Linkages, Community & Alumni Networking (PJIM&A)
Universiti Teknologi MARA Perak Branch

and

Academy of Language Study
Universiti Teknologi MARA Perak Branch

INNOVATION OF SELF-HEALING CONCRETE WALL PANEL

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ABSTRACT

Crack formation is a relatively typical event in concrete structures which enable penetration of water and various types of chemicals into the concrete and reduces its durability, strength, and affects the reinforcement when it comes into contact with water and other chemicals. Self-Healing Concrete (SHC) was introduced to solve the problems. Self-Healing Concrete is a concrete made from bacteria-derived calcite crystals created by Bacillus Subtilis (B.Subtilis) and Super Absorbent Polymers (SAPs), which can form limestone or calcium carbonate. Also, cracks problems of the IBS precast wall usually occur during the handling process especially during lifting, transporting, connecting for installation and concrete strengthening. The aim of this study is to investigate the potential for SHC wall panels for construction of IBS in Malaysia. Therefore, the objectives are to review the causes of cracks in current wall panel concrete products, propose a new innovative idea to enhance the performance of wall panel concrete products by using SHC and study the marketability and potential of SHC wall panels in the industry. The results of experiments show that Self-Healing Concrete has a good potential for crack remedy and application in the building industry.

Keyword: *Self-Healing Concrete, Crack, Bacillus Subtilis, Super Absorbent Polymers.*

1. INTRODUCTION

Finding the solutions to the world's issues is at the heart of evolution of innovation (Wright, 2021). Innovation is defined as a process of changing something established by introducing something new. In the building construction process, precast concrete walls create some problems that cause cracking problems during material handling, transporting, installing connections and concrete strengthening. Cracks indicate the occurrence of distress on the concrete structure and nonstructural structure. Looking at the present situation, a proposal of a new innovative idea by implementing the Self-Healing Concrete wall panel is proposed.

2. METHODOLOGY

2.1 Desk Study

Desk research was carried out to review previous research findings on SHC to gain a broad understanding of the field. The topic of research is available on internet platforms such as online articles, online newspapers, etc.

2.2 Observation

The observation will be conducted by watching an online video about the process, characteristic, background and most important is experimental in the lab.

2.3 Experimental Studies

The experiment is done due to the exchange of raw material, from Bacillus pseudofirmus and clay pellet to Bacillus subtilis and Super Absorbent Polymer (SAPs). Preparation of 4 concrete cubes of Self-Healing Concrete to examine the 7 and 28 days of compressive strength, density, and water absorption. It also will be compared with normal concrete which also has 2 concrete cubes to be tested. After the compressive strength is tested, observation will be continued to see the effectiveness of the substance in fixing the cracks.

3. FINDINGS

A mixture of 5% of B.Subtilis and SAPs into normal concrete results in the highest percentage of compressive strength and is highly concentrated. Besides, concrete density increases due to reduction of micro air void which leads to greater strength of concrete. High density concrete also can reduce the risk of thermal cracking which complies with the main purpose of the SHC to decrease crack issues. The percentage of water absorption in 5% of B.Subtilis and SAPs in concrete is the lowest compared to a normal concrete. The advantages of low water absorption are less volume change from wetting and drying concrete, lower moisture content and it reduces the chances of corrosion in reinforcement (steel). Based on the experiment result, the best mixture design for this precast wall panel is when 5% of B.Subtilis and SAPs are included in the SHC.

Autogenous healing is performed by visually observing the damaged concrete. Cracks were formed at 28 days after the compressive strength and were healed in complete water immersion. The process of healing the concrete starts when water comes in contact with B.Subtilis and SAPs in concrete. Then, calcium hydroxide is produced with the help of bacteria, which act as a catalyst. The calcium hydroxide reacts with atmospheric carbon dioxide and forms limestones or calcium carbonate (Joshi & Rai, 2018).

4. CONCLUSION

In general, Self-Healing Concrete (SHC) precast is the concept of innovative approach. SHC repairs any crack with water as the agent to activate the calcium carbonate. The advantages of SHC are maintenance work can be reduced, compressive strength can be increased, and the life span is extended compared to normal concrete. The SHC could increase water tightness for concrete and is a suitable application for concrete slabs at flat roof and toilet.

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Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

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