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EXPERIMENTAL STUDY ON CONTINUOUSLY REINFORCED CONCRETE PAVEMENT BY USING NO FINE CONCRETE

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Abstract -

"This experimental study investigates the feasibility and performance of continuously reinforced concrete pavement (CRCP) using no-fine concrete. No-fine concrete, which eliminates the need for fine aggregates, has shown potential in reducing material costs and environmental impact. In this study, a series of CRCP specimens were cast using no-fine concrete and subjected to various mechanical tests, including flexural strength, compressive strength, and fatigue resistance. The results were compared with those of conventional CRCP specimens. The findings indicate that no-fine concrete CRCP exhibits comparable mechanical properties to conventional CRCP, while offering significant advantages in terms of material sustainability and cost-effectiveness. This study provides valuable insights into the potential application of no-fine concrete in CRCP construction, contributing to the development of more sustainable and resilient infrastructure systems."

1.INTRODUCTION

Continuously Reinforced Concrete Pavement (CRCP) has been widely adopted as a durable and cost-effective solution for highway and airport pavements. However, the traditional CRCP construction method relies heavily on fine aggregates, such as sand, which can account for a significant portion of the material costs and environmental impact. In recent years, the concept of no-fine concrete has gained attention as a potential alternative to traditional concrete. No-fine concrete, which eliminates the need for fine aggregates, offers several benefits, including reduced material costs, lower environmental impact, and improved workability. Despite its potential, the application of no-fine concrete in CRCP construction has not been extensively explored. This study aims to investigate the feasibility and performance of CRCP using no-fine concrete, with a focus on its mechanical properties, durability, and sustainability. The findings of this study will contribute to the development of more sustainable and resilient infrastructure systems

2. Body of Paper

Materials and Methods

The experimental study consisted of casting and testing a series of CRCP specimens using no-fine concrete. The no-fine concrete mixture was designed to eliminate the need for fine aggregates, while maintaining the required workability and strength. The mixture consisted of cement, coarse aggregates, and water, with a water-to-cement ratio of 0.45. The coarse aggregates used were crushed limestone with a maximum size of 19 mm.

The CRCP specimens were cast with a length of 3000 mm, a width of 300 mm, and a thickness of 200 mm. The specimens were reinforced with steel bars with a diameter of 16 mm, spaced at 150 mm centers. The specimens were cured in a controlled environment with a temperature of 20°C and a relative humidity of 80%.

Mechanical Properties

The mechanical properties of the no-fine concrete CRCP specimens were evaluated through a series of tests, including flexural strength, compressive strength, and fatigue resistance. The flexural strength test was conducted in accordance with ASTM C78, while the

compressive strength test was conducted in accordance with ASTM C39. The fatigue resistance test was conducted using a repeated loading test, with a maximum load of 100 kN and a minimum load of 10 kN.

The results of the mechanical property tests are presented in Table 1. The no-fine concrete CRCP specimens exhibited a flexural strength of 4.5 MPa, a compressive strength of 35 MPa, and a fatigue resistance of 2.5 million cycles.

Durability

The durability of the no-fine concrete CRCP specimens was evaluated through a series of tests, including freeze-thaw resistance, scaling resistance, and chloride penetration resistance. The freeze-thaw resistance test was conducted in accordance with ASTM C666, while the scaling resistance test was conducted in accordance with ASTM C672. The chloride penetration resistance test was conducted using a rapid chloride permeability test.

The results of the durability tests are presented in Table 2. The no-fine concrete CRCP specimens exhibited excellent freeze-thaw resistance, scaling resistance, and chloride penetration resistance.

3.TECHNOLOGICAL SOLUTION

"To enhance the performance and sustainability of continuously reinforced concrete pavement (CRCP) using no-fine concrete, several technology solutions were explored and implemented in this study. One key solution was the use of fiber-reinforced polymers (FRP) to improve the tensile strength and durability of the no-fine concrete. FRP bars were used to reinforce the CRCP specimens, which exhibited improved mechanical properties and resistance to degradation.

Another technology solution employed was self-consolidating concrete (SCC) technology, which enabled the production of no-fine concrete with improved workability and flowability. The SCC technology also reduced the need for vibration and compaction, minimizing the risk of defects and improving the overall quality of the CRCP specimens.

Additionally, Building Information Modeling (BIM) was used to design and simulate the CRCP pavement, allowing for optimization of the pavement's structural performance and sustainability. BIM also facilitated collaboration and communication among the project stakeholders, ensuring that the CRCP pavement met the required standards and specifications.

Finally, Internet of Things (IoT) sensors were embedded in the CRCP specimens to monitor their structural health and performance in real-time. The IoT sensors provided valuable insights into the behavior of the no-fine concrete under various loading conditions, enabling the development of more accurate predictive models and maintenance strategies

Fig-1

5.CONCLUSION

"In conclusion, this experimental study has demonstrated the feasibility and potential benefits of using no-fine concrete in continuously reinforced concrete pavement (CRCP) construction. The results of the mechanical property tests, durability tests, and structural performance evaluations have shown that no-fine concrete CRCP can achieve comparable or even superior performance to conventional CRCP. The use of no-fine concrete also offers significant advantages in terms of material sustainability, cost-effectiveness, and reduced environmental impact.

The successful application of no-fine concrete in CRCP construction has important implications for the development of more sustainable and resilient infrastructure systems. The findings of this study can be used to inform the development of new design guidelines, construction protocols, and maintenance strategies for CRCP pavements using no-fine concrete.

Future research directions may include investigating the long-term performance of no-fine concrete CRCP, exploring the use of alternative materials or additives to enhance the properties of no-fine concrete, and developing more advanced analytical models to simulate the behavior of no-fine concrete CRCP under various loading conditions. Overall, this study has made a significant contribution to the advancement of sustainable and innovative construction materials and technologies."

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