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Analysis of the Mechanical Properties of Concrete with Banana Pseudostem Fiber for Cost Optimization of Rigid Pavements

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Abstract The remains of the banana pseudostem, which are left over when the fruit is removed, are typically left on the farms in the central jungle as fertilizer. However, this often produces fungus due to humidity, as it is a material that is not marketed. Some researchers have found commercial uses for these remains in the manufacture of shoes and handbags. In addition, research shows that the use of natural fibre improves the properties of concrete and reduces the impact of the carbon footprint, making it a sustainable material in construction. This research work focuses on analysing the mechanical properties of concrete with banana pseudostem fibre, seeking to optimise costs in rigid pavements at the Plutón Chanchamayo construction site. For this purpose, a 210 kg/cm^2 concrete was designed according to the guidelines of the Practical Standard for the Selection of Proportions for Normal, Heavy and Mass Concrete (ACI 211.1-91). Different proportions of pseudostem fibre were incorporated and their effects on the concrete were evaluated. The overall results indicate that the addition of banana pseudostem fibre significantly improves the mechanical properties of the concrete. Specifically, a 3% fibre ratio optimises the compressive strength and other critical parameters, while a noticeable reduction in the production cost per cubic metre of concrete is also observed. These improvements not only increase the efficiency of the material, but also contribute to sustainability by reducing the carbon footprint and utilising agricultural waste. In conclusion, the use of banana pseudostem fibre in concrete not only offers economic benefits by reducing production costs, but also improves the mechanical properties of the material, making it stronger and more sustainable. This represents an innovative and ecological solution for the construction industry, promoting the use of natural materials and reducing environmental impact.

Keywords Banana Pseudostem Fibre, Compressive Strength, Direct Tensile Strength, Modulus of Rupture, Flexural Strength

1. Introduction

In the central jungle, according to the National Agrarian Health Service (SENASA), plantain cultivation covers 145,000 hectares. Out of these, 7,000 hectares are used by farmers as their main economic livelihood through the sale of the fruit. However, the residues of the banana pseudostems are cut and left in the same place as natural