DEVELOPMENT OF PERVIOUS ALL-ROAD CLASS ALL-WEATHER MULTILAYERED PAVER BLOCKS

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Pervious Concrete (PC) is a special pavement material that comprises Portland cement, coarse aggregates, and water in definite proportions. The most critical property of PC is its high permeability, which allows passage of stormwater through its interconnected porous structure at a higher rate compared to Portland Cement Concrete Pavement (PCCP). Therefore, pervious concrete pavement (PCP) systems have gained acceptance as engineered solutions to alleviate stormwater runoff problems. However, successful implementation of PCP technology in the field requires high quality control and skilled labor. Also, since PCP possesses lower strength compared to PCCP, its application is limited to low-volume roads, sidewalks, and parking lots. In the first part of this research, two field test sections of PCP were designed, constructed, and monitored over a period of three years. During the construction of PCPs, several complexities related to quality control such as mixing procedures (in-situ or using ready-mix truck), compaction effort to attain balance between strength, durability, permeability, and curing techniques were observed. Based on the various problems observed with the field implementation such as clogging and low-strength in the PCP materials, there was a need to develop a strong and durable product that had superior structural and hydrological performance characteristics over traditional PCP.

Therefore, the major objective of this research was to develop a Pervious All-Road class All-weather Multilayered paver (PARAMpave) block of square geometry with dimensions 300 mm side and 90 mm thickness. A lower layer of 60 mm thickness was designed with high strength Portland cement concrete (PCC) of M40 grade such that it acted as a structural layer to carry design traffic loads, while the upper PC layer of 30 mm thickness served as a functional layer allowing for infiltration of stormwater through it. Two circular slots of 25 mm diameter were created within the lower layer to allow for water permeation through the composite and later into the underground layers. To minimize deterioration at the joints, all four edges were prepared with 30-mm thick PCC layer of a grade similar to the base PC layer.

PARAMpave products were characterized for porosity, permeability, texture depth, flexural strength and toughness, whose results were as follows: (i) Porosity ranged from 17-24%, while the falling head permeability test infiltration rate varied from 0.77-1.33 cm/s, both properties conforming to the fundamental definition of PC, (ii) Mean texture depth was in the realm of 2.64-2.78 mm, indicating high frictional characteristics offered by the functional PC layer, and (iii) Flexural strength was between 4.83 and 6.13 MPa, significantly higher than the threshold prescribed in the global procedures. All results indicated that the PARAMpave products were superior to traditional PCP designs in terms of structural as well as hydrological performance characteristics. Additionally, PARAMpave weighed around 17 kg, which is around 10% lighter than a PCC paver block of similar configurations, rendering it convenient for handling, repair, and maintenance. Overall, the results indicated that PARAMpave products have high potential to mitigate severe impacts of urbanization pertinent to rainfall-runoff response and are suitable set of candidates for applications in different road classes and diversified weather conditions. It is envisioned that the field implementation of PARAMpave will contribute to the development of sustainable and resilient pavement infrastructures.

Keywords: Pervious Concrete Pavements; PARAMpave; Paver Blocks; Porosity; Permeability; Compressive Strength; Flexural Strength; Lifecycle Assessment; Capital cost; Sustainability.