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Permeable Asphalt Pavement as a Measure of Urban Green Infrastructure in the Extreme Events Mitigation

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Abstract : Population growth in cities has led to an increase in the infrastructures construction, including buildings and roadways. This aspect leads directly to the soils waterproofing. In turn, changes in precipitation patterns are developing into higher and more frequent intensities. Thus, these two conjugated aspects decrease the rainwater infiltration into soils and increase the volume of surface runoff. The practice of green and sustainable urban solutions has encouraged research in these areas. The porous asphalt pavement, as a green infrastructure, is part of practical solutions set to address urban challenges related to land use and adaptation to climate change. In this field, permeable pavements with porous asphalt mixtures (PA) have several advantages in terms of reducing the runoff generated by the floods. The porous structure of these pavements, compared to a conventional asphalt pavement, allows the rainwater infiltration in the subsoil, and consequently, the water quality improvement. This green infrastructure solution can be applied in cities, particularly in streets or parking lots to mitigate the floods effects. Over the years, the pores of these pavements can be filled by sediment, reducing their function in the rainwater infiltration. Thus, double layer porous asphalt (DLPA) was developed to mitigate the clogging effect and facilitate the water infiltration into the lower layers. This study intends to deepen the knowledge of the performance of DLPA when subjected to clogging. The experimental methodology consisted on four evaluation phases of the DLPA infiltration capacity submitted to three precipitation events (100, 200 and 300 mm/h) in each phase. The evaluation first phase determined the behavior after DLPA construction. In phases two and three, two 500 g/m² clogging cycles were performed, totaling a 1000 g/m² final simulation. Sand with gradation accented in fine particles was used as clogging material. In the last phase, the DLPA was subjected to simple sweeping and vacuuming maintenance. A precipitation simulator, type sprinkler, capable of simulating the real precipitation was developed for this purpose. The main conclusions show that the DLPA has the capacity to drain the water, even after two clogging cycles. The infiltration results of flows lead to an efficient performance of the DPLA in the surface runoff attenuation, since this was not observed in any of the evaluation phases, even at intensities of 200 and 300 mm/h, simulating intense precipitation events. The infiltration capacity under clogging conditions decreased about 7% on average in the three intensities relative to the initial performance that is after construction. However, this was restored when subjected to simple maintenance, recovering the DLPA hydraulic functionality. In summary, the study proved the efficacy of using a DLPA when it retains thicker surface sediments and limits the fine sediments entry to the remaining layers. At the same time, it is guaranteed the rainwater infiltration and the surface runoff reduction and is therefore a viable solution to put into practice in permeable pavements.

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