



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Open graded asphalt friction course (OGAFC) is a special purpose bituminous mix applied as a surface course for improved skid resistance and road safety especially under wet weather conditions. These mixes are characterised by high air voids content, generally greater than 18% of the mix volume, which are achieved through a uniform aggregate gradation that predominantly comprises of coarse aggregates. For adequate load transfer in OGAFC mixes through proper stone-on-stone contact these mixes demand comparatively good quality road. The increasing cost and the shortage of good quality natural aggregates, have compelled researchers and practitioners to explore alternate aggregate materials to attain sustainability in road construction. Steel slag is an industrial by/co-product obtained during the conversion of pig iron or steel scrap to industrial quality steel. Steel slag is classified as either basic oxygen furnace (BOF) slag or electric-arc furnace (EAF) slag, depending on the furnace/process employed in its conversion.

This study investigated the utilisation of BOF steel slag in OGAFC mixes as a replacement to coarse natural aggregates in five percentages (0, 25, 50, 75, and 100%) with two types of modified binders (polymer modified bitumen (PMB) and crumb rubber modified bitumen (CRMB)). The ten OGAFC mix combinations formulated were investigated for design properties, functionality, durability, and performance characteristics. The functionality of the mixes was examined in terms of drainability characteristics, clogging resistance, and frictional properties. The durability of the mixes was assessed in terms of the resistance to moisture induced damage (under different moisture conditioning environments) and long-term binder draindown. Finally, the mechanical performance of the BOF steel slag incorporated OGAFC mixes was evaluated in terms of rutting resistance, cracking potential, fatigue life, and modulus properties.

The results of the study showed that for all the ten combinations of OGAFC mixes, at 6.0% binder content (by weight of the mixture), all the mix design requirements stipulated/stated by ASTM D7064 (2013) were met. According to the results of the drainability tests, incorporation of BOF steel slag in OGAFC mixtures decreased the clogging caused by stripping and permanent deformation. The use of BOF steel slags in OGAFC mixes significantly improved the frictional characteristics of the mixes and OGAFC mixes. The results of the moisture susceptibility tests revealed that an acidic environment exacerbated moisture damage; however, OGAFC mixtures containing BOF slag outperformed when compared to control mixture (with natural aggregates only). After being subjected to long-term binder draindown, the results revealed that ageing for different temperature and duration had a significant effect on binder draindown, and OGAFC mixes with BOF steel slag had a higher aging resistance and thus showed a better ravelling, rutting, and moisture performance. The performance test results indicated that the use of BOF steel slag not only improved the performance of OGAFC mixtures in terms of rutting resistance, cracking potential, and modulus properties; it also increased the fatigue life of OGAFC mixes. OGAFC mixes even up to 100% BOF steel slag substitution exhibited good performance in terms of functionality, durability and mechanical properties. OGAFC mixes with CRMB binder showed better results in terms of permeability, skid resistance, and resistance to long-term binder draindown; while OGAFC mixes with PMB binder reported superior results in terms of moisture damage resistance and the mechanical properties.