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POTENTIAL DURABILITY AND SERVICE LIFE PREDICTION OF REINFORCED CONCRETE BRIDGES ON THE SWAKOPMUND-WALVIS BAY FREEWAY UPGRADE

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ABSTRACT

Deterioration of concrete structures in the marine environment is a major concern for engineers and asset managers. This dissertation presents a case study involving the testing and assessment of concrete in newly constructed reinforced concrete bridges on the Swakopmund–Walvis Bay Freeway upgrade in Namibia, designed with the expectation of a maintenance-free service life of at least 100 years. The project specifications followed a prescriptive durability design and specification approach, setting restrictions and limits on concrete-related aspects such as binder type and content, maximum water-to-cement ratio, placement, compaction, and curing.

Testing was carried out for compressive strength, durability indexes (DI) and cover depth, and compared with performance-based specifications used by SANRAL. The measured DI values were found to be satisfactory, exceeding the minimum specifications in the 'deemed-to-satisfy' approach for concrete in a marine environment. The maintenance-free service life of the as-built structural bridge elements exposed to chlorides was predicted using the South African chloride ingress model. With this approach, 28% of bridge elements show areas of early local failure with potential service life as low as 56 years, and 11% of the bridge elements have a potential wider area of failure before the 100-year design life. The lower service life is attributed to inadequate cover to concrete. It is recommended that additional waterproofing and coatings be applied to these areas in order to achieve protection equivalent to concrete cover.