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Assessment of the durability performance of aged reinforced concrete water reservoirs in Gauteng

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ABSTRACT

This study assessed the durability performance of aged reinforced concrete reservoirs. The objectives were to conduct audits/surveys of Rand Water reservoirs and how they have performed over time through assessments of the selected structures with regard to durability performance and aggressiveness of the in-service exposure environment of the reservoirs.
The assessment was conducted in phases: preliminary assessments and detailed assessments. The preliminary assessments were used to characterise the nature of the deterioration and the possible mechanism and gave guidance in planning for the detailed assessments, based on visual inspections. The detailed assessments were then used to confirm the cause of deterioration and to quantify the severity of the deterioration mechanisms.
Cores were extracted from the reservoirs, and on-site visual assessments and laboratory tests were carried out. The tests included surface hardness assessment using the Schmidt hammer, compressive strength, cover depth and carbonation depth. An attempt to quantify the impact and effect of durability performance using durability indices and corrosion indices was also conducted.
The results from the durability indices tests, indicate that the concrete is of poor quality. The Water Sorptivity Index (WSI) test results ranged between 3.16 and 12.79, signifying concrete susceptible to moisture ingress by absorption for some reservoirs. The Oxygen Permeability Index (OPI) values ranged between 8.02 and 9.43, signifying poor quality concrete with regard to permeability for all reservoirs. The Chloride Conductivity Index (CCI) values ranged between 0.58 and 1.62, signifying susceptibility to chloride penetration leading to corrosion for some reservoirs. The indices characterise the near surface properties of concrete and measure its resistance to fluid and ionic transport mechanisms; therefore, a reduced quality in the surface concrete results in its inability to protect the reinforcement against corrosion.
The study indicated that all reservoirs tested for durability performance experienced poor concrete quality and were prone to corrosion due to carbonation, Alkali Silica Reaction (ASR), insufficient cover layer and aggressive waters.