第V部門　Partition of ASR-Induced Axial Strain between Interior and Surface Domains of RC Cylinders under Two Accelerated Exposure Regimes

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1. INTRODUCTION

Alkali-silica reaction (ASR) causes expansion and cracking in concrete. In reinforced-concrete (RC) members, reinforcement restrains the expansion, and the measured response depends on the location and direction of measurement [1-4]. Surface strain can be obtained readily; however, it does not directly represent the response inside the member.

The objective of this study is to examine the effect of the accelerated exposure regime on the partition of ASR-induced axial strain between the interior and surface domains of RC cylinders. A surface-to-embedded strain ratio is used to identify a surface-dominant response and its change toward approximate interior-surface parity. The complete stress and strain fields are not reconstructed in this study.

2. EXPERIMENTAL PROGRAM AND ANALYSIS

The specimens were RC cylinders 200 mm in diameter and 400 mm in height. S2 contained 6-D14 longitudinal bars (steel ratio 2.94%; clear spacing 54.0 mm), whereas S3 contained 12-D10 bars (3.00%; 26.2 mm). No transverse reinforcement was provided. One VWS-15 gauge was embedded at the geometric center and aligned with the cylinder axis. Z- and H-oriented resistance gauges were bonded to the surface at mid-height, at alternating bar-aligned positions P and inter-bar positions V (Fig. 1).

Strain increments were referenced to an exposure age of 1.0 d, and channel-level quality control was applied before the valid means were calculated. The reported embedded values are Day-1-referenced increments rather than absolute gauge readings and are not directly comparable with the manufacturer-reported nominal strain range. Stable embedded temperatures were approximately 36.1°C and 53.5-53.6°C in the nominal 38°C and 60°C regimes. Because the chamber operation and water-replenishment histories also differed, the comparison concerns two complete exposure regimes at the same age and is not interpreted as an isolated temperature effect.

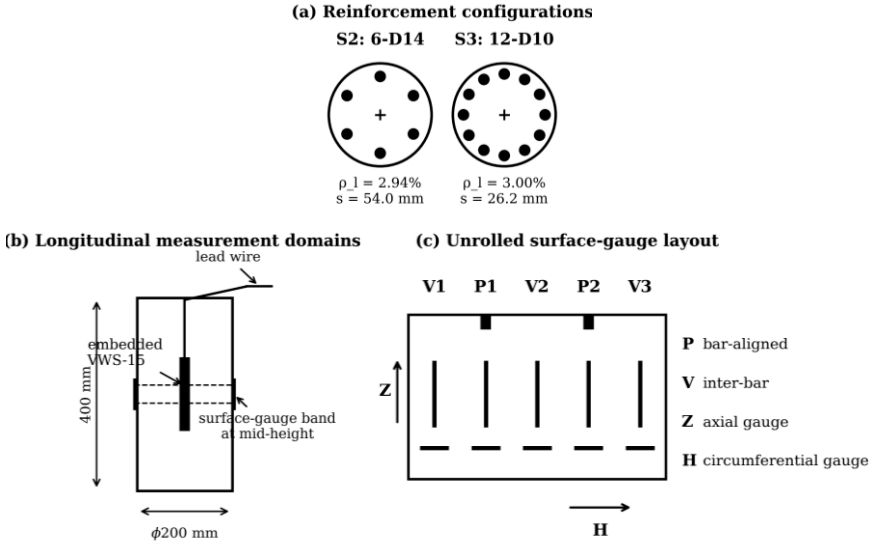


Fig. 1 Reinforcement configurations, longitudinal measurement domains, and unrolled surface-gauge layout.

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At 14 d, the partition index R(S/E) was defined as Δε(surface-Z) / Δε(embedded). Values greater than 1.0 indicate surface dominance, whereas values close to 1.0 indicate approximate interior-surface parity. R(S/E) is an index of two measurement domains and is not a radial strain gradient.

3. RESULTS AND DISCUSSION

Figure 2 shows the effect of the exposure regime on R(S/E). Under nominal 38°C, the embedded and surface-Z strains were 202.6 and 789.2 με for S2 and 192.1 and 717.0 με for S3; R(S/E) was 3.90 and 3.73, respectively. Under nominal 60°C, the corresponding strains were 1717.8 and 1846.2 με for S2 and 1855.4 and 1743.5 με for S3; R(S/E) decreased to 1.07 and 0.94. Thus, the initially surface-dominant partition diminished and approached interior-surface parity in both reinforcement configurations.

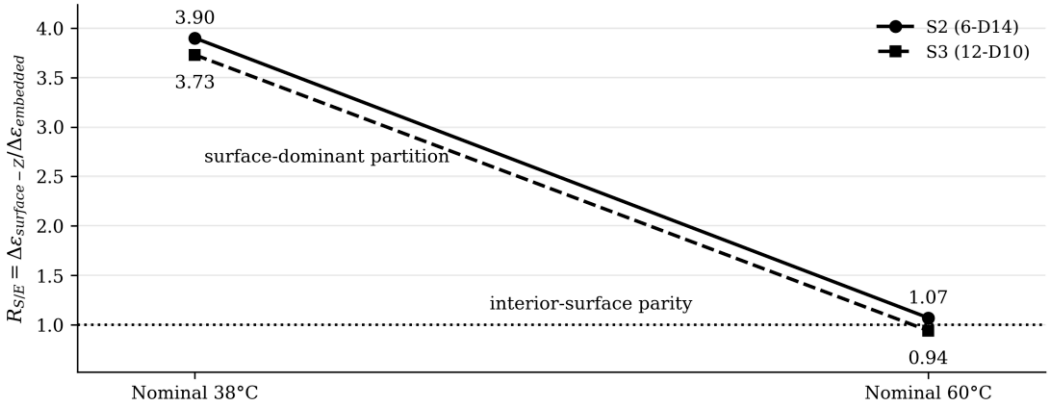


Fig. 2 Effect of the exposure regime on the surface-to-embedded axial-strain partition at 14 d.

The change in partition reflects the different regime-to-regime increases in the two domains. The embedded strains increased by factors of 8.48 and 9.66 for S2 and S3, whereas the surface-Z strains increased by factors of 2.34 and 2.43. The results indicate that the internal axial response increased more steeply than the surface axial response when the exposure regime was changed.

Approximate parity does not indicate equivalence of the two measurement systems because their gauge positions, gauge lengths, and sampled concrete domains are different. The change in R(S/E) is consistent with an interaction between ASR expansion and internal reinforcement restraint; however, a unique stress-transfer or damage mechanism cannot be identified from the present measurements. The surface H/Z ratios at nominal 60°C were 2.22 for S2 and 1.11 for S3. Since only one cylinder per configuration was instrumented with surface gauges, the configuration differences are treated descriptively.

4. CONCLUSIONS

Under nominal 38°C, R(S/E) was 3.90 for S2 and 3.73 for S3, indicating a surface-dominant response. Under nominal 60°C, it decreased to 1.07 and 0.94, respectively; the partition therefore approached interior-surface parity. The same tendency was obtained for both configurations. R(S/E) provides an index for evaluating exposure-regime dependence of the relationship between internal and surface axial responses. Further investigation is needed to relate this partition to internal stress and damage states.

REFERENCES

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