

Introduction

The Michigan Aggregate Test Road was constructed in 1992 to study the influence of different coarse aggregate types and their frost susceptibility in terms of long-term concrete pavement durability.

- Five PCCP test sections (5000 – 6500 ft. long each) were constructed using varying degrees of freeze-thaw resistant coarse aggregates.
- Concrete Mixture: 5.5 sk/cyd plus 15% Class F fly ash.
- The pavement structure for the entire test road consists of a 10.5 inch, 27 ft. jointed reinforced concrete pavement (JRCP) constructed on a 4 in. open-graded asphalt-treated permeable base (ATPB) layer on top of a 3 inch gravel separator layer. Half of each test section was built on the original 12 inch poorly-draining subbase with the other half constructed on a 12 inch “select” well-draining permeable sand subbase.
- Current AADT: approx. 20,000 vpd; 18 percent commercial.

Experimental

- Distress surveys
- International roughness index, IRI, (MDOT - PMS)
- Surface elevation profiles (2006, 2016)
- Air void analysis (2016)
- Rapid chloride permeability test, RCPT, (2016) at 23 years

Major findings

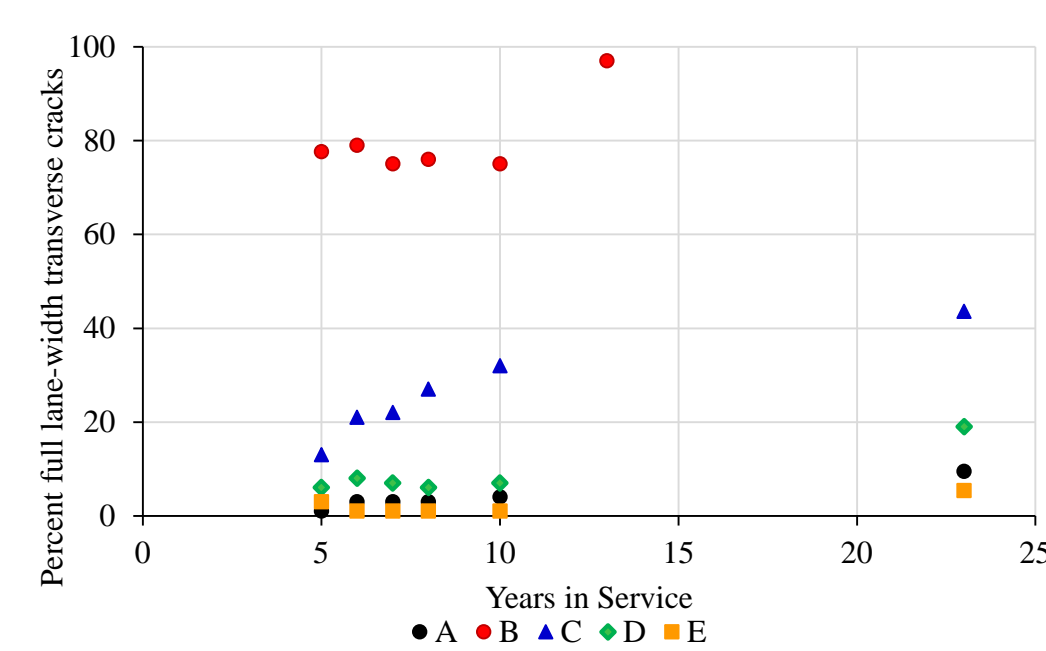


Fig.1 Transverse crack development

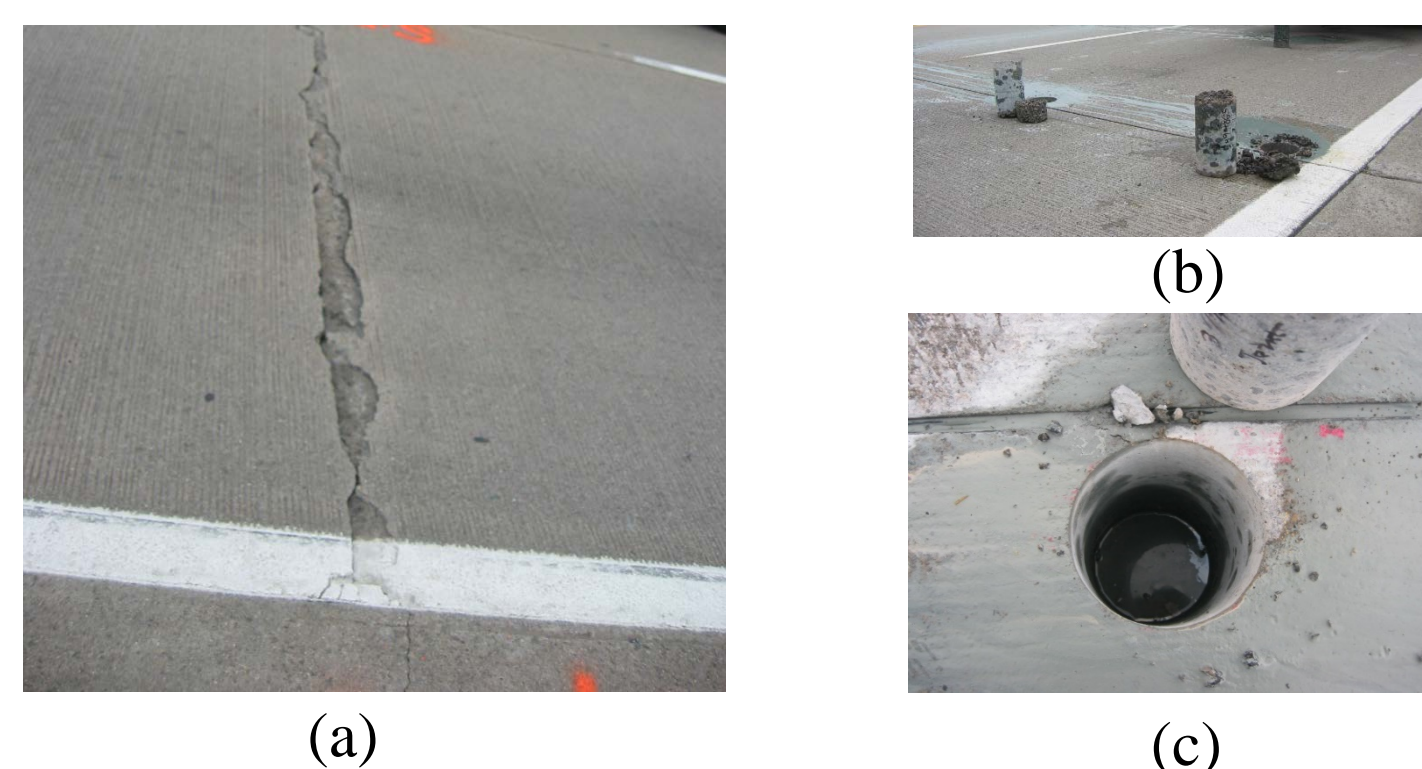


Fig.2 (a) Typical transverse crack in section B (b) ATPB erosion at outer corner and (c) standing water in core hole after 1 hour (2006)

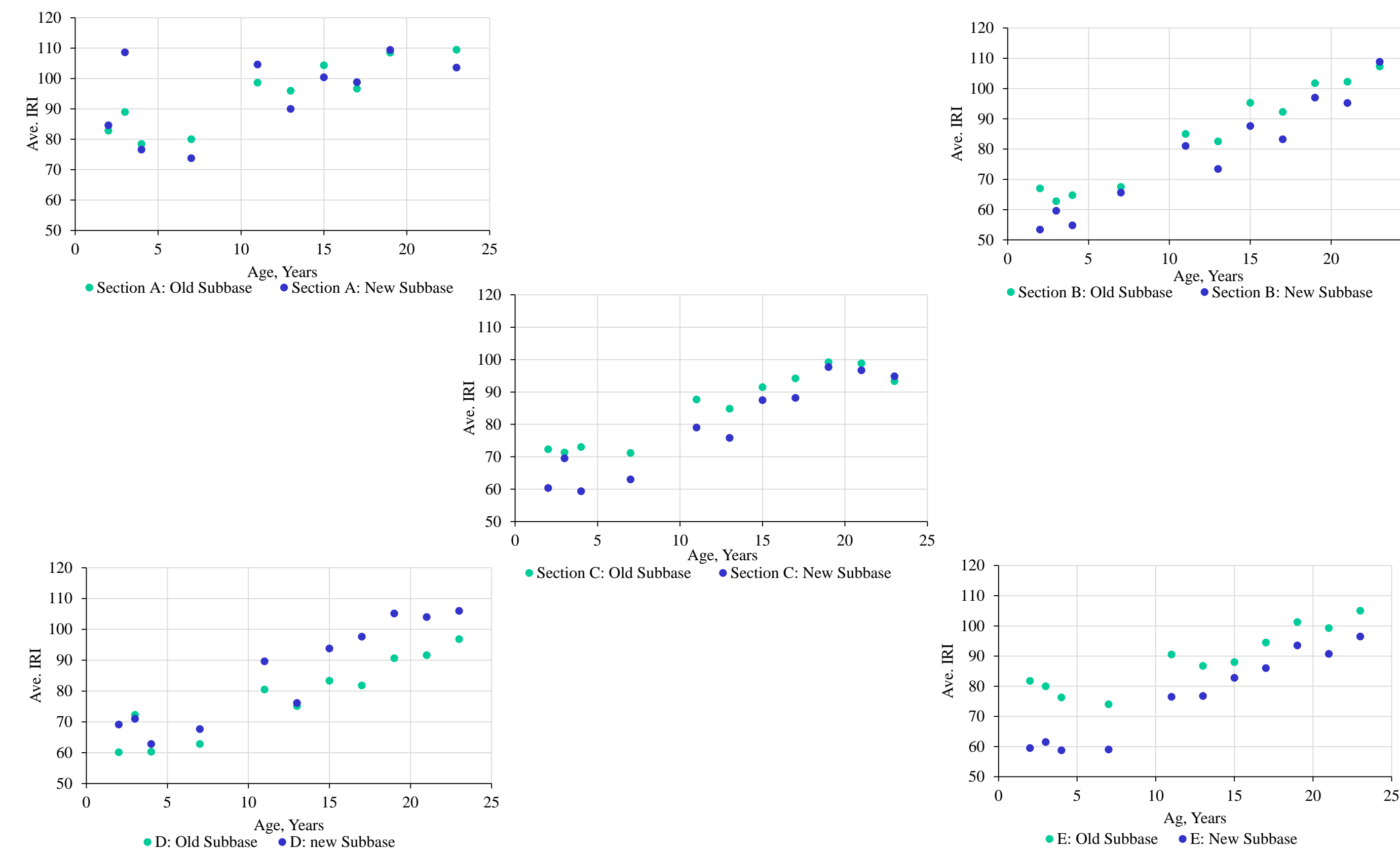


Fig. 3 IRI vs years in-service

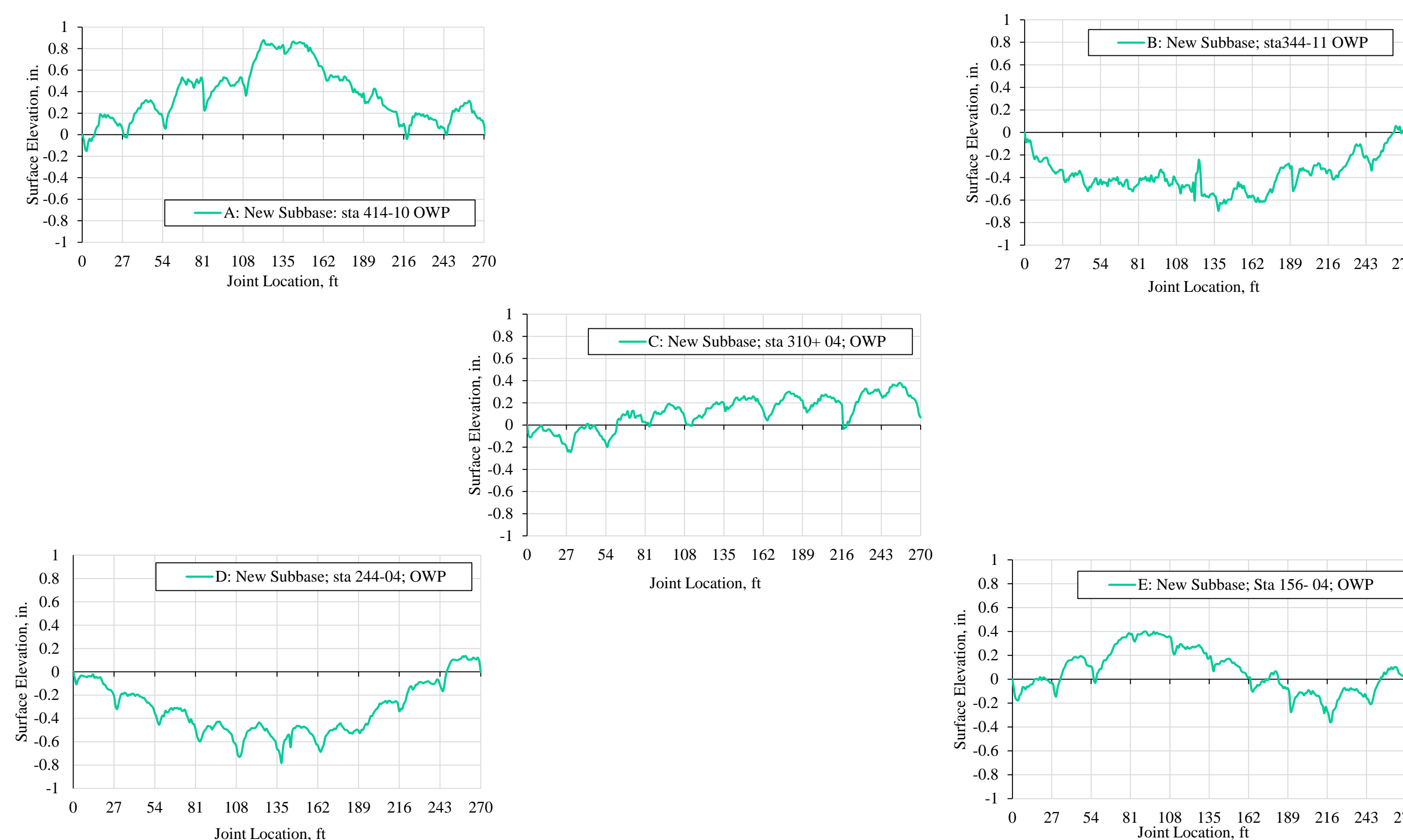


Fig.4 Permanent joint settlement from Dipstick surface elevation profiles in 2016

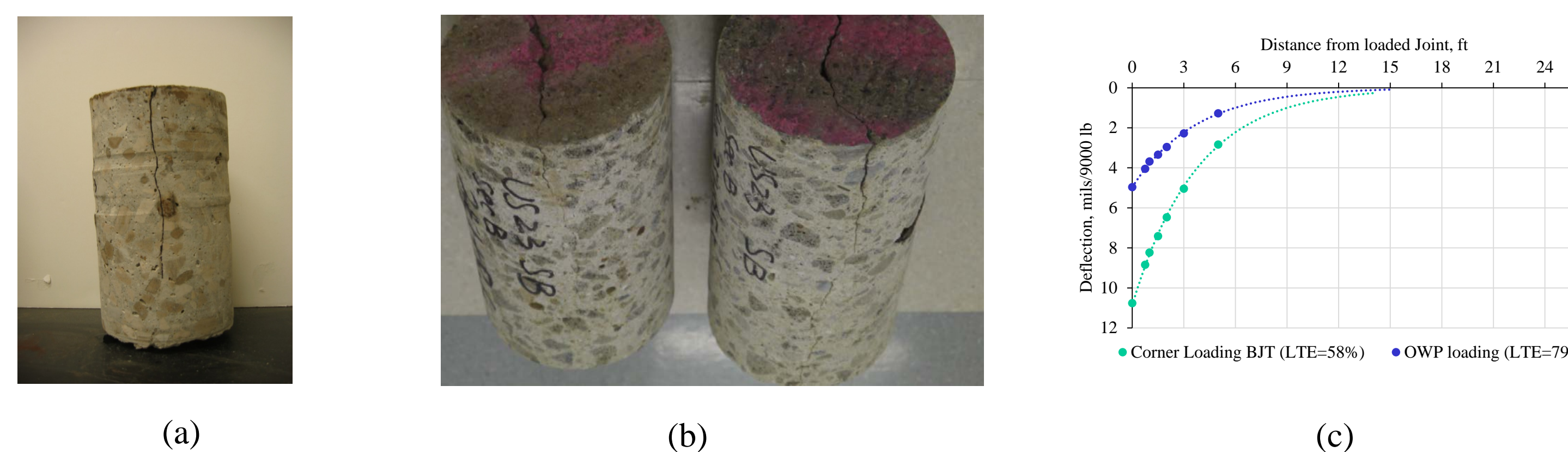


Fig. 5 Cores from section A(a) and B(b) illustrating Top-Down mid-slab crack development and (c) slab bending from FWD loading (9000 lb) at joint in Section A (2006)

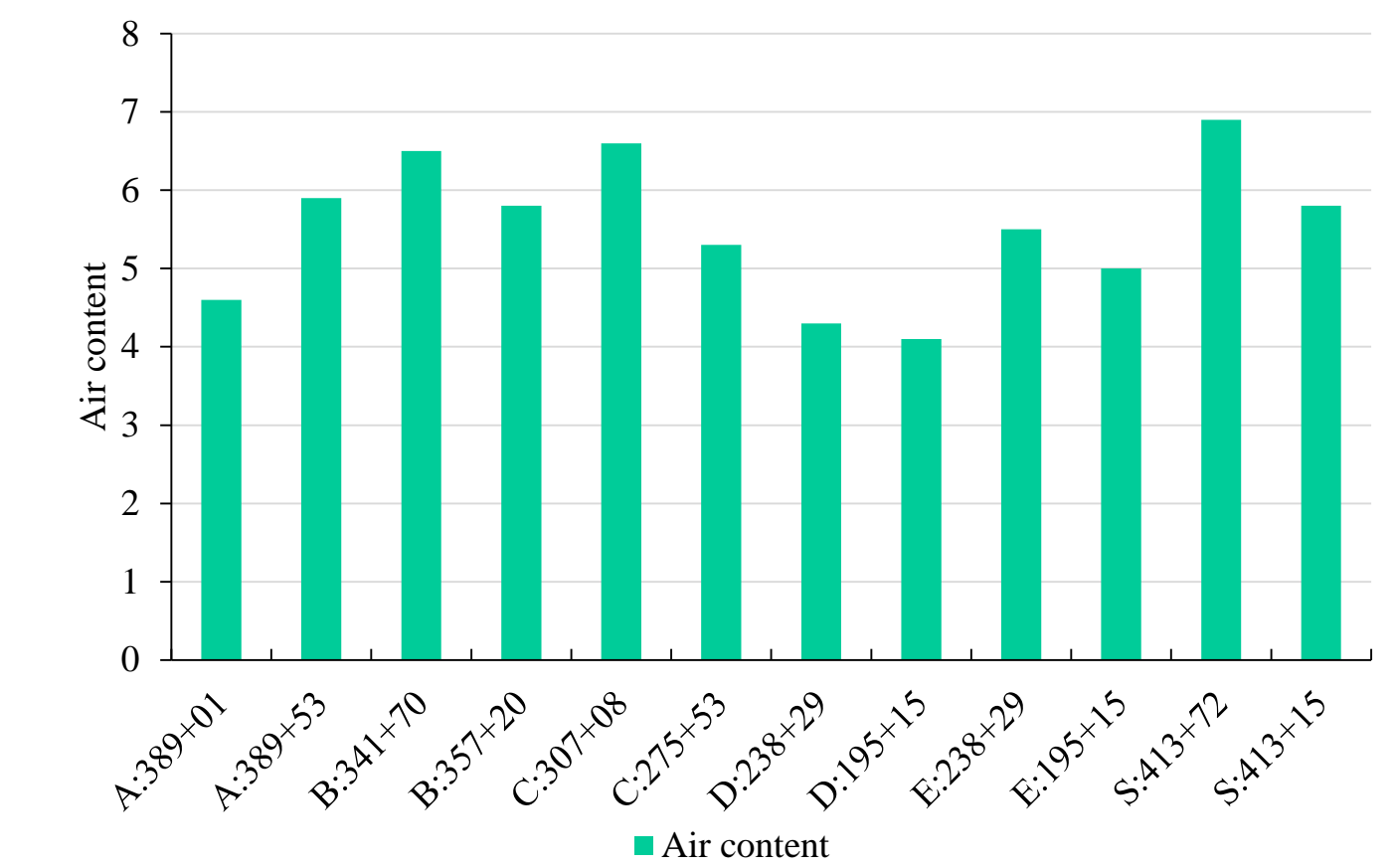


Fig.6 All sections including shoulder(S) concrete have air content (ASTM C 457) by point count (2016)

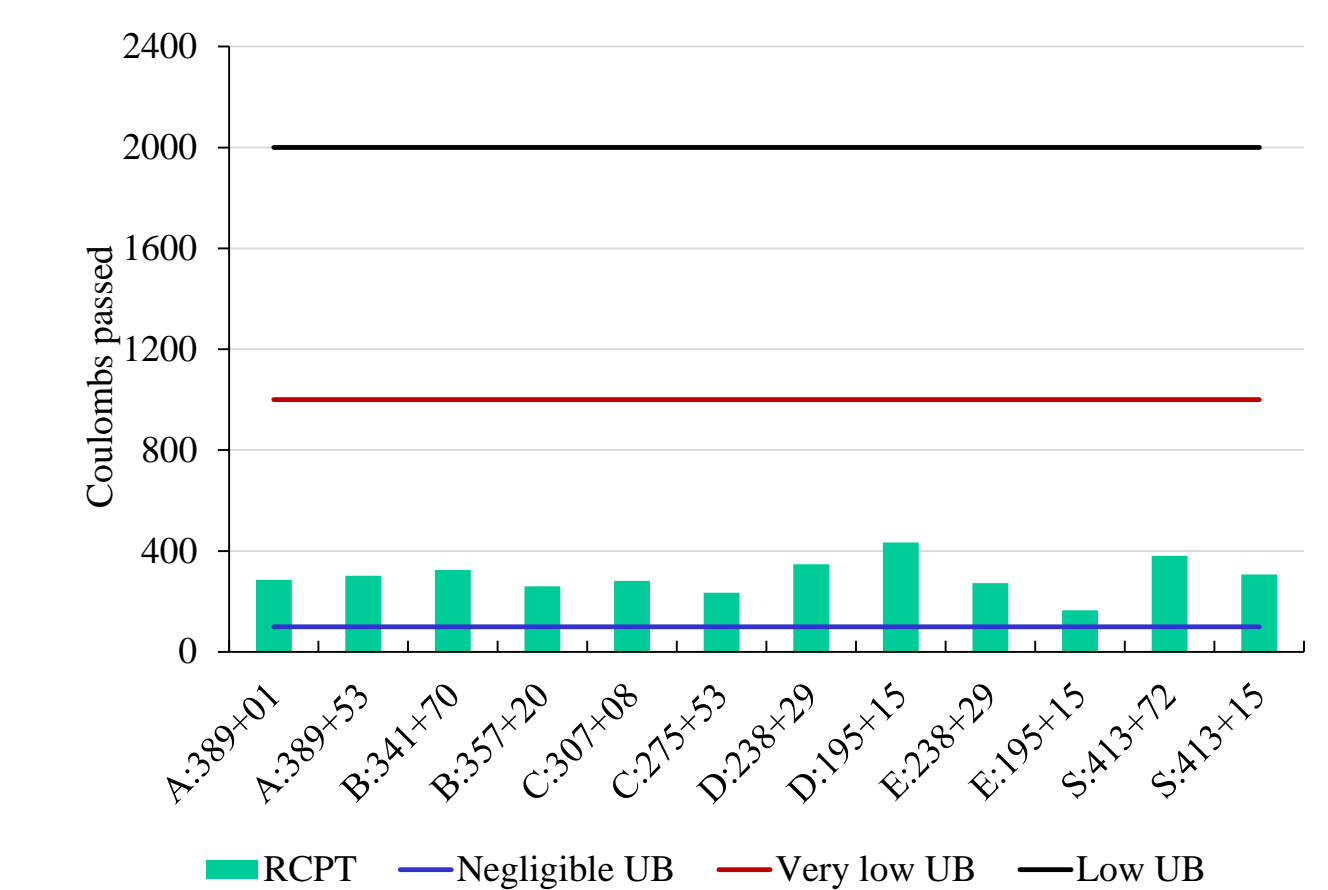


Fig. 7 Permeability of the concrete after 23 years in-service is in the very low category.

Conclusions

- Excellent long-term concrete joint durability was achieved. Validation of total air content and rapid chloride permeability (RCPT) values after 23 years in-service support these findings.
- Despite the pavement design (i.e. 27 ft JRCP) anticipating transverse cracking, most sections (A, D & E) report insignificant amount of mid-slab cracking during 23 years in-service. One section (B), however, reported only 6% of slabs with zero transverse cracking and spalling within 6 years (94% of slabs with at least one transverse crack) Section B required mid-panel full-depth repairs at 20 years in-service.
- Mid-slab cracking was found to be top-down. This cracking mode is expected from an increased slab bending associated with the permanent settlement of 0.1-0.2 inches found for all sections at the transverse joints. Despite this, three sections (A, D & E) developed insignificant slab cracking.