

Edge effects in propagation tests

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ABSTRACT: Guidelines suggest beams with lengths around 1 m for Extended Column Tests (ECTs) and Propagation Saw Tests (PSTs). The longest unstable tests published thus far have been about 3 m. We define unstable tests as “ECTP/ECTPV” or “PST End” with a cut length ≤ 50 cm. To examine edge effects and other biases, we performed 157 ECTs and PSTs with beams lengths 1-10 m. On days with unstable 1 m tests, we then made hi-speed or hi-definition video recordings of tests on beams 2-10 m long, including 33 tests on beams ≥ 5 m, with markers inserted for particle tracking. We found that: 1) stability increased with test length (Figure 1); 2) collapse was greater at the ends of the beams than in the center (Figure 2 and 3); 3) collapse amplitudes in the longer tests were consistent with the shorter tests and did not reach a constant value (Figure 2); 4) collapse wavelengths in the longer tests were around 3 m, 2X greater than what is predicted by the anticrack model. We conclude that the short tests had greater edge effects than the long tests, and these edge effects decreased stability. Spatial variability in the longer tests also likely increased stability. We suggest that longer tests could be used in addition to shorter tests to reduce false unstable results. We were also able to track collapse amplitude in tests done in the same area over an 11-12 day period. We found an average decrease of 0.65 mm/day due to strengthening of the weak layer. We also experimented with centered PSTs (CPSTs, i.e. notch in the center of the beam), and found that, as predicted by the anticrack theory, the critical length doubled.

KEYWORDS: crack propagation, Extended Column Test, Propagation Saw Test

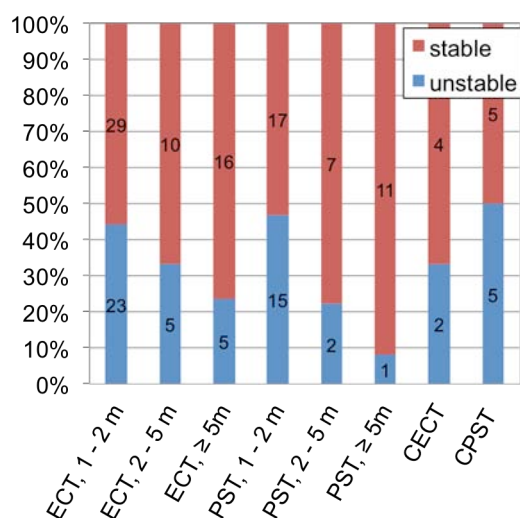


Figure 1 Propagation summary chart. Stacked columns are percentages of unstable/stable tests. Each stacked column refers to a type of test and beam length, e.g. “ECT, 1 – 2 m” are Extended Column Tests with 1 – 2 m beams. CECTs and CPSTs are centered tests, triggered from the center rather than the edge of the beam. Numbers inside stacked columns are the number of stable/unstable tests.

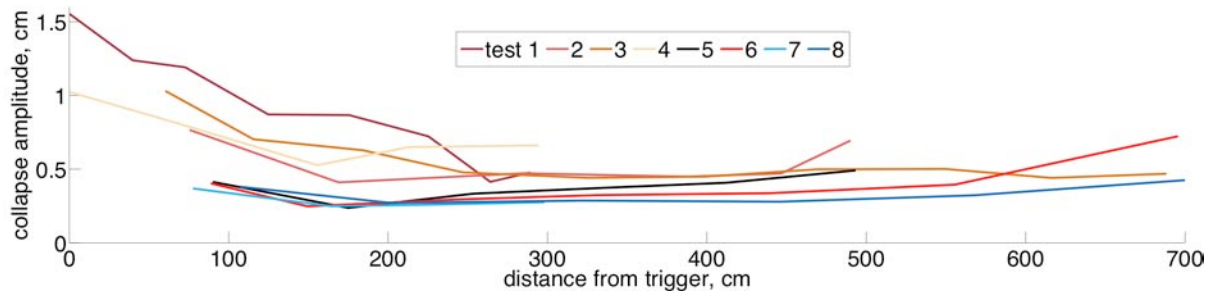


Figure 2 Collapse vs. distance from trigger for ECTs of different lengths. Collapse values in this plot are total displacements after movement stopped. The 8 tests shown were all done over an 11-12 day period on the same failure layer.

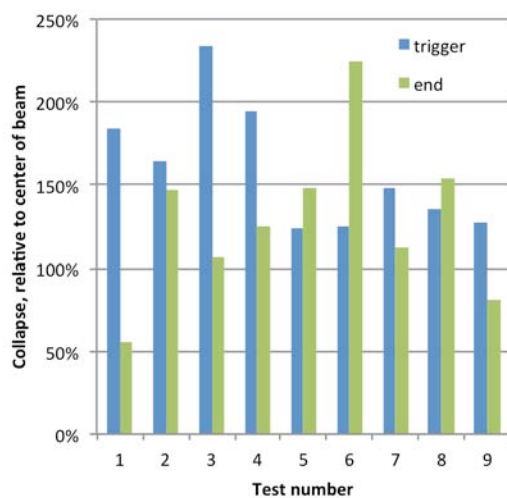


Figure 3 Edge collapse, relative to center of beam. "Trigger" refers to markers near the trigger and "end" refers to markers at the opposite end of the beam from the trigger. These are the same ECTs shown in Figure 2, plus and additional PST (test 9).