



Figure 3. Representative fractured spliced bar test specimens. Top: Bar fracture away from the coupler. Bottom: Bar fracture at indentation in bar created by the wedges internal to the coupler.

Comparison to AC133 Type 1 Requirements

AC133 Type 1 Cyclic Endurance Requirements. AC133 acceptance criteria for Type 1 (Section 4.2.3), mechanical splices requires that each spliced bar test specimen survive the cyclic loading of Stage 1 without breaking. All spliced bar specimens summarized in Table 6 survived the prescribed number of cycles for Stage 1 without breaking.

AC133 Type 1 Residual Slip Requirements. AC133 acceptance criteria for Type 1 mechanical splices also requires that residual slip, u_{20} , be determined at the end of Stage 1 (refer to AC133 Figure 1). While Table 6 of AC133 has no numeric criteria for residual slip for Type 1 splices, the value has been recorded from the digital recording and summarized in each stress-slip plot provided in Appendix E.

AC133 Type 1 Tensile Strength Requirements. AC133 acceptance criteria (Section 4.2.3 and subsequently Section 4.2.1) for Type 1 mechanical splices requires that the spliced bar specimens develop, in tension, a strength of 125 percent of specified yield strength f_y of the bar. This corresponds to a value of 75 ksi ($1.25 \times 60 \text{ ksi} = 75 \text{ ksi}$) for ASTM A615 Grade 60 and ASTM A706 Grade 60 reinforcement, both of which have a specified yield strength of 60 ksi minimum. The tensile strength of all spliced bar specimens summarized in Table 6 meets the AC133 tensile strength requirements for a Type 1 mechanical splice assembled with ASTM A615 Grade 60 reinforcing bars and also with ASTM A706 Grade 60 reinforcing bars.

Preload Slack. AC133 Section 3.2.3 requires that all types of splices be assessed for preload slack. Our observations related to preload slack are summarized in each stress-slip plot provided in Appendix E. We believe that none of the Wellsys Type D splices in this test program exhibited any observable preload slack.

Comparison to ACI 318-19 Requirements

ACI 318-19 Compression Strength Requirements. Section 18.2.7.1(a) of ACI 318-19 requires that a Type 1 splice develop, in compression, at least 125 percent of the specified yield strength, f_y , of the bar. This corresponds to a value of 75 ksi ($1.25 \times 60 \text{ ksi} = 75 \text{ ksi}$) for ASTM A615 Grade 60 and ASTM A706 Grade 60 reinforcing bars. The compressive strength of all spliced specimens summarized in Table 5 meets the Type 1 tensile strength requirements according to ACI 318-19.

Section 18.2.7.1(b) of ACI 318-19 requires that a Type 2 splice develop, in compression, at least 125 percent of the specified yield strength of the bar. This corresponds to a value of 75 ksi ($1.25 \times 60 \text{ ksi} = 75 \text{ ksi}$) ASTM A615 Grade 60 and ASTM A706 Grade 60 reinforcing bars. The compressive strength of all spliced specimens summarized in Table 5 meets the Type 2 compressive strength requirements according to ACI 318-19.

ACI 318-19 Tensile Strength Requirements. Section 18.2.7.1(a) of ACI 318-19 requires that a Type 1 splice develop, in tension, at least 125 percent of the specified yield strength, f_y , of the bar. This corresponds to a value of 75 ksi ($1.25 \times 60 \text{ ksi} = 75 \text{ ksi}$) for ASTM A615 Grade 60 and ASTM A706 reinforcing bars. The tensile strength of all spliced specimens summarized in Table 6 meets the Type 1 tensile strength requirements according to ACI 318-19.

Section 18.2.7.1(b) of ACI 318-19 requires that a Type 2 splice develop, in tension, at least 125 percent of the specified yield strength of the bar and also be capable of developing the specified tensile strength, f_u , of the bar. This corresponds to a value of 75 ksi ($1.25 \times 60 \text{ ksi} = 75 \text{ ksi}$) and 80 ksi ($1.0 \times 80 \text{ ksi}$) for ASTM A615 Grade 60 and ASTM A706 Grade 60 reinforcing bars. The tensile strength of all spliced specimens summarized in Table 6 meets the Type 2 tensile strength requirements according to ACI 318-19.

SUMMARY

Wiss, Janney, Elstner Associates, Inc. conducted a series of tests on reinforcing bar mechanical splices for Wellsys. The tests were conducted on the Wellsys Type D coupler system for use with ASTM A615 Grade 60 and ASTM A706 Grade 60 steel reinforcing bars in U.S. Customary sizes No. 4, 11, and 18. During monotonic compression tests, all spliced bar specimens met or exceeded the specified minimum compressive strength requirements of AC133 (August 2022) for Type 1 mechanical splices when used with ASTM A615 Grade 60 and ASTM A706 Grade 60 reinforcement. During reversed-load cyclic tests, all specimens survived the cyclic loading as prescribed by AC133. No noticeable preload slack was observed in any spliced bar test specimen prior to the application of test load. These specimens were then loaded in monotonic tension to fracture. The tensile strength after cycling of all spliced bar specimens exceeded minimum tensile strength requirements of AC133 for Type 1 mechanical splices when used with ASTM A615 Grade 60 and ASTM A706 Grade 60 reinforcement. The tensile strength after cycling of all spliced bar specimens exceeded minimum tensile strength requirements of ACI 318-19 for Type 1 and Type 2 mechanical splices when used with ASTM A615 Grade 60 and ASTM A706 Grade 60 reinforcement.