

C2/C3J Coupler Weld Evaluation for ACI-349 and AISC-N690 Requirements Public Meeting

July 16, 2015

Outline

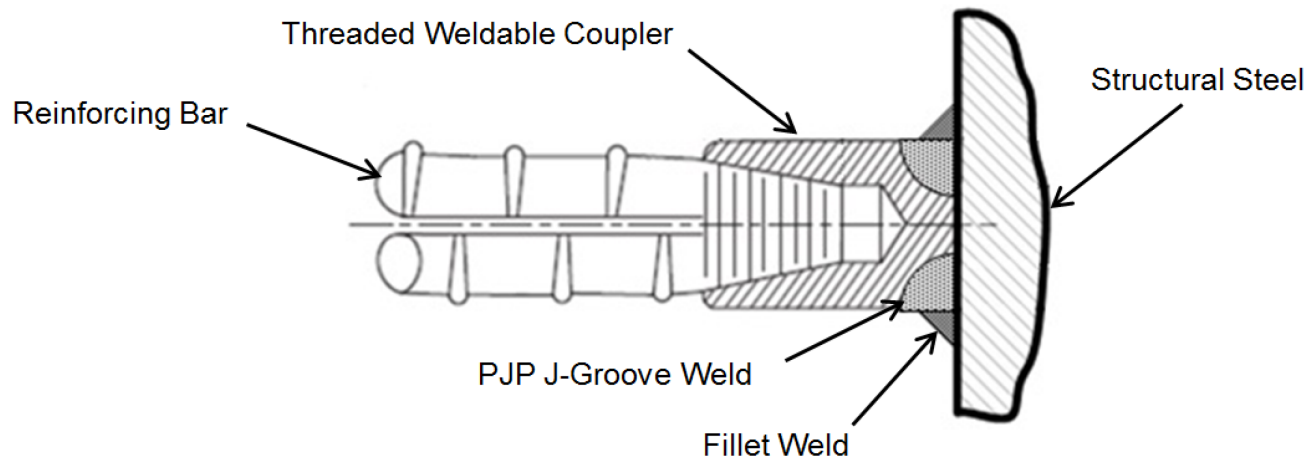
- Objectives
- Background
- Problem Statement
- Applicable Code Requirements
- Determination of the Weld Acceptance Criteria
- Licensing Basis Impact

Objectives

- Propose path for the determination of acceptance criteria for the Coupler PJP Weld with Fillet Reinforcement qualification
- Communicate Approach to Resolve Issue

Background

- Weldable couplers are utilized in the AP1000 design where reinforcing bars are attached to structural steel
- The coupler mechanical connection system consists of a reinforcing bar threaded at the end, a mechanical coupler, and a weld
- The coupler welds are a PJP J-Groove with fillet reinforcement



Lenton® C2/C3J Coupler

Background

- The design function of the couplers is to mechanically anchor reinforcing bars to structural steel.
- As specified in UFSAR subsection 3.8.4.5, “Structural Criteria,” the analysis and design of concrete and structural steel conform to ACI 349-01 and AISC N690-1994, respectively.

Problem Statement

- Design calculations invoked load directionality for coupler welds using PJP J-Groove with fillet reinforcement
- Weld design criteria are found in AISC N690 and AWS D1.1
 - Provisions for load directionality are not provided in AISC N690 or AWS D1.1 codes for PJP welds
- When load directionality is removed from calculations, an approach is needed to demonstrate coupler weld capacity for the 125% ACI-349 strength evaluation
 - Neither AISC-N690 nor ACI-349 explicitly define the acceptance criteria for the weld
 - In order to demonstrate coupler weld capacity, a comparison is performed between 125% of specified yield strength of rebar and the strength of the weld

An approach is needed to determine the appropriate acceptance criteria

Applicable Code Requirements

- ACI 349-01 125% strength requirement:
 - Section 12.14.3.4 - A full mechanical connection shall develop in tension or compression, as required, at least 125% of specified yield strength f_y of the bar.
- ACI-349 requirements for mechanical anchorage in Section 12.6 reference Appendix B
 - Section 12.6.2 - Mechanical anchorages shall be designed in accordance with Appendix B - Steel Embedments
 - ACI 349-01 Appendix B does not provide weld requirements
- AISC-N690-1994 Section Q1.22 provides requirements for design of steel embedments permitted by ACI 349 Appendix B, including welds
- AISC-N690 Section Q1.22.2 provides requirements for justification of stress limits by testing
 - Section Q1.22.2.1.2 - Design limits less conservative than those specified in this section may be used by the Engineer if substantiated by experimental or detailed analytical investigation.
- AISC-N690 Table Q1.5.7.1 defines load combinations and applicable SLCs
 - Table does not provide a SLC for the 125% strength comparison

Coupler Weld Code Discussion

- AISC N690 Load Combination Evaluation
 - Rebar assumed to be fully utilized for each load combination (i.e. $0.9f_y$)
 - Welds are evaluated using the SLC applicable to the load combination
 - All coupler welds are found to be adequate (previously discussed)
- ACI 349 125% Specified Yield Strength of Rebar Evaluation
 - Neither AISC nor ACI explicitly defines the acceptance criteria for this evaluation
 - The appropriate weld capacity for the 125% loading is proposed to be determined through: (Reference AISC-N690 Section Q1.22.2)
 - Testing to demonstrate appropriate weld capacity and acceptable margins
 - Testing the coupler, weld, reinforcement bar system
 - Testing the coupler weld to failure
 - This approach is being reviewed and vetted by industry experts

Safety Margin

- The as found condition and the proposed change have adequate safety margin
- Intent of ACI 349 is met as the mechanical coupler system (including the weld) meets the 125% yield strength requirement and the weld is stronger than the rebar to ensure design is ductile
 - Weld is not the weak link in the design
 - The test results support a higher weld capacity and demonstrate that the margin in the design is adequate to satisfy the yield strength requirements in the CLB

Licensing Basis Impact

- Since codes do not explicitly define the acceptance criteria for the 125% yield strength comparison, it will be proposed to add it to the CLB.
 - UFSAR Tier 2* Section 3.8.4.5.1 “Supplemental Requirements for Concrete Structures”
 - Applicable to C2/C3J coupler welds