
PART VI
Appendix N
Prequalification of Beam-Column and
Link-to-Column Connections

N.1 Scope

This Appendix contains minimum requirements for prequalification of beam-to-column moment connections in special moment frames (SMF), intermediate moment frames (IMF), and link-to-column connections in eccentrically braced frames (EBF). Prequalified connections are permitted to be used, within the applicable limits of prequalification, without the need for further qualifying cyclic tests. When the limits of prequalification or design requirements for prequalified connections conflict with the requirements of these Provisions, the limits of prequalification and design requirements for prequalified connections shall govern.

N.2 General Requirements

N.2.1 Basis for Prequalification

Connections shall be prequalified based on test data satisfying Section N.3, supported by analytical studies and design models. The combined body of evidence for prequalification must be sufficient to assure that the connection can supply the required interstory drift angle for SMF and IMF systems, or the required link rotation angle for EBF, on a consistent and reliable basis within the specified limits of prequalification. All applicable limit states for the connection that affect the stiffness, strength and deformation capacity of the connection and the seismic load resisting system (SLRS) must be identified. These include fracture related limit states, stability related limit states, and all other limit states pertinent for the connection under consideration. The effect of design variables listed in Section N.4 shall be addressed for connection prequalification.

N.2.2 Authority for Prequalification

Prequalification of a connection and the associated limits of prequalification shall be established by a connection prequalification review panel (CPRP) approved by the authority having jurisdiction.

N.3 Testing Requirements

Data used to support connection prequalification shall be based on tests conducted in accordance with Appendix Q. The CPRP shall determine the number of tests and the variables considered by the tests for connection prequalification. The CPRP shall also provide the same information when limits are to be changed for a previously prequalified connection. A sufficient number of tests shall be performed on a sufficient number of nonidentical specimens to demonstrate that the connection has the ability and reliability to undergo the required interstory drift angle for SMF and IMF and the required link rotation angle for EBF, where the link is adjacent to columns. The limits on member sizes for prequalification shall not exceed the limits specified in Appendix Q, Section Q.5.2.

N.4 Prequalification Variables

In order to be prequalified, the effect of the following variables on connection performance shall be considered. Limits on the permissible values for each variable shall be established by the CPRP for the prequalified connection.

- (1) Beam or link parameters:
 - (a) Cross-section shape: wide flange, box, or other.
 - (b) Cross-section fabrication method: rolled shape, welded shape, or other.
 - (c) Depth.
 - (d) Weight per foot.
 - (e) Flange thickness.
 - (f) Material specification.
 - (g) Span-to-depth ratio (for SMF or IMF), or link length (for EBF)
 - (h) Width thickness ratio of cross-section elements.
 - (i) Lateral bracing.
 - (j) Other parameters pertinent to the specific connection under consideration.
- (2) Column parameters:
 - (a) Cross-section shape: wide flange, box, or other.
 - (b) Cross-section fabrication method: rolled shape, welded shape, or other.
 - (c) Column orientation with respect to beam or link: beam or link is connected to column flange, beam or link is connected to column web, beams or links are connected to both the column flange and web, or other.
 - (d) Depth.
 - (e) Weight per foot.
 - (f) Flange thickness.
 - (g) Material specification.
 - (h) Width-thickness ratio of cross-section elements.
 - (i) Lateral bracing.
 - (j) Other parameters pertinent to the specific connection under consideration.
- (3) Beam (or link)—column relations:
 - (a) Panel zone strength
 - (b) Doubler plate attachment details
 - (c) Column-beam (or link) moment ratio

(4) Continuity plates:

- (a) Identification of conditions under which continuity plates are required
- (b) Thickness, width and depth
- (c) Attachment details

(5) Welds:

- (a) Location, extent (including returns), type (CJP, PJP, fillet, etc.) and any reinforcement or contouring required
- (b) Filler metal classification strength and notch toughness
- (c) Details and treatment of weld backing and weld tabs
- (d) Weld access holes: size, geometry and finish
- (e) Welding quality control and quality assurance beyond that described in Appendix O, including the nondestructive testing (NDT) method, inspection frequency, acceptance criteria and documentation requirements

(6) Bolts:

- (a) Bolt diameter
- (b) Bolt grade: ASTM A325, A490, or other
- (c) Installation requirements: pretensioned, snug-tight, or other
- (d) Hole type: standard, oversize, short-slot, long-slot, or other
- (e) Hole fabrication method: drilling, punching, sub-punching and reaming, or other
- (f) Other parameters pertinent to the specific connection under consideration

(7) Workmanship: All workmanship parameters that exceed AISC, RCSC and AWS requirements, pertinent to the specific connection under consideration, such as:

- (a) Surface roughness of thermal cut or ground edges.
- (b) Cutting tolerances.
- (c) Weld reinforcement or contouring.
- (d) Presence of holes, fasteners or welds for attachments.

(8) Additional connection details:

All variables pertinent to the specific connection under consideration, as established by the CPRP.

N.5 Design Procedure

A comprehensive design procedure must be available for a prequalified connection. The design procedure must address all applicable limit states within the limits of prequalification.

N.6 Prequalification Record

A prequalified connection shall be provided with a written prequalification record with the following information:

- (a) General description of the prequalified connection and drawings that clearly identify key features and components of the connection.
- (b) Description of the expected behavior of the connection in the elastic and inelastic ranges of behavior, intended location(s) of inelastic action, and a description of limit states controlling the strength and deformation capacity of the connection.
- (c) Listing of systems for which connection is prequalified: SMF, IMF, or EBF
- (d) Listing of limits for all prequalification variables listed in Section N.4.
- (e) Listing of demand critical welds.
- (f) Definition of the region of the connection that comprises of the protected zone.
- (g) Detailed description of the design procedure for the connection, as required in Section N.5.
- (h) List of references of test reports, research reports and other publications that provided the basis for prequalification.
- (i) Summary of quality control and quality assurance procedures.

PART VI
Appendix O
Quality Assurance Plan

O.1 Scope

Quality control (QC) and quality assurance (QA) shall be provided as specified in this Section.

O.2 Inspection and Nondestructive Testing Personnel

Visual welding inspection and nondestructive testing (NDT) shall be conducted in accordance with a written practice by personnel qualified in accordance with Appendix S.

Bolting inspection shall be conducted in accordance with a written practice by qualified personnel.

O.3 Contractor Documents

The following documents shall be submitted for review by the engineer of record or designee, prior to fabrication or erection, as applicable:

- (1) Shop drawings.
- (2) Erection drawings.
- (3) Welding Procedure Specifications (WPS), which shall specify all applicable essential variables of AWS D1.1 and the following, as applicable.
 - (a) power source (constant current or constant voltage).
 - (b) for demand critical welds, electrode manufacturer and trade name.
- (4) Copies of the manufacturer's typical certificate of conformance for all electrodes, fluxes and shielding gasses to be used. Certificates of conformance shall satisfy the applicable AWS A5 requirements.
- (5) For demand critical welds, applicable manufacturer's certifications that the filler metal meets the supplemental notch toughness requirements, as applicable. Should the filler metal manufacturer not supply such supplemental certifications, the contractor shall have the necessary testing performed and provide the applicable test reports.
- (6) Manufacturer's product data sheets or catalog data for SMAW, FCAW and GMAW composite (cored) filler metals to be used. The data sheets shall describe the product, limitations of use, recommended or typical welding parameters, and storage and exposure requirements, including baking, if applicable.