ICBO Evaluation Service, Inc.
A subsidiary corporation of the International Conference of Building Officials
5360 WORKMAN MILL ROAD • WHITTIER, CALIFORNIA 90601-2299 • (562) 699-0543
FAX (562) 695-4694

ACCEPTANCE CRITERIA FOR DUCTILE CONNECTORS IN PRECAST CONCRETE SPECIAL MOMENT RESISTING FRAMES

AC41

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PREFACE

Evaluation reports issued by the ICBO Evaluation Service, Inc. (ICBO ES), are based upon performance features of the *Uniform Building Code*™, ICBO *Uniform Mechanical Code*™ and related codes. Section 104.2.8 of the *Uniform Building Code* is the primary charging section upon which evaluation reports are issued. Section 104.2.8 reads as follows:

> The provisions of this code are not intended to prevent the use of any material, alternate design or method of construction not specifically prescribed by this code, provided any alternate has been approved and its use authorized by the building official.
>
> The building official may approve any such alternate, provided the building official finds that the proposed design is satisfactory and complies with the provisions of this code and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in suitability, strength, effectiveness, fire resistance, durability, safety and sanitation.
>
> The building official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use. The details of any action granting approval of an alternate shall be recorded and entered in the files of the code enforcement agency.

The attached acceptance criteria for the general code sections noted has been issued to provide all interested parties with guidelines on implementing performance features of the codes. The attached acceptance criteria was developed and adopted following public hearings conducted by the Evaluation Committee. If the criteria is an updated version from a previous edition, solid vertical lines (▌) in the outer margin within the criteria indicate a technical change or addition from the previous edition. Deletion indicators (⏵) are provided in the outer margins where a paragraph or item has been deleted if the deletion resulted from a technical change. This criteria may be revised from time to time as the need dictates.

ICBO ES may consider alternate criteria, provided the proponent submits valid data demonstrating that the alternate criteria are at least equivalent to the attached criteria and otherwise meet the applicable performance requirements of the codes. Notwithstanding that a material, type or method of construction, or equipment, meets the attached acceptance criteria, or that it can be demonstrated that valid alternate criteria are equivalent and otherwise meet the applicable performance requirements of the codes, if the material, product, system or equipment is such that either unusual care in its installation or use must be exercised for satisfactory performance, or malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use thereof, ICBO ES retains the right to refuse to issue or renew an evaluation report.

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1.0 INTRODUCTION

Scope: The Acceptance Criteria for Ductile Connectors in Precast Concrete Special Moment Resisting Frames (PC-SMRF) shall encompass both strength and deformation capacity in order to qualify as a PC-SMRF with an R_w=12 as required in Seismic Zones 3 and 4 by Section 1631.2.7 of the 1994 *Uniform Building Code*™. This criteria applies to the connections between the beams and columns in the frame. The design and construction of these beams and columns must comply with applicable portions of the code.

2.0 BASIC INFORMATION REQUIRED

2.1 Description: A detailed description of the connectors, including dimensions, materials, and drawings, and evidence of compliance with physical properties.

2.2 Installation Instructions: Instructions describing placement and inspection.

2.3 Design: Structural design and analysis procedures.

3.0 TESTING

3.1 Testing laboratories shall comply with the ICBO ES Acceptance Criteria for Laboratory Accreditation (AC89).

3.2 Test reports and test specimen sampling shall comply with the ICBO ES Acceptance Criteria for Test Reports and Product Sampling (AC85).

3.3 Test Method: A subassembly, at least one-third scale, shall be subjected to increasing pseudo-cyclic displacements. Loads may be applied by means of hydraulic or mechanical actuators or other acceptable means. The rate of loading may be slow and the loading and unloading phases must be continuous, without intermittent stops and pauses. Starting at an estimated drift less than first yield, at least three cycles at each displacement level shall be used to evaluate strength and stiffness degradation. The load-displacement readings shall be continuously recorded using digital or analog recorders. Each cycle shall be to a displacement no more than 50 percent greater than the previous cycle. The subassembly configuration shall be representative of the expected behavior of the frame. As a minimum, a beam column assembly (cruciform) extending to the anticipated inflection points of the beam and column will be tested.

4.0 CONDITIONS OF ACCEPTANCE

4.1 Strength: The maximum strength of the system shall be at least as great as the calculated nominal axial load, moment and shear strength (P_n, M_n, and V_n, respectively) calculated in accordance with Chapter 19 of the code. The maximum strength of the system shall be no greater than the overstrength factor (λ_o) times the calculated nominal strength. The overstrength factor is dependent on the system and considers overstrength characteristics of the yielding material, with a minimum value of 1.25.

4.2 Deformation: The system shall have the ability to deform to a story drift of at least 4 percent (three cycles) while retaining at least 80 percent of the maximum strength achieved during the preceding cycles.

4.3 Energy Dissipation: The energy dissipated per cycle shall be at least three-eighths that of an equivalent elastoplastic system.

5.0 QUALITY CONTROL

Ductile Connectors in Precast Concrete Special Moment Resisting Frames must be manufactured under a quality control program with inspections by a quality control agency accredited by ICBO ES or a compliance assurance/inspection agency recognized by the National Evaluation Service (NES). A quality control manual, jointly developed by the applicant and the agency, complying with the ICBO ES Acceptance Criteria for Quality Control Manuals (AC10), must be submitted.