

Background

This proposal was originally prepared for Part 1 of the Provisions as a change to ASCE 7-05, Section 11.1.4. The proposal was prepared in response to a growing interest in performance-based design and its use to develop alternate designs that are equivalent to prescriptive code provisions. The Provisions Update Committee wants to encourage development of construction equivalent to that provided by prescriptive provisions but that may have advantages in economy, construction speed, or performance. Lack of guidance on methods of approval for such submittals may discourage creation of review processes in some jurisdictions.

The voting by the BSSC membership included many concerns about the use of ATC 63 methodologies prior to completion of the project and/or prior to complete vetting of its recommendations, concerns about the approval methods for components and products on a smaller scale than full building systems, and comments about the lack of specificity in the suggestion approval processes. Although IT1 developed complete responses to these comments, the majority of the committee recommended interim placement in Part 3 of the Provisions. Due to the high interest and need for guidance on approval of submittals under the Alternate Means section, it is recommended that this or a similar change be considered for inclusion into ASCE 7 as soon as possible.

PROPOSAL IT1-3R (2008)

SCOPE: Part 3 Proposed Exceptions to ASCE 7-05 Sec 11.1.4 For Further Study

PROPOSAL FOR CHANGE:

Rearrange 11.1.4.1, add new Sec 11.1.4.2

11.1.4 Alternate materials, design, and methods of construction.

11.1.4.1 **General.** The provisions of this standard are not intended to prevent the use of any material, alternate design method, or alternate method of construction not specifically prescribed, provided that any such alternate has been approved and its use authorized by the authority having jurisdiction. The authority having jurisdiction may approve any such alternate, provided that the authority finds that the alternate is satisfactory and complies with the intent of the provisions of this standard, and that the alternate is, for the purpose intended, at least the equivalent of that prescribed in this standard in suitability, effectiveness, durability, and seismic resistance.

11.1.4.2 Approval of proposals under Sec 11.1.4. Nothing in this section shall limit the ability of the authority having jurisdiction to develop general requirements for proposals under Sec. 11.1.4 or specific requirements for particular components or systems, such as acceptance of reports from evaluation services or other demonstration of equivalence as specified in Sec 11.1.4.1. In the absence of such criteria, the approval process shall include the following elements:

11.1.4.2.1 Peer Review. Peer review of the preliminary submittal, final design, and/or construction documents.

1 **11.1.4.2.2 Preliminary Submittal.** *A submittal of a detailed description and, if applicable, design*
2 *criteria for the alternate material or method, for approval by the authority having jurisdiction,*
3 *prior to application for a building permit.*

4 **11.1.4.2.3 Structural Design Criteria.** *For submittals requesting use of alternate materials,*
5 *alternate design methods, or alternate methods of construction for the complete seismic force*
6 *resisting system, a structural design criteria shall be included based on the seismic performance*
7 *for the Performance Category as described in the International Code Council Performance*
8 *Code, 2006, that is equivalent to the Occupancy Category of the building.*

9 *The design criteria submittal shall demonstrate how the required seismic performance will be*
10 *met by generally following one of the two methods described below:*

11 *1. Nonlinear procedures described in ASCE/SEI 41-06 Seismic Rehabilitation of Existing*
12 *Buildings.*

13 *2. Probabilistic, nonlinear analysis methods of ATC 63, "Recommended Methodology for*
14 *Quantification of Building System Performance and Response Parameters," FEMA*
15 *P695, 90% Draft. Using these methods, it shall be demonstrated that for the required*
16 *performance objectives, there is an acceptably low probability of not reaching the*
17 *specified performance level, given the specified ground motion.*

18 **11.1.4.2.4. Nonstructural Design Criteria.** *For seismic protection of nonstructural components*
19 *not part of a designated seismic systems, the design shall demonstrate that the components and*
20 *systems are capable of remaining secured to the structure and will not generate life-threatening*
21 *debris under Design Earthquake Ground Motion. For designated seismic systems and*
22 *components of such systems, the design shall demonstrate that the components and systems will*
23 *be capable of remaining functional following design level shaking. The procedures of Sec.*
24 *13.2.5 and 13.2.6 may be applied as satisfactory fulfillment of these requirements.*

25 26 27 **Commentary**

28 29 **C11.1.4 Alternate materials, design, and methods of construction.**

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31 **11.1.4.1.** The seismic design provisions contained in this standard prescribe a series of analytical
32 procedures to derive the minimum permissible seismic resistance for buildings, structures and
33 components. This resistance is primarily expressed in terms of minimum permissible strength to
34 resist seismic forces in combination with other loads as well as an ability to limit, through
35 stiffness, damping, hysteretic behavior and other means, the lateral drifts experienced under
36 ground shaking. These strength and drift control criteria are tied to a series of design factors
37 including site seismicity, occupancy and use, configuration, materials of construction, and, types
38 of detailing incorporated into the design to provide for reliable inelastic response characteristics.
39 These prescriptive requirements and their limits of applicability have been developed over a
40 period of more than 100 years of observation of the actual performance of buildings and other
41 structures in earthquakes, together with extensive laboratory and analytical research into the
42 seismic behavior of structures.

43
44 While the developers of the standard believe that conformance with its prescriptive provisions
45 constitute a reliable means of designing buildings and structures that will provide acceptable
46 performance in future earthquakes, it is recognized that other means and methods may also result

1 in appropriate designs. Further, a rigid requirement that the design of all buildings and structures
2 conform to the prescriptive requirements of the standard would inhibit the development of new
3 structural systems and design methods that could represent substantial improvements over
4 existing systems and procedures currently contained in the standard.

5
6 Accordingly, this Section permits the use of alternative materials, design and methods of
7 construction to those covered by the prescriptive provisions. Designers using these alternative
8 means should do so with a thorough understanding of the intended earthquake performance of
9 buildings and structures under this Standard, as well as the performance characteristics of the
10 structure being designed and the uncertainties associated with attempting to assess the likely
11 performance of a structure using analytical means. In general, designers employing these
12 alternative procedures should anticipate that they will expend considerably more effort than
13 would be required to follow the prescriptive procedures. Further, designers should be aware that
14 the use of these alternative means is subject to the approval of the authority having jurisdiction,
15 who ultimately, but be satisfied the resulting design will provide performance equivalent or
16 superior to that which would be obtained if the prescriptive provisions were applied. This
17 process will inherently entail greater review by the building official and/or his designated peer
18 reviewers.

19
20 Designers should also recognize that use of alternative means of design under this section may
21 inherently open the designer to greater potential liability in the event of poor structural
22 performance than if the prescriptive provisions were followed. If a building that is designed
23 prescriptively fails to meet the intended performance in some way, the designer can usually
24 avoid liability if it can be demonstrated that the design conformed to the standard of care, which
25 generally can be met by conforming to the prescriptive requirements of the standard. For
26 designs that are intentionally conducted using alternative means, the standard of care will be less
27 clear and the mere fact that a structure failed to meet the performance expectations may be
28 interpreted by some as proof that the design was in some way negligent.

29
30 Section 11.1.4.2 specifies minimum procedures that should be followed when a design using
31 alternative means is conducted. An independent third party review by persons with the
32 appropriate expertise (11.1.4.2.1) is essential to this process. When a new structural material,
33 system or design technique is used, there are many opportunities for the designer, no matter how
34 knowledgeable or skilled, to overlook important aspects of the structure's likely behavior or to
35 mischaracterize this behavior. Independent review by parties with appropriate expertise can help
36 to identify such oversights before they result in the construction of a structure that will not be
37 able to perform properly. Further, since, many building departments and authorities having
38 jurisdiction do not have adequate expertise to judge the acceptability of new approaches, the
39 presence of an appropriate external review can help to assure the authority having jurisdiction
40 that the design is appropriate.

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42 Peer reviews may be conducted by one person or by a team of persons who together provide the
43 appropriate knowledge and skills to provide meaningful review. Areas of expertise should
44 include understanding of the performance intent of the Standard, knowledge of seismic hazards
45 and ground motions for the region in which the structure is to be constructed, knowledge of
46 earthquake behavior of structural systems, nonlinear dynamic analysis, laboratory research and

1 construction techniques. Although the peer reviewer may identify means of improving a design
2 and make specific design suggestions, the design professional of record remains the ultimate
3 authority with regard to the details of the design and must continue to be responsible for the
4 design's adequacy.

5
6 Section 11.1.4.2.2 requires that as part of the design process, the design professional of record
7 produce a written of the design, the intended performance objectives, the procedures and
8 acceptance criteria to be used to demonstrate acceptable performance capability. The design
9 professional of record, peer review and authority having jurisdiction should reach agreement on
10 these aspects of the design early in the design process in order to minimize the potential for
11 misunderstandings and disagreements as the design nears completion, as to whether the design
12 meets acceptable standards.

13
14 Section 11.1.4.2.3 references three authoritative documents as acceptable means of
15 demonstrating that a design will conform to the performance criteria inherent in this standard.
16 Many engineers who have used these procedures have deviated from the specific requirements of
17 these authoritative documents. Such deviations should be acceptable, provided that the reasons
18 for such deviation are sound and that the peer reviewers and authorities having jurisdiction
19 concur that appropriate acceptable criteria will be used.

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21 **REASON FOR PROPOSAL:**

22 To provide guidance to authorities having jurisdiction of acceptable approval processes for
23 submittals under the "Alternate Means and Methods" provision of the *Provisions*. Hesitation to
24 accept such submittal due to lack of approval procedures will stifle innovation and development
25 of new systems with improved performance or lower construction cost. In jurisdictions that
26 normally accept such proposals for review, procedures are used similar to those described in this
27 proposal. Due to the wide range of potential submittals, it is not possible to construct a
28 definitive prescriptive process, but guidance in the body of the *Provisions* will encourage
29 development of local policies.