PROPOSAL 8-44R-A (2009)

SCOPE: Table 15.4-1

PROPOSAL FOR CHANGE:

Revise Table 15.4-1 to Part 1 of the 2009 *Provisions*:

Table 15.4- 1 Seismic Coefficients for Nonbuilding Structures Similar to Buildings

Nonbuilding Structure Type	Required Detailing Provisions	R	Ω_0	C_d	Structural System and Height Limits (ft)[a, e]				
					A &B	C	D	E	F
Steel Storage Racks	15.5.3	4	2	3.5	NL	NL	NL	NL	NL
Building frame systems:									
Composite steel and concrete concentrically braced frames	14.3	5	2	4 ½	NL	NL	160	160	100
With permitted height increase	14.3	3	2	3	NL	NL	400	400	240
Ordinary steel concentrically braced frame	AISC 341	3 ¼	2	3 ¼	NL	NL	35[b]	35[b]	NP[b]
With permitted height increase	AISC 341	2 ½	2	2 ½	NL	NL	160	160	100
With unlimited height	AISC 350	1.5	1	1.5	NL	NL	NL	NL	NL

REASON FOR PROPOSAL:

This proposal is a revision to proposal 8-44. This proposal permits an increase in height limits if a lower R is used for design. In response to comments from Hamburger and Saunders who requested that the R value be changed from 4 to 3 which has been done. Trading off an increase of height limits for lower R values is permitted by other systems in Table 15.4-1. These new increased height limits are needed to permit construction of certain types of needed nonbuilding industrial structures.

Since the last PUC meeting in April when the resolution of comments for this proposal were voted, the Applied Technology Council published its 90% draft of the ATC-63 Project Report. While the project only studied a few structural system types, it did draw some pertinent conclusions relative to this proposal. The following is a statement from Section 9.2.8 of the draft report.

"Table 9-7 also showed a more important and disturbing trend, that the adjusted collapse margin ratio (ACMR) decreased (higher collapse risk) with increasing height. Haselton (2006) showed that this poor performance is caused by damage at localizing more taller moment frames (MRFs); this is driven primarily by higher P-Delta effects as the building height increases. This issue could be addressed in various ways. More conservative beam-column strength rations could be developed for taller buildings, in order to cause the damage to spread more uniformly over the height of the building. To reduce P-Delta effects, more restrictive height limits could be imposed. Strength requirements could be increased for taller buildings, by using a period dependent R factor; in a recent paper, Krawinkler and Zareian (2007) illustrated how the R factor would need to change, as a function of period, in order to create uniform collapse probabilities for moment frame buildings of varying height."

While the ATC-63 project only studied moment frames, it is rational and logical to conclude that the same types of increases in strength would be required for braced frame structure with longer periods and increased heights. This is exactly what is provided in Table 15-4.1 of ASCE 7-05. Krawinkler and Zareian (paper is provided an attachment to this Proposal) suggest that for tall buildings, the special moment frame R values of 8 be divided by a factor of 2. A reduction of the R value by a factor of slightly less than 2 is exactly what we are doing in this revised proposal. It should be noted that the factor they suggest is somewhat nonlinear depending on the starting R value. TS-8 is of the opinion, that the ATC-63 project has provided sufficient justification for the concept of trading off increased strength (reduced R) for permitted increases in height. The current proposed values are still based on judgment, but with more technical understanding then previously. It is hoped that future ATC-63 type studies will provide better justification for higher R values than those currently provided and proposed for Table 15.4-1.

TS 8 VOTE:

YES-6 Yes with Reservations-1 No-0 Not Voting-4 Abstain-1

TS-8 members Soulages, Dowty, Lake, and Haupt did not vote because they were on vacation. Their votes/comments will be forwarded when received.

Yes with Reservations

Philip Caldwell - Yes with Reservations and would change my vote to Yes as follows: The change in height limits proposed for nonbuilding structures in SDC D and higher appears to be based solely on expert judgment without the benefit of empirical knowledge gained from such structures during earthquakes or specialized studies such as the ATC-63 project. Is their more foundation to provide better insight into the basis of design to allow for a consistent application of these proposals by the structural design professional?

TS-8 Response - Current height limits and restrictions for structural systems are generally based on observed performance (empirical data) of structural systems in past earthquakes. However, one factor that has not entered these decisions is the impact of significant changes of design strength on these height limits and restrictions. In the past 10 years there have been several changes in required strengths along with increasing in detailing requirements for many structural systems.

Fortunately (or perhaps from a scientific bent unfortunately) there have been no earthquakes that would permit us to find out how new structures designed to these new criteria perform. However, a rational approach to establish R values along with appropriate height limits and restrictions was the primary motivation for the new ATC-63 project. To develop such a project was quite difficult and the members of the ATC-63 project should be applauded for their efforts.

However, the approach they have developed is very dependent on the broadness of the range of example structures they consider in their evaluations. Ordinary systems which have very broad ranges are especially difficult to evaluate since they are virtually unrestrained in geometry and physical design. To do proper ATC-63 evaluations for these types of systems will be quite costly and time consuming. At this point NIST is planning to fund some additional follow-up ATC-63 type studies (ATC-76) but none are focused on the systems that are the subject of this proposal. And the effort required to do a full ATC-63 type evaluation is far beyond that which can be done by the volunteer labor of current code committees. We look forward to the time when such funding is made available and such proper evaluations are performed based on the ATC-63 project methodology.

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