If you've ever asked yourself "why" about something related to structural steel design or construction, *Modern Steel Construction's* monthly *Steel Interchange* column is for you!

Change in *R* Values

(from November 2003)

There are several changes related to *R* (response modification coefficient) values. For example, the *R* value for Ordinary Steel Moment Frames changed from 4.0 (IBC 2000) to 3.5 (IBC 2003). What are the major reasons for these changes of *R* values?

Uksun Kim, Ph.D.
Georgia Institute of Technology

There are differences between the SMF, IMF, and OMF provisions in IBC 2000 (which references the 1997 AISC *Seismic Provisions*) and IBC 2003 (which references the 2002 AISC *Seismic Provisions*). IBC 2000 and the 1997 AISC *Seismic Provisions* had all three as tested assemblies with target story drifts of 4 percent, 3 percent and 2 percent, respectively. In IBC 2003 and the 2002 AISC *Seismic Provisions*, these systems were reclassified as follows:

SMF is a tested assembly that can provide an interstory drift of 4 percent

IMF is a tested assembly that can provide an interstory drift of 2 percent

OMF is a prescriptive assembly as described in the AISC *Seismic Provisions* that has demonstrated 2 percent

So, the changes boil down to (years referenced correspond to the referenced version of the AISC *Seismic Provisions*):

- SMF are essentially similar in both documents
- The 1997 IMF no longer exists
- The tested version of the 1997 OMF became the 2002 IMF
- The prescriptive version of the 1997 OMF and the 2002 OMF are essentially similar

Extending this explanation to FEMA 350, the FEMA 350 OMF corresponds to the 2002 AISC *Seismic Provisions* IMF, as explained in the last paragraph of Commentary Section C9 in the 2002 AISC *Seismic Provisions*. The FEMA 350 SMF corresponds to the 2002 AISC *Seismic Provisions* SMF.

Charles Carter, S.E., P.E.
Chief Structural Engineer, AISC

Weathering Steel

What are some design considerations for using ASTM A588 weathering steel? Should the steel be painted?

Question sent to the AISC Steel Solutions Center

United States Steel (USS) Corporation has a product called USS COR-TEN B that is available in ASTM A588. The following is an excerpt from some literature from USS regarding design considerations for USS COR-TEN:

Design Considerations

✔ Surfaces of COR-TEN Steel that are wet for prolonged periods of time will corrode at an unacceptably rapid rate. Therefore, the detailing of members and assemblies should avoid pockets, crevices, faying surfaces or locations that can collect and retain liquid water, damp debris and moisture. Damp debris on COR-TEN Steel surfaces will cause accelerated corrosion. In addition to these precautions, *all* interior surfaces, including faying surfaces, not boldly exposed to the weather *must* be protected by paint.

✔ Surfaces of COR-TEN Steel members and assemblies that are not boldly exposed to the atmosphere are subject to moisture accumulation from numerous sources including capillarity and condensation. The designer must, therefore, exercise extreme care in the detailing of such elements, to assure absolutely no possibility of moisture entrapment. All such unexposed surfaces, including faying surfaces, are to be treated as if they were carbon steel and must be protected by paint.

✔ Hollow steel members should be sealed to prevent entry of moisture. If this is not possible, provisions must be made to insure adequate drainage and ventilation so that the potential for entrapped moisture and accelerated corrosion is eliminated. Furthermore, if the member or structure is inaccessible for inspection and maintenance, protection of the interior surfaces should be considered. Those structures which are accessible may be left bare but the areas *must* be periodically inspected for evidence of corrosion. The frequency of inspection is to be established by the designer due to the many variables which influence the protective oxide. Should excessive corrosion become apparent, the steel must be cleaned and protected with paint.

✔ All COR-TEN Steel surfaces which are to be covered by caulking or gaskets must be painted before being covered. This is to insure a positive seal and to provide adequate protection against corrosion of the steel that is covered. If this is not done the COR-TEN Steel will corrode at an unacceptably rapid rate. See "Painting" section.

✔ To minimize "oil canning" in large, slat assemblies, the minimum recommended thickness for bare COR-TEN Steel application is 18 gage (0.0478 inches, or 1.2 mm).

✔ For structural joints where high-strength bolts are desired, ASTM A325, Type 3 bolts (COR-TEN X) must be used. Where lower strength bolts are satisfactory, bolts of either COR-TEN A Steel or stainless steel are suitable. Galvanized steel nuts and bolts are *not* suitable for use in time, the zinc coating will be consumed, leaving an exposed carbon-steel fastener which is less resistant to atmospheric corrosion than the COR-TEN Steel.

Painting

The paint requirements for the COR-TEN steels do not differ from those for carbon steels. In locations where the outdoor environment is aggressive, the same quality paint systems found effective in protecting carbon steel are recommended for the COR-TEN steels. As noted earlier, environments which prevent proper oxide formation require the same surface protection against the effects of moisture as do carbon steel surfaces. Similar requirements apply where faying surfaces and bolted joints are involved, and where COR-TEN steel surfaces are likely to be in contact with other structural materials. To achieve the effectiveness of the protective coating selected, the stringent rules of surface preparation must be adhered to. While the designer must specify the paint system for the particular environment, the following are two examples of paint systems which have been found readily available and generally acceptable under most environmental conditions.

- ✔ A one-coat system consisting of a high-quality air-drying rust-inhibitive shop-primer which is applied to a nominal dry film thickness of 1.5 to 2 mils.
- ✔ A two-coat baked system consisting of 0.2 to 0.25 mils of a rust-inhibitive primer such as epoxy chromate followed by a top coat of synthetic-resin paint such as a polyester, acrylic or alkyd applied to a total dry film-thickness of 1.0 mils.

However, for prolonged exposure to water, the coating system should be upgraded to that of a tank lining.

More information can be found at **www.ussteel.com**. Alternatively, information about weathering steel from Bethlehem Steel can be found at

www.intlsteel.com/PDFs/products/weather.pdf

Keith Mueller, Ph.D.
AISC Steel Solutions Center

Blast Effects

Reprint of FAQ 12.1.4 at www.aisc.org/faq

What are the damaging effects of explosions to structures?

Conventional structures, in particular those above grade, are susceptible to damage from explosions, because the magnitudes of design loads are significantly lower than those produced by most explosions. For example, design snow loads in the Midwest range from about 5 psf to about 50 psf. The peak pressure in the blast pulse produced by 10 lb of TNT at a range of about 50′ is approximately 2.4 psi (which is 348 psf!) with a duration of the positive phase of 7.7 ms. Conventional structures normally are not designed to resist blast loads.

Recent terrorist attacks demonstrate the types of damage that can be produced. The 1993 terrorist attack on the World Trade Center in New York City removed several thousand square feet of concrete floor slabs in the general area of the explosion and severely damaged several buildings' communication, transportation and utility systems. Due to the inherent redundancy of the steel frames, the structures did not collapse.

The 1995 attack on the Alfred P. Murrah Federal Building in Oklahoma City revealed the vulnerability of conventional structural designs when subjected to blast loads. When a weapon is located at street level, the blast shock wave acts up against the underside of the floor slabs at upper stories. Floor slabs are not designed for this magnitude and direction of load-for this direction of load, the reinforcement is in the wrong place.

Note: For more information on blast and progressive collapse resistance in steel, see the October and November 2003 issues of Modern Steel Construction *at www.modernsteel.com.*

newquestion

Steel Interchange Mailbag

From: Curious Reader
Sent: December 2003
To: solutions@aisc.org
Subject: Conformance Demonstration

According to Section 9.2b (special moment frames) of the 2002 AISC *Seismic Provisions*, conformance demonstration is required for all beam-to-column connections used in the seismic force resisting system. According to Section 15.4 (eccentrically braced frames) of the 2002 AISC *Seismic Provisions*, conformance demonstration is required for link-to-column connections in eccentrically braced frames. What prequalified connections are available to designers?

Do you have an answer? Contact AISC's Steel Solutions Center (information below). For a limited time, receive a free "magic eight-ball" (for life's *other* decisions) if your response to a question posted in *Steel Interchange* is printed in *Modern Steel Construction.*

Steel Interchange is an open forum for *Modern Steel Construction* readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine.

The opinions expressed in *Steel Interchange* do not necessarily represent an official position of the American Institute of Steel Construction, Inc. and have not been reviewed. It is recognized that the design of structures is within the scope and expertise of a competent licensed structural engineer, architect or other licensed professional for the application of principles to a particular structure.

If you have a question or problem that your fellow readers might help you to solve, please forward it to us. At the same time, feel free to respond to any of the questions that you have read here. Contact *Steel Interchange* via AISC's Steel Solutions Center:

Steel SolutionsCenter
Your connection to ideas + answers

One East Wacker Dr., Suite 3100
Chicago, IL 60601
tel: 866.ASK.AISC
fax: 312.670.9032
solutions@aisc.org