ASTM A615 Grade 75 Reinforcing Steel

When, Why & How to Use It

By Clifford W. Schwinger, P.E.

Most deformed reinforcing steel used in cast-in-place concrete construction today is ASTM A615 Grade 60 reinforcing steel.

When the American Society for Testing and Materials (ASTM) first adopted their *Standard for Billet-Steel Reinforcement Bars* in 1911, there were three grades of deformed bars – Structural Steel Grade (specified yield strength, f_y= 33 kips per square inch, ksi), Intermediate Grade (f_y = 40 ksi) and Hard Grade (f_y = 50 ksi). Today ASTM A615 recognizes four grades of deformed reinforcing bars, Grade 40, Grade 60, Grade 75 and the newly added Grade 80.

Just as Grade 40 reinforcing was replaced by Grade 60 steel, and ASTM A992 steel has replaced ASTM A36 steel for the design of structural steel W shape members, it is the author's opinion that Grade 75 – or more likely Grade 80 reinforcing steel – may someday be used exclusively in place of Grade 60 steel for larger bar sizes. Until that happens, designers should consider using Grade 75 reinforcing steel when appropriate. This article discusses the reasons, advantages and conditions for specifying ASTM A615 Grade 75 steel.

Code Issues

The American Concrete Institute's ACI 318-08, Section 3.5.3.1 specifies acceptable types of deformed reinforcing bars, of which ASTM A615 steel is one. Section 3.5.3.2 notes that when the specified yield strength, f_y, is greater than 60 ksi, the yield strength must be taken as the stress corresponding to a strain of 0.35 percent. The reason for this requirement is that reinforcing steels with yield strengths greater than 60 ksi sometimes exhibit neither a well-defined yield point nor the classic flat-line plastic zone on the stress-strain curve after yield. The addition of vanadium to increase strength is one of the contributors to this behavior. Because of the possibility of this behavior, ACI 318 imposes the additional requirement for computing the yield stress to insure that the yield strength determined by the ASTM A615 procedures do not unconservatively overestimate yield strength. Designers specifying Grade 75 steel must specify that the material has a yield strength no less than 75 ksi as measured by both the ASTM A615 and ACI 318 Section 3.5.3.2 procedures. Reinforcing steel producers manufacturing ASTM A615 Grade 75 steel may not automatically check the yield strength as required by ACI 318 Section 3.5.3.2, unless specifically required to do so.

Shear stirrups, shear friction reinforcing steel and torsional reinforcement are limited to f_y = 60 ksi. Likewise, the yield strength for bonded reinforcing steel in unbonded prestressed concrete members is limited to f_y = 60 ksi. The maximum specified yield strength of reinforcing steel in special moment frames and special structural walls in seismic load resisting systems is limited to 60 ksi, and the actual yield strength of the reinforcing steel in those elements must not exceed the specified yield strength by more than 18 ksi.

Why not use Grade 80 reinforcing steel?

Grade 80 reinforcing steel is new material that was added to the ASTM A615 Specification in 2009. The availability of Grade 80 steel is limited. Designers contemplating the use of Grade 80 steel must confirm its availability and cost premium.

If mechanical splice couplers are to be used, designers must also confirm the availability of couplers strong enough for use with Grade 80 bars.

Availability of Grade 75 Reinforcing Steel

Grade 75 reinforcing steel is manufactured when there is a sufficient demand for it. Reinforcing steel manufacturers do not warehouse large quantities of Grade 75 bars, and the lead time for obtaining it can be as long as three or four months. Planning by the project team is essential to insure timely delivery of Grade 75 bars. Designers contemplating using Grade 75 steel should discuss this idea with the construction manager or the general contractor early in the design, to insure that the material can be ordered in time so as not to delay the project. Most mills require a minimum quantity of each bar size to justify its production. Minimum order sizes vary from mill to mill, depending on the sizes of the furnaces in each mill. Furnaces vary from 45 tons to 250 tons in capacity. The furnaces produce steel in heat lots which are cast into billets. The billets are re-heated and rolled into the reinforcing bars. Some mills will break heat lots into billets for several different bar sizes.

Rules-of-Thumb for Specifying Grade 75 Reinforcing Steel

- Specify Grade 75 when there are at least 100 tons required for each bar size for which Grade 75 will be used.
- Use Grade 75 in columns, shear walls, foundations and flexural members for #9 and larger bars.

- When Grade 75 bars are used for particular bar sizes, all bars of those sizes on the project should be Grade 75.

Cost Savings

Steel is a commodity. Its price fluctuates. The mill cost for steel is only a fraction of the total installed cost. The total installed cost of reinforcing steel is the sum of the mill cost, detailing and fabricating costs, shipping cost and installation cost.

At the time this article was written, the mill cost of #11 Grade 60 bars was about $800 per ton and the premium for Grade 75 was about $40 per ton. The total installed cost of reinforcing steel varies significantly around the country, but on average it is about $2,000/ton. The $40/ton premium for Grade 75 bars adds only 2 percent to the total installed cost. Although these costs are approximate, they illustrate the small difference between the installed costs of Grade 60 and Grade 75 reinforcing steel.

The primary reason to use Grade 75 is that it has 20 percent more strength than Grade 60, and allows a 20 percent reduction in the amount reinforcing steel required. The slightly greater cost per ton (2 percent) is more than offset by the material savings (20 percent), yielding a net cost savings of about 18 percent. The time and effort it takes designers to make the switch is negligible compared to the significant savings realized.

Engineers planning to specify Grade 75 bars should take the following steps early in design:

- Estimate the tonnage of each Grade 75 bar size and confirm that there are sufficient quantities to justify mill production of the material.
- Discuss the plan to use Grade 75 reinforcing steel with the construction manager or general contractor so that they can place the mill order early.

Advantages

The ability to significantly reduce cost is reason alone to specify Grade 75 reinforcing steel. Other advantages include reduced congestion and, for columns and shear wall chord reinforcing, the possibility of fewer column ties due to fewer vertical bars. From a sustainability perspective, there are also green benefits (e.g., less steel used equals fewer carbon emissions) to using Grade 75, regardless of whether or not the use of this material qualifies for Leadership in Energy and Environmental Design (LEED) points.

Other Considerations

Tension lap splices for Grade 75 bars are proportionally longer than for Grade 60 reinforcing bars. If mechanical splice couplers are used for tension splices, then those couplers must be capable of developing 1.25 x Fy of the bars (ACI 318, Section 12.14.3.2). Grade 75 steel cannot be used in seismic load resisting systems utilizing special moment frames or special structural walls (ACI 318, Section 21.1.5.2)▪

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