ITG-6R-10

Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete

Reported by ACI Innovation Task Group 6

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This guide provides recommendations on design provisions for the use of ASTM A1035/ASTM1035M Grade 100 (690) deformed steel bars for reinforced concrete members. The recommendations address only those requirements of ACI 318-08 that limit efficient use of such steel bars. Other code requirements are not affected.

This guide includes a discussion of the material characteristics of Grade 100 (690) ASTM A1035/A1035M deformed steel bars and recommends design criteria for beams, columns, slab systems, walls, and footings for Seismic Design Category (SDC) A, B, or C, and also for structural components not designated as part of the seismic-force-resisting system for SDC D, E, or F.

Keywords: bar; concrete; design; guide; high-strength steel; structural.

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CHAPTER 1—INTRODUCTION

1.1—Objective

This guide provides design provisions for the use of ASTM A1035/A1035M Grade 100 (690) deformed steel bars for reinforced concrete structural members. This guide addresses only those requirements in ACI 318-08 that limit the more efficient use of such steel bars, and should not affect the application of other code requirements.

1.2—Scope

This guide includes a discussion of the material characteristics of ASTM A1035/A1035M steel bars and recommends design criteria for beams, columns, slab systems, walls, and footings for Seismic Design Category (SDC) A, B, or C. For a lack of adequate data, the application of this guide for SDC D, E, or F is limited to slab systems, foundations, and structural components not designated as part of the seismic-force-resisting system but explicitly checked for the induced effects of the design displacements. The only exception is the use of transverse reinforcement for concrete confinement with a specified yield strength, f_y, up to 100,000 psi (690 MPa) for special moment frames, special structural walls, and coupling beams as permitted by Section 21.1.5.4 of ACI 318-08. Refer to Section 10.1 of this guide for more information on seismic design considerations. Shells and folded plate members and prestressed concrete are beyond the scope of this guide. Design examples are included to illustrate design procedures and proper application of the design criteria. Modifications to these design criteria may be justified where the design adequacy within the scope of this guide is demonstrated by successful use, analysis, or test.

1.3—Historical perspective and background

For several decades, the design of structural concrete was restricted to using specified yield strength, f_y, of 60,000 psi (410 MPa) or less for reinforcing bars. Section A603(e) of ACI 318-56 specified that "Stress in tensile and compressive reinforcement at ultimate load shall not be assumed greater than the yield point or 60,000 psi, whichever is smaller."

Section 1505 of ACI 318-63, specified two requirements:

> "(a) When reinforcement is used that has a yield strength, f_y, in excess of 60,000 psi, the yield strength to be used in design shall be reduced to $0.85f_y$ or 60,000 psi, whichever is greater, unless it is shown by tension tests that at a proof stress equal to the specified yield strength, f_y, the strain does not exceed 0.003;
>
> (b) Designs shall not be based on a yield strength, f_y, in excess of 75,000 psi. Design of tension reinforcement shall not be based on a yield strength, f_y, in excess of 60,000 psi unless tests are made in compliance with Section 1508(b)."
>
> The Commentary on Section 1505 of ACI 318-63 states that "This section provides limitations on the use of high strength steels to assure safety and satisfactory performance. High strength steels frequently have a strain at yield strength or yield point in excess of the 0.003 assumed for the concrete at ultimate. The requirements of Section 1505(a) are to adjust to this condition.
>
> The maximum stress in tension of 60,000 psi without test is to control cracking. The absolute maximum is specified as 75,000 psi to agree with present ASTM specifications and as a safeguard until there is adequate experience with the high stresses."

Then the Commentary on Section 1508 of ACI 318-63 states that

> "When the design yield point of tension reinforcement exceeds 60,000 psi, detailing for crack control becomes even more important. Entirely acceptable structures have been built, particularly in Sweden, with a design yield strength approaching 100,000 psi but more design criteria for crack control and considerable American practical experience with