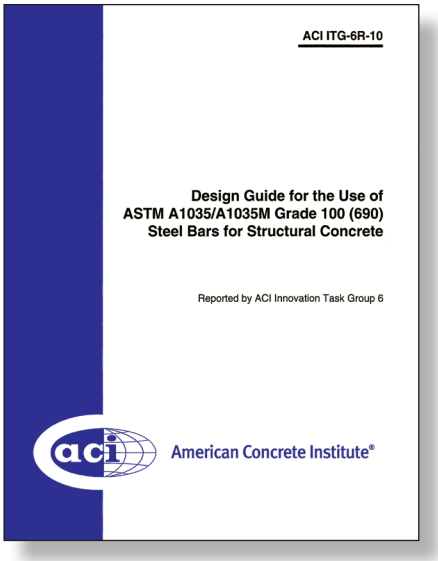
DESIGN GUIDE FOR THE USE OF MMFX$_2$ GRADE 100 (690) IN BUILDING STRUCTURES

ACI ITG06 DESIGN GUIDE FOR THE USE OF ASTM A1035/A1035M GRADE 100 (690) STEEL BARS FOR STRUCTURAL CONCRETE

Authored by the ACI Innovative Task Group 6 and published in August 2010 by the American Concrete Institute, this guide provides recommendations on design provisions for the use of ASTM A1035/ASTM1035M Grade 100 (690) high-strength deformed steel bars for reinforced concrete members. The guide was developed to specifically address certain requirements in ACI 318-08 that limit the efficient use of high-strength steel bars and only addresses those limitations. 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.

For high seismic areas, the application of this guide is currently 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 to this, is the use of transverse reinforcement for concrete confinement with specified yield strength (f_y) up to 100,000 psi (690 MPa) as permitted by Section 21.1.5.4 of ACI 318-08.

Design examples are included as part of this document to illustrate design procedures and proper applications of the recommended design criteria. Also included as part of these design examples are commentaries, which are provided to highlight the differences in design when using ASTM A1035 high-strength steel bars as opposed to the conventional ASTM A615 steel bars.

This document is available in Electronic PDF and can be purchased directly from the ACI Bookstore www.concrete.org/bookstorenet/.

MMFX STEEL

AVAILABILITY

REBAR: #3 - #11, #14, & #18
COIL: #3 & #4

SMOOTH ROUND DOWELS:
1-1/4 & 1-1/2 inch diameter

CUSTOM MILL-CUT LENGTHS:
Available by special order of 25 tons or greater and a minimum length of 20'

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The following design guidelines for use of MMFX$_2$ Grade 100 (690) steel bars for structural concrete are presented herein based on the recommendations of the ACI ITG 06 report. Please refer to the ACI guide for more details on these recommendations:

- A simplified design method is recommended for flexural tension, based on an idealized elasto-plastic stress-strain curve with a yield plateau at f_y = 100 ksi (690 MPa).
- The tension-controlled and compression-controlled strain limits and the strength reduction factor ϕ are adjusted to ensure satisfactory member behavior. The adjusted tension and compression strain limits are 0.009 and 0.004 respectively, and the adjusted strength reduction factor ϕ is given by the following equation:

  $$0.65 \le (\phi = 0.45 + 50\varepsilon t) \le 0.9$$
- Flexural and direct compression, f_y is taken as 80,000 ksi (550 MPa).
- Moment redistribution for flexural design using MMFX$_2$ reinforcement is not recommended.
- Flexural design using MMFX$_2$ Grade 100 (690) bars with f_y = 100,000 psi (690 MPa) would result in higher steel stress at service load conditions; designer should exercise caution in applying the ACI 318-08 provisions on crack and deflection controls.
- For shear design of beams, MMFX$_2$ Grade 100 (690) bars may be used as shear reinforcement with specified yield strength (f_{yt})= 80,000 psi (550 MPa).
- Development and splice length for MMFX$_2$ reinforcement in tension may be determined by Eq. (12-1) of ACI 318-08 provided the splice is confined.
- Design of slab systems using MMFX$_2$ Grade 100 (690) steel bars should follow the provisions in Chapter 11 of ACI 318-08 for shear in one-way slabs and Chapter 13 for two-way slabs.
- If shear reinforcement is required to provide sufficient shear strength for a two-way slab system, the f_{yt} for shear reinforcement should be limited to 60,000 psi (410 MPa) .
- There are no exceptions from the requirements of ACI 318-08 for designs of columns, walls, footings and pile caps, and mat foundations using MMFX$_2$ reinforcement other than the adjustments of f_y for tension and compression reinforcements, and f_{yt} for shear reinforcement, similar to the values used for beam design.
- The recommended specified yield strengths for design of various structural members using MMFX$_2$ reinforcement are summarized for convenient reference in Table 1.

Table 1 - Specified yield strengths for design of members using MMFX$_2$ reinforcement

	Longitudinal reinforcement (f_y)		Transverse reinforcement (f_{yt})		
Type of member	Tension, psi (MPa)	Compression, psi (MPa)	Shear, psi (MPa)	Torsion, psi (MPa)	Confinement, psi (MPa)
Beams and one-way slabs	100,000 (690)	80,000 (550)	80,000 (550)	60,000 (410)	N/A
Columns	100,000 (690)	80,000 (550)	80,000 (550)	60,000 (410)	100,000 (690)
Tension ties	80,000 (550)	N/A	N/A	N/A	N/A
Compression struts	N/A	80,000 (550)	N/A	N/A	N/A
Two-way slabs	100,000 (690)	80,000 (550)	60,000 (410)	60,000 (410)	N/A
Walls	100,000 (690)	80,000 (550)	80,000 (550)	N/A	100,000 (690)
Footings and pile caps	100,000 (690)	80,000 (550)	80,000 (550)	60,000 (410)	N/A
Mat foundations	100,000 (690)	80,000 (550)	80,000 (550)	N/A	N/A