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Table 1 – Summary of reinforced concrete design changes incorporated in UFC 3-340-02.

Description	References
Increases maximum design support rotation for non-laced reinforced concrete elements under flexural action to 6-degrees.	Section 4-9.2, Section 4-9.3, Section 4-16, Section 4-23.3, Section 4-24, Section 4-25.1, Section 4-25.3, Section 4-26.1 and Section 4-34
Increases maximum design support rotation for non-laced reinforced concrete elements under tension membrane action to 12-degrees.	Section 4-9.3 and Section 4-25.4
Allows use of ASTM A 706 reinforcing bars in lieu of ASTM A 615 reinforcing bars.	Section 4-12.2
Updates and expands dynamic increase factor data for concrete and reinforcing bars.	Section 4-13.2, Figure 4-9a, Figure 4-9b and Figure 4-10
Revises dynamic design stresses for elements with a maximum design support rotation, θ_m, $5^o < \theta_m \leq 6^o$.	Section 4-13.3 (Table 4-2)
Provides new equations for calculating minimum reinforcement ratios for slabs. Equations now explicitly consider the concrete's compressive strength and the reinforcing bar's yield strength.	Section 4-17.3, Table 4-3, Section 4-33.4.2 and Appendix 4A (Example 4A-1, step 6 and Example 4A-4, step 6)
Adds alternate ACI equation for calculating the allowable shear stress on the unreinforced web of an element subjected to flexure only.	Section 4-18.2
Revises diagonal tension design requirements for slabs that are based upon the scaled charge distance.	Section 4-18.3
Updates minimum design shear stresses. In addition, instead of basing requirements upon close-in and far design ranges, requirements are now based upon the scaled charge distance from an element.	Section 4-18.4 and Table 4-4
Revises the equation for allowable ultimate direct shear force, V_d, that may be resisted by the concrete in a slab.	Section 4-19.2 and Section 4-19.3
Adds new sections on tension design requirements in non-laced slabs, laced slabs and beams (previously provided in section 4-68).	Section 4-20A, Section 4-26.3 and Section 4-35A
Significantly revises reinforcing bar development and lap splice requirements. In general, reinforcing bar development and lap splice lengths now calculated in accordance with ACI 318. Supplementary requirements are noted.	Section 4-21 and subsections, Section 4-64, Section 4-65.3 and Section 4-66 subsections
Significantly expands allowable uses of single leg stirrups for diagonal	Section 4-22 and Section 4-32

tension reinforcement in slabs. Provides limits on the use of three different single leg stirrup types (designated as Type A, Type B and Type C).	
Updates figures summarizing design parameters for unlaced and laced elements to incorporate new criteria.	Figure 4-17 and Figure 4-29
Replaces minimum reinforcement ratio guidance with new equations that explicitly consider the concrete's compressive strength and the reinforcing bar's yield strength.	Section 4-38.3 and Appendix 4A (Example 4A-6, step 4d)
Provides new equations for calculating the minimum area of closed ties in columns.	Section 4-48.4
Provides new equations for calculating the minimum area of spiral reinforcement in columns.	Section 4-49.4
Section completely revised to incorporate UFC 3-340-01's procedures for predicting concrete spall and breach. Since UFC 3-340-01 is a limited distribution document, these open distribution procedures were not previously available to the public.	Section 4-55 (including Figure 4-65, Figure 4-65a and Table 4-15a)
Defines Type A, Type B and Type C single leg stirrups and their allowable uses.	Section 4-66.3.1
Section revised to eliminate now duplicate guidance for non-laced slabs, laced slabs and beams (now provided in Section 4-20A, Section 4-26.3 and Section 4-35A, respectively).	Section 4-68
Figures updated to incorporate changes to design criteria.	Figure 4-1, Figure 4-2, Figure 4-18, Figure 4-21, Figure 4-59, Figure 4-83, Figure 4-85, Figure 4-101, Figure 4-102 and Figure 4-103
Updates and expands bibliography.	Appendix 4C

Table 2 – Empirical data base for scaled distances less than 1.0 $ft/lb^{1/3}$ (0.4 $m/kg^{1/3}$) reported by McVay.

Scaled Distance ($ft/lb^{1/3}$)	**Number of Tests**
0.90 – 0.999	17
0.80 – 0.899	3
0.70 – 0.799	13
0.60 – 0.699	1
0.50 – 0.599	5
0.40 – 0.499	17
0.15 – 0.249	123
< 0.15	101

Table 3 – Major test parameters reported by Tancreto.

Slab Type	Slab Thickness (in.)	Flexural Steel (%)	Flexural Steel Spacing (in.)	Diagonal Tension Reinf. Spacing (in.)	Scaled Charge Distance (ft/lb1/3)	Type of Diagonal Tension Reinforcement
I	4.5	1.06	d/2	d/2	0.69	Stirrups
II	4.5	1.09	d	D	0.74	Lacing
III	4.5	1.52	d	D	0.65	Stirrups
IV	4.5	1.06	d/2	D	0.69	Stirrups
V	6.0	0.31	d	d	1.10	None
VI	4.5	2.54	d/2	d/2	0.65	Stirrups

Table 4 – Parametric ranges for spall prediction.

Parameter	Maximum	Minimum	Average
Standoff distance, R, in.	360	0.1	21.0
Charge weight, W, lb.	2299	0.03	24.4
Case length, in.	60.0	0.80	8.8
Case diameter, in.	18.0	0.80	4.0
Case thickness, in.	0.62	0.00	0.05
$R/W^{1/3}$, in/lb$^{1/3}$*	12.1	0.008	0.70
Concrete thickness, T, in.	84.0	2.00	9.23
f'_c, psi	13815	1535	5067
Rebar spacing, S, in.	11.8	7.16	1.25
Reinf. Ratio, ρ	0.025	0.0005	0.0054

*The minimum allowable design value for $R/W^{1/3}$ is approximately 0.25 ft/lb$^{1/3}$ (0.10 m/kg$^{1/3}$).

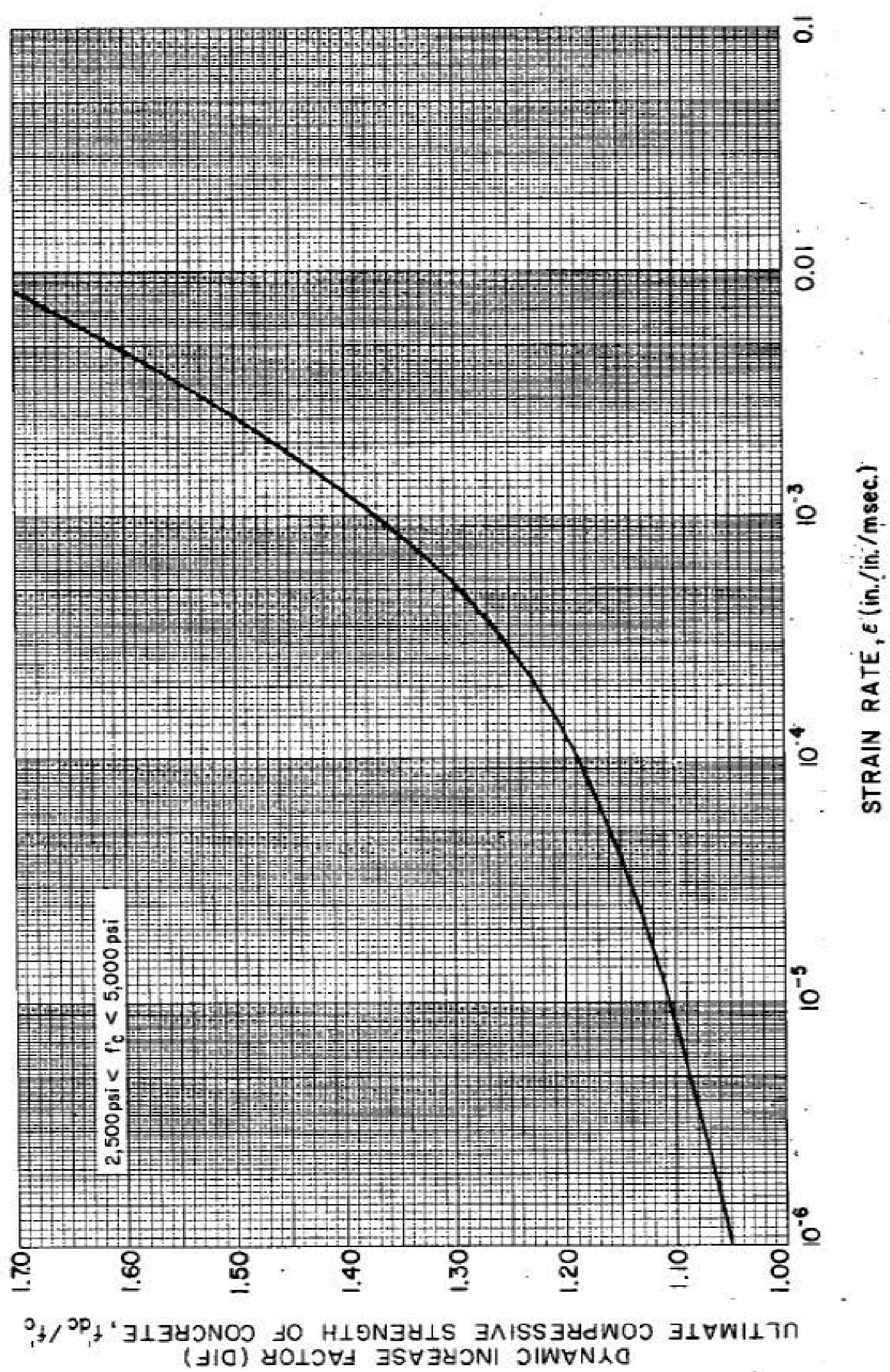

Figure 1 - Design curve for DIF for ultimate compressive strength of concrete, 2,500 psi < f'_c < 5,000 psi (17.2 Mpa < f'_c < 34.5 MPa).

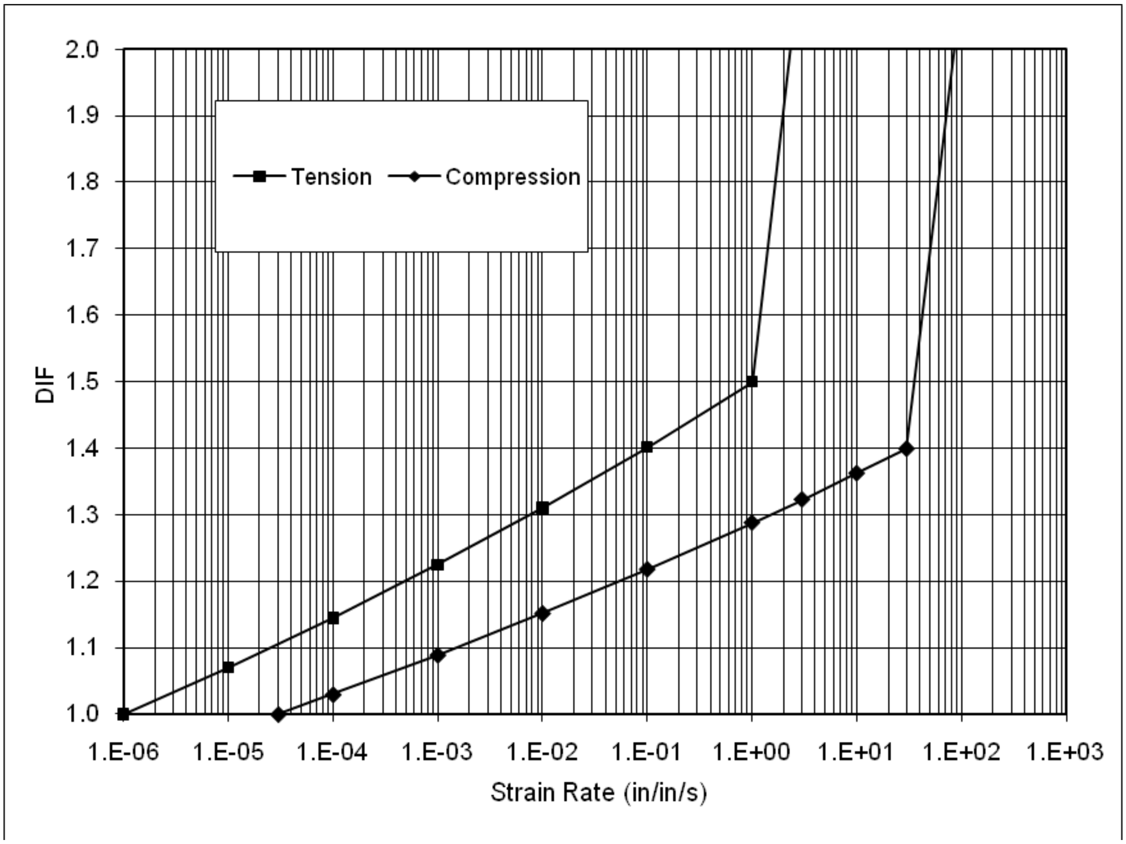

Figure 2 – Design curves for DIFs for ultimate compressive and tensile strengths of concrete, f'_c = 6,000 psi (41.4 MPa) in semi-log format.

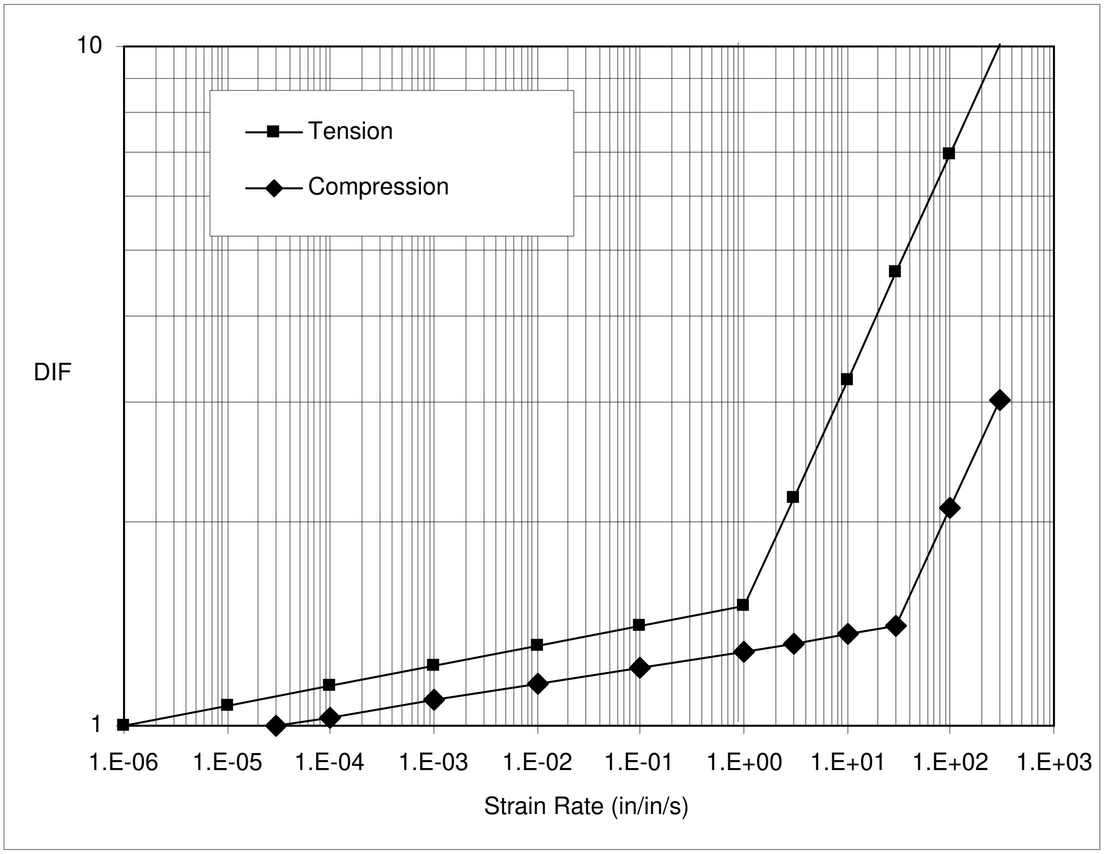

Figure 3 – Design curves for DIFs for ultimate compressive and tensile strengths of concrete, f'_c = 6,000 psi (41.4 MPa) in log-log format.