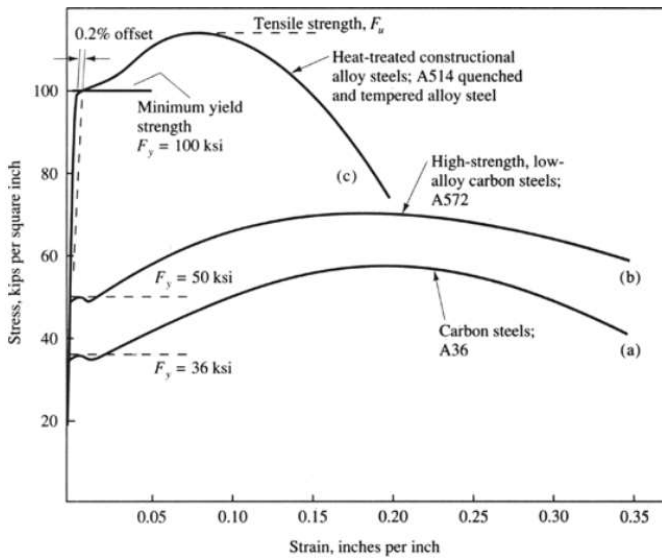


انواع فولاد سازه‌ای

<u>St 37</u> :	F_y	F_u	
	240	370	MPa
<u>St 52</u> :	360	520	MPa $c \uparrow$

مبحث دهم ص ۳ و ص ۴
 $F_y \leq 460 \text{ MPa}$
 $F_y \leq 65 \text{ ksi}$ Grade 65

لرزنا لب
 شکل بنیاد متوسط و ویژه
 $F_y \leq 355 \text{ MPa}$ Grade 50
 $F_y \leq 460 \text{ MPa}$ Grade 65
 $F_y/F_u \leq 0.8$! $F_u/F_y > 1.25$
 تیرب عضو سازه
 تصدیق بر استن



Carbon Steel ✓ ①
 High strength Low Alloy (HSLA) ✓ ②
 Quenched & Tempered (QT) ③
 انواع فولاد

Carbon Steel

$C \leq 0.15\%$ ①

Structural

$0.15\% \leq C \leq 0.29\%$ ✓ ②

$0.3\% \leq C \leq 0.6\%$ ③

$0.6\% \leq C \leq 1.7\%$ ④

High strength Low Alloy (HSLA)

Carbon Alloy
 98% + 2%
 $c \uparrow$
 $F_y, F_u \uparrow$
 $\epsilon_u \downarrow$
 weld \downarrow
 Tough \downarrow

40-70 ksi

Alloy element → fine microstructure → strength ↑

Quenched & Tempered (QT)

80 - 100 ksi

900°C →^Q 150-200°C →^T 500°C



Atmospheric Corrosion Resistant Steel
Weathering Steel (Cor-Ten Steel)

Copper (Cu)

W

Cr

deoxidized steel
killed steel

process

Al, Si, Mn
↳ Al₂O₃

Stainless Steel

Galvanized steel

انواع فولاد زود مطابق ASTM

A 36

Carbon

A572 - Gr 50

HSLA

W ← A992

HSLA

	HSS ← A500	Carbon
	Shape & plate ← A588	HSLA
Weathering	plate ← A606	HSLA
	← A852	HSLA-QT
Bridges	← A709	G30 Carbon
		G50-SRW HSLA
	Plate ← G100-100W	QT

TABLE 1.2 Shape	Preferred Steel
Angles	A36
Plates	A36
S, M, C, MC	A36
HP	A572 Grade 50
W	A992
Pipe	A53 Grade B (only choice)
HSS	A500 Grade C, $F_y = 46$ ksi (round) or A500 Grade C, $F_y = 50$ ksi (rectangular)

**Table 2-4
Applicable ASTM Specifications
for Various Structural Shapes**

Steel Type	ASTM Designation	F_y Yield Stress ^a (ksi)	F_u Tensile Stress ^a (ksi)	Applicable Shape Series											
				W	M	S	HP	C	MC	L	HSS				
											Rect.	Round	Pipe		
Carbon	A36	36	58-80 ^b												
	A53 Gr. B	35	60												
	A500	Gr. B	42	58											
			46	58											
		Gr. C	46	62											
	50		62												
	A501	Gr. A	36	58											
		Gr. B	50	70											
	A529 ^c	Gr. 50	50	65-100											
		Gr. 55	55	70-100											
	A709	36	36	58-80 ^b											
	A1043 ^{d,k}	36	36-52	58											
		50	50-65	65											
A1085	Gr. A	50	65												
High-Strength Low-Alloy	A572	Gr. 42	42	60											
		Gr. 50	50	65											
		Gr. 55	55	70											
		Gr. 60 ^e	60	75											
		Gr. 65 ^e	65	80											
	A618 ^f	Gr. Ia ^g , Ib & II	50 ^g	70 ^g											
		Gr. III	50	65											
	A709	50	50	65											
		50S	50-65	65											
		50W	50	70											
	A913	50	50 ^h	65 ^h											
		60	60	75											
		65	65	80											
	70	70	90												
A992		50 ⁱ	65 ⁱ												
A1065 ^k	Gr. 50 ⁱ	50	60												

= Preferred material specification.
 = Other applicable material specification, the availability of which should be confirmed prior to specification.
 = Material specification does not apply.

Footnotes on facing page.

Table 2-4 (continued)
Applicable ASTM Specifications
for Various Structural Shapes

Steel Type	ASTM Designation		F_y Yield Stress ^a (ksi)	F_u Tensile Stress ^a (ksi)	Applicable Shape Series									
					W	M	S	HP	C	MC	L	HSS		
												Rect.	Round	Pipe
Corrosion Resistant	A588		50	70										
High-Strength	A847 ^k		50	70										
Low-Alloy	A1065 ^k	Gr. 50W ⁱ	50	70										

= Preferred material specification.
 = Other applicable material specification, the availability of which should be confirmed prior to specification.
 = Material specification does not apply.

^a Minimum, unless a range is shown.
^b For wide-flange shapes with flange thicknesses over 3 in., only the minimum of 58 ksi applies.
^c For shapes with a flange or leg thickness less than or equal to 1½ in. only. To improve weldability, a maximum carbon equivalent can be specified (per ASTM A529 Supplementary Requirement S78). If desired, maximum tensile stress of 90 ksi can be specified (per ASTM A529 Supplementary Requirement S79).
^d For shape profiles with a flange width of 6 in. or greater.
^e For shapes with a flange thickness less than or equal to 2 in. only.
^f ASTM A618 can also be specified as corrosion-resistant; see ASTM A618.
^g Minimum applies for walls nominally ¾ in. thick and under. For wall thickness over ¾ in., $F_y=46$ ksi and $F_u=67$ ksi.
^h If desired, maximum yield stress of 65 ksi and maximum yield-to-tensile strength ratio of 0.85 can be specified (per ASTM A913 Supplementary Requirement S75).
ⁱ A maximum yield-to-tensile strength ratio of 0.85 and carbon equivalent formula are included as mandatory, and some variation is allowed, including for shapes tested with coupons cut from the web; see ASTM A992. If desired, maximum tensile stress of 90 ksi can be specified (per ASTM A992 Supplementary Requirement S79).
^j The grades of ASTM A1065 may not be interchanged without approval of the purchaser.
^k This specification is not a prequalified base metal per AWS D1.1/D1.1M:2015.

Table 2-5 Applicable ASTM Specifications for Plates and Bars

Steel Type	ASTM Designation	F_y Yield Stress ^a (ksi)	F_u Tensile Stress ^a (ksi)	Plates and Bars, in.											
				to 0.75 incl.	over 0.75 to 1.25 incl.	over 1.25 to 1.5 incl.	over 1.5 to 2 incl.	over 2 to 2.5 incl.	over 2.5 to 4 incl.	over 4 to 5 incl.	over 5 to 6 incl.	over 6 to 8 incl.	over 8		
Carbon	A36	32	58-80												
		36	58-80												
	A283 ^e	Gr. C	30	55-75					d						
		Gr. D	33	60-80					d						
	A529	Gr. 50	50	65-100		b	b	b	b	b					
		Gr. 55	55	70-100		c	c	c	c	c					
A709	Gr. 36	36	58-80												
High-Strength Low-Alloy	A572	Gr. 42	42	60											
		Gr. 50	50	65											
		Gr. 55	55	70											
		Gr. 60	60	75											
		Gr. 65	65	80											
	A709	Gr. 50	50	65											
	A1043 ^e	Gr. 36	36-52	58											
		Gr. 50	50-65	65											
	A1066 ^e	Gr. 50	50	65											
		Gr. 60	60	75											
Gr. 65		65	80						f						
Gr. 70		70	85												
	Gr. 80	80	90		g										
Corrosion Resistant High-Strength Low-Alloy	A242 ^e	42	63												
		46	67												
		50	70												
	A588	42 ^e	63												
		46 ^e	67												
	50	70													

= Preferred material specification.
 = Other applicable material specification, the availability of which should be confirmed prior to specification.
 = Material specification does not apply.

Footnotes on facing page.

Table 2-5 (continued)
Applicable ASTM Specifications
for Plates and Bars

Steel Type	ASTM Designation	F_y Yield Stress ^a (ksi)	F_u Tensile Stress ^a (ksi)	Plates and Bars, in.										
				to 0.75 incl.	over 0.75 to 1.25 incl.	over 1.25 to 1.5 incl.	over 1.5 to 2 incl.	over 2 to 2.5 incl.	over 2.5 to 4 incl.	over 4 to 5 incl.	over 5 to 6 incl.	over 6 to 8 incl.	over 8	
Quenched and Tempered Alloy	A514 ^e	90	100–130											
		100	110–130											
Corrosion Resistant Quenched and Tempered Low-Alloy	A709	Gr. 50W	50	70										
		Gr. HPS 50W	50	70										
		Gr. HPS 70W	70	85–110										
		Gr. HPS 100W ^e	90	100–130										
			100	110–130										

= Preferred material specification.
 = Other applicable material specification, the availability of which should be confirmed prior to specification.
 = Material specification does not apply.

^a Minimum, unless a range is shown.
^b Applicable for plates to 1 in. thickness and bars to 3½ in. thickness.
^c Applicable for plates to 1 in. thickness and bars to 3 in. thickness.
^d Thickness is not limited to 2 in. in ASTM A283 and thicker plates may be obtained but availability should be confirmed.
^e This specification is not a prequalified base metal per AWS D1.1/D1.1M:2015.
^f Applicable for plates to 3 in. thickness.
^g Applicable for plates to 1 in. thickness.

Table 2-6
Applicable ASTM Specifications for
Various Types of Structural Fasteners

ASTM Designation	F_y Min. Yield Stress (ksi)	F_u Tensile Stress ^a (ksi)	Diameter Range (in.)	Bolts			Nuts	Washers			Anchor Rods							
				High-Strength		Common Bolts		Hardened	Plain	Direct-Tension Indicator	Threaded Rods	Hooked	Headed	Threaded & Nutted				
				Conventional	Twist-Off-Type Tension-Control													
F3125	Gr. A325 ^d	–	120	0.5 to 1.5	■													
	Gr. F1852 ^d	–	120	0.5 to 1.25		■												
	Gr. A490 ^d	–	150	0.5 to 1.5	■													
	Gr. F2280 ^d	–	150	0.5 to 1.25		■												
F3111	–	200	1 to 1.25 incl.	■														
F3043	–	200	1 to 1.25 incl.		■													
A194 Gr. 2H	–	–	0.25 to 4				■											
A563	–	–	0.25 to 4				■											
F436	–	–	0.25 to 4 ^b				■											
F844	–	–	any					■										
F959	–	–	0.5 to 1.5						■									
A36	36	58–80	to 10								■							
A193 Gr. B7		105	125	2.5 and under								■						
		95	115	over 2.5 to 4								■						
		75	100	over 4 to 7									■					
A307 Gr. A	–	60	0.25 to 4				■											
A354	Gr. BC	109	125	0.25 to 2.5 incl.	e							e						
		99	115	over 2.5 to 4 incl.	e							e						
	Gr. BD	130	150	0.25 to 2.5 incl.	e							e						
		115	140	2.5 to 4 incl.	e							e						
A449 ^d		92	120	0.25 to 1 incl.	e							e						
		81	105	over 1 to 1.5 incl.	e							e						
		58	90	over 1.5 to 3 incl.	e							e						
A572	Gr. 42	42	60	to 6														
	Gr. 50	50	65	to 4 ^c														
	Gr. 55	55	70	to 2														
	Gr. 60	60	75	to 3.5														
	Gr. 65	65	80	to 1.25														
A588		50	70	4 and under														
		46	67	over 4 to 5 incl.														
		42	63	over 5 to 8 incl.														
F1554	Gr. 36	36	58–80	0.25 to 4														
	Gr. 55	55	75–95	0.25 to 4														
	Gr. 105	105	125–150	0.25 to 3														

■ = Preferred material specification.
 ■ = Other applicable material specification, the availability of which should be confirmed prior to specification.
 □ = Material specification does not apply.

– Indicates that a value is not specified in the material specification.
^a Minimum, unless a range is shown.
^b Diameter range is 2 in. to 12 in. for beveled and extra thick washers.
^c ASTM A572 permits rod diameters up to 11 in., but practicality of threading should be confirmed before specification.
^d When atmospheric corrosion resistance is desired, Type 3 can be specified.
^e See AISC Specification Section J3.1 for limitations on use of ASTM A449, A354 Gr. BC and A354 Gr. BD.