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From Prof. SEGui's Text book

5.8-1 Compute the nominal shear strength of an M10 × 7.5 of A572 Grade 65 steel. 6th edition

Solution:

Table 2-4

$F_y = 65 \text{ ksi}$

Table 2-4 Applicable ASTM Specifications for Various Structural Shapes												
Steel Type	ASTM Designation		F_y Yield Stress* (ksi)	F_u Tensile Stress* (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,e}	36	36–52	58								
		50	50–65	65								
	A1085	Gr. A	50	65								
	A572	Gr. 42	42	60								
		Gr. 50	50	65								
		Gr. 55	55	70								
		Gr. 60 ^g	60	75								
		Gr. 65 ^g	65	80								

Table 2-4 for F_y value of M section

ASTM A572



Which table is designated for *M* shapes?

PART 1 REFERENCES 1-11

DESIGN DIMENSIONS, DETAILING DIMENSIONS, AND AXIAL, STRONG-
AXIS FLEXURAL, AND WEAK-AXIS FLEXURAL PROPERTIES TABLES 1-12

Table 1-1. W-Shapes 1-12

Table 1-2. M-Shapes 1-32

Table 1-3. S-Shapes 1-34

Table 1-4. HP-Shapes 1-36

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Table 1-6. MC-Shapes 1-40

Table 1-7. Angles 1-44

Table 1-2



Use Table 1-2 for data for M shapes dimensions

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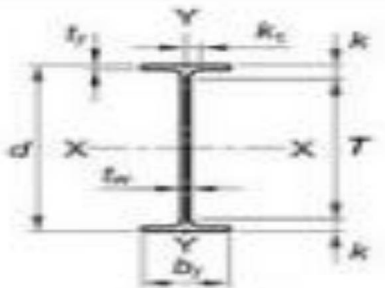
Given $M_{10} \times 7.5$

Table 1-2-part 1

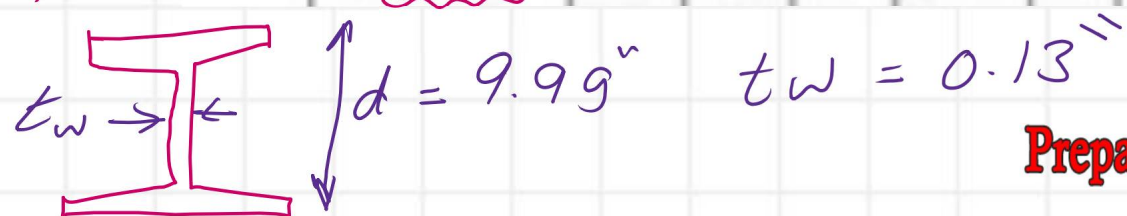
1-32

DIMENSIONS AND PROPERTIES

Part - 1

 Table 1-2 M-Shapes Dimensions														
Shape	Area, A	Depth, d		Web			Flange				Distance			
				Thickness, t_w		$\frac{t_w}{2}$	Width, b_f		Thickness, t_f		k	k_t	T	Workable Gage
	in. ²	in.		in.		in.	in.		in.		in.	in.	in.	in.
M12.5x12.4 ^{C-V}	3.63	12.5	12 1/2	0.155	1/8	1/16	3.75	3 3/4	0.228	1/4	9/16	3/8	11 3/8	—
x11.6 ^{C-V}	3.40	12.5	12 1/2	0.155	1/8	1/16	3.50	3 1/2	0.211	3/16	9/16	3/8	11 3/8	—
M12x11.8 ^C	3.47	12.0	12	0.177	3/16	1/8	3.07	3 1/8	0.225	1/4	9/16	3/8	10 7/8	—
x10.8 ^{C-V}	3.18	12.0	12	0.160	3/16	1/8	3.07	3 1/8	0.210	3/16	9/16	3/8	10 7/8	—
M12x10 ^{C-V}	2.95	12.0	12	0.149	1/8	1/16	3.25	3 1/4	0.180	3/16	1/2	3/8	11	—
M10x9 ^C	2.65	10.0	10	0.157	3/16	1/8	2.69	2 3/4	0.206	3/16	9/16	3/8	8 7/8	—
x8 ^{C-V}	2.37	9.95	10	0.141	1/8	1/16	2.69	2 3/4	0.182	3/16	9/16	3/8	8 7/8	—
M10x7.5 ^{C-V}	2.22	9.99	10	0.130	1/8	1/16	2.69	2 3/4	0.173	3/16	7/16	5/16	9 1/8	—

C_{xV}



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This is the second part of table 1-2

DIMENSIONS AND PROPERTIES TABLES

1-33

M10 X 7.5

Table 1-2-part 2

Table 1-2 (continued) M-Shapes Properties															
Nom- inal Wt.	Compact Section Criteria		Axis X-X				Axis Y-Y				r_{ts}	h_o	$\frac{J}{S_x h_o}$	Torsional Properties	
	$\frac{b_f}{2t_f}$	$\frac{h}{t_w}$	I in. ⁴	S in. ³	r in.	Z in. ³	I in. ⁴	S in. ³	r in.	Z in. ³				J in. ⁴	C_w in. ⁶
12.4	8.22	74.8	89.3	14.2	4.96	16.5	2.01	1.07	0.744	1.68	0.933	12.3	0.000283	0.0493	76.0
11.6	8.29	74.8	80.3	12.8	4.86	15.0	1.51	0.864	0.667	1.37	0.852	12.3	0.000263	0.0414	57.1
11.8	6.81	62.5	72.2	12.0	4.56	14.3	1.09	0.709	0.559	1.15	0.731	11.8	0.000355	0.0500	37.7
10.8	7.30	69.2	66.7	11.1	4.58	13.2	1.01	0.661	0.564	1.07	0.732	11.8	0.000300	0.0393	35.0
10	9.03	74.7	61.7	10.3	4.57	12.2	1.03	0.636	0.592	1.02	0.768	11.8	0.000240	0.0292	35.9
9	6.53	58.4	39.0	7.79	3.83	9.22	0.672	0.500	0.503	0.809	0.650	9.79	0.000411	0.0314	16.1
8	7.39	65.0	34.6	6.95	3.82	8.20	0.593	0.441	0.500	0.711	0.646	9.77	0.000328	0.0224	14.2
7.5	7.77	71.0	33.0	6.60	3.85	7.77	0.562	0.418	0.503	0.670	0.646	9.82	0.000289	0.0187	13.5



$\frac{I}{E_w} = 71$ From the second part of the Table.

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Relation between F_y , $\frac{h}{t_w}$ for Zone I $E = 29 \times 10^6 \text{ ksi}$

$$E = 29 \times 10^6 \text{ psi} \quad \frac{h}{t_w} = 2.24 \sqrt{\frac{E}{F_y}}$$

$$F_y = 36 \text{ ksi} \Rightarrow \frac{h}{t_w} = 2.24 \sqrt{\frac{29000}{36}} = 63.54 \approx 64$$

$$F_y = 42 \text{ ksi} \rightarrow \frac{h}{t_w} = 2.24 \sqrt{\frac{29000}{42}} = 58.86 \Rightarrow 58.90$$

$$F_y = 45 \text{ ksi} \rightarrow \frac{h}{t_w} = 2.24 \sqrt{\frac{29000}{45}} = 56.86 \Rightarrow 56.90$$

$$F_y = 50 \text{ ksi} \rightarrow \frac{h}{t_w} = 2.24 \left(\frac{29000}{50} \right)^{1/2} = 53.90$$

$$F_y = 60 \text{ ksi} \rightarrow \frac{h}{t_w} = 2.24 \left(\frac{29000}{60} \right)^{1/2} = 49.25$$

$$\Rightarrow F_y = 65 \text{ ksi} \rightarrow \frac{h}{t_w} = 2.24 \left(\frac{29000}{65} \right)^{1/2} \approx 47.30$$

$$F_y = 100 \text{ ksi} \rightarrow \frac{h}{t_w} = 2.24 \left(\frac{29000}{100} \right)^{1/2} = 38.15$$

Required h/t_w for $f_y = 65 \text{ ksi}$

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$$E = 29000 \text{ ksi}$$

$$F_y = 65 \text{ ksi}$$

$$h/t_w$$

Point - (1)

$$2.24 \sqrt{\frac{E}{F_y}}$$

$$= 2.24 \sqrt{\frac{29000}{65}}$$

$$= 47.30$$

Point - 2

$$h/t_w = 1.1 \sqrt{\frac{K_v E}{F_y}}$$

$$= 1.1 \sqrt{\frac{5.34 (29) 10^3}{65}}$$

$$= 53.692$$

$M_{10 \times 7.5}$

CM # 15

Specs # 2016

C_{v1}

$$0.6 F_y d t_w (1.0)$$

$$\frac{h}{t_w}$$

$$K_v = 5.34$$

$$F_y = 65 \text{ ksi}$$

$$\frac{h}{t_w} = 71$$

$$C_{v1} = \frac{1.10 \sqrt{\frac{K_v E}{F_{yw}}}}{h/t_w}$$

$$C_{v1} = \frac{53.69}{71}$$

$$= 0.7562$$

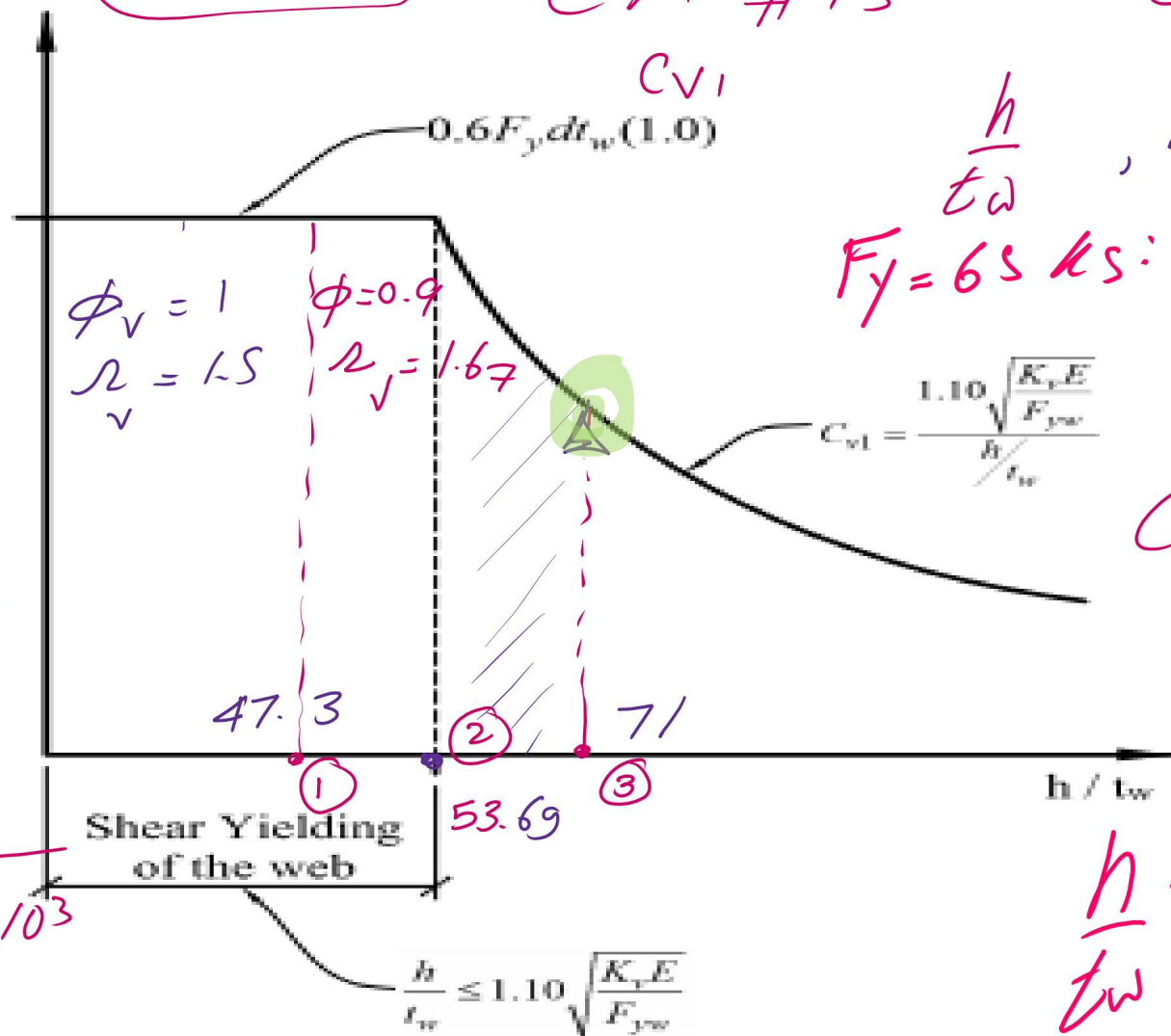


FIGURE 6-7c Shear strength variation in a flexural member

h/t_w plot versus V_n

$$\frac{h}{t_w} > 1.1 \sqrt{\frac{K_v E}{F_y}}$$

B₄₂

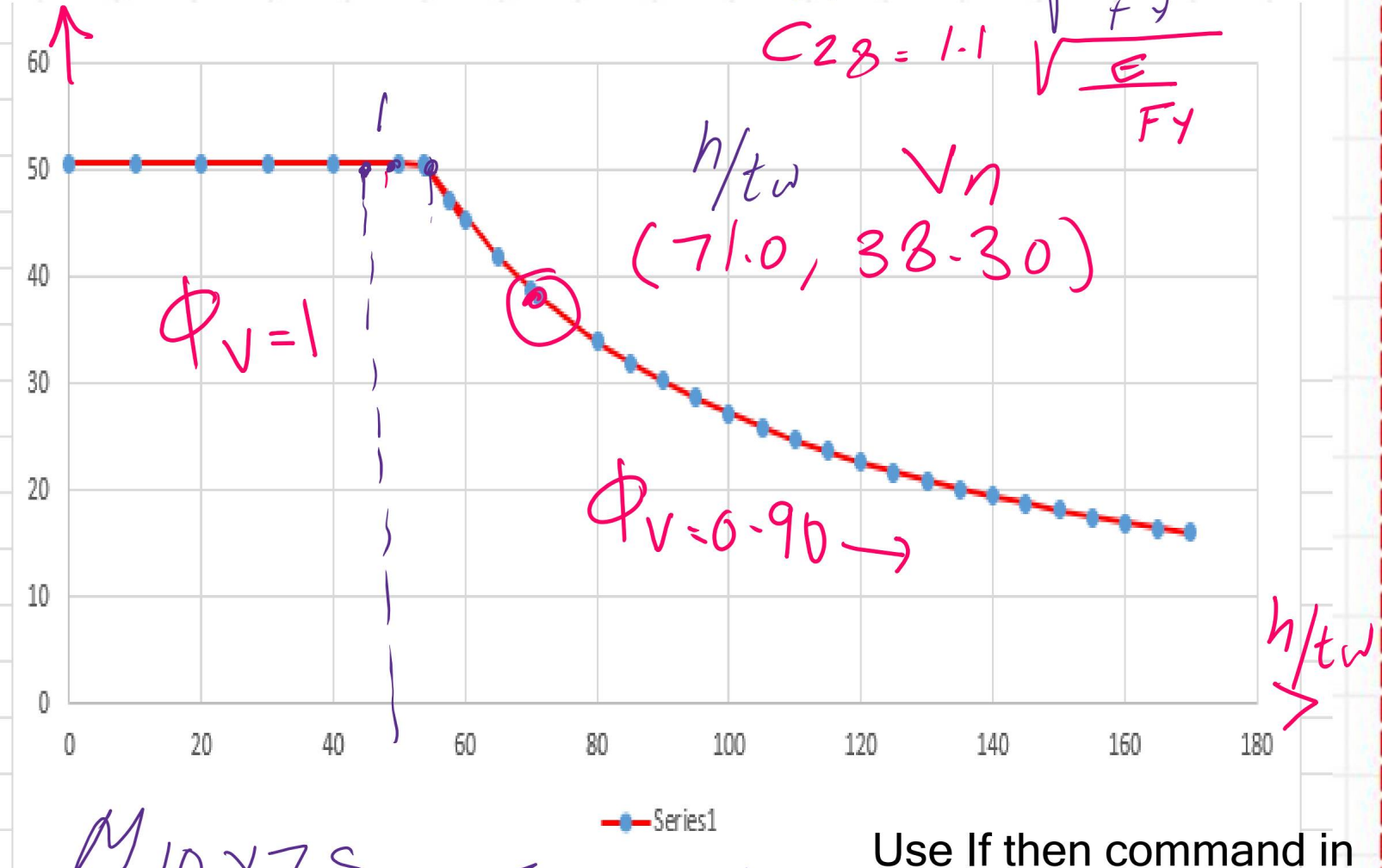
=IF(AND(0<=B42,B42<=\$C\$27),1,IF(AND(\$C\$27<B42,B42<=\$C\$28),1,IF(AND(\$C\$28<B42),1.1*(1/B42)*SQRT(5.34*\$C\$19/\$C\$20))))

$$C_{27} = 2.24 \sqrt{\frac{E}{F_y}}$$

$$C_{28} = 1.1 \sqrt{\frac{E}{F_y}}$$

h/tw	Cv1	Vn
0	1	50.65
10	1	50.65
20	1	50.65
30	1	50.65
40	1	50.65
47.314	1	50.65
50	1	50.65
53.946	0.9952825	50.41
54	1	50.36
57.5	1	47.29
60	0.895	45.32
53.692	1.000	50.65
65	0.826	41.84
70	0.767	38.85
71.0	0.756	38.3
80	0.671	33.99
85	0.632	31.99
90	0.597	30.77

V_n



M10x7.5

F_y = 65 ksi

Use If then command in Excel

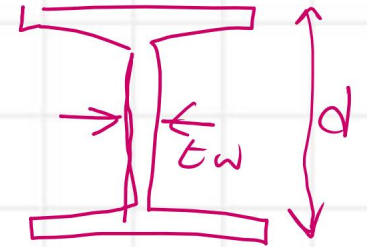
① Check $\frac{h}{t_w}$ against $2.24\sqrt{\frac{E}{F_y}}$ $F_y = 65 \text{ ksi}$

$$\frac{h}{t_w} = 2.24\sqrt{\frac{29000}{65}} = 47.30$$

Our $\frac{h}{t_w} = 71$ From table $> 1.1\sqrt{\frac{K_v E}{F_y}}$ $2.24\sqrt{\frac{E}{F_y}}$

$$d = 9.99''$$

$$t_w = 0.13''$$



$$A_w = d t_w = 9.99(0.13) = 1.2987 \text{ inch}^2$$

$$V_n = 0.60 F_y A_w C_v \rightarrow C_v = 0.7562$$

$$V_n = (0.6)(65)(1.2987)(0.7562) = 38.30 \text{ kips}$$

This is the value of Nominal shear
M10 x 7.5

The V_n value for M section