

How To select a W section with
a beam That has $L_b = 18'$?

L_b : Distance between bracings

McCormac section 9-8 $C_b = 1$

Given $M_U = 544$ FT. kips $\rightarrow \phi_b M_n$
 $M_T = 362$ FT. kips $\Rightarrow \frac{M_n}{\phi_b}$

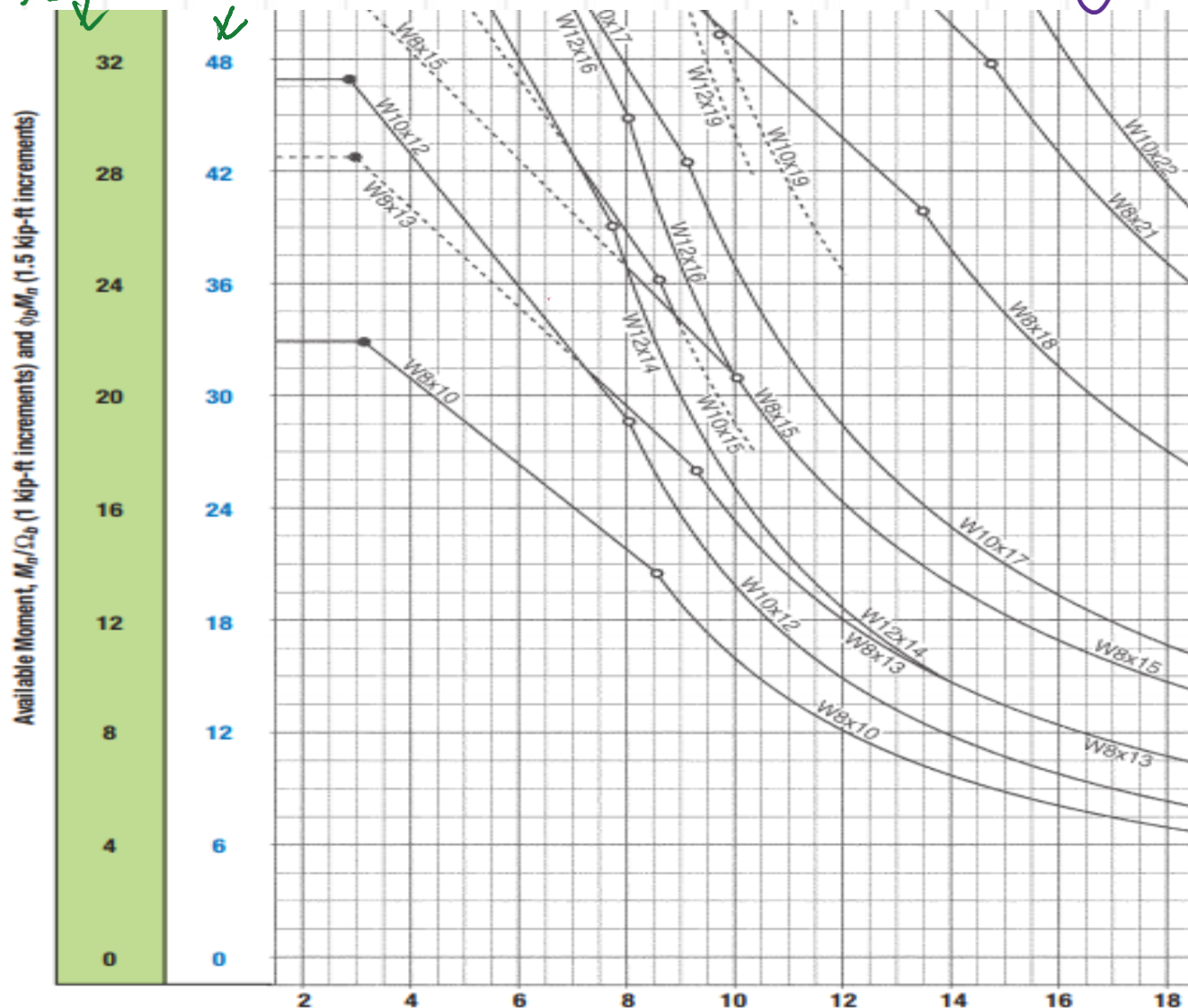
Table 3-10 $\rightarrow$ Page 3-92 $\rightarrow$ 3-127

CM #15 Page 3-127

434

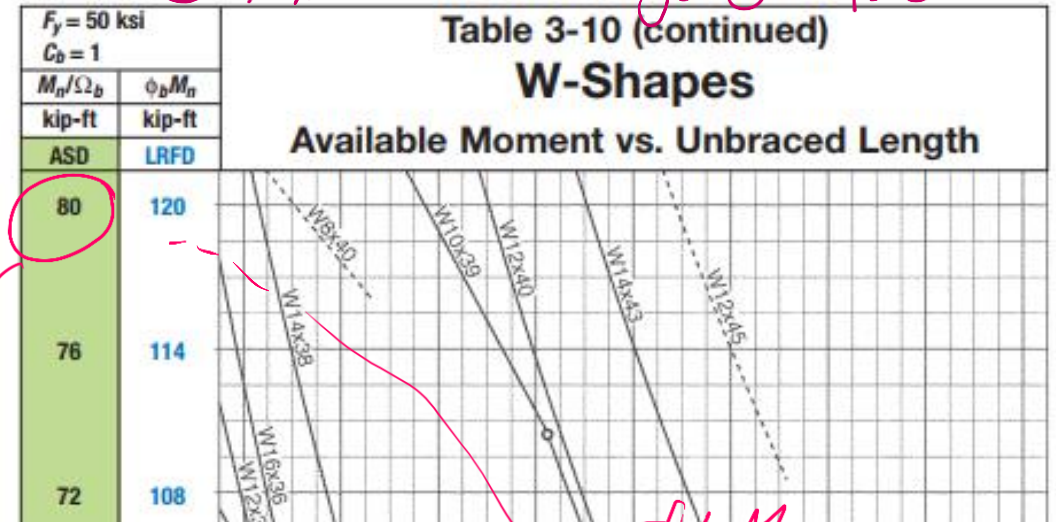
DESIGN OF FLEXURAL MEMBERS

AT Page 3-128 $\Rightarrow$ [channels
Table 3-11



$$L_6: 13' \rightarrow 34'$$

	Table 3-10 (continued) W-Shapes Available Moment vs. Unbraced Length
$\phi_b M_n$	
kip-ft	
LRFD	



FT. Kips

From $\phi 6$ $M_n = 60 - 120$
 $\rightarrow \frac{M_n}{2} = 40 - 80$

Prepared by Eng.Maged Kamel.

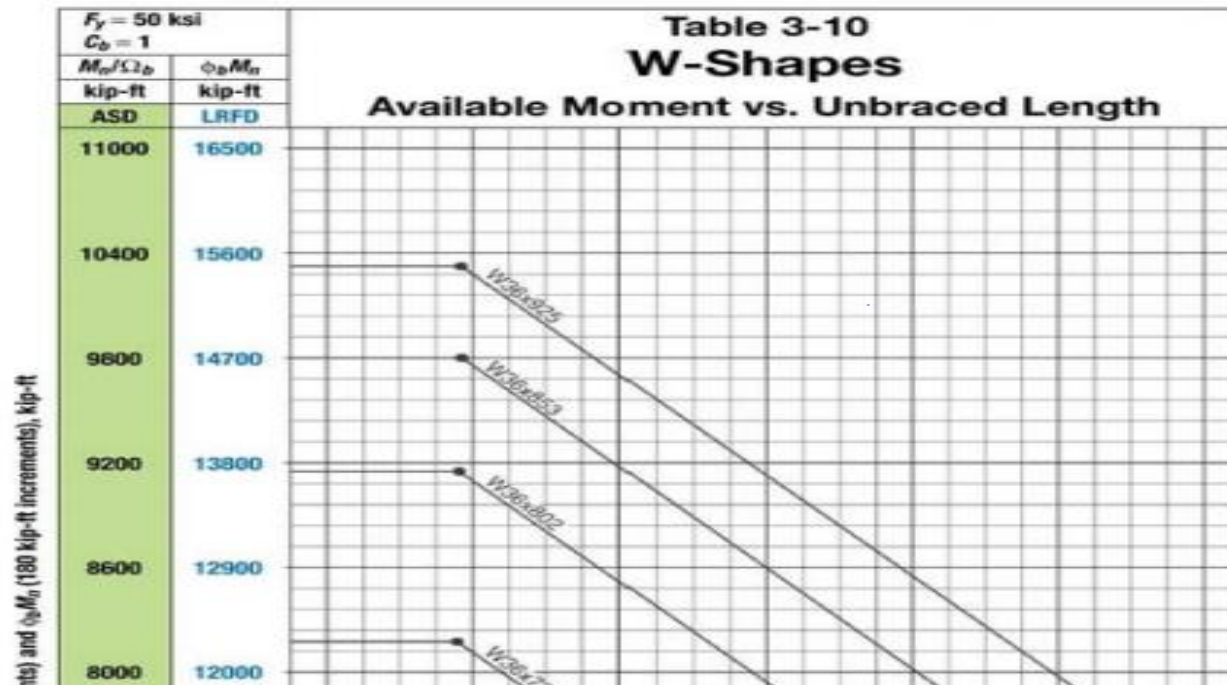
0.5' increments

This is the first Page in Table 3-10 ^{UC} CM #15 P 3-92

$F_y = 50 \text{ ksi}$ $C_b = 1$		$\Downarrow$ Table 3-10 W-Shapes Available Moment vs. Unbraced Length	
M_n/Ω_b	$\phi_b M_n$		
kip-ft	kip-ft		
ASD	LRFD		

3-92

DESIGN OF FLEXURAL MEMBERS



$$\phi M_n \Rightarrow 7500 \rightarrow 16500 \text{ Kips-FT}$$

$$M_n \Rightarrow 5000 \rightarrow 11000 \text{ Kips-FT}$$

$$\frac{\phi M_n}{M_n} = \phi \Rightarrow \phi \cdot \Omega = 1.50$$



Prepared by Eng.Maged Kamel.

Using table 3-10

$L_b = 18 \text{ Ft}$

$F_y = 50 \text{ ksi}$
 $C_b = 1$

$\frac{M_n}{2}$ ASD LRFD

544
Ft-kips

①

②
 $L_b = 18$

Uneconomical range
Economical range
Lightest section

Prepared by Eng. Maged Kamel.

$M_{ult} = 544$
 ϕM_n Ft-kips

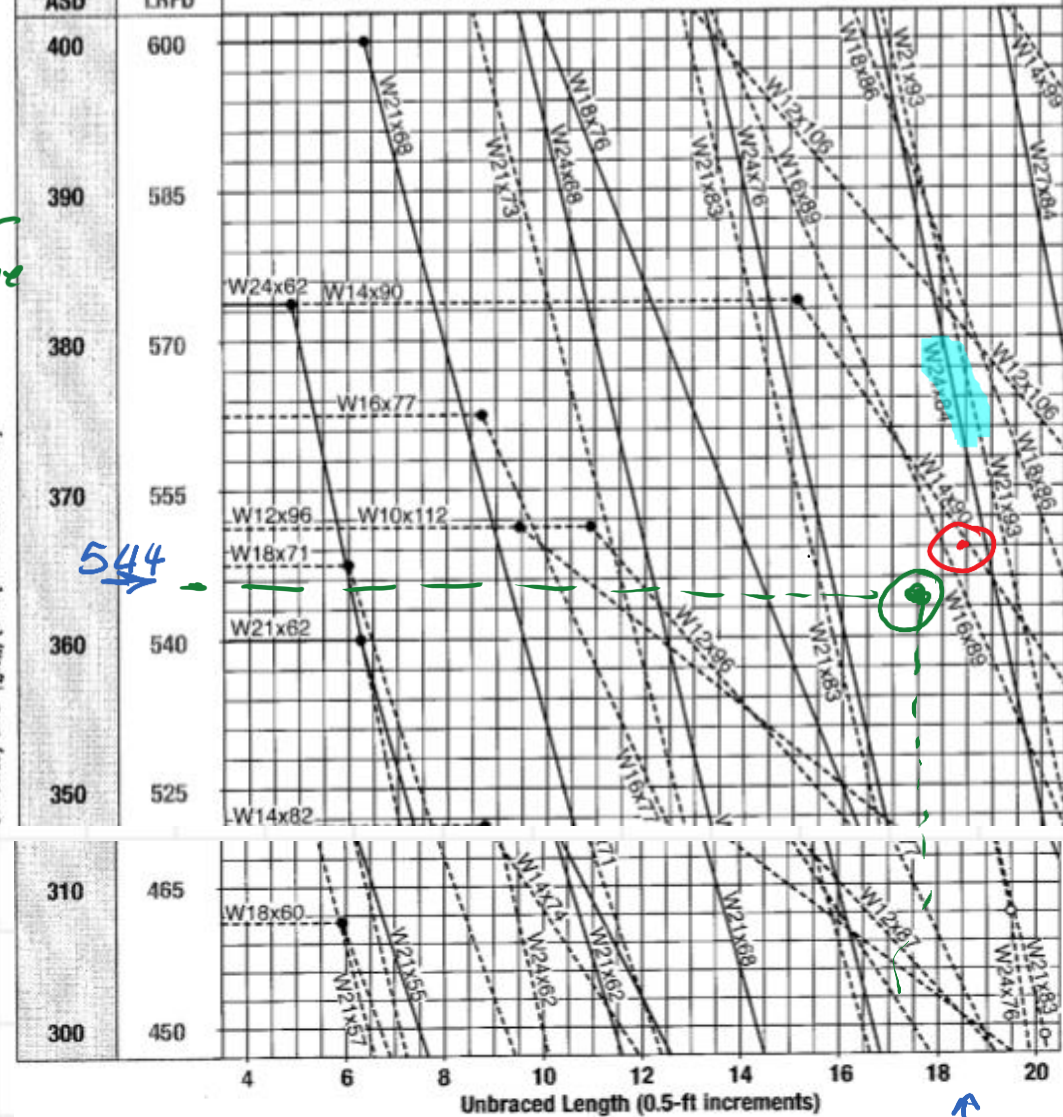
Solid Line

gives higher value
Close to 570
Ft-kips

W24x84

$F_y = 50 \text{ ksi}$
 $C_b = 1$
 M_n/Ω_b ASD
 $\phi_b M_n$ LRFD

Table 3-10 (continued)
W-Shapes
Available Moment vs. Unbraced Length



P-315
CM#15

L_b

if we use Table 3-2 $L_b = 18'$

First selection

$M_{ult} = 544$ ft-kips $\rightarrow$ Convert to inch-kips

$F_y = 50$ ksi, $\phi_b = 0.90$ LRFD

① Required $Z_x = M_{ult} / \phi F_y$
 $= 544 (12) / (0.90) (50) = 145.00 \text{ inch}^3$

② Use table 3-2 selection by Z_x .

W24 x 62 $\Rightarrow$ $L_p = 4.87'$
 $L_r = 14.40'$ } First choice.
 $Z_x = 153 \text{ inch}^3$

But our given $L_b = 18'$

First choice W24x62 $Z_x = 153 \text{ inch}^3$

Given $L_b = 18'$
 $\phi_b M_n = 544 \text{ FT. kip}$
 $F_y = 50 \text{ ksi}$

Table 3-2 (continued)
W-Shapes
 Selection by Z_x

Z_x

$L_b > L_r$
 $18' > 14.40'$

First choice →

Shape	Z_x	M_{px}/Ω_b	$\phi_b M_{px}$	M_{rx}/Ω_b	$\phi_b M_{rx}$	BF/Ω_b	$\phi_b BF$	L_p	L_r	I_x	V_{nx}/Ω_v	$\phi_v V_{nx}$
		kip-ft	kip-ft	kip-ft	kip-ft	kips	kips				kips	kips
	in. ³	ASD	LRFD	ASD	LRFD	ASD	LRFD	ft	ft	in. ⁴	ASD	LRFD
W24x62	153	382	574	229	344	16.1	24.1	4.87	14.4	1550	204	306
W16x77	150	374	563	234	352	7.34	11.1	8.72	27.8	1110	150	225
W12x96	147	367	551	229	344	3.85	5.78	10.9	46.7	833	140	210
W10x112	147	367	551	220	331	2.69	4.03	9.47	64.1	716	172	258
W18x71	146	364	548	222	333	10.4	15.8	6.00	19.6	1170	183	275
W21x62	144	359	540	222	333	11.6	17.5	6.25	18.1	1330	168	252
W14x82	139	347	521	215	323	5.40	8.10	8.76	33.2	881	146	219

$L_r = 14.40'$

$\phi_b M_{px} = 574 \text{ FT. kip}$

$\phi_b M_{rx} = 344 \text{ FT. kip}$

if we use Table 3-2 $L_b = 18'$ 2nd selection

$M_{ult} = 544$ ft-kips $\rightarrow$ Convert to inch-kips

$F_y = 50$ ksi, $\phi_b = 0.90$ LRFD

① Required $Z_x = M_{ult} / \phi F_y$
 $= 544 (12) / (0.90) (50) = 145 \text{ inch}^3$

② Use table 3-2 selection by Z_x .

W21x68 $\Rightarrow$ $L_p = 6.36'$
 $L_r = 18.70'$ } 2nd choice.

given $L_b = 18'$

$Z_x = 160 \text{ inch}^3$

$$Z_x = 160 \text{ inch}^3$$

2nd Choice

W 21 x 68

 Z_x

Table 3-2 (continued)
W-Shapes
Selection by Z_x

 $F_y = 50 \text{ ksi}$

Shape	Z_x	M_{px}/Ω_b	$\phi_b M_{px}$	M_{rx}/Ω_b	$\phi_b M_{rx}$	BF/Ω_b	$\phi_b BF$	L_p	L_r	I_x	V_{tx}/Ω_v	$\phi_v V_{tx}$
		kip-ft	kip-ft	kip-ft	kip-ft	kips	kips				kips	kips
	in. ³	ASD	LRFD	ASD	LRFD	ASD	LRFD				ASD	LRFD
W24x76	200	499	750	307	462	15.1	22.6	6.78	19.5	2100	210	315
W16x100	198	494	743	306	459	7.86	11.9	8.87	32.8	1490	199	298
W21x83	196	489	735	299	449	13.8	20.8	6.46	20.2	1830	220	331
W14x109	192	479	720	302	454	5.01	7.54	13.2	48.5	1240	150	225
W18x86	186	464	698	290	436	9.01	13.6	9.29	28.6	1530	177	265
W12x120	186	464	698	285	428	3.94	5.95	11.1	56.5	1070	186	279
W24x68	177	442	664	269	404	14.1	21.2	6.61	18.9	1830	197	295
W16x89	175	437	656	271	407	7.76	11.6	8.80	30.2	1300	176	265
W14x99 ^f	173	430	646	274	412	4.91	7.36	13.5	45.3	1110	138	207
W21x73	172	429	645	264	396	12.9	19.4	6.39	19.2	1600	193	289
W12x106	164	409	615	253	381	3.93	5.89	11.0	50.7	933	157	236
W18x76	163	407	611	255	383	8.50	12.8	9.22	27.1	1330	155	232
→ W21x68	160	399	600	245	368	12.5	18.8	6.36	18.7	1480	181	272
W14x90 ^f	157	382	574	250	375	4.82	7.26	15.1	42.5	999	123	185

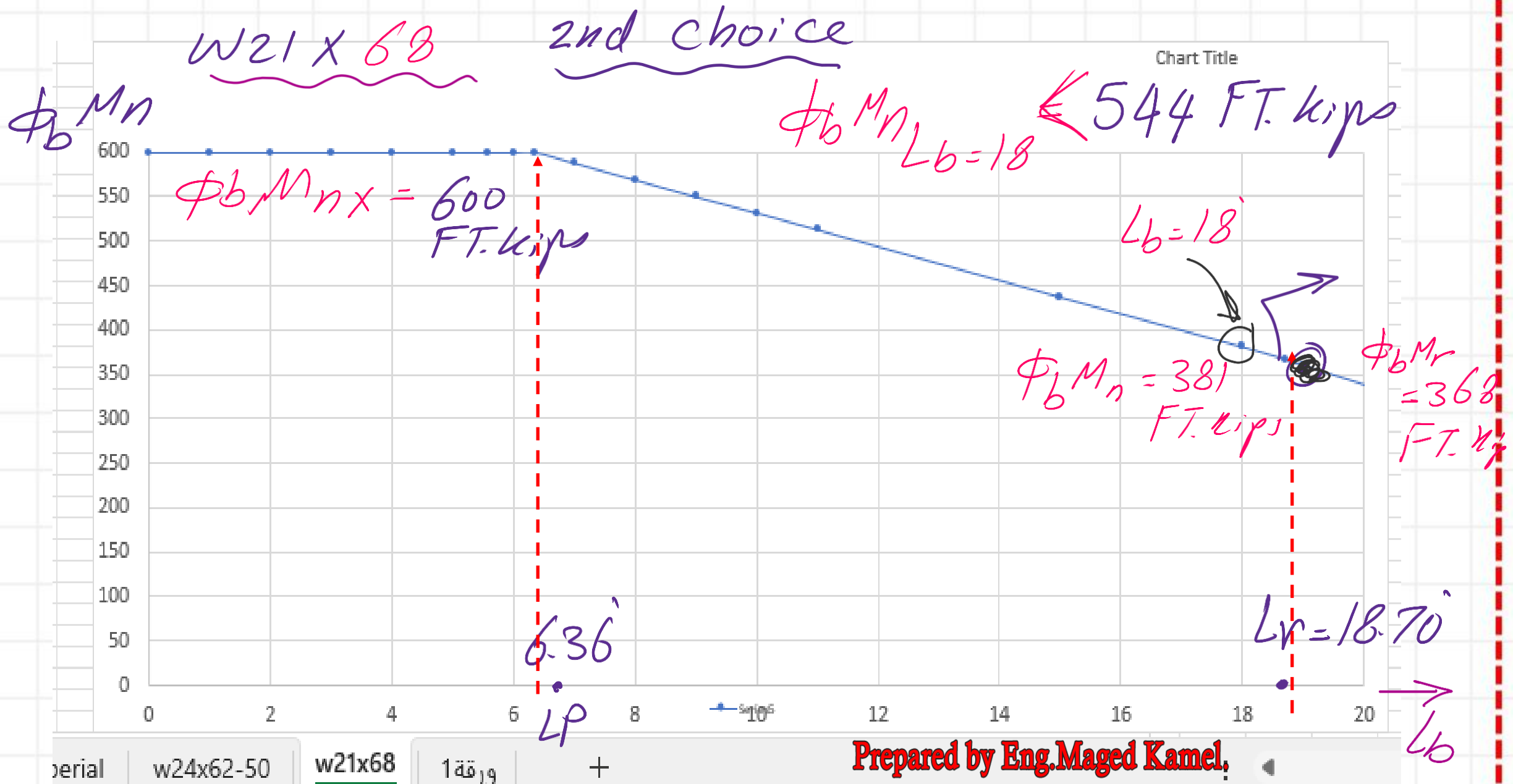
$$L_b = 6.36'$$

$$L_r = 18.7'$$

$$\phi M_p = 600 \text{ F.k}$$

$$\phi M_r = 368 \text{ F.k}$$

2nd choice



if we use Table 3-2 $L_b = 18'$

3rd - selection

$M_{ult} = 544$ ft-kips $\rightarrow$ Convert to inch-kips

$F_y = 50$ ksi, $\phi_b = 0.90$ LRFD

① Required $Z_x = M_{ult} / \phi F_y$
 $= 544 (12) / (0.90) (50) = 145 \text{ inch}^3$

② Use table 3-2 selection by Z_x .

W24x84 $\Rightarrow L_p = 6.89'$

$L_r = 20.30'$

given $L_b = 18'$

} 3rd choice.

$Z_x = 224 \text{ inch}^3$

3rd Choice W24 x 84

Z_x

Table 3-2 (continued)
W-Shapes
Selection by Z_x

$F_y = 50$ ksi

Shape	Z_x	M_{px}/Ω_b	$\phi_b M_{px}$	M_{rx}/Ω_b	$\phi_b M_{rx}$	BF/Ω_b	$\phi_b BF$	L_p	L_r	I_x	V_{tx}/Ω_v	$\phi_v V_{tx}$
		kip-ft	kip-ft	kip-ft	kip-ft	kips	kips				kips	kips
	in. ³	ASD	LRFD	ASD	LRFD	ASD	LRFD				ASD	LRFD
W27x84	244	609	915	372	559	17.6	26.4	7.31	20.8	2850	246	368
W12x152	243	606	911	365	549	4.06	6.10	11.3	70.6	1430	238	358
W14x132	234	584	878	365	549	5.15	7.74	13.3	55.8	1530	190	284
W18x106	230	574	863	356	536	9.73	14.6	9.40	31.8	1910	221	331
→ W24x84	224	559	840	342	515	16.2	24.2	6.89	20.3	2370	227	340
W21x93	221	551	829	335	504	14.6	22.0	6.50	21.3	2070	251	376
W12x136	214	534	803	325	488	4.02	6.06	11.2	63.2	1240	212	318
W14x120	212	529	795	332	499	5.09	7.65	13.2	51.9	1380	171	257
W18x97	211	526	791	328	494	9.41	14.1	9.36	30.4	1750	199	299

3rd choice $Z_x = 224 \text{ inch}^3 > 145 \text{ inch}^3$

$L_b = 6.89'$, $L_r = 20.3'$, $\phi M_p = 840 \text{ FT.kips}$
 $\phi M_r = 515 \text{ FT.kips}$

$\phi M_r > 544 \text{ FT.kips}$
 Prepared by Eng. Maged Kamel.

$\phi_b M_n \uparrow$ W 24 x 84 3rd choice

$$M_U = \phi_b M_n = 344 \text{ FT.kips}$$

$$\phi_b M_{px} = 840 \text{ FT.kip}$$

$$L_p = 6.89'$$

given
 $L_b = 18'$
 given

$$\phi_b M_n = 571 \text{ FT.kips}$$

> 344
 FT.kips

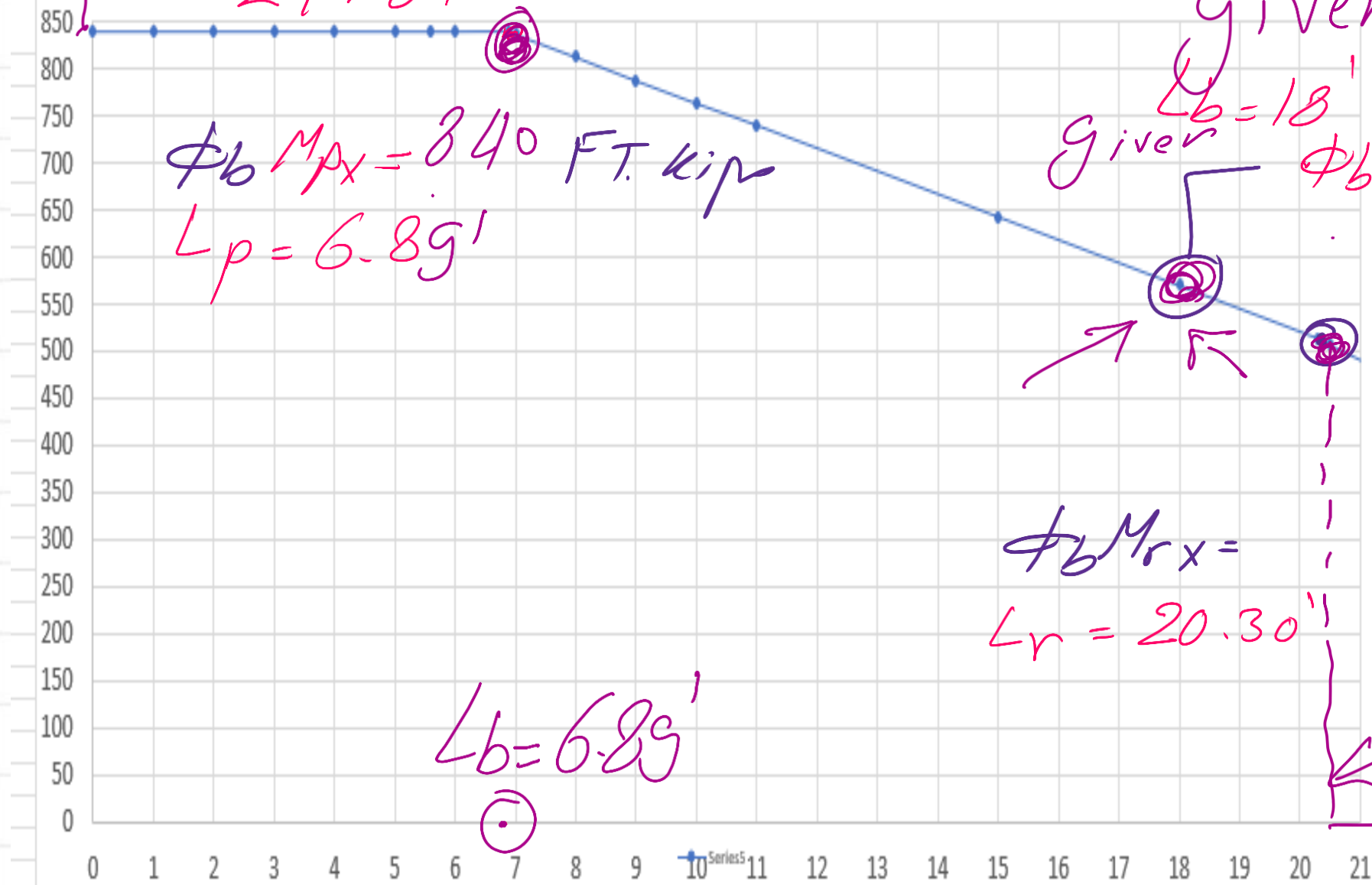
OK

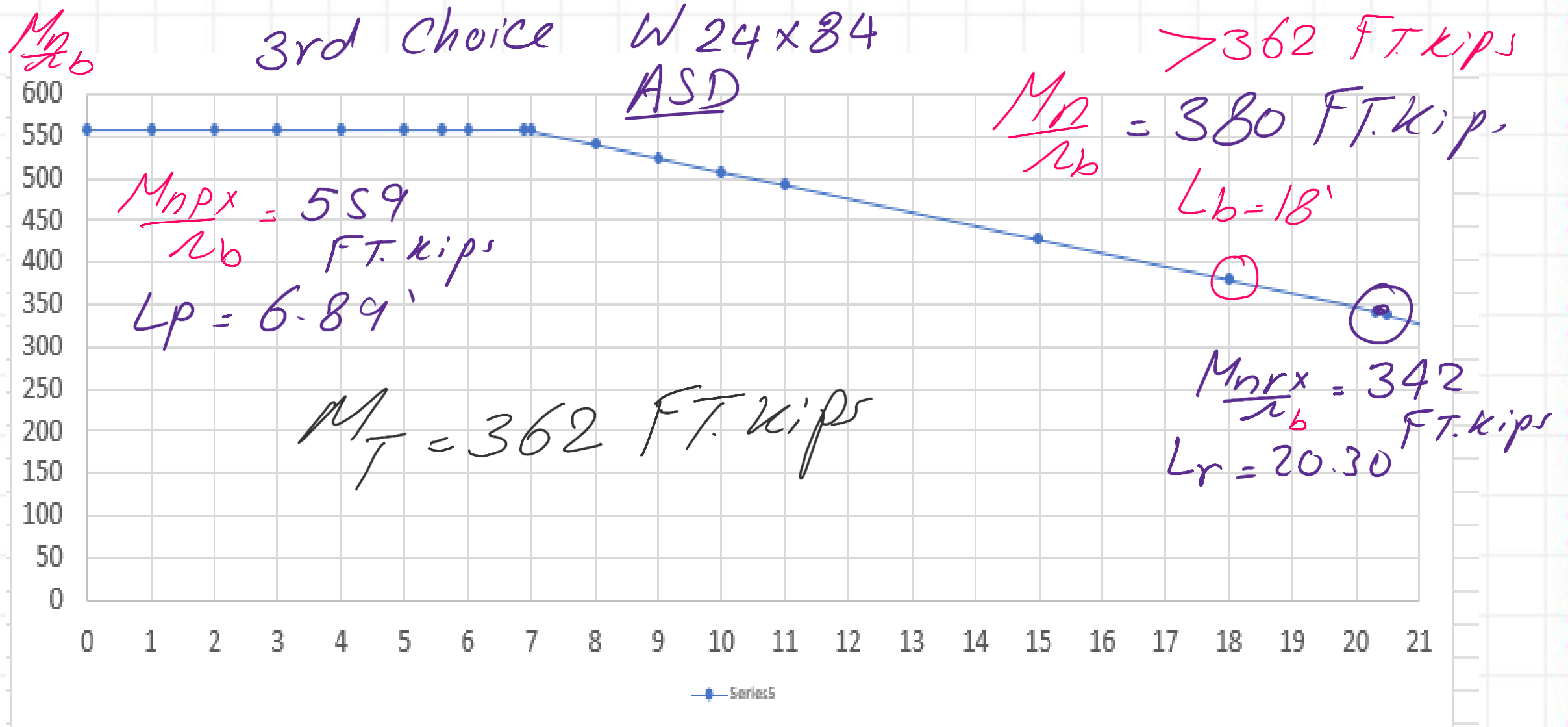
$$\phi_b M_{rx} =$$

$$L_r = 20.30'$$

$L_r = 20.30'$
 Line

L_b





Prepared by Eng.Maged Kamel.

Conclusion

: We have obtained Three
W24x62 Choices to find the Final
Wsection Using Table 3-2
For a given L_b & M_u & M_T

W21x68

W24x84

Last choice matches with Table 3-10

But: only one selection using Table 3-10
that saves our time

W24x84