

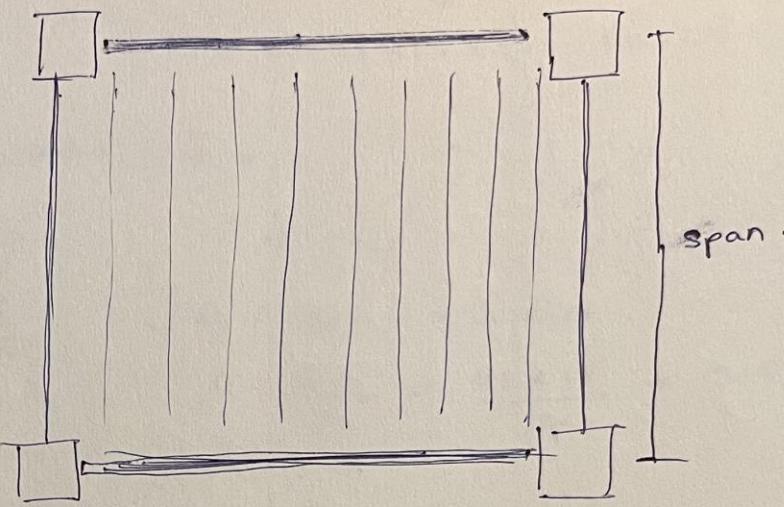
# Recitation 2

Wood Beam Design

# WOOD BEAM DESIGN

Q).

- Design 2x dimensional lumber.
- Floor meets condition 4.4.1
- $C_L = 1.0$ ,  $C_t = C_{fu} = C_i = 1.0$ .
- Wood species = spruce-fir-fir
- Wood grade = No. 1 / No. 2
- Span = 18 ft
- joist spacing, O.C = 12 IN
- Moisture content, M.C = 18 %
- Floor DL = 7 PSF
- Floor UL = 35 PSF



Answer)

- Q1) Tabulated Allow. Bonding stress ( $F_b$ ) = 875 psi (Table 4A - supplement).
- Q2) Tabulated Allow. Shear stress ( $F_v$ ) = 135 psi (Table 4A - supplement).
- Q3) Tabulated Modulus of elasticity ( $E$ ) = 1,400,000 psi (Table 4A - supplement).
- Q4) Total applied floor load ( $D_L + U_L$ ) =  $7 + 35 = 42$  PSF (Total load).
- Q5) Load on joist ( $w$ ) = [Total load]  $\times$  O.C (joist spacing)  $\times \frac{1\text{ft}}{12\text{in}}$   
 $= 42 \times 12 \times \frac{1}{12} = 42$  PSF

Table 4A  
(Cont.) Reference Design Values for Visually Graded Dimension Lumber  
(2" - 4" thick)<sup>1-2-3</sup>

(All species except Southern Pine — see Table 4B) (Tabulated design values are for normal load duration and dry service conditions. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4A ADJUSTMENT FACTORS

Species and commercial grade	Size classification	Design values in pounds per square inch (psi)						Specific Gravity <sup>4</sup> G	Grading Rules Agency
		Bending $F_b$	Tension parallel to grain $F_t$	Shear parallel to grain $F_v$	Compression perpendicular to grain $F_{tg}$	Compression parallel to grain $F_{pg}$	Modulus of Elasticity $E$		
<b>RED OAK</b>									
Select Structural		1,150	675	170	820	1,000	1,400,000	510,000	
No. 1	2" & wider	825	500	170	820	825	1,300,000	470,000	
No. 2		800	475	170	820	625	1,200,000	440,000	
No. 3		475	275	170	820	375	1,100,000	400,000	0.67 NELMA
Stud	2" & wider	625	375	170	820	400	1,100,000	400,000	
Construction		925	550	170	820	850	1,200,000	440,000	
Standard	2" - 4" wide	525	300	170	820	650	1,100,000	400,000	
Utility		250	150	170	820	425	1,000,000	370,000	
<b>REDWOOD</b>									
Select Structural		1,750	1,000	160	650	1,850	1,400,000	510,000	0.44
Select Structural, open grain		1,350	800	160	650	1,500	1,400,000	510,000	0.44
No. 1	2" & wider	1,100	625	160	650	1,100	1,100,000	400,000	0.37
No. 1, open grain		975	575	160	650	1,200	1,300,000	470,000	0.44
No. 2		925	525	160	650	950	1,200,000	440,000	0.44
No. 2, open grain		725	425	160	425	700	1,000,000	370,000	0.37 RIS
No. 3		525	300	160	650	550	1,100,000	400,000	0.44
No. 3, open grain		425	250	160	425	400	900,000	330,000	0.37
Stud	2" & wider	575	325	160	425	450	900,000	330,000	0.44
Construction		825	475	160	425	925	900,000	330,000	0.44
Standard	2" - 4" wide	450	275	160	425	725	900,000	330,000	0.44
Utility		225	125	160	425	475	800,000	290,000	0.44
<b>SPRUCE-PINE-FIR</b>									
Select Structural		1,250	700	135	425	1,400	1,500,000	550,000	
No. 1/No. 2	2" & wider	875	450	135	425	1,150	1,400,000	510,000	
No. 1		500	220	135	425	650	1,200,000	440,000	
Stud		675	350	135	425	725	1,200,000	440,000	0.42 NLGA
Construction		1,000	500	135	425	1,400	1,300,000	470,000	
Standard	2" - 4" wide	550	275	135	425	1,150	1,200,000	440,000	
Utility		275	125	135	425	750	1,100,000	400,000	

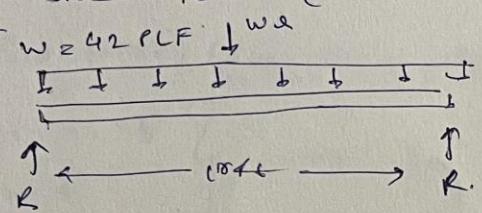
Q6) Actual Beam Bending Moment ( $M$ ) :

$$\frac{wL^2}{8} = \frac{w(\text{span})^2}{8}$$

$$= \frac{42 \times (18)^2}{8}$$

$$= 1181.25 \text{ Ft-LB.}$$

Q7). Actual Maximum Shear Force (at Reaction) ( $V$ ) :



$$V = R$$

$$\Sigma F_y = 2R - wL = 0.$$

$$R = \frac{wL}{2} = \frac{42 \times 18}{2} = 315 \text{ LBS.}$$

Q8). Nominal Depth of final joist used.

Part 1:- Estimate allowable stress

Bending stress

$$F'_b = F_b (C_M \times C_F \times C_r); \text{ since } C_L = C_f = C_{fu} = C_i = C_p = 1 \text{ (given)}.$$

•  $C_r \Rightarrow \Delta_{10}$  (lets solve  $\Delta_{10}$  first) (Repetitive member factor):-

if  $O.C \leq 24$  in ;  $C_r = 1.15$

if  $O.C > 24$  in ;  $C_r = 1$

(Table 4A :- Adjustment factors).

in this case  $O.C = 12$  in  $< 24$  in

$$\therefore C_r = 1.15$$

Solving  
for  
 $\Delta_{10}$ .

•  $C_M \Rightarrow \Delta_{11}$  (Next step) (Wet service factor for  $F_b$ ;  $C_{M-b}$ ) :-

if m.c.  $\leq 19\%$ , then  $C_{M-b} = 1$

if m.c.  $> 19\%$ , and  $F_b \times C_F \leq 1,150$  psi ;  $C_M = 1$

$\square \rightarrow F_b \times C_F > 1,150$  psi ; then  $C_{M-b} = 0.85$

in this case m.c.  $= 15\%$

$$\therefore C_M = 1$$

Solving  
for  
 $\Delta_{11}$ .

(Table 4A :- Adjustment factors)

•  $C_D = 1$  (for occupancy loads). (from table 2-3-2) (NDS code).

### Repetitive Member Factor, $C_r$

Bending design values,  $F_b$ , for dimension lumber 2" to 4" thick shall be multiplied by the repetitive member factor  $C_r = 1.15$ , when such members are used as joists, truss chords, rafters, studs, planks, decking, or similar members which are in contact or spaced not more than 24" on center, are not less than 3 in number and are joined by floor, roof, or other load distributing elements adequate to support the design load.

### Wet Service Factor, $C_M$

When dimension lumber is used where moisture content will exceed 19% for an extended time period, design values shall be multiplied by the appropriate wet service factors from the following table:

Wet Service Factors, $C_M$						
$F_b$	$F_t$	$F_v$	$F_{cL}$	$F_c$	E and $E_{min}$	
0.85*	1.0	0.97	0.67	0.8**	0.9	

\* when  $(F_b)(C_r) \leq 1,150$  psi,  $C_M = 1.0$

\*\* when  $(F_b)(C_r) \leq 750$  psi,  $C_M = 1.0$

**Table 2.3.2 Frequently Used Load Duration Factors,  $C_D$ <sup>1</sup>**

Load Duration	$C_D$	Typical Design Loads
Permanent	0.9	Dead Load
Ten years	1.0	Occupancy Live Load
Two months	1.15	Snow Load
Seven days	1.25	Construction Load
Ten minutes	1.6	Wind/Earthquake Load
Impact <sup>2</sup>	2.0	Impact Load

1. Load duration factors shall not apply to reference modulus of elasticity, E, reference modulus of elasticity for beam and column stability,  $E_{min}$ , nor to reference compression perpendicular to grain design values,  $F_{cL}$ , based on a deformation limit.

2. Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with water-borne preservatives (see Reference 30), or fire retardant chemicals. The impact load duration factor shall not apply to connections.

④ Currently we don't know CF, in this case we can estimate or skip.

$$F'_b = 875 (C_m \times C_F \times C_r) = 875 (1.15 \times C_F \times 1)$$

$$\approx 875 \times 1.15 \times C_F$$

$$\frac{= 1006.25 \times C_F}{\approx 1006.25 \text{ psi}}$$

④ Notes -

(not final) (don't put this as  
ans. in website).]

Shear stress :-

$$F'_v = F_v (C_D \times \underbrace{(C_m)}_1 \times C_t \times C_i) \rightarrow \text{for this lets solve Q12).}$$
$$= 135 (1 \times 1 \times 1 \times 1)$$
$$\boxed{F'_v = 135 \text{ psi}}$$

Wet service factor for  $F_v$ ,  $C_{M-v}$  :-

if M.C.  $\leq 19\%$ . then  $C_{M-v} = 1$

if M.C.  $> 19\%$ . then  $C_{M-v} = 0.94$ .

(Answer for Q14)

in this case M.C = 15%.

So,  $C_{M-v} = 1$

Answer of Q14

Part 2 :-

assume :-  $f_b = F'_b$  and use  $f_b = \frac{M}{S_x}$ ; to solve for  $S_x$ .

$$\cancel{S_x = \frac{M}{f_b}} \quad S_x = \frac{M}{F'_b} = \frac{1181.25}{1006.25} \times 12 = [14.086 \text{ in}^3]$$

- check table 1B on pg 22 of supplement, find the 2x's with the closest  $S_x$  value to  $S_x$ -approx. :-

in this case, 2x8 has  $S_x = 13.14 \text{ in}^3$  (might work) and 2x10 has  $S_x = 21.39 \text{ in}^3$ .

for 2x8

$$A = 10.88 \text{ in}^2$$

$$S_x = 13.14 \text{ in}^3$$

$$I_x = 47.63 \text{ in}^4$$

for 2x10

$$A = 13.88 \text{ in}^2$$

$$S_x = 21.39 \text{ in}^3$$

$$I_x = 88.93 \text{ in}^4$$

1x12	3/4 x 11-1/4	8.438	15.82	88.99	1.055	0.396	1.465	1.758	2.051	2.344	2.637	2.930
<b>Dimension Lumber (see NDS 4.1.3.2) and Decking (see NDS 4.1.3.5)</b>												
2 x 3	1-1/2 x 2-1/2	3.750	1.56	1.953	0.938	0.703	0.651	0.781	0.911	1.042	1.172	1.302
2 x 4	1-1/2 x 3-1/2	5.250	3.06	5.359	1.313	0.984	0.911	1.094	1.276	1.458	1.641	1.823
2 x 5	1-1/2 x 4-1/2	6.750	5.06	11.39	1.688	1.266	1.172	1.406	1.641	1.875	2.109	2.344
2 x 6	1-1/2 x 5-1/2	8.250	7.56	20.80	2.063	1.547	1.432	1.719	2.005	2.292	2.578	2.865
2 x 8	1-1/2 x 7-1/4	10.88	13.14	47.63	2.719	2.039	1.888	2.266	2.643	3.021	3.398	3.776
2 x 10	1-1/2 x 9-1/4	13.88	21.39	98.93	3.469	2.602	2.409	2.891	3.372	3.854	4.336	4.818
2 x 12	1-1/2 x 11-1/4	16.88	31.64	178.0	4.219	3.164	2.930	3.516	4.102	4.688	5.273	5.859
2 x 14	1-1/2 x 13-1/4	19.88	43.89	290.8	4.969	3.727	3.451	4.141	4.831	5.521	6.211	6.901
3 x 4	2-1/2 x 3-1/2	8.75	5.10	8.932	3.646	4.557	1.519	1.823	2.127	2.431	2.734	3.038
3 x 5	2-1/2 x 4-1/2	11.25	8.44	18.98	4.688	5.859	1.953	2.344	2.734	3.125	3.516	3.906
3 x 6	2-1/2 x 5-1/2	13.75	12.60	34.66	5.729	7.161	2.387	2.865	3.342	3.819	4.297	4.774
3 x 8	2-1/2 x 7-1/4	18.13	21.90	79.39	7.552	9.440	3.147	3.776	4.405	5.035	5.664	6.293
3 x 10	2-1/2 x 9-1/4	23.13	35.65	164.9	9.635	12.04	4.015	4.818	5.621	6.424	7.227	8.030
3 x 12	2-1/2 x 11-1/4	28.13	52.73	296.6	11.72	14.65	4.883	5.859	6.836	7.813	8.789	9.766
3 x 14	2-1/2 x 13-1/4	33.13	73.15	484.6	13.80	17.25	5.751	6.901	8.051	9.201	10.35	11.50
3 x 16	2-1/2 x 15-1/4	38.13	96.90	738.9	15.89	19.86	6.619	7.943	9.266	10.59	11.91	13.24
4 x 4	3-1/2 x 3-1/2	12.25	7.15	12.51	7.146	12.51	2.127	2.552	2.977	3.403	3.828	4.253
4 x 5	3-1/2 x 4-1/2	15.75	11.81	26.58	9.188	16.08	2.734	3.281	3.828	4.375	4.922	5.469
4 x 6	3-1/2 x 5-1/2	19.25	17.65	48.53	11.23	19.65	3.342	4.010	4.679	5.347	6.016	6.684
4 x 8	3-1/2 x 7-1/4	25.38	30.66	111.1	14.80	25.90	4.405	5.286	6.168	7.049	7.930	8.811
4 x 10	3-1/2 x 9-1/4	32.38	49.91	230.8	18.89	33.05	5.621	6.745	7.869	8.993	10.12	11.24
4 x 12	3-1/2 x 11-1/4	39.38	73.83	415.3	22.97	40.20	6.836	8.203	9.570	10.94	12.30	13.67
4 x 14	3-1/2 x 13-1/4	46.38	102.41	678.5	27.05	47.34	8.051	9.661	11.27	12.88	14.49	16.10
4 x 16	3-1/2 x 15-1/4	53.38	135.66	1034	31.14	54.49	9.266	11.12	12.97	14.83	16.68	18.53

Timbers (5" x 5" and larger)<sup>2</sup>

Part 3 :- check that the selected ~~ex works~~ ( $C_f v \leq f'_v$ ) and ( $F_b \leq F'_b$ ).

\* start with smaller beam if it works, use this value for nominal depth. otherwise, move select the larger beam dimension.

\* save your values for this section. If you pass, you can use them for later answer.

$$F'_b = F_b (C_M \times C_F \times C_r)$$

$$= 875 (1 \times C_F \times 1.15)$$

$$= 875 \times 1 \times 1.2 \times 1.15$$

$$\approx 1207.5 \text{ PSI}$$

$$f_b = \frac{M}{S_x} = \frac{1181.25}{13.14} \times \frac{1}{14} \times 14$$

$$= 1078.76 \text{ PSI}$$

answer of 1078.76  $\textcircled{2}$

$$\therefore f_b < F'_b \quad (\text{so pass})$$

Table 4A on pg 40 of supplement.

$C_F \text{ for } = 2'' \times 8''$

$$\boxed{C_F = 1.2}$$

$\textcircled{1}$  if the left case passes then  
that is the  $C_F$  value.

$$\therefore C_F = 1.2 \rightarrow \text{Answer for Qg}$$

$\textcircled{2}$  if the left case passes then  
nominal depth is correct

$$\left\{ \therefore d = 8'' \right\} \text{ Answer for Qg}$$

#### Size Factor, $C_F$

Tabulated bending, tension, and compression parallel to grain design values for dimension lumber 2" to 4" thick shall be multiplied by the following size factors:

Size Factors,  $C_F$

Grades	Width (depth)	$F_b$		$F_t$	$F_c$
		Thickness (breadth)		$F_t$	$F_c$
		2" & 3"	4"		
Select Structural, No.1 & Br, No.1, No.2, No.3	2", 3", & 4"	1.5	1.5	1.5	1.15
	5"	1.4	1.4	1.4	1.1
	6"	1.3	1.3	1.3	1.1
	8"	1.2	1.3	1.2	1.05
	10"	1.1	1.2	1.1	1.0
	12"	1.0	1.1	1.0	1.0
	14" & wider	0.9	1.0	0.9	0.9
Stud	2", 3", & 4"	1.1	1.1	1.1	1.05
	5" & 6"	1.0	1.0	1.0	1.0
	8" & wider	Use No.3 Grade tabulated design values and size factors			
Construction, Standard Utility	2", 3", & 4"	1.0	1.0	1.0	1.0
	4"	1.0	1.0	1.0	1.0
	2" & 3"	0.4	—	0.4	0.6

$$f_v = \frac{3}{2} \frac{V}{A}$$

use table Table 1B on pg 22 to find area.

$$f_v = 1.5 \times \frac{315}{10.88} = 43.428 \text{ psi}$$

← Answer to Q16)

$$f_v < f'_v \rightarrow \boxed{\text{so pass.}}$$

∴ Beam 2x8 passes, nominal depth  $d = 8$  in.

Dimension Lumber (see NDS 4.1.3.2) and Decking (see NDS 4.1.3.5)									
2 x 3	1-1/2 x 2-1/2	3.750	1.56	1.953	0.938	0.703	0.651	0.781	0.911
2 x 4	1-1/2 x 3-1/2	5.250	3.06	5.359	1.313	0.984	0.911	1.094	1.276
2 x 5	1-1/2 x 4-1/2	6.750	5.06	11.39	1.688	1.266	1.172	1.406	1.641
2 x 6	1-1/2 x 5-1/2	8.250	7.56	20.80	2.063	1.547	1.432	1.719	2.005
2 x 8	1-1/2 x 7-1/4	10.88	13.14	47.63	2.719	2.039	1.888	2.266	2.643
2 x 10	1-1/2 x 9-1/4	13.88	21.39	98.93	3.469	2.602	2.409	2.891	3.372
2 x 12	1-1/2 x 11-1/4	16.88	31.64	178.0	4.219	3.164	2.930	3.516	4.102
2 x 14	1-1/2 x 13-1/4	19.88	43.89	290.8	4.969	3.727	3.451	4.141	4.831
3 x 4	2-1/2 x 3-1/2	8.75	5.10	8.932	3.646	4.557	1.519	1.823	2.127
3 x 5	2-1/2 x 4-1/2	11.25	8.44	18.98	4.688	5.859	1.953	2.344	2.734
3 x 6	2-1/2 x 5-1/2	13.75	12.60	34.66	5.729	7.161	2.387	2.865	3.342
3 x 8	2-1/2 x 7-1/4	18.13	21.90	79.39	7.552	9.440	3.147	3.776	4.405
3 x 10	2-1/2 x 9-1/4	23.13	35.65	164.9	9.635	12.04	4.015	4.818	5.621
3 x 12	2-1/2 x 11-1/4	28.13	52.73	296.6	11.72	14.65	4.883	5.859	6.836
3 x 14	2-1/2 x 13-1/4	33.13	73.15	484.6	13.80	17.25	5.751	6.901	8.051
3 x 16	2-1/2 x 15-1/4	38.13	96.90	738.9	15.89	19.86	6.619	7.943	9.266
4 x 4	3-1/2 x 3-1/2	12.25	7.15	12.51	7.146	12.51	2.127	2.552	2.977
4 x 5	3-1/2 x 4-1/2	15.75	11.81	26.58	9.188	16.08	2.734	3.281	3.828
4 x 6	3-1/2 x 5-1/2	19.25	17.65	48.53	11.23	19.65	3.342	4.010	4.679
4 x 8	3-1/2 x 7-1/4	25.38	30.66	111.1	14.80	25.90	4.405	5.286	6.168
4 x 10	3-1/2 x 9-1/4	32.38	49.91	230.8	18.89	33.05	5.621	6.745	7.869
4 x 12	3-1/2 x 11-1/4	39.38	73.83	415.3	22.97	40.20	6.836	8.203	9.570
4 x 14	3-1/2 x 13-1/4	46.38	102.41	678.5	27.05	47.34	8.051	9.661	11.27
4 x 16	3-1/2 x 15-1/4	53.38	135.66	1034	31.14	54.49	9.266	11.12	12.97

Q17) Factored allow. Modulus of elasticity,  $E'$

$$\begin{aligned} E' &= E(C_m \times C_t \times C_i) \\ &= 1,400,000 (1 \times 1 \times 1) \\ \boxed{E' = 1,400,000 \text{ psi}} \end{aligned}$$

if m.c.  $\leq 19^{\circ}\text{l}$ , then  $C_{M-E} = 1$ .  
 if m.c.  $> 19^{\circ}\text{l}$ , then  $C_{M-E} = 0.9$   
 in this case m.c. =  $15^{\circ}\text{l} < 19^{\circ}\text{l}$ .  
 ∴  $C_{M-E} = 1$ .

formula on pg 41  
of NDS code

Table 4-3-1.

Table 4-4  
pg 40.

Q18). Short term deflection for 100' L.L

$$\Delta_{LL} = \frac{5w\lambda^4}{384(e)(I)}$$

↑ ~~2008~~

formula from lecture notes.

use table 1B to find I

$$w = L_{\text{Total}} \times \frac{O.C}{12} = 42 \times \frac{12}{12} = 42 \text{ PLF.}$$

for unit conversion ( $12^3 = 1728$ ).

$$\Delta_{LL} = \frac{5 \times 42 \times (15)^4 \times 1728}{384 \times 1,400,000 \times 47.65}$$

$$\Delta_{LL} = 0.5978 \text{ in}$$

Q19). Short term deflection from  $L/360$  :-

$$\frac{L}{360} = \frac{15 \times 12}{360} = 0.5 \text{ in}$$

(Pass = 1) or (Fail = 0)

Q20) Deflection passing

$$\Delta_{LL} > L/360 \rightarrow \therefore \text{fail} = \underline{\underline{0}}$$

Dimension Lumber (see NDS 4.1.3.2) and Decking (see NDS 4.1.3.5)												
2 x 3	1-1/2 x 2-1/2	3.750	1.56	1.953	0.938	0.703	0.651	0.781	0.911	1.042	1.172	1.302
2 x 4	1-1/2 x 3-1/2	5.250	3.06	5.359	1.313	0.984	0.911	1.094	1.276	1.458	1.641	1.823
2 x 5	1-1/2 x 4-1/2	6.750	5.06	11.39	1.688	1.266	1.172	1.406	1.641	1.875	2.109	2.344
2 x 6	1-1/2 x 5-1/2	8.250	7.56	20.80	2.063	1.547	1.432	1.719	2.005	2.292	2.578	2.865
2 x 8	1-1/2 x 7-1/4	10.88	13.14	47.63	2.719	2.039	1.888	2.266	2.643	3.021	3.398	3.776
2 x 10	1-1/2 x 9-1/4	13.88	21.39	98.93	3.469	2.602	2.409	2.891	3.372	3.854	4.336	4.818
2 x 12	1-1/2 x 11-1/4	16.88	31.64	178.0	4.219	3.164	2.930	3.516	4.102	4.688	5.273	5.859
2 x 14	1-1/2 x 13-1/4	19.88	43.89	290.8	4.969	3.727	3.451	4.141	4.831	5.521	6.211	6.901
3 x 4	2-1/2 x 3-1/2	8.75	5.10	8.932	3.646	4.557	1.519	1.823	2.127	2.431	2.734	3.038
3 x 5	2-1/2 x 4-1/2	11.25	8.44	18.98	4.688	5.859	1.953	2.344	2.734	3.125	3.516	3.906
3 x 6	2-1/2 x 5-1/2	13.75	12.60	34.66	5.729	7.161	2.387	2.865	3.342	3.819	4.297	4.774
3 x 8	2-1/2 x 7-1/4	18.13	21.90	79.39	7.552	9.440	3.147	3.776	4.405	5.035	5.664	6.293
3 x 10	2-1/2 x 9-1/4	23.13	35.65	164.9	9.635	12.04	4.015	4.818	5.621	6.424	7.227	8.030
3 x 12	2-1/2 x 11-1/4	28.13	52.73	296.6	11.72	14.65	4.883	5.859	6.836	7.813	8.789	9.766
3 x 14	2-1/2 x 13-1/4	33.13	73.15	484.6	13.80	17.25	5.751	6.901	8.051	9.201	10.35	11.50
3 x 16	2-1/2 x 15-1/4	38.13	96.90	738.9	15.89	19.86	6.619	7.943	9.266	10.59	11.91	13.24
4 x 4	3-1/2 x 3-1/2	12.25	7.15	12.51	7.146	12.51	2.127	2.552	2.977	3.403	3.828	4.253
4 x 5	3-1/2 x 4-1/2	15.75	11.81	26.58	9.188	16.08	2.734	3.281	3.828	4.375	4.922	5.469
4 x 6	3-1/2 x 5-1/2	19.25	17.65	48.53	11.23	19.65	3.342	4.010	4.679	5.347	6.016	6.684
4 x 8	3-1/2 x 7-1/4	25.38	30.66	111.1	14.80	25.90	4.405	5.286	6.168	7.049	7.930	8.811
4 x 10	3-1/2 x 9-1/4	32.38	49.91	230.8	18.89	33.05	5.621	6.745	7.869	8.993	10.12	11.24
4 x 12	3-1/2 x 11-1/4	39.38	73.83	415.3	22.97	40.20	6.836	8.203	9.570	10.94	12.30	13.67
4 x 14	3-1/2 x 13-1/4	46.38	102.41	678.5	27.05	47.34	8.051	9.661	11.27	12.88	14.49	16.10
4 x 16	3-1/2 x 15-1/4	53.38	135.66	1034	31.14	54.49	9.266	11.12	12.97	14.83	16.68	18.53