DUMACK ENGINEERING
CIVIL - STRUCTURAL ENGINEERS & SURVEYORS
677 DURHAM ROAD *P.O. BOX 487 * PENNS PARK, PA 18943
(215)598-1230

SHEET NO. 1 OF 8
JOB NO. 5115
PROJECT: VIXEN HILL 21' GAZEBO
BY: RCD DATE: 6-22-12

21' OCTAGONAL, SINGLE-TIERED ROOF GAZEBO
MFG'D BY VIXEN HILL CEDAR PRODUCTS.
P.O. BOX 389, ELVERSON, PA. 19520

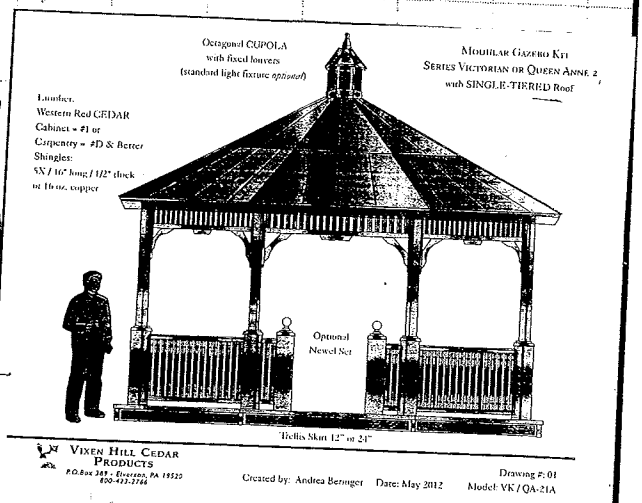
STRUCTURAL DESIGN CALCULATIONS:

LOCATION: BARTLETT, ILLINOIS 60103

CODES:

IBC 2006
A.C.I. 318
ASCE 7-05

LICENSED STRUCTURAL ENGINEER
RALPH C DUMACK
081-003653
6-28-12
STATE OF ILLINOIS



MATERIALS:

CONCRETE: A.C.I. 318-02
WOOD: #1 WESTERN CEDAR
STEEL: ASTM A-36

REFERENCE DRAWINGS:

VIXEN HILL DRAWINGS VK/QA-21A #01 to #09
" " SHELTER FOOTING DETAIL #8

WIND ANALYSIS:

LOADING AS PER ASCE-7-05

WIND VELOCITY, V = 90 MPH
IMPORTANCE, I = 1.0

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SHEET NO. 2 OF 8
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PROJECT: VIXEN HILL 21 GAZEBO
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WIND LOADING, CONT'D

OPEN BUILDING W/PITCHED FREE ROOF
ASCE 7, SEC 6.5.13

NET DESIGN PRESSURE:

$$P = q_h G C_N$$

$G = 0.85$

$$q_h = 0.00256 \times K_z K_{zt} K_d V^2 I$$

V = 90 mph

$K_d = 0.85$, TABLE 6-4

$K_{zt} = 1.00$

$$K_z = 2.01 \times \left(\frac{z}{z_g}\right)^{\frac{2}{\alpha}}$$

$\alpha = 9.5$

$z_g = 900$

$K_z = 0.85$

$q_h = 0.00256 \times 0.85 \times 0.85 \times 90^2$

$= 14.98$ PSF

$C_N = 1.3$, $C_{NL} = -0.7$ (FIG. 6-18C)

P_W (WINDWARD) = 16.56 PSF

P_L (LEEWARD) = −8.92 PSF

} ACTING CONCURRENTLY

SAIL AREAS

ROOF = $7 \times 20.8 \times \frac{1}{2} = 72.8$ S.F.
COL'S = $8 \times 0.7 \times 10 = 56$
EAVE TRUSS = $1.5 \times 18 = 27$
RAILING = $3.5 \times 18 = 63$

WIND LOAD (SHEAR)

ROOF = $72.8 \times (16.6 + 9.0)$	= 1,864	#
COL'S = 56×16.6	= 930	
EAVES = 27×16.6	= 448	} TOTAL = 4,288 #
RAILING = 63×16.6	= 1046	

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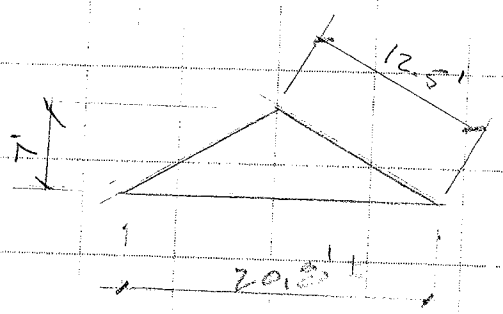
SHEET NO. 3 OF 8
JOB NO. 5115
PROJECT: VIXEN HILL 21' GAZEBO
BY: RCD DATE: 6-25-12

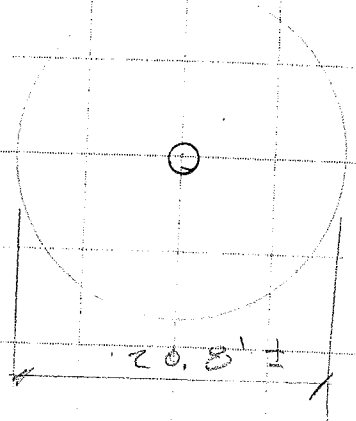
WIND LOADING (CONT'D):

WIND O.T. MOM

ROOF	1,864 × (0.67 × 7 + 11.8) (12.47)	=	23,164 #
COL's	930 × 8.3	=	7,719
EAVES	448 × 10.4	=	4,659
H.R.	1,046 × 3.0	=	3,138
	TOTAL	=	38,685 ft

DEAD LOAD OF GAZEBO





ROOF SURFACE AREA = $\pi \times r (r^2 + h^2)^{1/2}$

$= \pi \times 10.4 \times (10.4^2 + 7^2)^{1/2} = 410$ S.F.

EST. TOTAL D.L. ROOF = 5 × 410 = 2,050 #

EST. TOTAL L.L. (SNOW) = $\pi \times 20.8^2 \times \frac{1}{4} \times 15 = 5,097$ # (SEE BELOW)

SNOW LOAD: ASCE 7-05

$P_g = 25$ PSF; $P_f = 0.7 \times C_e \times C_t \times I \times P_g$

C_e = EXPOSURE FACTOR = 0.9 (TABLE 7-2)
C_t = THERMAL FACTOR = 1.2 (UNHEATED) (TABLE 7-3)
I = IMPORTANCE FACTOR = 0.8 (CONSTRUCTION)

$P_f = 0.7 \times 0.9 \times 1.2 \times 0.8 \times 25 = 15$ PSF

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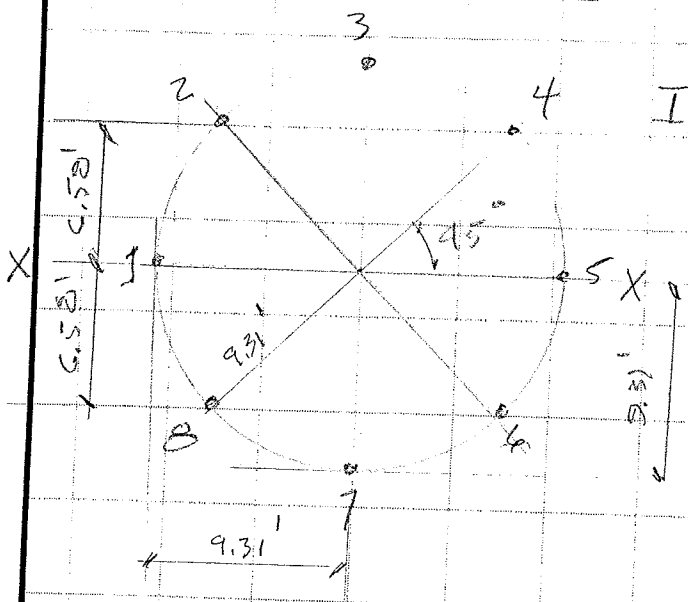
SHEET NO. 4 OF 8
JOB NO. 5115
PROJECT: VIXEN HILL CT GAZEBO
BY: RCD. DATE: 6-25-12

COLUMN PATTERNS (OCTAGONAL)

ORIENTATION "A":



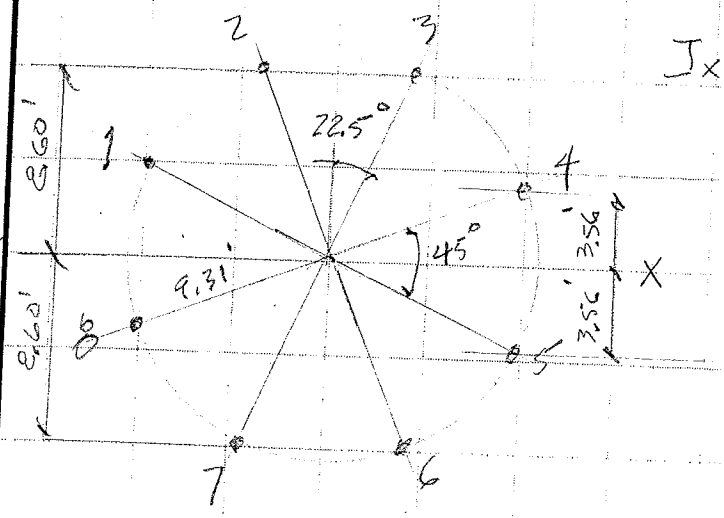
$I_x = 2 \times 1 \times 9.31^2 + 4 \times 1 \times 6.52^2$

$= 346.6 \text{ FT}^4$ (GOVERNS!)

PT's #3 & #7 $S_x = \frac{346.6}{9.31} = 37.3 \text{ FT}^3$

PT's #2, #4, #6 & #8 $S_x = \frac{346.6}{6.52} = 52.7 \text{ FT}^3$

ORIENTATION "B":



$J_x = 4 \times 1 \times 3.56^2 + 4 \times 1.0 \times 8.60^2$

$= 346.5 \text{ FT}^4$

PT's #1, #4, #5 & #8 $S_x = 346.5 \times \frac{1}{3.56} = 97.4 \text{ FT}^3$

PT's #2, #3, #6 & #7 $S_x = \frac{346.5}{8.60} = 40.3 \text{ FT}^3$

DUMACK ENGINEERING

CIVIL - STRUCTURAL ENGINEERS & SURVEYORS

Project Name: YIXEN HILLS GAZEBO

Date: 6-25-12 Job No. 5115

By: RCD Sheet 5 of 6

ROOF DESIGN

WOOD LATH 5/4 x 4" = 1¼ + ½ Av. SPACING = ½ + ¾ = 3¼"

No LATHS/FT = 12/3.25 = 3.7 ; A = 1.25 x 3.5 = 4.375 in²

MAX SPAN (OUTER ROOF) = 2'-10" ± DL = 20 PSF

STM/FT = 3.7 x 3.5 x 1.25² x 1/6 = 3.37 in³/FT

V = 20 x 2.83 x ½ = 28.3 # ; MOM/FT = 20 x 2.83² x ½ = 20 ft#

$f_b = \frac{20 \times 12}{3.37} = 71.2\ \# < 975\ \#$

$f_v = \frac{1.5 \times 28.3}{4.375} = 9.7\ \# < 140\ \#$ ∴ OK

ROOF RAFTERS:

OUTER ROOF INTERIOR JOIST; SPAN = 7½ x ½ = 6.5'

w = 2.8 x 20 = 56 #/' R = 56 x 3.5 x ½ = 182 #

TM = 56 x 6.5² x ½ = 296 ft#

FOR 2x6's A = 8.25 in²

STM = 1.5 x 5.5² x 1/6 = 7.56 in³

$f_b = \frac{296 \times 12}{7.56} = 470\ \# < 975\ \#$

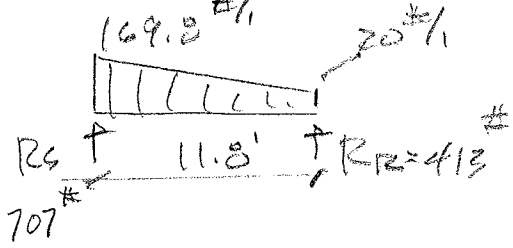
$f_v = \frac{1.5 \times 182}{8.25} = 33.1\ \# < 140\ \#$ ∴ OK

USE 2x6's FOR OUTER & INNER RAFTERS

PERIMETER RAFTERS:

MAX. MOM = 1,679 ft#

USE 2-3x6's; A = 27.5 in² STM = 25.2 in³



$f_b = \frac{1,679 \times 12}{25.2} = 800\ \# < 975\ \#$

$f_v = \frac{1.5 \times 707}{27.5} = 38.6\ \# < 140\ \#$ ∴ OK

COLUMN DESIGN:

D+SNOW/COL = (2,050 + 5,097) × 1/2 = 893.4 # (SH #3, D, SNOW)

WIND SHEAR/COL = 4,288 × 1/2 = 536 # (SH #2)

MAX WIND O.T. MOM = 30,685 in# (SH #3)

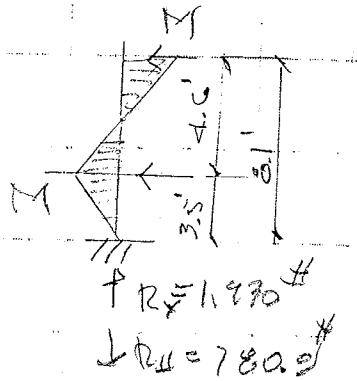
MAX VERT WIND DOWN/COL = 30,685 / 27.7 = 1,037 # ↓

MAX VERT WIND UPLIFT/COL = 35,085 / 37.3 = 1,037 # ↑

M = 536 × 2.3 = 1,232.8 in#

MAX R↓ = 893.4 + 1,037 = 1,930.4 # (D+C, WIND)

MAX NET UPLIFT R↑ = 1,037 − 0.9 × 2050/2 = 780.9 ↓



TRY 6 × 6 ; A = 5.5² = 30.25 in²

STM = 5.5 × 5.5² × 1/6 = 27.7 in³

$f_b = \frac{1,232.8 \times 12}{27.7} = 534\,\text{psi} < 975 \therefore \text{ok}$

$f_a = \frac{893.4 + 1,037}{30.25} = 63.8\,\text{psi}$ (D+C, WIND)

$\frac{l}{d} = \frac{4.6 \times 12}{5.5} = 10.0$

$F_a = \frac{0.3 \times E}{(\frac{l}{d})^2} = \frac{0.3 \times 1,000,000}{(10)^2} > 425\,\text{psi} \therefore \text{ok}$

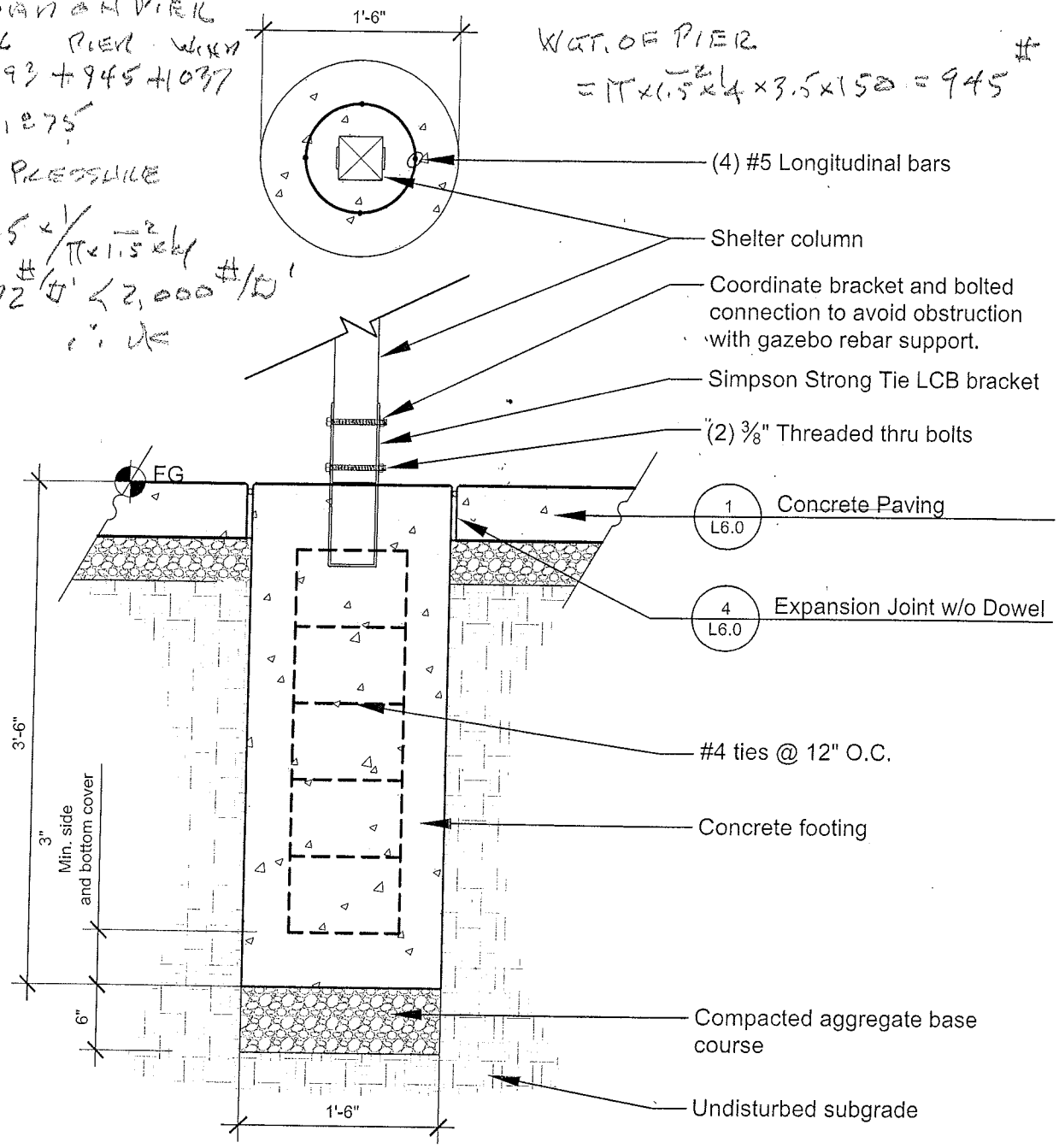
MAX NET UPLIFT

$= 1,037 - 0.9 \times \underset{1,845}{2,050} = 302$ # ↓

MAX COMMON PIER
D+L PIER WGHT
$P_{TOTAL} = 893 + 945 + 1037$
$= 2,875^{\#}$

MAX SOIL PRESSURE
$P = 2,875^{\#} / \pi \times 1.5^2 \text{ sq ft}$
$= 1,972^{\#}/\text{sq ft} < 2,000^{\#}/\text{sq ft}$
∴ OK

WGT. OF PIER
$= \pi \times 1.5^2 \times 4 \times 3.5 \times 150 = 945^{\#}$



8 Shelter Footing

d-foot-shelter
1" = 1'-0"

CHECK UPLIFT SAFETY FACTOR

D.L. = $0.9 \times 2850 = 1,845^{\#}$ } $2,790^{\#}$, NET UPLIFT = $808^{\#}$
PIER = 945

UPLIFT SAFETY FACTOR, SF = $\frac{2,790}{808} = 3.45 > 1.5$ ∴ OK

VIKEN HILLS GAZEBO, SHEET 8 OF 8

Table 4D (Cont.) Design Values for Visually Graded Timbers (5" x 5" and larger)[1]

(Tabulated design values are for normal load duration and dry service conditions, unless specified otherwise. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4D ADJUSTMENT FACTORS

Species and commercial grade	Size classification	Design values in pounds per square inch (psi)						Grading Rules Agency
		Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain F_c	Modulus of Elasticity E	
SPRUCE-PINE-FIR (SOUTH)[2]								
Select Structural	Beams and Stringers	1050	625	125	335	675	1,200,000	NELMA NSLB WWPA WCLIB
No.1		900	450	125	335	550	1,200,000	
No.2		575	300	125	335	375	1,000,000	
Select Structural	Posts and Timbers	1000	675	125	335	700	1,200,000	
No.1		800	550	125	335	625	1,200,000	
No.2		475	325	125	335	425	1,000,000	
WESTERN CEDARS								
Select Structural	Beams and Stringers	1150	675	140	425	875	1,000,000	WCLIB WWPA
No.1		975	475	140	425	725	1,000,000	
No.2		625	325	140	425	475	800,000	
Select Structural	Posts and Timbers	1100	725	140	425	925	1,000,000	
No.1		875	600	140	425	800	1,000,000	
No.2		550	350	140	425	550	800,000	
WESTERN CEDARS (NORTH)								
Select Structural	Beams and Stringers	1150	675	130	425	850	1,000,000	NLGA
No.1		925	475	130	425	700	1,000,000	
No.2		625	300	130	425	450	800,000	
Select Structural	Posts and Timbers	1050	700	130	425	900	1,000,000	
No.1		875	575	130	425	800	1,000,000	
No.2		500	350	130	425	550	800,000	
WESTERN HEMLOCK								
Select Structural	Beams and Stringers	1400	825	170	410	1000	1,400,000	WCLIB WWPA
No.1		1150	575	170	410	850	1,400,000	
No.2		750	375	170	410	550	1,100,000	
Select Structural	Posts and Timbers	1300	875	170	410	1100	1,400,000	
No.1		1050	700	170	410	950	1,400,000	
No.2		650	425	170	410	650	1,100,000	
WESTERN HEMLOCK (NORTH)								
Select Structural	Beams and Stringers	1400	825	135	410	1000	1,400,000	NLGA
No.1		1150	575	135	410	850	1,400,000	
No.2		750	375	135	410	550	1,100,000	
Select Structural	Posts and Timbers	1300	875	135	410	1100	1,400,000	
No.1		1050	700	135	410	950	1,400,000	
No.2		650	425	135	410	650	1,100,000	
WESTERN WHITE PINE								
Select Structural	Beams and Stringers	1050	600	120	375	775	1,300,000	NLGA
No.		850	425	120	375	625	1,300,000	
No.2		550	275	120	375	400	1,000,000	
Select Structural	Posts and Timbers	975	650	120	375	800	1,300,000	
No.1		775	525	120	375	700	1,300,000	
No.2		450	300	120	375	500	1,000,000	
WESTERN WOODS								
Select Structural	Beams and Stringers	1050	625	125	345	750	1,100,000	WCLIB WWPA
No.1		900	450	125	345	625	1,100,000	
No.2		575	300	125	345	425	900,000	
Select Structural	Posts and Timbers	1000	675	125	345	800	1,100,000	
No.1		800	525	125	345	700	1,100,000	
No.2		475	325	125	345	475	900,000	
WHITE OAK								
Select Structural	Beams and Stringers	1400	825	205	800	900	1,000,000	NELMA
No.1		1200	575	205	800	775	1,000,000	
No.2		750	375	205	800	475	800,000	
Select Structural	Posts and Timbers	1300	875	205	800	950	1,000,000	
No.1		1050	700	205	800	825	1,000,000	
No.2		600	400	205	800	400	800,000	