SSPD
(Single Span Post Design)
Version 2.0, 09/00

Program Purpose and Description

The purpose of this program is to aid in the design of open single span pole barn type structures. The program is a compiled version of a spreadsheet used to calculate post size, post embedment depth, and beam size for umbrella type structures (greater than 20% of the windward and leeward surface open). The calculations are based upon the procedures described in the National Forest Products Association's *National Design Specification For Wood Construction* and the American Society of Agricultural Engineer's Standards. Using this program, a user will be able to input structure data such as building dimensions, wind velocity, and wood design properties to check the adequacy of the structure. This program will allow the user to quickly change post size and spacing to determine the most economical structure design.

Software Requirements

Use of this spreadsheet requires that Microsoft Excel® be installed.

Installing the Program

It is recommended that the spreadsheet be copied into a separate directory.

Input Needed

Input data for SSPD is as follows:

A. Name of the system, designer, and date.
B. Dimensions of the building (See Figure 1).
   i. Eve Overhang
   ii. Post Height
   iii. Roof Slope
   iv. Span Width
   v. Post Spacing
   vi. Post Dimensions (See Exhibit 1 for dressed dimensions)
C. Properties of the building material (See Exhibit 2 and Table 1).
   i. Fibrus bending moment (F_b)
   ii. Maximum shear (F_v)
   iii. Modulus of Elasticity (E)
   iv. Maximum compression (F_c)
D. Wind Load
   i. Design wind velocity (See Figure 2).
   ii. Exposure Coefficients (K_z) (see Table 2)
   iii. Importance factor (I_w) (see Table 3, Category I or II)
   iv. Gust Factor (G), [0.85 for buildings in open areas, 0.8 for areas with wind obstructions]
   v. Drag Coefficient (Cp), [0.6 is used for umbrella type structures]
E. Dead Load

i. Truss dead weight (truss weight / (truss spacing * span)
ii. Purlin dead weight
iii. Steel roofing weight
iv. Miscellaneous dead weight

F. Post Embedment (See Table 4)
i. Bearing width of post (see Figure 1)
ii. Adjustment for wind load
iii. Adjustment for 1/2 inch movement at base (see program notes)
iv. Soil bearing pressure (see Table 4)

G. Beam properties
i. Number of beams
ii. Beam dimensions (See Exhibit 1)
iii. Material properties (See Exhibits 2 and Table 5)

Program Operation

Those familiar with EXCEL® and other similar spreadsheets will recognize the program format as similar. Move the cell pointer to the bright blue unprotected cells to change program inputs. The spreadsheet is not very large and you can easily move around using the arrow keys. Be sure to check each blue unprotected cell each time a structure is designed.

The spreadsheet has four main sections: **CALCULATE LOADS**, **SIZE POLES**, **SIZE BEAM**, and **CHECK POST EMBEDMENT**. Both the pole embedment and the sizing of the beam uses information developed within the calculate loads and size post section. Therefore all information must be correct for the entire spreadsheet in order for the answers to be correct.

See Exhibit 6 for sample of the output.

PROGRAM NOTES

This spreadsheet has been designed to calculate the effects of wind loads only. If the structure is being designed for other than wind load conditions, then other methods should be used to design the structure. Dead loads must also be calculated on a per square foot basis.

Sizing Post or Poles

Be careful to enter the actual dimensions of the post or poles being used for the design and be sure to enter a zero for pole diameter if using square or rectangular posts. For example, a 6" X 8" finished post would be entered as having a width of 5.5" and a depth of 7.5". This kind of mistake can drastically influence the program output. Also be careful to make sure the smaller post dimension is used as the width, since the orientation of these posts can affect the bending and deflection capacity of the post. If round poles are used the diameter is taken as the diameter at the smaller end.

Sizing Beam

This section of the program has been written to accommodate a single beam or the placing multiple boards together to act as a single beam. The calculations are based on beams being placed together on the same side of the pole or post. If the boards are separated, the load carrying capacity is reduced.

This step is used to size beams where trusses are equally spaced between the posts with a maximum truss spacing not to exceed 4 feet. Up to five trusses between the post can be used at one time.

In the case of trusses (normally metal) spaced equal to the post spacing, the beams should be sized not according to the truss load as this program does, but according to the size necessary to transfer a wind load perpendicular to the gable between the posts. This case will be designed by the truss company. All trusses should be designed and certified by a Florida licensed registered professional engineer.

Post Embedment

Post embedment has two options, with (constrained case) and without (non-constrained case) a concrete slab. The post embedment design is based on procedures in ASAE practice standard ASAE EP486. The lateral soil bearing pressure is taken from ASAE EP486 and is shown in Table 4.

For posts constrained by a concrete slab, lateral soil pressure may be doubled for isolated posts that are spaced at least six times their width. For non-constrained post, the lateral soil pressure may be doubled for isolated posts which are not adversely affected by up to 0.5 inch lateral deflection in the soil due to short term loads.

The lateral soil pressure may be increased one-third for wind forces acting alone or in combination with vertical loads (adjustment for wind load, factor = 1.3). Wind increases are cumulative with other pressure increases for both constrained and non-constrained cases.

Figure 1 - Post and Beam for Single Span Pole Building Diagram

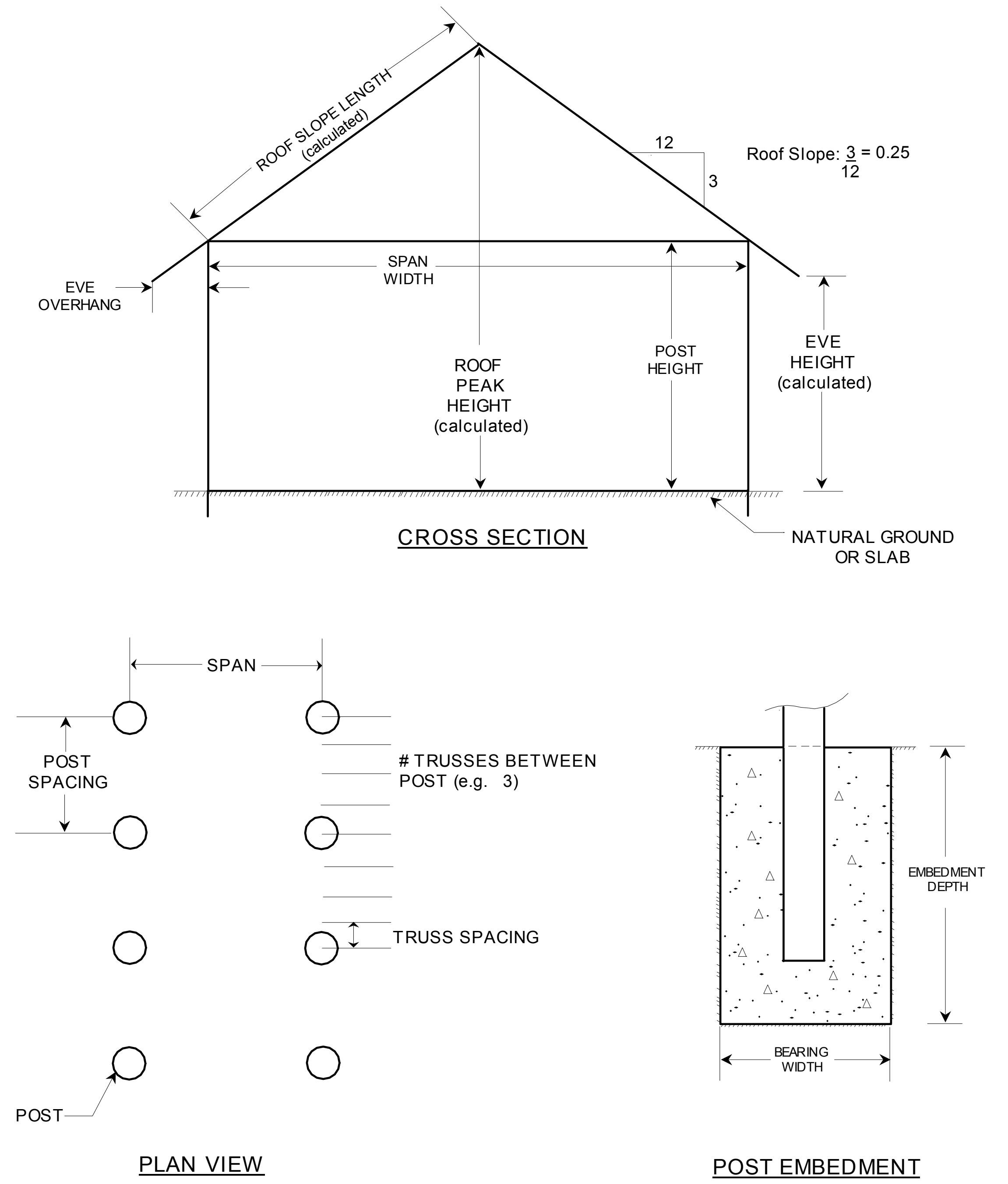


Exhibit 1 - Section Properties of Standard Dressed (S4S) Sawn Lumber

Nominal size b(inches)d	Standard dressed size (S4S) b(inches)d	Area of Section A	Moment of inertia I	Section modulus S	Approximate weight* in pounds per linear foot of piece when weight of wood per cubic foot equals: 25 lb.	30 lb.	35 lb.	40 lb.	45 lb.	50 lb.
1 x 3	3/4 x 2-1/2	1.875	0.977	0.781	0.326	0.391	0.456	0.521	0.586	0.651
1 x 4	3/4 x 3-1/2	2.625	2.680	1.531	0.456	0.547	0.638	0.729	0.820	0.911
1 x 6	3/4 x 5-1/2	4.125	10.398	3.781	0.716	0.859	1.003	1,146	1.289	1.432
1 x 8	3/4 x 7-1/4	5.438	23.817	6,570	0.944	1.133	1.322	1.510	1.699	1.888
1 x 10	3/4 x 9-1/4	6.938	49.466	10.695	1.204	1.445	1.686	1.927	2.168	2.409
1 x 12	3/4 x 11-1/4	8.438	88.989	15.820	1.465	1.758	2.051	2.344	2.637	2.930
2 x 3	1-1/2 x 2-1/2	3.750	1.953	1.563	0.651	0.781	0.911	1.042	1.172	1.302
2 x 4	1-1/2 x 3-1/2	5.250	5.359	3.063	0.911	1.094	1.276	1.458	1.641	1.823
2 x 5	1-1/2 x 4-1/2	6.750	11.391	5.063	1.172	1.406	1.641	1.875	2.109	2.344
2 x 6	1-1/2 x 5-1/2	8.250	20.797	7.563	1.432	1.719	2.005	2.292	2.578	2.865
2 x 8	1-1/2 x 7-1/4	10.875	47.635	13.141	1.888	2.266	2.643	3.021	3.398	3.776
2 x 10	1-1/2 x 9-1/4	13.875	98.932	21.391	2.409	2.891	3.372	3.854	4.336	4.818
2 x 12	1-1/2 x 11-1/4	16.875	177.979	31.641	2.930	3.516	4.102	4.688	5.273	5.859
2 x 14	1-1/2 x 13-1/4	19.875	290.775	43.891	3.451	4.141	4.831	5.521	6.211	6.901
3 x 1	2-1/2 x 3/4	1.875	0.088	0.234	0.326	0.391	0.456	0.521	0.586	0.651
3 x 2	2-1/2 x 1-1/2	3.750	0.703	0.938	0.651	0.781	0.911	1.042	1.172	1.302
3 x 4	2-1/2 x 3-1/2	8.750	8.932	5.104	1.519	1.823	2.127	2.431	2.734	3.038
3 x 5	2-1/2 x 4-1/2	11.250	18.984	8.438	1.953	2.344	2.734	3.125	3.516	3.906
3 x 6	2-1/2 x 5-1/2	13.750	34.661	12.604	2.387	2.865	3.342	3.819	4.297	4.774
3 x 8	2-1/2 x 7-1/4	18.125	79.391	21.901	3.147	3.776	4.405	5.035	5.664	6.293
3 x 10	2-1/2 x 9-1/4	23.125	164.886	35.651	4.015	4.818	5.621	6.424	7.227	8.030
3 x 12	2-1/2 x 11-1/4	28.125	296.631	52.734	4.883	5.859	6.836	7.813	8.789	9.766
3 x 14	2-1/2 x 13-1/4	33.125	484.625	73.151	5.751	6.901	8.051	9.201	10.352	11.502
3 x 16	2-1/2 x 15-1/4	38.125	738.870	96.901	6.619	7.943	9.266	10.590	11.914	13.238
4 x 1	3-1/2 x 3/4	2.625	0.123	0.328	0.456	0.547	0.638	0.729	0.820	0.911
4 x 2	3-1/2 x 1-1/2	5.250	0.984	1.313	0.911	1.094	1.276	1.458	1.641	1.823
4 x 3	3-1/2 x 2-1/2	8.750	4.557	3.646	1.519	1.823	2.127	2.431	2.734	3.038
4 x 4	3-1/2 x 3-1/2	12.250	12.505	7.146	2.127	2.552	2.977	3.403	3.828	4.253
4 x 5	3-1/2 x 4-1/2	15.750	26.578	11.813	2.734	3.281	3.828	4.375	4.922	5.469
4 x 6	3-1/2 x 5-1/2	19.250	48.526	17.646	3.342	4.010	4.679	5.347	6.016	6.684
4 x 8	3-1/2 x 7-1/4	25.375	111.148	30.661	4.405	5.286	6.168	7.049	7.930	8.811
4 x 10	3-1/2 x 9-1/4	32.375	230.840	49.911	5.621	6.745	7.869	8.933	10.117	11.241
4 x 12	3-1/2 x 11-1/4	39.375	415.283	73.828	6.836	8.203	9.570	10.938	12.305	13.672
4 x 14	3-1/2 x 13-1/4	46.375	678.475	102.411	8.047	9.657	11.266	12.877	14.485	16.094
4 x 16	3-1/2 x 15-1/4	53.375	1034.418	135.66	9.267	11.121	12.975	14.828	16.682	18.536
5 x 2	4-1/2 x 1-1/2	6.750	1.266	1.688	1.172	1.406	1.641	1.875	2.109	2.344
5 x 3	4-1/2 x 2-1/2	11.250	5.859	4.688	1.953	2.344	2.734	3.125	3.516	3.906
5 x 4	4-1/2 x 3-1/2	15.750	16.078	9.188	2.734	3.281	3.828	4.375	4.922	5.469
5 x 5	4-1/2 x 4-1/2	20.250	34.172	15.188	3.516	4.219	4.922	5.675	6.328	7.031
6 x 1	5-1/2 x 3/4	4.125	0.193	0.516	0.716	0.859	1.003	1.146	1.289	1.432
6 x 2	5-1/2 x 1-1/2	8.250	1.547	2.063	1.432	1.719	2.005	2.292	2.578	2.865
6 x 3	5-1/2 x 2-1/2	13.750	7.161	5.729	2.387	2.865	3.342	3.819	4.297	4.774
6 x 4	5-1/2 x 3-1/2	19.250	19.651	11.229	3.342	4.010	4.679	5.347	6.016	6.684
6 x 6	5-1/2 x 5-1/2	30.250	76.255	27.729	5.252	6.302	7.352	8.403	9.453	10.503
6 x 8	5-1/2 x 7-1/2	41.250	193.359	51.563	7.161	8.594	10.026	11.458	12.891	14.323
6 x 10	5-1/2 x 9-1/2	52.250	392.963	82.729	9.071	10.885	12.700	14.514	16.328	18.142
6 x 12	5-1/2 x 11-1/2	63.250	697.068	121.229	10.981	13.177	15.373	17.569	19.766	21.962
6 x 14	5-1/2 x 13-1/2	74.250	1127.672	167.063	12.891	15.469	18.047	20.625	23.203	25.781
6 x 16	5-1/2 x 15-1/2	85.250	1706.776	220.229	14.800	17.760	20.720	23.681	26.641	29.601
6 x 18	5-1/2 x 17-1/2	96.250	2456.380	280.729	16.710	20.052	23.394	26.736	30.078	33.420
6 x 20	5-1/2 x 19-1/2	107.250	3398.484	348.563	18.620	22.344	26.068	29.792	33.516	37.240
6 x 22	5-1/2 x 21-1/2	118.250	4555.086	423.729	20.530	24.635	28.741	32.847	36.953	41.059
6 x 24	5-1/2 x 23-1/2	129.250	5948.191	506.229	22.439	26.927	31.415	35.903	40.391	44.878
8 x 1	7-1/4 x 3/4	5.438	0.255	0.680	0.944	1.133	1.322	1.510	1.699	1.888
8 x 2	7-1/4 x 1-1/2	10.875	2.039	2.719	1.888	2.266	2.643	3.021	3.398	3.776
8 x 3	7-1/4 x 2-1/2	18.125	9.440	7.552	3.147	3.776	4.405	5.035	5.664	6.293
8 x 4	7-1/4 x 3-1/2	25.375	25.904	14.803	4.405	5.286	6.168	7.049	7.930	8.811
8 x 6	7-1/2 x 5-1/2	41.250	103.984	37.813	7.161	8.594	10.026	11.458	12.891	14.323
8 x 8	7-1/2 x 7-1/2	56.250	263.672	70.313	9.766	11.719	13.672	15.625	17.578	19.531
8 x 10	7-1/2 x 9-1/2	71.250	535.859	112.813	12.370	14.844	17.318	19.792	22.266	24.740
8 x 12	7-1/2 x 11-1/2	86.250	950.547	165.313	14.974	17.969	20.964	23.958	26.953	29.948
8 x 14	7-1/2 x 13-1/2	101.250	1537.734	227.813	17.578	21.094	24.609	28.125	31.641	35.156
8 x 16	7-1/2 x 15-1/2	116.250	2327.422	300.313	20.182	24.219	28.255	32.292	36.328	40.365
8 x 18	7-1/2 x 17-1/2	131.250	3349.609	382.813	22.786	27.344	31.901	36.458	41.016	45.573
8 x 20	7-1/2 x 19-1/2	146.250	4634.297	475.313	25.391	30.469	35.547	40.625	45.703	50.781
8 x 22	7-1/2 x 21-1/2	161.250	6211.484	577.813	27.995	33.594	39.193	44.792	50.391	55.990
8 x 24	7-1/2 x 23-1/2	176.250	8111.172	690.313	30.599	36.719	42.839	48.958	55.078	61.198

Exhibit 2 – Southern Pine Design Values - Based on 1994 SPIB Grading Rules

Dimension Lumber - 2" to 4" thick, 2" and wider

Based on Normal use Conditions (MC<=19%)[1]

Size	Grade	Extreme Fiber Stress in Bending "F_b" (psi) Single Member Uses	Extreme Fiber Stress in Bending "F_b" (psi) Repetitive Member Uses[2]	Tension Parallel to Grain "F_t" (psi)	Horizontal Shear "F_v" (psi)	Compression Perpendicular to Grain (psi)	Compression Parallel to Grain "F_c" (psi)	Modulus of Elasticity "E" (psi)
2" to 4" thick, 2" to 4" wide Includes: 2x2 2x3 2x4 3x4 4x4	Dense Select Structural	3050	3510	1650	100	660	2250	1,900,000
	Select Structural	2850	3280	1600	100	565	2100	1,800,000
	NonDense Select Struc	2650	3050	1350	100	480	1950	1,700,000
	No. 1 Dense	2000	2300	1100	100	660	2000	1,800,000
	No. 1	1850	2130	1050	100	565	1850	1,700,000
	No. 1 NonDense	1700	1950	900	100	480	1700	1,600,000
	No. 2 Dense	1700	1960	875	90	660	1850	1,700,000
	No. 2	1500	1720	825	90	565	1650	1,600,000
	No. 2 NonDense	1350	1550	775	90	480	1600	1,400,000
	No. 3 and Stud	850	980	475	90	565	975	1,400,000
	Construction (3)	1100	1270	625	100	565	1800	1,500,000
	Standard (3)	625	720	350	90	565	1500	1,300,000
	Utility (3)	300	345	175	90	565	975	1,300,000
2" to 4" thick, 5" to 6" wide Includes: 2x6 3x6 4x6	Dense Select Structural	2700	3100	1500	90	660	2150	1,900,000
	Select Structural	2550	2930	1400	90	565	2000	1,800,000
	NonDense Select Struc	2350	2700	1200	90	480	1850	1,700,000
	No. 1 Dense	1750	2010	950	90	660	1900	1,800,000
	No. 1	1650	1900	900	90	565	1750	1,700,000
	No. 1 NonDense	1500	1720	800	90	480	1600	1,600,000
	No. 2 Dense	1450	1670	775	90	660	1750	1,700,000
	No. 2	1250	1440	725	90	565	1600	1,600,000
	No. 2 NonDense	1150	1320	675	90	480	1500	1,400,000
	No. 3 and Stud	750	865	425	90	565	925	1,400,000

(1) Moisture designations KD19, KD15, S-DRY, MC15 and MC19 all have identical design values.
(2) Repetitive member uses apply to 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 three [3] in number, and are joined by floor, roof or other load distributing elements adequate to support the design load. The Repetitive Member Factor, C_r=1.15, has been included in the listed Repetitive Member Use design values.
(3) For construction, Standard, and Utility grades, the F_b, F_t and F_c values apply to 4" wide lumber only.

Exhibit 2 – Southern Pine Design Values - Based on 1994 SPIB Grading Rules (continued)

Dimension Lumber - 2" to 4" thick, 2" and wider								
Based on Normal use Conditions (MC<=19%)[1]								
Size	Grade	Extreme Fiber Stress in Bending "F_b" (psi)		Tension Parallel to Grain "F_t" (psi)	Horizontal Shear "F_v" (psi)	Compression Perpendicular to Grain (psi)	Compression Parallel to Grain "F_c" (psi)	Modulus of Elasticity "E" (psi)
		Single Member Uses	Repetitive Member Uses[2]					
2" to 4" thick, 8" wide Includes: 2x8 3x8 4x8[4]	Dense Select Structural	2450	2820	1350	90	660	2050	1,900,000
	Select Structural	2300	2650	1300	90	565	1900	1,800,000
	NonDense Select Struc	2100	2420	1100	90	480	1750	1,700,000
	No. 1 Dense	1650	1900	875	90	660	1800	1,800,000
	No. 1	1500	1730	825	90	565	1650	1,700,000
	No. 1 NonDense	1350	1550	725	90	480	1550	1,600,000
	No. 2 Dense	1400	1610	675	90	660	1700	1,700,000
	No. 2	1200	1380	650	90	565	1550	1,600,000
	No. 2 NonDense	1100	1260	600	90	480	1450	1,400,000
	No. 3 and Stud	700	805	400	90	565	875	1,400,000
2" to 4" thick, 10" wide Includes: 2x10 3x10 4x10[4]	Dense Select Structural	2150	2470	1200	90	660	2000	1,900,000
	Select Structural	2050	2360	1100	90	565	1850	1,800,000
	NonDense Select Struc	1850	2130	950	90	480	1750	1,700,000
	No. 1 Dense	1450	1670	775	90	660	1750	1,800,000
	No. 1	1300	1500	725	90	565	1600	1,700,000
	No. 1 NonDense	1200	1380	650	90	480	1500	1,600,000
	No. 2 Dense	1200	1380	625	90	660	1650	1,700,000
	No. 2	1050	1210	575	90	565	1500	1,600,000
	No. 2 NonDense	950	1090	550	90	480	1400	1,400,000
	No. 3 and Stud	600	690	325	90	565	850	1,400,000
2" to 4" thick, 12" wide[5] Includes: 2x12 3x12 4x12[4]	Dense Select Structural	2050	2360	1100	90	660	1950	1,900,000
	Select Structural	1900	2190	1050	90	565	1800	1,800,000
	NonDense Select Struc	1750	2010	900	90	480	1700	1,700,000
	No. 1 Dense	1350	1550	725	90	660	1700	1,800,000
	No. 1	1250	1440	675	90	565	1600	1,700,000
	No. 1 NonDense	1150	1320	600	90	480	1500	1,600,000
	No. 2 Dense	1150	1320	575	90	660	1600	1,700,000
	No. 2	975	1120	550	90	565	1450	1,600,000
	No. 2 NonDense	900	1040	525	90	480	1350	1,400,000
	No. 3 and Stud	575	660	325	90	565	825	1,400,000

(4) For lumber 4" thick and 8" or wider, the F_b value can be multiplied by C_F=1.1.
(5) For lumber wider than 12", multiply these 12" width values by C_F=.90 for F_b, F_t, and F_c values, and C_F=1.00 for F_v, and E values.

Exhibit 2 – Southern Pine Design Values - Based on 1994 SPIB Grading Rules (continued)

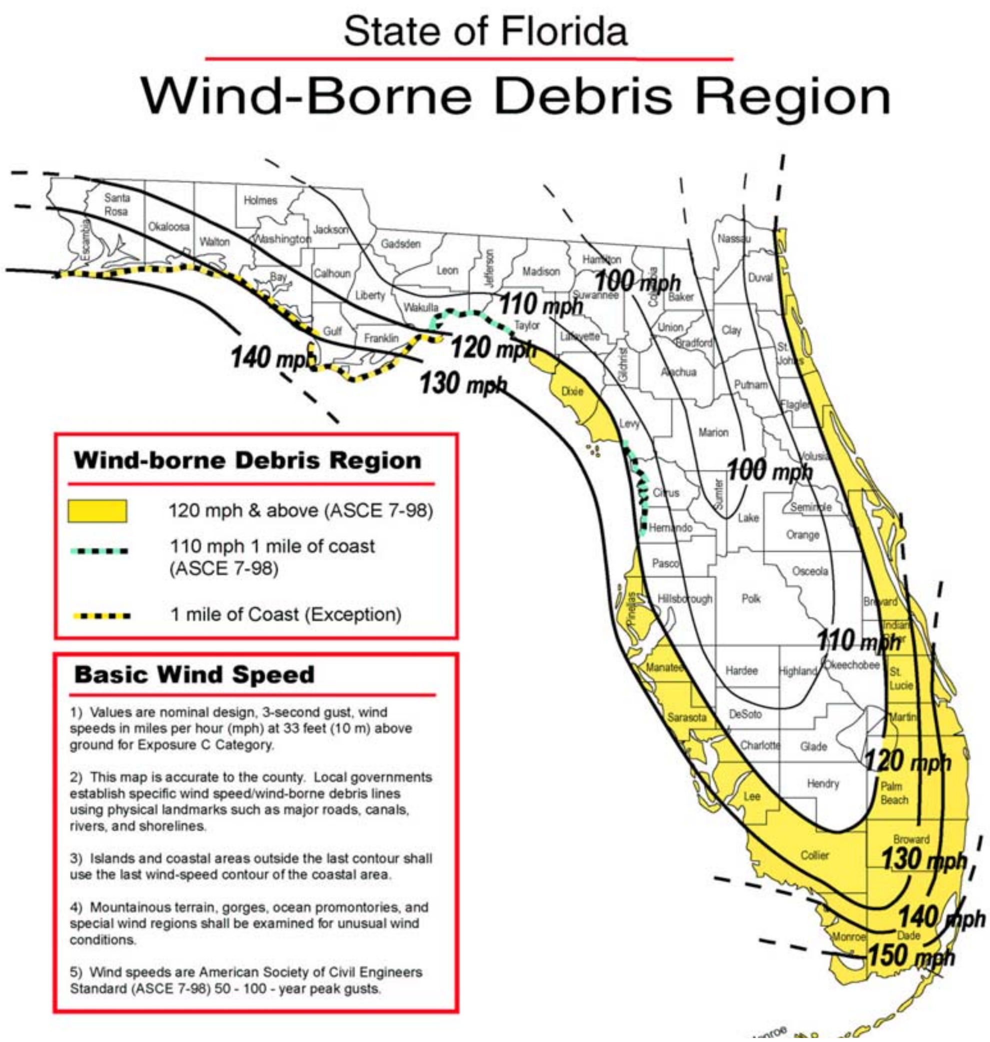
Timbers - 5" to 5" thick and wider							
Based on Dry or Wet Service Conditions							
	Grade	Extreme Fiber Stress in Bending "F_b"[6] **(psi)** Single Member Uses	Tension Parallel to Grain "F_t" **(psi)**	Horizontal Shear "F_v" **(psi)**	Compression Perpendicular to Grain **(psi)**	Compression Parallel to Grain "F_c" **(psi)**	Modulus of Elasticity "E" **(psi)**
5" x 5" and larger	Dense Select Structural	1750	1200	110	440	1100	1,600,000
	Select Structural	1500	1000	110	375	950	1,500,000
	No. 1 Dense	1550	1050	110	440	975	1,600,000
	No. 1	1350	900	110	375	825	1,500,000
	No. 2 Dense	975	650	100	440	625	1,300,000
	No. 2	850	550	100	375	525	1,200,000
(6) When the depth, d, of a timber exceeds 12", the tabulated bending design value, $\mathbf{F_b}$, shall be multiplied by the following size factor: $\mathbf{C_F=(12/d)^{1/9}}$ where **d** is the actual depth of the number							

Disclaimer:

The Southern Pine Council does not test lumber or establish design values. The purpose of the Use Guide is to collect and organize data available from other sources for the convenience of builders, engineers, architects and other professionals. The Southern Pine design values contained herein are taken from the Standard Grading Rules for Southern Pine Lumber, 1994 Edition, Published by the Southern Pine Inspection Bureau, and the adjustment factors are taken from the National Design Specification® (NDS®) for Wood Construction, 1997 Edition, published by the American Forest & Paper Association. Neither the Southern Pine Council, nor its members, warrant that the data from such sources on which the recommended uses of Southern Pine lumber contained herein are based is correct, and disclaim responsibility for injury or damage resulting from the use of such design values.

The conditions under which lumber is used in construction may vary widely, as does the quality of workmanship and construction methods. Neither the Southern Pine Council, nor its members, have knowledge of the quality of the workmanship or construction methods used on any construction project, and, accordingly, do not warrant the design or performance of the lumber in completed structures.

Figure 2 – Wind Zone Requirements



High Velocity Hurricane Zone - Miami-Dade and Broward Counties

In these highly vulnerable counties, stricter design and construction measures have been adopted than those provided by ASCE 7-98 – most notably, the requirements to protect windows with either shutters or impact resistant glass, and for wall and roof systems resistant to wind-borne debris penetration.

Wind-Borne Debris Region

Areas with wind speeds in excess of 120 MPH and/or areas within one mile of the coast where wind speed is 110 MPH or higher. In these areas, buildings must be designed to protect openings or to withstand the increase in internal pressures that will occur if an unprotected window or glass door is broken by debris.

Panhandle Protection Provision Zone

From Franklin County to the Alabama state line, the wind-borne debris region is restricted to the area within one mile of the coast.

Remaining Florida

Wind loads are calculated based on wind speed estimates as determined by ASCE 7-98 base wind speed map. For these areas, the buildings are designed and built much as they were using previous codes.

Exposure to Wind.

Except in the High Velocity Hurricane Zone, exposure C means that area which lies within 1500 feet of the coastal construction control line, or within 1500 feet of the mean high tide line, whichever is less. The forces exerted on buildings by winds are affected by obstructions such as trees and other buildings. Exposure C exists where there are few obstructions. Exposure B is characteristic of subdivisions and towns.

For more information on wind-zone requirements and the Florida Building Code, visit www.floridabuilding.org

Table 1 - Design Stresses [1/] for Selected Species of Preservative Treated Round Poles

Species	Bending [2/] F_b Psi	Axial Compression [3/] F_c psi	Horizontal Shear F_v psi	Compression Perpendicular to grain F_{ci} psi	Modulus of Elasticity E 10^6 psi
Northern white cedar (EC)	1050	525	80	225	0.6
Western red cedar (WC)	1350	750	95	255	0.9
Pondersosa pine (WP)	1300	650	90	320	1.0
Lodgepole pine (LP)	1350	700	85	240	1.1
Red or Norway pine (NP)	1450	725	85	265	1.3
Jack pine (JP)	1500	800	95	280	1.1
Douglas fir [4/] (DF)	1850	1000	115	375	1.5
Southern pine [5/] (SP)	1700	900	105	320	1.4
Western hemlock (WH)	1650	900	115	245	1.3
Western larch (WL)	2050	1050	120	375	1.5

1/ Determined according to ASTM Standard D2899, Establishing Design Stresses for Round Timber Piles, ASTM Standard D 3200, Specifications and Methods for Establishing Recommended Design Stresses for Round Timber Construction Poles, AITC Timber construction Manual, Table 5.41, for wet use conditions.

2/ Safety factor = 1.3 per ASTM D2899, Establishing Design Stresses for Round timber Piles.

3/ Safety factor = 1.25 per ASTM D2899, Establishing Design Stresses for Round Timber Piles.

4/ Interior north or coast.

5/ Loblolly, longleaf, shortleaf, or slash.

Table 2 – Velocity Pressure Exposure Coefficients, K_z

Design height above ground level, Z [1] (ft)	K_z for exposure categories [2]		
	B	C	D
0 – 15	0.57	0.85	1.03
20	0.62	0.90	1.08
25	0.66	0.94	1.12

Source: American society of Civil Engineers, *Minimum Design Loads for Buildings and Other Structures*, ASCE 7-95.

[1] For windward walls, the design height is equal to the eve height. For leeward walls, sidewalls, and roof, the design height is equal to the mid-elevation of the roof (i.e., eave height plus one-half roof height at the peak).

[2] Exposure categories reflect ground surface irregularities, as follows:

A - (Not shown) Large city centers with tall buildings (> 70 ft.)
B - Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions the size of single family dwellings or larger.
C - Open terrain with scattered obstructions less than 30 ft tall. This category includes flat open country and grasslands.
D - Flat, unobstructed areas exposed to wind flowing over open water for at least one mile. Exposure D extends itself from the shoreline a distance of 1500 ft. or 10 times the height of the building or structure, whichever is greater.

Table 3 – Importance Factor (I_w) for Wind Loads.

Category [1]	I_w
I	0.87
II	1.00
III	1.15
IV	1.15

Source: American Society of Civil Engineers, *Minimum Design Loads for Buildings and Other Structures*, ASCE 7-95.

[1] Category I – Buildings and structures that represent a low hazard to human life in the event of failure, such as agricultural buildings, certain temporary facilities, and minor storage facilities.
Category II – All buildings and structures except those listed in Categories I, III, IV.
Category III – Buildings and structures that represent a substantial hazard to human life in the event of failure, including but not limited to: buildings or other structures where more than 300 people congregate in one area , schools and daycare centers, health care facilities, jails and detention centers, and certain toxic or explosive storages.
Category IV – Buildings and structures designated as essential facilities, including but not limited to: hospitals, communication centers, power stations, fire or rescue, critical national defense.

Table 4 - Presumed Soil Properties for Post Foundation Design (for use in absence of codes or tests)

Class of Materials	Density [1/] or Consistency	Soil Bearing Pressure [2/] per unit of depth lb/ft^2
1. Massive crystalline bedrock	----	1200
2. Sedimentary and foliated rock	-----	400
3. Sandy gravel and/or gravel (GW and GP)	Firm	300
	- Loose	200
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, and GC)	Firm	200
	- Loose	150
5. Clay, sandy clay, silty clay and clayey silt (CL, ML, MH, and CH)	Medium	130
	- Soft	100

[1/] Firm consistency of class 4 and the medium consistency of class 5 can be molded by strong finger pressure, and the firm consistency of class 3 is too compact to be excavated with a shovel.

[2/] The hydrostatic increase in lateral pressure per unit depth has been included in the equations of this Engineering Practice. A per unit depth increase is allowed up to 4.5 m (15 ft). The shallow depth foundations of post frame buildings are well within this limit. Source: Table 29-B UBC modified with the addition of firm and medium values from Hough.

Table 5 – Lumber Density (seasoned)

Species	Density lbs/ft^3
Ash, White	41
Cypress	34
Fir, Douglas	34
Hem-Fir	28
Oak, red & white	47
Pine, Southern	37
Redwood	28
Spruce, red, white, and Sitka	29
Western Hemlock	32

Exhibit 8 – Sample Output

```
USDA Natural Resources Conservation Service
Single Span Post with only 2 supports

Project:               Wainwright

Designed by:           Elywn Cooper   Checked by:  Bill Reck

Date:                  Jun. 3, 1998   Date:      Jun. 3, 1998

Step 1: CALCULATE LOADS
==========================================================
Building Dimensions:
----------------------------------------------------------
Eve Overhang, ft                                  2.5
Eve Height, ft                                 11.375
Roof Peak Height, ft                               17
Post height, ft                                    12
Roof slope, ft/ft                                0.25
Span Width of poles, ft                            40
Post Spacing, ft                                   10
Roof slope length, ft                           23.19
Post x-sect @ base, sq in                       56.25
NOT USED for sq post [0 for sq post]                0
Post width [actual dimension]                     7.5
Post depth [larger actual dimension]              7.5
==========================================================
Check Bending                         Within 10%
Check Shear                           OK in Shear
Check Deflection                      OK in Deflection
Check Compression                     OK in Compression
==========================================================


Wind Load:
----------------------------------------------------------
Wind velocity (V), mph                            130 Figure 2
Roof Mid-Height,ft [min 15]                        15
Exposure Factor (Kz)                             0.85 Table 2
Gust Factor (G) [0.85 open, 0.80 wind            0.85 See Program Notes
Importance Factor [1.0 high, 0.87 low]           0.87 Table 3
WIND LOAD (q), psf                               27.2
Drag Coefficient (Cp)                             0.6 See Program Notes
ADJ. WIND LOAD (qd), psf                         16.3

Dead Load:
----------------------------------------------------------
Truss dead wt, psf                               1.25    <<<
Purlin dead weight, psf                           0.7    <<<
Steel roofing weight, psf                         0.8    <<<
Misc. dead weight,psf                             0.5    <<<
TOTAL DEAD WEIGHT, psf                           3.25
```

Exhibit 8 – Sample Output

```
Step 2: SIZE POLES              Wainwright
==========================================================

Horizontal Pressure Ph, lbs                      917.8
Vertical Pressure Pv, lbs                       4425.0
                                               -2917.5

Check Bending:
----------------------------------------------------------
Bending Moment M, ft-lb                           7343
Fibrus bending moment for post Fb, psi             850 Exhibit 2
Cd [USE 1.6 for Wind Load Designs]                 1.6
Cu                                                   1
Fb', psi                                          1360
S, in^3                                           70.3
fb , psi                                          1253 Within 10%

Check Shear:
----------------------------------------------------------
Maximum Shear (V), lb                              918
Fv                                                 100 Exhibit 2

fv for square pole                                  24 OK in Shear

Check Deflection:
----------------------------------------------------------
L/120                                              1.2
Effective diameter (D), in
Moment of Inertia (I), in^4                     263.67
Modulus of Elasticity (E)                      1200000 Exhibit 2
delta                                             0.72 OK in Deflection

Check Compression:
----------------------------------------------------------
Compression Load (Pc), lbs                        4425
Fc                                                 375 Exhibit 2
Cd                                                1.48
Cu                                                   1
Ccs                                                  1
Buckling Length Coef. (Ke), [suggest 1             1.2
Effective column length (le), ft                  14.4
Effective width (de)                               7.5
fv                                                  79 psi
Fce                                              97656
Fc*                                                555
Cp                                               0.999
Fc'                                                555 OK in Compression
```

```
Step 3: SIZE BEAM                Wainwright
==========================================================
Assuming Wooden Trusses spaced according to post spacing.
and beam boards are placed together.

Number of boards                                2
Actual board thickness, in                      2 Exhibit 1
Actual board width, in                         12 Exhibit 1
Post spacing, ft                               10
Number Trusses Between Post                     2
Lumber Density, pcf                            37 Table 5
Lumber weight per foot, lb/ft                6.17
Truss spacing, in                              40
Bending Limit for beam (Fb), psi              975 Exhibit 2
Modulus of Elasticity, E                  1600000 Exhibit 2
Shear Limit (Fv), psi                          90 Exhibit 2

==========================================================
Check Bending x-axis                  OK in Bending
Check Bending y-axis                  OK in Bending
Check board interaction               Checks

Check Shear x-axis                    OK in SHEAR
Check Shear y-axis                    OK in SHEAR

Check Beam Deflection vertical        OK V. Deflection
Check Beam Deflection horizontal      OK H. Deflection
==========================================================

Truss Dead Load, lb                           251
Max moment dead, ft-lb                        992

Truss wind load x, lb                         306
Truss wind load y, lb                        1224
Max wind moment x, ft-lb                     4079
Max wind moment y, ft-lb                     1020
Design Moment x, ft-lb                       5071
Design Moment y, ft-lb                       1020
```

```
Check Beam Bending:             Wainwright
----------------------------------------------------------
(Note that this calculation, for beams which have
 been doubled up, assumes the boards are on the
 same side of the post)

Fb                                             975
lu/d x-axis                                     10
lu/d y-axis                                     30
le x-axis                                      232
le y-axis                                      208
Rb 'x                                            2
Rb 'y                                           13
CD 'x                                          1.5
CD 'y                                          1.6
Fb*                                           1427
Fb*                                           1716
E'                                         1600000
Fbe                                         121526
Fbe                                           4035
R                                               85
R                                             2.35
Cl                                            1.00
Cl                                            0.97
Fb' x                                         1426
Fb' y                                         1658
S                                               96
S                                               32
fb x                                           634 OK in Bending
fb y                                           382 OK in Bending
Interaction ratio      0.675233     <            1 Checks

Check Beam Shear:
----------------------------------------------------------
Fv                                              90
Fv' x                                          144
Fv' y                                          142
V x                                            306
V y                                           1506
fv x                                            10 OK in SHEAR
fv y                                            47 OK in SHEAR

Check Beam Deflection:
----------------------------------------------------------
Allowable Deflection, in                         1
Ix                                             576
Iy                                              64
delta v (uniform load), in                   0.003
delta v (point loads), in                    0.081
delta v (TOTAL), in                          0.084 OK V. Deflection
delta h (wind load), in                      0.020 OK H. Deflection
```

```
Step 4: CHECK POST EMBEDMENT          Wainwright
==========================================================


POST Embedment Without Concrete Slab
Based upon ASAE EP484 4.3.1 1992
----------------------------------------------------------
Bearing width of post (b), ft                 1.5 Figure 1
Shear at ground surface (Vg), lb              918
Adjustment for wind load, factor              1.3 See Program Notes
Adj. for 1/2" movement at base, factor          2 See Program Notes
Soil Bearing Pressure                         150 Table 4
Adj. Lat. soil bearing pressure               390
Ground Surface Moment (Mg), ft-lb            7343
Soil resistance moment (Mr), ft-lb           8380

Embedment Depth (d), ft                       5.5 OK



POST Embedment With Concrete Slab
Based upon ASAE EP484 4.3.1 1992
----------------------------------------------------------
Horizontal Force (Ph), lb                     918
Slab Surface Moment (Ms), ft-lb              7343
Bearing width of post (b), ft                 1.5 Figure 1
Adjustment for wind load, factor              1.3 See Program Notes
Adj. for constrained post, factor               2 See Program Notes
Soil Bearing Pressure                         150 Table 4
Adj. Lat. soil bearing pressure               390

Mr must be > Ms            8649   >          7343


Embedment Depth (d), ft                         4 OK
```