Form # P 04

DISPLAY THIS CARD ON PRINCIPAL FRONTAGE OF WORK

CITY OF PORTLAND

BU... ...TION

PERMIT

PERMIT ISSUED

Permit Number: 100145

MAR 10 2010

City of Portland

Please Read Application And Notes, If Any, Attached

This is to certify that Olund Joshua & Melissa/Propert... ...wner

has permission to Remove load bearing wall repla... ...ith hea...

AT 123 EDWARDS ST CB... 120 D007001

provided that the person or persons, fi... or co... ...n ac... ...ting this permit shall comply with all of the provisions of the Statutes of Ma... and of the O... ...ces of the City of Portland regulating the construction, maintenance and use ... buildings and stru... ...res, and of the application on file in this department.

Apply to Public Works for street line and grade if nature of work requires such information.

Noti... ...tion o... ...spectio... ...ust be give... ...d writte... ...ermissio... ...rocured befo... ...his buil... ...g or pa... ...ereof is lath... ...or oth... ...ed-in. 24 HOU... NOTICE IS REQUIRED.

A certificate of occupancy must be procured by owner before this building or part thereof is occupied.

OTHER REQUIRED APPROVALS

Fire Dept. ____________________

Health Dept. ____________________

Appeal Board ____________________

Other ____________________
Department Name

Director - Building & Inspection Services

PENALTY FOR REMOVING THIS CARD

302.	Less amount paid by/for borrower (line 220)	249,700.00	602.	Less total reduction in amount due seller(line 520)	20,444.34
303.	CASH (X)FROM ()TO BORROWER	29,380.28	603.	CASH ()FROM (X)TO SELLER	253,911.89

SUBSTITUTE FORM 1099 SELLER STATEMENT - The information contained in Blocks E, G, H and I and on line 401 (or, if line 401 is asterisked, lines 403 and 404), 406, 407 and 408-412 (applicable part of buyer's real estate tax reportable to the IRS) is important tax information and is being furnished to the Internal Revenue Service. If you are required to file a return, a negligence penalty or other sanction will be imposed on you if this item is required to be reported and the IRS determines that it has not been reported.

SELLER INSTRUCTION - If this real estate was your principle residence, file form 2119, Sale or Exchange of Principal Residence, for any gain, with your income tax return; for other transactions, complete the applicable parts of form 4797, Form 6252 and/or Schedule D (Form 1040)

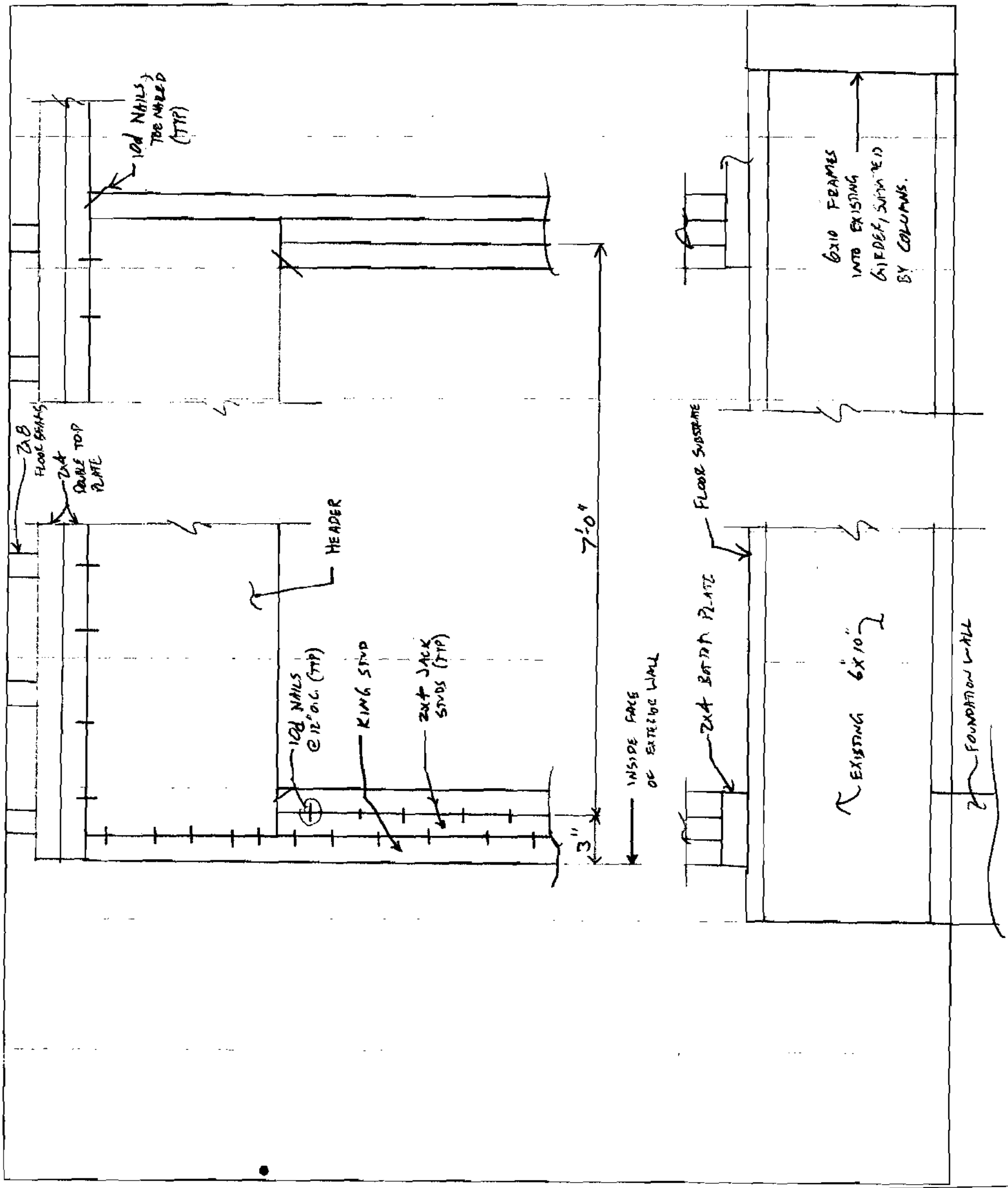
You are required by law to provide Bay Area Title Services LLC (207) 775-5900 with your correct taxpayer identification number.
If you do not provide Bay Area Title Services LLC (207) 775-5900 with your correct taxpayer identification number, you may be subject to civil or criminal penalties.

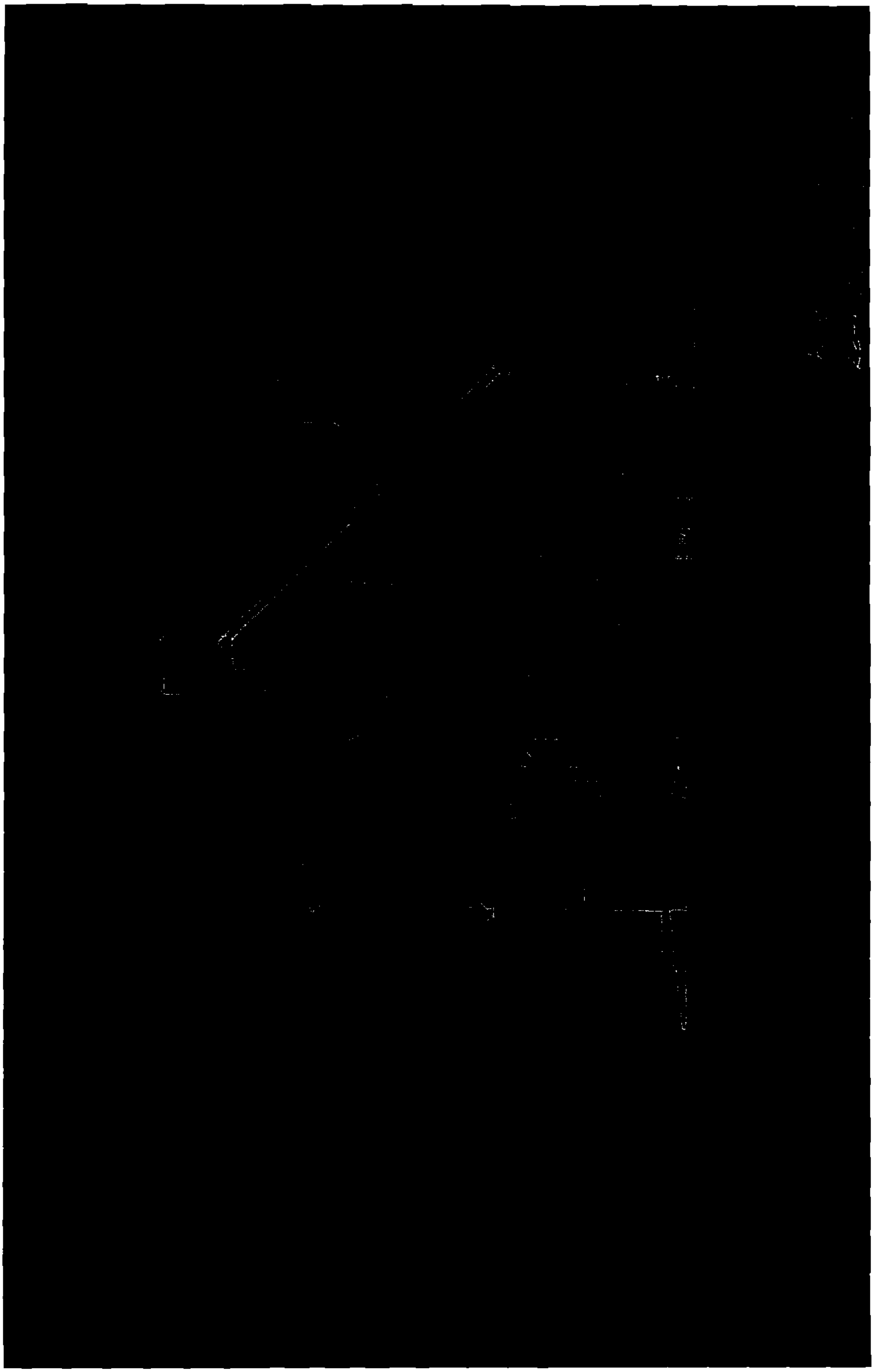
X ____________________ N. G.

Norman A. Galli

[redacted]

Project: LOAD BEARING WALL REMOVAL		Job No.	Sheet: of
Item: BEAM ELEVATION		Designer: J. OLUND	Date: 2/17/10
		Checker:	Date:
			Grid: 1/8"





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Project: LOAD BEARING WALL REMOVAL | Job No. | Sheet: of

Item: LOADS | Designer: J. OLUND | Date: 2/16/10

Checker: | Date:

Grid: 1/8"

LIVE LOAD:

REF: "ASCE - 7 (05)", APPLICABLE PAGE(S) ATTACHED.

$q_{LL} = 40 \text{ PSF}$

DEAD LOAD:

→ SEE SKETCH, PAGE

SPF UNIT WEIGHT ≅ 30 PCF → USE 35 PCF

HARDWOOD FLOORING UNIT WEIGHT ≅ 42 PCF → USE 45 PCF

→ HARD WOOD FLOORS:

$q = 45 \text{ PCF} (1'' \text{ THICK}) = 3.75 \text{ PSF}$

(1" thick — ASSUMED)

→ SPF FLOOR SUBSTRATE:

$q = 35 \text{ PCF} (1.5'' \text{ THICK}) = 4.38 \text{ PSF}$

(1.5" thick — ASSUMED)

→ FLOOR JOISTS:

2x8 @ 16 INCHES O.C.

$$q = 35 \text{ PCF} \left(\frac{(1.5'')(7.5'')}{16''} \right) \cdot \frac{1}{12''/'} = 2.05 \text{ PSF}$$

$q_{DL} = 10.18 \text{ PSF}$

TABLE 4-1 MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o, AND MINIMUM CONCENTRATED LIVE LOADS

Occupancy or Use	Uniform psf (kN/m²)	Conc. lb (kN)
Apartments (see *Residential*)		
Access floor systems		
Office use	50 (2.4)	2,000 (8.9)
Computer use	100 (4.79)	2,000 (8.9)
Armories and drill rooms	150 (7.18)	
Assembly areas and theaters		
Fixed seats (fastened to floor)	60 (2.87)	
Lobbies	100 (4.79)	
Movable seats	100 (4.79)	
Platforms (assembly)	100 (4.79)	
Stage floors	150 (7.18)	
Balconies (exterior)	100 (4.79)	
On one- and two-family residences only, and not exceeding 100 ft² (9.3 m²)	60 (2.87)	
Bowling alleys, poolrooms, and similar recreational areas	75 (3.59)	
Catwalks for maintenance access	40 (1.92)	300 (1.33)
Corridors		
First floor	100 (4.79)	
Other floors, same as occupancy served except as indicated		
Dance halls and ballrooms	100 (4.79)	
Decks (patio and roof)		
Same as area served, or for the type of occupancy accommodated		
Dining rooms and restaurants	100 (4.79)	
Dwellings (see *Residential*)		
Elevator machine room grating (on area of 4 in.² [2,580 mm²])		300 (1.33)
Finish light floor plate construction (on area of 1 in.² [645 mm²])		200 (0.89)
Fire escapes	100 (4.79)	
On single-family dwellings only	40 (1.92)	
Fixed ladders	See Section 4.4	
Garages (passenger vehicles only)	40 (1.92)[a,b]	
Trucks and buses		
Grandstands (see *Stadiums and arenas, Bleachers*)		
Gymnasiums—main floors and balconies	100 (4.79)	
Handrails, guardrails, and grab bars	See Section 4.4	
Hospitals		
Operating rooms, laboratories	60 (2.87)	1,000 (4.45)
Patient rooms	40 (1.92)	1,000 (4.45)
Corridors above first floor	80 (3.83)	1,000 (4.45)
Hotels (see *Residential*)		
Libraries		
Reading rooms	60 (2.87)	1,000 (4.45)
Stack rooms	150 (7.18)[c]	1,000 (4.45)
Corridors above first floor	80 (3.83)	1,000 (4.45)
Manufacturing		
Light	125 (6.00)	2,000 (8.90)
Heavy	250 (11.97)	3,000 (13.40)
Marquees	75 (3.59)	
Office Buildings		
File and computer rooms shall be designed for heavier loads based on anticipated occupancy		
Lobbies and first-floor corridors	100 (4.79)	2,000 (8.90)
Offices	50 (2.40)	2,000 (8.90)
Corridors above first floor	80 (3.83)	2,000 (8.90)
Penal Institutions		
Cell blocks	40 (1.92)	
Corridors	100 (4.79)	
Residential		
Dwellings (one- and two-family)		
Uninhabitable attics without storage	10 (0.48)	
Uninhabitable attics with storage	20 (0.96)	
Habitable attics and sleeping areas	30 (1.44)	
All other areas except stairs and balconies	40 (1.92)	
Hotels and multifamily houses		
Private rooms and corridors serving them	40 (1.92)	
Public rooms and corridors serving them	100 (4.79)	
Reviewing stands, grandstands, and bleachers	100 (4.79)[d]	

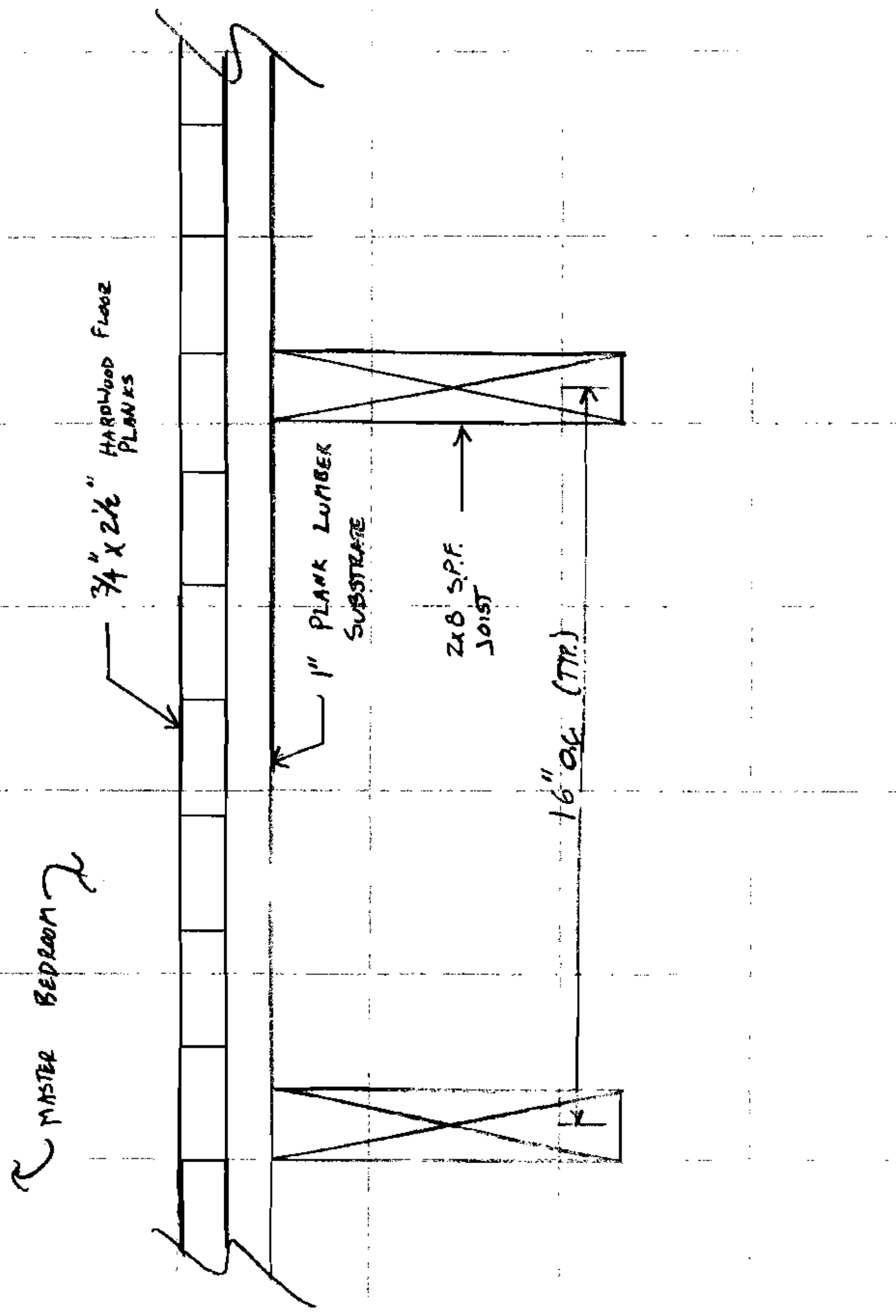
Appendix B. Typical Properties of Selected Materials Used in Engineering[1,5]
(U.S. Customary Units)
Continued from page 746

Material	Specific Weight, lb/in^3	Ultimate Strength: Tension, ksi	Ultimate Strength: Compression,[2] ksi	Ultimate Strength: Shear, ksi	Yield Strength[3]: Tension, ksi	Yield Strength[3]: Shear, ksi	Modulus of Elasticity, 10^6 psi	Modulus of Rigidity, 10^6 psi	Coefficient of Thermal Expansion, $10^{-6}/°F$	Ductility, Percent Elongation in 2 in.
Magnesium Alloys										
Alloy AZ80 (Forging)	0.065	50		23	36		6.5	2.4	14	6
Alloy AZ31 (Extrusion)	0.064	37		19	29		6.5	2.4	14	12
Titanium										
Alloy (6% Al, 4% V)	0.161	130			120		16.5		5.3	10
Monel Alloy 400(Ni-Cu)										
Cold-worked	0.319	98			85	50	26		7.7	22
Annealed	0.319	80			32	18	26		7.7	46
Cupronickel (90% Cu, 10% Ni)										
Annealed	0.323	53			16		20	7.5	9.5	35
Cold-worked	0.323	85			79		20	7.5	9.5	3
Timber, air dry										
Douglas fir	0.017	15	7.2	1.1			1.9	.1	Varies	
Spruce, Sitka	0.015	8.6	5.6	1.1			1.5	.07	1.7 to 2.5	
Shortleaf pine	0.018		7.3	1.4			1.7			
Western white pine	0.014		5.0	1.0			1.5			
Ponderosa pine	0.015	8.4	5.3	1.1			1.3			
White oak	0.025		7.4	2.0			1.8			
Red oak	0.024		6.8	1.8			1.8			
Western hemlock	0.016	13	7.2	1.3			1.6			
Shagbark hickory	0.026		9.2	2.4			2.2			
Redwood	0.015	9.4	6.1	0.9			1.3			
Concrete										
Medium strength	0.084		4.0				3.6		5.5	
High strength	0.084		6.0				4.5		5.5	
Plastics										
Nylon, type 6/6, (molding compound)	0.0412	11	14		6.5		0.4		80	50
Polycarbonate	0.0433	9.5	12.5		9		0.35		68	110
Polyester, PBT (thermoplastic)	0.0484	8	11		8		0.35		75	150
Polyester elastomer	0.0433	6.5		5.5			0.03			500
Polystyrene	0.0374	8	13		8		0.45		70	2
Vinyl, rigid PVC	0.0520	6	10		6.5		0.45		75	40
Rubber	0.033	2							90	600
Granite (Avg. values)	0.100	3	35	5			10	4	4	
Marble (Avg. values)	0.100	2	18	4			8	3	6	
Sandstone (Avg. values)	0.083	1	12	2			6	2	5	
Glass, 98% silica	0.079		7				9.6	4.1	44	

[1]Properties of metals vary widely as a result of variations in composition, heat treatment, and mechanical working.
[2]For ductile metals the compression strength is generally assumed to be equal to the tension strength.
[3]Offset of 0.2 percent.
[4]Timber properties are for loading parallel to the grain.
[5]See also *Marks' Mechanical Engineering Handbook*, 10th ed., McGraw-Hill, New York, 1996; *Annual Book of ASTM*, American Society for Testing Materials, Philadelphia, Pa.; *Metals Handbook*, American Society for Metals, Metals Park, Ohio; and *Aluminum Design Manual*, The Aluminum Association, Washington, DC.

[redacted]

Project: Load Bearing Wall Removal	Job No.	Sheet: of
Item:	Designer: J. Olund	Date: 2/16/10
	Checker:	Date:
		Grid: 1/8"



EXISTING FLOOR SECTION

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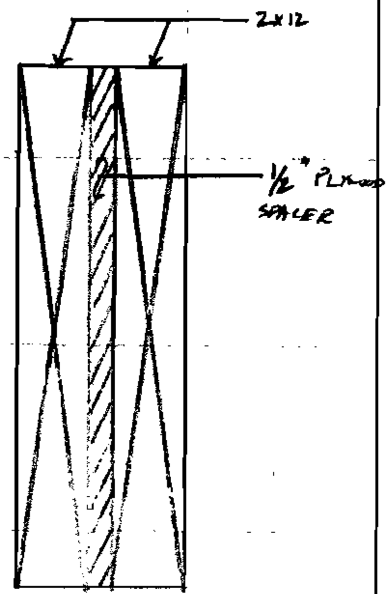
Project: Load Bearing Wall Removal	Job No.	Sheet: of
Item: Loads	Designer: J. Cland	Date: 2/17/10
	Checker:	Date:
		Grid: 1/8"

Self Weight:

→ Assume 2 - 2x12 S.P.F.'s and ½" plywood spacer

W_{self} = 35 PCF [(11.25")(1.5" + 1.5" + 0.5")] = 9.57 PLF



HEADER SECTION

Attachments & Misc. Loads:

→ ½" drywall @ 2 PSF : ((1.0 FT).2 + 0.5')(1 FT)(2 PSF) = 5 PLF

→ Estimate hardware @ 0.5 PLF

→ Estimate paint, trim, etc. @ 2.5 PLF

TOTAL = 8 PLF

Total Beam Load:

Tributary floor width = 13.0 FT (Half of floor plan dimension)

W = 9.57 PLF + 8 PLF + 13 FT (40 PSF + 10.18 PSF)

W = 669.91 PLF → use 670 PLF (= 55.83 LB/IN)

[redacted]

Project: LOAD BEARING WALL REMOVAL	Job No.	Sheet: of
Item: BEAM PROPERTIES	Designer: J. OLUND	Date: 2/17/10
	Checker:	Date:
		Grid: 1/8"

REF.: NATIONAL DESIGN SPECIFICATION, 2001 EDITION, ALLOWABLE STRESS DESIGN, AMERICAN FOREST & PAPER ASSOCIATION & AMERICAN WOOD COUNCIL

→ APPLICABLE PAGES ATTACHED.

$A = 16.88\ in^2$ EA.

$S_x = 31.64\ in^3$ EA.

$I_x = 178.0\ in^4$ EA

FORCES CHECKED / CONSIDERED:

→ VALUES LISTED ARE ALLOWABLE STRESSES WITHOUT ACCOUNT FOR MODIFICATION FACTORS.

BENDING STRESS: $F_b = 875$ PSI

HORIZONTAL SHEAR: $F_v = 135$ PSI

END BEARING: $F_{c\perp} = 425$ PSI

DEFLECTION:

LIMIT DEFLECTION TO: $L/360$ FOR LIVE LOADS

$L/240$ FOR DEAD LOADS

REF: IBC 2006, TABLE 1604.3

Table 1B Section Properties of Standard Dressed (S4S) Sawn Lumber

Nominal Size b×d	Standard Dressed Size (S4S) b×d inches x inches	Area of Section A in²	X-X AXIS Section Modulus S_{xx} in³	X-X AXIS Moment of Inertia I_{xx} in⁴	Y-Y AXIS Section Modulus S_{yy} in³	Y-Y AXIS Moment of Inertia I_{yy} in⁴	Approximate weight in pounds per linear foot (lb/ft) of piece when density of wood equals: 25 lb/ft³	30 lb/ft³	35 lb/ft³	40 lb/ft³	45 lb/ft³	50 lb/ft³
1 x 3	3/4 x 2-1/2	1.875	0.781	0.977	0.234	0.088	0.326	0.391	0.456	0.521	0.586	0.651
1 x 4	3/4 x 3-1/2	2.625	1.531	2.680	0.328	0.123	0.456	0.547	0.638	0.729	0.820	0.911
1 x 6	3/4 x 5-1/2	4.125	3.781	10.40	0.516	0.193	0.716	0.859	1.003	1.146	1.289	1.432
1 x 8	3/4 x 7-1/4	5.438	6.570	23.82	0.680	0.255	0.944	1.133	1.322	1.510	1.699	1.888
1 x 10	3/4 x 9-1/4	6.938	10.70	49.47	0.867	0.325	1.204	1.445	1.686	1.927	2.168	2.409
1 x 12	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
2 x 3	1-1/2 x 2-1/2	3.750	1.563	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	3.063	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	5.063	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	7.563	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	8.750	5.104	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	8.438	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	7.146	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	102.4	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	135.7	1034	31.14	54.49	9.266	11.12	12.97	14.83	16.68	18.53
5 x 5	4-1/2 x 4-1/2	20.25	15.19	34.17	15.19	34.17	3.516	4.219	4.922	5.625	6.328	7.031
6 x 6	5-1/2 x 5-1/2	30.25	27.73	76.26	27.73	76.26	5.252	6.302	7.352	8.403	9.453	10.50
6 x 8	5-1/2 x 7-1/2	41.25	51.56	193.4	37.81	104.0	7.161	8.594	10.03	11.46	12.89	14.32
6 x 10	5-1/2 x 9-1/2	52.25	82.73	393.0	47.90	131.7	9.071	10.89	12.70	14.51	16.33	18.14
6 x 12	5-1/2 x 11-1/2	63.25	121.2	697.1	57.98	159.4	10.98	13.18	15.37	17.57	19.77	21.96
6 x 14	5-1/2 x 13-1/2	74.25	167.1	1128	68.06	187.2	12.89	15.47	18.05	20.63	23.20	25.78
6 x 16	5-1/2 x 15-1/2	85.25	220.2	1707	78.15	214.9	14.80	17.76	20.72	23.68	26.64	29.60
6 x 18	5-1/2 x 17-1/2	96.25	280.7	2456	88.23	242.6	16.71	20.05	23.39	26.74	30.08	33.42
6 x 20	5-1/2 x 19-1/2	107.3	348.6	3398	98.31	270.4	18.62	22.34	26.07	29.79	33.52	37.24
6 x 22	5-1/2 x 21-1/2	118.3	423.7	4555	108.4	298.1	20.53	24.64	28.74	32.85	36.95	41.06
6 x 24	5-1/2 x 23-1/2	129.3	506.2	5948	118.5	325.8	22.44	26.93	31.41	35.90	40.39	44.88
8 x 8	7-1/2 x 7-1/2	56.25	70.31	263.7	70.31	263.7	9.766	11.72	13.67	15.63	17.58	19.53
8 x 10	7-1/2 x 9-1/2	71.25	112.8	535.9	89.06	334.0	12.37	14.84	17.32	19.79	22.27	24.74
8 x 12	7-1/2 x 11-1/2	86.25	165.3	950.5	107.8	404.3	14.97	17.97	20.96	23.96	26.95	29.95
8 x 14	7-1/2 x 13-1/2	101.3	227.8	1538	126.6	474.6	17.58	21.09	24.61	28.13	31.64	35.16
8 x 16	7-1/2 x 15-1/2	116.3	300.3	2327	145.3	544.9	20.18	24.22	28.26	32.29	36.33	40.36
8 x 18	7-1/2 x 17-1/2	131.3	382.8	3350	164.1	615.2	22.79	27.34	31.90	36.46	41.02	45.57
8 x 20	7-1/2 x 19-1/2	146.3	475.3	4634	182.8	685.5	25.39	30.47	35.55	40.63	45.70	50.78
8 x 22	7-1/2 x 21-1/2	161.3	577.6	6211	201.6	755.9	27.99	33.59	39.19	44.79	50.39	55.99
8 x 24	7-1/2 x 23-1/2	176.3	690.3	8111	220.3	826.2	30.60	36.72	42.84	48.96	55.08	61.20
10 x 10	9-1/2 x 9-1/2	90.25	142.9	678.8	142.9	678.8	15.67	18.80	21.94	25.07	28.20	31.34
10 x 12	9-1/2 x 11-1/2	109.3	209.4	1204	173.0	821.7	18.97	22.76	26.55	30.35	34.14	37.93
10 x 14	9-1/2 x 13-1/2	128.3	288.6	1948	203.1	964.5	22.27	26.72	31.17	35.63	40.08	44.53
10 x 16	9-1/2 x 15-1/2	147.3	380.4	2948	233.1	1107	25.56	30.68	35.79	40.90	46.02	51.13
10 x 18	9-1/2 x 17-1/2	166.3	484.9	4243	263.2	1250	28.86	34.64	40.41	46.18	51.95	57.73
10 x 20	9-1/2 x 19-1/2	185.3	602.1	5870	293.3	1393	32.16	38.59	45.03	51.46	57.89	64.32
10 x 22	9-1/2 x 21-1/2	204.3	731.9	7868	323.4	1536	35.46	42.55	49.64	56.74	63.83	70.92
10 x 24	9-1/2 x 23-1/2	223.3	874.4	10270	353.5	1679	38.76	46.51	54.26	62.01	69.77	77.52

[redacted]

value

[redacted]

T·Y·LIN INTERNATIONAL

Project: Load Bearing Wall Removal | Job No. | Sheet: of
Item: Allowable Stress Modification Factors | Designer: J. Olund | Date: 2/17/10
Checker: | Date:
Grid: 1/8"

→ All factors are 1.0 unless noted below:

$C_D = 0.90$ ~ Load duration factor, permanent

Design stresses:

$F_b' = 0.9(875) = 787.5$ psi

$F_v' = 0.9(135) = 121.5$ psi

$F_{c\perp}' = 425$ psi

Table 4.3.1 Applicability of Adjustment Factors for Sawn Lumber

		Load Duration Factor	Wet Service Factor	Temperature Factor	Beam Stability Factor	Size Factor	Flat Use Factor	Incising Factor	Repetitive Member Factor	Form Factor	Column Stability Factor	Buckling Stiffness Factor	Bearing Area Factor
$F_b' = F_b$	x	C_D	C_M	C_t	C_L	C_F	C_{fu}	C_i	C_r	C_f	-	-	-
$F_t' = F_t$	x	C_D	C_M	C_t	-	C_F	-	C_i	-	-	-	-	-
$F_v' = F_v$	x	C_D	C_M	C_t	-	-	-	C_i	-	-	-	-	-
$F_{c\perp}' = F_{c\perp}$	x	-	C_M	C_t	-	-	-	C_i	-	-	-	-	C_b
$F_c' = F_c$	x	C_D	C_M	C_t	-	C_F	-	C_i	-	-	C_P	-	-
$E' = E$	x	-	C_M	C_t	-	-	-	C_i	-	-	-	C_T	-

4.3.6.3 For beams of circular cross section with a diameter greater than 13.5", or for 12" or larger square beams loaded in the plane of the diagonal, the size factor shall be determined in accordance with 4.3.6.2 on the basis of an equivalent conventionally loaded square beam of the same cross-sectional area.

4.3.6.4 Bending design values for all species of 2" thick or 3" thick Decking, except Redwood, shall be multiplied by the size factors specified in Table 4E.

4.3.7 Flat Use Factor, C_{fu}

When sawn lumber 2" to 4" thick is loaded on the wide face, multiplying the bending design value, F_b, by the flat use factors, C_{fu}, specified in Tables 4A, 4B, 4C and 4F, shall be permitted.

4.3.8 Incising Factor, C_i

Tabulated design values shall be multiplied by the following incising factor, C_i, when dimension lumber is incised parallel to grain a maximum depth of 0.4", a maximum length of 3/8", and density of incisions up to 1,100/ft². Incising factors shall be determined by test or by calculation using reduced section properties for incising patterns exceeding these limits.

Table 4.3.8 Incising Factors, C_i

Design Value	C_i
E	0.95
F_b, F_t, F_c	0.80
F_v, $F_{c\perp}$	1.00

4.3.9 Repetitive Member Factor, C_r

Bending design values, F_b, in Tables 4A, 4B, 4C and 4F 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 centers, are not less than three in number and are joined by floor, roof or other load distributing elements adequate to support the design load. (A load distributing element is any adequate system that is designed or has been proven by experience to transmit the design load to adjacent members, spaced as described above, without displaying structural weakness or unacceptable deflection. Subflooring, flooring, sheathing, or other covering elements and nail gluing or tongue and groove joints, and through nailing generally meet these criteria.) Repetitive member bending design values in

Table 4A Adjustment Factors

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 centers, 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	$F_{c\perp}$	F_c	E
0.85*	1.0	0.97	0.67	0.8**	0.9

* when $(F_b)(C_F) \leq 1150$ psi, $C_M = 1.0$
** when $(F_c)(C_F) \leq 750$ psi, $C_M = 1.0$

Flat Use Factor, C_{fu}

Bending design values adjusted by size factors ar based on edgewise use (load applied to narrow face). Whe dimension lumber is used flatwise (load applied to wid face), the bending design value, F_b, shall also be multi plied by the following flat use factors:

Flat Use Factors, C_{fu}

Width (depth)	Thickness (breadth) 2" & 3"	4"
2" & 3"	1.0	—
4"	1.1	1.0
5"	1.1	1.05
6"	1.15	1.05
8"	1.15	1.05
10" & wider	1.2	1.1

[redacted]

Size Factor, C_F

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

Size Factors, C_F

Grades	Width (depth)	F_b Thickness (breadth) 2" & 3"	F_b Thickness (breadth) 4"	F_t	F_c
Select Structural, No.1 & Btr., 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			

[redacted]

Table 2.3.2 Frequently Used Load Duration Factors, C_D[1]

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[2]	2.0	Impact Load

1. Load duration factors shall not apply to modulus of elasticity, E, nor to compression perpendicular to grain design values, $F_{c\perp}$, 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.

2.3.3 Temperature Factor, C_t

Tabulated design values shall be multiplied by the following temperature factors, C_t, for structural members that will experience sustained exposure to elevated temperatures up to 150°F (see Appendix C).

Table 2.3.3 Temperature Factor, C_t

Design Values	In Service Moisture Conditions[1]	C_t T≤100°F	100°F<T≤125°F	125°F<T≤150°F
F_b, E	Wet or Dry	1.0	0.9	0.9
F_t, F_v, F_c	Dry	1.0	0.8	0.7
and $F_{c\perp}$	Wet	1.0	0.7	0.5

1. Wet and dry service conditions for sawn lumber, glued laminated timber, prefabricated wood I-joists, structural composite lumber, and wood structural panels are specified in 4.1.4, 5.1.5, 7.1.4, 8.1.4, and 9.3.3, respectively.

2.3.4 Fire Retardant Treatment

The effects of fire retardant chemical treatment on strength shall be accounted for in the design. Allowable design values, including connection design values, for lumber and structural glued laminated timber pressure-treated with fire retardant chemicals shall be obtained from the company providing the treatment and redrying service. Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with fire retardant chemicals (see Table 2.3.2).

3.2 Bending Members – General

3.2.1 Span of Bending Members

For simple, continuous and cantilevered bending members, the span shall be taken as the distance from face to face of supports, plus 1/2 the required bearing length at each end.

3.2.2 Lateral Distribution of Concentrated Load

Lateral distribution of concentrated loads from a critically loaded bending member to adjacent parallel bending members by flooring or other cross members shall be permitted to be calculated when determining design bending moment and vertical shear force (see 15.1).

3.2.3 Notches

3.2.3.1 Bending members shall not be notched except as permitted by 4.4.3, 5.4.4, 7.4.4, and 8.4.1. A gradual taper cut from the reduced depth of the member to the full depth of the member in lieu of a square-cornered notch reduces stress concentrations.

3.2.3.2 The stiffness of a bending member, as determined from its cross section, is practically unaffected by a notch with the following dimensions:

notch depth ≤ (1/6) (beam depth)
notch length ≤ (1/3) (beam depth)

3.2.3.3 See 3.4.3 for effect of notches on shear strength.

3.3 Bending Members – Flexure

3.3.1 Strength in Bending

The actual bending stress or moment shall not exceed the allowable bending design value.

3.3.2 Flexural Design Equations

3.3.2.1 The actual bending stress induced by a bending moment, M, is calculated as follows:

$$f_b = \frac{Mc}{I} = \frac{M}{S} \qquad (3.3\text{-}1)$$

For a rectangular bending member of breadth, b, and depth, d, this becomes:

$$f_b = \frac{M}{S} = \frac{6M}{bd^2} \qquad (3.3\text{-}2)$$

3.3.2.2 For solid rectangular bending members with the neutral axis perpendicular to depth at center:

$$I = \frac{bd^3}{12} = \text{moment of inertia} \qquad (3.3\text{-}3)$$

$$S = \frac{I}{c} = \frac{bd^2}{6} = \text{section modulus} \qquad (3.3\text{-}4)$$

3.3.3 Beam Stability Factor, C_L

3.3.3.1 When the depth of a bending member does not exceed its breadth, $d \le b$, no lateral support is required and $C_L = 1.0$.

3.3.3.2 When rectangular sawn lumber bending members are laterally supported in accordance with 4.4.1, $C_L = 1.0$.

3.3.3.3 When the compression edge of a bending member is supported throughout its length to prevent lateral displacement, and the ends at points of bearing have lateral support to prevent rotation, $C_L = 1.0$.

3.3.3.4 When the depth of a bending member exceeds its breadth, $d > b$, lateral support shall be provided at points of bearing to prevent rotation and/or lateral displacement at those points. When such lateral support is provided at points of bearing, but no additional lateral support is provided throughout the length of the bending member, the unsupported length, ℓ_u, is the distance between such points of end bearing, or the length of a cantilever. When a bending member is provided with lateral support to prevent rotational and/or lateral displacement at intermediate points as well as at the ends, the unsupported length, ℓ_u, is the distance between such points of intermediate lateral support.

3.3.3.5 The effective span length, ℓ_e, for single span or cantilever bending members shall be determined in accordance with Table 3.3.3.

3.3.3.6 The slenderness ratio, R_B, for bending members shall be calculated as follows:

$$R_B = \sqrt{\frac{\ell_e d}{b^2}} \quad (3.3\text{-}5)$$

3.3.3.7 The slenderness ratio for bending members, R_B, shall not exceed 50.

3.3.3.8 The beam stability factor shall be calculated as follows:

$$C_L = \frac{1+(F_{bE}/F_b^*)}{1.9} - \sqrt{\left[\frac{1+(F_{bE}/F_b^*)}{1.9}\right]^2 - \frac{F_{bE}/F_b^*}{0.95}} \quad (3.3\text{-}6)$$

where:

F_b^* = tabulated bending design value multiplied by all applicable adjustment factors except C_{fu}, C_V and C_L (see 2.3)

$F_{bE} = \frac{K_{bE}E'}{R_B^2}$

K_{bE} = 0.745 - 1.225(COV_E)
= 0.439 for visually graded lumber
= 0.561 for machine evaluated lumber (MEL)
= 0.610 for products with $COV_E \leq 0.11$
(see Appendix F.2)

3.3.3.9 See Appendix D for background information concerning beam stability calculations and Appendix F for information concerning coefficient of variation in modulus of elasticity (COV_E).

3.3.3.10 Members subjected to flexure about both principal axes (biaxial bending) shall be designed in accordance with 3.9.2.

3.3.4 Form Factor, C_f

Tabulated bending design values, F_b, for bending members with either a circular cross section or a square cross section loaded in the plane of the diagonal (diamond section) shall be multiplied by the following form factors, C_f:

Table 3.3.4 Form Factors, C_f

	C_f
Round Section	1.18
Diamond Section	1.414

These form factors insure that a circular or diamond shaped bending member has the same moment capacity as a square bending member having the same cross-sectional area. If a circular member is tapered, it shall be considered a beam of variable cross section.

3 DESIGN PROVISIONS AND EQUATIONS

3.4 Bending Members – Shear

3.4.1 Strength in Shear Parallel to Grain (Horizontal Shear)

3.4.1.1 The actual shear stress parallel to grain or shear force at any cross section of the bending member shall not exceed the allowable shear design value. A check of the strength of wood bending members in shear perpendicular to grain is not required.

3.4.1.2 The shear design procedures specified herein for calculating f_v at or near points of vertical support are limited to solid flexural members such as sawn lumber, glued laminated timber, structural composite lumber or mechanically laminated timber beams. Shear design at supports for built-up components containing load-bearing connections at or near points of support, such as between web and chord of a truss, shall be based on test or other techniques.

3.4.2 Shear Design Equations

The actual shear stress parallel to grain induced in a sawn lumber, glued laminated timber, structural composite lumber, timber pole or timber pile bending member shall be calculated as follows:

$$f_v = \frac{VQ}{Ib} \quad (3.4\text{-}1)$$

For a rectangular bending member of breadth, b, and depth, d, this becomes:

$$f_v = \frac{3V}{2bd} \quad (3.4\text{-}2)$$

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Project: LOAD BEARING WALL REMOVAL	Job No.	Sheet: of
Item: MAXIMUM BEAM LENGTH	Designer: J. OLUWO	Date: 2/17/10
	Checker:	Date:
		Grid: 1/8"

BENDING:

$$\sigma = \frac{M}{S_x} = \frac{wL^2}{8S_x} \leq F_b'$$

$$\therefore L \leq \sqrt{\frac{8F_b' \cdot S_x}{w}} = \sqrt{\frac{8(787.5\text{PSI})(2 \cdot 31.64\text{IN}^3)}{55.83\text{ LB/IN}}}$$

$$L \leq 84.5'' = \underline{\underline{7'\text{-}0\tfrac{1}{2}''}}$$

SHEAR:

$$F_v = \frac{V \cdot Q}{I_x b} \equiv \frac{3V}{2bd} \leq F_v'$$ ← FOR RECTANGULAR SECTIONS ONLY

$$V = \frac{wL}{2} \quad \therefore \quad \frac{3wL}{4bd} \leq F_v'$$

$$L \leq \frac{4bdF_v'}{3w} = \frac{4(3'')(11.25'')(121.5\text{PSI})}{3(55.83\text{ LB/IN})}$$

$$L \leq 97.9'' = \underline{\underline{8'\text{-}1\tfrac{7}{8}''}}$$

BEARING / COMPRESSION PERPENDICULAR TO GRAIN:

$$\frac{wL}{2b \cdot w} \leq 425\text{ PSI}$$

← ASSUME SUPPORTED ON TWO STUDS

$$L \leq \frac{2(3'')(27.5'')(425\text{PSI})}{55.83\text{ LB/IN}} = 137'' = \underline{\underline{11'\text{-}5''}}$$

[redacted]

Project: LOAD BEARING WALL REMOVAL	Job No.	Sheet: of
Item: MAXIMUM BEAM LENGTH	Designer: J. OLUND	Date: 2/17/10
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LIVE LOAD DEFLECTION:

$$\delta = \frac{5wL^4}{384EI} < \frac{L}{360}$$

$w = (40 psf)(13') = 520 PLF = 43.33 LB/IN$

$E = 1,400,000$ PSI

$I_x = (178.0 in^4) \cdot 2 = 356 in^4$

$$L_{max} = \sqrt[3]{\frac{384EI}{5w(360)}} \quad , L \leq 134.9 in. = 11'-2\tfrac{7}{8}"$$

DEAD & LIVE LOAD DEFLECTION:

$$\delta \leq \frac{L}{240}$$

$$L_{max} \leq 141.9 in = 11'-9\tfrac{7}{8}"$$

→ BENDING CONTROLS DESIGN

→ MAXIMUM SPAN LENGTH = 7'-0"