SPECIAL INSTRUCTIONS FOR CITIES/COUNTIES

LOG OF PILING DRIVEN – ENR

The "Log of Piling Driven" (Form 830210) is used on all projects built under the supervision of the project engineer whenever piles are driven for any bridge structure. The purpose of the report is to show the calculated bearing obtained for each individual pile driven. The project engineer should prepare two copies of the report immediately upon completion of the driving of the piles in each pier or abutment. Do NOT wait until the piles are driven for the entire structure before submitting the reports. Submit these reports to the District Local Systems Engineer (DLSE). The DLSE will forward the original to the Office of Bridges and Structures.

Before signing the report, the project engineer should see that all information needed in checking the pile bearings shown is included in the report. The bearing value of the piles should be computed to the nearest one-tenth ton by the use of the formulas given in the standard specifications.

The piles should be driven in accordance with the specifications. The test blows to calculate the average penetration and pile bearing shall be taken immediately upon completion of driving.

The length of piles shown on the plans or ordered by the engineer indicates the desired penetration. Although the specified bearing may have been obtained, driving shall be continued until this penetration is secured as long as the pile moves readily under each blow of the hammer and shows no signs of damage.

Log down one piling in each foundation of every new structure. If driving is hard, a 2 to 3 ft. interval would be sufficient; but if little resistance to driving is encountered, 4 to 5 ft. intervals can be used.

This information should be entered on a separate "Log of Piling Driven" form and sent with the "Log of Piling Driven" report for the completed foundation work to the DLSE. The logged piling data should include all the usual information required on the regular "Log of Piling Driven" including the hammer and bearing calculation data.

Calculation of Pile Bearing

The modified ENR formula presently in our Specifications Book will be used. Attached are two completed samples of "Log of Piling Driven" (Form 830210) showing the method of calculating pile bearings.

These calculations are on the back of the sample reports and illustrate the method of determining the values of the factors W divided by W+M and 3WH separately. When there are variations in the weight of piles driven, weight of cap, drop of hammer, etc., the separate determination of the values of W divided by W+M and 3WH simplifies the calculating of the bearings of the various piles.

The value of W divided by W+M is determined without reducing the weight of the separate terms in the factor to tons. Since these weights are all given in pounds, it makes additional work to change them to tons and this additional calculation increases the chance of error.

The value of the factor 3WH is determined separately for all different drops of the hammer. In this instance, the weight of the hammer must be given in tons, but this is the only place where this is necessary.

The next step is to combine the two factors for which the values have been determined separately into the formula $P = \frac{3WH}{S+0.35} \times \frac{W}{W+M}$ to give the calculated bearing of the piles if driven vertically (i.e.gravity hammer with wood, steel H, or shell pile). For battered piles, the right member of this equation, after being reduced to its simplest form, is then multiplied by the batter factor (cosine a)-(f sine a) to give the calculated bearing. This batter factor will vary with each variation in the rate of batter of the piles, but in the example given is for a batter of one in four.

Calculation of Pile Weight

Occasionally reports are received which give a different weight for each pile and an almost equal variation in the drop of the hammer. This adds to the work of checking the reported bearings and in most cases is unnecessary. The weight of wood piles should be determined in accordance with the tables in this appendix, and the same weight should be used for all piles in a single foundation unless they are of different lengths or of a different species of wood. When steel or concrete piles are extended, the weight used in the formula need not be changed unless the extension is greater then ten feet in length. In most cases, the test blows can be taken with the same drop for all piles in a single foundation. In general, the energy of the hammer for the test blows should be at or near the maximum allowed by the specifications unless the ease of securing the required bearing or the type or condition of the piles is such as to make heavy driving unnecessary or impractical.

Show Calculations on Back of Report

Many pile driving reports are received in which errors have been made in calculating the bearing for the piles. Often the error consists of an incorrect method of applying the formula so that all reported bearings are incorrect. To simplify the checking of the pile driving reports and to aid in determining where the errors are being made, use the method shown on the back of the sample reports in calculating pile bearings. The calculations should be shown on the back of the ORIGINAL COPY ONLY of the report. This should not add to the work of preparing these reports since similar calculations must be made in all cases, and this method would simplify the work of checking the reports.

Filling Out the Report

The columns for ~~length in leads, length cut off, and length in structure~~ plan length and extensions should be totaled and the length measured for payment should be shown on the report as the sample reports illustrate. ~~For furnishing wood piles, the length measured for payment shall be the length incorporated in the structure plus three-fourths of the length cut off during or after driving, except that cutoffs of 1.5 feet or less shall be included with the length in the structure. For furnishing steel H and steel shell piles, the length measured for payment will be the length incorporated in the structure plus one/half of the pile cut off, if it is over 5 feet. Cut-offs of five feet or less will be measured as length in structure for furnish payment. For driving steel H, steel shell, and wood piles, the engineer will measure the length incorporated in the structure.~~

When it is necessary to extend steel piles, the length of extension, etc. shall be placed on the "Log of Piling Driven" as shown on the attached sample reports. ~~The total furnish and drive lengths shall be computed as shown on the sample reports, and the~~ The number of field splices required shall be reported.

The following information is to be added to the “Log of Piling Driven” (Form 830210) if welding of steel piles was necessary:

1. Name of certified welder(s)
2. Certificate number(s)
3. Date(s) piles were welded

Steel Pile Cutoffs

Article 2501.20, ~~Paragraph G~~ Paragraph D, establishes the procedure for cutoffs. See *Construction Manual 11.24* for guidance.

FALSEWORK PLANS

Refer to *Construction Manual 11.31* for guidance on falsework.

The contractor must use a licensed professional engineer for falsework plans. The project design engineer (city or county) shall review the falsework plans.

Form 830210 9/06

Iowa Department of Transportation

LOG OF PILING DRIVEN BY FORMULA

Project No. _____ **Pile (Type and Size)** _____ (Wood, Steel or Concrete)

County _____

Design No. _____ **Hammer (Type & Model)** _____ (Gravity or Diesel manufacturer and model)

Contractor _____

Iowa DOT Hammer No. _____ **Foundation Description** _____ (North abut, Pier 1, etc.)

Gross Weight of Hammer _____ **Effective Wt.** _____

Weight of Driving Parts _____ **Station of Foundation C.L.** _____

Weight of Anvil _____

Weight of Cap _____ **Cap No.** _____ **Formula Used** _____

Weight of Pile _____

Plan Pile Length _____ **Plan Driving Resistance** _____

Sketch foundation below, number each pile and show steel H-pile orientation as installed. Note battered piles on sketch,and give the amount of batter. Place name and certificate numt of welder below if welding was necessary. Forward 2 copies to the Iowa DOT District Office upon completion of each foundation. Note on drawing which pile has been logge

Batter Piling _____ in the direction shown.

Pile No.	Date Driven	(1) Plan Length (ft.)	Length Cutoff (0.0 ft.)	(2) Average Penetration Last Blows (inches)	Ram Rise (ft.)	Driven Resistance (Tons)	**RETAP** (3) Date	Ram Rise (ft.)	(2) Ave. Penetration Last Blows (inches)	Driven Resistance (Tons)	**PILE EXTENSIONS** (4) Length Added (0.0 ft.)	Length Cutoff (0.0 ft.)	Ram Rise (ft.)	(2) Ave. Penetration Last Blows (inches)	Driven Resistance (Tons)	Welds (Count)

(1) Record in the Remarks section below if the pile length is anything other than the plan length at the beginning of drive.

(2) For gravity hammers, enter the penetration in the last 5 blows divided by 5. For steam or diesel hammers, enter the penetration in the last 10 blows divided by 10.

(3) Indicate date of retap in date column (1 day delay min.). List only pile actually checked.

(4) Additional pile length to be authorized by the Engineer.

Total Welds: _____

Plan Length: _____ Feet

Extensions: _____ Feet

Total: _____ Feet

Welders Name: _____ Lab No.: _____ Exp. Date: _____

Remarks: _____

_____ Inspector

_____ Date

_____ Project Engineer

Form 830210 9/06

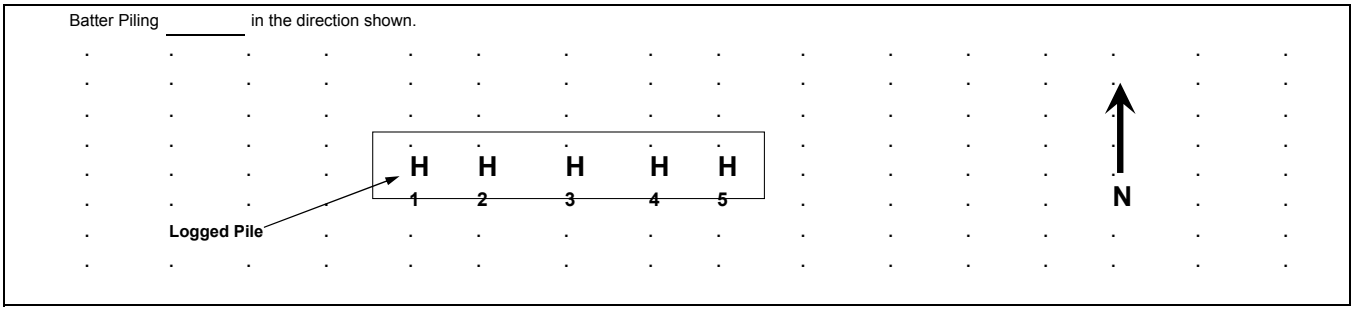
Iowa Department of Transportation

LOG OF PILING DRIVEN BY FORMULA

Project No. BRM-4062(2)8N-57
County Linn
Design No. 1276
Contractor Lunda Construction Company
Iowa DOT Hammer No.
Gross Weight of Hammer **Effective Wt.**
Weight of Driving Parts 4850 lbs
Weight of Anvil 1600 lbs
Weight of Cap 2100 lbs **Cap No** 930
Weight of Pile 1764 lbs - 42' & 2226 lbs - 53'
Plan Pile Length 42'

Pile (Type and Size) Steel HP 10 x 42 (Wood, Steel or Concrete)
Hammer (Type & Model) Diesel Delmag D22 (Gravity or Diesel manufacturer and model)
Foundation Description North Abutment (North abut, Pier 1, etc.)
Station of Foundation C.L. 322+82
Formula Used (3E/ S+0.1) x (W/ W+M)
Plan Driving Resistance 35 Ton

Sketch foundation below, number each pile and show steel H-pile orientation as installed. Note battered piles on sketch,and give the amount of batter. Place name and certificate numb of welder below if welding was necessary. Forward 2 copies to the Iowa DOT District Office upon completion of each foundation. Note on drawing which pile has been logge



Pile No.	Date Driven	(1) Plan Length (ft.)	Length Cutoff (0.0 ft.)	(2) Average Penetration Last Blows (inches)	Ram Rise (ft.)	Driven Resistance (Tons)	RETAP (3) Date	RETAP Ram Rise (ft.)	RETAP (2) Ave. Penetration Last Blows (inches)	RETAP Driven Resistance (Tons)	PILE EXTENSIONS (4) Length Added (0.0 ft.)	PILE EXTENSIONS Length Cutoff (0.0 ft.)	PILE EXTENSIONS Ram Rise (ft.)	PILE EXTENSIONS (2) Ave. Penetration Last Blows (inches)	PILE EXTENSIONS Driven Resistance (Tons)	Welds (Count)
1	05/24/06	42	0.4	0.362	5.0	37.0										
2	05/24/06	42	0.0	0.650	5.0	20.5					11.0	0.2	6.0	0.379	41	1
3	05/24/06	42	0.0	0.675	4.5	19.9					11.0	0.4	6.0	0.379	41	1
4	05/24/06	42	0.0	0.725	4.5	18.7	05/25/06	5.0	0.510	28.0	11.0	0.3	6.0	0.416	38	1
5	05/24/06	42	0.0	0.750	4.5	18.1	05/25/06	5.0	0.450	31.0	11.0	0.4	6.0	0.391	40	1

(1) Record in the Remarks section below if the pile length is anything other than the plan length at the beginning of drive.
(2) For gravity hammers, enter the penetration in the last 5 blows divided by 5. For steam or diesel hammers, enter the penetration in the last 10 blows divided by 10.
(3) Indicate date of retap in date column (1 day delay min.). List only pile actually checked.
(4) Additional pile length to be authorized by the Engineer.

Total Welds: 4

Plan Length: 210.0 Feet
Extensions: 44.0 Feet
Total: 254.0 Feet

Welders Name: Leroy Riedesel Lab No.: ASB-393 Exp. Date: 12/31/07

Remarks:

Inspector Date Project Engineer

42’ Steel HP 10x42

$$\frac{w}{W+M}=\frac{4850}{10314}=.470$$

W=4850
C=2100
A=1600
42’ P=1764
W+M=10314

3E=3WH=3(2.425)(4.5)=32.74

3E=3WH=3(2.425)(5.0)=36.38

$$P=\frac{3E}{S+0.1}x\frac{W}{W+M}$$

$$P=\frac{32.74}{S+0.1}x.470=\frac{15.39}{S+0.1}$$ 4.5’ Ram Rise

$$P=\frac{36.38}{S+0.1}x.470=\frac{17.10}{S+0.1}$$ 5.0’ Ram Rise

53’ Steel HP 10x42

$$\frac{W}{W+M}=\frac{4850}{10776}=.450$$

W=4850
C=2100
A=1600
53’P=2226
W+M=10776

3E=3WH=3(2.425)(5.0)=36.38

3E=3WH=3(2.425)(6.0)=43.65

$$P=\frac{36.38}{S+0.1}x.450=\frac{16.37}{S+0.1}$$ 5.0’ Ram Rise

$$P=\frac{43.65}{S+0.1}x.450=\frac{19.64}{S+0.1}$$ 6.0’ Ram Rise

Form 830210 9/06

Iowa Department of Transportation

LOG OF PILING DRIVEN BY FORMULA

Project No. BRM-4062(2)8N-57 **Pile (Type and Size)** Steel HP 10 x 42 (Wood, Steel or Concrete)

County Linn

Design No. 1276 **Hammer (Type & Model)** Diesel Delmag D22 (Gravity or Diesel manufacturer and model)

Contractor Lunda Construction Company

Iowa DOT Hammer No. _____ **Foundation Description** North Abutment (North abut, Pier 1, etc.)

Gross Weight of Hammer _____ **Effective Wt.** _____

Weight of Driving Parts 4850 lbs **Station of Foundation C.L.** 322+82

Weight of Anvil 1600 lbs

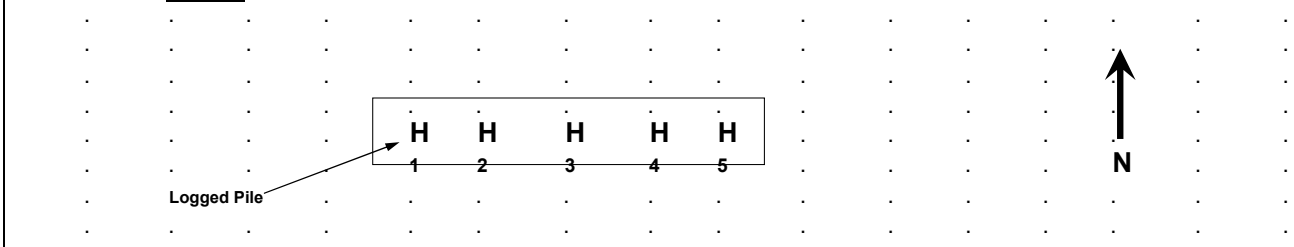
Weight of Cap 2100 lbs **Cap No** 930 **Formula Used** (3E/ S+0.1) x (W/ W+M)

Weight of Pile 1764 lbs - 42'

Plan Pile Length 42' **Plan Driving Resistance** 35 Ton

Sketch foundation below, number each pile and show steel H-pile orientation as installed. Note battered piles on sketch,and give the amount of batter. Place name and certificate numt of welder below if welding was necessary. Forward 2 copies to the Iowa DOT District Office upon completion of each foundation. Note on drawing which pile has been logge

Batter Piling _____ in the direction shown.



Pile No.	Date Driven	(1) Plan Length (ft.)	Length Cutoff (0.0 ft.)	(2) Average Penetration Last Blows (inches)	Ram Rise (ft.)	Driven Resistance (Tons)	RETAP (3) Date	RETAP Ram Rise (ft.)	RETAP (2) Ave. Penetration Last Blows (inches)	RETAP Driven Resistance (Tons)	PILE EXTENSIONS (4) Length Added (0.0 ft.)	PILE EXTENSIONS Length Cutoff (0.0 ft.)	PILE EXTENSIONS Ram Rise (ft.)	PILE EXTENSIONS (2) Ave. Penetration Last Blows (inches)	PILE EXTENSIONS Driven Resistance (Tons)	Welds (Count)
1	05/24/06	10		1.439	4.5	10.0										
		15		1.182	4.5	12.0										
		20		0.755	4.5	18.0										
		25		0.669	4.5	20.0										
		30		0.492	4.5	26.0										
		35		0.418	5.0	33.0										
		38		0.389	5.0	35.0										
		42	0.4	0.362	5.0	37.0										

(1) Record in the Remarks section below if the pile length is anything other than the plan length at the beginning of drive. Total Welds: _____

(2) For gravity hammers, enter the penetration in the last 5 blows divided by 5. For steam or diesel hammers, enter the penetration in the last 10 blows divided by 10.

(3) Indicate date of retap in date column (1 day delay min.). List only pile actually checked.

(4) Additional pile length to be authorized by the Engineer.

Plan Length: _____ Feet

Extensions: _____ Feet

Welders Name: _____ Lab No.: _____ Exp. Date: _____ Total: _____ Feet

Remarks: _____

Inspector Date Project Engineer

Form 830210 9/06

Iowa Department of Transportation

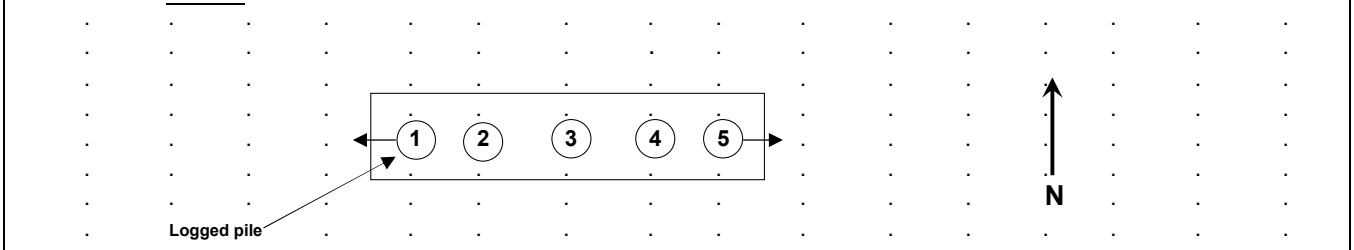
LOG OF PILING DRIVEN BY FORMULA

Project No. BROS-64(53)--60-64
County Marshall
Design No. 276
Contractor Fagre Construction Co.
Iowa DOT Hammer No. 172
Gross Weight of Hammer 4990 **Effective Wt.** 4990
Weight of Driving Parts
Weight of Anvil
Weight of Cap 730 **Cap No** 2120
Weight of Pile 922.2
Plan Pile Length 30'

Pile (Type and Size) Treated yellow southern pine (Wood, Steel or Concrete)
Hammer (Type & Model) Gravity (Gravity or Diesel manufacturer and model)
Foundation Description Pier 1 (North abut, Pier 1, etc.)
Station of Foundation C.L. 300+12
Formula Used P=(3WH/S+0.35) x (W/W+M)
Plan Driving Resistance 25 Ton

Sketch foundation below, number each pile and show steel H-pile orientation as installed. Note battered piles on sketch,and give the amount of batter. Place name and certificate numt of welder below if welding was necessary. Forward 2 copies to the Iowa DOT District Office upon completion of each foundation. Note on drawing which pile has been logge

Batter Piling 1:4 in the direction shown.



Pile No.	Date Driven	(1) Plan Length (ft.)	Length Cutoff (0.0 ft.)	(2) Average Penetration Last Blows (inches)	Ram Rise (ft.)	Driven Resistance (Tons)	RETAP (3) Date	RETAP Ram Rise (ft.)	RETAP (2) Ave. Penetration Last Blows (inches)	RETAP Driven Resistance (Tons)	PILE EXTENSIONS (4) Length Added (0.0 ft.)	PILE EXTENSIONS Length Cutoff (0.0 ft.)	PILE EXTENSIONS Ram Rise (ft.)	PILE EXTENSIONS (2) Ave. Penetration Last Blows (inches)	PILE EXTENSIONS Driven Resistance (Tons)	Welds (Count)
1	06/27/06	30	0.7	0.65	5	26.5										
2	06/27/06	30	0.4	0.65	5	28										
3	06/27/06	30	0.3	0.60	5	29.5										
4	06/27/06	30	0.3	0.63	5	28.6										
5	06/27/06	30	0.5	0.63	5	27										

(1) Record in the Remarks section below if the pile length is anything other than the plan length at the beginning of drive.
(2) For gravity hammers, enter the penetration in the last 5 blows divided by 5. For steam or diesel hammers, enter the penetration in the last 10 blows divided by 10.
(3) Indicate date of retap in date column (1 day delay min.). List only pile actually checked.
(4) Additional pile length to be authorized by the Engineer.

Total Welds:

Plan Length: 150.0 Feet
Extensions: 0.0 Feet
Total: 150.0 Feet

Welders Name: Lab No.: Exp. Date:

Remarks:

Inspector Date Project Engineer

A Treated So. Yel. Pine
32.34 Mid. Cir. (field measure)
17.4 cu. ft. x 53#/cu. ft. = 922.2 lbs

$$P = \frac{3wh}{s+0.35} \text{ X } \frac{w}{w+m}$$

$$= \frac{(3)(2.49)(5)}{s+0.35} x \frac{2.49}{3.31}$$

$$= \frac{28.01}{s+0.35} Straightpiles$$

W= $4990 \div 2000 = 2.49 tons$

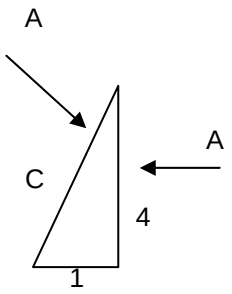
M= $\frac{922.2+730}{2000} = 0.82 tons$

$W + M = 2.49 + 0.82 = 3.31 tons$

H=5

S=Avg Pen/5 blows

B



sine A = $\frac{1}{4.1231} = .24254$

Batter Factor (1:4) = cosine A – (f sine A) f=0.10
= 0.97014 – (0.10)(0.24254)
= 0.94589

C

$$p = \frac{28.01}{s+0.35} x 0.94589$$

$$= \frac{26.49}{s+0.35} Batter 1:4$$

D Required bearing 28 Tons Batter 1:4 s=?

$$28 = \frac{26.49}{s+0.35}$$

$$s + 0.35 = \frac{26.49}{28}$$

$$s = \frac{26.49}{28} - 0.35 = 0.596 perblow x 5 = 2.98"5 blows$$

Note: This procedure shows maximum penetration to obtain plan formula bearing. Use actual penetration in the formula to get formula bearing.
Only data in A & C above, if applicable, needs to be shown on the back side of the Log of Piling.

ENR PILE TABLES

VOLUME AND WEIGHT OF WOOD PILES

The determination of the weight of the pile is a simple matter of computation when steel or concrete piles are used. However, when wood piles are used the determination of the weight to be used in the formula becomes more difficult. Obviously it would prove quite laborious to weight each pile and use a different value for "M" in the formula when computing the bearing value of each individual pile. Such procedure is neither feasible nor required.

The pile weight to use for wood piles should be determined for each length of pile used on the job and for each different kind of wood, in case all piles of a given length are not of the same kind. Measurements should be taken and weights determined for not less than two piles from each group for which the weight is to be determined. The piles selected should be of average size or slightly above the average for the group. The average of the two pile weights obtained should be the weight used in computing the pile bearing.

CALCULATION OF PILE WEIGHT

In order that our practice may be uniform, all pile weights should be determined by using tables in this appendix.

To obtain the weight of the pile, use the volume in cubic feet, multiplied by the weight per cubic foot of the pile. The weight per cubic foot of various species of wood is given on a separate note.

WEIGHTS OF STEEL SHELL, STEEL H, AND CONCRETE PILES

The following shall be used for computing the weights of various types of piles.

Steel H Piles

Steel H piles are designated as 10 x 42, 10 x 57, 12 x 53, etc., steel H piles. The second number indicates the weight per foot of the pile. Thus a 10 x 42 steel H pile 40 feet in length weighs 42 x 40 or 1,680 pounds.

Concrete Piles

For purposes of calculating the weight of concrete piles, it shall be assumed that the pile weighs 150 pounds per cubic foot. Thus a 14-inch square concrete pile 40 feet in length would weigh 1.167 x 1.167 x 40 x 150 or 8,171 pounds.

Cylindrical Steel Shell Piles (Type II or VII)

For 12-inch diameter piles, weight in pounds = 18.94L + 20
For 14-inch diameter piles, weight in pounds = 27.66L + 33
For 16-inch diameter piles, weight in pounds = 36.87L + 50
Where L is the length of shell in feet.

UNION METAL MONOTUBES (Type I or VI)

Weights of Type I and Type VI piles are to be computed from the attached table. The weight of a 7-gauge 14-inch 40-foot pile with 15-foot y taper (345 pounds) and 25 foot N section (731 pounds) is 1076 pounds.

WEIGHT PER CUBIC FOOT OF DIFFERENT SPECIES OF WOOD		
Species	**Green Lbs.**	**Air Dry Lbs.**
Ash	48	41
Cedar-Western Red	27	23
Cedar-Southern White	26	23
Cottonwood-Northern	46	24
Cypress-Southern	51	32
Fir-Douglas	38	24
Fir-White	46	27
Elm	54	35
Gum-Red	50	34
Hackberry	50	37
Hickory	63	51
Maple-Hard	56	44
Maple-Soft	47	34
Oak-Red	64	44
Oak-White	63	47
Pine-Northern White	36	25
Pine-Western White	35	27
Pine-Norway	42	34
Pine-Southern Yellow	55	41
Sycamore	52	34
Tamarak	47	37
Black Walnut	58	38
Note: (1) Air dry wood has moisture content of 12%.		
(2) For weight of treated piling, add 12 lbs. to the air dry weight.		
Reference: Wood Handbook, U.S. Department of Agriculture		

AMERICAN WOOD-PRESERVERS' ASSOCIATION STANDARD
F3-78 STANDARD VOLUMES OF ROUND FOREST PRODUCTS

Note: Standard F3-78 consists of six pages dated as follows: 1-2, 1978; 3-4 1961; 5-6, 1978.

The volume in cubic feet of all round forest products shall be calculated by one of the following methods:

Method 1. Standard Method*

a. Determine the nominal length of the piece, and its circumference, to the nearest quarter inch, at midpoint. Read the volume direct from Table 1.

b. If the nominal length is not covered in Table 1, refer to Table 2 and multiply the factor corresponding to the midpoint diameter, to the nearest quarter inch, by the length in feet.

Method 2. Alternate Method*

Find the average diameter of the butt and of the top, to the nearest half inch. Multiply the factor in Table 3 corresponding to these average diameters by the length of the piece in feet to obtain the volume. Multiply the total volumes thus obtained by the correction factor indicated below.

Correction Factors

Oak Piles	0.82
Southern pine piles	0.93
Southern pine and red pine poles	0.95

*Method 1 is the official method and must be used in all cases of dispute, except that for Douglas fir piles and poles either Method 1 or 2 may be used as the official method.

TABLE 1

Formula: $V = 3L \left(\frac{Cm}{3.1416} \right)^2 \times 0.001818$

Where V = total volume, cubic feet;
L = length, feet;
Cm = midpoint circumference, inches

Volume – Cubic Feet

Midpoint circumference	Length											
	16	18	20	22	25	30	35	40	45	50	55	60
14.0	1.8	2.0	2.2	2.4	2.8	3.3	---	---	---	---	---	---
1/4	1.8	2.0	2.2	2.4	2.8	3.3	---	---	---	---	---	---
1/2	1.8	2.1	2.3	2.5	2.9	3.5	---	---	---	---	---	---
3/4	1.9	2.2	2.4	2.6	3.0	3.6	---	---	---	---	---	---
15.0	2.0	2.3	2.5	2.8	3.2	3.8	---	---	---	---	---	---
1/4	2.0	2.3	2.5	2.8	3.2	3.8	---	---	---	---	---	---
1/2	2.1	2.4	2.6	2.9	3.3	3.9	---	---	---	---	---	---
3/4	2.2	2.4	2.7	3.0	3.4	4.1	---	---	---	---	---	---
16.0	2.3	2.6	2.8	3.1	3.5	4.3	---	---	---	---	---	---
1/4	2.4	2.7	2.9	3.2	3.7	4.4	---	---	---	---	---	---
1/2	2.5	2.8	3.1	3.4	3.8	4.6	---	---	---	---	---	---
3/4	2.5	2.8	3.1	3.4	3.8	4.6	---	---	---	---	---	---
17.0	2.5	2.9	3.2	3.5	4.0	4.8	---	---	---	---	---	---
1/4	2.6	3.0	3.3	3.6	4.1	4.9	---	---	---	---	---	---
1/2	2.7	3.1	3.4	3.8	4.3	5.1	---	---	---	---	---	---
3/4	2.8	3.2	3.5	3.9	4.4	5.3	---	---	---	---	---	---
18.0	2.8	3.2	3.5	3.9	4.4	5.3	6.2	---	---	---	---	---
1/4	2.9	3.3	3.7	4.0	4.6	5.5	6.4	---	---	---	---	---
1/2	3.0	3.4	3.8	4.2	4.7	5.7	6.6	---	---	---	---	---
3/4	3.1	3.5	3.9	4.3	4.9	5.9	6.9	---	---	---	---	---
19.0	3.1	3.5	3.9	4.3	4.9	5.9	6.9	---	---	---	---	---
1/4	3.2	3.6	4.0	4.5	5.1	6.1	7.1	---	---	---	---	---
1/2	3.4	3.8	4.2	4.6	5.2	6.3	7.3	---	---	---	---	---
3/4	3.5	3.9	4.3	4.8	5.4	6.5	7.6	---	---	---	---	---
20.0	3.6	4.0	4.5	4.9	5.6	6.7	7.8	8.9	---	---	---	---
1/4	3.6	4.0	4.5	4.9	5.6	6.7	7.8	8.9	---	---	---	---
1/2	3.7	4.1	4.6	5.1	5.8	6.9	8.1	9.2	---	---	---	---
3/4	3.8	4.3	4.8	5.2	5.9	7.1	8.3	9.5	---	---	---	---
21.0	3.9	4.4	4.9	5.4	6.1	7.3	8.6	9.8	---	---	---	---
1/4	3.9	4.4	4.9	5.4	6.1	7.3	8.6	9.8	---	---	---	---
1/2	4.0	4.5	5.0	5.5	6.3	7.6	8.8	10.1	---	---	---	---
3/4	4.2	4.7	5.2	5.7	6.5	7.8	9.1	10.4	---	---	---	---

TABLE 1 (Continued)
Volume – Cubic Feet

Midpoint	Length											
circumference	16	18	20	22	25	30	35	40	45	50	55	60
22.0	4.3	4.8	5.3	5.9	6.7	8.0	9.4	10.7	---	---	---	---
1/4	4.4	4.9	5.5	6.0	6.9	8.2	9.6	11.0	---	---	---	---
1/2	4.5	5.1	5.7	6.2	7.1	8.5	9.9	11.3	---	---	---	---
3/4	4.5	5.1	5.7	6.2	7.1	8.5	9.9	11.3	---	---	---	---
23.0	4.7	5.2	5.8	6.4	7.3	8.7	10.2	11.6	13.1	---	---	---
1/4	4.8	5.4	6.0	6.6	7.5	9.0	10.5	11.9	13.4	---	---	---
1/2	4.9	5.5	6.1	6.7	7.7	9.2	10.7	12.3	13.8	---	---	---
3/4	5.0	5.7	6.3	6.9	7.9	9.5	11.0	12.6	14.2	---	---	---
24.0	---	5.7	6.3	6.9	7.9	9.5	11.0	12.6	14.2	15.8	---	---
1/4	---	5.8	6.5	7.1	8.1	9.7	11.3	12.9	14.6	16.2	---	---
1/2	---	6.0	6.6	7.3	8.3	10.0	11.6	13.2	14.9	16.6	---	---
3/4	---	6.1	6.8	7.5	8.5	10.2	11.9	13.6	15.3	17.0	---	---
25.0	---	6.3	7.0	7.7	8.7	10.5	12.2	14.0	15.7	17.5	---	---
1/4	---	6.3	7.0	7.7	8.7	10.5	12.2	14.0	15.7	17.5	---	---
1/2	---	6.4	7.2	7.9	8.9	10.7	12.5	14.0	16.1	17.9	---	---
3/4	---	6.6	7.3	8.1	9.2	11.0	12.8	14.7	16.5	18.3	---	---
Midpoint	Length											
circumference	18	20	22	25	30	35	40	45	50	55	60	65
26.0	6.8	7.5	8.3	9.4	11.3	13.2	15.0	16.9	18.8	---	---	---
1/4	6.8	7.5	8.3	9.4	11.3	13.2	15.0	16.9	18.8	---	---	---
1/2	6.9	7.7	8.5	9.6	11.5	13.5	15.4	17.3	19.2	---	---	---
3/4	7.1	7.9	8.7	9.9	11.8	13.8	15.8	17.7	19.7	---	---	---
27.0	7.3	8.1	8.9	10.1	12.1	14.1	16.1	18.2	20.2	22.2	---	---
1/4	7.4	8.3	9.1	10.3	12.4	14.4	16.5	18.6	20.6	22.7	---	---
1/2	7.4	8.3	9.1	10.3	12.4	14.4	16.5	18.6	20.6	22.7	---	---
3/4	7.6	8.4	9.3	10.6	12.7	14.8	16.9	19.0	21.1	28.2	---	---
28.0	7.8	8.6	9.5	10.8	13.0	15.1	17.3	19.4	21.6	23.8	---	---
1/4	8.0	8.8	9.7	11.0	13.3	15.5	17.7	19.9	22.1	24.3	---	---
1/2	8.1	9.0	9.9	11.3	13.5	15.8	18.1	20.3	22.6	24.8	---	---
3/4	8.1	9.0	9.9	11.3	13.5	15.8	18.1	20.3	22.6	24.8	---	---
29.0	8.3	9.2	10.2	11.5	13.8	16.2	18.5	20.8	23.1	25.4	---	---
1/4	8.5	9.4	10.4	11.8	14.2	16.5	18.9	21.2	23.6	25.9	---	---
1/2	8.7	9.6	10.6	12.0	14.5	16.9	19.3	21.7	24.1	26.5	---	---
3/4	8.9	9.8	10.8	12.8	14.8	17.2	19.7	22.1	24.6	27.1	---	---
30.0	---	9.8	10.8	12.3	14.8	17.2	19.7	22.1	24.6	27.1	29.5	---
1/4	---	10.1	11.1	12.6	15.1	17.6	20.1	22.6	25.1	27.6	30.2	---
1/2	---	10.3	11.3	12.8	15.4	18.0	20.5	23.1	25.7	28.2	30.8	---
3/4	---	10.5	11.5	13.1	15.7	18.3	21.0	23.6	26.2	28.8	31.4	---
31.0	---	10.7	11.8	13.4	16.0	18.7	21.4	24.1	26.7	29.4	32.1	---
1/4	---	10.7	11.8	13.4	16.0	18.7	21.4	24.1	26.7	29.4	32.1	---
1/2	---	10.9	12.0	13.6	16.4	19.1	21.8	24.5	27.8	30.0	32.7	---
3/4	---	11.1	12.2	13.9	16.7	19.5	22.3	25.0	27.8	30.6	33.4	---
32.0	---	11.3	12.5	14.2	17.0	19.9	22.7	25.5	28.4	31.2	34.0	---
1/4	---	11.6	12.7	14.5	17.4	20.3	23.1	26.0	28.9	31.8	34.7	---
1/2	---	11.6	12.7	14.5	17.4	20.3	23.1	26.0	28.9	31.8	34.7	---
3/4	---	11.8	13.0	14.7	17.7	20.6	23.6	26.5	29.5	32.4	35.4	---
33.0	---	12.0	13.2	15.0	18.0	21.0	24.1	27.1	30.1	33.1	36.1	39.1
1/4	---	12.3	13.5	15.3	18.4	21.4	24.5	27.6	30.6	33.7	36.8	39.8
1/2	---	12.5	13.7	15.6	18.7	21.9	25.0	28.1	31.2	34.3	37.5	40.6
3/4	---	12.7	14.0	15.9	19.1	22.3	25.4	28.6	31.8	35.0	38.2	41.3

TABLE 1 (Continued)
Volume – Cubic Feet

Midpoint	Length											
circumference	25	30	35	40	45	50	55	60	65	70	75	80
34.0	15.9	19.1	22.3	25.4	28.6	31.8	35.0	38.2	41.3	44.5	---	---
1/4	16.2	19.4	22.7	25.9	29.2	32.4	35.6	38.9	42.1	45.4	---	---
1/2	16.5	19.8	23.1	26.4	29.7	33.0	36.3	39.6	42.9	46.2	---	---
3/4	16.8	20.2	23.5	26.9	30.2	33.6	37.0	40.3	43.7	47.0	---	---
35.0	16.8	20.2	23.5	26.9	30.2	33.6	37.0	40.3	43.7	47.0	---	---
1/4	17.1	20.5	23.9	27.4	30.8	34.2	37.6	41.0	44.5	47.9	---	---
1/2	17.4	20.9	24.4	27.9	31.3	34.8	38.3	41.8	45.3	48.7	---	---
3/4	17.7	21.3	24.8	28.4	31.9	35.4	39.0	42.5	46.1	49.6	---	---
36.0	18.0	21.6	25.2	28.9	32.5	36.1	39.7	43.3	46.9	50.5	---	---
1/4	18.0	21.6	25.2	28.9	32.5	36.1	39.7	43.3	46.9	50.5	---	---
1/2	18.3	22.0	25.7	29.4	33.0	36.7	40.4	44.0	47.7	51.4	---	---
3/4	18.7	22.4	26.1	30.0	33.6	37.8	41.1	44.8	48.5	52.3	---	---
37.0	19.0	22.8	26.6	30.4	34.2	38.0	41.8	45.6	49.4	53.2	---	---
1/4	19.3	23.2	27.0	30.9	34.8	38.6	42.5	46.3	50.2	54.1	---	---
1/2	19.3	23.2	27.0	30.9	34.8	38.6	42.5	46.3	50.2	54.1	---	---
3/4	19.6	23.6	27.5	31.4	35.8	39.3	43.2	47.1	51.0	55.0	---	---
38.0	---	24.0	27.9	31.9	35.9	39.9	43.9	47.9	51.9	55.9	59.9	---
1/4	---	24.4	28.4	32.5	36.5	40.6	44.6	48.7	52.8	56.8	60.9	---
1/2	---	24.8	28.9	33.0	37.1	41.3	45.4	49.5	53.6	57.8	61.9	---
3/4	---	24.8	28.9	33.0	37.1	41.3	45.4	49.5	53.6	57.8	61.9	---
39.0	---	25.2	29.4	33.5	37.7	41.9	46.1	50.3	54.5	58.7	62.9	---
1/4	---	25.6	29.8	34.1	38.3	42.6	46.9	51.1	55.4	59.7	63.9	---
1/2	---	26.0	30.3	34.6	39.0	43.3	47.6	52.0	56.3	60.6	64.9	---
3/4	---	26.4	30.8	35.3	39.6	44.0	48.4	52.8	57.2	61.6	66.0	---
40.0	---	26.4	30.8	35.2	39.6	44.0	48.4	52.8	57.2	61.6	66.0	70.4
1/4	---	26.8	31.2	35.7	40.2	44.7	49.1	53.6	58.1	62.6	67.0	71.5
1/2	---	27.2	31.8	36.3	40.8	45.4	49.9	54.5	59.0	63.5	68.1	72.6
3/4	---	27.7	32.3	36.9	41.5	46.1	50.7	55.3	59.9	64.5	69.1	73.7
41.0	---	---	---	37.4	42.1	46.8	51.5	56.2	60.8	65.5	70.2	74.9
1/4	---	---	---	37.4	42.1	46.8	51.5	56.2	60.8	65.5	70.2	74.9
1/2	---	---	---	38.0	42.8	47.5	52.3	57.0	61.8	66.5	71.3	76.0
3/4	---	---	---	38.6	43.4	48.2	53.1	57.9	62.7	67.5	72.4	77.2
42.0	---	---	---	39.2	44.1	49.0	53.9	58.8	63.7	68.6	73.4	78.3
1/4	---	---	---	39.2	44.1	49.0	53.9	58.8	63.7	68.6	73.4	78.3
1/2	---	---	---	39.8	44.7	49.7	54.7	59.6	64.6	69.6	74.5	79.5
3/4	---	---	---	40.4	45.4	50.4	55.5	60.5	65.6	70.6	75.7	80.7
43.0	---	---	---	41.0	46.1	51.2	56.3	61.4	66.6	71.7	76.8	81.9
1/4	---	---	---	41.5	46.7	51.9	57.1	62.3	67.5	72.7	77.9	83.1
1/2	---	---	---	41.5	46.7	51.9	57.1	62.3	67.5	72.7	77.9	83.1
3/4	---	---	---	42.2	47.4	52.7	58.0	63.2	68.5	73.8	79.0	84.3

TABLE 1 (Continued)
Volume – Cubic Feet

Midpoint	Length											
circumference	40	45	50	55	60	65	70	75	80	85	90	95
44.0	42.8	48.1	53.5	58.8	64.1	69.5	74.8	80.2	85.5	90.9	---	---
1/4	43.4	48.8	54.2	59.6	65.1	70.5	75.9	81.3	86.7	92.2	---	---
1/2	44.0	49.5	55.0	60.5	66.0	71.5	77.0	82.5	88.0	93.5	---	---
3/4	44.0	49.3	55.0	60.5	66.0	71.5	77.0	82.5	88.0	93.5	---	---
45.0	---	---	55.8	61.3	66.9	72.5	78.1	83.6	89.2	94.8	100.4	---
1/4	---	---	56.5	62.2	67.9	73.5	79.2	84.8	90.5	96.1	101.8	---
1/2	---	---	57.3	63.1	68.8	74.5	80.3	86.0	91.7	97.5	103.2	---
3/4	---	---	58.1	63.9	69.8	75.6	81.4	87.2	93.0	98.9	104.6	---
46.0	---	---	58.1	63.9	69.8	75.6	81.4	87.2	93.0	98.9	104.6	110.5
1/4	---	---	58.9	64.8	70.7	76.6	82.5	88.4	94.3	100.2	106.1	112.0
1/2	---	---	59.7	65.7	71.7	77.6	83.6	89.6	95.6	101.5	107.5	113.5
3/4	---	---	60.5	66.6	72.6	78.7	84.8	90.8	96.9	102.9	109.0	115.0
47.0	---	---	---	---	73.6	79.8	85.9	92.0	98.2	104.3	110.4	116.6
1/4	---	---	---	---	74.6	80.8	87.1	93.3	99.5	105.7	111.9	118.1
1/2	---	---	---	---	74.6	80.8	87.1	93.3	99.5	105.7	111.9	118.1
3/4	---	---	---	---	75.6	81.9	88.2	94.5	100.8	107.1	113.4	119.7
48.0	---	---	---	---	76.6	83.0	89.4	95.8	102.1	108.5	114.9	121.3
1/4	---	---	---	---	77.6	84.4	90.5	97.0	103.5	109.9	116.4	122.9
1/2	---	---	---	---	77.6	84.1	90.5	97.0	103.5	109.9	116.4	122.9
3/4	---	---	---	---	78.6	85.2	91.7	98.3	104.8	111.4	117.9	124.5
49.0	---	---	---	---	79.6	86.3	92.9	99.5	106.2	112.8	119.5	126.1
1/4	---	---	---	---	80.7	87.4	94.1	100.8	107.6	114.3	121.0	127.7
1/2	---	---	---	---	81.7	88.5	95.3	102.1	108.9	115.7	122.5	129.3
3/4	---	---	---	---	81.7	88.5	95.3	102.1	108.9	115.7	122.5	129.3
50.0	---	---	---	---	82.7	89.6	96.5	103.4	110.3	117.2	124.1	131.0
1/4	---	---	---	---	83.8	90.8	97.7	104.7	111.7	118.7	125.7	132.6
1/2	---	---	---	---	84.8	91.9	99.0	106.0	113.1	120.2	127.2	134.3
3/4	---	---	---	---	85.9	93.0	100.2	107.3	114.5	121.7	128.8	136.0
51.0	---	---	---	---	---	---	100.2	107.3	114.5	121.7	128.8	136.0
1/4	---	---	---	---	---	---	101.4	108.7	115.9	123.2	130.4	137.7
1/2	---	---	---	---	---	---	102.7	110.0	117.4	124.7	132.0	139.4
3/4	---	---	---	---	---	---	103.9	111.4	118.8	126.2	133.6	141.1
52.0	---	---	---	---	---	---	105.2	112.7	120.2	127.7	135.3	142.8
1/4	---	---	---	---	---	---	105.2	112.7	120.2	127.7	135.3	142.8
1/2	---	---	---	---	---	---	106.5	114.1	121.7	129.8	136.9	144.5
3/4	---	---	---	---	---	---	107.8	115.4	123.1	130.8	138.5	146.2
53.0	---	---	---	---	---	---	109.0	116.8	124.6	132.4	140.2	148.0
1/4	---	---	---	---	---	---	109.0	116.8	124.6	132.4	140.2	148.0
1/2	---	---	---	---	---	---	110.3	118.2	126.1	134.0	141.9	149.7
3/4	---	---	---	---	---	---	111.6	119.6	127.6	135.6	143.5	151.5

STANDARD MONOTUBE WEIGHTS AND VOLUMES

Type	Length (Feet)	Nominal Diameter (Inches)	Theoretical Weights of Steel - Lbs.*					Est. Conc. Vol. Cu. Yds.
			11 Ga.	9 Ga.	7 Ga.	5 Ga.	3 Ga.	
F Taper .14 inch per foot	25	12	338	421	502	591	711	0.43
	30	12	388	484	579	681	820	0.55
	40	14	595	748	900	1059	1275	0.95
	60	16	--	1213	1465	1733	2093	1.68
	75	18	--	--	1962	2312	2792	2.59
J Taper .25 inch per foot	17	12	225	279	332	390	468	0.32
	25	14	364	457	549	645	777	0.58
	33	16	--	653	786	924	1112	0.95
	40	18	--	--	1038	1221	1469	1.37
Y Taper .40 inch per foot	10	12	139	171	202	239	285	0.18
	15	14	229	288	345	404	484	0.34
	20	16	--	412	494	579	696	0.56
	25	18	--	--	663	778	934	086
N 12	20	12	317	398	478	558	668	0.51
	25		394	495	593	694	831	0.64
	30		471	589	708	829	993	0.77
	35		547	687	825	967	1158	0.89
	40		625	784	942	1100	1317	1.02
N 14	20	14	392	490	587	689	823	0.70
	25		485	606	731	858	1025	0.87
	30		581	727	877	1023	1222	1.05
	35		679	849	1018	1194	1427	1.22
	40		773	967	1166	1368	1634	1.40
N 16	20	16	--	555	666	781	933	0.90
	25		--	687	829	971	1161	1.13
	30		--	824	988	1158	1384	1.35
	35		--	957	1153	1352	1615	1.58
	40		--	1095	1320	1539	1840	1.80
N 18	20	18	--	--	755	880	1052	1.16
	25		--	--	934	1095	1308	1.45
	30		--	--	1119	1311	1566	1.75
	35		--	--	1305	1522	1819	2.04
	40		--	--	1486	1741	2081	2.33

**The above weights should not be used for final determination of shipping costs.*