

ENGINEERING ANALYSIS

FOR

8 X 32 LEADS  
(KIEWITT, CALIFORNIA)

MANUFACTURER:

AMERICAN PILE DRIVING EQUIPMENT, INC.  
7032 SOUTH 196<sup>TH</sup> STREET  
KENT, WA 98032

ENGINEER:

DELCON SERVICES  
PMB NO. 65, 6517 S. KINGS RANCH ROAD,  
GOLD CANYON, AZ 85219



EXPIRES 9-3-03

8/22/01

## DESIGN SUMMARY

### 8 X 32 LEADS FOR KIEWITT, CALIFORNIA

- 1.0 EQUIPMENT LIST
  - 1.1 LEADS
    - 1.1.1 APE 8 X 32 (ORIGINAL STYLE) X 150 FT LONG.
    - 1.1.2 HANGING W/ TAPERED TOP SECTION.
    - 1.1.3 FIXED W/ BOOM CONNECTED AT 30 FT, 35 FT, OR 40 FT FROM TOP OF LEADS (OVERHANG).
  - 1.2 HAMMER
    - 1.2.1 D46 MODEL APPROXIMATELY 20,000 LB. WEIGHT.
  - 1.3 PILE
    - 1.3.1 25,000 LB. PILE X 120 FT LONG (MAX.)
    - 1.3.2 PLUMB TO 3 IN 12 FORE/AFT BATTERS (NO SIDE BATTERS)
  - 1.4 CRANE
    - 1.4.1 UNKNOWN MODEL WITH 100 FT. BOOM FOR FIXED LEADS.
- 2.0 OPERATING LIMITS
  - 2.1 HANGING LEADS
    - 2.1.1 ERECTION WITH ONE CRANE WITH CONNECTION AT TOP OF THE LEADS.
    - 2.1.2 PLUMB AND BATTER DRIVING UP TO 3 IN 12 ANGLE.
  - 2.2 FIXED LEADS
    - 2.2.1 30 FT OVERHANG - PLUMB AND BATTERS UP TO 3 IN 12 ANGLE.
    - 2.2.2 35 FT OVERHANG - PLUMB AND BATTERS UP TO 2 IN 12 ANGLE.
    - 2.2.3 40 FT OVERHANG - PLUMB AND BATTERS UP TO 1 IN 12 ANGLE.
- 3.0 DESIGN PARAMETERS.
  - 3.1 TUBING MATERIAL IS ASTM A500 STEEL WITH 42000 PSI YIELD STR.
  - 3.2 PLATES AND CONNECTING LUGS ARE ASTM A36 STEEL (36 KSI YLD).
  - 3.3 PINS AT SPLICE CONNECTIONS ARE 1.5 IN. DIA. AISI 4140 ALLOY.
  - 3.4 SAFETY FACTORS
    - 3.4.1 ERECTION CONDITION USES 2 : 1 FOR YIELD STRENGTH.
    - 3.4.2 DRIVING CONDITION USES 3 : 1 FOR YIELD STRENGTH.
  - 3.5 NO SIDE LOADS OR DYNAMIC FORCES FROM ACCELERATION/DECELERATION OR WIND IS INCLUDED. THESE CONDITIONS MUST BE CONSIDERED BY THE OPERATOR AND LOADS REDUCED ACCORDINGLY.
- 4.0 MAINTENANCE
  - 4.1 OPERATOR MUST MAINTAIN LEADS AND INSPECT BEFORE EACH USE
  - 4.2 WELDS TO BE CHECKED FOR CRACKING AND REPAIRS MADE IMMEDIATELY WHEN DISCOVERED.

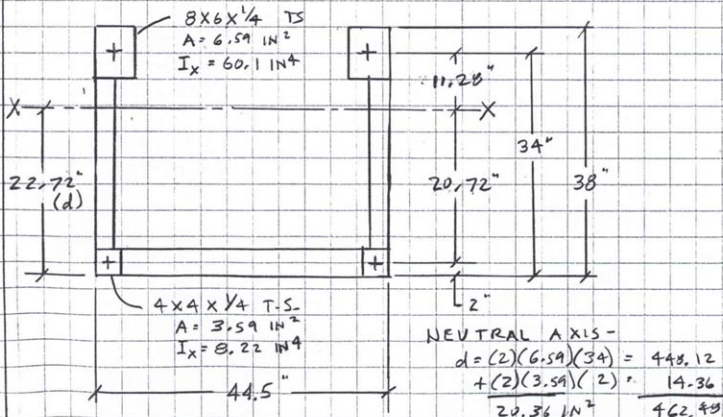
1.0 WEIGHT CALCULATION

10 FT. SECTION -

(2)	6x8x1/4	X 9.5 FT.	(22.42 #/FT)	426.0 LB
(2)	4x4x1/4	X 9.5 FT.	(12.21 " )	232.0 LB
(4)	4x3x3/16	X 3.04 FT.	(9.51 " )	103.0 LB
(8)	3x3x3/16	2.167 FT.	(6.87 " )	119.0 LB
(4)	3x2x3/16	3.0 FT.	(5.59 " )	67.0 LB
(2)	3x2x3/16	4.0 FT.	( " " )	44.7 LB
(4)	3x2x3/16	4.59 FT.	( " " )	103.0 LB
(1)	3x2x3/16	4.89 FT	( " " )	27.4 LB
(16)	1x4x4.9		(0.285 LB/IN <sup>3</sup> )	83.4 LB
(2)	1/2 (6x8x1/4) X 4.9 IN.		(1/2 x 22.42 #/FT)	9.2 LB
(8)	1x6x8		(0.285 LB/IN <sup>3</sup> )	109.4 LB
(4)	1 1/2 # X 8" LG.		(0.285 " )	16.12 LB

TOTAL WT. = 1340.7 LB  
(134 LB / FT.)

2.0 SECTION MODULUS



$$I_{xx} = A d^2 + I_x$$

$$= (2)(6.59)(11.28)^2 + (2)(60.1)$$

$$+ (2)(3.59)(20.72)^2 + (2)(8.22)$$

$$d = \frac{462.48}{20.36} = 22.72 \text{ IN}$$

$$I_{xx} = 1797.2 + 3098.95 = 4896.15 \text{ IN}^4$$

# 3.0 CRANE PICK (ERECTION)

DEL  
B-23-00

\*\* Leads 8 x 32 \*\* (KIEWIT STYLE)

BEAM LENGTH = 1800.0 in

## MATERIAL PROPERTIES

Steel A36:

Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>

Stress limit = 12000.0 lb/in<sup>2</sup>

## CROSS-SECTION PROPERTIES

8 x 32 Lead:

Moment of inertia = 4896.15 in<sup>4</sup>

Top height = 15.28 in

Bottom height = 22.72 in

Area = 20.36 in<sup>2</sup>

## UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 11.167 lb/in at 0.0 over 1800.0 in

## LIMITS - ABSOLUTE

8 x 32 Kiewit Leads:

Tensile = 42000.0 lb/in<sup>2</sup>

Compressive = 42000.0 lb/in<sup>2</sup>

Shear = 22500.0 lb/in<sup>2</sup>

Deflection = 15.0 in

## SUPPORT REACTIONS \*\*\*

Crane Pick: Simple at 0.0 in

Reaction Force = -10050.3 lb

Ground: Simple at 1800.0 in

Reaction Force = -10050.3 lb

## MAXIMUM DEFLECTION \*\*\*

10.7501 in at 900.0 in

Safety Factor = 1.395

Safety Margin = 4.249897 in

## MAXIMUM BENDING MOMENT \*\*\*

4522635.0 lb-in at 900.0 in

## MAXIMUM SHEAR FORCE \*\*\*

10050.3 lb at 0.0 in

-10050.3 lb at 1800.0 in

## MAXIMUM STRESS \*\*\*

Tensile = 20986.75 lb/in<sup>2</sup>

Compressive = 14114.33 lb/in<sup>2</sup>

Shear (Avg) = 493.6297 lb/in<sup>2</sup>

Safety Factor = 2.001

Safety Factor = 2.976

Safety Factor = 45.581

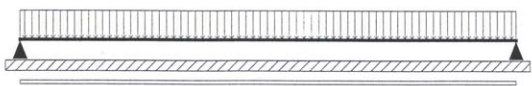
Z: O.K.  
ERECTION

FOR



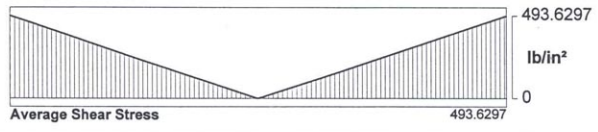
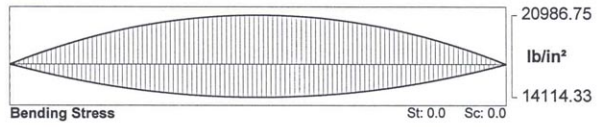
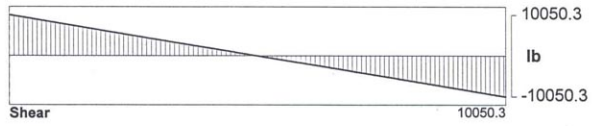
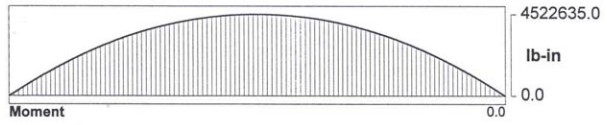
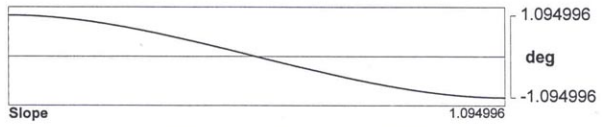
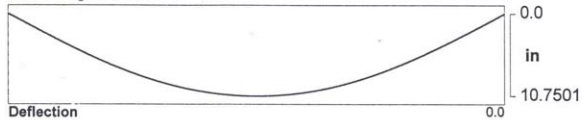
### 3.1 DIAGRAMS - CRANE PICK

Leads\_8 x 32



Beam Length: 1800.0 in

Location: 0.0 in



## 3.2 CONNECTION FITTINGS

3.2.1) 6 X 8 TUBE - FORCE =  $-14,114 \text{ PSI} \times 13.18 \text{ IN}^2$   
 $= 186,023 \text{ LBS. TOTAL}$   
 EA. TUBE IS  $\frac{1}{2}$  TOTAL

PIN SHEAR -

$$1\frac{1}{2} \text{ " } \phi \times 2 \text{ SHEAR PLANES} = 3.53 \text{ IN}^2$$

$$f_s = \frac{186,023}{2 \times 3.53} = 26,349 \text{ PSI}$$

ASTM A140 - OIL QUENCH FROM 1550 °F  
 TEMPER TO 1000 °F

140,000 PSI Y.P. TENSILE

87,500 PSI Y.P. SHEAR

$$(S.F. = \frac{87,500}{26,349} = 3.3)$$

LUG STRESS - ASTM A36



$$f_c = \text{COMPRESSION} = \frac{186,023}{(2)(8-1.5)(2.0)} = 7,155 \text{ PSI}$$

BRG. STRESS -

$$f_{bm} = \frac{186,023}{2 \times 1.5 \times 2.0} = 31,004 \text{ PSI}$$

## 3.2 CONNECTION FTGS (CONT'D)

$$3.2.2) \quad 4 \times 4 \text{ TUBE} - \text{FORCE} = + 20,987 \times 7.10 \text{ IN}^2 \\ = 150,686.7 \text{ PSI} \\ \text{EA. TUBE IS } \sqrt{2} \text{ TOTAL}$$

PIN SHEAR &lt; 3.2.1

✓  
SO, O.K.

$$\text{LUG STRESS -} \\ \text{TENSION} = \frac{150,686.7}{(2)(4-1.5)(2.0)} \\ = 15,069 \text{ PSI}$$

$$\left( \text{S.F.} = \frac{36000}{15069} = 2.39 \right)$$

## 3.2.3) WELDS -



TOTAL LENGTH OF WELD.

$$\boxed{\text{LUGS}} = 4" \times 4 \text{ PLACES} = 16 \text{ IN.}$$

$$\text{STRESS} = \frac{186,023}{16} = 11,626.44 \text{ LB/IN.}$$

3/8 FILLET

$$\text{STRENGTH} = 28,000 \text{ LB/IN. VLT. STRE}$$

$$\left( \text{S.F.} = \frac{28,000}{11626} = 2.4 \right)$$

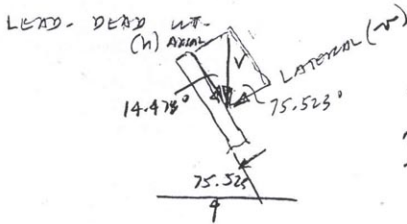
$$\boxed{\text{MTG. PL.}} = 2 \times 6 + 2 \times 4 = 20 \text{ IN.}$$

$$\text{STRESS} = 186,023 \div 20 = 9,301 \text{ LB/IN.}$$

# 8 X 32 LEADS (KIEWIT)

DE  
B-20

4.0 3 IN 12 FORK / APT BATTER - 150 FT LEADS -  
(75.523 DEG INCLINE)



$$v = V \text{ SINE } 14.478$$

$$v = (11.167) / (0.25)$$

$$v = 2.8 \text{ LB/IN.}$$

HAMMER WT -  
(D46)

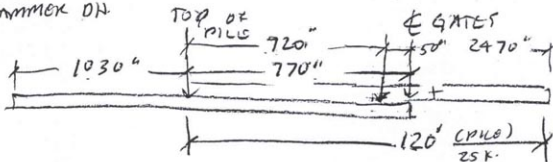
$$\frac{20,000 \text{ #}}{180 \text{ IN}} = 111.11 \text{ #/IN.}$$

$$v = 111.11 \text{ SINE } 14.478$$

$$= (111.11) (0.25)$$

$$= 27.8 \text{ LB/IN}$$

PILING - 25,000 LB (120 FT PILE LENGTH)  
HAMMER DN



$$\text{@ GATES} = \frac{720 \times 25,000}{770} = 23,377 \text{ LB.}$$

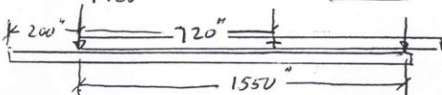
$$\times 0.25 = 5,844 \text{ LB.}$$

$$\text{@ TOP} = 25,000 - 23,377 = 1,623 \text{ LB.}$$

$$\times 0.25 = 406 \text{ LB.}$$

PILE WITH  
HAMMER UP

$$\text{TOP OF PILE} = 13,307 \times 0.25 = 3,347 \text{ LB}$$



$$\frac{25000 \times 720}{1550} = 11,613$$

$$\times 0.25 = 2903 \text{ LB}$$



4.1 3 IN 12 FORE/ATT BATTERY - NO PILE  
HAMMER VP.

\*\* Leads 8 x 32 \*\*

BEAM LENGTH = 1800.0 in

MATERIAL PROPERTIES

Steel A36:  
Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>  
Stress limit = 12000.0 lb/in<sup>2</sup>

CROSS-SECTION PROPERTIES

8 x 32 Lead:  
Moment of inertia = 4896.15 in<sup>4</sup>  
Top height = 15.28 in  
Bottom height = 22.72 in  
Area = 20.36 in<sup>2</sup>

UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 2.8 lb/in at 0.0 over 1800.0 in  
D46 Hammer Wt.: ~~11-11~~ lb/in at 10.0 over 190.0 in

27.5

LIMITS - ABSOLUTE

8 x 32 Kiewit Leads:  
Tensile = 42000.0 lb/in<sup>2</sup>  
Compressive = 42000.0 lb/in<sup>2</sup>  
Shear = 22500.0 lb/in<sup>2</sup>  
Deflection = 15.0 in

SUPPORT REACTIONS \*\*\*

Crane Pick: Simple at 0.0 in  
Reaction Force = -22399.43 lb

Ground: Simple at 1800.0 in  
Reaction Force = -3751.469 lb

MAXIMUM DEFLECTION \*\*\*

5.871475 in at 829.0037 in  
Safety Factor = 2.555  
Safety Margin = 9.128525 in

MAXIMUM BENDING MOMENT \*\*\*

2513129.0 lb-in at 460.1896 in

MAXIMUM SHEAR FORCE \*\*\*

22399.43 lb at 0.0 in

MAXIMUM STRESS \*\*\*

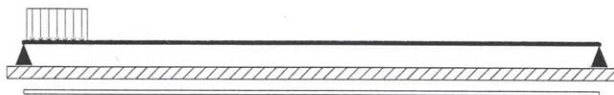
Tensile = 11661.87 lb/in <sup>2</sup>	Safety Factor = 3.601
Compressive = 7843.021 lb/in <sup>2</sup>	Safety Factor = 5.355
Shear (Avg) = 1100.168 lb/in <sup>2</sup>	Safety Factor = 20.451

4-1-1

3 IN 12

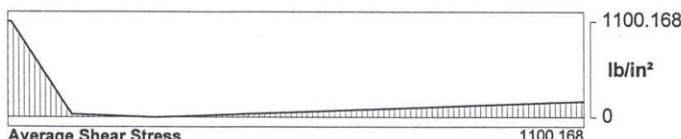
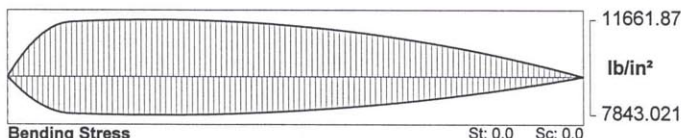
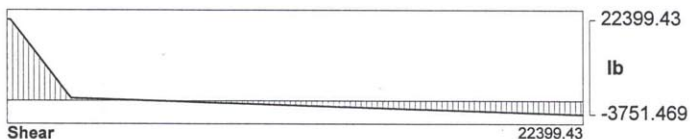
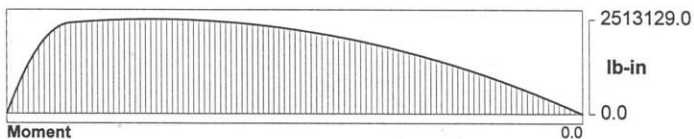
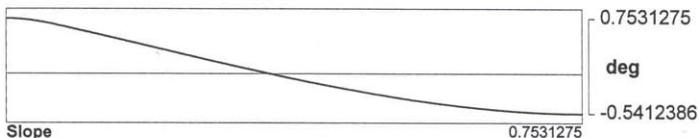
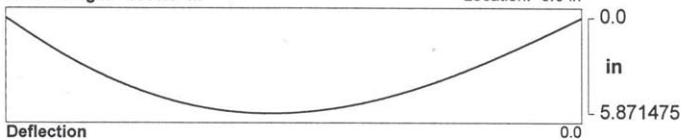
NO PILE - HAMMER UP

### Leads\_8 x 32



Beam Length: 1800.0 in

Location: 0.0 in



4-2 3 IN 12 FORC /AFT BATTER - HAMMER UP WITH PILE

\*\* Leads\_8 x 32 \*\*

BEAM LENGTH = 1800.0 in

MATERIAL PROPERTIES

Steel A36:  
Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>  
Stress limit = 12000.0 lb/in<sup>2</sup>

CROSS-SECTION PROPERTIES

8 x 32 Lead:  
Moment of inertia = 4896.15 in<sup>4</sup>  
Top height = 15.28 in  
Bottom height = 22.72 in  
Area = 20.36 in<sup>2</sup>

EXTERNAL CONCENTRATED FORCES

Top of Pile: 3347.0 lb at 200.0 in  
Gate Load: 2903.0 lb at 1750.0 in

UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 2.8 lb/in at 0.0 over 1800.0 in  
D46 Hammer Wt.: 27.8 lb/in at 10.0 over 190.0 in

LIMITS - ABSOLUTE

8 x 32 KiewitLeads:  
Tensile = 42000.0 lb/in<sup>2</sup>  
Compressive = 42000.0 lb/in<sup>2</sup>  
Shear = 22500.0 lb/in<sup>2</sup>  
Deflection = 15.0 in

SUPPORT REACTIONS \*\*\*

Crane Pick: Simple at 0.0 in  
Reaction Force = -10549.63 lb

Ground: Simple at 1800.0 in  
Reaction Force = -6022.367 lb

MAXIMUM DEFLECTION \*\*\*

4.637234 in at 857.6933 in  
Safety Factor = 3.235  
Safety Margin = 10.36277 in

MAXIMUM BENDING MOMENT \*\*\*

1882730.0 lb-in at 685.9405 in

MAXIMUM SHEAR FORCE \*\*\*

10549.63 lb at 0.0 in

MAXIMUM STRESS \*\*\*

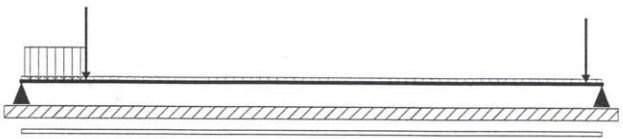
Tensile = 8736.584 lb/in<sup>2</sup> Safety Factor = 4.807  
Compressive = 5875.661 lb/in<sup>2</sup> Safety Factor = 7.148  
Shear (Avg) = 518.1549 lb/in<sup>2</sup> Safety Factor = 43.423

4.2.1

3 IN 12

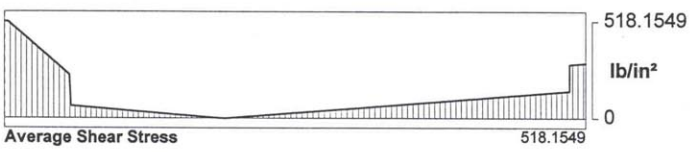
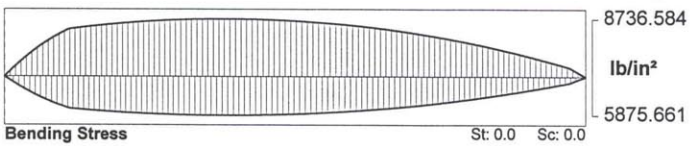
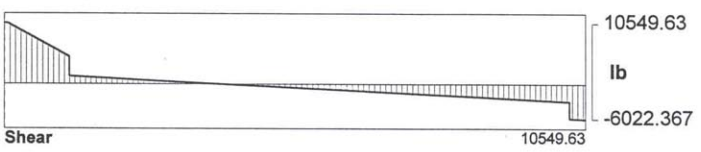
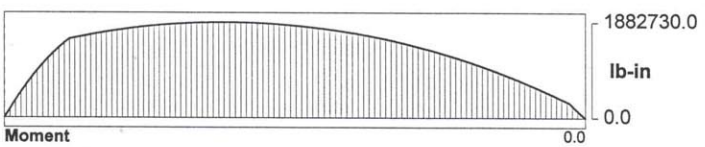
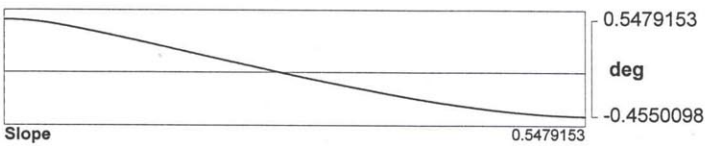
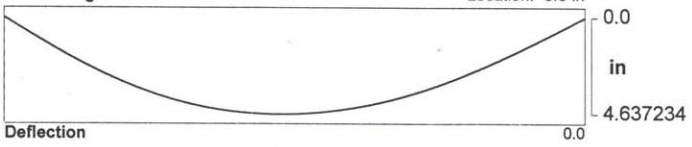
BATTER - HAMMER UP W/ PILE

### Leads\_8 x 32



Beam Length: 1800.0 in

Location: 0.0 in



4.3 3 IN 12 FORG /ART BATTER - HAMMER DOWN  
w/ PILE

\*\* Leads\_8 x 32 \*\*

BEAM LENGTH = 1800.0 in

MATERIAL PROPERTIES

Steel A36:

Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>

Stress limit = 12000.0 lb/in<sup>2</sup>

CROSS-SECTION PROPERTIES

8 x 32 Lead:

Moment of inertia = 4896.15 in<sup>4</sup>

Top height = 15.28 in

Bottom height = 22.72 in

Area = 20.36 in<sup>2</sup>

EXTERNAL CONCENTRATED FORCES

Top of Pile: 406.0 lb at 1030.0 in

Gate Load: 5844.0 lb at 1750.0 in

UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 2.8 lb/in at 0.0 over 1800.0 in

D46 Hammer Wt.: 27.8 lb/in at 840.0 over 190.0 in

LIMITS - ABSOLUTE

8 x 32 KiewitLeads:

Tensile = 42000.0 lb/in<sup>2</sup>

Compressive = 42000.0 lb/in<sup>2</sup>

Shear = 22500.0 lb/in<sup>2</sup>

Deflection = 15.0 in

SUPPORT REACTIONS \*\*\*

Crane Pick: Simple at 0.0 in

Reaction Force = -5394.306 lb

Ground: Simple at 1800.0 in

Reaction Force = -11177.69 lb

MAXIMUM DEFLECTION \*\*\*

7.936982 in at 913.9871 in

Safety Factor = 1.89

Safety Margin = 7.063018 in

MAXIMUM BENDING MOMENT \*\*\*

3694612.0 lb-in at 939.4218 in

MAXIMUM SHEAR FORCE \*\*\*

-11177.69 lb at 1800.0 in

MAXIMUM STRESS \*\*\*

Tensile = 17144.41 lb/in<sup>2</sup>

Safety Factor = 2.45

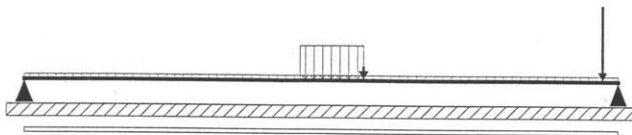
Compressive = 11530.22 lb/in<sup>2</sup>

Safety Factor = 3.643

Shear (Avg) = 549.0027 lb/in<sup>2</sup>

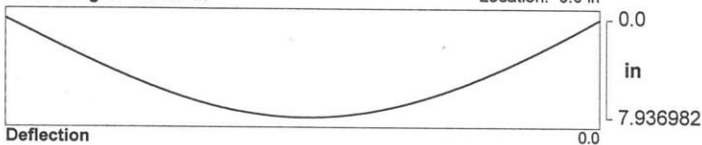
Safety Factor = 40.983

## Leads\_8 x 32



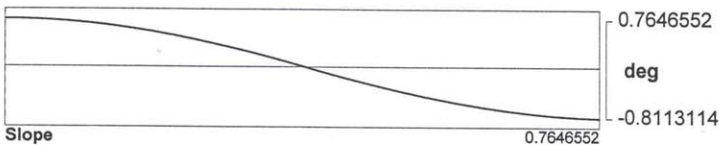
Beam Length: 1800.0 in

Location: 0.0 in



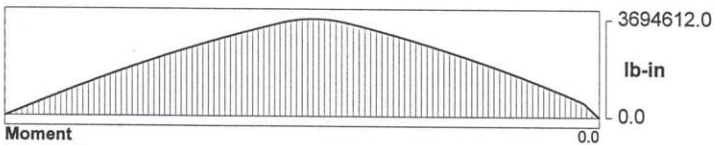
Deflection

0.0



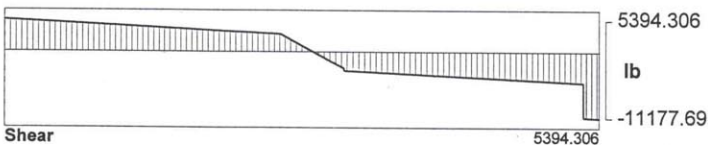
Slope

0.7646552



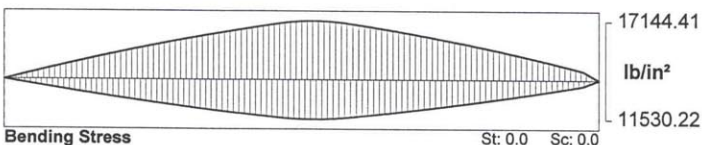
Moment

0.0



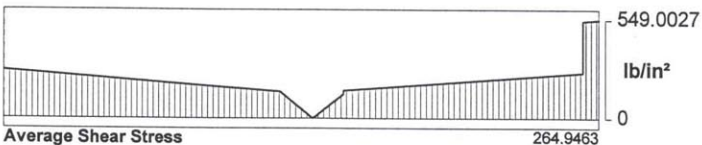
Shear

5394.306



Bending Stress

St: 0.0 Sc: 0.0



Average Shear Stress

264.9463

## 5.1 FIXED LEADS - HAMMER UP - NO PILE

3 11-12  
BATTER

\*\* Fixed leads 8x32 \*\*

BEAM LENGTH = 1800.0 in

## MATERIAL PROPERTIES

Steel A36:  
Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>  
Stress limit = 12000.0 lb/in<sup>2</sup>

## CROSS-SECTION PROPERTIES

8 x 32 Lead:  
Moment of inertia = 4896.15 in<sup>4</sup>  
Top height = 15.28 in  
Bottom height = 22.72 in  
Area = 20.36 in<sup>2</sup>

## UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 2.8 lb/in at 0.0 over 1800.0 in  
D46 Hammer Wt.: 27.8 lb/in at 10.0 over 190.0 in

## LIMITS - ABSOLUTE

8 x 32 Leads:  
Tensile = 42000.0 lb/in<sup>2</sup>  
Compressive = 42000.0 lb/in<sup>2</sup>  
Shear = 22500.0 lb/in<sup>2</sup>  
Deflection = 15.0 in

## SUPPORT REACTIONS \*\*\*

Crane Pick: Simple at 480.0 in  
Reaction Force = -10218.93 lbGround: Simple at 1800.0 in  
Reaction Force = -103.0682 lb

## MAXIMUM DEFLECTION \*\*\*

3.584225 in at 0.0 in  
Safety Factor = 4.185  
Safety Margin = 11.41578 in

## MAXIMUM BENDING MOMENT \*\*\*

-2303310.0 lb-in at 480.0 in

## MAXIMUM SHEAR FORCE \*\*\*

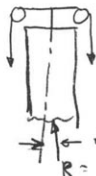
-6626.0 lb at 480.0 in

## MAXIMUM STRESS \*\*\*

Tensile = 7188.214 lb/in<sup>2</sup> Safety Factor = 5.843  
Compressive = 10688.24 lb/in<sup>2</sup> Safety Factor = 3.93  
Shear (Avg) = 325.442 lb/in<sup>2</sup> Safety Factor = 69.137

## AXIAL STRESS

$$f_a = \frac{P}{A} = \frac{40,000}{20.36} = 1965 \text{ PSI}$$



HAMMER + 20 K

 $e = 3.58 \text{ IN.}$   
 $R = 2 \times 20 = 40 \text{ K}$ 

## ECCENTRIC MOMENT -

$$40,000 \times 3.58 = 143,200$$

$$f_b = \frac{M_c}{I} = \frac{143,200 \times 15.28}{4896.15}$$

$$f_b = 446.9 \text{ PSI.}$$

## TOTAL COMBINED STRESS

$$10688 + 446.9 + 1965 = 13,100 \text{ PSI}$$

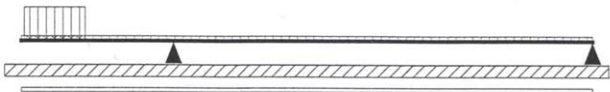
$$\left( S.F. = \frac{42000}{13100} = 3.2 \right)$$

S-1-1

HAMMER UP - NO PILE

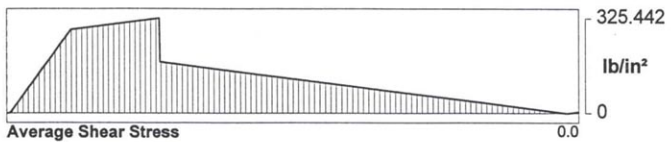
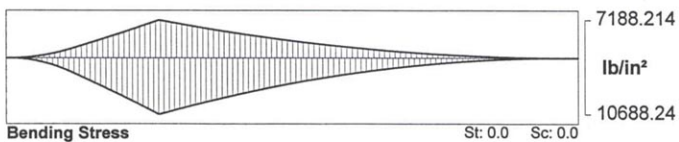
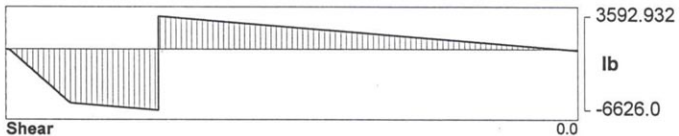
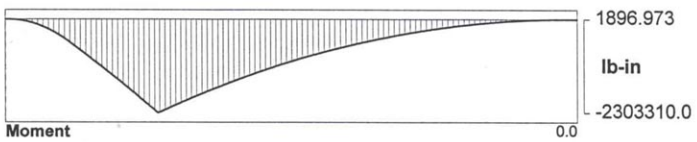
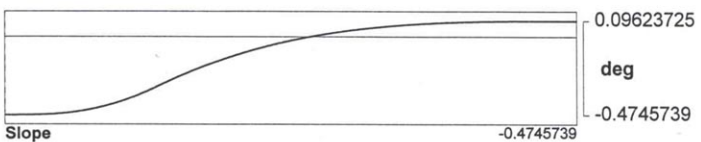
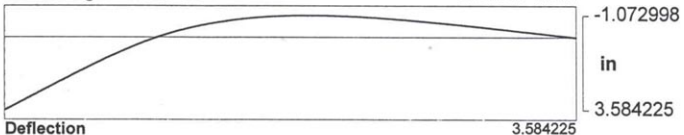
3 7 H 12 BATTER

### Fixed leads 8x32



Beam Length: 1800.0 in

Location: 0.0 in





# 5.2 FIXED LEADS - HAMMER UP W/PILE

3 IN 12  
BATTER

\*\* Fixed leads 8x32 \*\*

BEAM LENGTH = 1800.0 in

MATERIAL PROPERTIES

Steel A36:

Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>

Stress limit = 12000.0 lb/in<sup>2</sup>

CROSS-SECTION PROPERTIES

8 x 32 Lead:

Moment of inertia = 4896.15 in<sup>4</sup>

Top height = 15.28 in

Bottom height = 22.72 in

Area = 20.36 in<sup>2</sup>

EXTERNAL CONCENTRATED FORCES

Top of Pile: 3347.0 lb at 200.0 in

Gate Load: 2903.0 lb at 1750.0 in

UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 2.8 lb/in at 0.0 over 1800.0 in

D46 Hammer Wt.: 27.8 lb/in at 10.0 over 190.0 in

LIMITS - ABSOLUTE

8 x 32 Leads:

Tensile = 42000.0 lb/in<sup>2</sup>

Compressive = 42000.0 lb/in<sup>2</sup>

Shear = 22500.0 lb/in<sup>2</sup>

Deflection = 15.0 in

SUPPORT REACTIONS \*\*\*

Crane Pick: Simple at 480.0 in

Reaction Force = -14385.86 lb

Ground: Simple at 1800.0 in

Reaction Force = -2186.136 lb

MAXIMUM DEFLECTION \*\*\*

5.227697 in at 0.0 in

Safety Factor = 2.869

Safety Margin = 9.772303 in

MAXIMUM BENDING MOMENT \*\*\*

-3240470.0 lb-in at 480.0 in

MAXIMUM SHEAR FORCE \*\*\*

-9973.0 lb at 480.0 in

MAXIMUM STRESS \*\*\*

Tensile = 10112.92 lb/in<sup>2</sup>

Safety Factor = 4.153

Compressive = 15037.01 lb/in<sup>2</sup>

Safety Factor = 2.793

Shear (Avg) = 489.833 lb/in<sup>2</sup>

Safety Factor = 45.934



Hammer + 20 K  
PILE + 25 K  
-----  
45 K TOTAL

$e = 5.23 \text{ IN.}$

$R = 2 \times 45 = 90 \text{ K}$

$$f_a = \frac{R}{A} = \frac{90,000}{20.36}$$

$$f_a = 4420.4 \text{ PSI}$$

ECCENTRIC MOMENT STRESS -

$$f_b = \frac{M c}{I} \quad M = 90,000 \times 5.23$$

$$= 470,700 \text{ LB-IN}$$

$$= \frac{470,700 \times 15.28}{4896.15}$$

$$f_b = 1469 \text{ PSI}$$

TOTAL COMBINED STRESS = 15037 + 4420 + 1469 = 20,926 PSI

$$\left( \text{S.F.} = \frac{42000}{20926} = 2.0 \right)$$

5.3 FIXED LEADS - HAMMER UP w/ PILE 3 IN 12 BATER

30 FT OVERHANG ABOVE BUSH TOP

\*\* Fixed leads 8x32 \*\*

BEAM LENGTH = 1800.0 in

MATERIAL PROPERTIES

Steel A36:  
Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>  
Stress limit = 12000.0 lb/in<sup>2</sup>

CROSS-SECTION PROPERTIES

8 x 32 Lead:  
Moment of inertia = 4896.15 in<sup>4</sup>  
Top height = 15.28 in  
Bottom height = 22.72 in  
Area = 20.36 in<sup>2</sup>

EXTERNAL CONCENTRATED FORCES

Top of Pile: 3347.0 lb at 200.0 in  
Gate Load: 2903.0 lb at 1750.0 in

UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 2.8 lb/in at 0.0 over 1800.0 in  
D46 Hammer Wt.: 27.8 lb/in at 10.0 over 190.0 in

LIMITS - ABSOLUTE

8 x 32 Leads:  
Tensile = 42000.0 lb/in<sup>2</sup>  
Compressive = 42000.0 lb/in<sup>2</sup>  
Shear = 22500.0 lb/in<sup>2</sup>  
Deflection = 15.0 in

SUPPORT REACTIONS \*\*\*

Crane Tip: Simple at 360.0 in  
Reaction Force = -13187.04 lb  
  
Ground: Simple at 1800.0 in  
Reaction Force = -3384.958 lb

MAXIMUM DEFLECTION \*\*\*

2.012676 in at 0.0 in  
Safety Factor = 7.453  
Safety Margin = 12.98732 in

MAXIMUM BENDING MOMENT \*\*\*

-2063870.0 lb-in at 360.0 in

MAXIMUM SHEAR FORCE \*\*\*

-9637.0 lb at 360.0 in

MAXIMUM STRESS \*\*\*

Tensile = 6440.965 lb/in<sup>2</sup> Safety Factor = 6.521  
Compressive = 9577.143 lb/in<sup>2</sup> Safety Factor = 4.385  
Shear (Avg) = 473.33 lb/in<sup>2</sup> Safety Factor = 47.536

ECCENTRIC MOMENT STRESS

$$f_b = \frac{Mc}{I}$$

$$M = 90,000 \times 2.013 = 181,117 \text{ LB-IN}$$
$$c = 15.28 \text{ IN}$$
$$I = 4896.15 \text{ IN}^4$$

$$f_b = 565.4 \text{ PSI}$$

$$\text{TOTAL COMBINED STRESS} = 9577.14 + 4420 + 565.4 = 14,563 \text{ PSI}$$

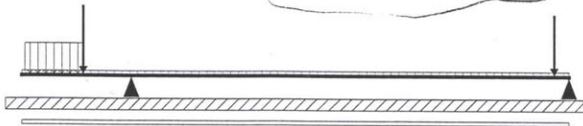
$$(S.F. = \frac{42000}{14563} = 2.9)$$

5.3 FIXED LEADS - HAMMER UP W/ LEADS

31412  
BATTEN

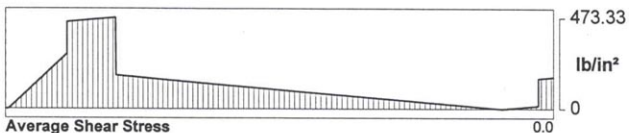
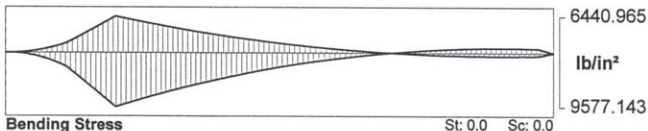
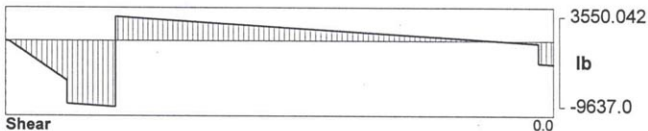
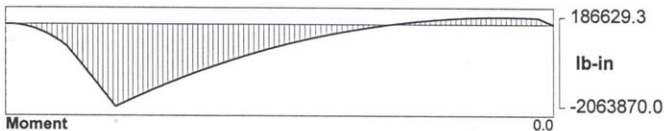
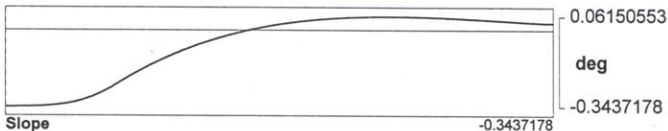
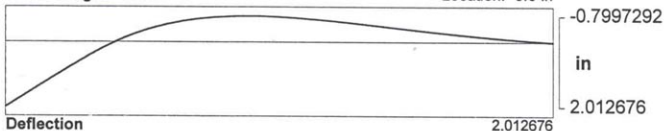
Fixed leads 8x32

30 FT OVER HANG

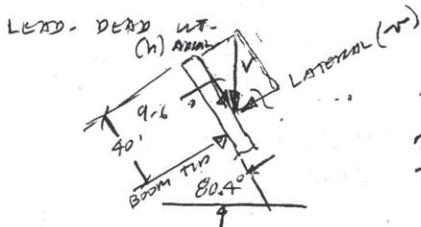


Beam Length: 1800.0 in

Location: 0.0 in



G.10 2 IN 12 FORK / APT BATTER - 150 FT LEADS  
(80.4 DEG INCLINE)



$$v = V \text{ SINE } 9.6^\circ$$

$$v = (11.167) (0.1667)$$

$$v = 1.85 \text{ LB/IN.}$$

HAMMER WT -  
(D46)

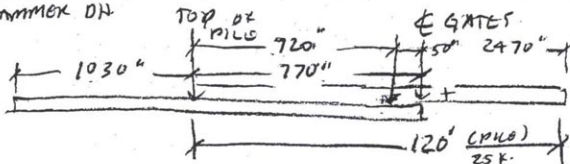
$$\frac{20,000 \text{ #}}{100 \text{ IN}} = 111.11 \text{ #/IN.}$$

$$v = 111.11 \text{ SINE}$$

$$= (111.11) (0.1667)$$

$$= 18.52 \text{ LB/IN}$$

PILING -  
HAMMER ON 25,000 LB (120 FT PILE LENGTH)



$$\text{@ GATES} = \frac{720 \times 25,000}{770} = 23,377 \text{ LB.}$$

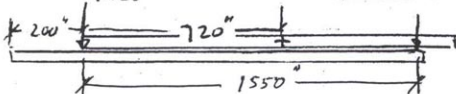
$$\times 0.1667 = 3,897 \text{ LB}$$

$$\text{@ TOP} = 25,000 - 23,377 = 1,623 \text{ LB.}$$

$$\times 0.1667 = 270 \text{ LB}$$

PILE WITH  
HAMMER UP

$$\text{TOP OF PILE} = 13,367 \times 0.1667 = 2232 \text{ LB}$$



$$\frac{25000 \times 720}{1550}$$

$$= 11,613$$

$$\times 0.1667$$

$$= 1936 \text{ LB.}$$

61 2 IN 12

FORE / AFT BATTERY

HAMMER UP  
W/ PILE

40 FT OVER HANG

\*\* Fixed leads 8x32 \*\*

BEAM LENGTH = 1800.0 in

## MATERIAL PROPERTIES

Steel A36:

Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>Stress limit = 12000.0 lb/in<sup>2</sup>

## CROSS-SECTION PROPERTIES

8 x 32 Lead:

Moment of inertia = 4896.15 in<sup>4</sup>

Top height = 15.28 in

Bottom height = 22.72 in

Area = 20.36 in<sup>2</sup>

## EXTERNAL CONCENTRATED FORCES

Top of Pile: 2232.0 lb at 200.0 in

Gate Load: 1936.0 lb at 1750.0 in

## UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 1.9 lb/in at 0.0 over 1800.0 in

D46 Hammer Wt.: 18.52 lb/in at 10.0 over 190.0 in

## LIMITS - ABSOLUTE

8 x 32 Leads:

Tensile = 42000.0 lb/in<sup>2</sup>Compressive = 42000.0 lb/in<sup>2</sup>Shear = 22500.0 lb/in<sup>2</sup>

Deflection = 15.0 in

## SUPPORT REACTIONS \*\*\*

Crane Pick: Simple at 480.0 in

Reaction Force = -9629.065 lb

Ground: Simple at 1800.0 in

Reaction Force = -1477.735 lb

## MAXIMUM DEFLECTION \*\*\*

3.480065 in at 0.0 in

Safety Factor = 4.31

Safety Margin = 11.51993 in

## MAXIMUM BENDING MOMENT \*\*\*

-2163390.0 lb-in at 480.0 in

## MAXIMUM SHEAR FORCE \*\*\*

-6662.8 lb at 480.0 in

## MAXIMUM STRESS \*\*\*

Tensile = 6751.549 lb/in<sup>2</sup>

Safety Factor = 6.221

Compressive = 10038.95 lb/in<sup>2</sup>

Safety Factor = 4.184

Shear (Avg) = 327.2495 lb/in<sup>2</sup>

Safety Factor = 68.755

## ECCENTRIC MOMENT STRESS

$$f_b = \frac{Mc}{I}$$

$$M = 90000 \times 3.90 = 313,200 \text{ LB-IN}$$

$$c = 15.28$$

$$f_b = 977.94 \text{ PSI}$$

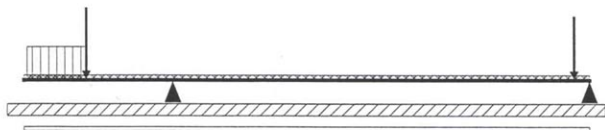
$$I = 4896.15$$

TOTAL COMBINED STRESS - 10038.95 + 4420 + 977.94  
= 15,436.9 PSI.

$$(S.F. = \frac{42000}{15436.9} = 2.72)$$

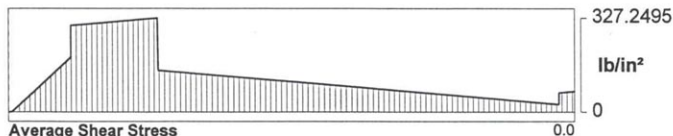
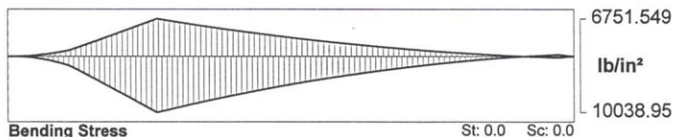
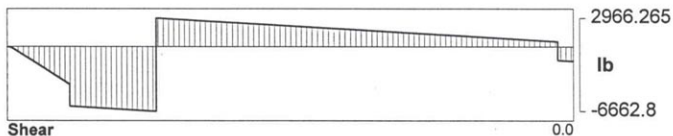
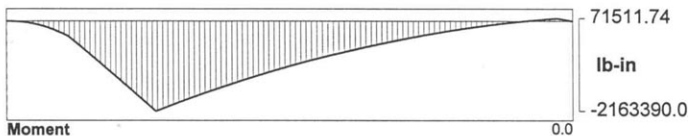
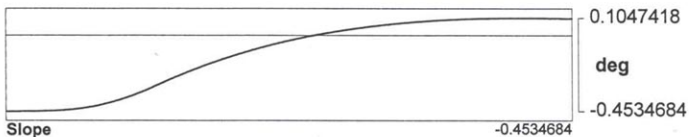
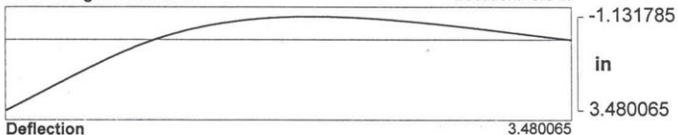
6.1.1 2 IN 12 FORE/AFT BATTER HAMMER UP w/ PILE

Fixed leads 8x32



Beam Length: 1800.0 in

Location: 0.0 in



6, 2 2 IN 12 PURE / ART BATTER HAMMER UP W/ PILE  
35 FT OVER HANG

\*\* Fixed leads 8x32 \*\*

BEAM LENGTH = 1800.0 in

MATERIAL PROPERTIES

Steel A36:  
Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>  
Stress limit = 12000.0 lb/in<sup>2</sup>

CROSS-SECTION PROPERTIES

8 x 32 Lead:  
Moment of inertia = 4896.15 in<sup>4</sup>  
Top height = 15.28 in  
Bottom height = 22.72 in  
Area = 20.36 in<sup>2</sup>

EXTERNAL CONCENTRATED FORCES

Top of Pile: 2232.0 lb at 200.0 in  
Gate Load: 1936.0 lb at 1750.0 in

UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 1.9 lb/in at 0.0 over 1800.0 in  
D46 Hammer Wt.: 18.52 lb/in at 10.0 over 190.0 in

LIMITS - ABSOLUTE

8 x 32 Leads:  
Tensile = 42000.0 lb/in<sup>2</sup>  
Compressive = 42000.0 lb/in<sup>2</sup>  
Shear = 22500.0 lb/in<sup>2</sup>  
Deflection = 15.0 in

SUPPORT REACTIONS \*\*\*

Crane Tip: Simple at 420.0 in  
Reaction Force = -9210.41 lb

Ground: Simple at 1800.0 in  
Reaction Force = -1896.39 lb

MAXIMUM DEFLECTION \*\*\*

2.298309 in at 0.0 in  
Safety Factor = 6.527  
Safety Margin = 12.70169 in

MAXIMUM BENDING MOMENT \*\*\*

-1767042.0 lb-in at 420.0 in

MAXIMUM SHEAR FORCE \*\*\*

-6548.8 lb at 420.0 in

MAXIMUM STRESS \*\*\*

Tensile = 5514.619 lb/in<sup>2</sup> Safety Factor = 7.616  
Compressive = 8199.748 lb/in<sup>2</sup> Safety Factor = 5.122  
Shear (Avg) = 321.6503 lb/in<sup>2</sup> Safety Factor = 69.952

ECCENTRIC MOMENT STRESS

$$f_b = \frac{Mc}{I} \quad M = 90,000 \times 2.3 = 207,000 \text{ LB-IN.}$$
$$c = 15.28 \text{ IN.}$$
$$f_b = 646 \text{ PSI} \quad I = 4896.15 \text{ IN}^4$$

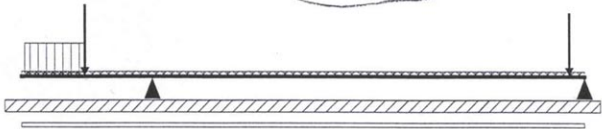
TOTAL COMBINED STRESS - 8199.75 + 4420 + 646 = 13266 PSI

$$(S.F. = \frac{42000}{13266} = 3.1)$$

6-2-1 2 IN 12 FUR/APT BATTER HAMMER UP W/ PILE

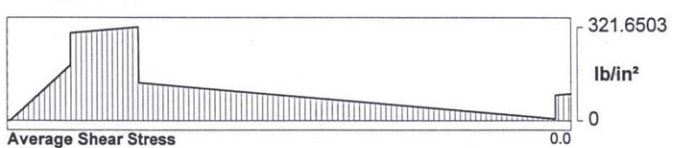
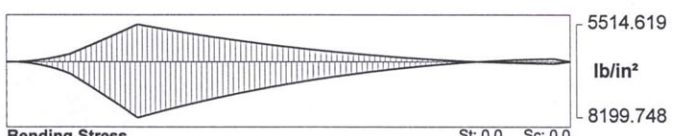
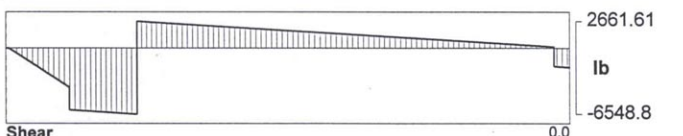
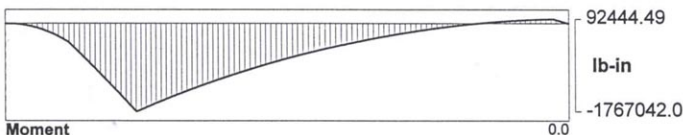
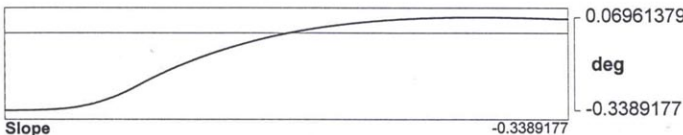
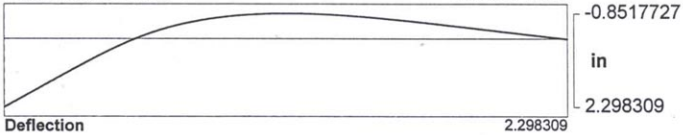
Fixed leads 8x32

35 FT. OVER HANG



Beam Length: 1800.0 in

Location: 0.0 in





63

2 IN 12 FORK/AFT BATTER

HAMMER UP  
W/ PILE30 FT. OVERHANG FROM BOTH  
TIP

\*\* Fixed leads 8x32 \*\*

BEAM LENGTH = 1800.0 in

## MATERIAL PROPERTIES

Steel A36:

Modulus of elasticity = 29000000.0 lb/in<sup>2</sup>Stress limit = 12000.0 lb/in<sup>2</sup>

## CROSS-SECTION PROPERTIES

8 x 32 Lead:

Moment of inertia = 4896.15 in<sup>4</sup>

Top height = 15.28 in

Bottom height = 22.72 in

Area = 20.36 in<sup>2</sup>

## EXTERNAL CONCENTRATED FORCES

Top of Pile: 2232.0 lb at 200.0 in

Gate Load: 1936.0 lb at 1750.0 in

## UNIFORMLY DISTRIBUTED FORCES

Weight of Leads: 1.9 lb/in at 0.0 over 1800.0 in

D46 Hammer Wt.: 18.52 lb/in at 10.0 over 190.0 in

## LIMITS - ABSOLUTE

8 x 32 Leads:

Tensile = 42000.0 lb/in<sup>2</sup>Compressive = 42000.0 lb/in<sup>2</sup>Shear = 22500.0 lb/in<sup>2</sup>

Deflection = 15.0 in

## SUPPORT REACTIONS \*\*\*

Crane Tip: Simple at 360.0 in

Reaction Force = -8826.643 lb

Ground: Simple at 1800.0 in

Reaction Force = -2280.157 lb

## MAXIMUM DEFLECTION \*\*\*

1.33357 in at 0.0 in

Safety Factor = 11.248

Safety Margin = 13.66643 in

## MAXIMUM BENDING MOMENT \*\*\*

-1377534.0 lb-in at 360.0 in

## MAXIMUM SHEAR FORCE \*\*\*

-6434.8 lb at 360.0 in

## MAXIMUM STRESS \*\*\*

Tensile = 4299.035 lb/in<sup>2</sup>

Safety Factor = 9.77

Compressive = 6392.282 lb/in<sup>2</sup>

Safety Factor = 6.57

Shear (Avg) = 316.0511 lb/in<sup>2</sup>

Safety Factor = 71.191

## ECCENTRIC MOMENT STRESS

$$f_b = \frac{M_c}{I}$$

$$f_b = 379.4$$

PSI

$$M_c = 90,000 \times 1.333 = 119,970 \text{ LB-IN}$$

$$c = 15.28 \text{ in}$$

$$I = 4896.15 \text{ IN}^4$$

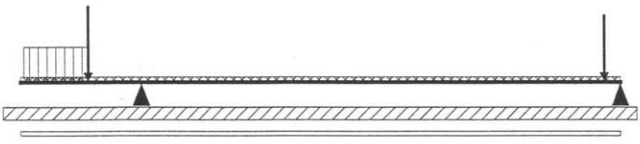
TOTAL COMBINED STRESS - 6392.28 + 4420 + 379.4  
= 11,187 PSI

$$\left( S.F. = \frac{42000}{11187} = 3.75 \right)$$

G-3.1 2 IN 12 PORE / API ENTER  
30 FT. OVERHANG

HAMMERED UP  
w/ PILE

### Fixed leads 8x32



Beam Length: 1800.0 in

Location: 0.0 in

