Mobile Crane Lift Planning in Construction Environments

Guest Speaker: Kevin O’Neill, P.E.
Project Engineer, Sieffert Associates

Host: Mike Parnell
President / CEO, ITI
ASME B30 Vice Chair (Cranes & Rigging)
ASME P30 Chair (Lift Planning)

The views expressed in this presentation are that of ITI and are not necessarily the views of the ASME or any of its committees.
WHO WE ARE

A world leader in crane and rigging training and consulting.

We Rig It Right!
WHO WE ARE

Serves a Variety of Industries

• Aerospace
• Chemicals
• Construction
• DOD
• DOE
• Electric Utility
• Hydro
• Manufacturing
• Maritime
• Mining
• Nuclear
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• Pulp & Paper
• Railroad
• Shipbuilding
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OUR CUSTOMERS

The World's Greatest Organizations Trust ITI's Expertise with their Crane & Rigging Operations
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Past Presentations:
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Effective Crane & Rigging Training Methods for Your Employees
10 Audit Points for Your Crane & Rigging Operations: An HSE Perspective
Tackling the Challenges of Training Site Supervisors, Lift Directors, and other Leaders
How Studies of Crane Accidents and Trends Lead to a Safer Work Environment

Today's Presentation:
Mobile Crane Lift Planning in Construction Environments

Upcoming Presentations:
4 Major Lifting Considerations in Power Gen Environments
Mr. Parnell has a wealth of knowledge regarding cranes, rigging, and lifting activities throughout a variety of industries.

• 30+ years learning about wire rope, rigging, load handling, and lifting activities.

• Vice Chair of the ASME B30 Main Committee which sets the standards in the US for cranes and rigging

• Chair of the ASME P30 Main Committee which sets the standards for lift planning.

ASME standards are also adopted by many countries around the world.

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ABOUT THE SPEAKER

Kevin O' Neill, P.E., Project Engineer, Siefert Associates

Mr. O'Neill is a member of the ASME P30 Main Committee (Planning for the Use of Cranes, Derricks, Hoists, Cableways, Aerial Devices and Lifting Accessories) and currently serves as a Project Engineer for Siefert Associates, Naugatuck, Connecticut.

Current responsibilities as a Project Engineer include directing and managing multiple concurrent engineering projects while ensuring their success in meeting their respective objectives.

Mr. O'Neill provides Construction Engineering Services for contractors including erection and demolition plans, crane and rigging layouts/design and equipment foundation analysis.
Mobile Crane Lift Planning in Construction Environments

Kevin O’Neill, P.E.
Siefert Associates, LLC
Mobile Crane Lift Planning in Construction Environments

SIEFERT ASSOCIATES, LLC
180 CHURCH STREET NAUGATUCK, CT 06770
PHONE 203-723-1477
www.siefertassociates.com

The Premier Construction Engineering Firm in the NYC Metro Area
Professional, Capable, and Dedicated.

Structural and Geotechnical Engineering: Working Drawings and Calculations prepared by Professional Engineers Licensed in CT, NY, NJ, PA, DC, RI, VT, MA, WA & IN tailored to the preferred means and methods of the Client.
Mobile Crane Lift Planning in Construction Environments

- Demolition and Erection Plans for Bridges and Buildings
- Crane Layout and Rigging Design
- Temporary Bridges and Structures
- Heavy Hauling and Alternative Lifting Schemes
- Structural Rehabilitation and Retrofit Operations
- Access Platforms and Debris Shields
- Bridge Jacking and Bearing Replacement
- Concrete Forming and Shoring
- Temporary Earth Support - Sheet Piling etc.
- Temporary Cofferdams
- Detailed Work Plans
- Analysis of Construction Loads on Structures
- Detailed Work Plans

Permanent Design Drawings and Calculations for:
- Foundations and Retaining Walls
- Bridges and Buildings
New Definitions ASME P-30

• **Lift Director** – Responsible for verifying the category of the load handling activity, reviewing and implementing the lift plan.

• **Lift Planner** - Responsible for developing the lift plan.

• Load Handling Equipment (LHE)

• Load Handling Activity (LHA)
Assessing Loads to Be Handled

- **New Construction**
  - Known weights of loads, pick point locations & center of gravity
  - Drawings/data available

- **Demolition**
  - Unknown weights of loads and center of gravity
  - Elaborate calculations/very conservative guesswork
  - Cutting free while hoisting
Assessing Loads to Be Handled Cont.

- Equipment Loads
  - Hook block(s) – rigging – falls - jib
- Chart Reduction
  - 125% -150% picking capacity (i.e. RR)
  - 85% capacity of rated chart – rule of thumb
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LHE Position

• Cost Considerations
  • Relative efficiency of operation from one location over another
  • Radius increase leads to crane increase
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LHE Selection

- Crane Basics
  - Capacity
  - Reieving
  - Reach
  - Clearance
  - Constructability
  - Availability
LHE Selection Continued

• Telescopic/Hydraulic
  • Short term operation
  • Quick setup/small crew
  • May have limited onsite mobility (larger cranes)
  • Higher rental rate
LHE Selection Continued

- Lattice Boom Truck/Crawler
  - Long term operation
  - Onsite mobility
  - Added labor for assembly/disassembly
  - High transportation cost
  - Low rental rate
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Lift/Swing Clearances

• Lift Clearances
  • Tip height
  • Range diagram
  • Rigging drift
  • Two blocking

• Swing Clearances
  • Spreadsheet calculations
  • Drafting
  • Lift planning programs
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LHE Loads on Surface

- Spreadsheet Calculations
  - Component weights and centers of gravity
- Manufacturer’s Programs or Charts
- Hydraulic/Truck Cranes
  - Point loads
- Crawler Cranes
  - Pressure diagrams (uniform, trapezoidal & triangular)
LHE Loads on Structures

- Foundation walls
- Tunnels or subways
- Bridge decks
- Piers
- Slabs
- Utility banks
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Mobile Crane Lift Planning in Construction Environments

2.4 Major component weights and center of gravity

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight (kg)</th>
<th>Distance from center of swaying (m, forward)</th>
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<tbody>
<tr>
<td>Boom section</td>
<td>8774</td>
<td>-</td>
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<tr>
<td>Slowing portion</td>
<td>6205</td>
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<tr>
<td>Carrier portion</td>
<td>14682</td>
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\[ A_1 = 4.776, A_2 = 0.506, A_3 = 0.086, A_4 = 1.73, A_5 = 0.166, W = 5.466 \]

2.5 Amount of counterweight (Reg. No. 342-307-30000)
- mass: 1000 kg
- mounting bolt: JIS B1105, M14 × 140, class 10.9, number: 2
- JIS B1105, M12 × 120, class 10.9, number: 4

2.6 Boom section weight and center of gravity

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight (kg)</th>
<th>Distance from boom pivot point (m)</th>
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<tr>
<td>Base boom</td>
<td>1478</td>
<td>4.570</td>
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<td>Red boom</td>
<td>1026</td>
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<td>Red boom</td>
<td>900</td>
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<td>Top boom</td>
<td>850</td>
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2.7 Weight of boom extension cylinder

- \( D_1 \): distance from bottom of boom part
- \( D_2 \): length of boom part (if \( D_2 \) = 0, it means constant load)
- \( D_3 \): distance from bottom of the boom part to center of gravity
- \( W_1 \): weight of a boom part
- \( W_2 \): weight increase due to unit extension of the telescoping cylinder

2.8 Details of jib mounting on boom: Reg. No. 342-208-81000 and 342-207-02300
2.9 Details of jib top shear mounting: Reg. No. 342-209-44000
# Mobile Crane Lift Planning in Construction Environments

![Image of crane](image-url)

Siefert Associates, LLC  
180 Church Street  
Naugatuck, CT 06770

**Subject:** Maximum Outrigger Load  
**Tadano TR450-XL4**

**Job No.: XXXX**  
**Sheet No.** Of  
**Made By** Date  
**Ckd By** Date

---

<table>
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<tr>
<th>Shadow Length Boom Angle</th>
<th>$\gamma = \arccos\left(\frac{R-1}{d}\right)$</th>
<th>$\gamma = 47.704\deg$</th>
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<tr>
<td>Boom Angle</td>
<td>$\theta = \beta + \gamma$</td>
<td>$\theta = \beta$</td>
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<td><strong>Tip Height:</strong></td>
<td>$H_{tip} = h + \sqrt{R^2 - (R - 1)^2}$</td>
<td>$H_{tip} = 64.50$</td>
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<tr>
<td><strong>Boom Moment:</strong></td>
<td>$M_b = \left[ W_w (t + d_w \cos(\theta)) \right] + \left[ W_j (t - L_j \cos(\theta) - d_j \cos(\theta - \mu)) \right]$</td>
<td>$M_b = 433.7\text{kip}$</td>
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<tr>
<td><strong>Superstructure Moment:</strong></td>
<td>$M_u = M_b + W_R - W_u a_u - W_{ctw} d_{ctw}$</td>
<td>$M_u = 57.3\text{kip}$</td>
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<tr>
<td><strong>Superstructure Vertical Load:</strong></td>
<td>$V_u = W_b + W_j + W_a + W_{ctw} + W$</td>
<td>$V_u = 33.3\text{kip}$</td>
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<tr>
<td><strong>Total Vertical Load:</strong></td>
<td>$V = V_u + W_c$</td>
<td>$V = 71.1\text{kip}$</td>
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<td><strong>Portion of Moment:</strong></td>
<td>$M_{u} = (M_u \cos(\alpha - \deg) - W_c d_c - V_u x_u)$</td>
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<tr>
<td><strong>Outrigger Reactions:</strong></td>
<td>$M_{o} = (M_o \sin(\alpha - \deg))$</td>
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<td><strong>Front Outrigger Boom Side:</strong></td>
<td>$P_{FB} = \frac{V}{4} + \frac{1}{2} \left( \frac{M_{u}}{d_1} - \frac{M_{o}}{d_1} \right)$</td>
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<tr>
<td><strong>Front Outrigger Counterweight Side:</strong></td>
<td>$P_{FC} = \frac{V}{4} + \frac{1}{2} \left( \frac{M_{u}}{d_1} - \frac{M_{o}}{d_1} \right)$</td>
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<td><strong>Rear Outrigger Boom Side:</strong></td>
<td>$P_{RB} = \frac{V}{4} - \frac{1}{2} \left( \frac{M_{u}}{d_1} - \frac{M_{o}}{d_1} \right)$</td>
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<tr>
<td><strong>Rear Outrigger Counterweight Side:</strong></td>
<td>$P_{RC} = \frac{V}{4} - \frac{1}{2} \left( \frac{M_{u}}{d_1} - \frac{M_{o}}{d_1} \right)$</td>
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<tr>
<td><strong>Total Outrigger Loads:</strong></td>
<td>$P_{crane} = P_{FB} + P_{FC} + P_{RB} + P_{RC}$</td>
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</table>

This document creates the maximum outrigger load for a Tadano TR-450XL-4 Hydraulic Crane. Reference: Shapiro, Cranes and Demiconks Third Edition

### Crane Data

- **Outrigger Spread (Front to Rear):** $d_1 = 22.97\text{ft}$
- **Outrigger Spread (Side to Side):** $d_2 = 22.97\text{ft}$
- **Distance from CL to Outrigger Centroid (+ Rear of CL):** $x_o = -4.85\text{ft}$
- **Boom Pin Distance (+ Front of CL):** $t = 7.22\text{ft}$
- **Boom Pin Height:** $h = 12\text{ft}$
- **Length of Boom:** $L_b = 71\text{ft}$
- **Length of Jib:** $L_j = 0\text{ft}$
- **Jib Offset:** $\mu = 0\deg$
- **Operating Radius:** $R = 550\text{ft}$
- **Slew Range (deg):** $\alpha = 0.5 - 180$

### Weights

- **Weight of Carrier:** $W_c = 37.86\text{kip}$
- **Weight of Superstructure:** $W_s = 14.3\text{kip}$
- **Weight of Counterweight:** $W_{ctw} = 6\text{kip}$
- **Weight of Boom:** $W_b = 15.1\text{kip}$
- **Weight of Jib:** $W_j = 6\text{kip}$
- **Weight of Hook Load (Block, Rigging, Lifted Load, Falls):** $W = 4\text{kip}$

### CG Distances

- **Carrier CG:** $d_c = 1\text{ft}$
- **Superstructure CG:** $d_u = 5.38\text{ft}$
- **Counterweight CG:** $d_{ctw} = 6\text{ft}$
- **Boom CG:** $d_b = L_b - 0.45$  
  $d_b = 32\text{ft}$
- **Jib CG:** $d_j = L_j - 0.45$  
  $d_j = 0$

### Calculations

#### Boom Angle

- $x_j = L_j \sin(\mu)$  
  $x_j = 0$
- $y_j = L_j \cos(\mu)$  
  $y_j = 0$

#### Enclosed Angle

- $\beta = \arctan\left( \frac{x_j}{y_j} \right)$  
  $\beta = 0\deg$

#### Shadow Length of Combined Boom

- $d = \sqrt{x_j^2 + (y_j + h)^2}$  
  $d = 71\text{ft}$
# Mobile Crane Lift Planning in Construction Environments

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<th>Summary</th>
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<tr>
<td><strong>Counterweight</strong></td>
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<td><strong>Length of Jib</strong></td>
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<td><strong>Tip Height</strong></td>
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<td><strong>Max Pick</strong></td>
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<td>50.3</td>
<td>32.6</td>
<td>30.4</td>
<td>5.2</td>
<td>3</td>
<td>71.1</td>
</tr>
<tr>
<td>180</td>
<td>-631.2</td>
<td>0</td>
<td>31.5</td>
<td>31.5</td>
<td>4</td>
<td>4</td>
<td>71.1</td>
</tr>
</tbody>
</table>

Max Outrigger Load: \( M_{\text{Max}} = 36.7 \) kip
Mobile Crane Lift Planning in Construction Environments

**CALCULATE MAX OUTRIGGER LOADS USING REACTION TABLES**

Calculate outrigger reactions for KMK5175.

**Tilt boom - 99.2 k, crane load wt: 73.3 k, Radius: 40 ft.**

**Left Rear Outrigger**

- \( P_{n1} = 189.6 \text{ k} \)
- Outrigger loading at position IV 45 deg over Rear outrigger (HR) for 96.0k and 40ft
- \( P_{n0} = 46k \)
- Outrigger loading at position IV (HR) for 0k and 40ft
- \( W_L = 73.3k \)
- Load to be lifted
- \( W_T = 96k \)
- Load according to Lifting capacity table

\[
P_{IVLR} = \frac{P_{n1} - P_{n0}}{W_T} = P_{n0} \Rightarrow P_{IVLR} = 155.6 \text{ k}
\]

**Right Rear Outrigger**

- \( P_{n2} = 74.9k \)
- Outrigger loading at position IV 45 deg over Rear outrigger (HL) for 96.0k and 40ft
- \( P_{n02} = 62.3k \)
- Outrigger loading at position IV (HL) 0k and 40ft

\[
P_{IVR} = \frac{P_{n2} - P_{n02}}{W_T} = P_{n02} \Rightarrow P_{IVR} = 71.4 \text{ k}
\]

**Left Front Outrigger**

- \( P_{n3} = 0k \)
- Outrigger loading at position IV 45 deg over Rear outrigger (VL) for 96.0k and 40ft
- \( P_{n03} = 64.6k \)
- Outrigger loading at position IV (VL) 0k and 40ft

\[
P_{IVFR} = \frac{P_{n3} - P_{n03}}{W_T} = P_{n03} \Rightarrow P_{IVFR} = 15.3 \text{ k}
\]

**Right Front Outrigger**

- \( P_{n4} = 59.0k \)
- Outrigger loading at position IV 45 deg over Rear outrigger (VR) for 96.0k and 40ft
- \( P_{n04} = 54.2k \)
- Outrigger loading at position IV (VR) 0k and 40ft

\[
P_{IVLF} = \frac{P_{n4} - P_{n04}}{W_T} = P_{n04} \Rightarrow P_{IVLF} = 57.9 \text{ k}
\]

Max Outrigger Reaction

\[
OR_{\text{max}} = \max(P_{IVLR}, P_{IVR}, P_{IVFR}, P_{IVLF}) = 155.6 \text{ kip}
\]
Mobile Crane Lift Planning in Construction Environments
Mobile Crane Lift Planning in Construction Environments

Calculation of ground pressure LR 1300

<table>
<thead>
<tr>
<th>Load</th>
<th>22.7 t</th>
<th>Radius</th>
<th>12.2 m</th>
<th>Boom</th>
<th>74.0 m</th>
<th>Fixed jib</th>
<th>6.0 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counter weight at the booms</td>
<td>134.01 t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions of the undercarriage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moment</td>
<td>3316.0 [kNm]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width of track shoes</td>
<td>b: 1200.0 [mm]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Var. Load</td>
<td>2104.0 [kN]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of crawler</td>
<td>l: 8435.0 [mm]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center of gravity</td>
<td>1034.4 [mm]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight of undercarriage</td>
<td>1102.0 [kN]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tipping line</td>
<td>kk: 7100.0 [mm]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Load over front:
- p max: 274.9 kN/m²
- Distribution of pressure in shape of trapezium

Load over side:
- p max: 206.6 kN/m²
- Distribution of pressure in shape of trapezium

Maximum ground pressure at an angle of 35.0° (2° = longitudinal to the crawlers)

Load over the edge:
- Ground pressure under front track: 206.6 kN/m²
- 29.35 psi
- Ground pressure under rear track: 110.2 kN/m²
- 15.67 psi

Diagram of pressure along the crawlers [mm]
Mobile Crane Lift Planning in Construction Environments

Manufacturer Hydraulic/Truck Crane Outrigger Loads

- **Manitowoc/Grove**

- **Liebherr**
  LICCON (Liebherr Computer CONtrolling) program that needs a USB Key to operate, software comes with crane.

- **Tadano**
  [https://www.tadano.co.jp/service/data/tdnsys/jackale/register.asp](https://www.tadano.co.jp/service/data/tdnsys/jackale/register.asp)

- **Terex/Demag**
  [http://www.cranimax.com](http://www.cranimax.com)
  Program that needs a USB Key to operate, third party provider.

- **Krupp**
  Outrigger load tables provided by manufacture.

- **Link-Belt**
Mobile Crane Lift Planning in Construction Environments

Manufacturer Crawler Crane Loads

- **Manitowoc**
  http://www.manitowoccranes.com/en/Resources/tools

- **Liebherr**
  LICCON for the LR 1400. Excel spread sheets for the later models

- **Demag/Terex**
  http://www.cranimax.com
  Program that needs a USB Key to operate, third party provider

- **Link-Belt**
  http://www.linkbelt.com/gbpl/gbnav.asp

- **Kobelco**

- **Mantis**
  Some success calling a dealer for crawler loads
Supporting the LHE

- Crane must be level
- Surface protection
- Allowable ground bearing pressure
  - Loading diagrams, project requirements
- Cribbing/Dunnage design – timber, steel plate or steel beam
- Structural analysis (i.e. bridge deck)
Mobile Crane Lift Planning in Construction Environments

Liebherr LTM-1400 Hydraulic Crane

Inputs
- Maximum Outrigger Reaction: \( P = 151 \text{kip} \)
- Maximum Allowable Soil Bearing Pressure: \( F_{\text{max}} = 3.5 \text{ ksf} \)
- Outrigger Length (Parallel to Length of Plate): \( L_p = 7 \text{ ft} \)
- Outrigger Width (Parallel to Width of Plate): \( W_p = 7 \text{ ft} \)
- Maximum Allowable Bending Stress: \( F_B = 0.75 F_Y = 27 \text{ ksf} \)
- Actual Steel Plate Length: \( L_p = 7 \text{ ft} \)
- Actual Steel Plate Width: \( W_p = 7 \text{ ft} \)
- Actual Steel Plate Thickness: \( T_p = 2 \text{ in} \)
- FV = 0.4 F_Y = 14.4 \text{ ksf} 
- Modulus of Elasticity: \( E = 20000 \text{ ksf} \)

Calculations
- Minimum Bearing Area on Surface: \( A_{\text{min}} = \frac{P}{F_{\text{max}}} = 3.1435 \text{ in}^2 \)
- Moment Arm: \( M_{\text{arm}} = \frac{(L_p - L_0)}{2} = 2.167 \text{ ft} \)
- Uniform Load Under Plate: \( q = \frac{21.57}{L_p} \text{ ksf/ft} \)
- Steel Plate Bending Moment: \( M = (qL^2) = 50.63 \text{ kip-ft} \)
- Minimum Section Modulus: \( S_{\text{min}} = \frac{(M)}{F_B} = 22.62 \text{ in}^3 \)
- Minimum Plate Thickness: \( T_{\text{min}} = \frac{S_{\text{min}}}{F_B} = 1.288 \text{ in} \)
- Actual Bearing Pressure on Surface: \( F_{\text{actual}} = \frac{P}{A} = 3.06 \text{ ksf} \)
- Bearing Pressure: \( F_{\text{max}} > F_{\text{actual}} \text{ "OK", "Review" = "OK"} \)
- Actual Bending Stress on Plate: \( F_{B_{\text{actual}}} = \frac{M}{T_p} = 10.6 \text{ ksf/ft} \)
- Actual Shear Stress on Plate: \( F_{V_{\text{actual}}} = 1.5 \frac{(L_p)}{T_p} = 0.42 \text{ ksf/ft} \)
- Maximum Deflection: \( d = \left( \frac{c N_{\text{arm}}}{E I} \right) = 0.065 \text{ in} \)

Minimum Steel Plate Outrigger Dunning Centered under all outriggers - Use:
- Minimum Width of Plate: \( L_p = 7 \text{ ft} \)
- Minimum Length of Plate: \( W_p = 7 \text{ ft} \)
- Minimum Thickness of Plate: \( T_p = 2 \text{ in} \)

MathCAD Dunning Calc Steel

LIEBHERR LR-1300 CRAWLER CRANE
MIXED HARDWOOD CRANE MAT DUNNAGE CALCULATION

INPUT
- Maximum Crawler Reaction: \( P_{\text{max}} = 7.37 \text{ kipsft} \)
- Minimum Crawler Reaction: \( P_{\text{min}} = 1.04 \text{ kipsft} \)
- Maximum Allowable Bearing Pressure: \( F_{\text{max}} = 5.15 \text{ ksf} \)
- Actual Timber Length: \( L = 30.0 \text{ ft} \)
- Actual Timber Width: \( W = 12.0 \text{ in} \)
- Actual Timber Depth: \( D = 12.0 \text{ in} \)
- Weight of Centerline of Crawler: \( w = 22.52 \text{ ksf} \)
- Effective Tread Bearing Length: \( DL = 27.67 \text{ ft} \)
- Tread Bearing Width: \( DW = 3.33 \text{ ft} \)
- Design Value Bending (Beam and Stringers No. 2): \( B = 0.625 \text{ ksf} \)
- Design Value Shear (Beam and Stringers No. 2): \( V = 0.155 \text{ ksf} \)
- Load Duration Adjustment Factor (Ten Minute Load): \( CD = 1.00 \)

PROPERTIES
- Maximum Allowable Stress: \( F_B = 0.625 \text{ ksf} \times 1.60 \times 1.00 = 1.00 \text{ ksf} \)
- Maximum Allowable Shear Stress: \( F_V = 0.155 \times 1.60 = 0.248 \text{ ksf} \)
- Maximum Allowable Bending Stress: \( F_p = 0.248 \text{ ksf} \)

CALCULATIONS
- Rate of Pressure Under Tread: \( Pr = \frac{P_{\text{max}} - P_{\text{min}}}{1.4} \times (1.27 - 1.04) \times 1 = 0.23 \text{ ksf/ft} \)
- Minimum Pressure on One 4 ft Pontoons: \( Q_{\text{min}} = P_{\text{max}} \times (4 \text{ ft}) = 7.4 \times 0.92 = 6.68 \text{ ksf/ft} \)
- Total Load on One 4 ft Pontoons: \( Q_P = 4 \text{ ft} \times 6.68 \text{ ksf/ft} = 108.8 \text{ ksf} \)
- Minimum Required Surface Bearing Area: \( A_{\text{min}} = \frac{Q_P}{F_{\text{max}}} = 108.8 \times 1.15 \times 21.1 = 23.22 \text{ ft}^2 \)
- Effective Bearing Length under 4ft Pontoons: \( C = L_x \times 2 = 30.0 \times 2 = 60 \text{ ft} \)
- Effective Bearing Length: \( C = 23.3 \text{ ft} \)
- Arm: \( A = (C - D)/2 = (7.68 - 3.53)/2 = 1.87 \text{ ft} \)
- Maximum Load on an Individual Timber: \( P = Q_P / 4 = 27.2 \text{ ksf} \)
- Actual Section Modulus of Wood: \( S_x = \frac{W^2 	imes D}{12} = 12.00 \times 12.00 \times 12 = 288.0 \text{ in}^3 \)
- Actual Bearing Pressure on Surface: \( F_P = P \times (C / W) = 27.20 \times (7.68 / 21.12) = 3.54 \text{ ksf/ft} \)
- Pontoons Bending Moment: \( M = (F_x \times A_{\text{max}})^2 / 2 = 1.00 \text{ ksf} \)
- Actual Bending Stress in Timbers: \( F_b = M / S_x = 6.21 \times 288.0 = 0.259 \text{ ksf} \)
- Actual Shear Stress in Timbers: \( F_V = (L_x / A_{\text{max}}) \times (F_x / L_x) = (1.5 \times 3.54 / 12) = 0.069 \text{ ksf} \)

RESULT

MIXED HARDWOOD CRANE MAT DUNNAGE
ONE (1) LAYER OF 12" X 4" X 30" TIMBER CRANE MATS MINIMUM CENTERED UNDER CRANE

Note: Mixed Hardwood is one or more of the following - Beech-Birch-Hickory, Mixed Oak or Mixed Maple. The Design Value Bending and Shear is the minimum combination.
**Mobile Crane Lift Planning in Construction Environments**

**Steel Plate Outrigger Dunnage Calculation**

**Grove GMK-5210 Hydraulic Crane - Top Dunnage Layer - Steel Plate Inputs**
- Maximum Outrigger Reaction: $P = 151 \text{kip}$
- Actual Steel Plate Length: $L_p = 3.75 \text{ft}$
- Maximum Allowable Soil Bearing Pressure: $F_{max} = 11 \text{ksi}$
- Actual Steel Plate Width: $W_p = 3.75 \text{ft}$
- Outrigger Length (Parallel to Length of Plate): $L_O = 11.6 \text{ft}$
- Actual Steel Plate Thickness: $T_p = 1 \text{in}$

**Properties**
- Minimum Yield Stress: $F_y = 39 \text{ksi}$
- Maximum Allowable Shear Stress: $F_{vp} = 0.4 F_y = 14.4 \text{ksi}$
- Maximum Allowable Bending Stress: $F_{BP} = 0.75 F_y = 27 \text{ksi}$
- Modulus of Elasticity: $E = 290000 \text{ksi}$

**Calculations**
- Minimum Bearing Area on Surface: $A_{min} = \frac{P}{F_{max}} = 13.7 \text{in}^2$
- Moment Arm: $M_{arm} = \frac{L_p - L_O}{2}$
- Actual Bearing Area: $A_G = L_p W_p = 14.1 \text{in}^2$
- Uniform Load Under Plate: $P = \frac{40.267}{L_p}$
- Actual Section Module of Plate: $S_{x,p} = \frac{(W_p T_p^2)}{6}$
- Steel Plate Bending Moment: $M_p = \frac{(4P M_{arm})^2}{T_p^2}$
- Minimum Section Module: $S_{min} = 7.1 \text{in}^2$
- Moment of Inertia: $I_p = W_p T_p^2 = 3.6 \text{in}^4$
- Minimum Plate Thickness: $T_{min} = \sqrt{\frac{S_{min} P}{A_p W_p L_p}}$
- Actual Bearing Pressure on Surface: $F_{actual} = \frac{P}{A_G}$
- Actual Bending Stress on Plate: $F_{b,actual} = \frac{M_p}{S_{x,p}}$
- Actual Shear Stress on Plate: $F_{V,actual} = \frac{(M_{arm})}{A_G}$
- Maximum Deflection: $d = \frac{(4P M_{arm})^3}{8E I_p}$

**Minimum Steel Plate Outrigger Dunnage Centered Under all Outriggers - Use:**
- Minimum Width of Plate: $L_p = 3.75 \text{ft}$
- Minimum Length of Plate: $W_p = 3.75 \text{ft}$
- Minimum Thickness of Plate: $T_p = 1 \text{in}$

---

**Grove GMK-5210 Hydraulic Crane - Bottom Dunnage Layer - Timber Inputs**
- Maximum Outrigger Reaction: $P = 151 \text{kip}$
- Timber Type: $Type_T = \text{Mixed Hardwood}$
- Maximum Allowable Soil Bearing Pressure: $F_{max} = 4 \text{ksi}$
- Normal Timber Size: $Size_T = 12" x 12"$
- Outrigger Length (Parallel to Length of Timber): $L_O = 3.75 \text{ft}$
- Dressed Width of Timber: $W_D = 12 \text{in}$
- Outrigger Length (Parallel to Width of Timber): $W_O = 3.75 \text{ft}$
- Number of Timbers: $Num_T = \text{on} \frac{W_D}{W_O} = 4$
- Try Timber Length: $L_T = 11 \text{ft}$
- Actual Timber Width: $W_T = Num_T \cdot W_D = 4 \text{ft}$
- Actual Timber Thickness: $T_T = W_D = 12 \text{in}$

**Constants**
- (American Wood Council NDS)
- Bending Design Value (No. 2): $B_s = 0.6 \text{ksi}$
- Repetitive Member Adjustment Factor: $C_{RT} = 1$
- Shear Design Value (No. 2): $V_T = 0.2 \text{ksi}$
- Load Duration Adjustment Factor: $C_{DT} = 1.6$

**Properties**
- Max Allowable Bending Stress: $F_{BT} = \frac{B_s C_{RT} C_{DT}}{2} = 1 \text{ksi}$
- Max Allowable Shear Stress: $F_{VT} = \frac{V_T C_{RT} C_{DT}}{2} = 0.2 \text{ksi}$

**Calculations**
- Minimum Bearing Area on Surface: $A_{min,T} = \frac{P}{F_{max}} = 37.8 \text{in}^2$
- Moment Arm: $M_{arm,T} = \frac{L_O - L_T}{2}$
- Actual Bearing Area: $A_T = L_T W_T = 44 \text{in}^2$
- Uniform Load Under Wood: $P_T = \frac{1372}{K}$
- Actual Section Module of Wood: $S_{x,T} = \frac{(W_T T_T^2)}{6}$
- Timber Bending Moment: $M_T = \frac{(2)}{E I_T}$
- Minimum Section Module: $S_{min,T} = 1023 \text{in}^3$
- Minimum Timber Thickness: $T_{min,T} = \sqrt{\frac{S_{min,T} P}{A_T W_T L_T}}$
- Actual Bearing Pressure on Surface: $F_{act,T} = \frac{P}{A_T}$
- Actual Bending Stress in Timbers: $F_{b,act,T} = \frac{M_T}{S_{x,T}}$
- Actual Shear Stress in Timbers: $F_{V,act,T} = \frac{(M_{arm,T})}{A_T}$

**Minimum Top Layer Timber Outrigger Dunnage Centered Under all Outriggers - Use:**
- Number of Timbers: $Num_T = 4$
- Size of Timbers: $Size_T = 12" x 12"$
- Minimum Length of Timbers: $L_T = 11 \text{ft}$
Rigging Design

- Sling & rigging hardware capacities (charts)
- Inspected and/or tested
- Determining load in such components
- BTH-1 (lift lugs, spreader bars)
- Rigging protection
Mobile Crane Lift Planning in Construction Environments

**Lifted/Braced Load Analysis**

- Rigging attachment points
  - Lift lugs, precast inserts, trunnions
- Stability during lift
  - Steel girder buckling
  - Precast cracking
  - Tilting operations
- Temporary bracing and stability after release form crane
Multiple LHE Lifts

- More complex
- Location of cranes at the beginning of lift
- Movement of cranes during lift
- Distribution of load between the cranes
  - Change of load distribution during lift
- Clearances between the load, fixed obstructions and the cranes themselves
- Communication during lift
- Reduced allowable loads +/- 75%
Decision Tree ASME P-30

• Review the list of Considerations
  • Hazards to Persons or Work Area
  • Impact - Commercial or Environmental
  • Complexity of Lift, Repetitive, Capacities
  • Site Requirements
• Standard Lift – verbal or brief written document
• Critical Lift – fully written plan (engineered drawings and calculations)
Mobile Crane Lift Planning in Construction Environments

LIFT DATA SHEET (Single Crane)

<table>
<thead>
<tr>
<th>Project:</th>
<th>Originator:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job No.:</td>
<td>Checker:</td>
<td>Date:</td>
</tr>
<tr>
<td>Lift Company:</td>
<td>Preparing Co.:</td>
<td></td>
</tr>
<tr>
<td>Sheet No.:</td>
<td>Revision:</td>
<td>Date:</td>
</tr>
</tbody>
</table>

Units of Measure: U.S. (Ft. - Lbs)
Length: ft
Weight: lbs

Pay Load Name
Lift Description

Load details
Quantity
Wt./each
Weight

Net load (actual weight of item to be lifted)

Manbasket lift (yin) NO
(NB: 50% crane chart reduction applied when using manbasket)

Rigging Bill of Material’s
Quantity
Wt./each
Weight

Crane Details
Manufacturer
Model No.

Boat Type
Block Capacity
Jib Type
Boom Length Used
Line size
Jib Length Used

Gross Capacity Deductions

Main Load Block
Wire Strike
Jib Block
Aux Boom Sheaves
Slowed Jib
Other (specify):

Gross Capacity Deductions:

Net crane capacities

<table>
<thead>
<tr>
<th>Radius 1</th>
<th>Radius 2</th>
<th>Radius 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft</td>
<td>ft</td>
<td>ft</td>
</tr>
</tbody>
</table>

Chart Radius:
Chart Capacity:

Gross load to hook (load + rigging)

Max % of capacity used

Ground Bearing Pressure: Actual

Min clearance boom to obstruction:
3 ft

Notes
Attach sketch showing plan and elevation. Attach relevant crane chart extract

APPROVALS:
Signature
Title
Date

Manitowoc Cranes, Inc.
 Manitowoc, Wisconsin 54228 USA

8659-B, 2005-06-11
4/9
Mobile Crane Lift Planning in Construction Environments

![Diagram of crane lift planning in construction environments](image-url)
Mobile Crane Lift Planning in Construction Environments

RIGGING NOTES
1. CONTRACTOR TO VERIFY ALL DIMENSIONS AND SITE CONDITIONS PRIOR TO COMMENCING WORK.
2. ALL DIMENSIONS TO BE VERIFIED BY CONTRACTOR TO THE NEAREST INCH (2), ANY ERRORS, OMISSIONS, OR UNUSUAL CONDITIONS TO BE REPORTED TO SIEFFERT ASSOCIATES, LLC IMMEDIATELY.
3. LEAD RIGGER OR LIFT SUPERINTENDENT MUST KNOW THE SAFE WORKING LOAD OF RIGGING BEING USED AND DETERMINE THE LOAD WEIGHT AND CENTER OF GRAVITY PRIOR TO ANY LIFT.
4. EXAMINE ALL RIGGING, HARDWARE, SLINGS ETC., FOR DEFECTS AND COMPLIANCE WITH SITE APPROVED DRAWINGS.
5. SHARP BENDS, PINCHING AND CRUSHING MUST BE AVOIDED ON ALL SLINGS. THIMBLES AND SOFTENERS SHOULD BE USED AT ALL TIMES.
6. COMBINED WEIGHT OF ALL RIGGING MUST BE SUBTRACTED FROM LOAD CAPACITY OF HOSTING EQUIPMENT.
7. RIGGING DESIGN IN ACCORDANCE WITH A.5.I./A.S.M.E. B30.9 AND B30.20, APPROPRIATE OSHA RULES AND STATE OR CITY CODE IF NEEDED.
8. DANGER: NEVER EXCEED WLL.

NOTE: CONTRACTOR TO PROVIDE ADEQUATE SOFTENERS FOR ALL SLINGS

GIRDER G1 RIGGING DETAILS

CRANE BLOCK

4 PART LINE

1-1/2" x 25'-0" wire rope slung (typ.) SWL=211t

2ST CROSBY SHACKLE (typ.)

BURN HOLE 6"/6" THRU GIRDER WEB (typ. below 6" x 6" angle)

GIRDER G1 Wt=70.0 kips

1-1/2" x 10'-0" wire rope slung in a basket hitch (typ.) SWL=241t

BURN HOLE 6"/6" THRU GIRDER WEB (below 6" x 6" angle)

CRANE BLOCK

4 PART LINE

1-1/2" x 25'-0" wire rope slung SWL=211t

2ST CROSBY SHACKLE

9" PIPE SOFTENERS ALL EDGES (typ.)

GIRDER G1 Wt=70.0 kips

CONTRACTOR:

CONSTRUCTION ENGINEER:

CUSTOMER:

MIDDLESEX CORPORATION
1 SPECTACLE POND ROAD
LITTLETON, MA 01460

SIEFFERT ASSOCIATES, LLC
180 CHURCH STREET
NAUGATUCK, CT 06770

ENG. NO. 063-643

STATE PROJECT NO.
BRIDGE DEMO OVER NEW BRITAIN AVE

NEW BRITAIN - HARTFORD BUSWAY

STEEL GIRDER DEMOLITION

RIGGING DETAILS

DWG. NO.
317.2-9

11/21/12
0
K

CHECKER:
SUPERVISOR:

4
5
2
1

4
5
2
1

1"/8" = 1'-0"
Mobile Crane Lift Planning in Construction Environments

GIRDER DEMOLITION PROCEDURE:
1. PRIOR TO CRANE MOBILIZATION DEENERGIZE POWER LINES UNDER BRIDGE AND SECURE TO ABUTMENT.
2. SECURE INTERIOR EXISTING FLOORBEAMS BACK TO GIRDER G2 WITH LASHING PRIOR TO FINAL CUT.
3. SECURE EXISTING FLOORBEAMS BACK TO GIRDER G1.
4. CUT EXISTING FLOORBEAM BRACING AT MID-SPAN.
5. CUT EXISTING FLOORBEAM BRACING AT THE NORTH, SOUTH ABUTMENT.
6. RAISE GIRDER ABOVE BEARING ELEVATION.
7. SWING GIRDER G1 TOWARDS EXISTING NORTH ABUTMENT.
8. SWING GIRDER G1 TOWARDS EXISTING SOUTH ABUTMENT.
9. SWING GIRDER G1 TO DISPOSAL LOCATION.
10. TEMPORARILY SECURE THE GIRDER ON THE GROUND BY CONTRACTOR'S MEANS AND METHODS.
11. DISCONNECT RIGGING.
12. SWING CRANE BACK AND CONNECT ADEQUATE RIGGING TO FLOORBEAM.
13. REMOVE RIGGING FROM GIRDER 2 AND CUT FREE FROM GIRDER 1.
14. REPEAT STEPS 7-11.
15. REPEAT STEPS 12-14 FOR ALL REMAINING FLOORBEAMS.
16. DEMOBILIZE CRANE 2 AS NEEDED.

FLOORBEAM DEMOLITION PROCEDURE:
1. REMOVE CONCRETE BALLAST BY CONTRACTORS MEANS AND METHODS.
2. REMOVE SLOPED STEEL PLATES, DIAGONAL ANGLES, TRIANGULAR STEEPENED PLATES FROM BOTH SIDES OF GIRDER G1 AND G2 BY CONTRACTOR'S MEANS AND METHODS.
3. MOBILIZE CRANE 1 INTO POSITION 1.
4. BURY DEMO HOLES ON THE HORIZONTAL BALLAST PLATE.
5. CONNECT RIGGING ON THE HORIZONTAL BALLAST PLATE supporting the floorbeams.
6. FLAME CUT THE HORIZONTAL BALLAST PLATE AND FLOORBEAM TO GIRDER CONNECTIONS AS SHOWN ON THESE DRAWINGS.
7. WITH THE FLOORBEAM ASSEMBLY ENTIRELY SUPPORTED ON CRANE HOIST SELF-DEPLOY DISPOSAL LOCATION AS SPECIFIED BY CONTRACTOR'S MEANS AND METHODS.
8. DISCONNECT RIGGING.
9. REPEAT STEPS 4-8 FOR THE REMAINING FLOORBEAM UNITS.
10. MOBILIZE CRANE 1 INTO POSITION 2.
11. REPEAT STEPS 4-8 FOR THE REMAINING FLOORBEAM UNITS.
12. DEMOBILIZE CRANE 1 AS NEEDED.

GENERAL NOTES:
1. THESE DRAWINGS AND THE ACCOMPANYING CALCULATIONS WERE PREPARED TO REPRESENT THE FOLLOWING: DEMOLITION OF GIRDER G1 AND FLOORBEAMS.
2. CRANE 1 TO BE A GROVE RT 760 HYDRAULIC CRANE, WITH 13.9K CTW. AND 25-FOOT BOOM, OPERATED ON FULLY EXTENDED OUTTRIGGERS.
3. CRANE 2 TO BE A MANITOWOC 4100W SERIES 1 CRAWLER, WITH 192.4K CTW. AND 120-FOOT BOOM, OPERATED ON FULLY EXTENDED TRACKS.
4. CRAWLERS TO BE OPERATED PER MANUFACTURER'S RECOMMENDATIONS, IN ACCORDANCE WITH ANSI/ASME B30.5 [LATEST REVISION] AND APPROPRIATE OSHA RULES.
5. THE CONTRACTOR IS RESPONSIBLE FOR THE ACTUAL OPERATION AND PROCEDURES, THESE PLANS ARE PROVIDED BASED ON THE BEST INFORMATION AVAILABLE AT THE TIME OF PREPARATION.
6. CONTRACTOR MAY ADJUST PICK/DISPOSAL LOCATION INDICATED AS LONG AS THE CRITICAL RADII AND CLEARANCES ARE MAINTAINED.
7. PICK AND RADIUS GIVEN IN LIFT DATA TABLE MUST NOT BE EXCEEDED. THE WEIGHT SHOWN IS THE MAXIMUM ALLOWABLE WEIGHT TO BE LIFTED AT THE CORRESPONDING RADIUS.
8. REDUCE CRANE LOAD RATINGS TO ACCOUNT FOR WIND ON LOAD. CONSULT OPERATOR'S MANUAL FOR REQUIREMENTS WHEN WIND EXCEEDS 20 M.P.H. DO NOT OPERATE IN WINDS OVER 30 M.P.H. IF WIND EXCEEDS 50 M.P.H. LOWER BOOM TO GROUND UNLESS MANUFACTURER'S INSTRUCTIONS INDICATE OTHERWISE.
9. CRANE IS TO BE OPERATED ONLY BY A LICENSED OPERATOR.
10. ALL DIMENSIONS AND WEIGHTS TO BE VERIFIED PRIOR TO THE LIFTING OPERATION.
11. NO CRANE WILL BE OPERATED IN A MANNER THAT WILL EXCEED ITS RATED CAPACITY AT ANY RADIUS AS SPECIFIED BY THE MANUFACTURER.
12. ALL TRUCK/CRANES SHALL BE LOCATED ON OR WITHIN BARRICADED AREA AND NO LIFTING SHALL BE DONE OVER PEDESTRIANS, VEHICLES, AND ADJACENT BUILDINGS.
13. CRANE MAY OPERATE IN VARIOUS POSITIONS ON SITE PROVIDING THAT THE PICK/RADIUS LIMITATIONS SHOWN ON THE DRAWINGS ARE NOT EXCEEDED.
14. THE TABLE OR CHART PREPARED BY THE CRANE OPERATOR TO DESCRIBE THE MAXIMUM LIFT AT ALL CONDITIONS OF LOADING SHALL BE POSTED IN EACH CRANE CAB IN CLEAR VIEW OF THE OPERATOR.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE WEIGHT OF EACH UNIT AND FOR INSURING THE STABILITY OF EACH UNIT DURING PHASES OF ERECTION, INCLUDING LIFTING AND RELEASING OF THE UNIT.
16. THE DESIGN GIRDER WEIGHT REPRESENTS THE MAXIMUM WEIGHT THAT CAN BE ERECTED BY THE SPECIFIED CRANE WHILE MEETING THE GEOMETRY CRITERIA STATED IN THESE DRAWINGS.
17. ALLOWABLE GROUND BEARING PRESSURE TO BE 3.5 KSF MINIMUM ON ASPHALT.
18. FLAGMAN SHALL STOP PEDESTRIANS AND VEHICLES WHEN LIFTING OVERHEAD [AS APPLICABLE].
19. MAXIMUM FLOORBEAM PICK WEIGHT TO BE 10.0 KIPS FOR CRANE 1.
20. MAXIMUM GIRDER WEIGHT TO BE 70.0 KIPS FOR CRANE 2.
21. CRANE 1 & 2 IS CONFIGURED WITH 1.5 SAFETY FACTOR FOR PICKING CAPACITY.

MATERIAL NOTES:
1. ALL STEEL PLATES TO BE GRADE A36 OR BETTER.
2. ALL WIRE ROPE SLINGS TO BE 8 KIPS [EXTRA IMROVPEW FLOW REE] IWRW 6X19 OR 6X37 WITH MECHANICALLY SPUN ENDS.
3. ALL SHACKLES TO BE CROSBY OR EQUAL.
4. TIMBER TO BE MIXED HARDWOOD NO. 2 [BEECH-BIRCH-HICKORY, MIXED OAK OR MIXED MAPLE] OR BETTER.
5. CRANE MATS TO BE TIMBER BLOCKING, 12" THICK, MIXED HARDWOOD NO. 2 [BEECH-BIRCH-HICKORY, MIXED OAK OR MIXED MAPLE] OR BETTER.

NEW BRITAIN - HARTFORD BUSWAY
STATE PROJECT NO. 063-643
BRIDGE DEMO OVER NEW BRITAIN AVE
STEEL GIRDER DEMOLITION
NOTES & PART PLAN

CONSTRUCTION ENGINEER:
SIEBERT ASSOCIATES, LLC
180 CHURCH STREET,
NAUGATUCK, CT 06770

DRAPER: MIDDLESEX CORPORATION
1 SPECTACLE ROAD
LITTLETON, MA 01460

SUPERVISOR:

DATE: 10-1-12

DCW. NO.
317.2-10
Mobile Crane Lift Planning in Construction Environments

GENERAL NOTES:
1. CRANE TO BE A LIEBHERR LR-1160 WITH 225FT BOOM (121.3k CTWT & 33.1k CARDBOARD WT ON EXTENDED TRACKS
2. CRANE TO BE OPERATED PER MANUFACTURER'S RECOMMENDATIONS. PLANS ARE PROVIDED BASED ON THE BEST INFORMATION AVAILABLE AT THE TIME OF PREPARATION. CONTRACTOR MAY NEED TO ADJUST PLACEMENT LOCATION INDICATED AS LONG AS THE CRITICAL RADII AND CLEARS ARE MAINTAINED WITH.
3. MAXIMUM SUSTAINED WIND SPEED DURING ALL LIFTING OPERATIONS SHALL NOT EXCEED 30 MPH. REDUCE PICKING LOADS BY 10% WHEN WIND SPEED IS 25MPH OR GREATER.
4. CRANE IS NOT TO BE DELIVERED TO SITE BEFORE INSPECTION DATE AND IS TO BE OPERATED BY NEW YORK CITY LICENSED OPERATOR.
5. NO CRANE WILL BE OPERATED IN A MANNER THAT WILL EXCEED ITS RATED CAPACITY AT ANY RADIUS AS SPECIFIED BY MANUFACTURER.
6. ALL DIMENSIONS AND WEIGHTS TO BE VERIFIED PRIOR TO THE LIFTING OPERATION.
7. THIS INSTALLATION REQUIRES CONTROLLED INSPECTION OF CRANE SUPPORT AND PLACEMENT BY NEW YORK STATE LICENSED PROFESSIONAL ENGINEER OR REGISTERED ARCHITECT (FORMS 10E & 10F).
8. THIS APPROVAL IS FOR CRANE PLACEMENT ONLY WITH PERMISSION TO OPERATE AND LIFT LOADS SUBJECT TO WRITTEN APPROVAL BY ENGINEER OR ARCHITECT DESIGNATED FOR CONTROLLED INSPECTION AS EVIDENCED BY SIGNED AND SEALED FORM 10E OR 10F. COPY OF SIGNED AND SEALED FORM 10E TO BE KEPT ON CRANE AT ALL TIMES.
11. DURING TRAVEL 12' x 12' x 10' FT CRANE MUST BE CENTERED UNDER EACH CRAWLER AT ALL TIMES WHEN TRAVELING OVER FOUR STRAP.
12. BOOM ANGLE RANGE DURING TRAVEL IS BETWEEN 61° AND 78° WITH BOOM OVER TOES ONLY AND NO LOAD.

MATERIAL NOTES:
1. ALL TIMBER TO BE MIXED HARDWOOD (BEECH-BIRCH-HICKORY, MIXED MAPLE OR MIXED OAK) NO.2. Fp = 1.00 k.s.i.; Fv = 340 k.s.i. MINIMUM.
2. LUMBER TO BE APA STRUCTURAL 1 RATED SHEATHING EXT. 2 THICKNESS.

ERCTION PROCEDURES:
1. MOBILIZE CRANE INTO ON-SITE POSITION
2. TRANSPORT THE APPROPRIATE MATERIAL TO TOGGLE SITE TO THE ASSEMBLY LOCATION
3. LOWER BLOCKS AND ATTACH RIGGING
4. RAISE BLOCKS TO LIFT MATERIAL TO ERECT ON SITE
5. SWING WITH LOAD TO NECESSARY LOCATION
6. LOWER LOAD FOR TEMPORARY PLACEMENT OR ERECTION
7. DISCONNECT RIGGING
8. REMOVE STEPS 2-7 FOR THE REMAINDER OF THE MATERIAL ERECTION
9. DEMOBILIZE CRANE

CRANE ON-SITE GENERAL NOTES:
1. PICK AND RADIUS GIVEN IN LIFT DATA TABLE MUST NOT BE EXCEEDED.
2. ALL TRUCKS SHALL BE LOCATED ON-SITE OR WITHIN BARRICADED AREA AND NO LIFTING SHALL BE DONE ON PEDESTRIANS, VEHICLES AND ADJACENT BUILDINGS.
3. FLAGMAN SHALL STOP PEDESTRIANS AND VEHICLES WHEN LIFTING OVERHEAD (AS APPLICABLE).
4. ONLY ONE CRANE SHALL BE ON-SITE AT ANY TIME UNDER THIS CRANE APPLICATION.

WORK THIS DRAWING WITH: 226.36-1 THRU 226.36-3

WORLD TRADE CENTER PATH HALL CONSTRUCTION
CONTRACT NO. WTC - 264.595

CONTRACTOR: SKANSKA PARKER/SKANSA J.V.
2 RECTOR STREET 8TH FLOOR
NEW YORK, NY 10006

CONSTRUCTION ENGINEER: SIEFERT ASSOCIATES, LLC
180 CHURCH STREET
NAUGATUCK, CT 06770

MOBILIZATION/DEMOBILIZATION
LR1160 - SECTION NOTES - POS. 2

IT IS A VIOLATION OF THE PROFESSIONAL LICENSE LAW FOR ANY PERSON TO ALTER THE DRAWING IN ANY WAY UNLESS ACTING UNDER THE DIRECTION OF A PROFESSIONAL LICENSE IN ANY FIELD. THE PROFESSIONAL LICENSEE'S NAME AND THE NOTATION ALTERED BY FOLLOWED BY HIGHER SIGNATURE AND DATE OR ALTERNATION.
Mobile Crane Lift Planning in Construction Environments
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CONSTRUCTION NOTES:
1. ALLOWABLE BEARING CAPACITY OF SUBGRADE SOILS FOR THE OUTRIGGERS IS ESTIMATED TO BE A MINIMUM OF 2500PSI.
2. CONTRACTOR TO VERIFY THE BEARING CAPACITY OF SUBGRADE SOILS, ANY LOCALIZED UNSTABLE AREAS TO BE STABILIZED TO IMPROVE THE BEARING CAPACITY.
3. THIS CRANE LAYOUT IS FOR A TADANO TR 450XL CRANE. FOR LARGER CRANES WITH HEAVIER LOADING CONDITIONS, DETAILED SLOPE STABILITY ANALYSIS WOULD BE REQUIRED.
4. A REPRESENTATIVE FROM SEIFERT ASSOCIATES, LLC. SHOULD BE PRESENT AT THE TIME OF REMOVAL AND COMPACTION OF EXISTING SOILS.

CONSTRUCTION PROCEDURE:
1. REMOVE LOOSE SOILS FROM THE ENTIRE AREA INFLUENCED BY THE CRANE LOADING TO A MINIMUM DEPTH OF 2 FEET FROM EXISTING GRADE. REMOVAL OF SOILS TO EXTEND A MINIMUM OF 10 FEET BEYOND THE FOOTPRINT AREA OF THE NORTH OUTRIGGERS OF THE CRANE.
2. COMPACT THE BOTTOM OF THE EXCAVATION USING THE HEAVY BUCKET OF A BACKHOE OR ANY OTHER SUITABLE METHOD. IF ANY CLUSTERS OF BOULDERS WERE EXPOSED DURING THE EXCAVATION, THEY SHOULD BE REMOVED AND THE AREA NEEDS TO BE COMPACTED. THE AREA OF INFLUENCE NEEDS TO BE CLEARED OF ANY CONSTRUCTION DEBRIS.
3. PROCEED WITH THE PLACEMENT OF FLOWABLE FILL ON TOP OF THE STABILIZED SOILS.

MATERIAL NOTES:
1. ALL STEEL PLATES TO BE GRADE 38.
2. FLOWABLE FILT CONCRETE TO HAVE MINIMUM COMPREHENSIVE STRENGTH OF 1000 PSI.
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Questions?
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Thank You