NOTE: This training does not address OSHA requirements for mobile crane operations that are involved in construction activities.
Introduction

There are many types of overhead cranes at WHOI:

- Jib Cranes
- Overhead Hoists
- Underhung Hoists
- Some “Home made” systems
Jib Crane
Underhung Hoist
Underhung Hoist
Overhead Crane
Underhung Hoist
Basic Requirements for Hoists

- All parts must be of adequate strength for rated service.
- Cranes and hoists must have an adequate design safety factor.
- Each independent hoisting unit shall have brakes.
- The rated load of a crane shall be plainly marked on each side.
- The rated load of each hoist shall be marked on its load block.
- All markings must be visible from the floor.
CAPACITY

SINGLE PART 1800 LBS.

TWO PART 3600 LBS.
Overhead and Gantry Crane Operation

- Hoist operators must inspect equipment daily before use.
  - This operational inspection does not need to be documented.

- Never operate a crane or hoist if limit switches, steel ropes, chains or other safety-significant components are worn or in disrepair.

- Replace nylon or web slings immediately if excessively worn, damaged, or potentially overloaded.
Overhead and Gantry Crane Operation

- Personnel in the direction of travel should be warned to move and remain clear of a lifted load at all times.
Overhead and Gantry Crane Operation

Pendant Controls indicate direction of travel and must be marked.
Overhead and Gantry Crane Operation

Pendant Controls correspond with facility markings
Overhead and Gantry Crane Operation

- Loads should not be suspended over personnel below.
- Under no circumstances may anyone ride the hook or load.
Overhead and Gantry Crane Operation

- Directional movement should be made smoothly and deliberately.
- Avoid rapid movements in any direction.
Overhead and Gantry Crane Operation

- Ensure hook is directly above load’s Center of Gravity (CG) for a stable pick
- Use tag lines to stabilize lift and control the load
Overhead and Gantry Crane Operation

- Do not exceed the rated load capacity of the crane, hoist, chain, cable, slings, or other component.

- When planning a lift, it is critical to understand and identify the weakest component of the crane or hoist system (this could be the rigging or part of the crane/hoist system)
Slings, Load Chains, Other Lifting Devices

- Slings, load chains and other lifting devices must be fully and securely seated in the hook before moving a load.

- Remove slack from the sling, chain, or cable before lifting a load.

- Avoid shock loading
Avoid Swinging Loads
Practices to Avoid Swinging Loads

Use the following practices to avoid swinging loads:

− Before lifting, locate the hook and rigging connection directly above the Center of Gravity of the load.

− Ensure hoisting ropes are vertical. Do not pull or push the load.

− Maintain two full wraps of cable on the hoisting drum.
Overhead and Gantry Crane Operation

- When lifting loads at or near capacity, test the hoist brakes by returning the master switch or push button to the “OFF” position after raising the load a few inches off the floor.

- If the brakes do not hold, lower the load to the floor slowly and do not operate the crane. Report the situation immediately to the Facilities Department and DO NOT USE until repaired.
Overhead and Gantry Crane Operation

- Ensure that all loads are lifted high enough to clear obstructions before moving the bridge or trolley.

- Whenever possible, maintain a minimum clearance of one foot above loads and to the sides. Raise the load only to the height necessary to clear lower objects.

- Never pull a hoist by the pendant cable.

- Hard hats are required if the hook is raised above your head.
Overhead and Gantry Crane Operation

- Never leave the controls unattended while a load is suspended. If it becomes necessary to leave the controls, lower the load to the floor or stable surface.

- Familiarize yourself with the location of the disconnect switch.

- If loss of electrical power occurs, place controls in the “OFF” position to prevent unexpected startup upon restoration of power. Consider blocking or isolating.
Overhead and Gantry Crane Operation

- Disconnect power to a hoist that is unsafe or in need of repair. Arrange to have the disconnect switch locked and the control panel tagged with an “Out of Order” or “Do Not Operate” tag.

- **Never** operate a hoist that has been tagged with an “Out of Order” or “Do Not Operate” tag, or is your opinion, UNSAFE TO OPERATE.
Overhead and Gantry Crane Operation

- At end of operation – place hook and pendant out of the way so as not to be an obstruction
HOISTS/CRANES

Daily Inspection Checklist

- Check for any loose or missing parts.
- Check end stops. End stops prevent the trolley from running off the beam.
- Know the location of disconnect switch that will cut the power to the hoist or crane. Be sure it is readily accessible and not blocked.
**HOISTS/CRANES**

*Daily Inspection Checklist*

- Make sure all control buttons are labeled to indicate their function. Operate each button to make sure it functions properly, releases immediately, and does not stick.

- Check upper hoist limit switch by slowly raising the block to trip the switch.
HOISTS/CRANES

Daily Inspection Checklist

- Operate the crane or hoist several feet in each direction that it travels. Listen for any unusual noises. Look for any jerky movements.

- When moving an A frame hoist, take care to ensure that the wheels on each side stay on the track.
HOISTS/CRANES

Daily Inspection Checklist

- Check all hooks. Hooks should not be cracked, stretched, bent, or twisted. Each hook must have a safety latch that automatically closes the throat of the hook.

- If the latch is bent, spring is broken, or is otherwise damaged the latch must be repaired before use. Hooks should rotate freely in block assembly without any “grinding” felt or heard.

- Report problems to Facilities Department and tag out of service.
HOISTS/CRANES

Daily Inspection Checklist

- Check the block assembly for structural damage or cracks in any components.
- Sheaves should rotate freely without any grinding.
- The sheave guard must be unbroken and intact. No part of the sheave guard should be in contact with the wire rope or sheave.
Check the wire rope by lowering the block to the lowest level and looking for the following conditions. If any of these conditions are observed, they should be reported immediately and tagged out of service.

- Kinked, crushed, cut, or “bird caged” wiring, or wiring with heat damage.
HOISTS/CRANES

Daily Inspection Checklist

- Check load chain for damage, wear at contact points, cracks, or distorted (bent, twisted, or stretched) links.

- Inspect all mechanical coupling links to insure linking pins are secure and in good condition. Report unsafe conditions immediately and tag out of service.
HOISTS/CRANES

Annual Inspection and Maintenance

- Facilities is responsible for annual inspection, proof tests and preventive maintenance

- If there is a problem with the hoist/crane, notify Facilities

- **DO NOT OPERATE DEFECTIVE OR OTHERWISE UNSAFE CRANES OR HOISTING DEVICES**
  – TAG OUT OF SERVICE
Synthetic Slings

- Strong and dependable
- Suitable smooth surfaces
- Relatively easy to cut, little resistance to abrasion, chemicals, UV
- ASTM B783-1990 Breaking strength 5X rated capacity
Synthetic Slings

- Must be labeled with:
  - Manufacturer ID
  - Code Number
  - Rated Load Capacity for 3 common hitches
  - Nylon, polyester, and other synthetic materials
Synthetic Slings

Initial Inspection

- New and Repaired slings
  - Obtained from approved source with proper engineering design
  - Correct type and rated capacity marked on sling
  - Not damaged in shipment/handling
Synthetic Slings

**Inspections**

- Sling shall be inspected *each time* that it is used
- Annual inspection by designated personnel experienced in the inspection of slings
- Look for:
  - Excessive abrasive wear
  - Cuts, tears, punctures, crushed fabric
  - Burns, charring, chemical damage
  - Knots that cause doubt about safety
“Inspect before each use and discard when red striped core yarns appear. Do not exceed rated capacity”
Synthetic Slings

- Capacity ratings must be legible on the manufacturer’s label. The capacity of the sling being used must be adequate for the load and attachment (sling hitching) method.

- Replace slings immediately if excessive wear occurs.
Synthetic Slings

Storage

- Slings should be hung up in a designated location, cool, dry and away from exposure to UV, sunlight, and non-compatible chemicals.
We Like This!
Analyzing and Rigging the Load

The following steps must be taken before performing a lift:

- Determine the total weight of the load and the WLL of the crane/hoist
- Decide how the load will be connected to the lifting hook and how the sling will grip the load
- Determine sling capacity required
  - Calculate the loads for the angles and attachments
Determining the Weight

“ The most important step in any hoisting operation is to determine the weight of the load. Only after this determination is made, can proper rigging equipment be selected.”

NOTE: Contact EH&S to obtain a copy of Bob’s Rigging and Crane Handbook
Determining the Weight

- Sources of weight determinations
  - Documents, manuals, engineering designs
    - Information on the name plate, shipping tag, painted on the load
    - Weighing the load – weight scales, crane load indicating system
    - Calculating the Weight
- See Bob’s!
Determining the Weight

See Bob’s

\[
\text{WEIGHT} = \text{length} \times \text{width} \times \text{height} \times \text{unit weight}
\]
Determining the Weight

- Examples from Bob’s
  - Cone shapes
  - Pyramids
  - Wedge
  - Etc.
Center of Gravity

- On initial pick – the load tilts - mark load
- Select two slings of different lengths to tilt load in the opposite direction
- After center of gravity is determined, position hook directly above
Load on sling = vertical load divided by the sin of angle
Calculating Sling Loads

Vertical load = 500 lbs for each sling

- **60 degrees**
  - \( \frac{1}{\sin (60)} = 1/0.866 = 1.15 \times 500 = 577 \text{ lbs} \)

- **45 degrees**
  - \( \frac{1}{\sin (45)} = 1/0.707 = 1.414 \times 500 = 707 \text{ lbs} \)

- **30 degrees**
  - \( \frac{1}{\sin (30)} = 1/0.500 = 2.00 \times 500 = 1,000 \text{ lbs} \)

Also can use “load angle factor” from Bob’s
Calculating Sling Loads

- What would the load on each sling be if the angle were 10 degrees?
- If it were 5 degrees?
Calculating Sling Loads

- **Vertical load = 500 lbs for each sling**

**For 10 degrees**

\[
\sin 10 \text{ degrees} = 0.174
\]

\[
\frac{1}{0.174} = 5.75 \times 500 = 2,879 \text{ lbs}
\]

**For 5 degrees**

\[
\sin 5 \text{ degrees} = 0.087
\]

\[
\frac{1}{0.087} = 11.47 \times 500 = 5,736 \text{ lbs}
\]
Rules of Thumb

- **Never rig below 30 degrees**
  - 30 degrees doubles the tension
- **45 or higher is preferred**
Forged Eye Bolts

- Never use regular eye bolts for angular lifts
- Always use shoulder type eye bolt for angular lifts

<table>
<thead>
<tr>
<th>Direction of Pull</th>
<th>Adjusted Working Load Limit (WLL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 Degrees</td>
<td>30% of WLL</td>
</tr>
<tr>
<td>90 Degrees</td>
<td>25% of WLL</td>
</tr>
</tbody>
</table>
Example Problem

- Lift is a rectangular container full of sea water measuring 3 feet by 3 feet by 2 feet (3x3x2)
- 4 sling legs
- Sling angle of 45 degrees

Questions:
- Determine the weight of the load?
- Select the appropriate sling?
- What type and size eye bolts should be used?
Example Problem - Information

- Average density of sea water * – 64 lbs/ft³
- Sin (45) = 0.707
  - also see Bob’s for load angle factors
- Rigging Hardware factors – see Bobs

* Verify density with knowledgeable person
Answers

✓ **L x W x H x Density**
  - $3 \times 3 \times 2 \times 64 = \text{Weight} = 1,152 \text{ lbs}$

✓ **Vertical load for each sling (one sling is balancing)**
  - $1,152 \text{ divided by 3 legs} = 384 \text{ lbs}$

✓ **Tension in each sling leg**
  - $\frac{1}{\sin (45)} = \frac{1}{0.707} = 1.414 \times 384 = 543 \text{ lbs}$

✓ **Eye Bolt (from table)**
  - $\frac{1}{2}”$ is the best choice; $0.3 \times 2,200 = 660 \text{ lbs}$
  - $3/8”$ is too small; $0.3 \times 1,200 = 360 \text{ lbs}$
  - Always use a shoulder type eye bolt for angular lifts
To receive credit for this training access the following link [Hoist and Crane Safety Quiz](#) and complete the quiz.

- Passing grade is 80%
- Quiz results will automatically be forwarded to EH&S
- You can retake the quiz if you fail
- For questions contact EH&S at ext. 3347 or [gcrowley@whoi.edu](mailto:gcrowley@whoi.edu)