Heavy Intermodal Lift & Transport – Engineering Considerations

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ITI President/CEO
ASME B30 Vice Chair (Cranes & Rigging)
ASME P30 Chair (Lift Planning)

Guest Speaker: **Jim Yates, P.E.**
SVP of Engineering & Technical Services, Barnhart Crane & Rigging
ASME B30.1 (Jacks/Rollers) Committee Member
ASME P30 (Lift Planning) Committee Member

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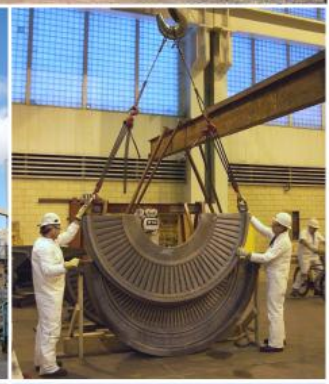

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Heavy Intermodal Lift & Transport - Engineering Considerations

Upcoming Presentations:

ITI Master Rigger Course: Interactive Demo (Wednesday, July 11, 2012 - 2pm EST)

Lift Planning Considerations (Thursday, August 2, 2012 - 1pm EST)

ASME B30 & P30 Developments (Friday, September 7, 2012 - 1pm EST)

MIKE PARNELL – ABOUT YOUR HOST

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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JIM YATES – ABOUT THE SPEAKER

- 28 years in heavy lifting industry
- US Naval Academy at Annapolis Graduate, BS in Aerospace Engineering, 1983
- US Naval Officer – Nuclear Navy
- Masters Degree in Mechanical Engineering in 1990, University of Connecticut
- Tennessee Valley Authority at the Watts Bar Nuclear Plant 1990-1997; Senior Reactor Operators license (#21223)
- Joined Barnhart Crane & Rigging in 1997
- Registered Professional Engineer in Tennessee and Alabama
- SVP of Engineering & Technical Services
- His current responsibilities include oversight of all engineering functions to support heavy lift, rigging and heavy haul services to all markets including, fossil power generation, wind turbine erection & maintenance, nuclear and DOE, refineries, heavy civil, and general construction. Jim is responsible for corporate safety, quality and fabrication operations as well.
- 25-Time “Rigging Job of the Year” Award Winner (while Yates has been at Barnhart) - Specialized Carriers & Riggers Association (SC&RA) for innovative rigging, lifting and heavy haul solutions; 4 of these jobs were performed at nuclear power plants.

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Minds Over Matter

Engineering Considerations for Heavy Intermodal Transport

Jim Yates, P.E.
SVP Engineering & Technical Support

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Outline

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Minds Over Matter

- Need for Engineering
- Boundaries of the topic
- Engineering Considerations
  - Lift Planning
  - Ship
  - Environmental
  - Load Handling Equipment (LHE)
  - Rigging
  - Transport
    - Barge
    - Rail
    - Trailers
- Management of Change

Need for Engineering

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Minds Over Matter

- Heavy Loads require additional diligence to ensure safe delivery
- Things that we take for granted, like dock strength, must be evaluated
- Proper engineering analysis and planning prevents accidents
- It can also help you from looking like Fido's rear end!

A "Fido" Moment!

Topic Boundaries

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- Heavy Marine lifting/transport is very large topic and we could spend days discussing the various elements to be considered
- We will limit our discussion today to some of the engineering associated with heavy cargo (usually equipment) offload from ship to transporter (trailer, rail, barge)
- We will not consider offshore maritime lifting, open ocean or underwater lifting environments
- We will also not be discussing all the operational considerations

Lift Planning

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Minds Over Matter

- All heavy maritime lifting and transportation should have a Lift Plan
- The Lift Plan (sometimes called Method Statements) should cover all aspects of the lift/transport
- Engineering is just one of the many aspects covered in the Lift Plan
- Guidelines for maritime lift planning:
  - Noble Denton
  - IMO
  - IMCA

Ship Considerations

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Minds Over Matter

- LHE (Load Handling Equipment)
- Position at the dock
- Stability
- Strength (ramps)

Ship - LHE

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Minds Over Matter

- Many ships are equipped with heavy lift cranes/derricks in order to self load/unload
- Load charts need to be reviewed in relation to the lift and set radius of the loads in order to ensure the lift is planned within the capacity of the crane(s)
- If the ship is not equipped with adequate LHE, then alternate plans need to be made
  - May require going to a port where a heavy lift crane is available (dockside or floating)

Ship - LHE

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Minds Over Matter

- LHE inspection and maintenance records should be inspected to ensure the gear is ready for service, especially for a maximum capacity lift
- High risk lifts may warrant a load test of the LHE
- Failure of LHE could be catastrophic

Ship – Dock Position

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Minds Over Matter

- Ship position is important to ensuring lifting efficiency
- Improper ship position may cause the lift plan to become invalid
- Ship position may need to changed to accommodate the capacity of the LHE (dockside, ship's gear, or mobile crane)

Ship – Stability

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Minds Over Matter

- Ship stability must be maintained during the lifting operation
- Heavy loads can quickly affect the ship's stability during a lift
- Usually the ship's crew will determine a ballasting plan to maintain stability during the lift, this plan should be part of the Lift Plan and should be properly communicated to the lift team
- Complicated or high risk lifts should have a Naval Arch of Marine Engineer validate the ballasting plan

Ship – Stability

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Minds Over Matter

- Stability failures can be disastrous

Ship – Strength

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Minds Over Matter

- For the sake of our discussion, we will only discuss ramp strength
- We will assume the ship owners have already accounted for the ship's structural strength to support heavy loads
- The ship owners and the heavy transport/lift company must communicate the loads for the offload/onload since the loads are dependent upon the equipment used

Ship – Strength

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Minds Over Matter

- Platform trailers are commonly used for RO/RO operations
- The axel loads must be considered in order to ensure the ramps are adequate to support the loaded trailer weights
- Coordination Note: The shipper and transporter company can save the customer considerable cost by coordinating their efforts, note the long beams under the rail car which supported the load and allowed the trailer to get under load without jacking

Environmental Considerations

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Minds Over Matter

- Weather related
- Tidal/Current Affects
- Environmental Laws

Environmental - Weather

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- Wind limits
  - Most LHE's have a limit for conducting operations
  - The normal limit is based on a particular size and weight for the load
  - Special considerations may need to be made for heavy loads and loads with large sail areas
  - Engineering restrictions on the maximum wind speed may be required

Environmental - Weather

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Minds Over Matter

- Wave Limits
  - Wave height will impact the ability of an LHE to make a lift
  - Even in ports, the LHE may have a limit on the wave height for conducting operations
  - Engineering restrictions may be required to prevent exceeding the design limits for the equipment involved

Tidal/Current Considerations

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Minds Over Matter

- Engineering must consider the affects of tides and currents
- Timing of the lifting/transport operations may be critical in some areas where the tides/currents have large swings
  - Moorings
  - Water Depth
  - Station Keeping

Environmental - Restrictions

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Minds Over Matter

- Local Environmental Laws
  - Ports in the US now have rules associated with ballast discharges
  - This can greatly affect heavy lift operations since ballasting plays a large role
  - Engineering needs to account for the rules/laws and design the operation to ensure conformance

Common LHE Considerations

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Minds Over Matter

- Load Charts
- Equipment configuration

Common Port LHE Considerations

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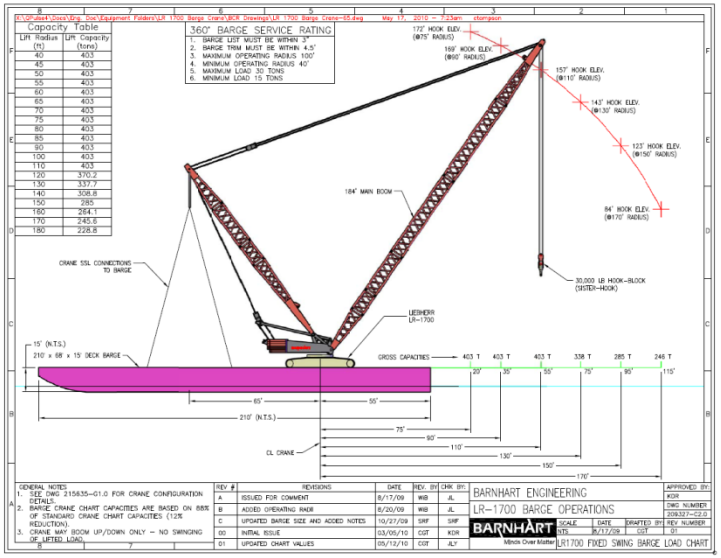
Minds Over Matter

- Load Charts
  - Static and dynamic affects
  - Local restrictions on % capacity
- Equipment Configurations
  - Jibs, counterweight configurations, etc
  - Multiple cranes
  - Clearance issues (load and LHE)



Other LHE Considerations

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- Load Support for mobile cranes
  - Docks must be analyzed for their ability to support the high loads imposed by mobile cranes.
  - Special load spreading means may need to be designed to support the loads
  - Punching failures are common accidents for mobile cranes

Common LHE Considerations

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Minds Over Matter

Rigging Considerations

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Minds Over Matter

- Engineering may be required for non-routine lifting operations or when the lift/transport is considered a high risk
- Things to consider:
  - Rigging Arrangement
  - Lift point capacity
  - CG locations
  - Dynamic effects

Rigging Considerations

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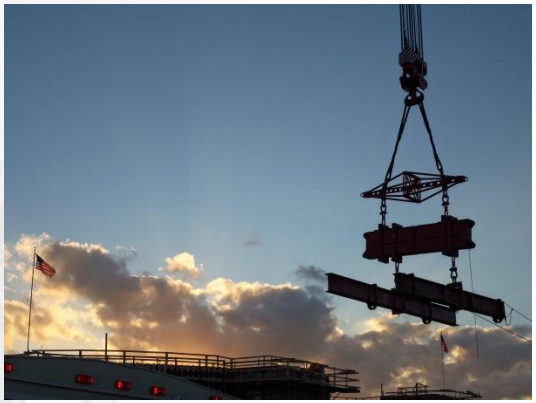
Minds Over Matter

- Rigging Arrangement
- Some loads may require advanced rigging techniques to perform the lift
- Engineering is used to determine and validate a safe arrangement



Rigging Considerations

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Minds Over Matter

- Lift Point Capacity
  - Many times, the load's ability to support its own weight during lifting or transporting may not have been considered when the equipment was being manufactured
  - Engineering must determine the structural ability of the lift point and load to adequately support the imposed loads

Rigging Considerations

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Minds Over Matter

- CG Location
- Off center CG locations can make the rigging arrangement a challenge
- Engineering should determine the exact location of the CG and make sure the stability of the rigging is adequate for the lift
- Also, note the multiple lifting points

CG Control is important!!

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Minds Over Matter

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Rigging Considerations

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Minds Over Matter

- Dynamic Effects
- Some lifts, especially maritime lifts, need to have “impact” factors or “dynamic” effects taken into consideration
- Engineering should consider the following:
  - Environment
    - On shore
    - Sheltered Waters
    - Open ocean
  - Risks
    - Multiple LHE’s
- Noble Denton has some guidelines for determining these factors

Poor rigging practices can lead to accidents

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Minds Over Matter

Transporter Considerations

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Minds Over Matter

- Ship to Barge
- Ship to Rail
- Ship to Trailer

Barge Considerations

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Minds Over Matter

- Strength
  - Deck
  - Global
- Stability
- RO/RO
- Position Keeping
- Load Staging
- Transport Securement

Barge Considerations

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Minds Over Matter

- Deck Strength
  - Barges come in all types of sizes/shapes/deck strength and classifications
  - The barge must be strong enough to support all the loading conditions for the operations
  - Load spreaders may need to be designed to spread large loads

Barge Considerations

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Minds Over Matter

- Global Strength
  - Overall barge strength needs to be analyzed to ensure adequate global strength
  - We do not want to break our barge in half!

Barge Considerations

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Minds Over Matter

- Stability
  - A stability analysis is required to ensure the barge is able to support the load in the expected travel area
  - Open ocean tows need to account for large wave action so stability is a major concern to prevent the loss of the barge
  - A ballast plan for loading and traveling should be developed and be part of our lift plan

Barge Considerations

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Minds Over Matter

- RO/RO operations after the transfer from ship also needs to be considered
- The barge must be able to support the barge ramp reactions

Barge Considerations

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Minds Over Matter

- Inadequate deck strength can be disastrous!!

Barge Considerations

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Minds Over Matter

- Structural adequacy of the landing must also checked
- Temporary supports may need to be engineered for the RO/RO ops

Barge Considerations

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Minds Over Matter

- Barge position keeping is must also be considered
- Adequate restraints must be designed
- Tugs can be used to ensure barges don't shift

Barge Considerations

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Minds Over Matter

- Load staging
  - For load handling efficiency, loads may need to be staged on stands
  - The higher positions mean the tie down loads are increased
  - Engineering must be done to account for the higher loads as well as the stability of the load and barge

Barge Considerations

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Minds Over Matter

- Load staging
  - Coordination between the fabricator, ship, and heavy hauler is crucial to ensure the load is adequately supported during the entire transport
  - Saddle design and placement needs to be considered
    - Saddle strength
    - Strap strength
    - Tie down points
    - Stability

Barge Considerations

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Minds Over Matter

- Load staging
  - Sometimes the loads are so large that elevated staging is not practical
  - Engineering will need to account for a means to lift the load on the barge
    - Deck strength is again a major consideration
    - Stability must also be considered

Barge Considerations

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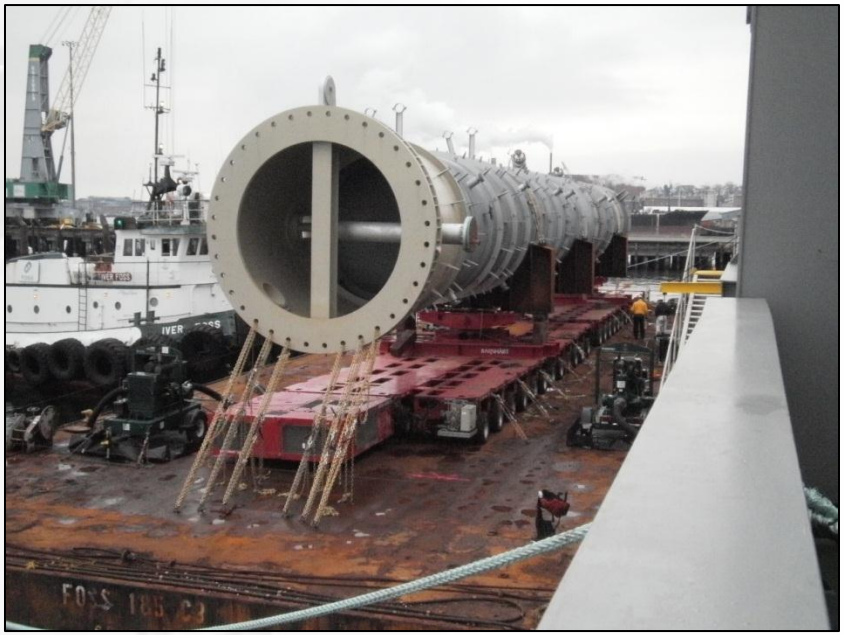
Minds Over Matter

- Transport Securement
  - Adequate restraints must be used to ensure the load does not shift during transport
  - Engineering analysis is required to ensure the load is properly secured
    - Determination of tie down requirements
      - Open ocean/protected water
    - Load's ability to withstand tie down forces
    - Barge ability to withstand tie down forces



Rail Considerations

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Minds Over Matter

- Load Size
- Tie down design

Rail – Load Size

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Minds Over Matter

- Load size may make rail transport unfeasible
- Surveying should be performed to ensure an adequate route is available by train

Rail – Tie Down Design

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- Tie down design for rail can be considerable for heavy loads

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Trailer considerations

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- Hydraulic platform trailers are usually the trailer of choice for heavy loads
- Considerations include:
  - Staging of the piece for self load and unload
  - Load support of dock
  - Route survey to ensure adequate road support

Trailer considerations

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Minds Over Matter

- Load staging on barge or dock
  - The load should be staged so that the transporter can get under it

Trailer considerations

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Minds Over Matter

- Dock Support
  - Loaded transporters can impart heavy loads to the dock
  - The structural adequacy of the dock must be verified

Trailer considerations

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Minds Over Matter

- Route surveys
  - Determining clearances ensures smooth transport
  - Adequate structural support from the dock to the final set point is critical

Trailer considerations

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Minds Over Matter

- Route surveys
  - Engineering analysis of bridges should prevent accidents

Management of Change (MOC)

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Minds Over Matter

- Our planning and engineering are done to manage our risk to an acceptable level so that we prevent accidents.
- We must have processes in place to ensure that changes to our plans are properly analyzed.
- The chief question to any change is “How does the change to our plan effect our risk?”
- All projects should have MOC built into the project planning and execution process.
- The MOC process should be clearly communicated to the team.
- Team management should monitor the project planning and execution to ensure adherence to the MOC process.
- Don’t let a good plan be negated by improper MOC!

Summary

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Minds Over Matter

- There are lots of things that need to be considered to ensure safe and efficient heavy lifts and transports
- Engineering considerations as part of our Lift Plan play a major role in marine heavy lift/transport in preventing accidents and ensuring efficient operations.

Q&A

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Minds Over Matter

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