



Ship Production Rigging Planning Guide
Ship Production Process Technology Panel

September 2009

Rigging Guidance Presentation Agenda

- Shipyard Rigging is:
 - Lifting
 - Moving
 - Transporting
 - Turning
 - Ship Components
- Background
- Problem Statement
- Proposed Standards
- Documents Created
- Future Study



Background

- To Support Shipyard Rigging Engineers Requires
 - Guidance
 - Standards
- Are There Universal Shipyards Rigging Standards?
 - For the Lifting of Large Blocks?
 - Rigging Standards?
 - Governmental Regulations for Rigging?
- Temporary Construction Support Standards?



Background

Ship Production Rigging Planning Guide.

- Review of requirements for ship assemblies
 - Rigging and Shoring
 - Government Regulations
 - Industry Standards
 - Equipment
 - Training documents
 - Organizational Planning



Problem Statement

- Lift planning and operation can have significant impacts on safety and schedule:

- **Safety:**

- Improper Rigging is a danger to personnel, equipment, and products

- **Schedule:**

- Effort on critical path and must be complete successfully or construction stops

- **Dedication of Capital Assets,**

- Time of Key personnel,
- Time of Cranes,
- Rigging equipment



- Creating training aids helps free up the time of key personnel for yard specific planning

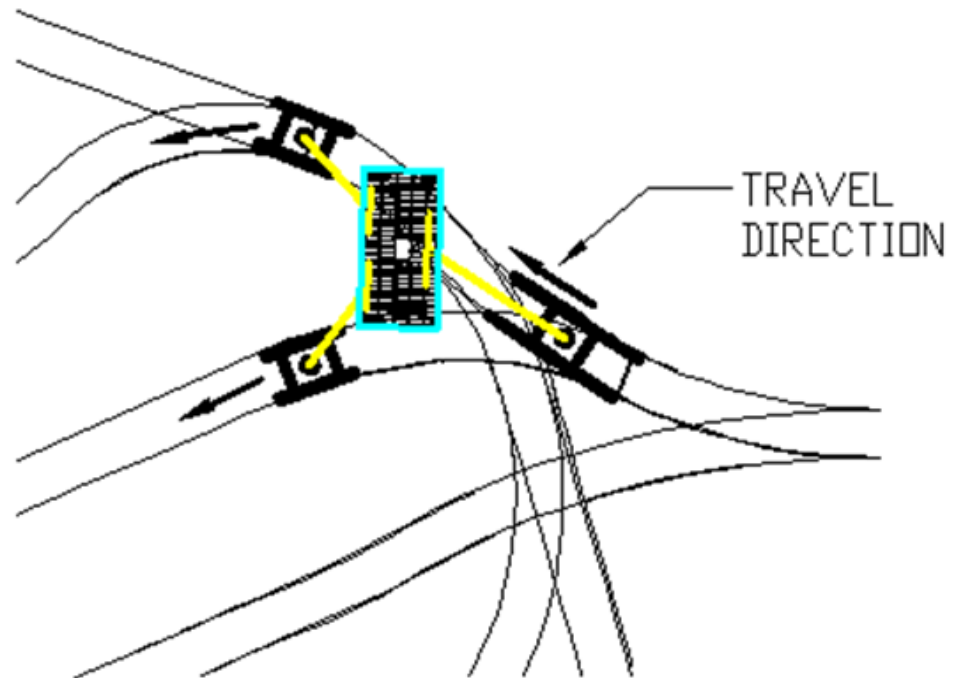
Background

Critical Lift

-A lift of an item that is unique, irreplaceable, and vital to a program, that would have severe negative impacts, including the delay of operations and affect program commitments, if damaged or upset.

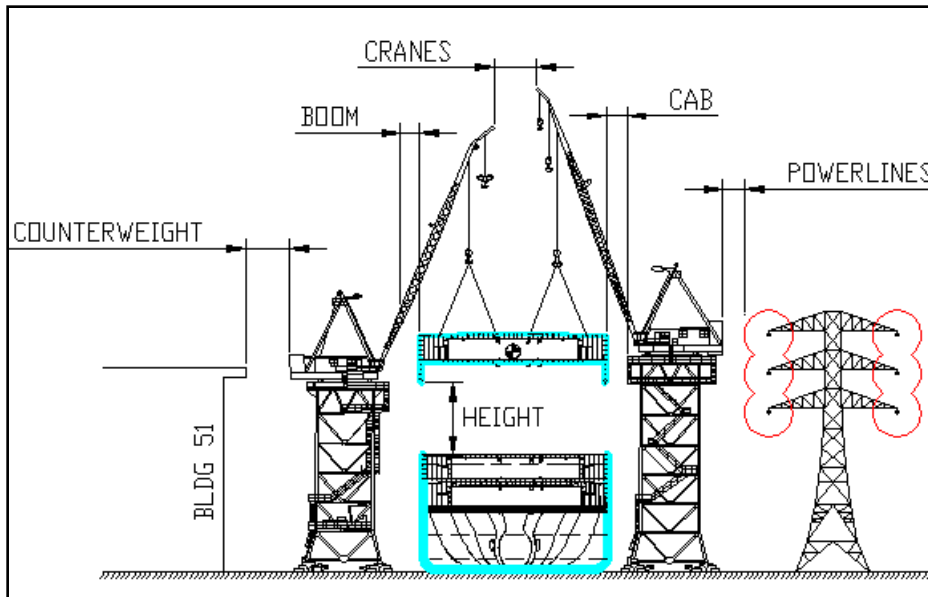
Background

- **Significant operational planning and Engineering required.**
 - **Lift plans needed for each “Critical Lift” movement**
 - **Weight and CG,**
 - **Structural rigidity,**
 - **Temporary structure,**
 - **Crane reach,**
 - **Crane travel**
 - **Equipment:**
 - Shackles,**
 - Lifting attachments,**
 - Slings,**
 - Spreader bars,**



Background

- **Significant operational planning and Engineering required.**
 - **Lift plans needed for each “Critical Lift” movement**
 - Multiple angles need to be looked at
 - Interferences



Problem Statement

- **Limited documentation to guide the process:**
 - **OSHA does not provide design guidance for load**
 - **Specific requirements for ladders, handrails, and scaffolding, cranes, shackles, slings.**
 - **ASME BTH does not currently cover load or lifting attachments.**
 - **OSHA does not provide guidance for temporary construction related supports or Falsework**
 - **Process is typically guided by experienced personnel, not detailed work instructions**
 - **Lack of documentation makes it difficult to train or guide Engineers on appropriate procedures and considerations**

Documentation Produced



CATALOG

Detailed description of rigging items

Capacities

Integration

Manufacture Data

Catalog and Guidance document complement each other



GUIDANCE DOCUMENT

Detailed explanation of check sheet questions:

Regulations
Approches
Explanation
Equipment



CHECK SHEET

Simple questions

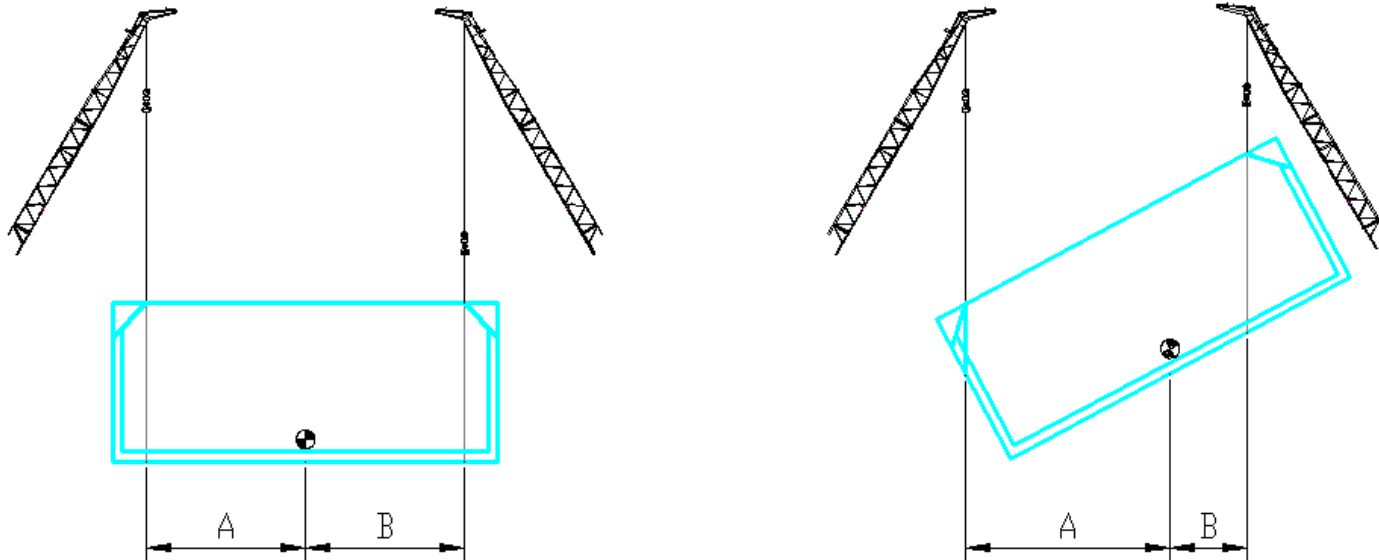
Big implications

Guidance Documentation

- **Check Sheet & Guidance**
- **CHECK SHEET**
 - **Simple questions to prompt the designer of a critical lift to account for different things.**
- **Typical Question:**
 - **For a two crane lift, has load orientation effects been accounted for on each crane?**
- **Detailed answer can be found in guidance document complete with background information**

Guidance Documentation

-Depending on the orientation of the load, the center of gravity may not remain at a constant distance between the two hooks. This means the amount of load that any given crane may see will vary ...

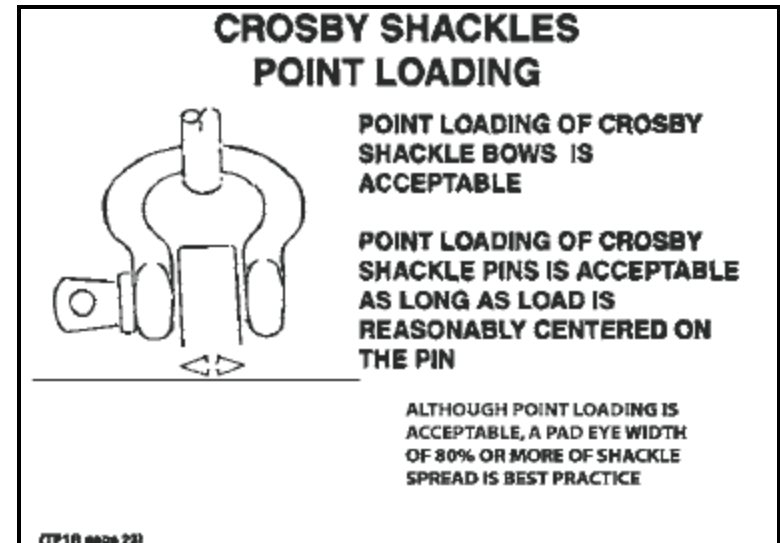
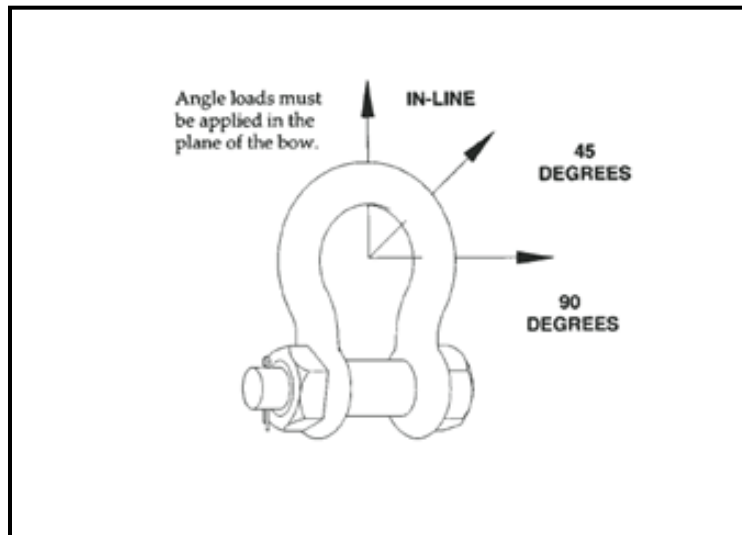


Guidance Documentation

- **Catalog**

- **General information about how some rigging equipment is used.**
- **Listed restrictions of use on equipment used for critical lifts.**

- **Padeye, Shackles, Slings, Spreader Beams, Hooks...**



Documentation Produced



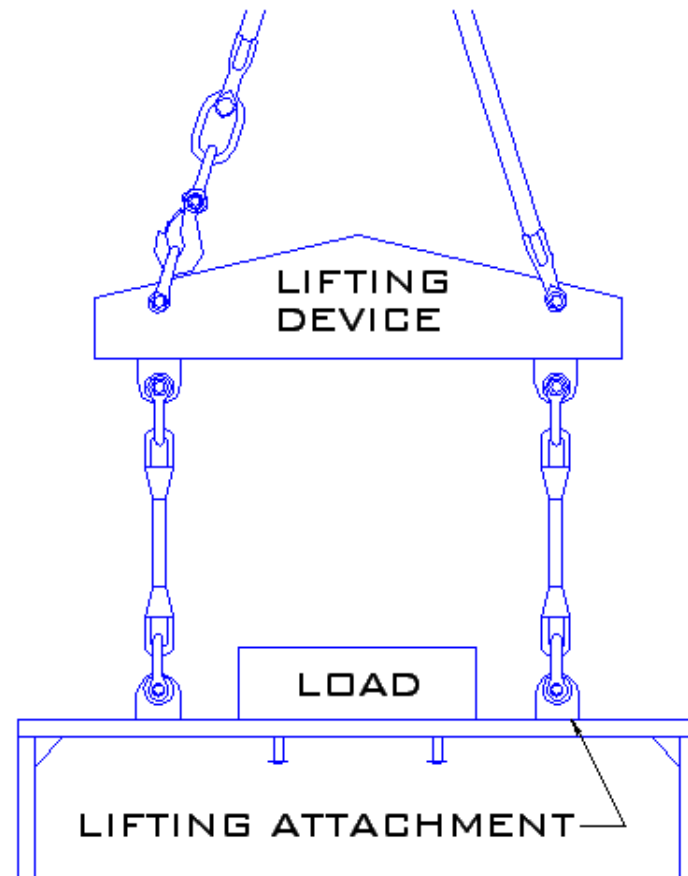
FINAL REPORT

PROPOSES ASME BELOW-THE-HOOK
STANDARDS BE APPLIED TO LIFTING
DEVICES, LIFTING ATTACHMENTS,
AND LOAD BEING LIFTED

PROPOSES
FALSEWORK
STANDARDS
BS 5975

Proposed Rigging Design Standard

- ASME BTH-1-2008
 - Design Guide Chapter 3
 - Currently does not apply to lifting attachments or load lifted.
- Recently voted to include lifting attachments in the next revision.
 - How this will be integrated is yet unknown.



Proposed Rigging Design Standard

- For critical links in lift It is logical to have similar probabilities of failure.
 - Failure of spreader beam could be just as disastrous as failure of padeye or block itself.
- Apply current ASME guidelines to padeye and block
 - Highest stress in block is typically under padeye.
 - Category A Engineered lift corresponding to a factor of safety to yield of two (Von Mises combined stress)

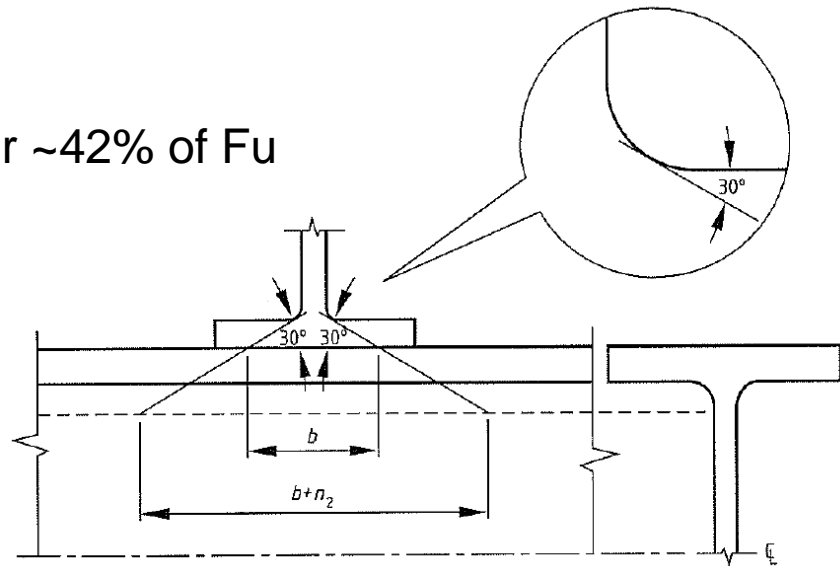


Proposed Falsework Design Standard

- No OSHA regulations for Falsework or temporary support structure.
- Most guidance found related to building construction
- BS-5975:2008
 - Code of practice for temporary works procedures and the permissible stress of design of falsework
 - Falsework being temporary is not connected to foundation.
 - Relies on own stability and self weight to remain stable.
 - Because loads are known within close limits, stresses are more likely to be near their permissible working stress than structure on which future loading may vary.

Proposed Falsework Design Standard

- Comprehensive standard for supporting of concrete and steel structure
 - Defines Design Loads
 - Impact, working loads, wind load, ice load
 - Defines Design Failure Modes
 - Strength, Lateral stability, Overturning, Positional stability
 - Defines Allowable stresses
 - Bending $\sim 65\%$ of F_y or $\sim 42\%$ of F_u
 - Bearing $\sim 76\%$ of F_y

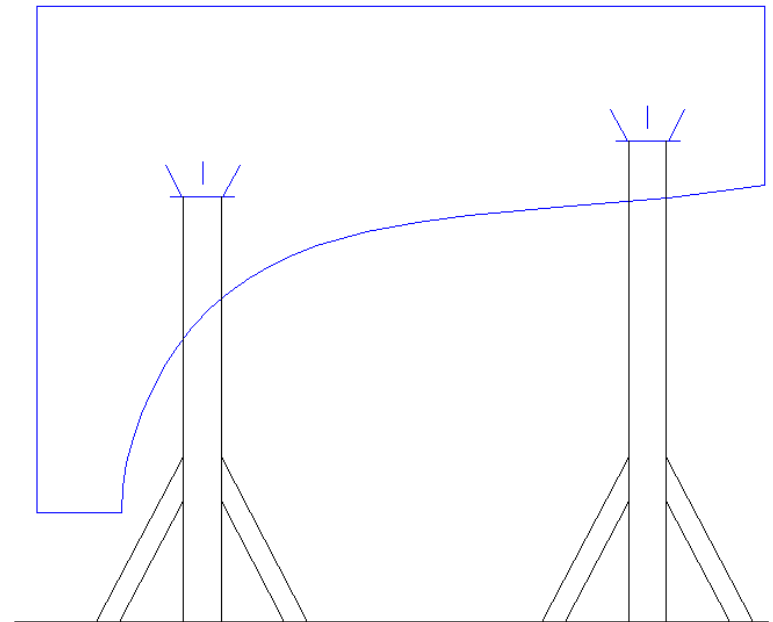


Proposed Falsework Design Standard

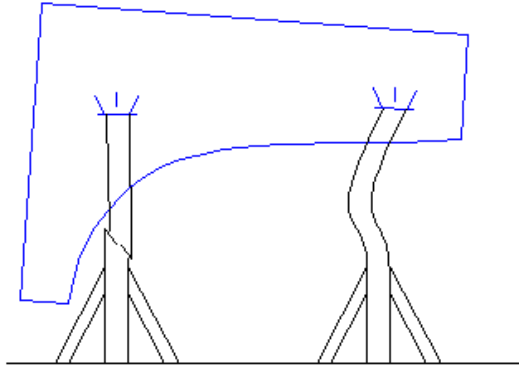
SIDE LOAD

- Disturbing Force should be the greater of:
 - 2.5% of block weight
- Or
- Imposed Loads+
 - Erection Tolerances +
 - Impact Forces+
 - Wind Loads and other site specific Environmental Loads

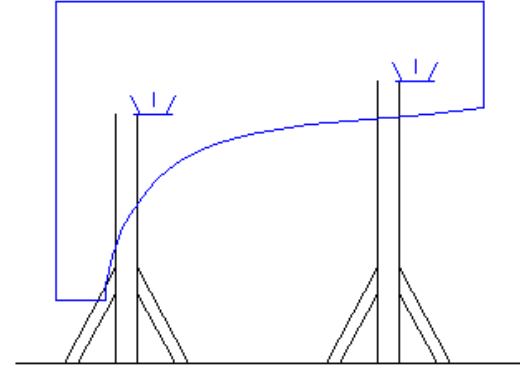
FORCE



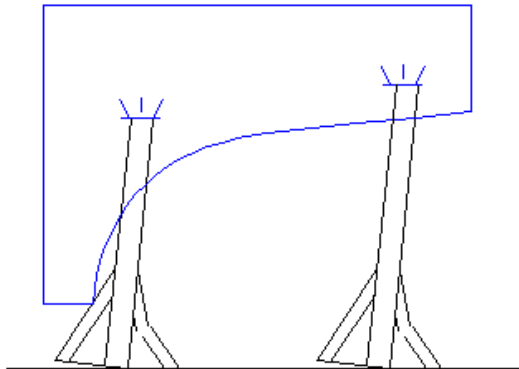
Proposed Falsework Design Standard



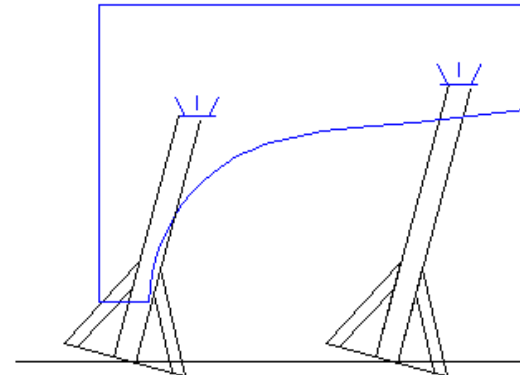
STRENGTH



POSITIONAL STABILITY



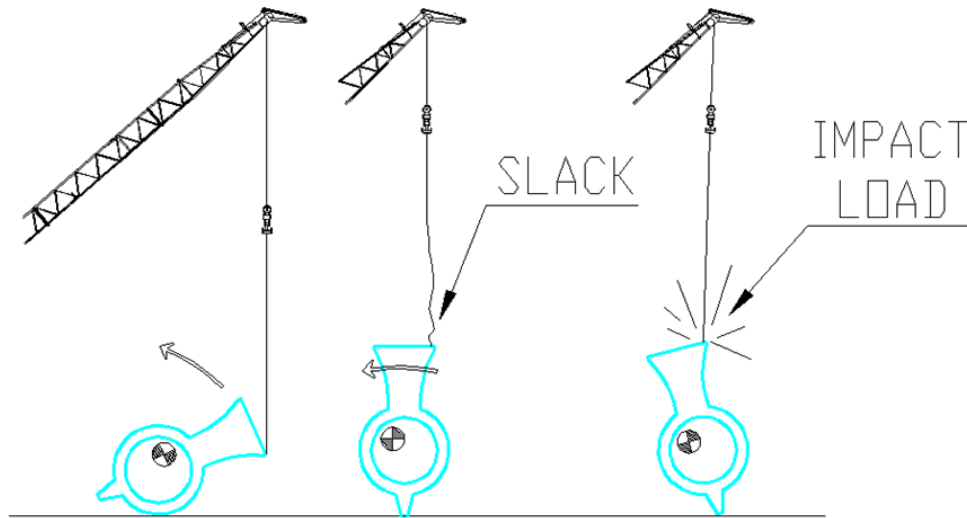
LATERAL STABILITY



OVERTURNING

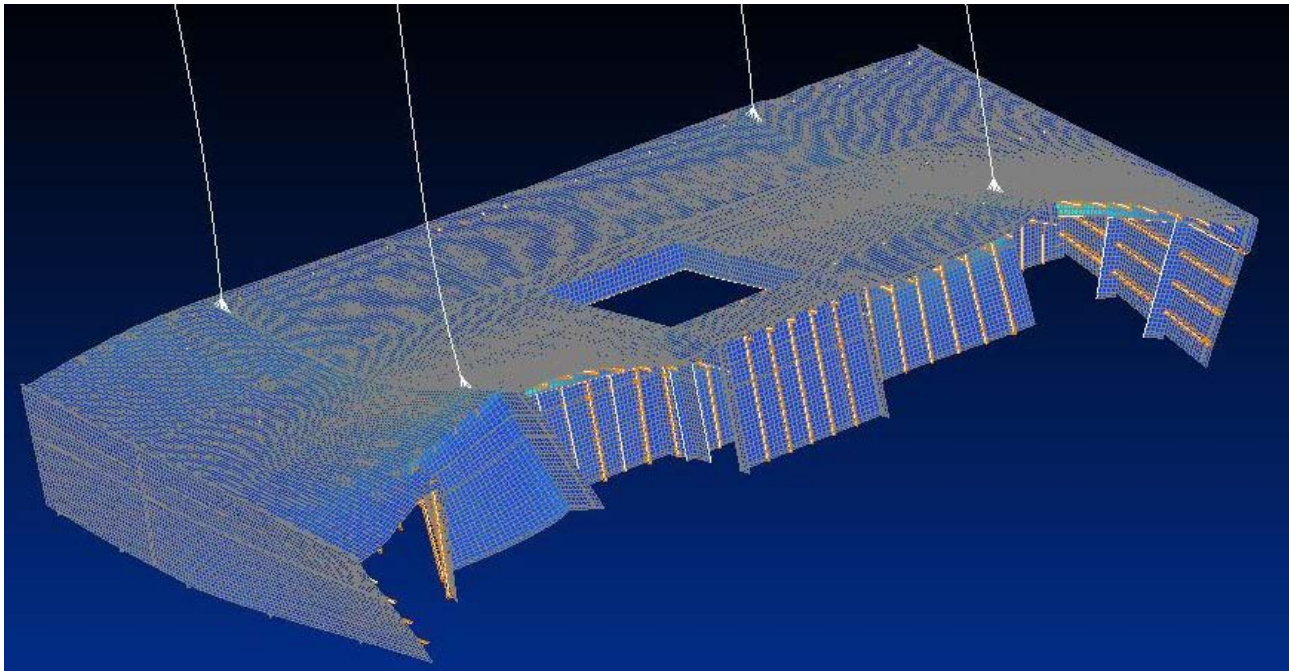
Summary

- **Guidance documents produced**
- **Extensive Catalog of equipment created**
- **Training documents**
- **Proposed standards for**
 - **Temporary support of ship structure**
 - **Allowable stresses in lifted structure**



Future Work

- **Expand catalog of equipment**
- **Additional training information**
- **Comparative information deficiency of synthetic slings**
- **Methods of reducing or limiting complexity of FE models**
- **Guide for classically analyzing blocks based on structure type.**



Thanks

- Questions?

