“Understanding your limits”

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The Problem:

“Engineers, offshore operations teams, ship owners, marine warranty surveyors, clients and regulatory bodies fail to fully understand dynamic capacity of offshore cranes, and its utilisation in dynamic lifting applications.”

This leads to conflict, stress, wasted man hours, and inflates costs.
Why is there a failure to fully understand dynamic capacity?

- Few crane manufacturers address the subject within their user documentation.
- Crane manuals are often misleading on the issue.
- Many lifting specialists within the industry have a background in static lifting applications.
- Crane safety systems (inc alarms) are designed to comply with prevailing standards (based on static lifting applications).
- There hasn’t been a need to understand when transient loads have been below SWL.

However:
- Subsea architecture is moving towards larger, heavier components in deeper locations leading to greater equipment utilisations. Thus we need to make full use of our equipment capabilities.
Crane Load chart Overview

Contrast between:
• Conventional use of load chart
• Engineered Lift approach
Conventional use of load chart

- Crane designer engineers the crane and determines dynamic factor and off lead/side lead values in accordance with code.
- Crane designer derives de-rated load charts accordingly for Harbour, Internal & Ship-ship applications.
- User simply compares static load with charts.

Example of derating for successive sea states for Internal duty.
Subsea Lifting – the problem

- Variables:
  - Sea state/ wave height
  - Wave period
  - **Load shape**
  - Trapped water
  - Vessel (and therefore crane) heel, trim, roll and pitch
  - Current
  - Water depth (& rope weight)
  - Radius
  - Others

- Impossible to create set of crane load charts for all eventualities

- **Crane designer cannot engineer the operation**
Engineered lift approach

• Reference is made to load chart where dynamic factor and OL/SL are known.

• Responsibility of the ship operator to engineer the lifting operation within the envelope provided by the crane designer.

• Lifting operation is designed (by the ship operator) within the envelope of the reference chart, satisfying 3 tests:
  - Static Load (inc weight of wire rope) ≤ SWL
  - Dynamic load ≤ Dynamic capacity
  - Off lead/side lead loading ≤ that assumed in the reference load chart.
Illustration of dynamic lifting scenarios

Illustration of loading scenarios on 100te SWL crane with DAF 1.3
A. Maximum utilisation of static and dynamic capacities
B. Maximum utilisation of static and overload of dynamic capacities
C. Under utilisation of static and maximum utilisation of dynamic capacities
D. Exceeding static capacity (SWL) whilst fully utilising dynamic capacity.
Applications which can involve significant lead angles:

- Riser/flexible handling
- Cross hauling
- Hinged cover opening
- PLET laydown
- Deployment with significant vessel movement

Riser handling with crane
Assessment of lifting operation lead angles against crane limits

- **Structurally**
  - Ensure that lead angle related loads do not:
    - Exceed crane’s side load tolerance
    - Lead to excessive overturning moment

- **Geometrically**
  - Ensure that we do not:
    - Subject wire rope to excessive scuffing on sheave
    - Peel rope off the sheave
Relationship between lead angle and dynamic load

For any point on a load radius chart, relationship between max lead angle and dynamic load can be plotted.

Basis:
- Load chart
- Associated Design assumptions
  - Dynamic factor (Hoist Factor)
  - Off lead/side lead
Caution

- Some load charts are based on very small off lead and side lead values
- Thus a capability is presented which may be operationally impractical
- Some load charts have limited/no application in an offshore environment, despite how they may be presented
- Need to critically review the crane’s limitations when selecting a vessel for a lifting operation.
“Glass ceilings”

Limiting dynamic transients to within SWL
Limiting equipment utilisation
Impact of dynamic transient restriction

- Some ship owners and Clients will not permit engineered lifts where peak dynamic loading may exceed SWL (static capacity).
  - Drives up costs within the industry (can force use of larger crane/vessel)
  - It rejects the classification society’s design code methodology
  - It rejects the crane designer’s ability to design to the code and the subsequent design appraisal
  - It rejects the crane manufacturer’s ability to build in accordance with the design and specification, and the associated verification process
  - This can lead to conflict

- Is this a conscious decision, or a policy made without full understanding?
What do we mean by utilisation?

• A measure of how much of a lifting appliance’s capacity are we using?
  • Static utilisation = static load/SWL
  • Dynamic utilisation = dynamic load/ dynamic capacity

• “Dynamic load/ SWL” is a meaningless comparison.

• Don’t compare Apples with Pears!
Limiting equipment utilisation

- Some contractors and Clients will seek additional review and approval for lifting operations involving equipment utilisation above a threshold (e.g., 80%)
- It is entirely necessary to manage risk to equipment integrity, operations personnel, cost, schedule, environment, subsea infrastructure, and reputation

- But!

- Process should be rigorous but not overwhelming!
- Threshold should not be a false limit.

- It can encourage project decisions which import risk (e.g., Use of main hoist rather than auxiliary, use of double fall configuration rather than single fall)
Hook block size (eg 400te SWL examples)

<table>
<thead>
<tr>
<th></th>
<th>1 fall</th>
<th>2 fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWL (m)</td>
<td>2.5m</td>
<td>4.5m</td>
</tr>
<tr>
<td>SWL (te)</td>
<td>4te</td>
<td>9.5te</td>
</tr>
</tbody>
</table>

3.2m, 13te
How do we manage utilisations up to 100% safely?

- Lift planning and engineering analysis must be proportionate to the utilisation.
- Lifting operation execution must be managed with commensurate rigour, such that assumptions made in analysis are valid/not exceeded.

- Why substitute the necessary rigour in engineering and strict control during execution with arbitrary limits?

- We need to fully **understand** our crane limits
- We then need to manage our projects such that we do not exceed those limits, but be able to use the full capacity
- By doing this we bring value to our Clients, whilst managing risk
Proposal

- IMCA drafts and issues a guidance document:
  - To describe the principals of dynamic lifting
  - To describe how the approach can be applied to offshore lifting operations
  - Give guidance in interpretation of load charts when referenced for engineering such lifting operations
  - Consistent with offshore crane design/certification standards and classification society interpretation, without a need for the audience to fully understand and interpret those standards.

- This will provide an independent and respected reference within the industry for those not familiar with the approach.
Questions....
THANK YOU

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