Rigging & Sling Failures: Case Studies & Solutions

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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!
Serving a Variety of Industries

- Aerospace
- Chemicals
- Construction
- DOD
- DOE
- Electric Utility
- Hydro
- Manufacturing
- Maritime
- Mining
- Nuclear
- Oil & Gas
- Pulp & Paper
- Railroad
- Shipbuilding
- Wind Energy
OUR CUSTOMERS

The World's Greatest Organizations Trust ITI's Expertise with their Crane & Rigging Operations
SHOWCASE WEBINAR SERIES

Past Presentations:
Cranes, Rigging & Your Organization

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

4 Major Lifting Considerations in Power Gen Environments

Today's Presentation:
Rigging & Sling Failures: Case Studies & Solutions

WEBINAR TRAINING COURSES

• Lift Director & Site Supervisor
• Critical Lift Planning
• Rigging Gear Inspection for Supervisors
• Advanced Rigging: Load Distribution & Center of Gravity
• Advanced Rigging: Multi-Crane Lifts & Load Turns
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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Rigging & Sling Failures
Case Studies & Solutions
60 Total Cases in 25 years

- Synthetic Sling: 20 cases
- Chain Sling: 5 cases
- Wire Rope Sling: 3 cases
- Rigging Hardware: 3 cases
- Wire Rope: 30 cases
- Crane & Rigging Procedures: 5 cases
87% of Sling Accident Investigations Involve Synthetic Slings

23 Sling Accident Investigations

- Synthetic Sling: 20
- Chain Sling Category: 4
- Wire Rope Sling: 2
## Mode of Failure

<table>
<thead>
<tr>
<th>Type</th>
<th>Abuse</th>
<th>Fabrication</th>
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<tbody>
<tr>
<td>Synthetic Sling</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Chain Sling</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Wire Rope Sling*</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Rigging Hardware</td>
<td>100%</td>
<td>0%</td>
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</table>

* Homemade with clips
Case 1

- 4,000 lb. Steel Ring
- Abrasion Wear Pad on 2 of 4 edges
- Stood up, rolled, sliced sling
- Amputee, mid-thigh down
- Settled out of court
Case 2

- 5,500 lb. Mini-excavator
- One older, UV degraded and previously cut web sling
- Two new web slings
- Triple sling failure
- $35,000 lost machine
- 9 men off for a day, no planning
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C 14
Case 3

- 4,500 lb. Steel Beam
- Two web slings, choker hitches
- No protection
- Helicopter lift, vibration
- $40,000 damages, hotel roof
Fig. 5 Failure site.
Case 4

- 19,000 lb. Papermill machine
- Two-crane pick
- Crane hook, bowl gouges
- Severed sling, dropped machine
- $300,000 damages
- 4 month replacement, lost revenue
Case 5

- 23,000 lb. Steel Box Beam
- Two web slings, basketed
- Abrasion wear pads
- Slings slid, friction and cutting
- Tumbled beam, 1 death
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Sling Failures & Case Studies

Initial Slide

2nd sling went uphill

Friction Failure
Case 6

- Tower Crane Jumping
- Four web slings, inverted choker hitches around tower column H-beams, no protection
- Cutting failures
- Dropped stabilizing collar
- 7 deaths
<table>
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<th>CRIME:</th>
<th>Investigate Accident</th>
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<tbody>
<tr>
<td>LOCATION:</td>
<td>303 E. 51st</td>
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<tr>
<td>EVIDENCE(Type):</td>
<td>Braided Steel Wire</td>
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<td>LOCATION RECOVERED:</td>
<td>Accident Debris</td>
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<td>RUN#</td>
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<td>SIGNED DET.:</td>
<td>Det Hennessy, 17 PDA</td>
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<td>VOUCHER#:</td>
<td>GB1</td>
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<tr>
<td>PCT.#</td>
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</table>
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Points to Remember

1) If rigging with synthetic slings, ensure sufficient protection is in place.

2) Inspect crane hooks and shackles for rough or gouged surfaces.

3) Consider using a “clean” rigging shackle or master link assembly to avoiding bunching of slings and to ensure smooth connections.
Typical method.

Sling angle should never exceed 45 deg from horizontal, or 90 deg full included angle.
Both flat web and roundslings are 2" and just fit.

Inspect sling-to-hook contact area, and ensure there is no scoring or gouging in hook bowl.
Exceeds 45 deg angle and causes tip loading of hook.
Sub-link assembly can help equalize sling leg loading and avoid sling contact with “rough” hooks.
Positive Connections
When available, use qualified lifting lugs.

Note: Double shackles help move slings away from crush points.
Swivel hoist rings can be attached to the load with threaded or through-bolt engagement.

Proper torquing is required.

These devices provide 360° rotation and pivot 180°.
Rig slings using a portion of load that “stops” sling movement.

Look for or create “STOPPER POINTS” to inhibit sling sliding.
Spreader bars help provide perpendicular sling alignment.

Straightaway-perpendicular is “BEST” as it produces no horizontal force that might initiate a horizontal movement.
Double wrap basket hitches provide 540° grip and sling contact.

High friction material helps and attention must be paid to ability to withstand p.s.i.
Sling sliding can result in cutting or friction failure.

End result = DROPPED LOAD.
Recommendations
Request that Vendors provide loads with fixed rigging points.
If the load has to be basketed, consider using a Triple Strong Back.
If Rigging Points are at or below CG, consider using a Spreader Frame.
Sling Protection
Here a thimble helps protect the wire rope, even in the body.

Newco Mfg®, Crescent Shape Thimble
A robust wire rope sling protector.

Interfron®, Wire Rope Sling Corner Protector, magnetic
Ideally designed for 90 deg corners.

Slingmax ®, Cornermax Pad
Super cut-resistant synthetic sleeve.
In many cases, the rigger should calculate the sling loading in square inches and compare it to the load capacity of the sling protector.
Lift-It Mfg®, Meshguard, Edge Protector
Heavy synthetic webbing is wrapped around the sling body to resist damage from abrasive load surfaces.
Machined high-capacity plastic maintains solid barrier between sling and load edge.

Linton Rigging Gear Supply®, 90 deg. Corner Protector, magnetic
Even helps prevent damage against beam flanges.
In all cases, sling “sliding” can upset even the best plans. Cutting or friction can easily result.
Below-the-Hook Lifting Devices
Clamps for Beams

Renfroe

Caldwell Group
Clamps for Beams

MINIMUM ANGLE 75°.

The Crosby Group
Adjustable Lifting Frame

Caldwell Group
PRODUCT FEATURES:

- New knock-down design is easily transported
- 6 or 9 ton capacity
- Spreads up to 12' x 12'
- Four point spreader beam provides added stability
- Chain top rigging and hoist rings
- Lower lifting shackles standard
- Complies with ASME standards
Rig-Release

- Lift Arm only moves when the load line is slack.
- Manual pull rope or radio remote.

Caldwell Group
Rig-Release

• Design factor is 5.

• Even works for Christmas treeing.
Pallet Fork for Crane Loads

- Adjustable bail and forks.
- 1-20 ton capacity.
Adjustable Spreader Bar

- Spread 4-20 ft.
- 2-15 ton capacity.

Caldwell Group
Spreader

- Tandemlock ends, your pipe.

- 14 tons and above.
Below-the-Hook Lifting Devices

Counter-Balance Spreader Bar

Bushman Avontec
Tilt-Up Rigging

Tandemlock and Rigging Block Vendor