On the Mend

Liftech

LIFTECH CONSULTANTS INC.

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Liftech engineers have been mending cranes for over 40 years.

A repair must be speedy and cost efficient. This requires experience, creativity, teamwork, and technology.

These pages present some of Liftech's projects and an overview of the mending process.

When your crane needs mending, we are here to help.

Damaged Crane Boom Repairs

Container crane booms are frequently damaged due to ship collisions.

Liftech has been involved in dozens of repairs and provides all aspects of engineering for repairs.

Repairs range from rebuilding, or stiffening, damaged sections to heat straightening damaged sections.

Paceco Crane Damage Review

A departing ship struck Paceco Crane 313 on January 31, 2004. Virginia International Terminals retained Liftech to review the damaged crane and wharf, design temporary bracing to stabilize the crane, and design repair details for the damaged crane stop.

Virginia International Terminals
Newport News Marine Terminal, Virginia
2004

Fire Damaged Coal Loader Repair

A coal loader built by Krupp was severely damaged in two fires and suffered significant damage during a ship collision.

After each incident, Liftech provided on-site engineering to assist with repairs. Repairs consisted of replacement or stiffening of buckled sections, restoring the geometry of the boom and shuttle structures to mitigate operational problems, and development of a structural maintenance program to ensure long-term reliability of the repaired structure.

The loader was returned to operation within five weeks of the first fire, within four weeks of the second fire, and within days of the ship collision.

Port of Los Angeles,
California
2000 and 2001

Krupp Crane Repair

A ship struck a Krupp crane at the Port of Oakland. The bow hit one of the waterside legs just above the portal beam, about 45 feet above the gantry rail. This impact pushed the waterside legs 35 inches to the right and 30 inches toward the land. Because the wheels remained on the rail, the waterside and landside sill beams partially separated from the equalizer beams.

Liftech helped the Port of Oakland temporarily secure the crane, then reposition and repair the damage. The crane was secured by installing posts at two corners and a crib pile under the sill beam near one corner. The crane was repositioned by lifting the waterside legs with a mobile crane, jacking up the landside legs, and jacking the landside horizontally until it could be placed back down on the equalizer assemblies. Replacing the buckled plates in the area of ship impact repaired the damaged leg.

The crane was recommissioned one week after the accident.

Port of Oakland, California
1997

Paceco Crane Truss Boom – Damage Repairs

The Paceco crane truss boom rotated and was pushed into the bumper stops when it was struck by a barge-mounted crane. The landside and waterside gantry equalizers were torn from the legs, the boom tip was severely distorted, and the upper and lower boom chords buckled. The crane wheel gage shortened four inches (100 mm) and several plates on the waterside legs and sill beam buckled.

The boom and frame were temporarily secured against collapse, and the crane was transported to the backlands for repairs.

For the frame repair, the buckled leg and sill beam sections were heat straightened. Using heat straightening, the shortened wheel gage was corrected to within 1/8 inch (3 mm) of the acceptable gage tolerance.

The boom was removed, a section of the boom tip was replaced, and the salvageable portions of the boom structure were heat straightened. The repaired boom was raised into position, and the entire crane was transported to the rails. At this point, the boom was straight, but misaligned. The boom alignment was restored by adjusting the length of the lower frame diagonals. The lower end of each diagonal was disconnected from the gusset plate, pushed or pulled using jacks, and reconnected to the gusset plate.

The heat straightening was completed in ten days. All required repairs were completed in 60 days.

Sheedy Drayage Company
Matson Terminal
Sand Island, Hawaii
1995

Paceco Crane Truss Boom Repairs

The lower chord of a Paceco crane's truss boom in Haifa was damaged when the boom struck a berthed vessel. The lower chord pipes were bent inward and the pipe buckled approximately four inches at the point of impact.

Using the rail girder to provide restraint during the repairs, the damaged length of pipe was heat straightened to within 1/8 inch (3 mm) tolerance. The local buckles were also repaired by heat straightening. A cover plate was welded over the local damaged section of pipe.

Repairs were completed in two days.

Israel Ports and Railways Authority
Port of Haifa and Ashdod, Israel
1995

Paceco Truss Boom Crane – Boom Repairs

Over the years, the frame of this Virginia International Terminals Paceco truss boom crane had been modified several times. As a result, the frame was twisted and the boom misaligned. The resulting six inch (150 mm) lateral misalignment at the boom tip severely affected the crane operation.

The repair concept was to twist the frame in plan until the boom was properly aligned

Liftech designed a special push-pull jacking concept for the diagonals to untwist the frame. The two lower diagonals were released at the portal connection, and opposite compression and tension forces were applied. Computer analysis was used to determine the required jacking forces for the boom realignment.

The boom was aligned in less than a day after the jacking system was set up.

Virginia International Terminals
Norfolk, Virginia
1992

Paceco Crane – Boom Damage Repairs

The Paceco crane boom was struck by a container vessel, and the boom tip was forced out of alignment by eight inches (200 mm). The boom was lowered to the ground, and repairs were made by heat straightening.

The heating pattern was determined using analysis to simulate the boom damage during impact. Required restraining forces were determined and applied to the structure during heat straightening. This method did not rely on any external supports. The boom was aligned to within 5/16 inch (8 mm) tolerance.

The boom was repaired in six days.

Rigging International
Port of San Francisco
1991

Paceco Truss Boom Crane – Damage Repairs

This Paceco truss boom crane was pushed off the rails when a container vessel struck a waterside leg during berthing. The gantry frame at the legs and at the portal tie beams was extensively damaged. Sections of the leg and portal were removed and replaced.

Liftech designed a self-supporting concept for the repair. A frame was built and attached to each side of the damaged sections to support the leg and portal tie, while the damaged sections were replaced.

Liftech has since used this support concept on other projects. The concept is particularly useful where a wharf is inadequate to carry the equipment loads. The strongback support frame eliminates the need for heavy lifting equipment to support the crane during repairs.

Repairs were completed in 15 days after the setup.

Paceco Corporation
Port of Honduras, Puerto Cortez, Honduras
1990

Paceco Low Profile Crane Repairs

While berthing, a Sea-Land container vessel struck one of the waterside legs of a Paceco low profile crane, pushing it back eight feet and causing extensive damage. The impact tore the landside and waterside gantry equalizer systems from the sill beams, the frame tilted backward, and the waterside legs buckled at the portal tie and sill beams. The frame list caused the boom to roll back into its bumper stops, deforming the lower chord.

The boom and frame were temporarily secured against collapse. The boom was lowered to the ground, and the boom and frame structures were transported to the backlands behind the loading wharf for repairs. Portions of the waterside leg, sill beam, and portal tie were replaced. The landside legs and sill beam were salvaged and repaired by heat straightening. The boom lower chord was heat straightened to its original condition. Trucks and equalizers were replaced. The 350-ton boom was lifted and positioned on the hangar system, and the crane was transported back onto the wharf.

Repairs were completed in 90 days.

Sea-Land Services, Inc., Sea-Land Terminal
Port of New York and New Jersey
Elizabeth, New Jersey
1987

Paceco Crane Truss Boom Repairs

While raising the Paceco crane truss boom, the boom hoist rope improperly wrapped around the drum. As the boom was lowered, the loose rope unraveled, and the boom dropped several feet onto one set of rails damaging the boom. The boom tip was deformed laterally 14 inches (350 mm) out of alignment. The trolley rail girder deformed into an S-shape. The support cross bracing at the boom hoist bracket buckled.

The boom was repaired in place by heat straightening. The deformation of the truss boom due to the accident was calculated. A finite element analysis was used to calculate the restraining forces needed to facilitate the straightening. The lower chord and rail girder were heat straightened. The boom was aligned to within 1/8 inch (3 mm) tolerance, and the damaged upper chord bracing members were replaced.

Repairs were completed in three days after the setup.

Israel Ports and Railways Authority
Port of Haifa, Israel
1983

The Mending Process

Liftech provides innovative solutions to the container handling industry. We develop innovative repair solutions stressing imagination, teamwork, and technology. We emphasize safe, economic, and speedy repairs using techniques best suited for the type of damage, site conditions, and local capabilities.

OBJECTIVE

The mend must do the following:

return the crane to pre-accident condition
restore normal operations
be safe
be quick
be competitive

ASSESSMENT

When an accident has occurred, the owner, operator, and insurance carrier need timely answers to several key questions:

What caused the accident?
Is the crane secure against further damage?
Is the crane safe to operate?

Liftech assesses the damage and provides answers to these questions.

SECURING THE CRANE

When an initial assessment is completed, the task of securing the crane against further damage begins.

Is the crane in danger of collapse?
Is the damaged crane obstructing normal shipping activity?
Can the crane be relocated?

If the crane needs to be secured against collapse, Liftech's on-site engineer, in consultation with the home office, develops emergency procedures to ensure the safety of the structure.

Sometimes the damaged crane needs to be relocated out of the way of normal shipping activity. Liftech works with local rigging contractors to develop safe relocation schemes with minimal disruption to normal traffic flow.

DEVELOPING REPAIR CONCEPTS

When the crane is safely located and secured, Liftech begins developing repair concepts. The owner is eager to know the answers to some key questions:

Is it practical to repair the crane?
When will the crane be back in operation?

Liftech reviews the damage to determine its extent and if repairs are practical. Review may include:

visual review of affected structural and mechanical components
review of the structure's geometry
NDT examination of critical welds and bolts
destructive testing and ultrasonic thickness testing, if drawings are unavailable and material properties and plate sizes are unknown
analysis and design review of the load carrying capacity of the damaged crane

Based on the condition of the crane, we work with the selected contractor to develop repair procedures that best suit the site conditions, equipment availability, and owner's time schedule.

REPAIR TECHNOLOGY

Mechanical Realignment

When frame distortion causes the boom tip to be significantly out of alignment, the crane operator will be unable to load a row of containers without frequent gantry adjustments. This makes ship operation inefficient and sometimes unsafe. Rotating the frame of the crane slightly in plan will often eliminate this problem. Liftech has developed a unique "push-pull" jacking scheme to mechanically untwist the frame to return the boom tip within normal operating tolerances. This method requires no heavy equipment and the jacking operation requires less than a day.

Heat Straightening

Liftech has combined structural analysis and heat straightening to repair numerous damaged container cranes that, using traditional repair methods, were considered impractical to repair. Heat straightening can eliminate weeks, even months, from a repair schedule. The repairs do not require heavy equipment. Fewer construction personnel are needed than with traditional repair concepts. If properly executed, the crane repairs can often achieve structural and operational tolerances superior to those achieved during original fabrication.

Analytical calculations are used to optimize the heat straightening procedure. Calculations determine the best point of application, direction, and magnitude of the assisting forces; the most effective heating locations; and provide an estimate of the required heating effort. Efficient heat straightening often requires a trained and knowledgeable structural engineer to analyze the structure, develop a heat straightening procedure, and direct the repair operation.

Self-Supporting Braced Repairs

Liftech has developed a method to support the damaged crane with the use of self-supporting bracing that eliminates the use of shoring or lifting equipment. The braces support the crane structure above the damaged section, allowing the damaged section to be safely repaired or replaced. This support concept is especially useful where heavy lifting cranes are not easily available, are prohibitively expensive, or an existing wharf cannot safely or economically support heavy equipment.

Reconstruction and Replacement

Liftech has been involved in numerous challenging repair projects requiring reconstruction of large structural components or even the replacement of the entire boom and other members. Each repair solution is unique. Liftech has developed innovative repair techniques customized to suit the contractor's capabilities and the conditions at the job site.

RECOVERY

When the crane is mended, we recommend it be tested prior to acceptance.

Liftech Consultants Inc. is an internationally recognized engineering company with over 40 years of experience in the container crane, heavy lift crane, specialized rigging, waterfront, and building industries. Our container crane expertise includes procurement services, technical review, construction and quality control review, structural maintenance programs, design and analysis, simulations studies, upgrades, remodeling, and transportation. Other expertise includes wharf design and review, industrial and commercial buildings, rail installations, silos, and unusual structures. Our designs include concrete, wood, and steel structures.


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