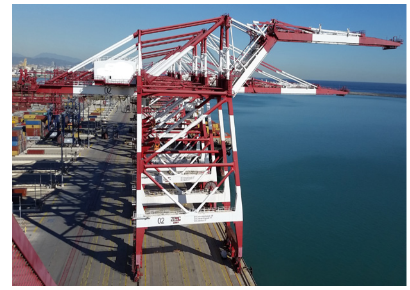
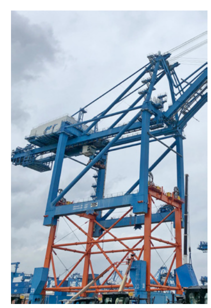
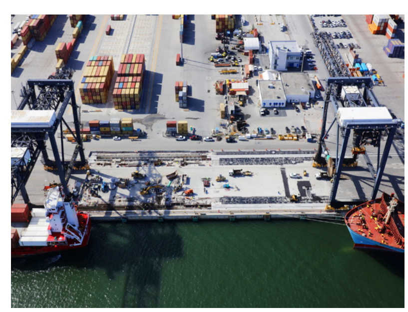
WHARF DESIGN AND ANALYSIS SERVICES



Liftech Consultants Inc.





COMPANY OVERVIEW
WHARF DESIGN AND ANALYSIS

Liftech Consultants Inc. is a consulting engineering firm, founded in 1964, with special expertise in dockside container handling cranes and other complex structures. Our experience includes structural design for wharf structures, buildings, container handling equipment, and yard structures. Our national and international clients include owners, engineers, operators, manufacturers, and riggers.

Design Philosophy

We design functional, environmentally sound structures for the most economical investment. We believe in converting natural resources and labor into usable facilities that are a blend of aesthetic, structural, and functional considerations. We work well with owners, engineers, contractors, and architects.

Wharf and Pier Structures

We provide design and analysis services for wharf and pier structures. Our experience includes the design of wharf and pier structures for large earthquake loads, including cast-in-place and precast concrete systems, as well as steel systems. Select projects include design of the following:

Over 9,500 feet of new crane rail girders for Port Everglades to support existing and new low profile cranes.

A MOTEMS-compliant wharf. The design permitted continued operations during construction by fabricating most of the structures off-site and installing prefabricated components between vessel calls.

A 426-foot wharf in Redwood City designed to state-of-the-art seismic criteria and to support mobile crane operations.

A 550-foot wharf at the Port of West Sacramento that supports a cement unloader.

Over 5,000 feet of wharves at the Port of Oakland that support container cranes.

We evaluated all of the wharves at the Ports of Oakland and Virginia to determine the crane girder capacities to aid the ports in their equipment decisions. We performed evaluation studies and justified increased crane girder capacities for over a dozen girder systems. We performed wharf evaluations for heavy temporary loadings, e.g., moving container cranes over the wharf.

For more information, please visit the Liftech website: www.Liftech.net

SELECTED WHARF DESIGN AND ANALYSIS PROJECTS

Client & Project Location	Year	Project Description
Port of Oakland, Berth 10 Oakland, California	2023	The port wanted to use the wharf for storing and handling dredging materials. Performed wharf assessment review and documented the damaged condition. Based on the existing condition, performed analysis to determine the safe loading that can be applied on the wharf deck.
McNears Beach Fishing Pier County of Marin, California	2023	High winds blew a small vessel into the pier causing damage. Performed site visit evaluation and submitted report recommending the damaged section be shored for structural stability. Developed the design of the permanent repair of the damage.
AAK USA, Inc. Terminal 2 Port of Richmond, California	2022	Designed short-term repair of a fender system that was damaged by vessels berthing to the dock. Work included removing damaged timber piles, designing 55-ft-long steel waler beams spanning between the undamaged composite piles, and providing support to assist obtaining repair permit through approval agencies.
Port of Oakland Berths 9, 10, 20, 21 Oakland, California	2022	The concrete wharf structure at Berths 9, 10, 20, and 21 was constructed in the 1940s and had damage to the pilings and deck. Over the years, various repairs were performed. At Berth 10, the port wanted to use the wharf for storing and handling dredging materials. Performed wharf assessment review and documented the damaged condition. Based on the existing condition, performed analysis to determine the safe loading that can be applied on the wharf deck. At Berths 9, 20, and 21, the port wanted to perform berth dredging and was concerned about the impact to the wharf structure. Performed analysis to demonstrate the impact to the wharf structure is small. Performed a wharf assessment at pre-dredged condition and another assessment at post-dredged condition. Documented the existing damage for future reference.
Winehaven Legacy LLC Point Molate Pier Richmond, California	2021	As part of Point Molate Development, evaluated the wharf condition and recommended the follow-up work to address the damage identified in the assessment. Developed a concept layout for a water taxi terminal.
WSP USA Berths F4 to F6 Port of Guam	2021	Designed Berth F5 in 1998 and provided crane girder upgrade design at Berths F4 and F6 in 2008. Provided girder capacities for Berths F4 to F6 to help the port determine the allowable crane wheel loads for larger cranes and with preparing the crane specification.
Power Engineering Construction Company Pier 22 ½ Port of San Francisco	2019	Designed the marine components of the new floating San Francisco Fire Station 35. This included a landside pier near the bulkhead of the San Francisco seawall. The design dealt with significant seawall seismic design movements. The steel superstructure was installed into sockets on top of driven steel piles allowing for rapid installation.
ASR/ C&H Sugar Crockett, California	2019	Wharf seismic performance evaluation of an older wharf structure with reinforced concrete piles socketed into bedrock and with a tie-back deadman system. Provided recommendations, repair concepts, and cost estimates.
Mott MacDonald Berths 25 and 26 Port of Oakland	2017	Designed fender and bollard upgrades for EEE-size vessels. Upgrades included verifying the existing wharf structural capacity.

Client & Project Location	Year	Project Description
Power Engineering Construction Company Alameda, California	2016	As part of WETA Central Bay Maintenance facility design, designed reinforced concrete pier on steel piling to support gangway to float system.
Port Everglades, Florida	2015	Designed approximately 10,000 feet of new crane rail girders including crane stowage hardware, stops, cable trenches, and power vaults.
Port of Oakland Berths 23 to 25 Oakland, California	2015	Developed concept for strengthening waterside crane rail girder and provided cost estimates.
Port of Oakland Berths 25 and 26 Oakland, California	2015	Developed wharf upgrades including mooring and berthing systems and wharf strengthening for mooring larger vessels including cost estimates.
Manson Construction Co. IMTT Richmond Terminal Richmond, California	2015	Designed new MOTEMS-compliant wharf structures that use significant off-site fabrication to minimize on-site construction and permit continued operations.
Manson Construction Co. Redwood City Wharves 1 & 2 Redwood City, California	2014	Designed a 426-ft replacement wharf, 955-ft seawall, and longshoreman building. The wharf is designed to state-of-the-art seismic criteria and to support mobile crane operations.
Global Rigging & Transport Port of New Orleans New Orleans, Louisiana	2010	Analyzed the wharf structure to verify it was capable of supporting skid system loads for moving a container crane across the wharf.
TransDevelopment Group Port of Richmond Richmond, California	2010	Designed wharf repairs and modifications for berthing, mooring, and offload for RORO operations for Berths RCH-7 and RCH-8.
Port of Richmond Richmond, California	2009	Designed Terminal 3 extension using ductile batter piling.
Manson Construction Co. Dutra Group Joint Venture Marin, California	2009	Designed repairs, including seismic upgrades, to portions of McNears Beach Park Pier damaged by barge.
Horizon Lines Port of Guam	2008	Designed Berth F6 wharf modifications for stowing cranes modified and delivered from Los Angeles.
Manson Construction Co. Sacramento, California	2007	Provided wharf design as part of design-build team for 550-ft wharf for Cemex West Sacramento for unloading cement from vessels.
TG Engineers Port of Guam	2004	Designed two-berth wharf structure for the Guam Port Authority. Structure included a rail girder and supports for post-Panamax cranes.
Virginia Port Authority Norfolk, Virginia	2004	Provided structural design to significantly improve the capacity of the existing stowage hardware in the Newport News Marine Terminal North Berths that involved modifications of the existing hardware, new hardware, and improved integration with the existing wharf structure.
Virginia Port Authority Norfolk, Virginia	2003	Analyzed all crane rail girders at the Portsmouth Marine Terminal to justify larger girder capacities. The increased rated capacity eliminated the need to strengthen the existing wharf or to limit crane operations. Performed structural design of new stowage hardware and its integration with the existing wharf structure.

Client & Project Location	Year	Project Description
Port of Oakland Oakland, California	2003	Designed structural rehabilitation of an existing 1,700-ft container wharf, Berths 32–33. Modifications included adding a new waterside crane girder and changing the crane rail gage to 100 feet.
Modern Terminals Limited Hong Kong	2002	Reviewed design load criteria on wharf design, Berth One, Kwai Chung. Made design changes to increase the crane girder capacity. Designed curved rail. Reviewed design of switching system and frog to enable crane transfer between adjacent non-parallel wharves.
Port of Oakland Oakland, California	2000	Designed structure of a new 3,600-ft container wharf that uses 48 in diameter cylinder piles and standard 24 in prestressed piles in combination with cement deep soil mixing (CDSM), Berths 57–59. Also developed a new ductile shear key design for use between wharf sections that is economical and easily repairable.
Marine Terminals Corp. Port of Los Angeles, California	1999	Calculated wheel loads for the ZPMC cranes operating on Berths 121 and 126 and evaluated crane girder capacity. Determined the maximum possible outreach extension for the existing MHI cranes that does not exceed the allowable wheel loads.
Port of Oakland Oakland, California	1997	Conducted an extensive wharf and crane study to help the port in their overall planning. Calculated the ultimate wheel load capacity of all crane rail girders, waterside and landside, at all container wharves for current and future channel depths. Calculated the wheel loads of all dockside container cranes at the port.
Virginia International Terminals Norfolk, Virginia	1996	Calculated the ultimate wheel load capacity of the crane rail girders at all wharves at Norfolk, Portsmouth, and Newport News. The calculated capacities were used by the port to determine which existing cranes may be relocated to other wharves. Calculated the wheel loads of all dockside container cranes at the port.
Guam Port Authority Port of Guam	1996	Designed structure for replacement of an earthquake-damaged container wharf consisting of tied back sheet piles and fill with a new concrete deck on pile structure, Berths F3–F6.

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SELECTED CRANE GIRDER CAPACITY ANALYSIS PROJECTS

Client & Location	Year	Project Description
Total Terminals International Port of Long Beach Pier T Long Beach, California	2016 & 2018	Phase 1: A two-dimensional finite element analysis (FEA) of the crane girders to determine the feasibility of justifying increased crane girder capacity to accommodate EEE-compatible container cranes. Phase 2: A three-dimensional FEA of the waterside crane girder and two-dimensional FEA of the landside crane girder to determine if the existing structure requires strengthening to accommodate new and larger container cranes. A strut-and-tie analysis was also used to evaluate the waterside girder.
Port of Oakland Oakland, California	2017	Several years ago, Liftech conducted an extensive wharf and crane study to help the Port of Oakland in their overall planning. Liftech calculated the ultimate wheel load capacity of all crane rail girders, waterside and landside, at all container wharves for current and future channel depths. Liftech also calculated the wheel loads of all the dockside container cranes at the port. The port can use the calculated capacities to determine which cranes can be relocated from one wharf to another or what new cranes are practical. Liftech provides periodical updates due to code changes or more refined analyses to justify increased capacity.
Port of Felixstowe Felixstowe, England, UK	2015	Evaluated the landside crane girder system at Berths 5, 6, and 7 of the Trinity III wharf to determine the existing capacity. Analyzed the landside crane girder and pile caps using strut-and-tie analysis. Developed procedures for load testing the landside girder to determine whether the existing structure requires strengthening. Provided recommendations regarding possible reinforcement.
Ports America Port of Oakland, California	2015	Assessed the capacity of the existing crane girders at Berths 22 to 26 to determine the adequacy of the wheel loads for new and larger container cranes. Provided girder strengthening suggestions, cost estimates, and anticipated schedule for upgrading the girders.
Halifax Port Authority Halifax, Nova Scotia, Canada	2012	Using strut-and-tie model analysis, justified the crane girder capacity up to 70% higher than the published capacity, allowing placement of new ZPMC cranes.
APL Limited Port of Los Angeles, California	2011	Performed two-dimensional finite element analyses of the existing concrete crane rail girders at Pier 300 and justified girder capacities 15% and 45% greater than the reported capacities.
Panama Ports Company Port of Cristobal, Panama	2011	Performed two-dimensional finite element analysis of the existing concrete and steel crane rail girders and determined that there was sufficient capacity for new cranes.
Matson Navigation Sand Island, Hawaii	2011	Performed calculations for the existing concrete crane rail girders, and justified girder capacities 9% to 80% greater than the reported capacities.

Client & Location	Year	Project Description
New York Container Terminal Port Authority of New York	2010	Performed two-dimensional finite element analysis and strut-and-tie analysis for the existing concrete crane rail girders, and justified girder capacities significantly larger than the reported capacities. Assisted NYCT with a detailed Port of New York and New Jersey review.
APL Limited Dutch Harbor, Alaska	2010	Performed two-dimensional finite element analysis for the existing concrete and steel crane rail girders and justified girder capacities 30% to 140% greater than the reported capacities.
Port Authority of Guam	2009	Performed a two-dimensional finite element analysis of the existing concrete crane rail girders and determined that there was sufficient capacity for newly modified cranes that were being installed at the port.
Yusen Terminal Port of Los Angeles, California	2007	Performed conventional two-dimensional finite element analysis and strut-and-tie analysis of the existing concrete crane rail girders and justified girder capacities 45% to 70% greater than the stated capacities.
Esperance Port Authority Esperance, Western Australia	2007	Performed a two-dimensional finite element analysis of the existing concrete crane rail girders and determined that there was sufficient capacity for new bulk unloaders being installed at the port. Strut-and-tie analysis was used to justify greater girder capacities.
Matson Navigation Hilo & Kahului, Hawaii	2007	Performed two-dimensional finite element analysis of the existing concrete crane rail girders and determined that there was sufficient capacity for planned cranes.

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SELECTED CRANE LOAD STUDY PROJECTS

Client & Project Location	Year	Project Description
Virginia Port Authority NIT North, Virginia	2022	Provided a feasibility study and budgetary cost estimates for up to eight of the largest low profile shuttle boom cranes to date and estimated crane wheel loads for wharf modifications for NIT North.
WSP Port of Guam	2022	Provided engineering services for crane load study for a 50 gage crane capable of sustaining 210 mph wind. Assisted WSP/Port of Guam with technical crane specifications, crane procurement documents, and developing scope for wharf improvements and crane review.
Port of Oakland SSA Terminals Oakland, California	2020	Verified weighing procedure, observed weighing, and reviewed wheel load and stability calculations.
Everport Terminal Services Ports of Oakland and Tacoma	2019	Estimated crane wheel loads for potential raise modifications of three cranes for Port of Oakland and seven cranes for Port of Tacoma.
CH2M Hill Virginia Port Authority NIT South, Virginia	2019	Estimated crane wheel loads for increasing the lift height of up to eight existing ZPMC STS cranes by 40 ft to determine if wharf capacity would be exceeded.
Everport Terminal Services Port of Los Angeles	2018	Provided engineering services for a wheel load study to determine if the wharf capacity is adequate to accommodate the wheel loads of three potential future cranes.
Moffatt & Nichol Long Beach Container Terminal, California	2017	Calculated automatic stacking crane longitudinal rail loads based on acceleration measurements.
Moffatt & Nichol T5 Wharf, Seattle, Washington	2017	Developed recommended wharf design loads for potential future cranes to service ultra large container vessels.
Hongkong International Terminals, Hong Kong	2017	Estimated crane wheel loads and tie-down loads for the purchase of two STS cranes for HIT's Hong Kong terminal.
DP World Saint John, NB, Canada	2016	Estimated wheel loads for operating larger used cranes relocated to the terminal.
Modern Terminals T1 & T2, Hong Kong	2015	Estimated crane loads based on supplier proposed designs to determine if wharf capacity would be exceeded.
Port Everglades, Florida	2015	Developed concept design for new low profile crane. Estimated crane loads for the design of the new crane girder system.
Port of Oakland Berth 25-26	2015	Estimated wheel loads for a potential raise modification of two existing cranes.
CH2M Hill Port of Anchorage, Alaska	2015	Assisted with definition of crane geometry based on the port's operational requirements. Estimated crane loads for this geometry and provided design review for crane-wharf interface hardware.
KPFF Consulting Engineers Port of Tacoma, Washington	2015	Estimated crane loads for the design of a new wharf at Pier 4 for 100 ft gage cranes capable of serving ultra large container vessels.
PBI/CYS MOTCO, Concord, California	2014	Estimated crane design loads for a new wharf structure to support military operations.

Client & Project Location	Year	Project Description
APM Terminals	2014	Estimated crane loads to assist in the potential relocation of cranes from a terminal on the West Coast to one in the southwest.
ZPMC Intermodal Yard Crane Concept Design Review	2014	Estimated crane loads including those for travel on a curved rail, e.g., lateral loads on rollers and reactions between gantrying system components.
Moffatt & Nichol TraPac, Port of Los Angeles, California	2013	Estimated crane loads for 42 m gage RMG cranes at Berths 142 to 147 for design of crane rail and foundation.
McKay International Engineers Mississippi State Port Authority, Gulfport	2013	Estimated crane loads and recommended design loads for upgrading the existing wharf to support larger container cranes that are capable of serving larger vessels.
APM Terminals	2013	Estimated crane loads for a potential crane raise to confirm that the crane loads would not exceed the wharf rated capacity.
Parsons Long Beach Container Terminal, California	2013	Estimated crane loads for 51 m gage RMG cranes at Pier E for design of crane rail and foundation.
CH2M Hill Port Newark Container Terminal, New Jersey	2013	Estimated crane loads for new low profile cranes for design of new wharf structure.
CH2M Hill Port Newark Container Terminal, New Jersey	2012	Estimated crane loads for new Super post-Panamax cranes for design of wharf structure.
Virginia Port Authority Norfolk, Virginia	2012	Estimated crane loads for hurricane winds for existing ZPMC cranes in Houston to assess the feasibility of relocating the cranes from Portsmouth, Virginia, to Houston, Texas.
Officine Meccaniche Galileo La Spezia, Italy	2012	Developed conceptual design for a 62 m outreach crane with a narrow rail gage on an old wharf with limited wheel load capacity. Optimized crane design to minimize wheel loads.
Port of Houston Authority Houston, Texas	2012	Estimated crane loads and recommended design loads for upgrading the existing Barbours Cut Terminal wharves to support larger container cranes capable of serving 22-wide vessels. Assisted the port in selecting the crane configuration criteria.
Moffatt & Nichol Port of Long Beach, California	2011	Collected crane data from five crane manufacturers, reviewed equipment arrangements, developed seismic and wind load criteria, and estimated wheel loads for automated stacking cranes at an automated yard at Pier E.
TransHoist Engineering Inc. Cai Lan (Hanoi), Vietnam	2011	Estimated crane loads for new 49 m outreach, 42 m lift height ZPMC cranes. Wheel loads were estimated for 20 m and 30.48 m crane gages.
Moffatt & Nichol Port of Long Beach, California	2010	Provided recommended design crane loads for new wharf structure at Pier E to support cranes with a 120 ft rail gage, dual trolleys, tandem front lift, and single back lift.
APL Limited Dutch Harbor, Alaska	2010	Calculated crane loads on wharf for a modified MES crane with articulating boom, evaluated wharf capacity for crane loads, and designed wharf modifications to stow crane on wharf.

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SELECTED RAIL PROJECTS

Client & Location	Year	Project Description
Power Engineering Construction Company Alameda, California	2018	Designed new wheel and rail system for several marine gangway systems.
Port Everglades, Florida	2015	Designed new DIN A150 gantry rail system on new crane girders to accommodate the largest low profile cranes in the world and new 171 pound crane rail for extending the existing crane rail system. Included frog details for rail crossing.
AECOM Melbourne, Australia	2014	Designed new gantry rail system to accommodate existing and new cranes at Swanson Dock. Included typical and expansion joint details.
APM Terminals	2011	Designed trolley rail replacement, including a new detail at boom hinge and epoxy grouted support to improve rail vertical alignment.
Hutchison Port Holdings Sydney, Australia	2011	Detailed review of boom rail stresses for a low profile container crane.
Johnson, Mirmiran & Thompson Port of Baltimore, Maryland	2009	Provided consulting for gantry rail replacement project at the Dundalk Terminal. Rehabilitation work was due to vertical and lateral alignment issues.
Yusen Terminals Inc. Port of Los Angeles, California	2008	Designed temporary landside crane rail and foundation system to temporarily support four new MES cranes at Berth 218. The temporary rail was used during erection and storage until the new wharf was ready.
Whitney Bailey Cox & Magnani Baltimore, Maryland	2008 & 2006	Provided trolley rail replacement procedures for two cranes involving increasing the rail size and redesigning the rail joint at the boom hinge.
Manson Construction Co. Sacramento, California	2007	Provided wharf design as part of design-build team for a 550-ft long cement unloader wharf with rail systems nearly the full length at Cemex West Sacramento Import Terminal.
Moffatt & Nichol Port of Tampa, Florida	2005	Provided curved gantry rail design for transferring container cranes between non-linear berths at Berth 213.
Gantry SA Belgium Bremerhaven, Germany	2005	Provided curved gantry rail design geometry for transferring container cranes between non-linear berths. A constant radius curve was used at the waterside.
TG Engineers Port of Guam	2004	Designed a two-berth wharf structure, including new rail systems for post-Panamax cranes.
Holmes and Narver Port of Los Angeles, California	2003	Curved gantry rail design for Pier 400 at the Port of Los Angeles, including a detailed review of rail and grout stresses at Pier 400.

Client & Location	Year	Project Description
Port of Oakland, California	2001 to 2003	Provided structural design of the rehabilitation of an existing 1,700-ft container wharf at Berths 32–33. Modifications included adding a new waterside crane girder with rail systems for 100-ft gage container cranes.
Modern Terminals Hong Kong	2002	Provided design of curved rail at Berth One, Kwai Chung. Reviewed design of switching system and frog to enable crane transfer between adjacent non-parallel wharves. Evaluated stresses in rail and grout and assisted in designing special rail clips to resist rail uplift from typhoon winds.
Port of Oakland, California	1999 to 2000	Designed structure of a new 3,600-ft container wharf at Berths 57–59, including container crane gantry rail systems with multiple expansion joints.
Port of Amsterdam	1998	Designed curved gantry rail design geometry for transferring cranes around perpendicular rails.

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SELECTED CURVED RAIL AND CRANE TRANSFER PROJECTS

Client	Year	Project Description
Hatch Infrastructure	2020	Provided a concept study and designed a curved rail for DP World's Port Saint John wharf in Halifax, Nova Scotia, Canada.
Matson	2016	Provided concept study of a curved rail for a terminal in Hawaii.
Halcrow Group Ltd.	2006	Designed curved rail geometries for a wharf at Dames Point at Jaxport.
Gantry SGM	2005	Designed curved rail geometries for Bremerhaven Container Terminal.
Moffatt & Nichol	2005	Designed curved rail geometries for Port of Tampa Berth 213.
Modern Terminals Ltd.	2004	Designed curved rail geometries for a terminal in Taicang, China.
Port of Tanjung Pelepas	2003	Designed curved rail geometries and calculated the geometry of the lowest guide on the crane for the power cable.
Modern Terminals Ltd.	2002	Designed curved rail geometry for an asymmetrical curve for Terminal CT9 that required clearing stowage hardware. Reviewed switch system design while assisting manufacturer with its design.
Port of Oakland	2002	Designed curved rail between Berth 59 and Berth 60, including concepts for switching between conductor bar supplied power and cable supplied power. Designed the end of Berth 59 to facilitate the future curve.
Seaside Transportation Services, LLC	2002	Optimized curved rail geometries that reduced the required curve radius from 68 meters to 20 meters for Port of Los Angeles Evergreen Terminal.
Amsterdam Port Authority	1999	Designed curved rail geometry and switch design for transferring cranes from the typical berths and the "ship in a slip" berth perpendicular to the typical berths.
Sverdrup Civil, Inc.	1998	Designed curved rail and switch for 900 ft berth extension for Port Everglades Berth 30. Designed method and structures for handling the power cables when transferring the cranes.
Tampa Port Authority	1997	Designed curved rail geometries.
Port Authority of Guam	1997	Designed curved spur rail to transfer three cranes behind main wharf. Project included design of curve, rail girder, rail switch, and frog. Modification of three cranes to go around the curve.
Port of Oakland	1988	Shuttle system to transfer Sea-Land cranes around a corner.
Port Everglades	1987	Reviewed curved rail at Berths 31 and 32 to transfer four post-Panamax low profile cranes around the corner. Reviewed the curved rail for Samsung Heavy Industries, the crane supplier.
Port of Long Beach	1986	Provided concept study of a curved rail at the Port of Long Beach for Moffatt & Nichol.

Port of Oakland Crane X437 Demolition Plan
Oakland, California

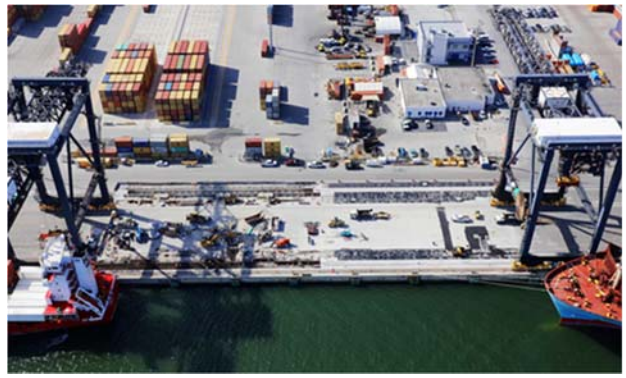
Liftech provided engineering to demolish the articulated boom Crane X437 at Port of Oakland Berth 37, including review of the associated wharf loads.

Power Engineering Construction Co. used their DB Pacific floating crane, a Liebherr LR1300 crawler crane, and a hydraulic mobile crane. The crawler and mobile cranes imposed large, localized loads on the wharf structure.

Liftech's scope included wharf review for the land-based crane loadings and submittal calculations; development of the dismantling plan including strength and stability review, boom lowering procedure, rigging arrangements and details; and construction support with site visits. The boom removal procedure takes advantage of the articulation linkages that simplified removal by lowering the waterside boom segment to a vertical position.

Reference:
Power Engineering Construction Company
Alameda, California, USA


New cranes in blue operating with existing cranes


Cranes operating and new girder construction

Crane Procurement, Crane Modification, and Wharf Expansion
Port Everglades Department of Broward County, Fort Lauderdale, FL

Port Everglades operates seven 1990s, 46.5-LT capacity low profile STS cranes at their Southport terminal for servicing vessels up to 16 containers across. The port is also serving vessels up to 22 containers across with up to 8 high on deck and purchased new 65-LT capacity cranes.

Liftech made studies to determine parameters for the new cranes and identify required upgrades to the landside infrastructure. Liftech provided crane procurement specifications, design review, and fabrication review services for the new cranes fabricated in China.

Liftech designed upgrades for the existing cranes including lift capacity increase from 46.5 to 65 LT and crane structure upgrades to comply with current wind design loads. The upgrade required replacing the existing DC main hoist drive. To simplify maintenance, the main hoist, trolley, boom hoist, and gantry DC drives on the existing cranes were replaced with new AC drives.

Liftech designed 5,000 feet of new crane girders, about 3,500 feet for the new cranes at Berths 30–32, and an additional 1,500 feet for the existing cranes at Berth 30. The new girders were offset from the existing girders, permitting continued operations of the existing cranes during construction, and to suit a larger rail span. The crane girder systems include cable trenches, power vaults, crane stowage locations, rail frogs, and compact crane stops.

Other infrastructure work included a two-story building to house switchgear for a 13.2 kV power supply.

Client:
Port Everglades Department
of Broward County
Fort Lauderdale, Florida, USA

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Berths 57-59 Wharf
Port of Oakland, California

Liftech designed a new 3,600-foot container wharf for the Port of Oakland at Berths 57-59. This $90 million construction project gives the port a state-of-the-art facility designed to resist the highest probable earthquakes with minimum damage. The wharf serves six new container cranes for which Liftech provided design and fabrication review.

The innovative wharf design used 48-inch diameter cylinder piles and standard 24-inch prestressed piles in combination with cement deep soil mixing (CDSM). Liftech also developed a new ductile shear key design for use between wharf sections that is economical and easily repairable.

The project involved excavation of 2.1 million cubic yards of soil; stockpiling, testing, and treating 400,000 cubic yards of material; installation of CDSM walls, large diameter piling, and storm drains; and construction of an embankment dike and fill that was incorporated into Middle Harbor Shoreline Park.

Reference:
Port of Oakland
Oakland, California, USA

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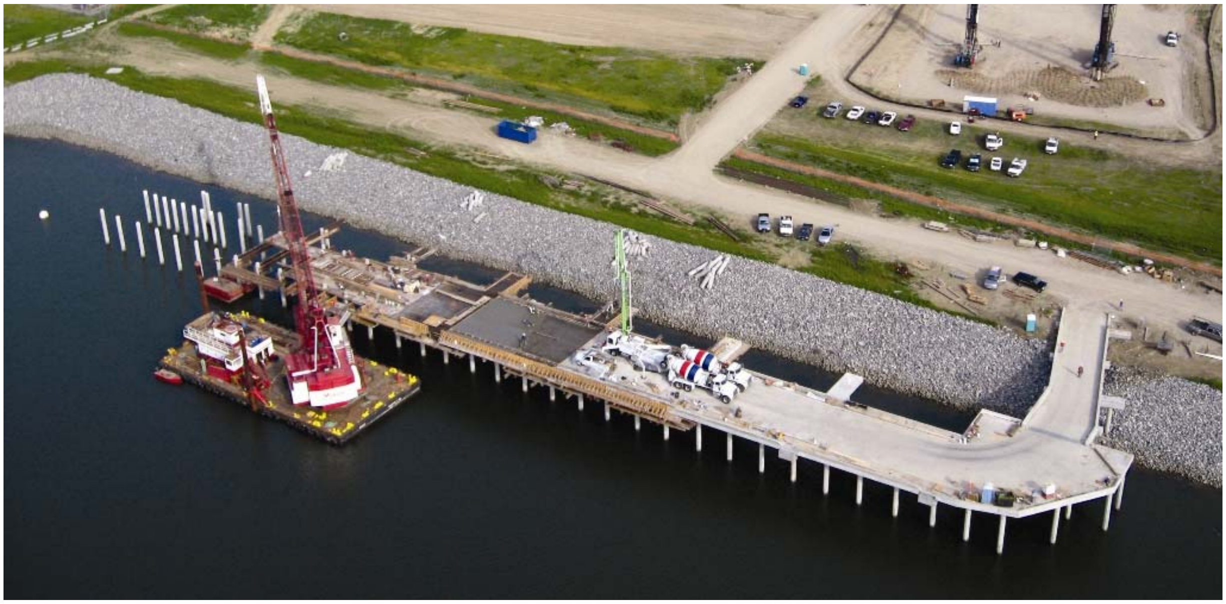

Cemex West Sacramento Wharf Project
Sacramento, California

Liftech worked with Manson Construction as part of their design-build team to design the wharf, access bridge, and mooring platform structures for a cement unloading facility for Cemex Inc. The 550-foot wharf supports a cement unloader and screw conveyor system to transfer cement from the vessel to storage structures on land. The moment frame design for the wharf structure limits seismic forces on the unloader and conveyor structures.

Liftech also made a dynamic analysis of the combined wharf and unloader structure for seismic forces.

Reference:
Manson Construction Company
Richmond, California, USA

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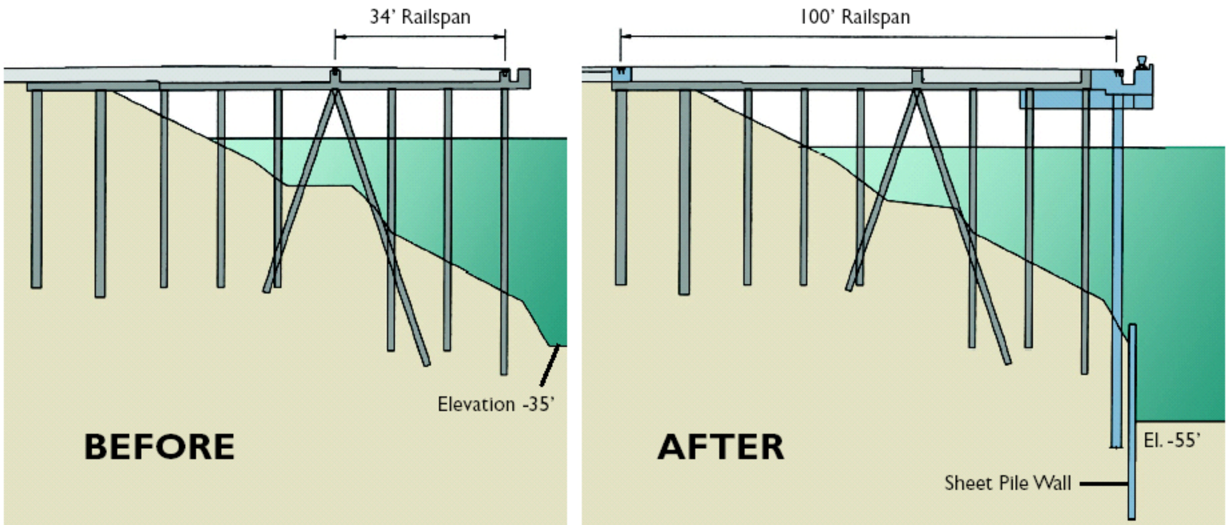


Port of Oakland Berths 32/33 Rehabilitation
Oakland, California

Liftech designed a remodel to a 1,500-foot container wharf for the Port of Oakland at Berths 32/33 and a new 250-foot wharf extension to Berth 30. This $20 million construction project allows 100-foot rail span container cranes to travel from the Berth 30 wharf to the Berths 32/33 wharf. In addition, sheet piling was installed at the toe of the embankment to allow the berth to be dredged to elevation -55 feet. Without the remodel, Berths 32/33 could only accommodate 34-foot rail span cranes, and the cranes could not travel between Berths 32/33 and Berth 30.

Reference:
Port of Oakland
Oakland, California, USA

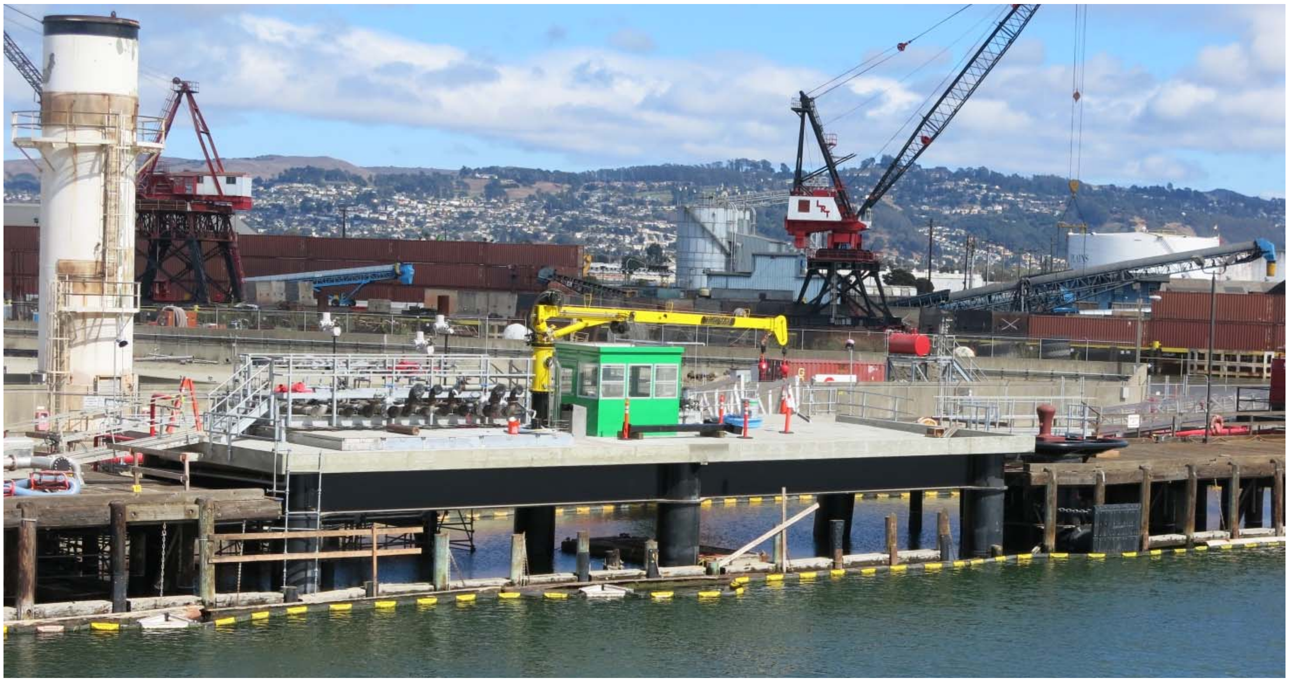
Port of Redwood City Wharf Design
Redwood City, California

Liftech worked with Manson Construction Company as part of their design-build team to design a 426-foot-long wharf, two access bridges, a 955-foot-long sheet pile seawall, mooring platforms, walkways, and a longshoreman building. The moment frame and thin deck of the wharf structure limit the seismic forces and number of piles required.

References:

Manson Construction Company
Richmond, California, USA

Port of Redwood City
Redwood City, California, USA



Marine Oil Terminal, Wharf Replacement
International-Matex Tank Terminals, Richmond, CA

International-Matex Tank Terminals (IMTT) replaced portions of an existing wood wharf structure at their Richmond, California, facility to meet Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS).

Liftech worked with Manson Construction Company to develop the replacement design. The design allowed IMTT to limit time on-site and maintain operations during construction. The design consists of individual steel-framed platforms supported on steel pipe piles and connected walkways. The structure includes two platforms for piping operations and eleven dolphins for mooring and berthing.

Liftech worked closely with California State Lands Commission and other agencies to help obtain necessary permits. This retrofit was the first major project designed and built to meet the MOTEMS code requirements.

Reference:
International-Matex Tank Terminals
Richmond, California, USA

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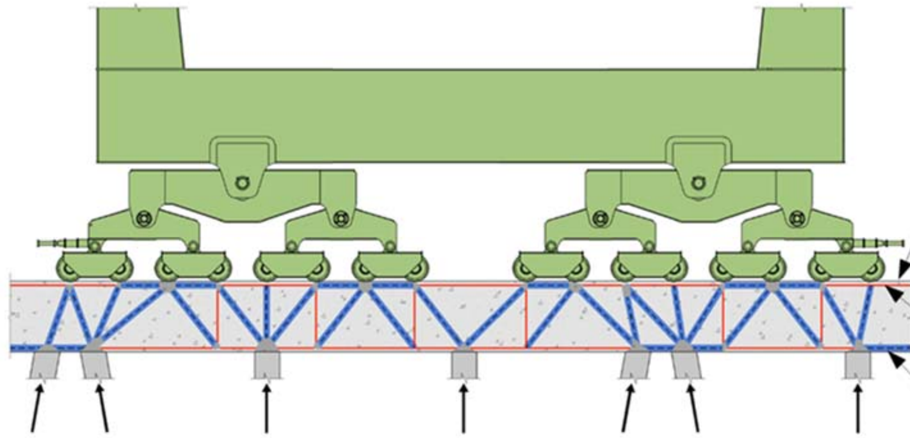

Wharf Crane Girder Capacity Study
Halifax, Nova Scotia, Canada

A Halifax Port Authority tenant purchased new ship-to-shore container cranes. The wharf was extended several times between 1969 and 2010. The new crane wheel loads exceeded the allowable wheel loads on the existing girders. The port authority was faced with the possibility of reinforcing the majority of the girders.

Liftech analyzed the girders and estimated the girder capacity for shear, flexure, concrete bearing, and pile bearing. The capacities of a significant portion of the girders were governed by shear, as calculated with conventional analysis.

Liftech further analyzed these girders using strut-and-tie model analysis as permitted by the concrete design code, and justified up to 70% higher shear capacity. With the advanced analysis, girder reinforcing was limited to only a short span, resulting in significant cost savings for our client.

The figure above shows the concrete girder as a strut-and-tie model.

Reference:
Halifax Port Authority
Halifax, Nova Scotia, Canada

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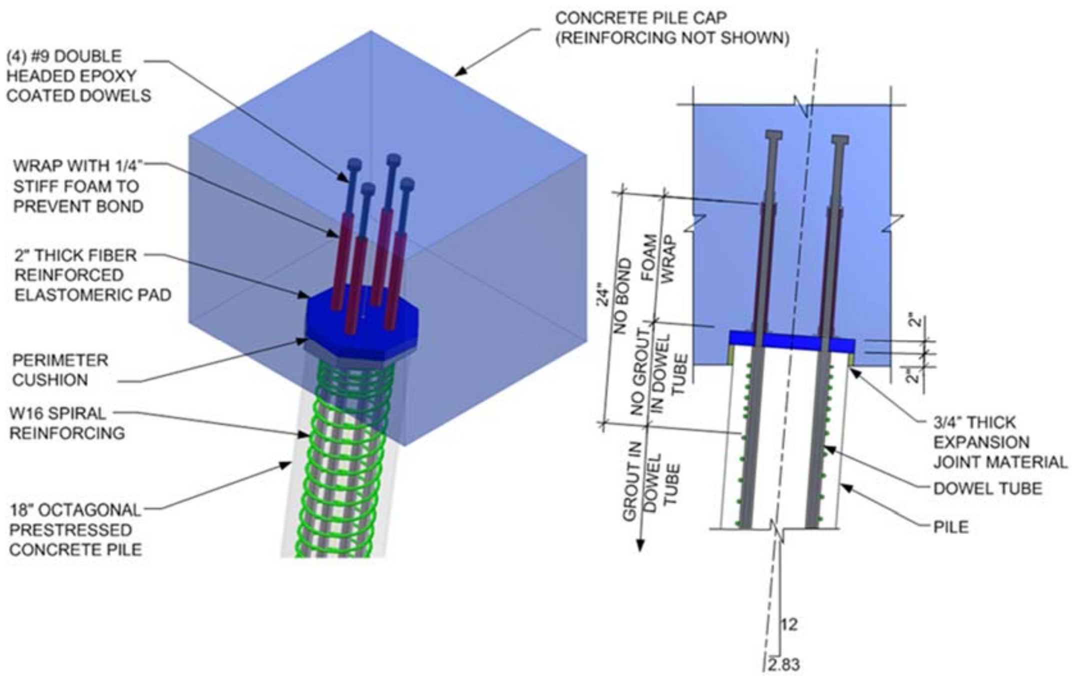

McNears Beach Pier Repair and Seismic Upgrade
Marin County, California

During a storm, a 100’ by 400’ barge broke its mooring and collided with the pier at McNears Beach Park, damaging about half of the pier structure.

The original pier structure consisted of a precast concrete superstructure supported by slightly battered 18” octagonal precast, prestressed piles.

Liftech designed a replacement pier structure with details to provide significantly better seismic performance. These details included pile-to-pile cap connections designed using a fiber reinforced bearing pad, isolating the sides of the embedded pile, and unbonding the dowels for 24” of length. This flexible connection results in considerable elastic rotation.

Testing by the University of Washington has shown that similar connections perform significantly better during seismic loading than a classical pile connection.

Client:
Manson/Dutra JV
Richmond, California, USA

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Wharf and Crane Study
Port of Oakland, California

Liftech conducted an extensive wharf and crane study to help the Port of Oakland in their overall planning. Liftech calculated the ultimate wheel load capacity of all crane rail girders, waterside and landside, at all dockside container wharves for current and future channel depths. Liftech also calculated the wheel loads of all the dockside container cranes at the port. The port can use the calculated capacities to determine which cranes can be relocated from one wharf to another.

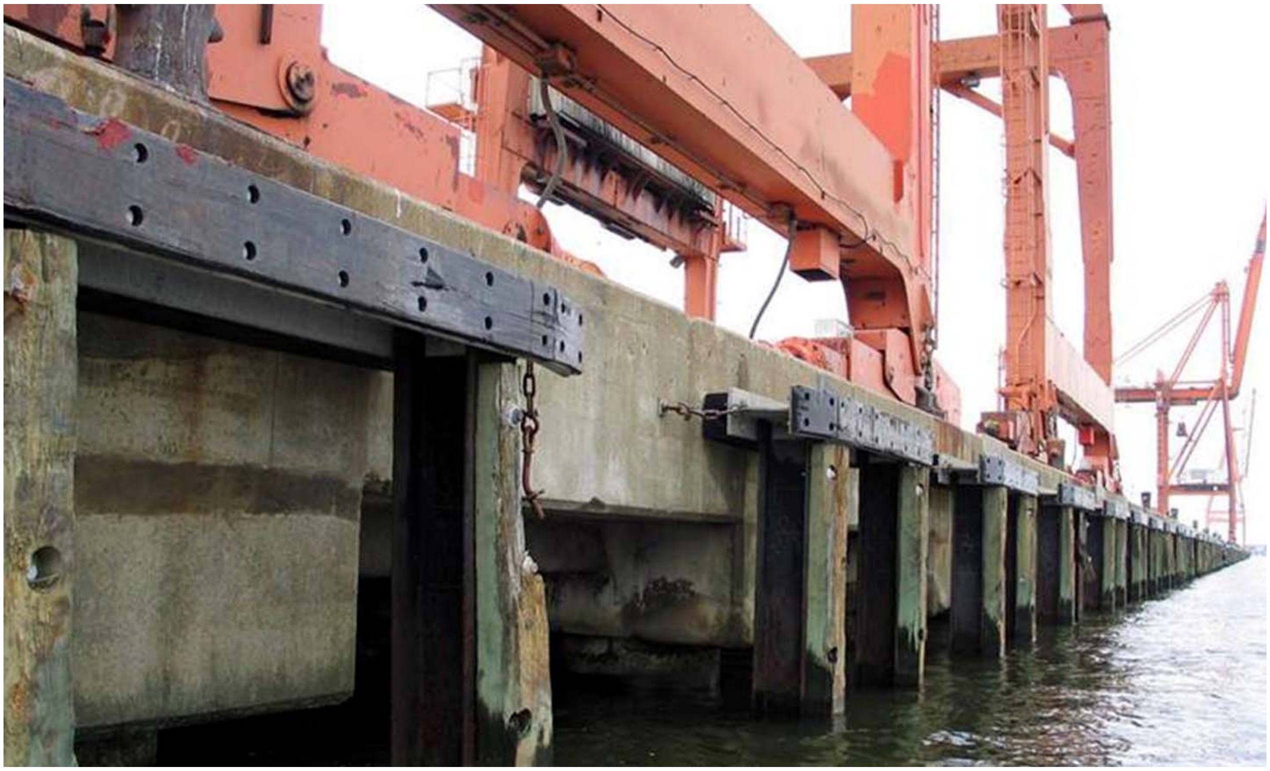
Reference:
Port of Oakland
Oakland, California, USA

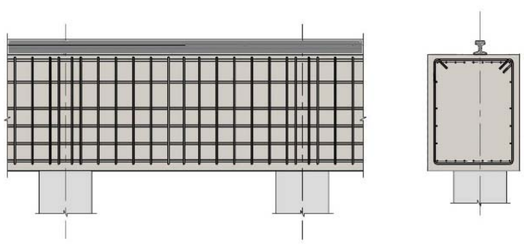
Crane Transfer System Design, Berth 30
Port Everglades, Florida

Many wharves have nonlinear berths that meet at a corner. It is often economical to share cranes between these berths. To share, cranes must transfer between them. Transfer methods range from shuttle systems that move the cranes between the berths to curved rails that the cranes gantry on. Recently, the most popular method has been the curved rail. This seemingly simple method is actually complicated to design and has many options for the owner. Larger curve radii use up valuable yard space. Smaller radii may require a side shift mechanism in the gantry system to accommodate gage change. Extending straight rails to the corner requires switches and a power transfer method.

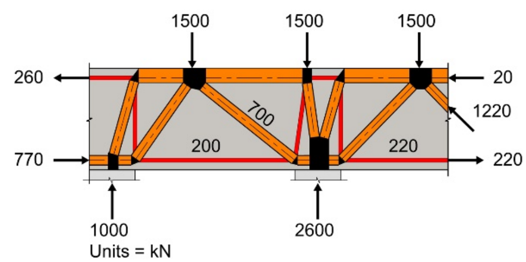
Liftech assisted with the wharf design for a 900-foot berth extension. As subconsultant to Sverdrup, Liftech designed the curved rail, switches, and frogs to enable crane transfer between adjacent perpendicular wharves.

Reference:
Sverdrup Civil, Inc.
Edison, New Jersey, USA





Crane Girder Structure



Strut-and-Tie Model

Wharf Evaluation and Modification
Portsmouth, Virginia

The rated capacity of existing wharf structures was increased up to 35% after Liftech evaluated the strength of the structures at Portsmouth Marine Terminal.

Increasing the rated load eliminated the need to strengthen the wharves or limit the operations of the larger, newly purchased cranes. Liftech's assessment included state-of-the-art methods such as strut and tie.

Liftech also designed improved stowage hardware for both the newly purchased cranes and existing cranes. The design facilitated installation and integration with the existing wharf structures.

Reference:
Virginia Port Authority
Norfolk, Virginia, USA

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Port of New Orleans Wharf Analysis
Port of New Orleans, Louisiana

Global Rigging & Transport unloaded two Doosan cranes at the Port of New Orleans using a dolly system.

Liftech reviewed the wharf structure to determine its adequacy to support the dolly loads and helped select the offload location.

Reference:
Global Rigging & Transport, LLC
Virginia Beach, Virginia, USA

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Stowage Hardware Design
Virginia Port Authority

VPA needed cranes for their Portsmouth Marine Terminal facilities. They purchased three new ZPMC cranes, knowing the PMT wharf had wheel load and other limitations. On the crane side, VPA retained Liftech to work with ZPMC to assist in designing a light-weight truss boom crane for reduced waterside wheel loads. On the wharf side, Liftech reviewed the wharf girders and designed new stowage hardware.

Liftech justified the new crane loading, without requiring VPA to modify the existing wharf, by reviewing the existing wharf using new ACI load factors, assuming reduced dead load factors for as-weighed crane loads, and using more detailed calculation methodologies, such as the strut-and-tie method.

As part of the combined review, Liftech calculated crane tie-down and stowage pin forces and designed new wharf crane stowage hardware to mate with the soon-to-be-delivered new crane stowage systems.

Liftech designed new stowage pin sockets and hurricane tie-down link plates, including design for integration with the existing wharf structure. The new design reduced costs by limiting the amount of field work.

Tie-downs were designed to accommodate crane deflections.

To facilitate handling and tie-down installation, link plates were designed with high-strength steel to reduce weight.

Reference:
Virginia Port Authority
Norfolk, Virginia, USA

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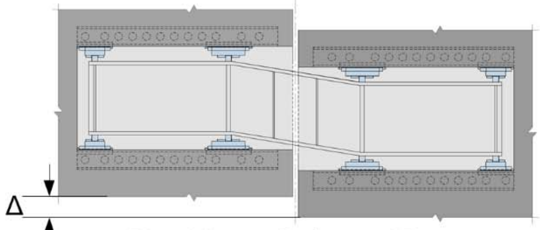
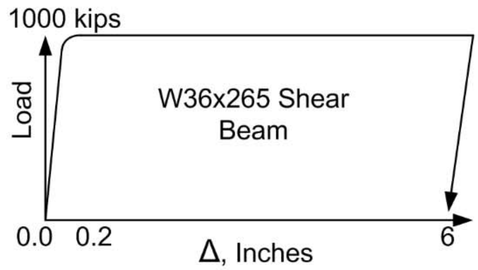
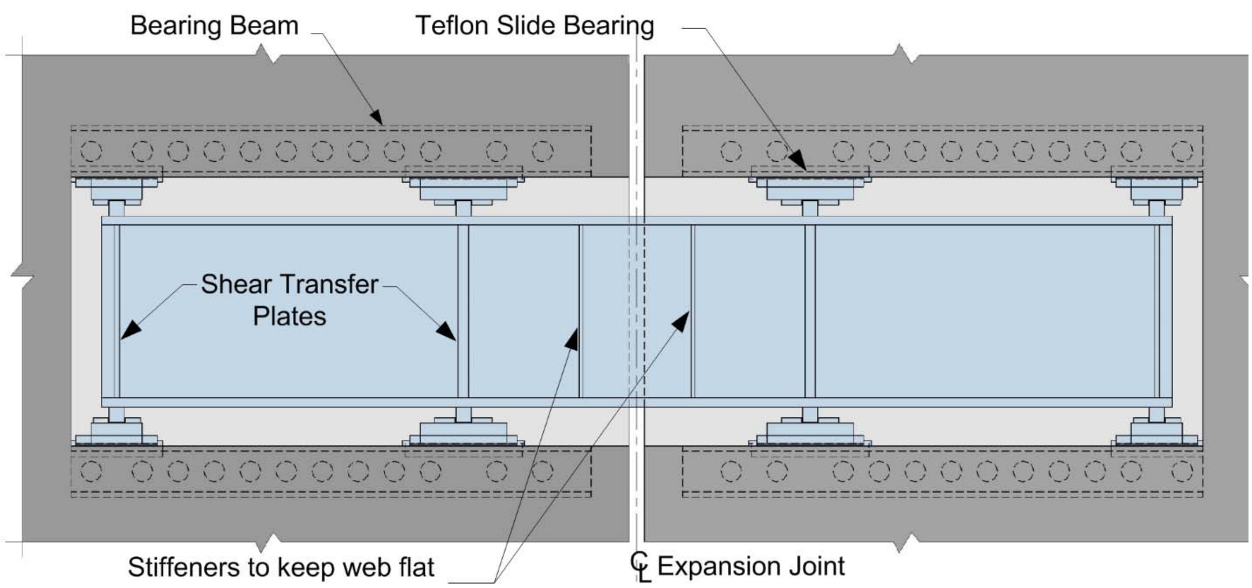


Plan View – Deformed Beam



Beam Installation



Wharf Ductile Shear Key

Shear keys connect wharf sections at expansion joints, permitting relative longitudinal movement between sections while restraining transverse movement. Shear keys experience large loads during earthquakes and are sometimes damaged. Traditionally, keys have been made of reinforced concrete.

The ductile shear key is made of a steel beam. It will yield in a large earthquake and provide significant energy absorption and damping through multiple cycles of deformation. The beam can be easily removed and replaced.

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Finned Monopile

Pile supported dolphins are used to moor and berth vessels. Supporting a dolphin structure with one large pile is often advantageous compared to using multiple smaller piles. One pile is often easier to fabricate and install than a structure with several piles; and fenders, platforms, and other hardware can be secured with one simple connection to the pile, facilitating the use of a prefabricated superstructure.

Large lateral soil pressures develop where the pile enters the soil. If the pressure is too large, the soil might fail plastically and the pile could become out of plumb.

Liftech developed a design in which fins are welded to the pile as shown in the photograph above. The fins develop large forces near the soil surface, reducing the required pile embedment. If an accidental overload occurs, the fins reduce the permanent lateral displacement.

Liftech
LIFTECH CONSULTANTS INC.

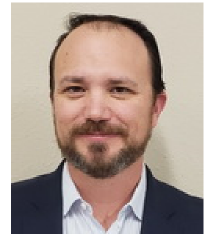
COMPANY PRINCIPALS

Erik Soderberg
President, Structural Engineer
Mr. Soderberg is a skilled designer and project manager. He is experienced in the design, review, repair, and modification of a variety of structural and crane related systems including wharves, container cranes, and bulk loader structures. Other structures include crane lift and transfer systems and concrete and steel floats. He oversees the technical and contractual aspects of Liftech's projects in addition to his design work.

Jonathan Hsieh
Vice President, Structural Engineer
Mr. Hsieh is experienced in design, review, analysis, and modification of container cranes, bulk handling cranes, and special structures. His expertise includes crane procurement, fatigue failure investigation and repair, and computer modeling and analysis. He has also worked on structural maintenance programs, seismic design of container cranes, crane instrumentation, and voyage bracing.

Arun Bhimani
Founding Principal, Past President, Structural Engineer
Mr. Bhimani is an expert in all phases of container crane and wharf design. He has developed innovative solutions to container crane design problems, including a technique for combining analysis with heat straightening for repairing damaged container crane booms, the first seafastening design for transporting fully erected container cranes on barges, and a structural maintenance program used to periodically inspect cranes.

Catherine Morris
Vice President, Structural Engineer
Ms. Morris has a wide range of experience in the design of container cranes, buildings, and miscellaneous special structures. She has worked on all facets of container crane design including designing new cranes, reviewing crane designs, designing modifications, and voyage bracing. She has also reviewed and designed reinforcing for barge structures for transport of various equipment, designed chassis storage racks, and analyzed and designed equipment to lift and replace steam generators in nuclear power plants.



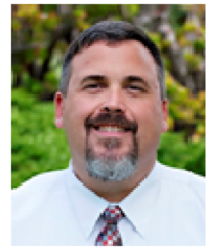
Nicholas Grebe
Principal, Mechanical Engineer
Mr. Grebe has extensive experience performing conceptual and detailed designs of mechanisms and systems, analyzing dynamic mechanical systems, and developing designs and detailed drawings suitable for manufacture. He is responsible for developing purchase specifications and reviewing contractors' mechanical, hydraulic, and electrical designs for feasibility and contract compliance. He is experienced in reviewing heavy machinery and container crane controls including logic, interlocks, system architecture, and automation features. He provides project management, condition assessment, commissioning, troubleshooting, and acceptance testing of material handling equipment including container cranes and bulk loaders.

Sugiarto Loni
Principal, Structural Engineer
Mr. Loni has extensive management experience and design expertise with marine terminal structures including crane-wharf interface, container and intermodal yard structures, building facilities, and marine structures. He is responsible for contract negotiations, technical oversight, and quality assurance of project deliverables. His work includes managing a variety of engineering projects ranging from small projects with short duration to large projects with multi-discipline coordination. As project engineer, he performs civil and structural design of marine terminal facilities, seismic retrofit design of existing building structures, and civil and structural design of wharves and marine structures.

Kenton Lee
Principal, Structural Engineer
Mr. Lee is experienced in design, analysis, and project management of container cranes, floating cranes, rigging, and special structures. He specializes in container and floating crane procurement projects and crane modification projects. He is also involved in preparing structural maintenance programs. Some of the technical aspects of his work that are of special interest to him are steel connection design, wind effects on structures, wind tunnel testing, and structural fatigue of steel structures.

Patrick McCarthy
Principal, Professional Engineer
Mr. McCarthy is experienced in ship-to-shore and port yard container crane procurement, modification, reliability, and repairs. His work includes project management, condition assessment, and developing structural maintenance programs and repair procedures. He is Liftech's manager for developing crane technical specifications and helps clients with various aspects of the crane procurement process, including pre-bid assistance, post-award design and fabrication review, and post-delivery structural assessment. He also has expertise in wind provisions, has been involved in wind tunnel and other wind studies, and is an associate member of the Wind Load Subcommittee of ASCE 7.

Derrick Lind
Principal, Structural Engineer



Mr. Lind is experienced with project management, design, review, analysis, and modification of many types of structures, including container cranes, unique industrial equipment, buildings, wharves, and bridges. He specializes in all facets of crane modification, including crane raises, boom extensions, capacity upgrades, and wheel load feasibility studies. His work has included crane procurement, structural analysis and design, checking shop drawings, developing construction documents, and managing design teams and project budgets and schedules.

Simo Hoite
Principal, Professional Engineer

Mr. Hoite is a registered professional engineer with extensive experience in container crane design, modifications, specifications, and procurement, as well as container and rail terminal operations. His experience includes development of innovative RTG and STS crane designs for container terminals. He is also experienced in the heavy rigging industry and has managed substantial design projects including wharf design.

Anna Dix
Principal, Structural Engineer

Ms. Dix is a registered structural engineer in California with experience in the design and analysis of various steel and concrete structures. Her focus is on ship-to-shore cranes and other structures that reside next to, in, or on top of the water, such as heavy lift and container handling equipment, wharves, and floating cranes. She likes earthquake and fatigue engineering topics and working with clients.

Leah Olson
Principal, Professional Engineer

Ms. Olson has managed multiple wharf and float projects, and has participated in the design, analysis, and modification of wharf and float structures, container cranes, steel barges, and other rigging structures. She has evaluated the behavior of various concrete and steel structures using finite element analysis (FEA) computer software. Her work includes project management, structural analysis and design, and site inspection and reporting.

Di Liu
Principal, Professional Engineer

Mr. Liu is an experienced designer and project manager. His work includes structural analysis, design review, modification review, and feasibility studies of container cranes, wharves, and other structures.