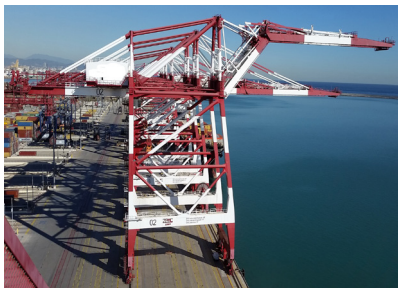
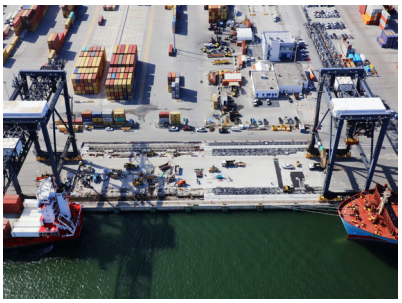
CRANE SERVICES

Liftech Consultants Inc.





Liftech

LIFTECH CONSULTANTS INC.

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COMPANY OVERVIEW
CRANE SERVICES

Liftech Consultants Inc. is a consulting engineering firm, founded in 1964, with special expertise in the design and procurement of dockside container handling cranes and other complex structures. Our experience includes design for wharves and wharf structures, heavy lift structures, buildings, container yard structures, and container handling equipment. We provide structural, mechanical, and electrical engineering services. 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 and functional considerations. We work well with owners, engineers, contractors, and architects.

Crane Design

We design cranes for most of the world's container crane manufacturers.

For Paceco, we developed the original standard A-frame, modified A-frame, low profile quay cranes, and RTG and RMG frame structures that have become the industry standard.

For Mitsubishi, we provided structural design for the first machinery-on-trolley cranes to meet the strict stiffness criteria of the Port of Singapore Authority.

For Paceco, Italimpianti, and Samsung, we designed the then largest low profile cranes and provided designs of articulated boom cranes worldwide.

Most recently, we helped design the largest quay crane for ZPMC with a 100-ton capacity and reviewed many of the manufactured DHT40 (dual-hoist-tandem-40) cranes.

Crane Procurement

We provide crane procurement assistance to port authorities, shipping lines, and terminal operators. Our services range from preparing specifications to complete assistance from the initial needs assessment through final acceptance and warranty, including concept design, crane load studies, technical specifications, bid evaluation, comprehensive design review, quality assurance audits, fabrication oversight, voyage bracing review, offload review, and commissioning services.

Liftech created the first comprehensive technical specifications for STS container cranes and has continuously improved them to remain the industry-leading specifications in use today. We have written specifications to assist in procuring hundreds of container cranes. We work with the crane owner to develop site-specific and other requirements tailored to the owner's needs. Our specifications include provisions for structural, mechanical, electrical, controls, automation, reliability, manufacturing, documentation, testing, seismic performance, and other requirements.

Crane Assessment, Maintenance, and Modification

We help clients by assessing crane equipment and providing recommendations for maintenance, modification, or purchase. Our services include condition surveys, useful life assessment, reliability studies, structural maintenance and inspection programs, repair procedures for defects discovered during inspections, and modification design. We design modifications for improving reliability, increasing the lift height, extending the outreach or backreach, increasing the capacity, changing the rail span, improving seismic performance, and others. We design jacking systems used to raise cranes while dramatically decreasing the out-of-service time for the crane.

Liftech helps clients resolve persistent maintenance and reliability issues through improved designs and modifications of existing equipment. Using a combination of experience, analysis, testing, and known good designs, we can help identify the root cause of failures and design practical modifications to reduce or eliminate causes of downtime and ease maintenance burdens.

Crane Relocation / Sea Transportation

We provide engineering for transporting cranes, oil processing modules, offshore oil structure components, bridges, and other miscellaneous equipment on barges and ships. Our services include reviewing the procedures for moving the object onto and off of the vessel, designing attachments to the vessel, designing required reinforcing for the object and/or vessel structures, reviewing the object and vessel structures for voyage forces, and reviewing the wharf (or wharves) for the crane transport loading.

Crane Repair, Failure Analysis, and Expert Witness

We are often called upon for consultations for damaged cranes and accident investigations. Liftech uses our industry leading expert knowledge, familiarity with a wide range of designs, and expert analysis to provide clients with insight into the cause of crane failures and for designing repairs and modifications to prevent reoccurrences.

Our repair services include assessing the situation, designing temporary securing, designing repairs, and reviewing the repair work. Repair projects typically include damage caused by fatigue, crane-to-crane and vessel-to-crane collisions, boom hoist failures, snag, storm wind, tornadoes, earthquakes, and others. Repairs typically involve replacing members, strengthening local areas, and heat straightening. We are occasionally retained as an expert witness to assess crane accidents, evaluate repair estimates, and help resolve disputes.

Crane Transfer Systems

We designed many systems for transferring container cranes between non-linear berths including above ground shuttles, below ground shuttles, turntables, and curved rails with and without switches. We developed a computer program that calculates the near optimal curved rail geometry that typically avoids the need for a side shift mechanism between the crane and its gantry system.

Heavy Lift Design and Review

Liftech provides structural design and review of heavy lift procedures including criteria; lift systems, such as jacking systems and cranes; and various hardware. Projects include nuclear power plants, offshore platforms, blimp hangar repairs, and others.

Our expertise also includes structural design and review of large land-based and floating cranes. We have helped design and review cranes of capacity up to 12,000 t. Examples include assistance with the 1,700 t floating crane that erected the major components of the San Francisco-Oakland Bay Bridge self-anchored suspension span and the Bigge AFRD land-based ringer cranes. We have worked on several other specialized, confidential crane systems that have major impacts in their marketplace.

Material Handling Equipment

Liftech provides design and analysis services for a variety of material handling equipment including loaders, unloaders, stacker reclaimers, and hydraulic excavators. Our services include procurement assistance, design, condition review, repair design and assessment, oversight of repairs, inspection programs, fatigue cracking analysis and reliability studies, and seismic analysis and advice.

Equipment Transportation

We provide engineering for the transportation of cranes, oil processing modules, offshore oil structure components, and miscellaneous equipment on barges and ships. Our services include reviewing the structures and the vessels for voyage forces, designing any required reinforcing for the cargo, vessel, or both, and designing the attachments to the vessel.

Other Structures

We provide design and review services for a variety of other structures that often require a unique understanding of mechanics and are sometimes not covered by standard building codes. We are well suited to work on these structures due to our familiarity with dynamically loaded structures that undergo their design loading on a regular basis and our unique design experience and understanding of mechanics, load paths, and stability.

Crane Analysis Software

We developed a proprietary program for the design and analysis of quay cranes and other container handling equipment. The program is capable of designing or analyzing cranes for the various international standards. We have licensed this software to select crane manufacturers.

More Information

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

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SELECTED STS CRANE DESIGN AND PROCUREMENT REVIEW PROJECTS

User/Client Name Project Location	Start Year	Crane Supplier and Crane Type (Twin-20' STS, unless noted)	Number of Cranes	Services Provided						
				Technical Specifications	Design Assistance	Design Review	QA/QC Audit & Mfg. Review	Assembly / Shipping Review	Testing / Acceptance Review	Contract Management
ICAVE Veracruz, Mexico	2024	ZPMC	1			✓ Cursory	✓	✓		
Terminal Catalunya S.A. Barcelona, Spain	2024	ZPMC, Articulated boom	2		✓	✓	✓	✓		
SICTL Sydney, Australia	2024	ZPMC, Articulated boom	2		✓	✓	✓	✓		
Laemchabang Terminal Thailand	2024	ZPMC	3			✓ Cursory	✓	✓		
Red Sea Container Terminal Sokhna Port, Egypt	2024	ZPMC	6			✓	✓	✓		
Confidential	2024	ZPMC Special boom	4			✓	✓	✓		
ICAVE Veracruz, Mexico	2023	ZPMC	1			✓ Cursory	✓	✓		
Laemchabang Terminal Thailand	2023	ZPMC	4			✓ Cursory	✓	✓		
Confidential	2023	ZPMC, Articulated boom	4		✓	✓	✓	✓		
Virginia Port Authority Norfolk, Virginia	2023	ZPMC, Low Profile	4	✓	✓	✓	✓	✓		
Confidential	2023	SANY	4		✓	✓				
CMA Terminals Khalifa LLC Khalifa, Abu Dhabi	2022	ZPMC	8			✓ Cursory				
ICAVE Veracruz, Mexico	2021	ZPMC	1			✓ Cursory	✓	✓		
Confidential	2021	SANY	5		✓	✓				
Laemchabang Terminal Thailand	2021	ZPMC	4			✓ Cursory	✓	✓		

User/Client Name Project Location	Start Year	Crane Supplier and Crane Type (Twin-20' STS, unless noted)	Number of Cranes	Services Provided						
				Technical Specifications	Design Assistance	Design Review	QA/QC Audit & Mfg. Review	Assembly / Shipping Review	Testing / Acceptance Review	Contract Management
SSA Atlantic Jacksonville Container Terminal Jacksonville, Florida	2021	ZPMC	1	✓		✓				
Manzanillo Int'l. Terminal Panama	2021	ZPMC	2	✓		✓	✓			
San Antonio Terminal Internacional, SA San Antonio, Chile	2021	ZPMC	2	✓		✓		✓		
Maher Terminals Elizabeth, New Jersey	2021	Liebherr	3	✓	✓	✓	✓	✓	✓	
DP World Prince Rupert, BC, Canada	2020	ZPMC	1	✓ Review		✓	✓	✓		
DP World Vancouver, BC, Canada	2020	ZPMC	2	✓ Review		✓	✓	✓		
Confidential	2019	HSHI	4		✓	✓				
Everport Terminal Services Oakland, California	2019	ZPMC	1	✓						
Everport Terminal Services Los Angeles, California	2019	ZPMC	2	✓		✓				
Evergreen Kaohsiung, Taiwan	2019	ZPMC	8	✓		✓				
Confidential	2019	ZPMC, Low Profile	3	✓	✓	✓	✓	✓		
Abu Dhabi Terminals Khalifa Port	2018	ZPMC	10			✓	✓			
Laemchabang Terminal Thailand	2018	ZPMC	3			✓		✓		
Eagle Marine Services Los Angeles, California	2018	ZPMC	4	✓ Review		✓	✓	✓		
Virginia Port Authority VIG & NIT, Virginia	2018– 2024	ZPMC	4+4+ 4+4				✓	✓	✓	

User/Client Name Project Location	Start Year	Crane Supplier and Crane Type (Twin-20' STS, unless noted)	Number of Cranes	Services Provided						
				Technical Specifications	Design Assistance	Design Review	QA/QC Audit & Mfg. Review	Assembly / Shipping Review	Testing / Acceptance Review	Contract Management
Northwest Seaport Alliance Tacoma, Washington	2018	ZPMC	4	✓		✓	✓	✓	✓	✓
San Vicente Terminal Inc. San Vicente, Chile	2017	ZPMC	2	✓		✓	✓	✓		
Freeport Container Port Freeport, Grand Bahama	2017	ZPMC	3			✓	✓	✓		
ICAVE Veracruz, Mexico	2017	ZPMC	3			✓	✓	✓		
SPRC + CONTECAR Cartagena, Colombia	2016	ZPMC	2+4			✓	✓	✓	✓	
SSA Manzanillo Manzanillo, Mexico	2016	ZPMC	2	✓		✓		✓		
Hongkong Int'l. Terminals Hong Kong	2016	SANY	1		✓	✓	✓	✓		
DP World Prince Rupert, BC, Canada	2016	ZPMC	3			✓	✓	✓		
Modern Terminals, T1 & T2 Hong Kong	2016	ZPMC	5			✓	✓	✓		
Yantian Int'l. Container Terminal, West Port Shenzhen, China	2016	ZPMC Truss boom	2			✓	✓	✓		
DP World, Centerm Vancouver, BC, Canada	2015	ZPMC	1	✓ Review		✓	✓	✓		
Port of Tacoma Tacoma, Washington	2015	ZPMC	4	✓		✓	✓	✓	✓	✓
Yantian Int'l. Container Terminal, Phase 3 Shenzhen, China	2015	ZPMC 4 Conventional 3 Truss boom	4		✓	✓	✓			
SPRC + CONTECAR Cartagena, Colombia	2014	ZPMC	2+3			✓	✓	✓	✓	
SSA Manzanillo Manzanillo, Mexico	2014	ZPMC	2	✓		✓		✓		

User/Client Name Project Location	Start Year	Crane Supplier and Crane Type (Twin-20' STS, unless noted)	Number of Cranes	Services Provided						
				Technical Specifications	Design Assistance	Design Review	QA/QC Audit & Mfg. Review	Assembly / Shipping Review	Testing / Acceptance Review	Contract Management
San Antonio Terminal Int'l. San Antonio, Chile	2014	ZPMC	2	✓		✓		✓		
Manzanillo Int'l. Terminal Panama	2014	ZPMC	4	✓		✓	✓	✓		
Maher Terminals Elizabeth, New Jersey	2014	Liebherr	2	✓		✓				
Port Authority of Altamira Mexico	2014	ZPMC	2		✓	✓		✓		
TransHoist, Port of Gulfport Gulfport, Mississippi	2014	ZPMC	3	✓		✓	✓	✓	✓	
ICAVE Veracruz, Mexico	2013	ZPMC	2			✓	✓	✓		
SSA, Tuxpan Port Veracruz, Mexico	2014	ZPMC	4	✓		✓	✓			
Evergreen Kaohsiung, Taiwan	2013	ZPMC	5	✓		✓	✓	✓		
Evergreen Los Angeles, California	2013	ZPMC	3	✓		✓	✓	✓		

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SELECTED CRANE PROJECTS
ASC, RMG, RTG, RGC

Client Name Project Location	Start Year	Crane Supplier	Number of Cranes	Services Provided							
				Cost Study	Technical Specifications	Design Assistance	Design Review	QA/QC Audit & Mfg. Review	Assembly / Shipping Review	Assessment or Repair	Contract Management
DP World Vancouver Vancouver, Canada	2020	ZPMC	5 RMG		✓ *Review*		✓	✓	✓		
Confidential USA	2018	Konecranes	2 RTG				✓				
Hongkong International Terminals, Hong Kong	2018	Mitsubishi	Several RMG							✓	
Tanger-Med 2 SA Tangier, Morocco	2017	Kunz	32 RMG					✓			
Cascade Steel McMinnville, Oregon	2016	Danieli	2 RMG							✓	
Evergreen Marine Corp. Colon, Panama	2016	ZPMC	4 ARMG		✓		✓				
Paceco España Madrid, Spain	2015	Paceco España	1 RMG			✓					
SSA Mexico Tuxpan, Mexico	2014	ZPMC	8 ASC		✓		✓				
GCT Canada Vancouver, BC, Canada	2014	Kunz	8 RMG		✓						
TSI Terminal Systems, Inc. Vancouver, BC, Canada	2014	Konecranes	4 RTG		✓						
Crane Services of America Tuxpan, Veracruz, Mexico	2014	ZPMC	8 ASC		✓		✓				
Manzanillo International Terminals, Panama	2012	ZPMC	6 ASC		✓		✓				
Confidential Maasvlakte 2 Rotterdam, Netherlands	2012	Kunz	26 ARMG 2 RGC				✓				
Confidential Jebel Ali, UAE	2012	ZPMC TGPC	50 ARMG 50 ARMG				✓	✓	✓		

Client Name Project Location	Start Year	Crane Supplier	Number of Cranes	Services Provided							
				Cost Study	Technical Specifications	Design Assistance	Design Review	QA/QC Audit & Mfg. Review	Assembly / Shipping Review	Assessment or Repair	Contract Management
Felixstowe Dock & Railway Company, Felixstowe, UK	2012	Liebherr	1-4 RMG				✓				
Ancon Peru	2011		3 RTG		✓						
Long Beach Container Terminal, California	2011	ZPMC	70 ASC 5 RMG		✓	✓	✓				
Confidential Singapore	2010	Doosan	100 RTG							✓	
TECON Santa Catarina Itapoà Terminal, Brazil	2009	ZPMC	11 RTG		✓		✓	✓	✓		✓

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SELECTED CRANE MODIFICATION PROJECTS

Client & Location	Mod. Year	Manufacturer & Year	Project Description
Terminal Rio de la Plata Buenos Aires, Argentina	2024	Liebherr, 1 crane, 1996	Structural engineering to increase gantry wheel span from 18.5 m to 31.4 m, extend the boom for two additional containers of outreach, and for crane local relocation. Services included feasibility studies, structural analyses, modifications design, wheel load and stability review, mechanical and electrical review and design for modifying the boom hoist reeving, and reviewing the relocation contractor's concept and procedures.
Mott MacDonald Port of Portland Portland, Oregon	2023	ZPMC, 2 cranes, 2005	As subconsultant to Mott MacDonald, Liftech assisted with engineering services for crane raise feasibility and grant application for increasing the lift height by 6 m, from 29 m to 35 m.
Modern Terminals Hong Kong	2022	ZPMC, 2 cranes, 2016, 2018	Provided design, design review, and fabrication review for increasing the main hoist lift height by 5.5 m, from 42.5 m to 48 m and extending the outreach by 2.5 m, from 62.5 m to 65 m.
Everport Terminal Services Oakland, California	2022	ZPMC, 2 cranes, 2010	Provided feasibility study, and concept design for increasing the main hoist lift height by 12 m, from 40 m to 52 m, with services similar to Everport Tacoma, below.
Terminales Rio de la Plata Buenos Aires, Argentina	2021	ZPMC, 1 crane, 2008	Provided a feasibility study and concept design for extending the boom outreach by 5.5 m, from 50 m to 55.5 m, and extending the lift height by 6.0 m, from 36 m to 42 m. (ongoing project)
Everport Terminal Services Tacoma, Washington	2021	ZPMC, 7 cranes, 2004–2006	Provided structural and limited mechanical services to increase the main hoist lift height by 12 m, from 40 m to 52 m, including: (1) evaluating the main hoist drum, (2) performing a seismic study, structural analysis, and modification concept design drawings to upgrade the seismic design to current standards, (3) developing crane modification technical specifications, (4) reviewing bids for technical compliance, (5) crane structural modification design review and wheel load and stability review for crane during jacking and in service, (6) sensibility review of jacking system and review connections between jacking frame and crane, (7) structural fabrication audit for manufacturing in China and field work in Tacoma, (8) limited mechanical design review for main hoist drum replacement and gantry cable reel, (9) limited electrical review for electrical modifications.
Manzanillo International Terminal Colon, Panama	2019	ZPMC, multiple cranes	Provided structural design review to raise eight STS cranes in Panama to serve larger ships, and potentially for other terminals in Mexico and Chile. Previously assisted with crane procurement, including technical specifications. Also reviewed the crane raise procedures and the jacking frame erection/relocation methods.

Client & Location	Mod. Year	Manufacturer & Year	Project Description
Port of Oakland Oakland, California	2019	ZPMC, late 1990s	Estimated wheel loads to determine feasibility of a 26 ft crane raise. Reviewed design of raise, jacking frame, and fabrication. Periodically visited the site to review fabrication workmanship. Amended original specifications to include raise components.
APM Terminals Tangier, Morocco	2017	ZPMC, 2013	Provided structural design review to raise four STS cranes by 9 m, from 41 m to 50 m.
Maher Terminals Elizabeth, New Jersey	2016	Fantuzzi, 2003	Provided crane raise technical specifications to raise five STS cranes to increase the lift height from 120 ft to 165 ft. Also performed design review for the crane and the jacking system, and limited fabrication review
Maher Terminals Elizabeth, New Jersey	2016	ZPMC, 2006	Provided structural engineering study to increase lift height of STS cranes from 120 ft to 140 ft, 155 ft, and 160 ft. Also provided study for lift height increase of 165 ft with the existing 200 ft outreach and for a 215 ft future outreach.
Barcelona Europe South Terminal Barcelona, Spain	2016	ZPMC, 2012	Provided a feasibility study for a 5 m raise for 11 STS articulated boom cranes. Reviewed specifications, structural design, submittals, and fabrication.
ZPMC/PSA Zeebrugge, Belgium	2015	ZPMC, 2007	Provided a feasibility study for crane modification of a 4 m raise and a 0.5 m gage change.
McKay International Engineers Long Beach, California	2015	ZPMC, 2001	Provided construction documents and bid support for a 32 ft crane raise. Reviewed submittals and fabrication.
APM Terminals Los Angeles, California	2015	Noell, 2000	Provided peer review services for design to modify ten cranes for a 33 ft raise and 15 ft boom extension. Reviewed specifications.
West Basin Container Terminal San Pedro, California	2013	ZPMC, 2011	Designed structural modification concept to raise four STS cranes 26 ft. Reviewed fabrication drawings and provided construction support. Reviewed the jacking frame structural design.
APL Limited Los Angeles, California	2013	Noell, 1995	Designed structural modifications to raise STS cranes 35 ft.
Terminales Rio de la Plata Buenos Aires, Argentina	2013	ZPMC, 2005 & 2007	Designed structural modifications of two STS cranes to extend the boom outreach by 6 m from 45 m to 51 m. The cranes have double trapezoidal box boom girders. Also, reported the revised wheel loads and uplift loads.
McKay International Engineers Port of Long Beach, California	2013	ZPMC	Designed structural modifications to 14 STS cranes to serve larger vessels.
APL Limited Los Angeles, California	2012	Noell, 1995	Designed structural modifications of 12 STS cranes to increase backreach from 50 ft to 75 ft, including new festoon supports and walkways.
Confidential Saudi Arabia	2012	ZPMC, 2009	Designed structural modifications for two types of STS cranes to compensate for 150 mm landside rail settlement.

Client & Location	Mod. Year	Manufacturer & Year	Project Description
Confidential United States	2012	310 t capacity goliath crane, 1969	Studied upgrade and replacement options, including cost and schedule estimates, for an existing goliath crane. Developed repair concepts.
Whitney Bailey Cox & Magnani Dundalk Terminal Maryland	2011	IHI, IMPSA	Studied concepts to raise cranes by 10 ft and extend outreach by 12 ft.
Fay, Spofford & Thorndike Massport, Boston, Massachusetts	2010	Kocks low profile, 1981	Designed crane frame reinforcement for hurricane winds and modifications for crane-wharf interface for relocation from Oakland to Boston. Designed crane voyage bracing.
Yantian International Container Terminals Ltd. Shenzhen, China	2010	SPMP, 2004 & 2006	Designed crane frame reinforcement for typhoon winds, new tie-downs, and crane stowage hardware.
APL Limited Dutch Harbor, Alaska	2010	Mitsui, 1987	Designed structural modifications to change crane gage from 24 m to 15 m and voyage bracing for transport from Taiwan to Alaska.

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SELECTED CRANE ASSESSMENT PROJECTS

Client & Location	Year	Crane Supplier & Crane Type (Twin-Lift STS typical)	Number of Cranes	Services Provided									
				Health Assessment				Damage Assessment					
				Condition Survey	Inspection Program	Life Assessment	Repair Program	Earthquake	Voyage Collision	Hurricane	Vibration	Fatigue or Operations	Corrosion
Maher Terminals New Jersey	2020	Fantuzzi A-frame	5		✓								
DP World Canada, Saint John, NB, Canada	2018	Paceco A-frame	2		✓								
TOTE Maritime Jacksonville, Florida	2018	Kocks & CMI A-frame	4	✓									
McKay Int'l. Engineers Benicia, California	2017	Bulk Loaders	2	✓		✓							
Douala International Terminal, Cameroon	2015	IHI A-frame	2	✓		✓							
CH2M New York and Baltimore	2015	Asset maintenance and renewal		✓		✓							
Red Team Northport, Malaysia	2015	IMPSA A-frame	5	✓	✓		✓						
Virtual Investment Group Singapore	2012	Krupp Coal Loader	1	✓	✓								
Matson Navigation Hawaii	2012	Barge Crane	1						✓				
Matson Navigation Hawaii	2010 to 2012	Barge Cranes & Runway Girders	2	✓	✓		✓						
Rio Tinto Alcan Quebec, Canada	2011	Heyl & Patterson, Inc. Unloader	2	✓									

Client & Location	Year	Crane Supplier & Crane Type (Twin-Lift STS typical)	Number of Cranes	Services Provided									
				Health Assessment				Damage Assessment					
				Condition Survey	Inspection Program	Life Assessment	Repair Program	Earthquake	Voyage Collision	Hurricane	Vibration	Fatigue or Operations	Corrosion
Freeport Container Port Grand Bahama	2011	Hyundai Monogirder	9	✓	✓		✓			✓			
Freeport Container Port Grand Bahama	2010	OMG Monogirder	4	✓			✓			✓			
Panama Ports Corp. Panama	2010	Samsung & Hitachi	2	✓			✓						✓
Confidential	2010	Paceco Torque Unloader	1	✓	✓		✓						
PSA Corporation Singapore	2009	MGM, MHI, and MES A-frame	6	✓	✓	✓	✓						
Jakarta Int'l. Container Terminal Jakarta, Indonesia	2009	Hitachi	1	✓								✓	
Jakarta Int'l. Container Terminal Jakarta, Indonesia	2009	Gunanusa Paceco	2	✓									
Confidential	2008	MES Grab Unloader & Babcock-Moxey Stacker Reclaimer	2	✓	✓		✓						
DP World Southampton, UK	2008	Morris A-frame	7	✓	✓								
Yantian Int'l. Container Terminals West Port Shenzhen, China	2008	SPMP A-frame	3	✓	✓	✓	✓						
McKay Int'l. Engineers Benicia, California	2007	ZPMC A-frame	14				✓					✓	

Client & Location	Year	Crane Supplier & Crane Type (Twin-Lift STS typical)	Number of Cranes	Services Provided									
				Health Assessment				Damage Assessment					
				Condition Survey	Inspection Program	Life Assessment	Repair Program	Earthquake	Voyage Collision	Hurricane	Vibration	Fatigue or Operations	Corrosion
COSCO-HIT Hong Kong	2007	IHI Articulated boom, A-frame	4	✓	✓		✓						✓
Price Companies Inc. Oklahoma	2007	Log Handling Crane	1	✓	✓		✓						
Maryland Port Administration Baltimore, Maryland	2006	Price Revolver	1	✓			✓				✓	✓	
Marine Technical Services, Inc. Los Angeles, California	2006	AmClyde Revolver	1	✓	✓		✓					✓	
Manzanillo Int'l. Terminal Panama	2006	Hyundai A-frame	1				✓					✓	
Manzanillo Int'l. Terminal Panama	2006	ZPMC A-frame	6				✓				✓	✓	
APM Terminals New Jersey	2006	ZPMC Underhung trolley	6	✓	✓		✓					✓	
Hongkong Int'l. Terminals Ltd. Hong Kong	2006	ZPMC A-frame	1				✓				✓	✓	
USS-Posco Industries Pittsburg, California	2006	Paceco A-frame	2				✓					✓	
Hongkong Int'l. Terminals Ltd. Hong Kong	2006	MHI RMGC	24				✓					✓	
ZPMC, China FDRC, UK	2006	ZPMC A-frame	1						✓				

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Port Everglades Low Profile Crane Procurement
Port Everglades Department of Broward County, Fort Lauderdale, FL

Port Everglades (PED) serves vessels up to 22 containers across and 8 high on deck at their Southport terminal with three new 65-LT capacity low profile STS cranes procured from ZPMC China with help from the Liftech team, also including McKay International Engineers, Leader Firm International, and Liftech Shanghai Limited. At the time of construction, these were the three largest low profile cranes in the world. PED also operates seven 1990s, 46.5-LT capacity Samsung low profile STS cranes to serve vessels with up to 16 containers across.

The Liftech team determined parameters for the new cranes, prepared preliminary design of the cranes, and provided engineering services to upgrade the wharf girders and infrastructure. Liftech provided crane procurement services including developing crane specifications, design review, manufacturing review, and commissioning audit. Liftech also helped prepare crane purchase contract documents and collaborated closely with PED throughout the project including crane receiving, commissioning, and acceptance at PED.

McKay (now merged with Liftech) provided mechanical and electrical engineering design review, manufacturing audit, and commissioning services.

Leader Firm, a Shanghai-based inspection agency, provided third-party manufacturing audit services at the ZPMC facilities. Liftech Shanghai Limited personnel helped coordinate the project with ZPMC and Leader Firm and monitored the manufacturing schedule.

Some key challenges that Liftech helped resolve included:

(1) crane concept and geometry design for ship, wharf, and aircraft clearance limitations

(2) crane weight, interaction with new wharf girders, and inertial loading for large shifts in crane center of gravity due to shuttling boom

(3) design and fabrication considerations for boom supports design and for boom camber and deflections for aircraft clearance

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

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Low Profile Crane Procurement
Sydney International Container Terminals Pty Ltd

Liftech assisted Sydney International Container Terminals Pty Ltd with structural design and review of four post-Panamax ZPMC low profile shuttle boom cranes for their new container terminal across from an airport in Sydney, Australia.

Liftech participated in the conceptualization and design of the shuttle boom structure, the boom hangers, and the crane structure. Liftech's work included assisting with design, design review, fabrication observation, and seafastening review.

The key design issues were related to the truss boom and the boom hangers, which are unique to shuttle boom cranes.

The key parameters are:

Rail span	35 m
Overall height	52 m
Outreach	50 m
Container lift height	34 m above rail

Reference:
Hutchison Port Holdings
Hong Kong

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Crane Procurement
Port of Houston, Bayport Terminal
Houston, Texas

Port of Houston purchased three dockside container cranes from ZPMC for Bayport Terminal. Liftech provided the technical specifications, reviewed the structural and mechanical designs, and provided fabrication support for the new cranes. We also reviewed the manufacturer's structural maintenance program.

Prior to the purchase of the cranes, Liftech provided a study to estimate the crane wheel load and tie-down forces. The cranes are designed for hurricane winds and large uplift forces.

Owner:
Port of Houston Authority
Houston, Texas, USA

Manufacturer:
ZPMC
Shanghai, China

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Dual Hoist Tandem Lift Crane Procurement

Liftech provides structural engineering services for procurement of dual hoist, tandem lift cranes. Some projects include:

Yantian International Container Terminals Ltd., Shenzhen, China	30 cranes
Shenzhen Dachan Bay Terminal Shenzhen, China	24 cranes
Port of Singapore Authority Singapore	23 cranes

Liftech and McKay International Engineers provide the conceptual design for the mechanism docking the two independent headblocks and for stowing the headblock under the trolley. These cranes have differing designs stemming from our headblock interface concept.

Our services include preparing technical specifications; evaluating the technical portions of the tenders; reviewing structural, mechanical, and seafastening designs; manufacturing and commissioning review; and follow- through services after the cranes are placed in service.

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Long Beach Container Terminal Crane Modification
Long Beach, California

Long Beach Container Terminal wanted to raise five IHI dockside cranes and extend the outreach to accommodate larger vessels. Liftech provided the design of the modifications to Bickerton Iron Works to raise the 1980's container cranes by 10 feet and extend the boom 10 feet. Two years later, Liftech provided the design to raise the cranes an additional 20 feet for a total of 30 feet lift height increase. Liftech also designed a jacking frame for Bickerton Iron Works that allows them to raise each crane in less than a week.

Reference:
Bickerton Iron Works
Torrance, California, USA

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Kocks Crane Modification and Relocation
Port of Oakland to Massachusetts Port Authority

Massachusetts Port Authority (Massport) purchased two Kocks low profile cranes from the Port of Oakland for capacity expansion of their Conley Terminal. The Oakland post-Panamax Kocks cranes were a near-perfect match for the Conley Terminal.

Low profile cranes, also known as shuttle boom cranes, are used where overall height is restricted because of aircraft clearance requirements. Because of their unique nature and limited demand, the cost of new low profile cranes is about 50% more than for a typical quay crane. Reuse of an existing crane is more attractive.

Liftech surveyed the condition of the cranes before the purchase and developed construction documents for modification and transport of the cranes from the Port of Oakland to Massport. We also provided bid review assistance and construction support services.

Structural modifications required for the Massport location were limited to minimal frame strengthening for higher storm winds, addition of a boom latch, installation of an 11.5” riser at the landside equalizer system, gantry bumper modifications, and gantry stowage pin modifications.

Liftech provided the procurement services to the Port of Oakland for the original Kocks crane purchase and assisted with the structural design of the cranes.

Client:
Fay, Spofford & Thorndike, Inc.
Burlington, Massachusetts, USA

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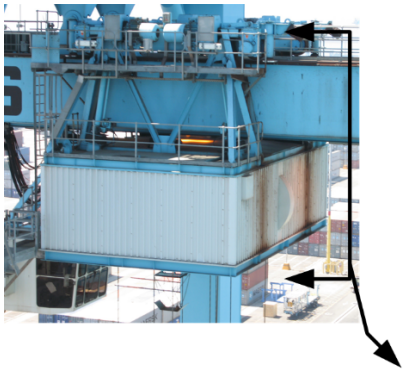

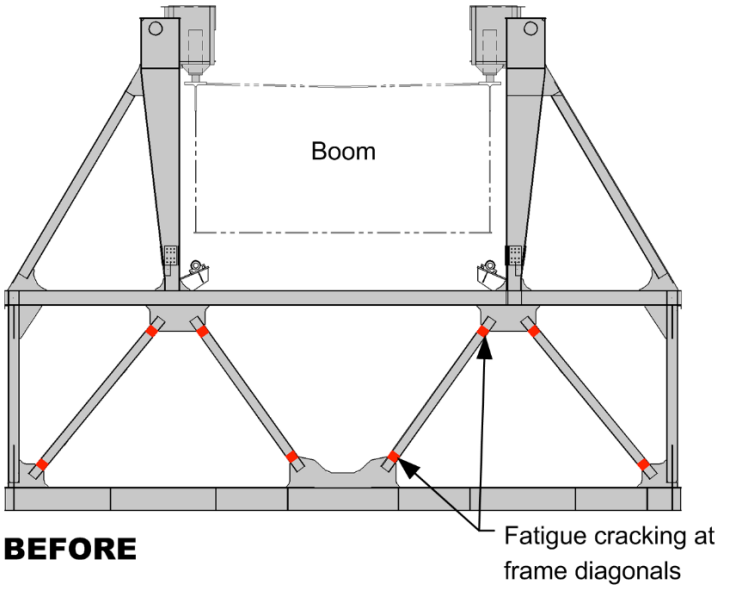

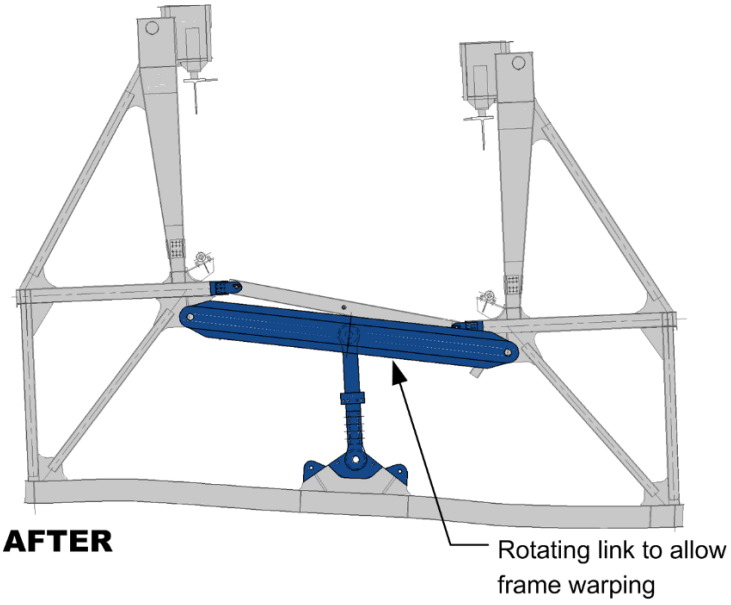

Machinery Trolley Modification
APMT, Port of Los Angeles, California

APMT operates ten Noell machinery-on-trolley cranes at their Pier 400 terminal in Los Angeles. The original trolley structure was torsionally rigid. Some of the diagonal members cracked due to warping caused when one wheel is out-of-plane to the other three. Liftech provided design modifications to reduce the stresses in the members due to warping.

The trolley modifications involved replacing the diagonals with a link system in the waterside wall of the trolley. The modified trolley structure is torsionally flexible.

Client:
APM Terminals
Los Angeles, California, USA

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Hyundai Crane Damage Assessment and Repair
Freeport, Grand Bahama

A tornado damaged six Hyundai monogirder cranes and toppled another. Liftech assessed the damage to the untoppled cranes and assisted with engineering for the repairs.

Hyundai Crane 9 suffered severe damage when it collided with Crane 10. The boom detached from the right lower hinge pin, the upper hinge broke off, the forestay apex connection plate bent, and the boom rotated more than 45 degrees.

The boom was brought back into its lower hinge seating, the upper hinge connections were replaced, and the forestay connection plates were heat straightened.

Liftech also assisted with engineering for modifications to the gantry and gantry connections, geometry survey procedures, and reinforcing for recent wind code requirements.

Reference:
Freeport Container Port Limited
Freeport, Grand Bahama

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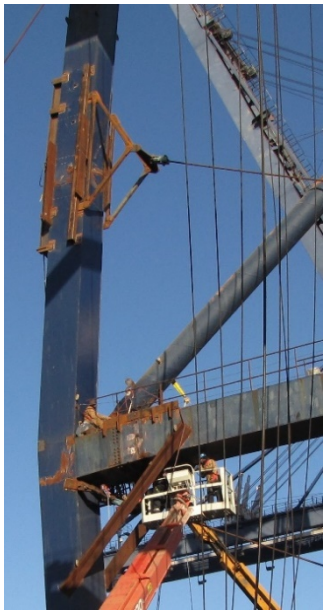

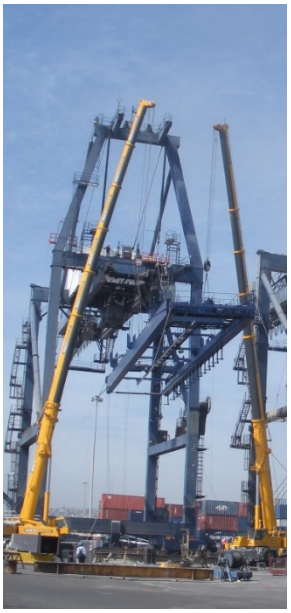

Paceco Crane Damage Assessment and Repair
San Antonio, Chile

Two Paceco cranes operated by San Antonio Terminal Internacional at their San Antonio Terminal in Chile suffered damage when the cranes were struck by departing ships in the aftermath of the February 2010 magnitude 8.8 earthquake.

One crane suffered significant damage to the boom and the portal frame. The other crane suffered significant damage to the boom and the trolley. The port was concerned with the structural integrity of the cranes and that the damaged cranes would cause long-term interruption to the port's operation.

Within days of the earthquake, Liftech sent a structural engineer to the site to assess the crane damage. We provided a damage assessment report, which allowed the port to evaluate whether to replace or repair the cranes. The port decided to repair the cranes since repairs would be completed within a few months and at a fraction of the cost of buying new cranes.

We worked with the contractor to develop the repair concepts, including an innovative frame straightening concept and a strongback system to support the damaged legs and portal beams. We provided design drawings for the frame straightening and the frame and boom repair.

Reference:
San Antonio Terminal Internacional
San Antonio, Chile

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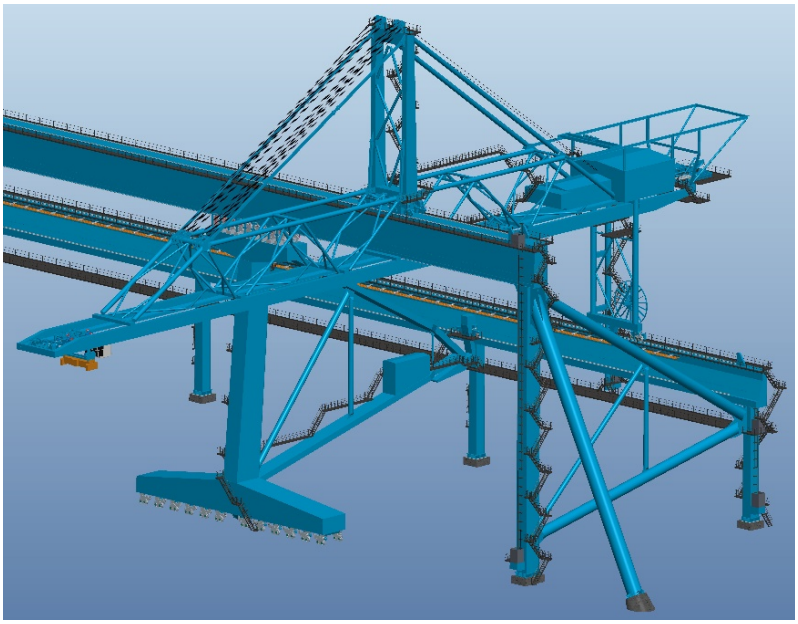

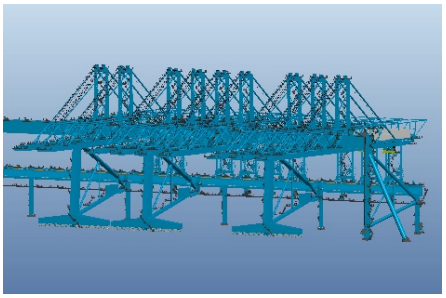

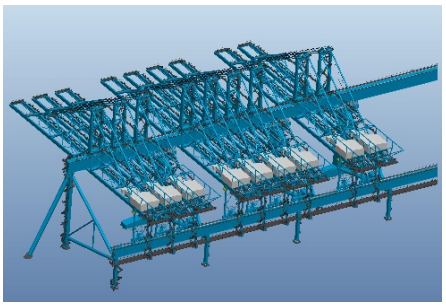

FastNet
APM Terminals

Liftech participated with APM Terminals to conceptualize and design FastNet, a crane technology that enables STS gantry cranes to work adjacent, instead of alternate, bays of a large container ship. APMT estimates that FastNet can deliver berth productivity of 450 moves an hour.

Liftech designed the structures and collaborated with TransHoist Engineering Inc. to conceptualize and develop some new mechanical components. Structural designs included the cranes, waterside and landside elevated girders, fixed landside girder supports, and moveable waterside girder supports. Mechanical design included a new system for equalizing loads on the tower frame traveling wheels using wire ropes.

Reference:
APM Terminals

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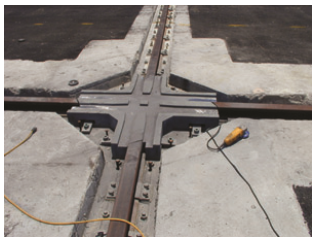


Crane Transfer System Design, Berth 30
Port Everglades, Florida

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

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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.

Anna Dix
Principal, Structural Engineer

Ms. Dix has 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.

Tais Shiratsubaki
Principal, Professional Engineer

Ms. Shiratsubaki is experienced in project management and structural design, review, analysis, modification, and repair of various marine structures including container cranes, bulk material handling equipment, and special structures. She is involved in research and development and enjoys collaborating with clients to produce improved designs and solutions.