A JV Company between Mitsubishi Heavy Industries Ltd. (MHI), Japan and Anupam Industries Ltd., India

ADVANCED CARGO HANDLING SOLUTIONS

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a group company of MITSUBISHI HEAVY INDUSTRIES, LTD.
MHI INDUSTRIAL ENGINEERING & SERVICES PRIVATE LTD.
Ahead in Technology Unmatched in Performance.

With more than 50 years of experience in material handling segment, we continue to thrive and innovate advanced concepts and technologies to ensure higher uptime. Our Cranes are designed with the help of sophisticated softwares at MHI, Japan and later manufactured at the two ultra-modern manufacturing facilities in India.

A perfect blend of Anupam’s manufacturing excellence, skilled human resources and MHI’s technological and management expertise leads to creation of top-notch cranes. Manufactured at state-of-the-art infrastructure, our cranes deliver high value at competitive pricing.
Worldwide Distribution of Our Cranes

From establishing manufacturing processes to implementing distribution chains, ANUPAM-MHI is creating value for its customers, **globally**.

A rising demand of our container handling cranes and bulk material handling equipment in the global markets testifies the quality and expertise that goes into manufacturing each product at ANUPAM-MHI.
ANUPAM-MHI brings you the most reliable and dependable STS that delivers unmatched performance every time. Maximizing the overall efficiency, we help our customers achieve outstanding results by providing next generation high performance workhorse.

**Ship to Shore Gantry Cranes**

### Standard Features
- Can manufacture all kinds of crane required by customers through our state-of-the-art technologies and vast experience of the international market.

### Available Vessel
- Container vessels from coastal feeders to super post panamaxes (22 rows).
- Rich selection of multi-purpose cranes fully operable for bulk/pulp carriers.

### Advanced Features

<table>
<thead>
<tr>
<th>Advanced Features</th>
<th>Operability</th>
<th>Maintainability</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-sway System</td>
<td>Anti-sway System</td>
<td>Remote Monitoring</td>
<td>Prevention of Collision with Vessel</td>
</tr>
<tr>
<td>Rich selection from a variety of electric, mechanical systems and hybrid models in which both systems are combined based on the accumulated experiences and proven performance.</td>
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<td>Prompt support of technical maintenance and minimization of downtime by the real-time data communication with our engineering department.</td>
<td>Prevention of Collision with Vessel</td>
</tr>
<tr>
<td>Auto Anti-skew System</td>
<td>Auto Anti-skew System</td>
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</tr>
<tr>
<td>Improvement in the efficiency of loading/unloading operations through the automatic skew reduction of the suspended loads so far difficult to control.</td>
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<td></td>
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<tr>
<td>Semi-automatic Operation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Improvement in efficiency and reduction in operator’s fatigue through the semi-automatic sea-side/shore-side operations.</td>
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<td></td>
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</tr>
</tbody>
</table>

### Dependable Structure
- Light weight design with extensive fatigue life of structure achieved by using ADAMS dynamic analysis and FEM analysis.
- Highly reliable crane structure drastically reduces maintenance.

### Safety
- Prevention of Snag Load
- Crane damage due to the abnormal catch on a container vessel is prevented and thus safety is ensured.

### Seismic Isolation System
- Can withstand an earthquake with an intensity of the Southern Hyogo Earthquake class, and the crane loading/unloading after earthquake are also easy. Influence on the foundation is minimized thanks to absorption of earthquake forces.
A New Generation of Super Lightweight Container Crane

With a focus on innovation and technological advancement we are doing a lot more than just meeting customer requirements - We are also anticipating their needs for tomorrow. Our Super Lightweight Container Crane is a result of this commitment. Specially designed to move the containers higher, faster and more accurately these cranes are setting new standards in container handling industry.

Features
- Projected as a 22-row vessel compatible container crane installed in the exiting wharf exclusive for 18-roll vessel without needing any drastic reinforcement absorption of earthquake forces.
- Lightweight has been realized by the adoption of 3-point hanging by mean of the boom tension bar, while the boom/girder are formed to a simple box with trapezoidal cross section to materialize lightweight.
- Reduction of the boom weight has been achieved through the configuration of converting the tilt system (formerly installed in the boom end) to the rear of the girder to be installed with the small-turn device and anti-snag system.
- The rated load capacity of 61 tons makes it possible to hoist two 20-feet containers (30.5 tons each) simultaneously.

Seismic Isolation System (Patented)

Functions
- Lowering of the crane natural frequency by means of the seismic isolation system installed on the legs of the cranes.
- Decrease of the acceleration of seismic response.
- Decrease of seismic loads onto the crane.
- Structural reinforcement is unnecessary owing to the reduction of the stress on crane legs.
- Prevention of derail by the control of rocking vibrations.
- Reduction in the crane reaction to the wharf.
- Maintenance of functions and soundness of the crane systems after suffering from an earthquake are possible.

Automatic Anti-Skew System (Patented)

Improved efficiency of cargo handling thanks to the short-time attenuation of the loading skew that is difficult to control.
- Detection of loaded positions by means of the image processing technology.
- Simplified mechanism (activation of the existing skew device).
- Excellent anti-sway performance.
- The optimal regulator control realizes skew attenuation and positioning simultaneously.

Remote Monitoring

Effects of Introducing the Crane
- Attentive support is provided by the AMIL engineers who have a thorough knowledge of hardware and software in the event of trouble.
- Minimization of downtime.
- Proper upkeeping of the crane through a long-term maintenance service.
- Minimization of the crane natural frequency by means of the seismic isolation system installed on the legs of the cranes.
- Decrease of the acceleration of seismic response.
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- Structural reinforcement is unnecessary owing to the reduction of the stress on crane legs.
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- Reduction in the crane reaction to the wharf.
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The outline of the system
- Trouble Diagnoses: Automatic notification of trouble information / Remote reading of the data required for the isolation of cause. / Control logic can be remotely changed. / The site conditions can be fully grasped by means of a photo telegram.
- Preventive Maintenance: Suggestions on the next term maintenance items are possible based on the ongoing operating conditions.
- Management of Spare Parts: Proposal of parts replacement based on the maintenance record.
Transfer Cranes

Highly Sophisticated Transfer Cranes to Enhance the Efficiency of Container Yard

ANUPAM-MHI Gantry cranes include Transfer Cranes for on/off loading available in a broad range of lifting capacities. Specially designed for space intensive container stacking these cranes meet the most demanding requirements of modern day ports and ensure highest customer satisfaction. Featuring state of the art technology ANUPAM-MHI Transfer Cranes guarantee excellent reliability, performance and long service life.

**RTG (Rubber Tyred Gantry Crane)**

<table>
<thead>
<tr>
<th>Type</th>
<th>1 over 4 stack RTG</th>
<th>1 over 5 stack RTG</th>
<th>1 over 6 stack RTG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity under spreader</td>
<td>40.6 ton</td>
<td>40.6 ton</td>
<td>40.6 ton</td>
</tr>
<tr>
<td>Lift height under spreader</td>
<td>15.24m</td>
<td>17.75m</td>
<td>21.0m</td>
</tr>
<tr>
<td>Span</td>
<td>23.47m</td>
<td>23.47m</td>
<td>23.47m</td>
</tr>
<tr>
<td>Trolley travel range</td>
<td>19.07m</td>
<td>19.07m</td>
<td>19.07m</td>
</tr>
<tr>
<td>Wheel base</td>
<td>6.4m</td>
<td>6.4m</td>
<td>8.0m</td>
</tr>
<tr>
<td>Overall width</td>
<td>11.5m</td>
<td>11.5m</td>
<td>14.3m</td>
</tr>
<tr>
<td>Operating speed</td>
<td>23/52</td>
<td>23/52</td>
<td>23/52</td>
</tr>
<tr>
<td>T.Travel</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>G.Travel</td>
<td>135</td>
<td>135</td>
<td>135</td>
</tr>
<tr>
<td>Steering</td>
<td>Differential and 90° cross travel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RMGC (Rail Mounted Gantry Crane)**

<table>
<thead>
<tr>
<th>Type</th>
<th>(12 rows + 2 chassis) x 6 stacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity under spreader</td>
<td>41.0 ton</td>
</tr>
<tr>
<td>Lift height under spreader</td>
<td>21.668m</td>
</tr>
<tr>
<td>Span</td>
<td>37.03m</td>
</tr>
<tr>
<td>Trolley travel range</td>
<td>45.43m</td>
</tr>
<tr>
<td>Wheel base</td>
<td>15.0m</td>
</tr>
<tr>
<td>Overall width</td>
<td>24.0m</td>
</tr>
<tr>
<td>Operating speed</td>
<td>35/96</td>
</tr>
<tr>
<td>Main hoist (m/min)</td>
<td>135</td>
</tr>
<tr>
<td>T.Travel</td>
<td>150</td>
</tr>
<tr>
<td>G.Travel</td>
<td>120</td>
</tr>
</tbody>
</table>
**Transfer Cranes**

**Automation**

The outline of the method for controlling hoisting acceleration/deceleration

**Maximum Speed**

- Constant Output Range
- Constant Torque Range

**Base Speed**

- Graph of Max Speed Setting

**Smart Hoist**

Minimized cycle time achieved by the increase of hoisting speed/acceleration up to the marginal capacity of the motor depending on the load conditions.

**Ultrasonic sensors**

- Used for prevention of collision through real-time detection of acoustic reflection from the adjoining cranes.

**Smart Hoist**

- Minimized cycle time achieved by the increase of hoisting speed/acceleration up to the marginal capacity of the motor depending on the load conditions.

**Automatic Steering**

- Strong rubber magnets are embedded breadth-wise and height-wise along the gantry passage to sense the magnetism, enabling the straight travel of a gantry at an accuracy of ±50 mm.

**Prevention of Collision with Adjoining Cranes**

- Ultrasonic sensors are used for the prevention of collision through real-time detection of the acoustic reflection from the adjoining cranes.

**Small Turn System; Skew Anti-sway System**

- Equipped with small-turn system to manipulate the spreader horizontal angle which enables the sway control of the spreader horizontal spin. Facile maneuverability is ensured by the prompt curbing of the spin-sway developed due to the staggered center of the gravity of the containers.

**Right-Angle Stop**

- Front/rear embedded magnets detect the amount of offset when coming to a stop, thereby enabling a right-angle stoppage.

**Stack Profile Sensor**

- Collision of the stacked containers with a loading cargo is prevented by means of the optical range finder detecting the number of tiered containers per row with minimum interlocking configuration.

**Mechanical Anti-Sway System**

- Mechanical anti-sway system using obliquely stretched wire ropes to stop the crane and container swaying. High degree of reliability and anti-sway efficiency.

**Magic Eye**

- A camera is installed on the hanging beam to detect the offset between the suspended load and its target to ensure high precision of detection. A highly accurate automatic transport system has been achieved through the sophisticated operation combined with the predicted seating control.
E-RTG (Electric Rubber Tyred Gantry Crane)

Being a sustainability driven company, ANUPAM-MHI is constantly involved in developing innovative products and solutions that help in reducing environmental impact. ANUPAM-MHI’s Electric Rubber Tyred Gantry Crane is an exemplar product that combines technology with sustainability. While it enhances the operational efficiency it also helps in reducing the consumption of diesel fuel and emission of pollutants.

Advantages over conventional RTG

- No engine is equipped on RTG, hence environment friendly
- Reduction of time and costs due to the shorter maintenance intervals of the diesel-electric-drive
- Reduction of intervals for refueling results in reduced costs and efforts
- Significantly less emission by the lesser use of the combustion engine and thus better environmental conditions at the site

Benefits by E-RTGs

<table>
<thead>
<tr>
<th></th>
<th>Conventional RTG</th>
<th>E-RTG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Cost</td>
<td>$54700</td>
<td>$5500</td>
</tr>
<tr>
<td>CO₂ Exhaust</td>
<td>169.8ton</td>
<td>22.2ton</td>
</tr>
<tr>
<td>Deviation during gantry travel (Max.speed 135m/min)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Actual measurement)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Highly reliable Auto Steering System

Performance record of Tobishima Container Terminal in Nagoya, Japan

Auto steering control system provides high straightness & stable gantry travel.

Countermeasures against Meandering

Controller  
Auto-steering system  
Sensing: Magnetic detector & guidelines  
Deviation: ±100mm

Cable Tension Control

Cable reel winding control provides the stable cable tension.

Arrangement of E-RTG(Cable reel)
Grab Bucket Type Ship Unloader

Engineered to unload greater volume of bulk, ANUPAM-MHI Grab Bucket Type Unloaders serve ports throughout the world. Each functional specifications of the product is designed and developed to deliver high-quality, performance-backed results for our customers. Ensuring efficient, economical and reliable results with a long service life, our bucket type unloaders prove to be a perfect solution that meets the most demanding unloading facility requirements.

<table>
<thead>
<tr>
<th>Semi-Automatic Operation</th>
<th>Conventional Type</th>
<th>Advanced Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Operation</td>
<td>Teaching playback type</td>
<td>Feed-forward feed-back control (with sensor-less anti-sway control)</td>
</tr>
<tr>
<td>Setting Method</td>
<td>Requiring model operation for various patterns by expert operator</td>
<td>No need of model operation (hatch clear point setting only)</td>
</tr>
<tr>
<td>Anti-Sway Performance</td>
<td>Influenced by wind and initial sway</td>
<td>Less influenced by initial sway and other factors</td>
</tr>
<tr>
<td>Work Efficiency</td>
<td>Subject to the performance of model operation</td>
<td>Higher efficiency like skilful operator</td>
</tr>
<tr>
<td>Total Evaluation</td>
<td>Not Recommendable</td>
<td>Highly Recommendable</td>
</tr>
</tbody>
</table>

Semi-Automatic Operation

<table>
<thead>
<tr>
<th>Outline of Semi-Automatic Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Grabbing (manual)</td>
</tr>
<tr>
<td>2. Holding start (manual)</td>
</tr>
<tr>
<td>3. Starting automatic operation by pedal switch</td>
</tr>
<tr>
<td>4. Automatic hoisting up and traverse to hopper</td>
</tr>
<tr>
<td>5. Automatic grab open above hopper</td>
</tr>
<tr>
<td>6. Automatic traverse to ship</td>
</tr>
<tr>
<td>7. Holding down to the next grabbing position (manual)</td>
</tr>
</tbody>
</table>

Anti-Sway System

Providing high-performance anti-sway and accurate positioning operation by combination of feed-forward control and feed-back control.

Sensor-less Sway Detection System

- Load Position Calculation from torque feedback of trolley motor
- Semi-automatic operation is available without additional sensors
**Grab Bucket Unloader**

**Automatic Control for Bucket Grabbing**

- **Grabbing Torque Control**: Real time torque control of bucket grabbing when accelerated traverse movement to avoid material drop.

- **Bucket Lowering Control**: Grabbed material amount control according to material gravity to avoid overload by lowering bucket when grabbing. Lowering length can be set at operator’s cabin.

- **Bucket Tip Horizontal Control**: Bucket grabbing control to make its tip horizontal for enhancing efficiency when unloading material at the bottom of ship. Can be selected at operator’s cabin

**Light-Weight Trapezoidal Box Structure**

Light wheel load by applying Trapezoidal Box Structure.