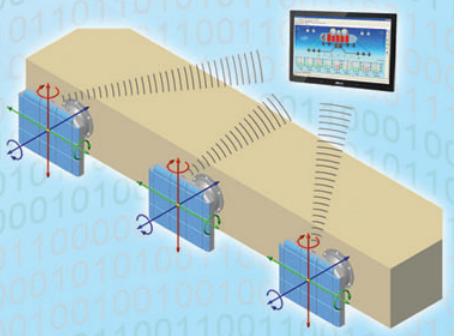
Zalda Technology
ENGINEERED MARINE SYSTEMS

BIM Berthing Impact Monitoring System

The Zalda Technology BIM Berthing Impact Monitoring System, also known as the “Smart Fender System" or "Fender Monitoring System", is the first cost realistic product of its kind, that is capable of comprehensive ship berthing impact and fender system status monitoring on large scale. The BIM system was developed from aviation inertial guidance technologies, through close collaborations between the world’s top marine monitoring experts and marine fender specialists. It is designed to improve harbor safety & maintenance standards, reduce fender maintenance costs, and provide base data for fender system design - development and marine structure - vessel - navigation studies.

BIM System Objectives:

- To generate value by elevating marine terminal safety & maintenance standards with real time berthing accident detection, fender system damage detection, and accountability data
- To provide accurate, comprehensive, and reliable ship berthing impact amplitude monitoring, fender system status monitoring, and fender system design weakness detection
- To provide accumulate long term berthing impact and mooring fatigue impact database for structural design, crisis analysis and engineering / academic studies
- Minimum maintenance and zero interference with existing pier operation
- Suitable for most marine terminals with mainstream design marine fender systems



BIM System Function Highlights:

- **Ship Berthing Energy Amplitude Monitoring and Alarm**
  The BIM System detects ship berthing kinetic energy amplitude and generates alarms when detected value exceeds design fender system ennergy absorption capacity

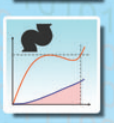
- **Ship Berthing Impact Load Monitoring & Alarm**
  The BIM system monitors combined reaction force of all fender systems on the pier and generates alarms when detected value exceeds preset pier structural limit

- **Fender System Damage Alarm and Maintenance Guidance**
  With its ability to detect fender system permanent deformation, fender panel permanent deformation, and restraining device (such as chains and motion guidance devices) damage, the BIM system can provide automatic fender maintenance guidance to prevent unexpected terminal down time due to hidden damage

- **Fender System Design Weakness Detection**
  The BIM system detects fender system design weaknesses such as insufficient / diminished fender energy capacity, insufficient fender panel design, insufficient restraints design, and unexpected berthing practice, paving the way for timely design adjustment to prevent costly permanent damage

- **Fender 3D Speed - Displacement Monitoring and Alarm**
  The BIM system monitors fender system movement velocity and displacement in six degree of freedom, and generates alarms if speed (such as berthing speed) or displacement (such as fender compression) thresholds are breached

- **Fender 3D Rotation Angle Monitoring and Alarm**
  The BIM system monitors fender rotation in six degree of freedom and generates alarms when angle (such as ship berthing angle and flare angle) thresholds are breached



- **Fender Compression, Energy Absorption and Reaction Force Monitoring**
  The BIM system monitors compression of each individual fender element and generates alarm when over compression is detected; it also provides fender energy absorption / reaction force data on any combination of fender elements or fender systems

- **Accidental Vessel Drift Alarm**
  The BIM system detects accidental drifting of moored ship by monitoring absence of ship - fender mooring fatigue impacts and a special progression signature of such absence unique to accidental drifting situations.

- **Fender Fatigue Statistics**
  The BIM system maintains full database of recorded impact & movement data for further analysis / study, including fender compression counts for normal berthing compressions, abnormal compressions, and fatigue compressions, which can be use to develop berth specific fender life expectancy and fender maintenance guidance algorithm

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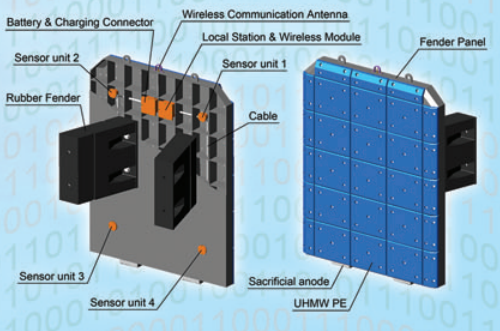
BIM Berthing Impact Monitoring System

BIM System Schematics

Zalda Technology Berthing Impact Monitoring System
Illustration for New Fender Panel Installation

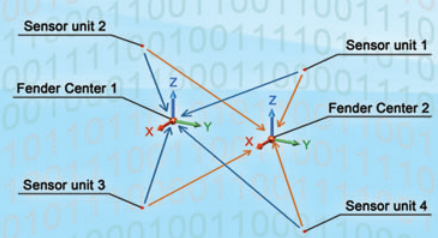


- Field components to be installed on each fender system:
  - One LIS Local Interface Station with wireless antenna
  - A number of PSU Positioning Sensor Units connected to the LIS
  - A battery with quick exchange design to power LIS / PSU if shore power is not used
  - All BIM field components in submersible enclosures, installed on fender system frontal structures, such as a front panel.
- Control room components
  - A PC workstation running BIM software and database
  - Wireless access points connecting the workstation with all LIS in the field
- The BIM workstation wirelessly collects fender position and attitude data from field LIS installed on each fender system. Analyzed terminal berthing impact and fender status data is displayed on user interface and recorded in the database. Values exceeding preset thresholds are transmitted to all user interfaces as text and audio / visual alarms.

BIM Technology General Principles

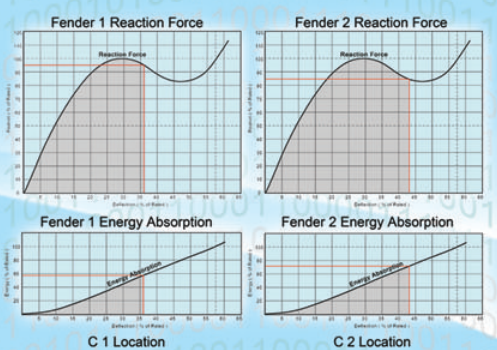
- Ship to dock berthing impacts and mooring fatigue impacts are transmitted through marine fender system, which is used by the BIM system as its monitoring medium
- The BIM system utilizes motion sensors, such accelerometers and gyroscopes, to track fender system linear and angular movements using a modified navigation guidance algorithm. Specialty BIM sensors are used to increase accuracy.
- The BIM system monitors real time 3D coordinates of each Positioning Sensor Unit (PSU) mounted at predetermined locations of rigid fender system frontal structures. This enables the BIM system to create dynamic 3D model of the fender system in the computer, which yields fender system displacement, speed, and rotation angle in six degree of freedom.

Monitor Multiple Fender Centers Through PSU 3D Coordinates



- Ship theoretical berthing energy amplitude is calculated based on the first fender movement speed detected during each berthing process, using traditional ship berthing energy formula and known berthing ship weight / coefficients.
- The BIM system can provide ER data on any single or combination of fender element(s) / system(s). This is done by monitoring the compression of every individual rubber fender elements, deducing its compression rate / speed, and retrieving corresponding energy absorption / reaction force values from stored fender performance database.
- Detection of fender system permanent deformation is based on comparison between fender system detected geometry and its design geometry. Detection of fender panel deformation is based on comparison amongst gyroscope heading angles of different PSU installed on the same rigid fender frontal structure. Restraining device damage warning will be triggered wehen fender motion envelop set by system motion restraining design is breached.
- Ship accidental drift detection is done by monitoring the absence of ship - fender fatigue impacts during ship mooring stage, along with a special progression signature of such absence associated usually with accidental drifting.

Deduce Compression / ER on Multiple Fender Elements



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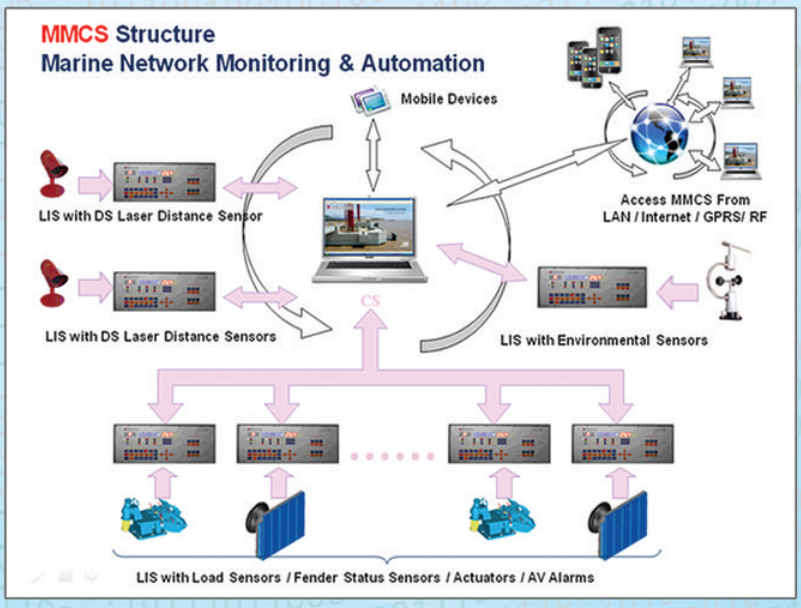
BIM - A Zalda MMCS Platform Application System



Zalda BIM is one of many applications built upon Zalda's mature MMCS network monitoring – automation platform. It is supported by MMCS multiplex information systems and integrates seamlessly with other MMCS applications such as BSM berthing status monitoring, MLM mooring load monitoring, MEM marine environment monitoring and ACM mooring line release automation systems.

- Zalda MMCS Network Central Monitoring Stations, Local Monitoring Stations and Handheld Monitoring Stations
- Windows / IOS / Android Devices with Web Browser
- Automated Email & SMS Notification System
- Large LED Display Monitoring Units
- RF Communication Devices

Zalda BIM System General Specifications

Positioning Sensor Unit (PSU)	
Sensor Array	Gyroscope / Accelerometer / BIM Specialty Sensors
Communication with LIS	Wired or Wireless
Shock Survival	3000G
Measurement Accuracy	5% or Better (Speed / Angle / Displacement)
Measurement Range	+/- 3G 300°/s
Number of PSU Per Fender System	1-6 Depending On Required Functions
Location Interface Station (LIS)	
Sensor Input	24 Analog or Digital / Expandable
Control Output	Expandable
Communication with CS	Wireless with 500m / 1km / 2 km Range
Local Data Storage	12 Month or More
Battery Maintenance	6 / 12 / 18 /24 Month Interval / Quick Exchange Design
Field Equipment General Information	
Enclosure Construction	Submersible 10m / IP68 / ExdIIBT4
Operating Temperature	- 40 - 85°C
Required installation Space	240mm x 240mm x 140mm Deep
Suitable Monitoring Objects	Most Main Stream Design Marine Fender Systems
Central Monitoring Station (CS)	
Hardware	Intel I3 CPU / 4GB RAM or Better
Software	MMCS-BIM Software Suite with Database & Utility, Multi Berth / Cross Platform
Available Communication Extensions	Email / SMS / RF / LDMU / WWW

- Battery replacement interval is mostly dependent on battery size, which is dependent on impact frequency and available installation space
- Wireless communication range is mostly dependent on transmission output power, which is dependent on battery size
- All specs are subject to revision without notice. Please contact us to verify prior to ordering.

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