



# Case Study - Transportation

## Hull Stress Monitoring System

Korea

2009





Aim	The aim is to measure the stresses and torsions caused by waves, cargo operations and motions.
Location	Korea
System Integrator	GME, Global Maritime Engineering
Customer	Samsung Heavy Industries Co., Ltd.
Date	March 2009
Instrumentation	<ul style="list-style-type: none"><li>• Micron Optics, sm130 Optical Sensing Interrogator</li></ul>
Sensors	<ul style="list-style-type: none"><li>• GME, 1.5m HULLFIB-LGL Strain Sensor</li><li>• GME, Fiberoptic Accelerometer and Pressure Transducer</li></ul>
Software	Customer designed
FBG Technology Benefit	<ul style="list-style-type: none"><li>• No need to recalibrate sensors – zero drift.</li><li>• No electrical power at sensors – intrinsically safe.</li><li>• Sensors immune to electromagnetic radiation and no download effects.</li><li>• Long-term stability and durability.</li><li>• Built-in temperature compensation available</li></ul>



- HULLFIB is used to monitor the behavior of hull girders during navigation, loading, and unloading. HULLFIB is also used to provide real-time information on stress levels due to longitudinal bending moment and acceleration levels due to the ship's motion.
- The system will give a warning when stress and bending moment levels and acceleration of ship motion approach levels which require corrective action such as escaping the area, reducing the speed or changing the heading of the vessel.
- In addition, the information on the navigational condition and environment is provided from the GPS, and navigation equipment etc.
- The new fiber optic technology allows any number of sensors to be fitted anywhere in the ship's hull for uninterrupted recordings of actual degree of stress.
- Major class notation of ABS, BV, DNV, LRS etc is available.





- HULLFIB-LGL long gage length strain sensor comprises two deck fixings which are either bolted or welded to the deck or the inner hull structure.
- Between them is a fiber optic sensor assembly which measures the average strain and also temperature for compensation.
- A two-way fiber optic cable exits the arrangement from one end. The complete assembly is protected by a cover for LGL or a putting compound for SGL.



1.5m HULLFIB-LGL Strain Sensor

- HULLFIB-ACCEL and HULLFIB-PRESS are fiber optic transducers to measure acceleration and bow pressure. When required, then can be easily added to the strain sensor network and read by the same FBG interrogator.



HULLFIB-ACCEL  
Accelerometer



HULLFIB-PRESS  
Pressure Sensor

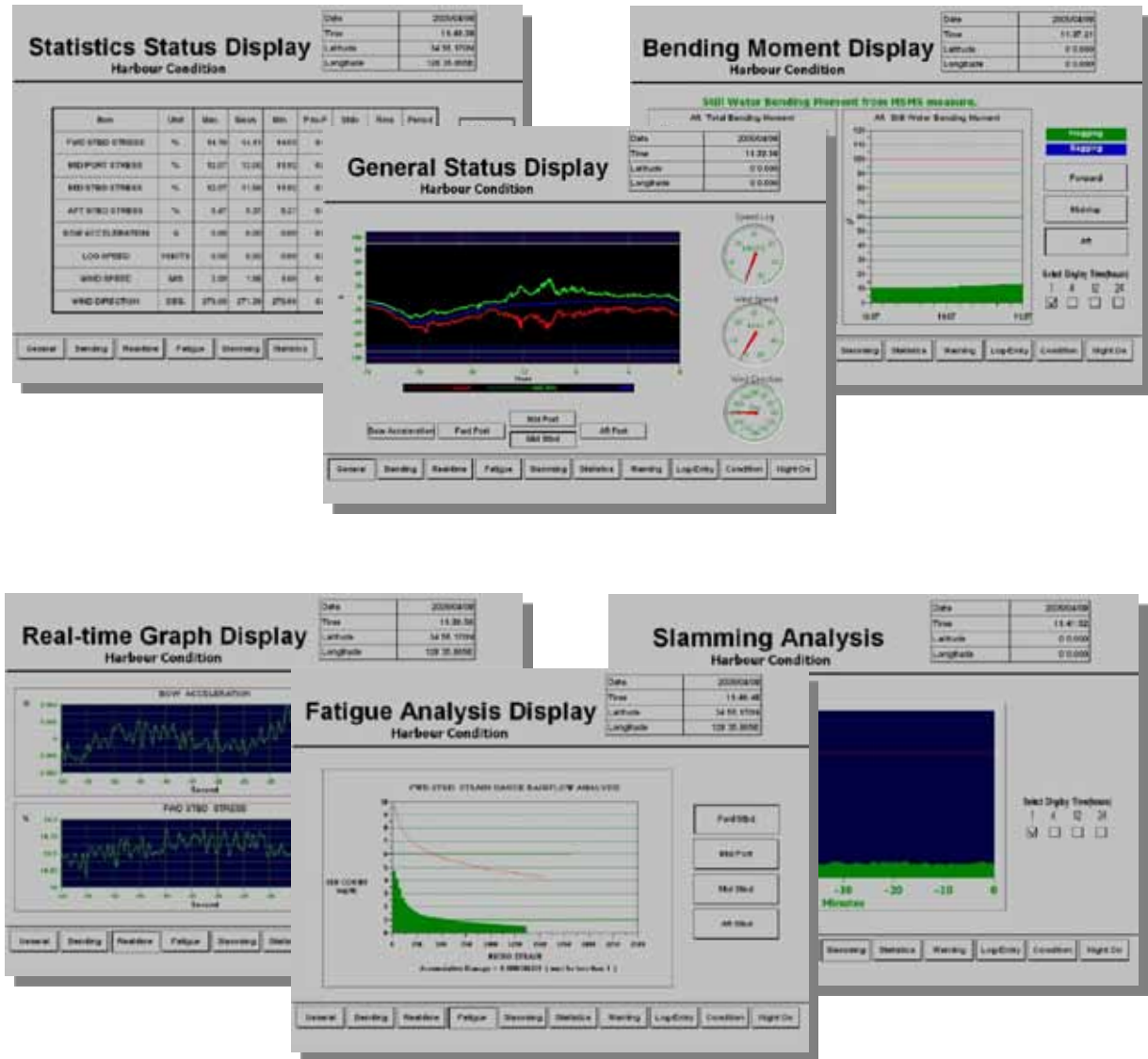


- An sm130, Optical Sensing Interrogator is used to illuminate the sensor network, read the reflected sensor wavelength and calculate the strains, temperature, acceleration, pressure, etc.
- Various interrogators are available to give the required system performance.



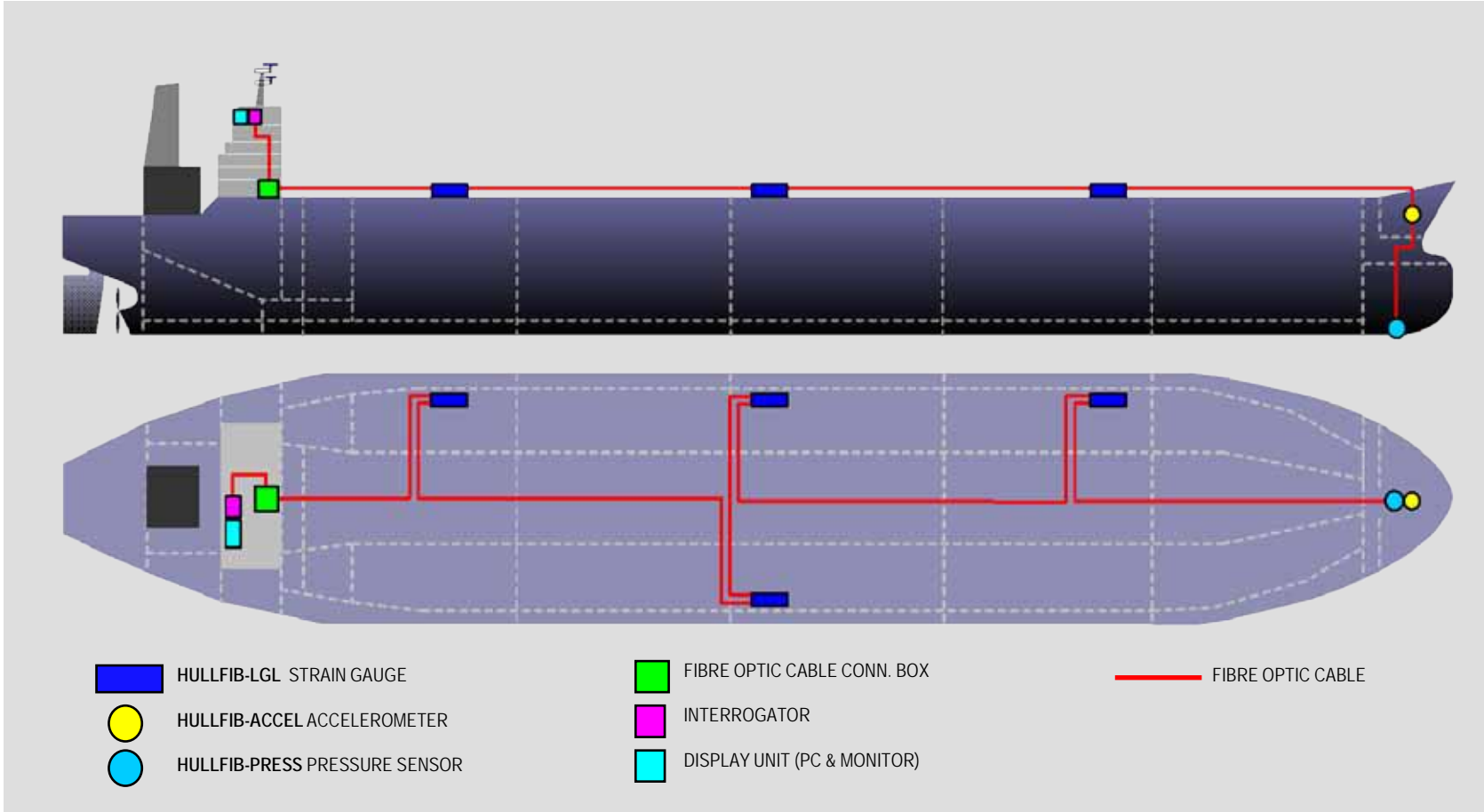
Micron Optics FBG  
Interrogation System

- Complete Software Monitoring System combines and analyses data from both optical and conventional sensors.
- General Status and Statistics Display.
- Bending Moment Trend over the last 24 hrs.
- Real time display of each sensor.
- Fatigue Analysis with cumulated stress cycle count.
- Slamming Analysis provide trend of wave impacts.





## TYPICAL ARRANGEMENT OF HULLFIB







- Results
  - § Vessel informed that the HULLFIB is a more convenient tool for navigation compared with conventional system adapted with electric sensors, as the annual calibration in a hazardous area is not required.
  - § No requirement to recalibrate sensors is a big advantage of this system.
  
- Acknowledgements
  - § Samsung Heavy Industries Co., Ltd., Korea  
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