

ADECS³ - MDM (MULTI-AXIS DEFLECTION MONITORING)

Digital Deflection Monitoring for Floating Dry Docks

ADECS³ Module: MDM

Contact Info: <http://www.dockcontrol.com>

Telephone (USA): +1 760-801-5569

email: sales@dockcontrol.com



The Multi-Axis Deflection Monitoring (MDM) module (also called DM4AS: 4-Axis Deflection Monitoring System as a stand-alone) is a primary component of the Automated Dock Evolution Control System (ADECS³). It continuously measures multiple types of deflection (in the simplest form: both linear and transverse hog and sag) on a floating dry dock. Using small sensors mounted in the wing walls (usually indoors on the safety deck) the DM4AS provides readings that can be accurate to 2.5 millimeters of deflection over 100 meters of dock.

In addition to the normal hog and sag readings, the system provides several types of bend, flex, and angular information about the dock that are not available through other standard deflection measurement systems. Included in this array of information is data that can be used to calculate wing wall strain for vessel haul-in and haul-out.

Since the sensors are non-optical the system does not need line-of-sight or clear weather to operate. When calibrated to a manual optical system, the MDM will accurately replicate the same information (and more). Commonly, the system will be paired with the ADECS³ AAM (Attitude and Alarm Monitoring) module that can provide a corroborative waterline deflection reading which can then be used as an alternate method of deflection determination.

The ADECS³ MDM module provides information which is arranged into overall, wing-wall specific, and cross section specific groupings. The following is a partial list of those items:

Dock Overall Deflection Information:

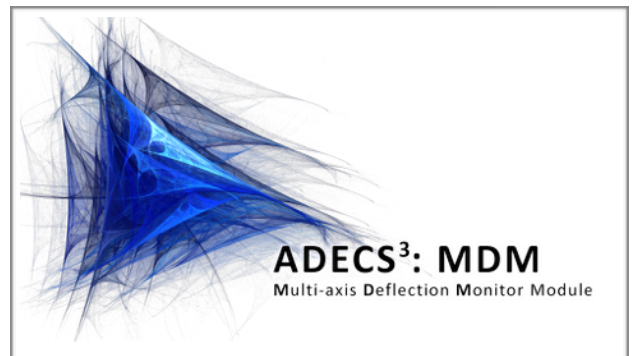
- Trim and List
- Tilt Direction and Angle
- Longitudinal Deflection (Hog/Sag)
- Longitudinal & Transverse Skew (Twist)
- Longitudinal Linearity
- Transverse Deflection (wall toe-in/out)
- Transverse Squareness (wall/keel trim)

Wing Wall specific Information:

- Wall Trim
- Wall Deflection and Skew
- Sectional Deflection
- Greatest Deflection Point
- Longitudinal Deflection (Hog/Sag)

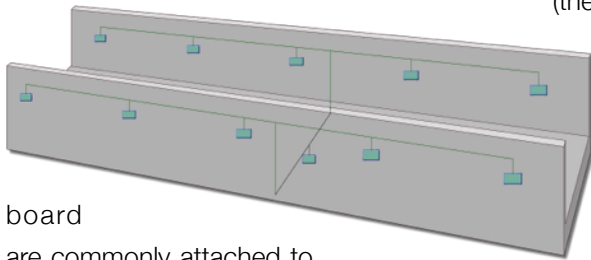
Cross Section (Fwd/Mid/Aft) Information:

- Sectional List
- Transverse Deflection
- Transverse Skew
- Transverse Squareness



Physical Description

The MDM stand-alone module consists of a central data analysis unit and one or more interconnected system hubs which are wired to multiple sensors (at least 5, but typically 9 or more). The sensors are mounted throughout the dock along each wing wall with one more centered over the keel as close to the middle of the dock as possible. A graphical monitor, mouse, and key-

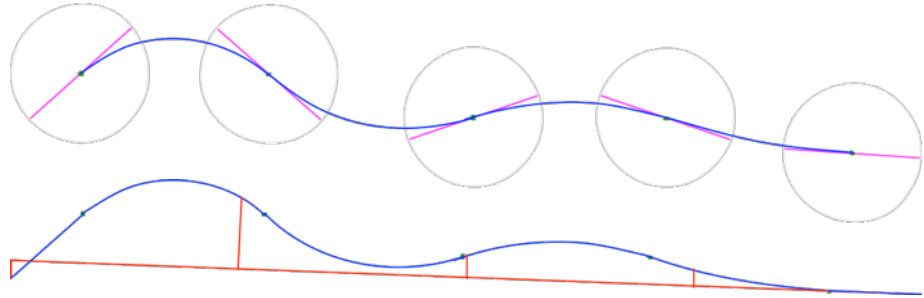


board are commonly attached to the system hub for user interface.

Theory of Operation

Each sensor consists of a very sensitive inclinometer and a communications interface. These sensors return a high precision reading of list and trim at that exact location, and when combined together with the other sensors, this provides a “map” of the wing walls showing deflection angles at specific points, from which deflection distances can be derived. The picture at the top of the page* is a

Simplified Deflection Calculation (5 wing wall sensors)



simplified and obviously exaggerated graphical representation of the calculations used. These calculations are then referenced to the keel sensor (the red line) and split along the desired points for legacy reporting (as shown in the second picture). In addition to the legacy data, additional information (such as “point of greatest deflection”) is generated and reported.

With the precision level of these detectors the deflection distance accuracy at midpoint between two sensors mounted 20 meters apart is theoretically .04 millimeters. In actual use, the sensors are damped to provide vibration and noise free readings accurate to 0.5 millimeters (+/- 2.5mm over 100M). The system works best when there is a sensor mounted at the junction of every other ballast tank along each wing wall.

Expandability and interoperability

The MDM module is an important part of any automated Dock Evolution system or Dock Alarming system. It works directly with any of the ADECS³ components and can be configured to supply information to many other types of systems.

Hardware can be added for electrical alarm signals or chart recorder type data. A built-in Web Server provides up to date information for anyone on the network. Historical information is available for export for use reporting.

Multiple MDM systems can be configured to work together if there are connected docks or platforms, and a redundant system configuration is also available depending on sensor selection.

Summary: The ADECS³ Multi-axis Deflection Monitor (MDM) module is a digital deflection monitoring system that uses solid state sensors mounted to the dock. It provides substantially more information, more accurately, than is available from any other type of deflection detection system and it monitors and logs that information continuously. In addition, the accuracy and speed of the system provides the various deflection data required for safe, automated dock evolutions and dock operations. It can be used as a stand-alone system or in conjunction with any ADECS³ module and is designed to be able to communicate with external systems.