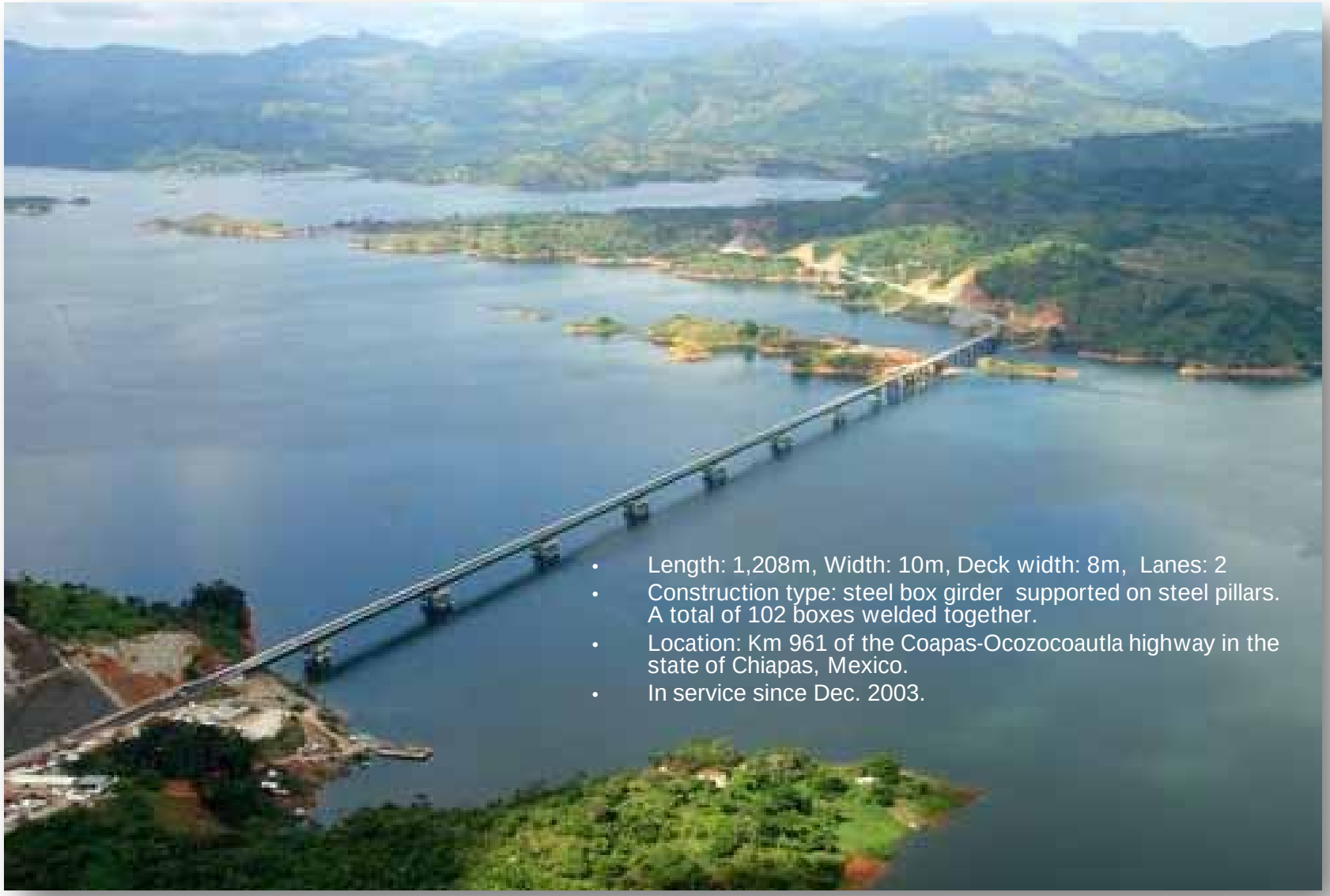
Case Study – Bridges
Chiapas Bridge

Chiapas, México, 2008

Chiapas Bridge- General Characteristics

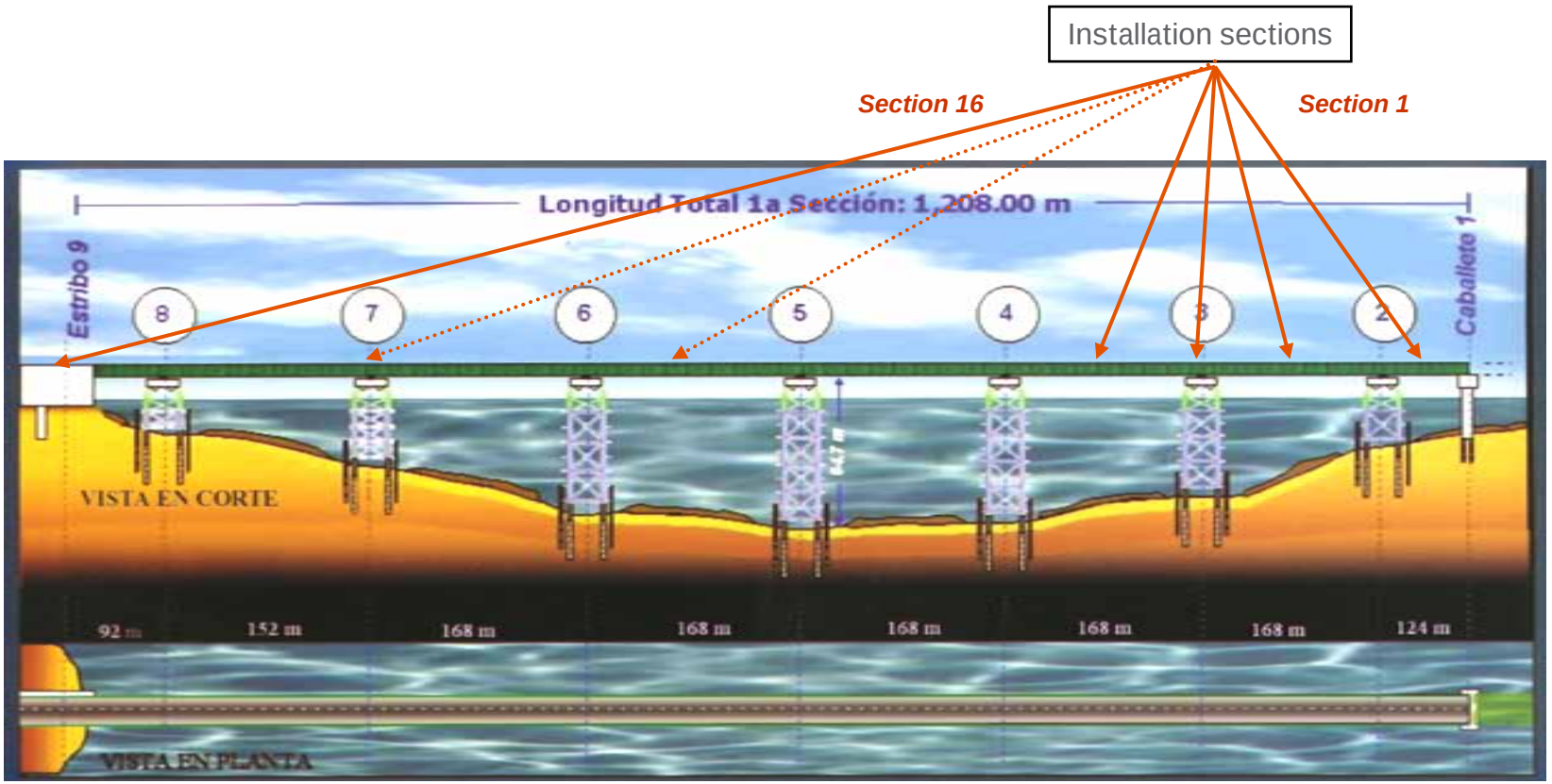


- Length: 1,208m, Width: 10m, Deck width: 8m, Lanes: 2
- Construction type: steel box girder supported on steel pillars. A total of 102 boxes welded together.
- Location: Km 961 of the Coapas-Ocozocoautla highway in the state of Chiapas, Mexico.
- In service since Dec. 2003.

Chiapas Bridge – Structural Monitoring System Overview

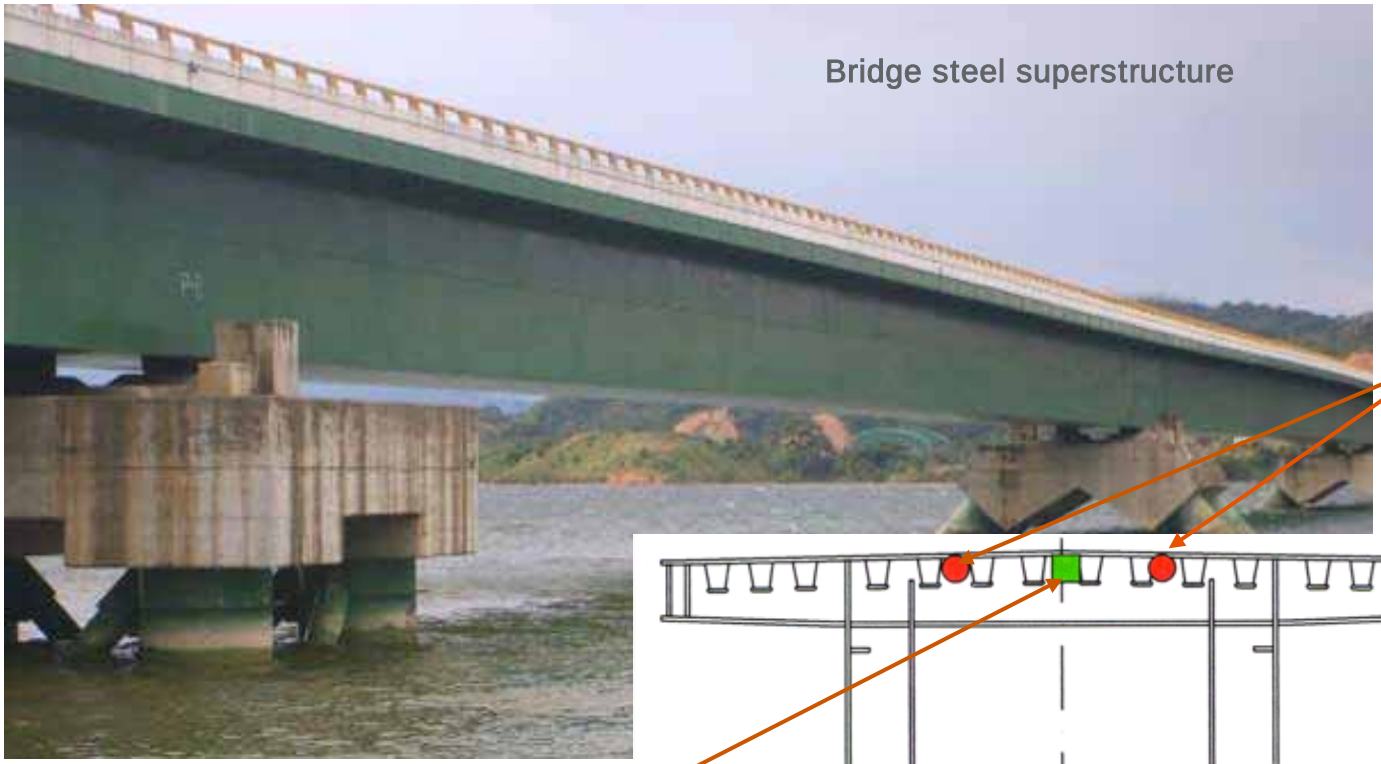
Aim	To monitor the integrity and behavior of the bridge structure, and effects due to high traffic and heavy truck loads that could cause possible damage & fatigue.
Location	Chiapas, Mexico
System Integrator	Chandler Monitoring Systems, Inc. http://www.chandlermonitoring.net
Customer	Instituto de Ingeniería, National Univ. of Mexico (UNAM)
Date	November 2-16, 2008
Instrumentation	(1) Micron Optics sm130-500 Optical Sensing Interrogator (1) Micron Optics sp130-500 Optical Sensing Processor Module (1) Micron Optics sm041-416 Optical Channel Switch Extension
Sensors	(64) Micron Optics os3100 Spot-Weld Strain Gage (18) Micron Optics os4100 Temperature Compensation Sensors
Project Scope	• Long-term monitoring of strain and temperature at 16 different sections along bridge span. • System powered on-site via solar panels. • On-site and remote data retrieval. • Sensors monitor the strains, deflection and possible sloping of the steel girder bridge box. Data also helps determine strain variations, vibrations and expansion effects as a function of time of day, seasons and traffic.

Chiapas Bridge: Longitudinal Section

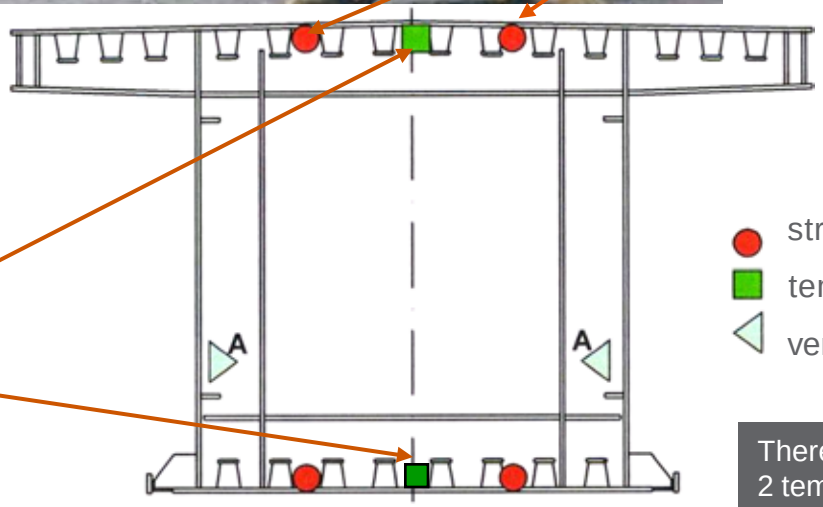


- Sensors were installed along the length of the steel box girder at 16 different sections.
- Key sections are located at pillar support points and pillar-to-pillar mid-span points.
- A total of 82 sensors (64 strain and 18 temperature) were installed.
- Additional accelerometers and tilt meters are planned to be installed later.

Chiapas Bridge: Cross-Section and Sensor Locations



Strain Sensors, os3100

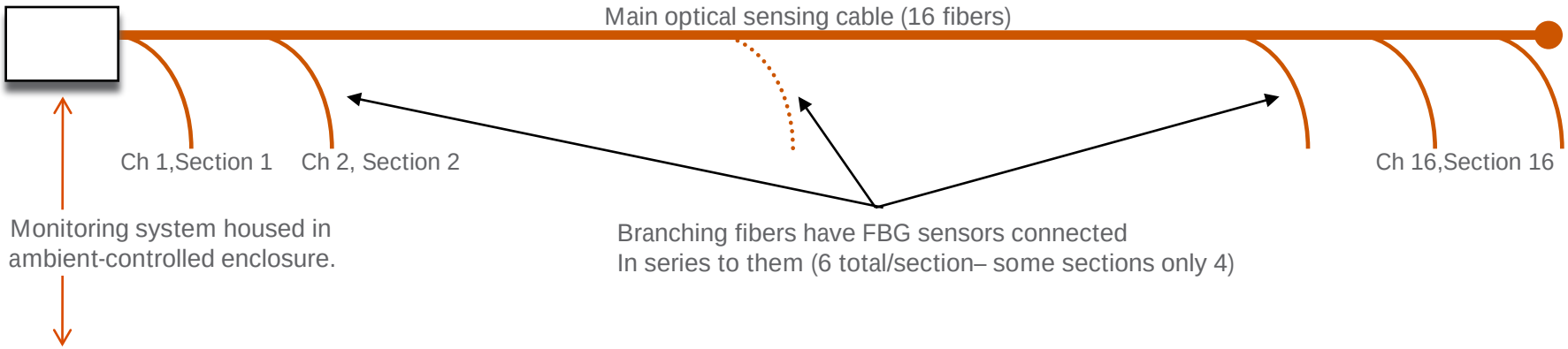


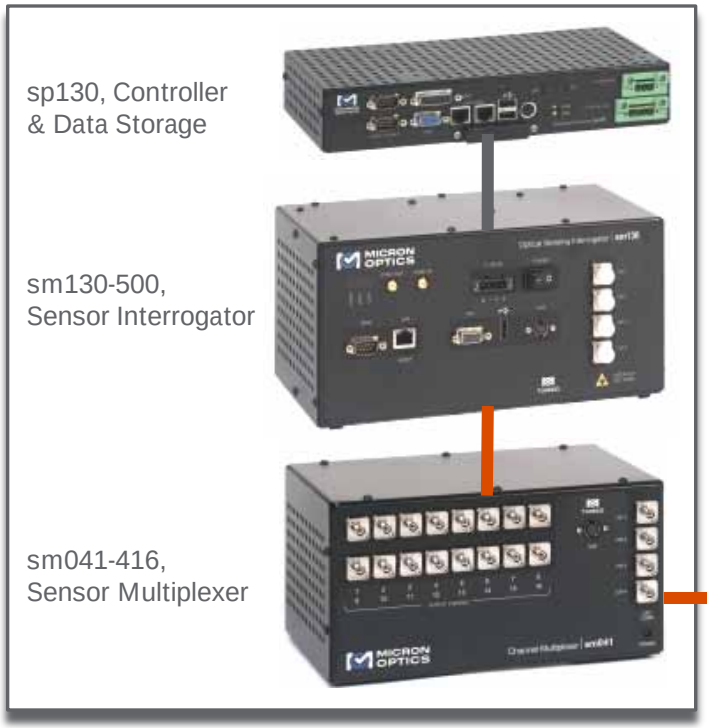
strain sensor
temperature sensor
ventilation opening

Temperature Sensors,os4100

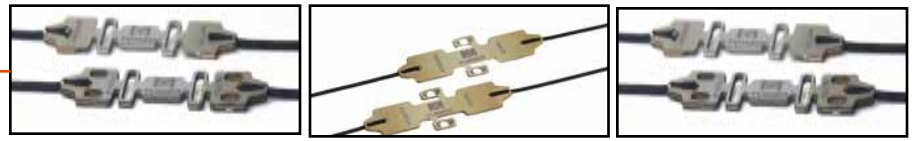
There are 4 strain & 2 temperature sensors per section. Spot-welded

Chiapas Bridge: Sensor Network Configuration

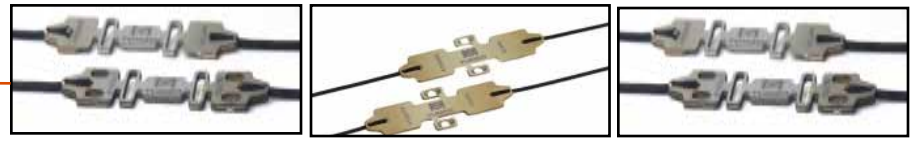




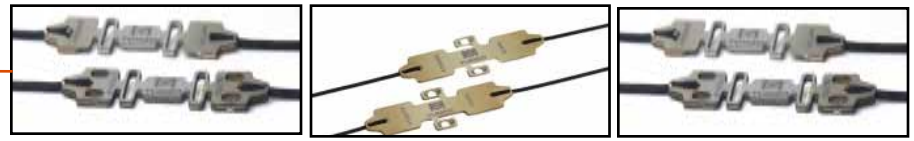
Ch 1 (Bridge Section 1)



(…) Ch 15 (Bridge Section 15)



Ch 16 (Bridge Section 16)



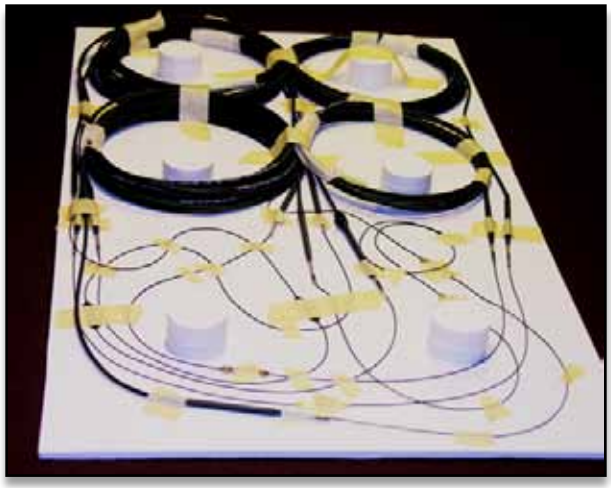
Chiapas Bridge – Installation (Bridge Access)

- Installation crew—Chandler Monitoring Inc.—arrives on site.
- All hardware and sensors were previously shipped to Mexico City and then trucked to the site.
- Access to the inside of the bridge is via an external access ladder.

Chiapas Bridge – Installation

FBG sensor arrays preparation

- Pre-assembled to length for each bridge segment
- Each bridge segment array tested before packaging
- Custom packaged before shipping to the site



FBG sensor arrays on-site deployment

- Once on-site, sensor sections are unpacked
- Each section is retested before installation on the steel bridge truss

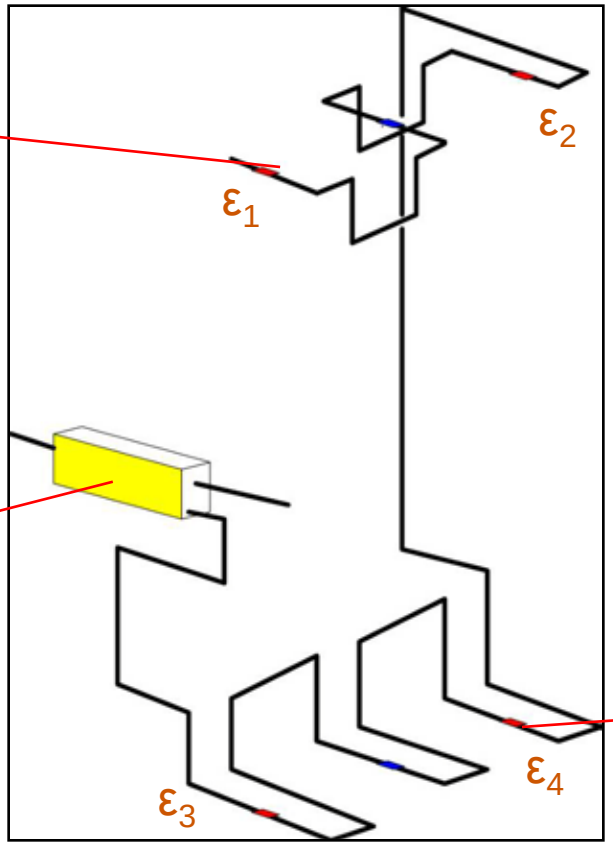
Chiapas Bridge – Installation (Sensor Array Topology)

Schematic of sensor cable layout for each bridge segment tapped from main feed.

os3100 on truss ceiling..

Splice tray for segment 2.

Bridge roof



Bridge floor

Crush resistant fiber cable.

os3100 with protective cover patch (Aquaseal)

Chiapas Bridge: Aspect of Installed Sensors (Section 4)

Chiapas Bridge – Installation of Roof Sensors (Section 4)

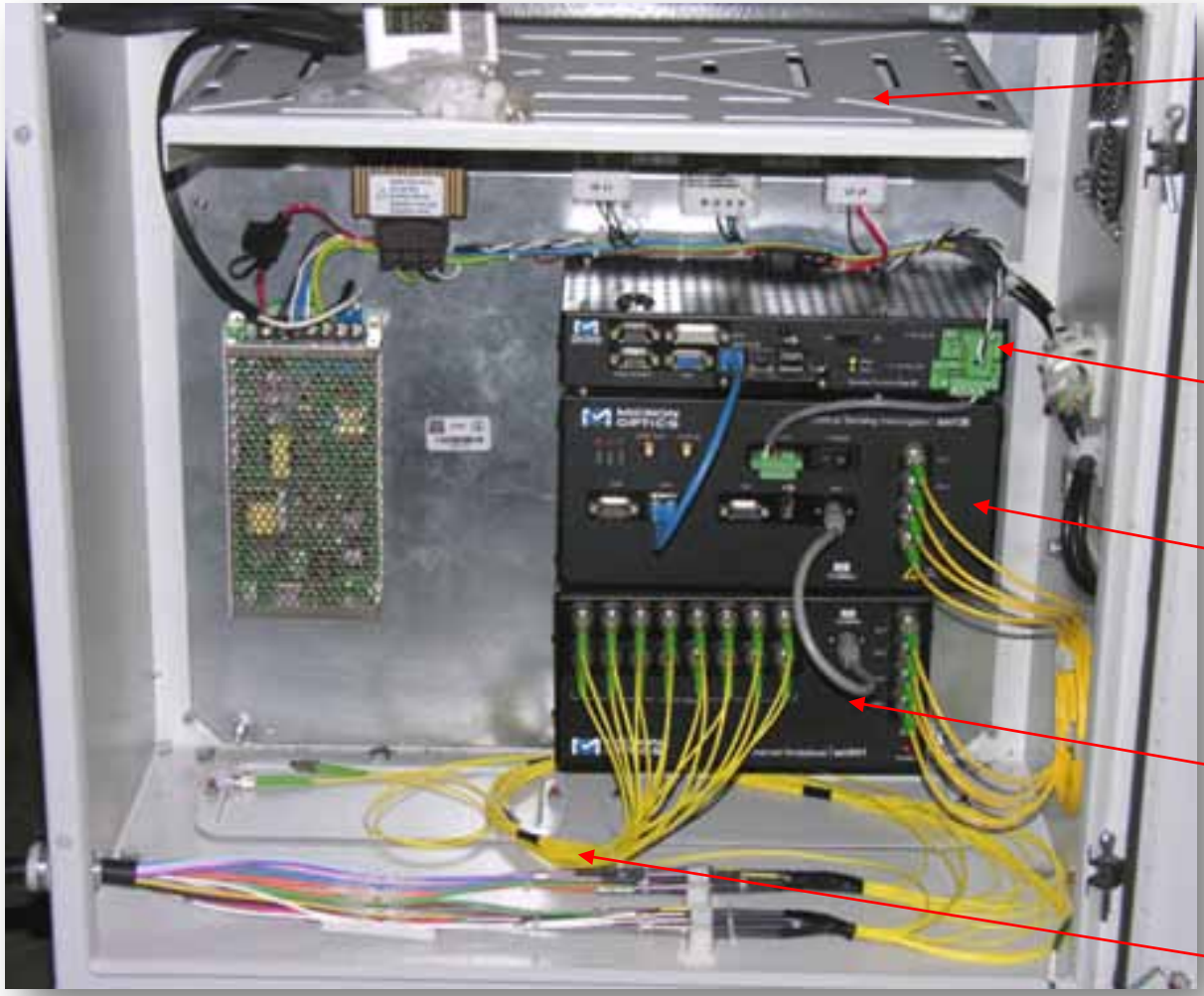
os3100 strain sensors being installed on the ceiling of the bridge truss.

Chiapas Bridge – Installation (Splicing to Trunk FO Cable)

Tapping into the main 1.1km cable feed at each of the 16 bridge segment locations.

Main cable feed tapping point and industrial grade splice tray.

Chiapas Bridge – Installation (Protective Cabinet)



The optical system is housed inside NEMA type box with controlled temperature and humidity.

sp130-500 (controller)

sm130-500 (interrogator)

sm041-416 (multiplexer)

Fiber cables (16) leading to sensors

Chiapas Bridge – Results and Acknowledgements

- Results
  - Customer is currently monitoring the bridge. More information will become available in the future.
  - The installation process was simplified and future upgrades will be easy, due to the simple, bus-type signal cable architecture of the monitoring system and it's clear wavelength allocation.

- Acknowledgements
  - Drs. Roberto Gómez Martínez and David Muria Vila of the Instituto de Ingeniaría, Universidad Nacional Autónoma de México (UNAM) - End customer and operator of the monitoring system.
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