Note Title 5/9/2018

Module 4

Lecture 6 :

STM design / experimental investigation on TLP – I

Health monitoring of TLP – lab scale – postulated failure

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TLP - Tension Leg platform

- offshore platforms, meant for deep water oil & gas exploration.

depth > 1200m ≈ 1500m

TLP - compliant structure

- ~~compliancy~~ Compliancy vs Compliant
- flexibility

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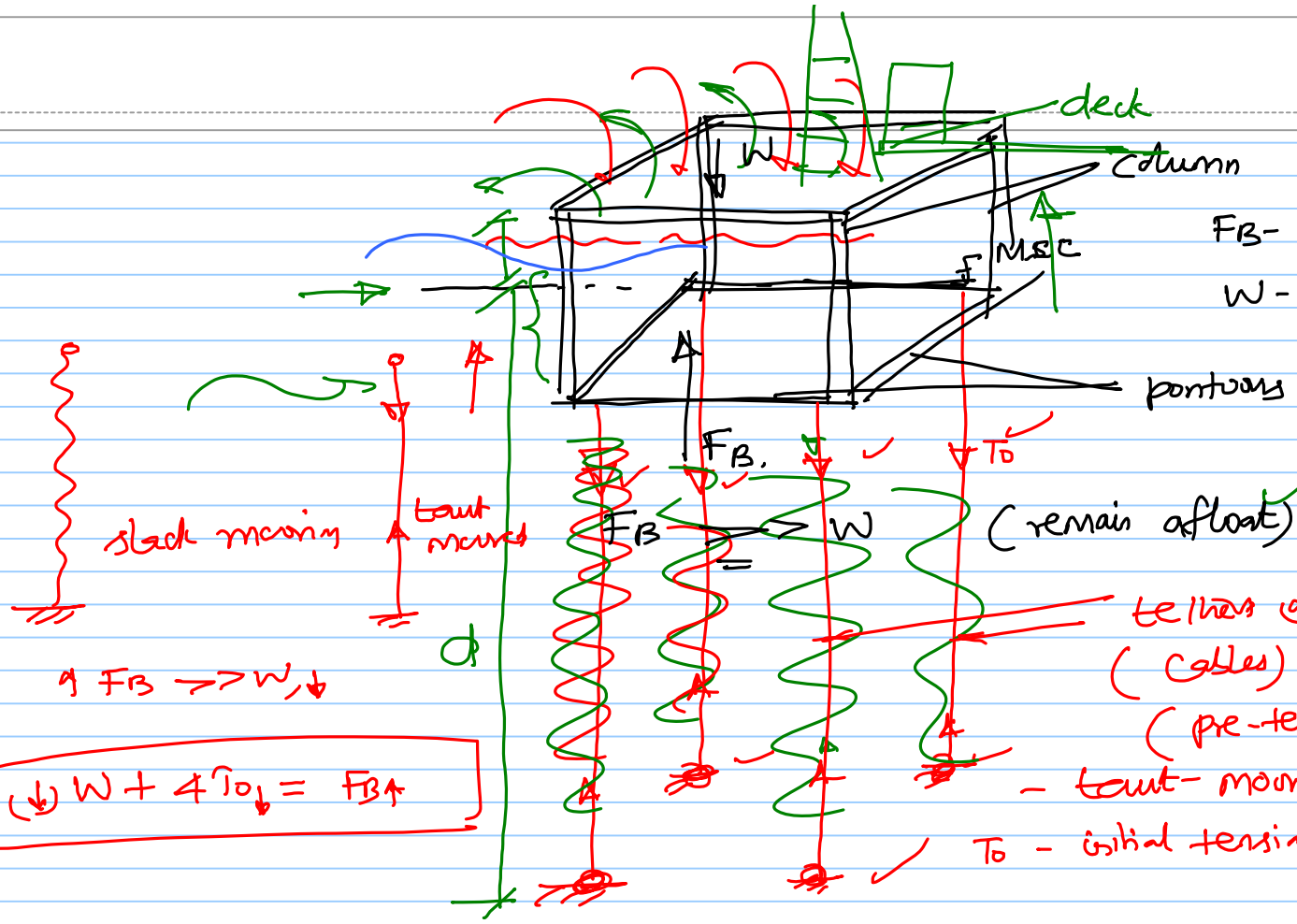

F_B - Buoyant force

W - weight (steel)

Tension Leg platform (TLP)

tethers or tendons (cables) (pre-tensioned)

- taut - moved (slack moved)

T_o - initial tension (each teth tether)

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TLP - scaled model

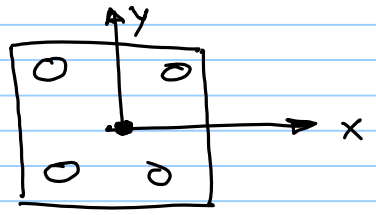
- lab scale

- TLP is commissioned (deep water)

- lateral loads (wave actn)

- postulated failures → failure created (extensions)

surge - displ along x
sway - " along y
heave " " z
roll - rotatn about x
pitch - " " y
yaw - rotatn about z



- failure / health under this conditn

SHM - failed condn

WSN

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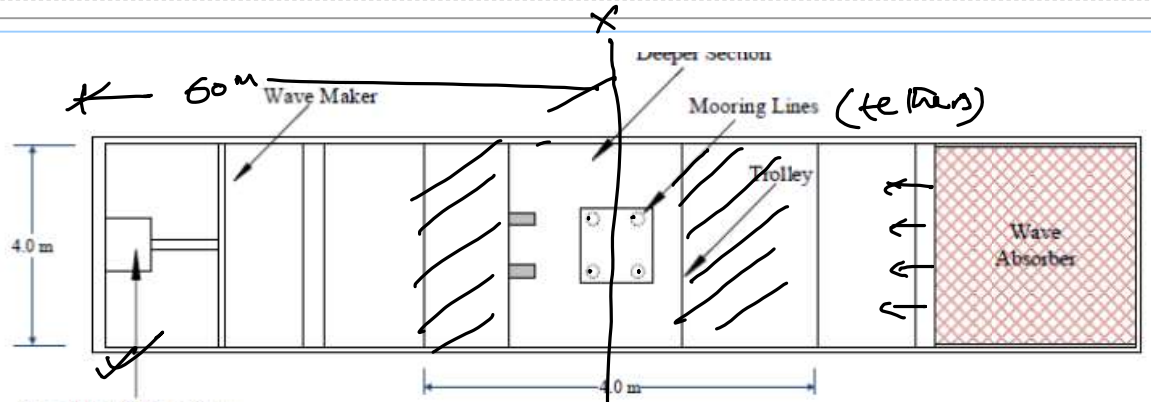


Test section

≃ 100m (ocean Engg Dept IIT M)

Wave flume, 100m long, 4m deep et

- 4th wave flume - for the experiment

- primary idea - investigate the successful application of wireless sensor network
  - examine the postulated failure of the platform
  - Alert Maintain System - (AMS) in case a failure is noticed

SHM - AMS
  - notify the damage
  - SMS, email etc
  -

Integrating the SHM to AMS,
on a lab scale.

- challenges
  - choice of the sensors
  - integrated network of the sensors

- SHM data used in this study is already developed @ our lab. (patented as well)

- use commercially available sensors
- use existing communication protocol
- SHM + AMS

Experimental setup:

wave flume - 100 m in length
- 4 m in width
- 4.5 m deep in the test section

- Mechanical-type wave Maker
  - capable of generating regular waves @ one end
  - at the beach end, absorbed by wave absorber

Max wave period - 3.6 s
max wave ht - 20 cm

Biaxial inclinometer (posital probe)

(a) Accelerometer
PCB 393B04 (ICP sensor) ± 5g 1V/g 0.3 Hz
(uniaxial)

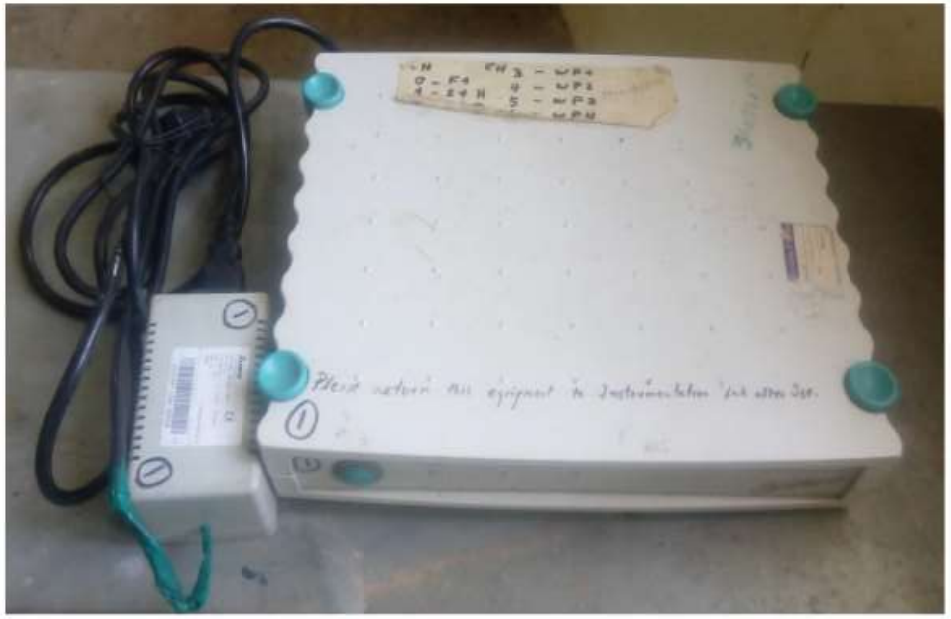
(b) Inclinometer
± 80°
biaxial
10-30V DC
RS 232 & Voltage
0.10°.

(c) loadcells (Ring type load cell)

(i) wired ✓
(ii) wireless ✓
- load cell
Steel ring
32mm ϕ 10mm
12mm th.
- half-bridge
- 15 pin connector

wave probes are used to measure wave height - Calibrated (any preset error)

(1) load sensor - axial tension is tether
(2) Inclinometer to measure the rotation
(3) accelerometer to measure the displacement
} 5Hz sensor



Data Acquisition System

DAQ

- Spider 8
- installed sensor modules will be connected
- Eight channels, for 11 measurements
- inclinator
  strain
  axial force
  accelerat / displacement

- Interfaced with computer RS 232 serial port
- Catman software, real time data - DAQ

During experiments, output from the ICP (accelerometers), inclinometers and load cells

→ DAQ, 15 pin connector

- sampling rate is about 50 Hz

Wireless sensor network – Typ

(1) primary component is the sensor node.

- each node consists of
  - (1) sensing unit
  - (2) processor unit
  - (3) transceiver unit

processor unit – Raspberry Pi Board –

- low-cost device

processor of Pi board is ARMv7 processor with 700 MHz clock speed

- can operate in Unix-based Raspbian Wheezy O/S.
- Pi board is integrated with multiple I/O peripherals
- gyro unit MPU 6050 (Micro Electro Mechanical system MEMS) chip
  - connected to the processor through GPIO pins

Summary

- SHM – applied on TLP.
  - offshore platform – deep water
  - acts on TLP – waves
  - data to be acquired during exp mode
  - units of SHM < wired / wireless >