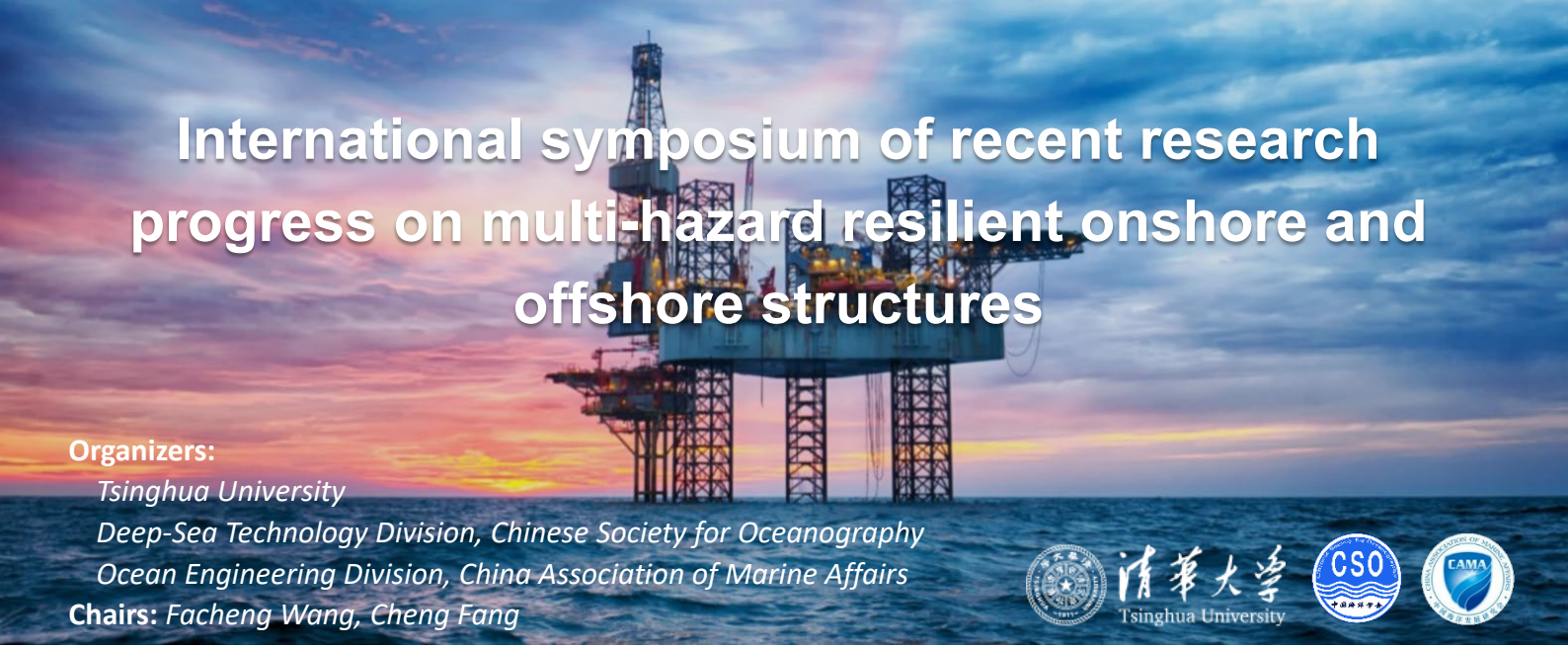


International symposium of recent research progress on multi-hazard resilient onshore and offshore structures

Organizers:
Tsinghua University
Deep-Sea Technology Division, Chinese Society for Oceanography
Ocean Engineering Division, China Association of Marine Affairs
Chairs: *Facheng Wang, Cheng Fang*

28th October 2022 | 16:00-19:00 (China) 9:00-12:00 (UK)
ONLINE meeting
Connect to the Symposium by Microsoft Teams (Link: https://teams.live.com/meet/9541762195835)

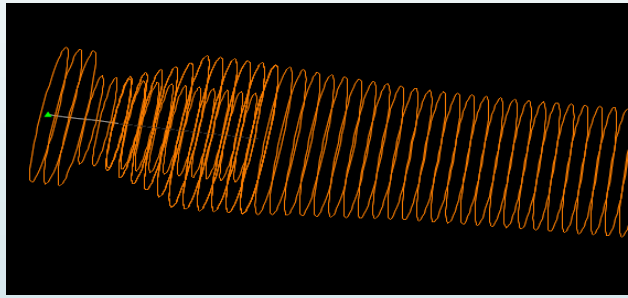
Program and Agenda

China Time	UK Time	Program
16:00-16:05	9:00-9:05	**Welcome Speech** Facheng Wang, Associate Professor, Tsinghua Univ.
16:05-16:25	9:05-9:25	**Advanced Seismic Mitigation Strategy and Resilience Enhancement for Engineering Structures** Cheng Fang, Professor, Tongji Univ.
16:25-16:45	9:25-9:45	**Natural Fibre Reinforced Concrete for Seismic Applications** Adelaja Osofero, Senior Lecturer, Univ. of Aberdeen
16:45-17:05	9:45-10:05	**Analytical Behavior of CFDST Structure Subjected to Underwater Blast Loading** Sumang Li, PhD Candidate, Tsinghua Univ.
17:05-17:25	10:05-10:25	**Guidelines for Designing Marine Hoses for Oil/Gas Applications** Chiemela Victor Amaechi, Associate Lecturer, Lancaster Univ.
17:25-17:45	10:25-10:45	**Influence of Atmospheric Corrosion on Cyclic Behavior of Low-alloy Steel and its Butt-joint Weld** Yuelin Zhang, PhD Candidate, Tongji Univ.
17:45-18:05	10:45-11:05	**Investigation on the Bending Fatigue Performance of Circular Concrete-Filled Double Skin Steel Tube with Butt Weld** Zhengqing Cheng, PhD Candidate, Tsinghua Univ.
18:05-18:25	11:05-11:25	**Effect of Corrosion on Microstructure and Mechanical Properties of Steel** Zhenxing Zhu, PhD Candidate, Beijing Univ. of Technology
18:25-19:00	11:25-12:00	**Discussion**

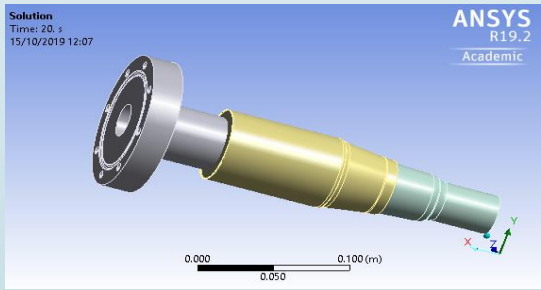
For further information, contact Facheng Wang (wangfacheng@tsinghua.edu.cn), Sumang Li (lisumang21@mails.tsinghua.edu.cn).

Lancaster University

Guidelines for designing marine hoses for oil /gas applications



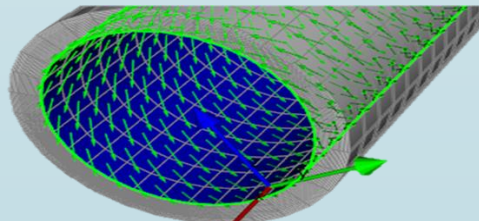
AMAECHI CHIEMELA VICTOR



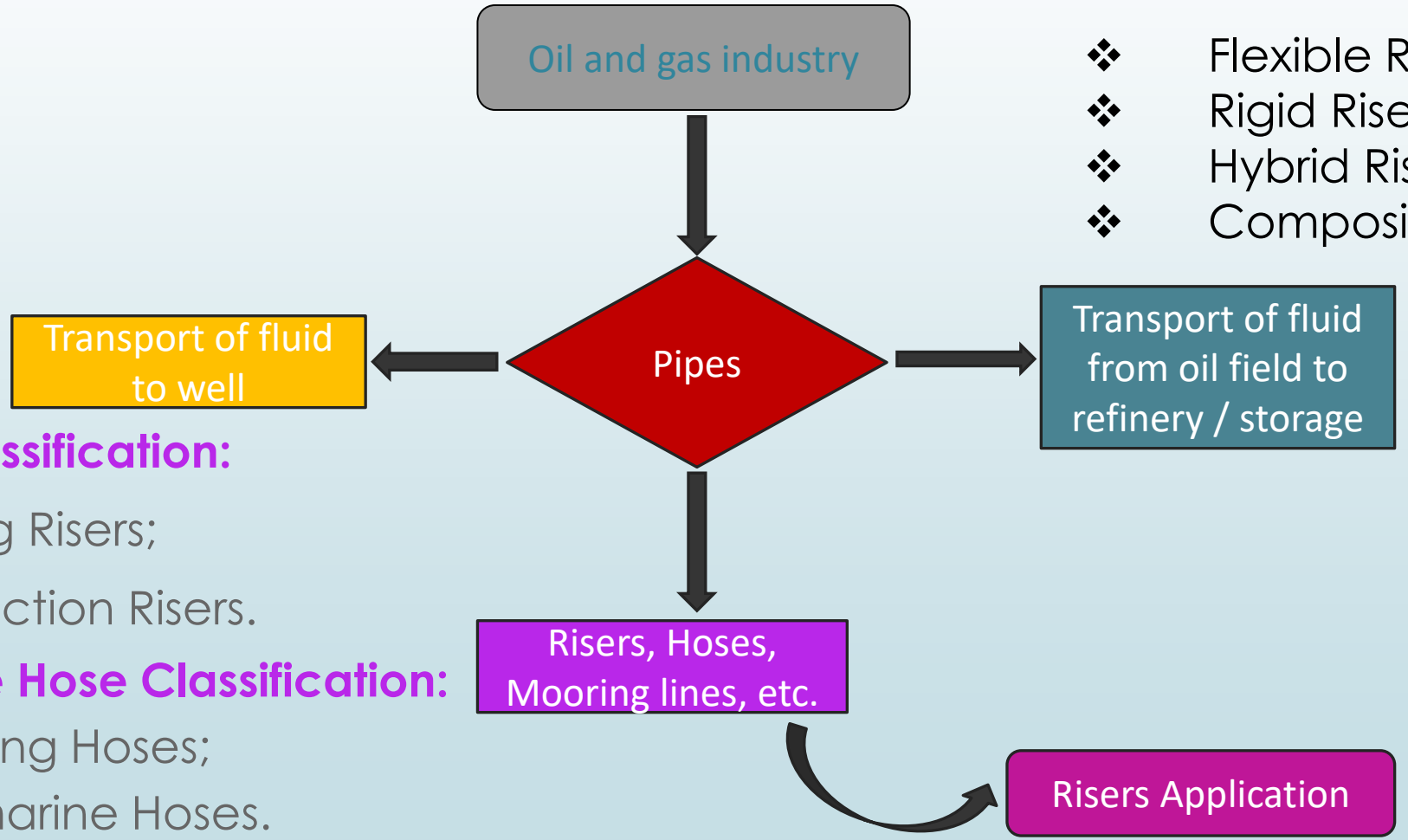
International symposium of recent research progress on multi-hazard resilient onshore and offshore structures

Date: Friday, 28/10/2022
Time: 10:05am -10:25am, Online via MS Teams
Affiliation: Lancaster University, School of Engineering, UK

(Link: https://teams.live.com/meet/9541762195835)



Development of Marine Hoses

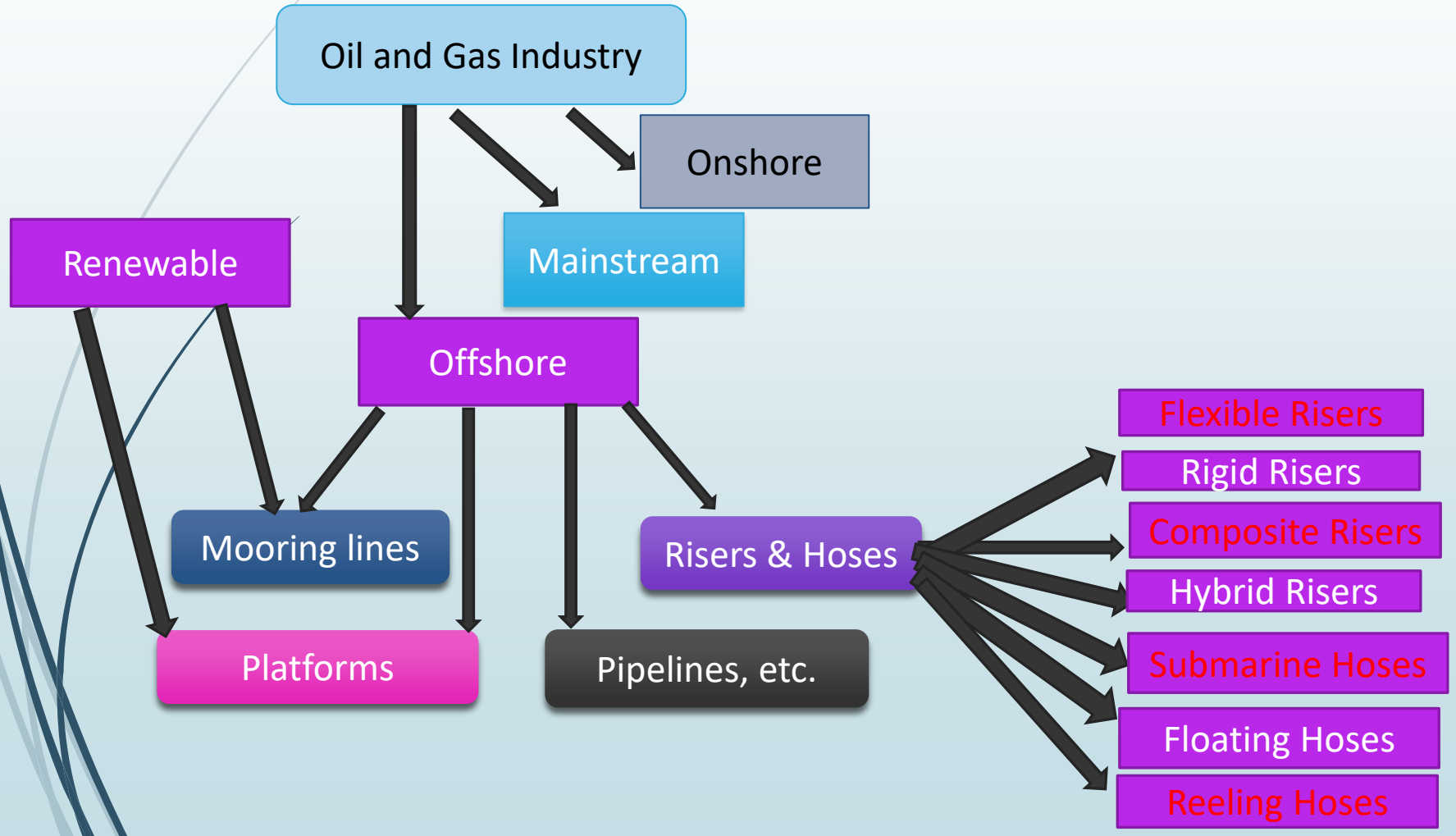


Types of Risers

- Flexible Risers;
- Rigid Risers;
- Hybrid Risers;
- Composite Risers

- **Riser Classification:**
  - Drilling Risers;
  - Production Risers.
- **Offshore Hose Classification:**
  - Floating Hoses;
  - Submarine Hoses.

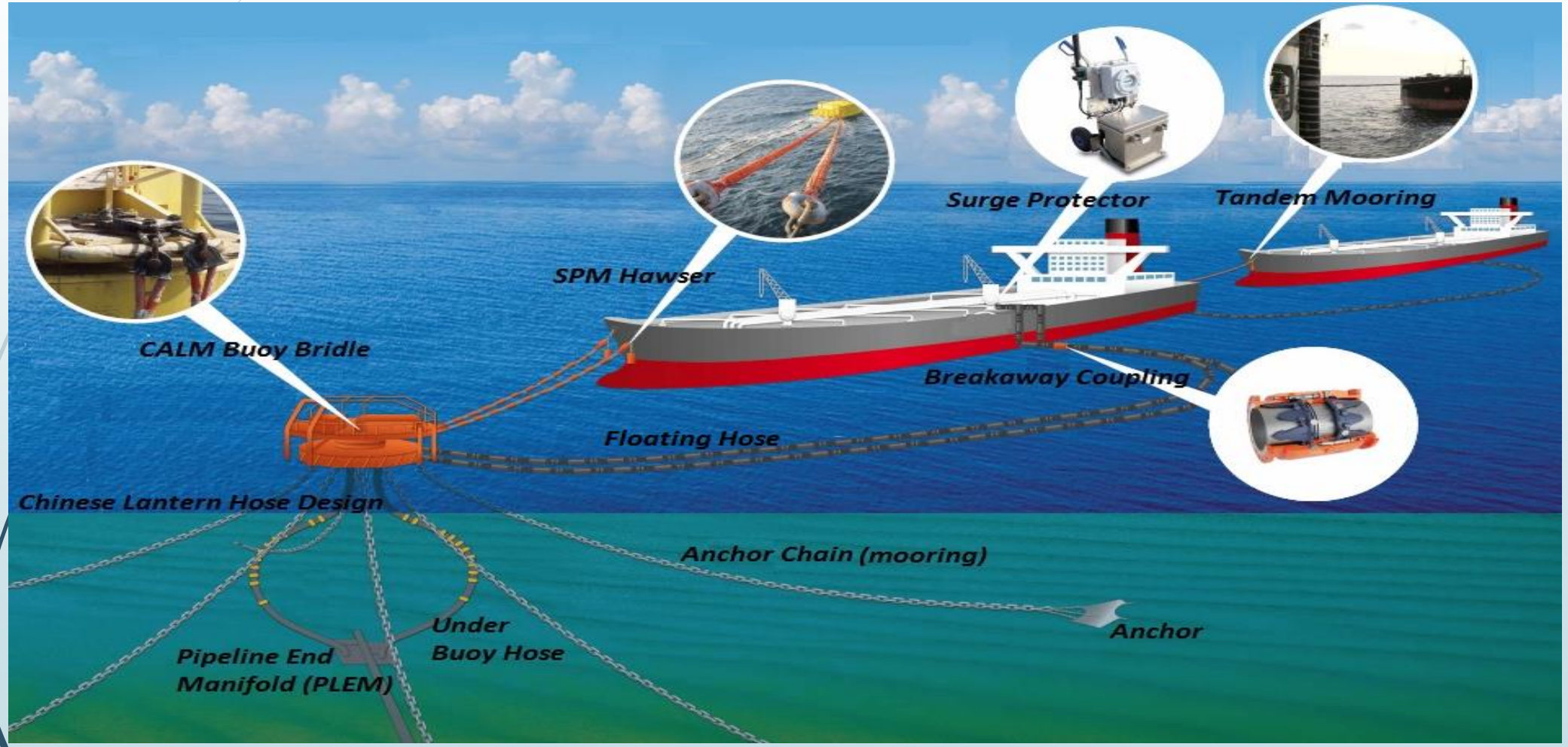
Literature Review on Research



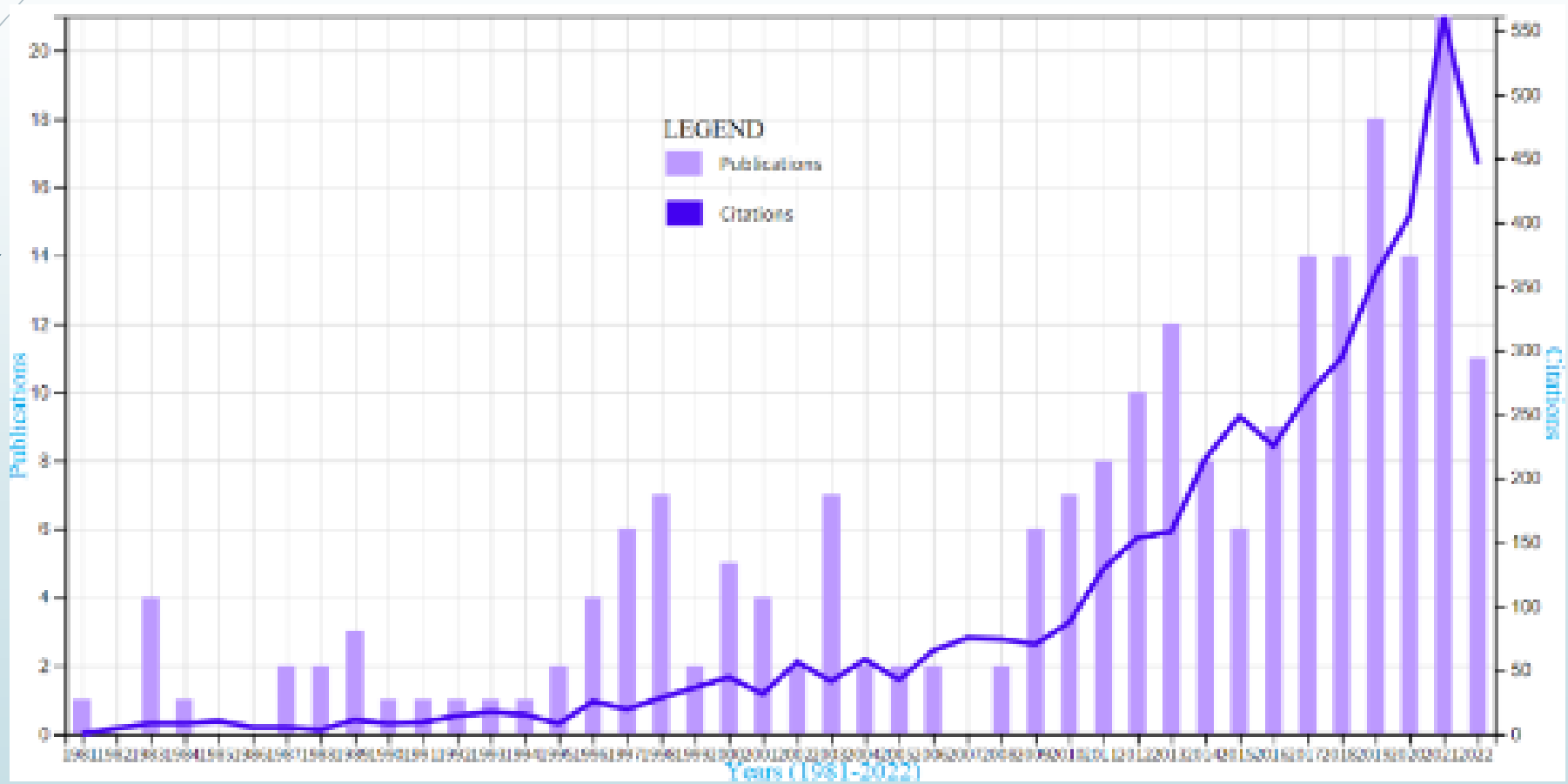
Research Collaborations

- Tsinghua University, Beijing, China;
- Xidian University, China;
- Orcina, Ulverston, Cumbria;
- Bluewater Netherlands;
- Dunlop Oil and Marine, Grimsby, UK;
- Airborne Oil and Gas Netherlands,
- Magma UK;
- Siemens Ulverston, Cumbria;
- Composites UK;
- Coventry University, Coventry, UK;
- University of Liverpool, Liverpool, UK
- Lancaster University, Lancaster, UK
- Newcastle University, Newcastle, UK.

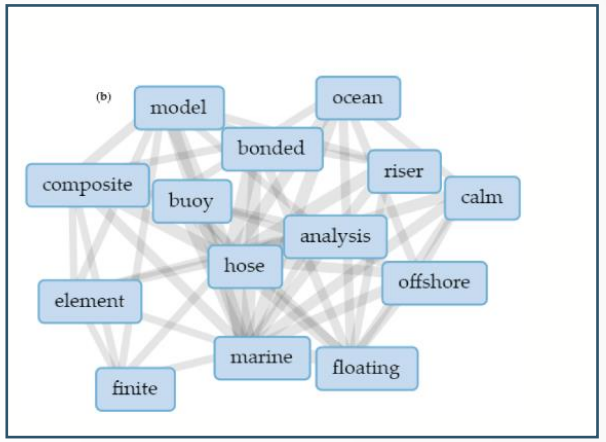
Industry Application: CALM Buoy-Chinese Lantern

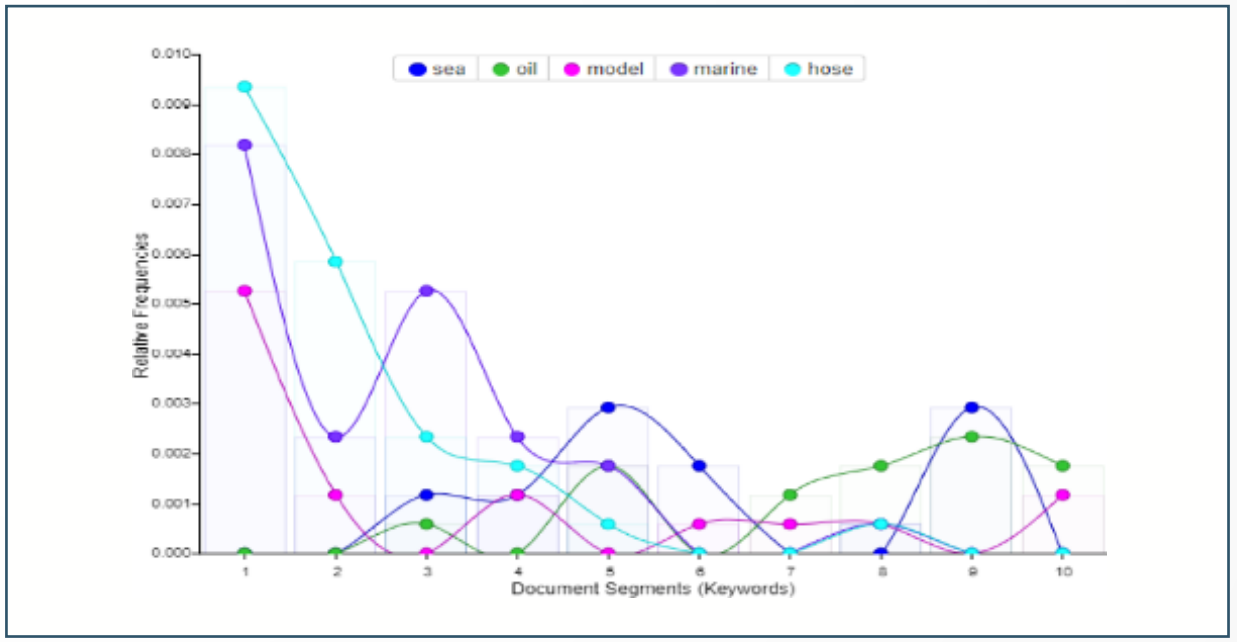


Scientometic Review on Marine Hoses



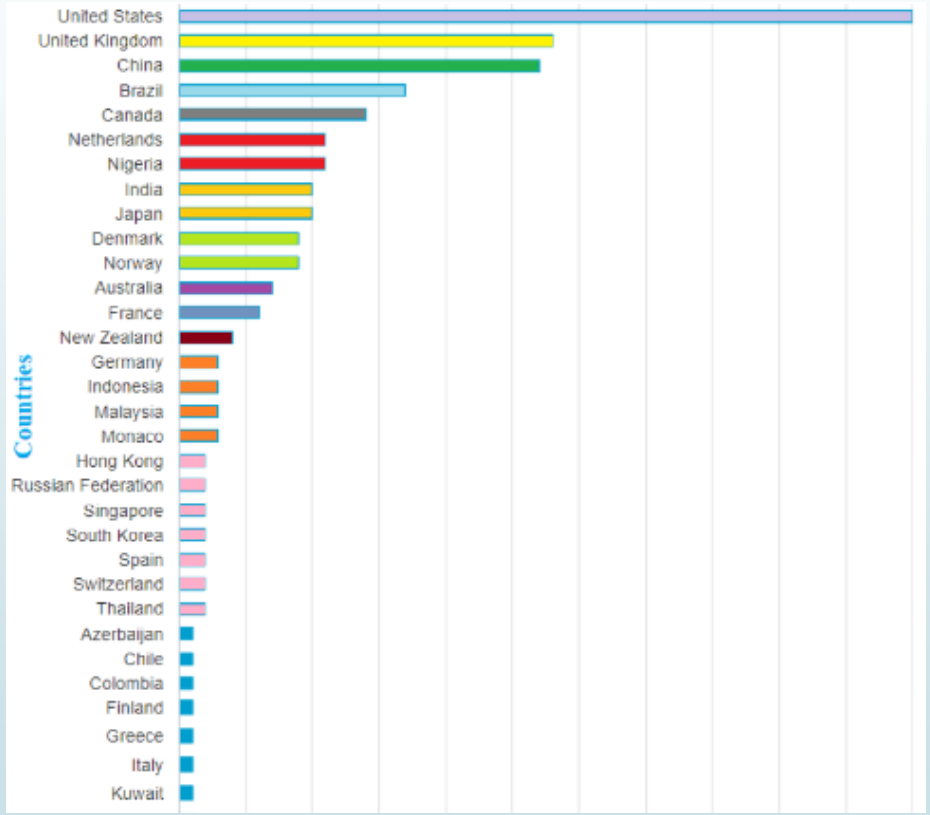
Scientometic Review on Marine Hoses

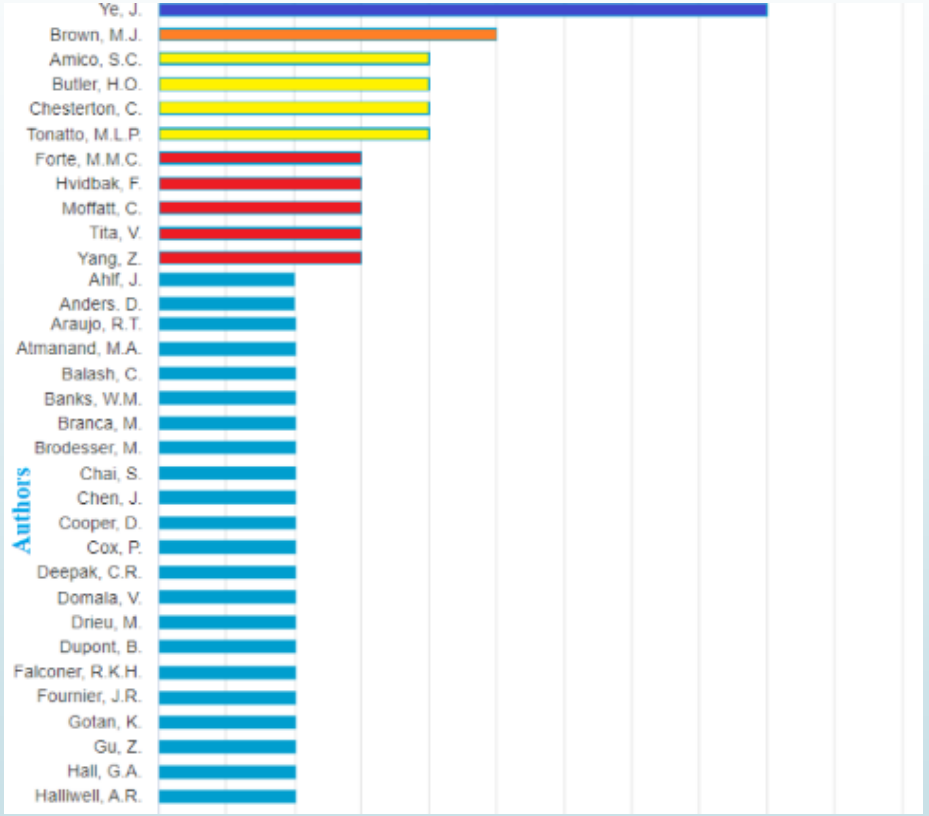




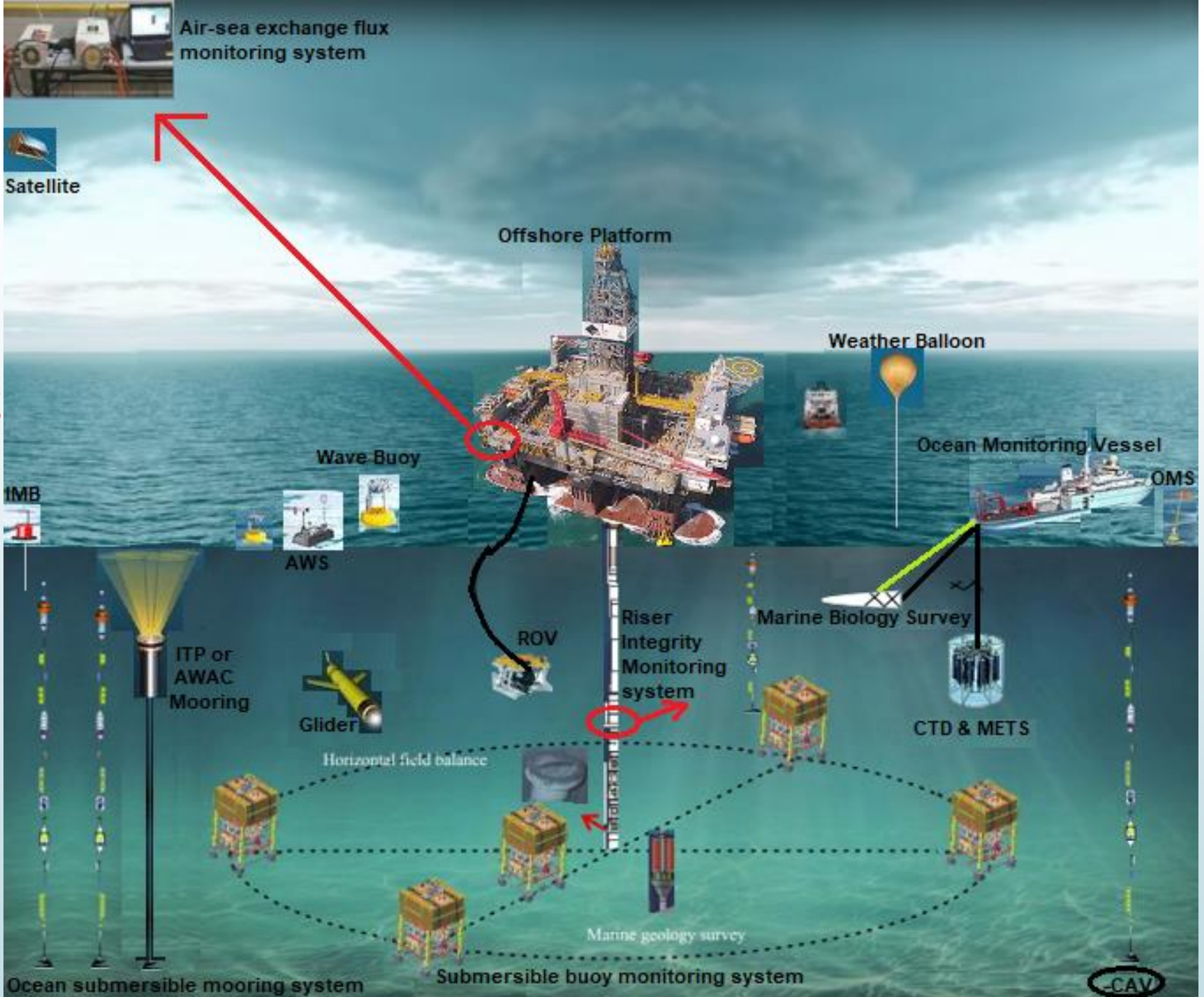
https://doi.org/10.3390/en15207723

Research in brief –Countries and Authors



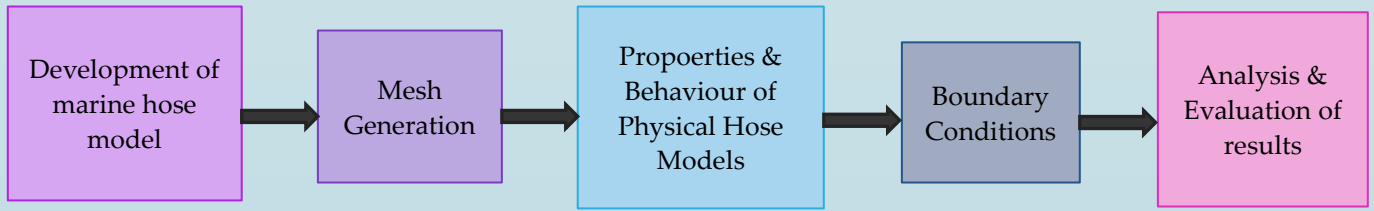


Monitoring of Subsea Facilities

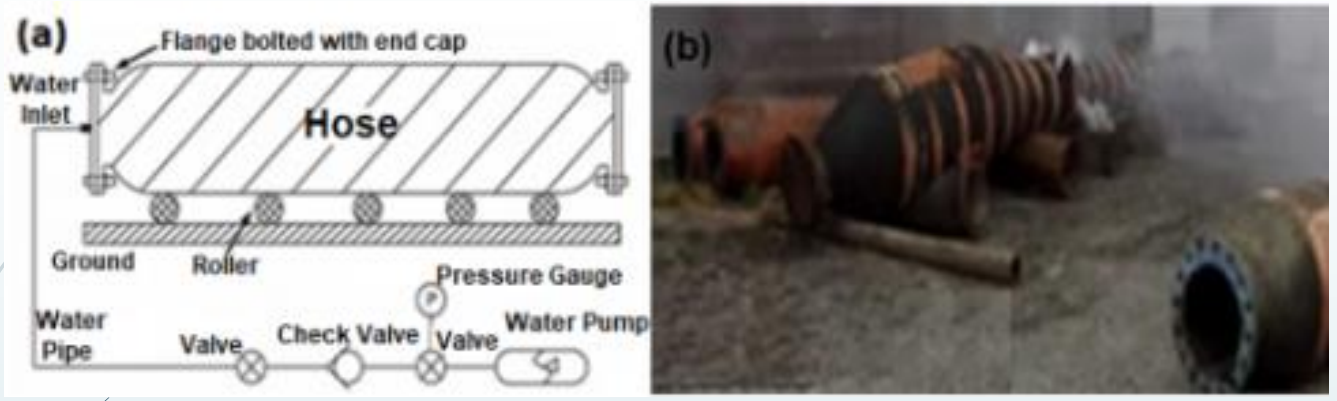


PhD Research Outline

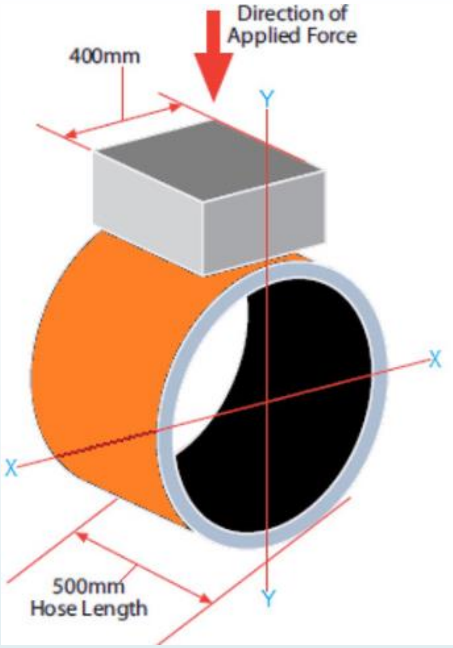
Chapter	Chapter One: Introduction
Chapter	Chapter Two: Review on the mechanics and hydrodynamics of Marine Hoses for CALM buoys
Chapter	Chapter Three: Experimental Study on Motion Characterization of CALM buoy hose system
Chapter	Chapter Four: Finite Element Modelling (FEM) on Bonded Marine Hose
Chapter	Chapter Five: Numerical simulation on motion characterization from hydrodynamic loading on a CALM buoy and its marine hoses
Chapter	Chapter Six: Strength of submarine hoses in Chinese-lantern config from wave loads on CALM buoy
Chapter	Chapter Seven: Dynamic behaviour of submarine hoses on CALM buoy in Lazy-S config under water waves
Chapter	Chapter Eight: Conclusions and Recommendations



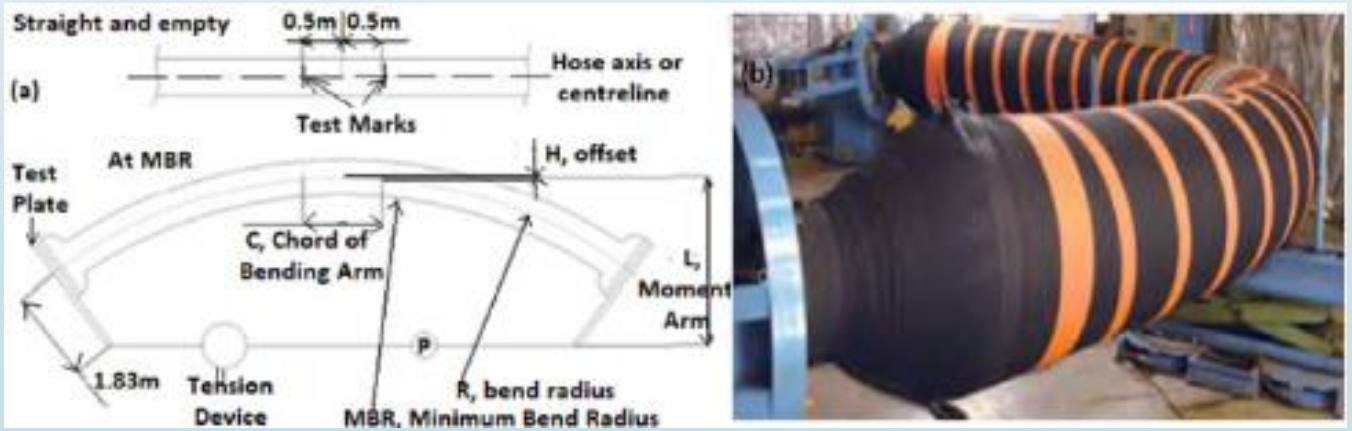
Some Recommended Tests



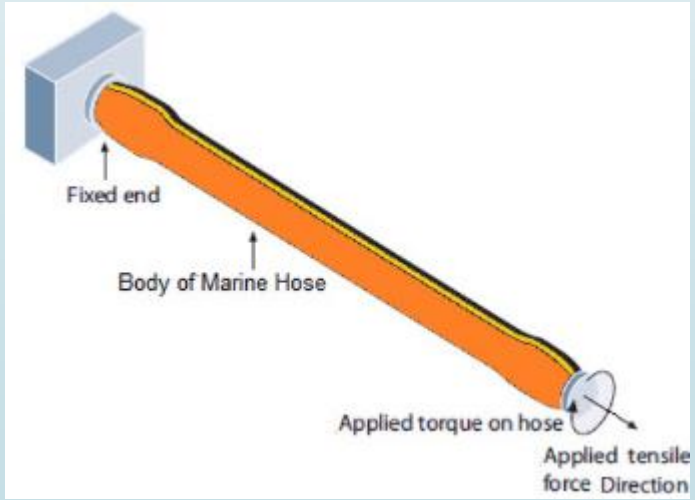
Burst Load



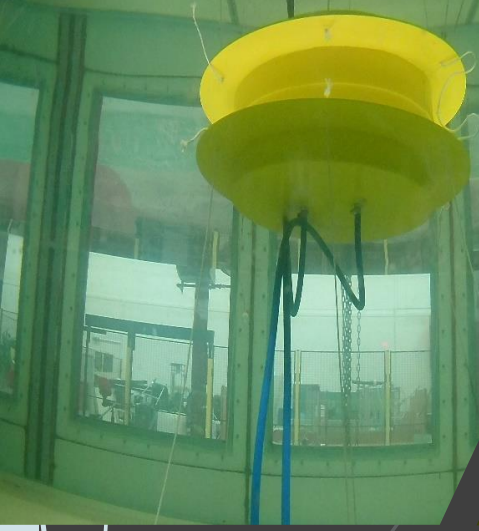
Depiction of crush load test on hose

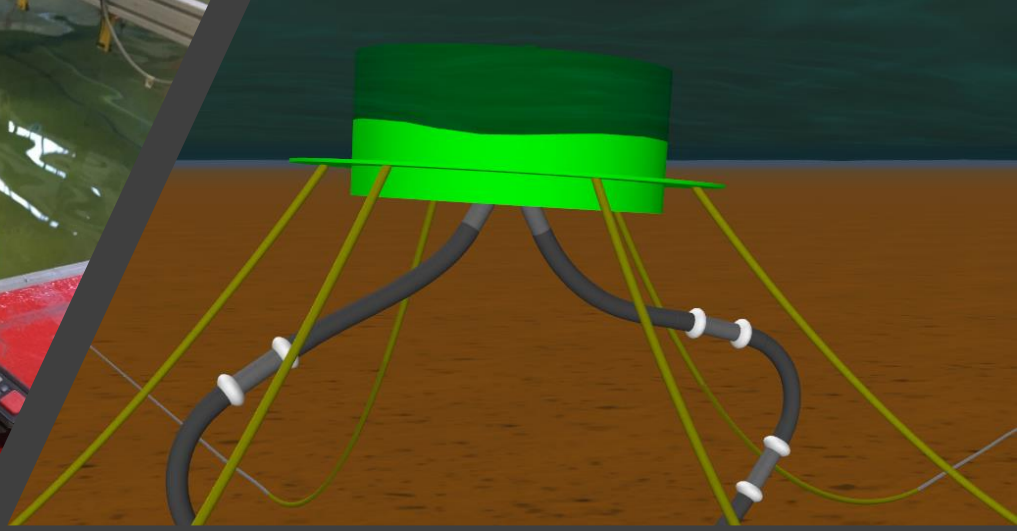


Bending Stiffness Test



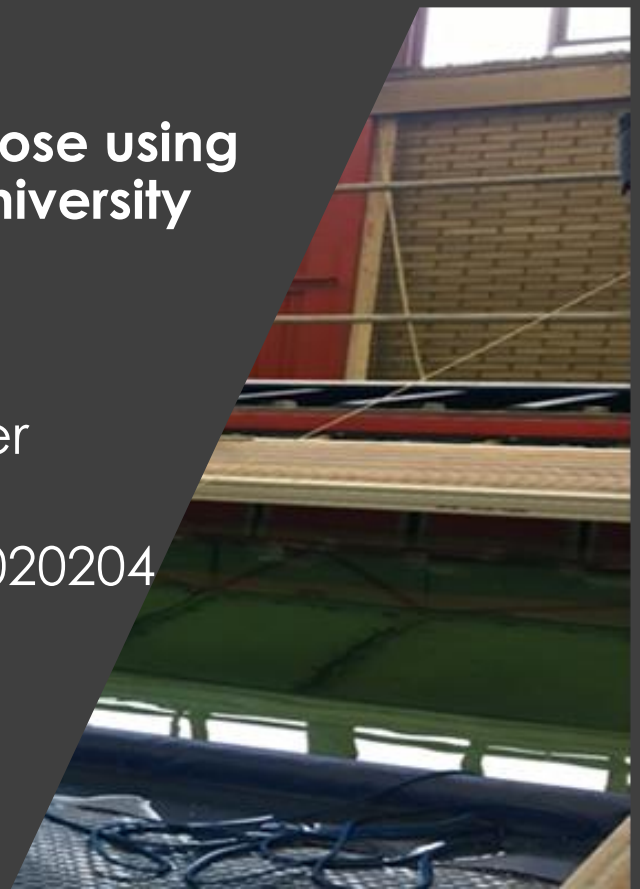
Depiction of torsion and tensile tests



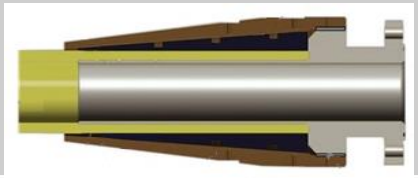
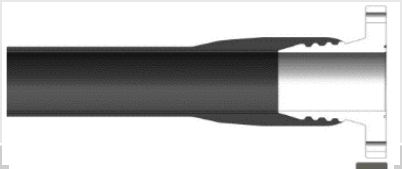
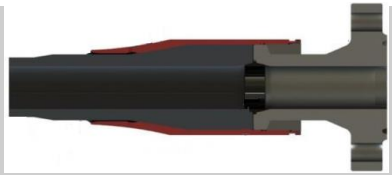
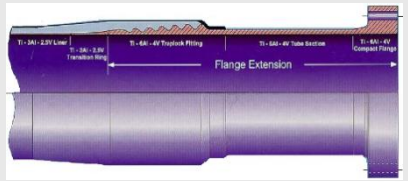
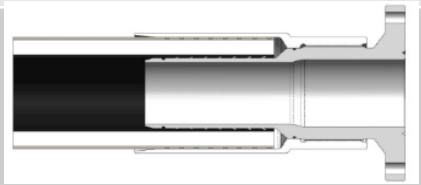
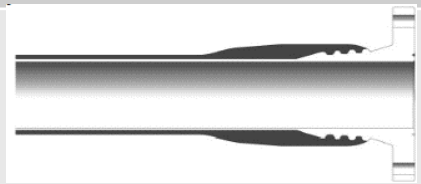



Experimental work on submarine hose using CALM buoy model on Lancaster University Wave Tank

- (images taken using Underwater camera, from different views)
- https://doi.org/10.3390/jmse10020204




Hose-Riser End-fitting Designs

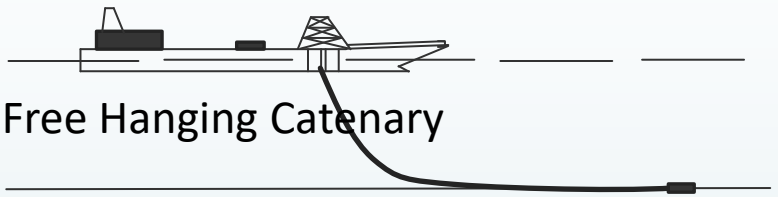
End-fitting	Description of the design	Reference
Airborne end-fitting design		Airborne, (2016)
Traplock end-fitting design		Hatton et al., (2013)
Magma end-fitting design		Magma, (2016)
Swagged End-fitting		Hatton et al., (2013)
Heidrun End-fitting		Salama et al. (2005)
Metallic liner end-fitting		Hatton et al., (2013)

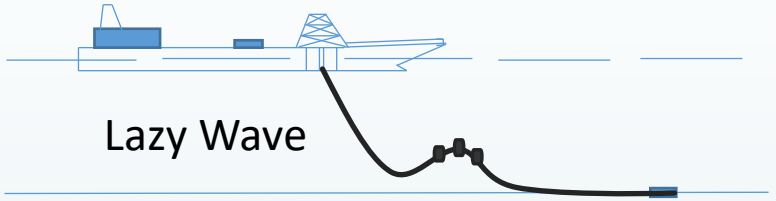
Determination of Interface Load / Stresses

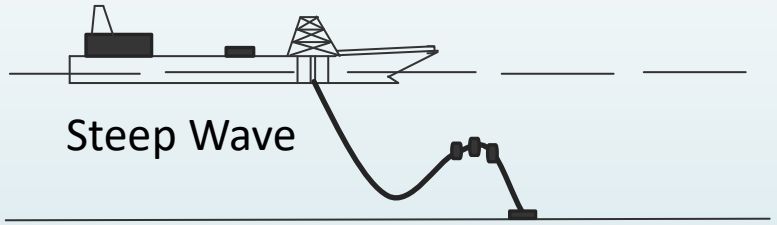
- Crude oil and LNG loading / offloading operations utilizes flexible medium (steel and composite pipes) which are most often reeled on drums during installation and after use, depending on what type of riser.
- Recently, oil well operator are beginning to experience failures with their reeled risers from loads which are generated from the reel; crush loads, delamination from steel and rubber interface.
- This is generating a huge cost on offshore offloading as the risers are constantly been changed. This project is aimed at understanding the stress distribution on offshore reeling risers during service.

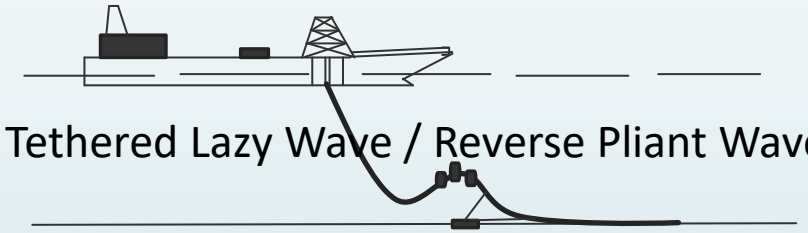
Hoses & Riser Configurations

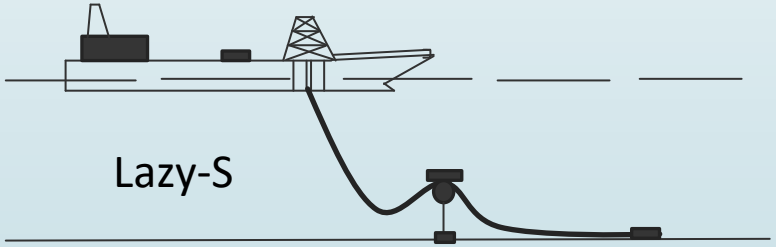
Reeled Hoses

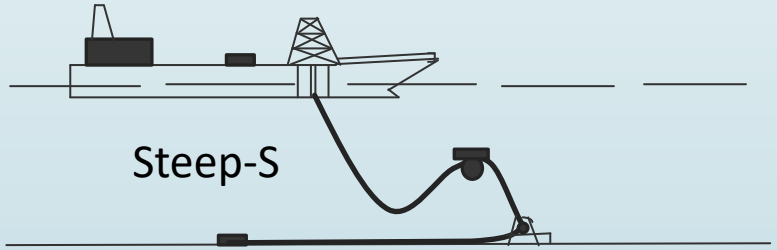


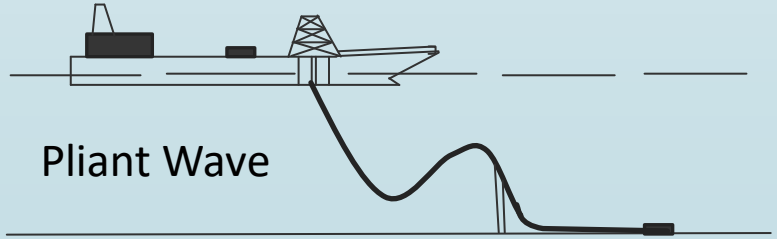


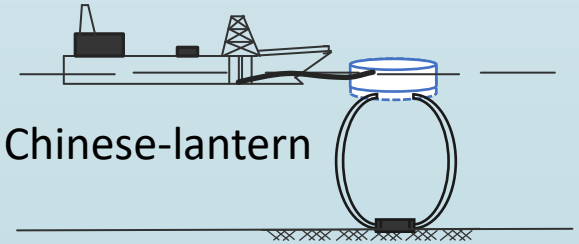




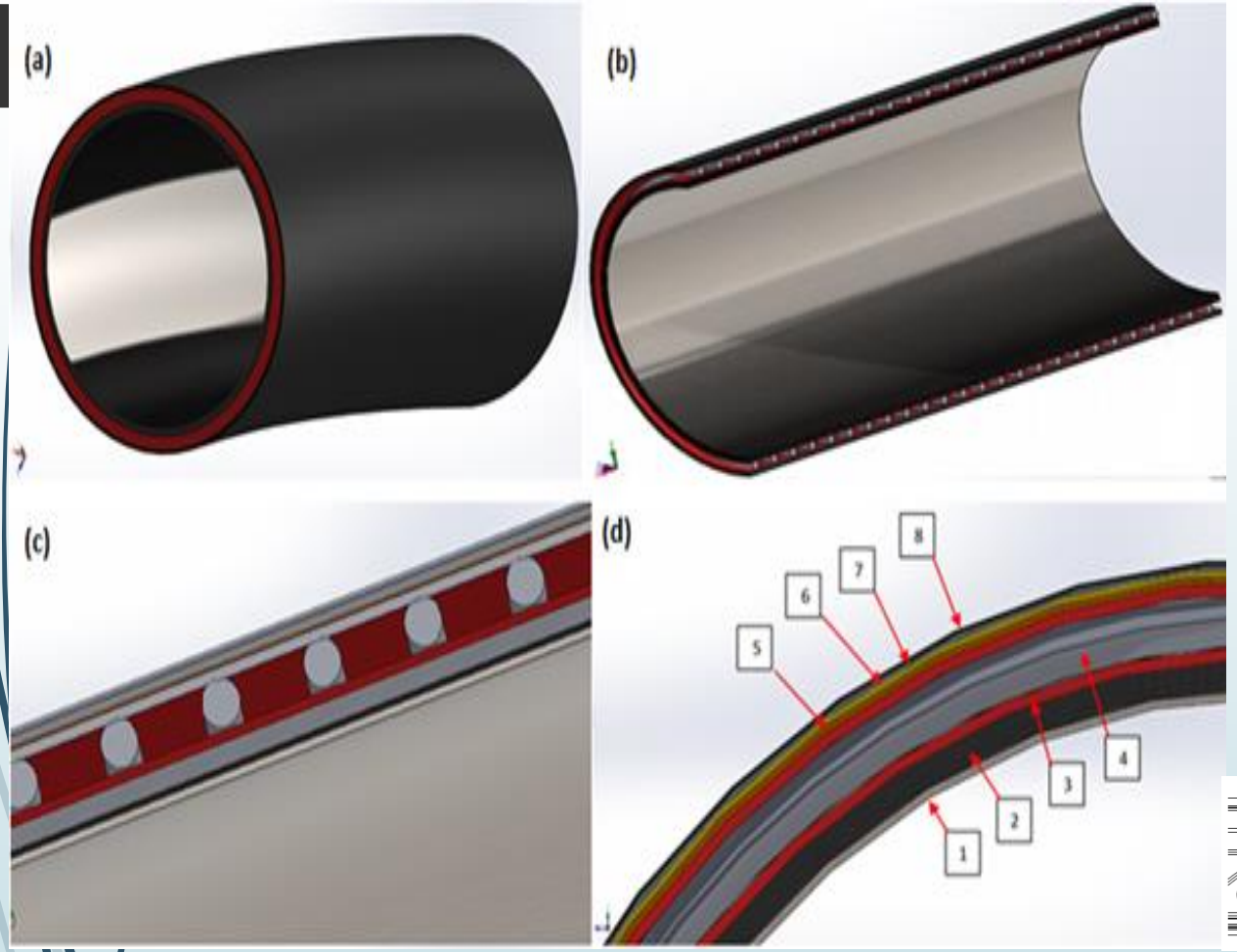


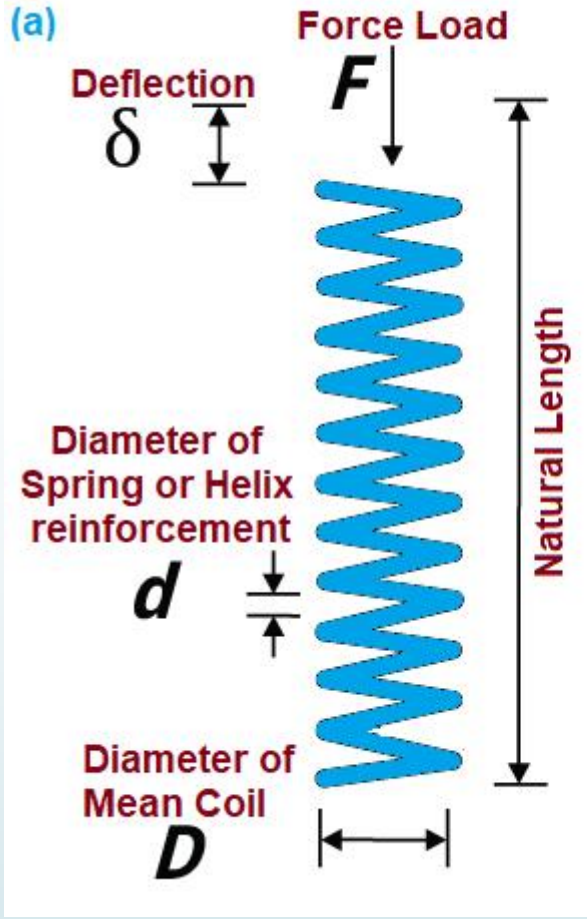


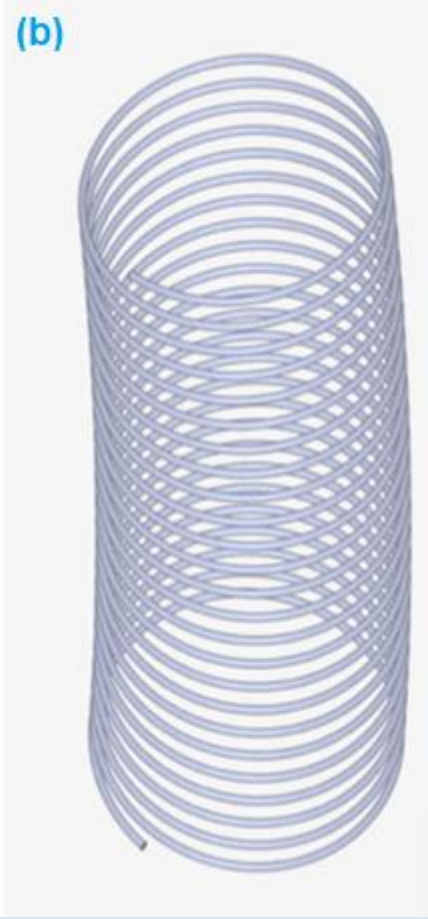


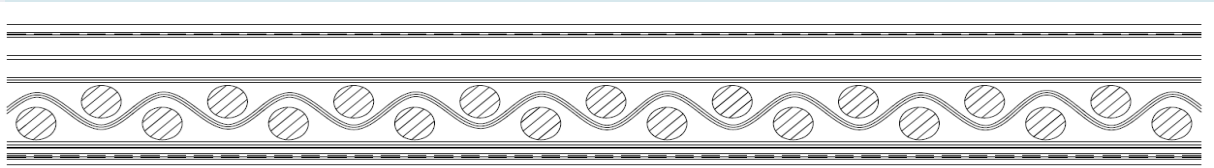


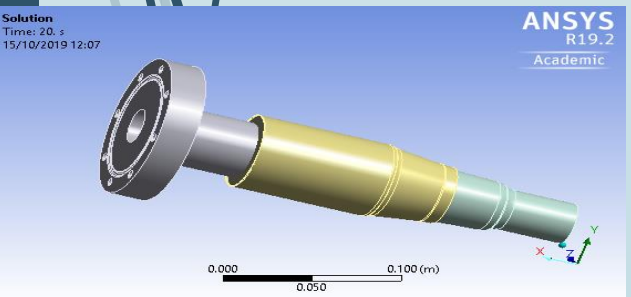
Marine Hose & Helix Models









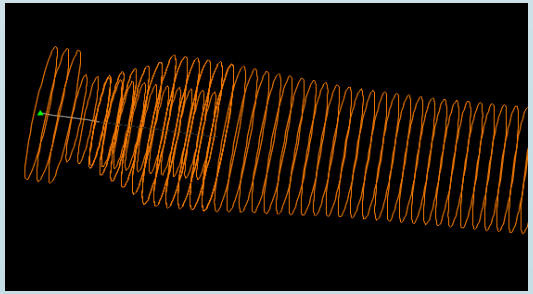


The section should layers:

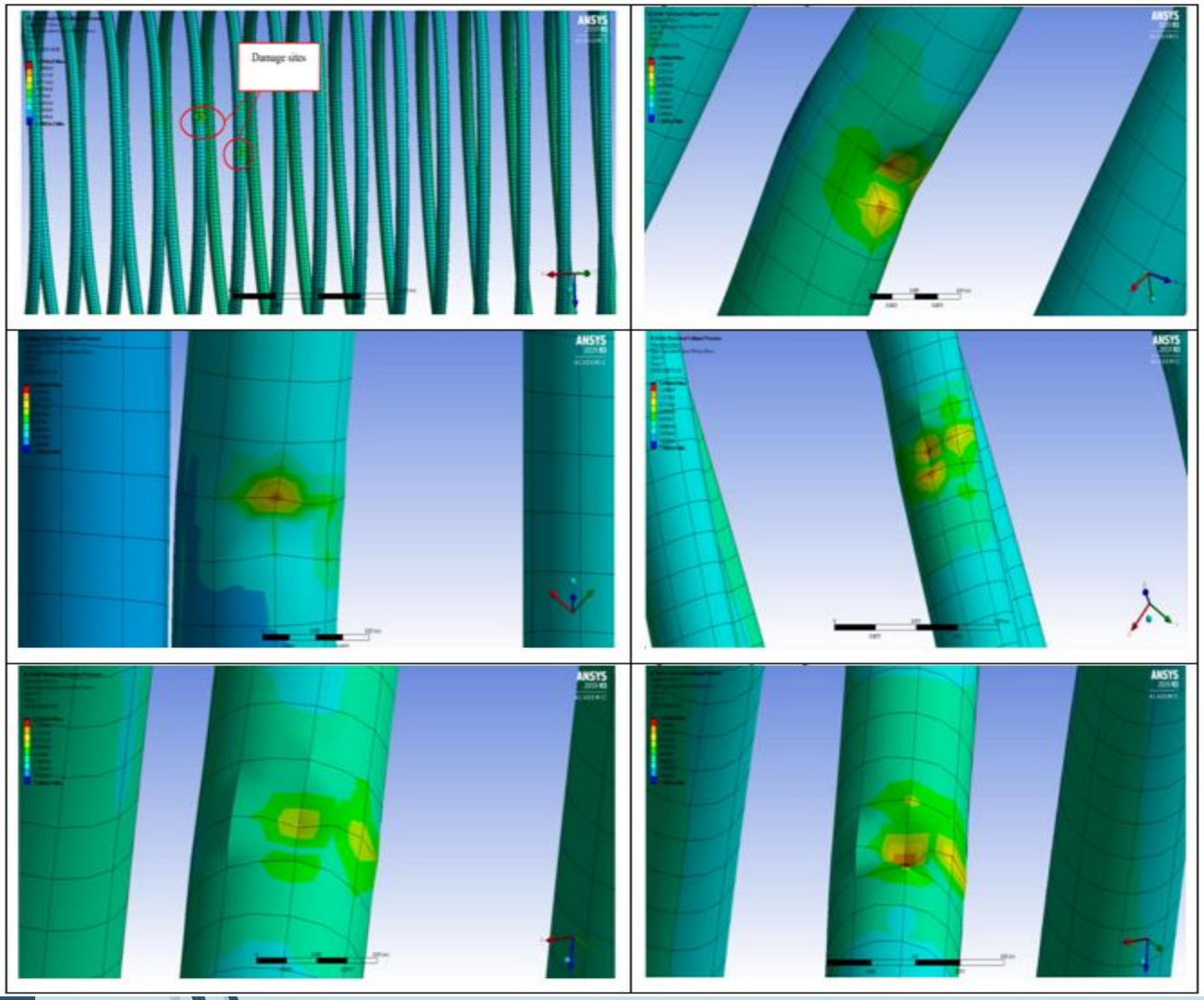
---The Lining
---The Main Plies
---The Embed Wire
---The Cover
---The End Fitting.

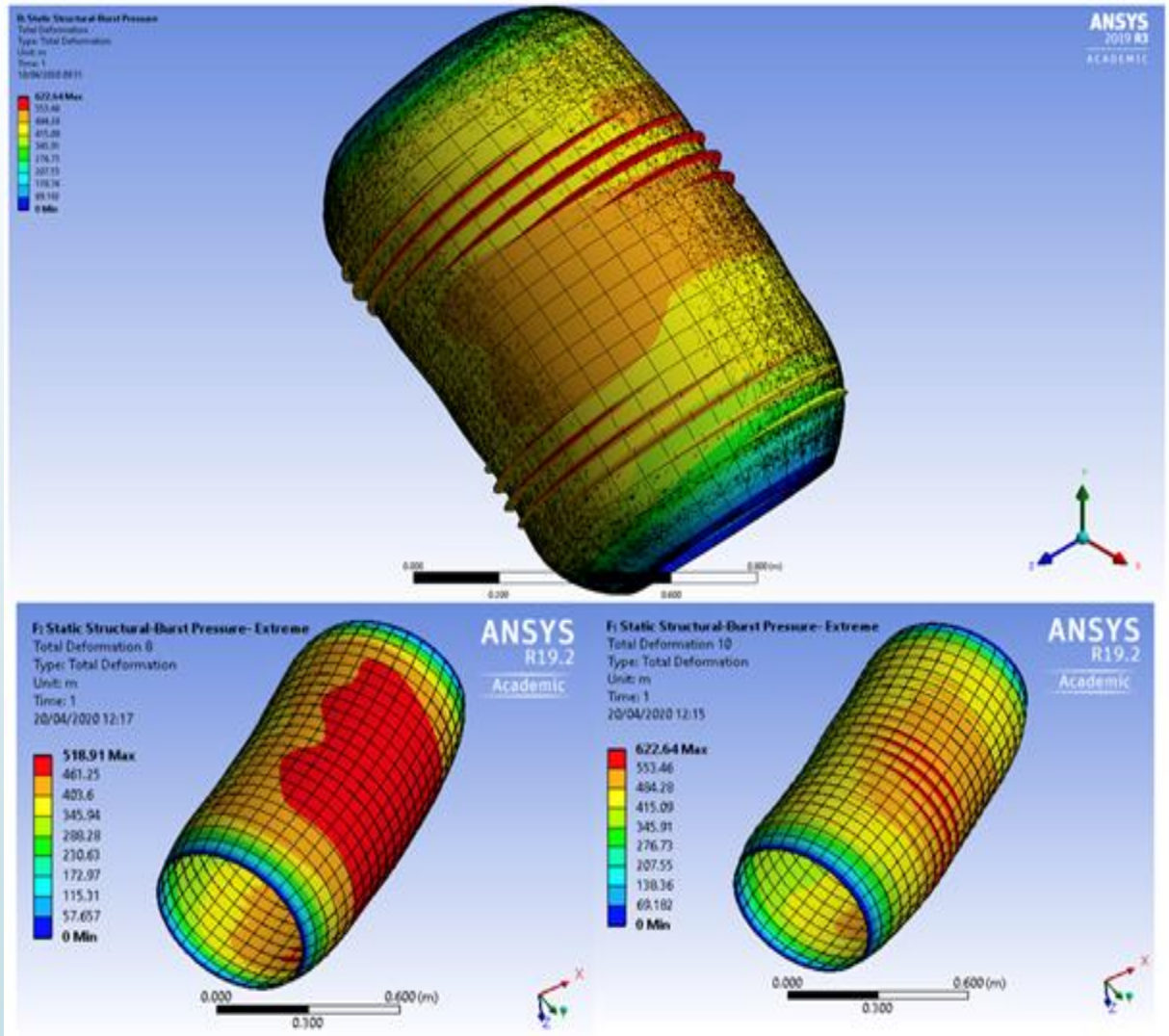
doi: 10.3390/jcs6030079

doi: 10.3390/jmse10020151



Results of Local Design

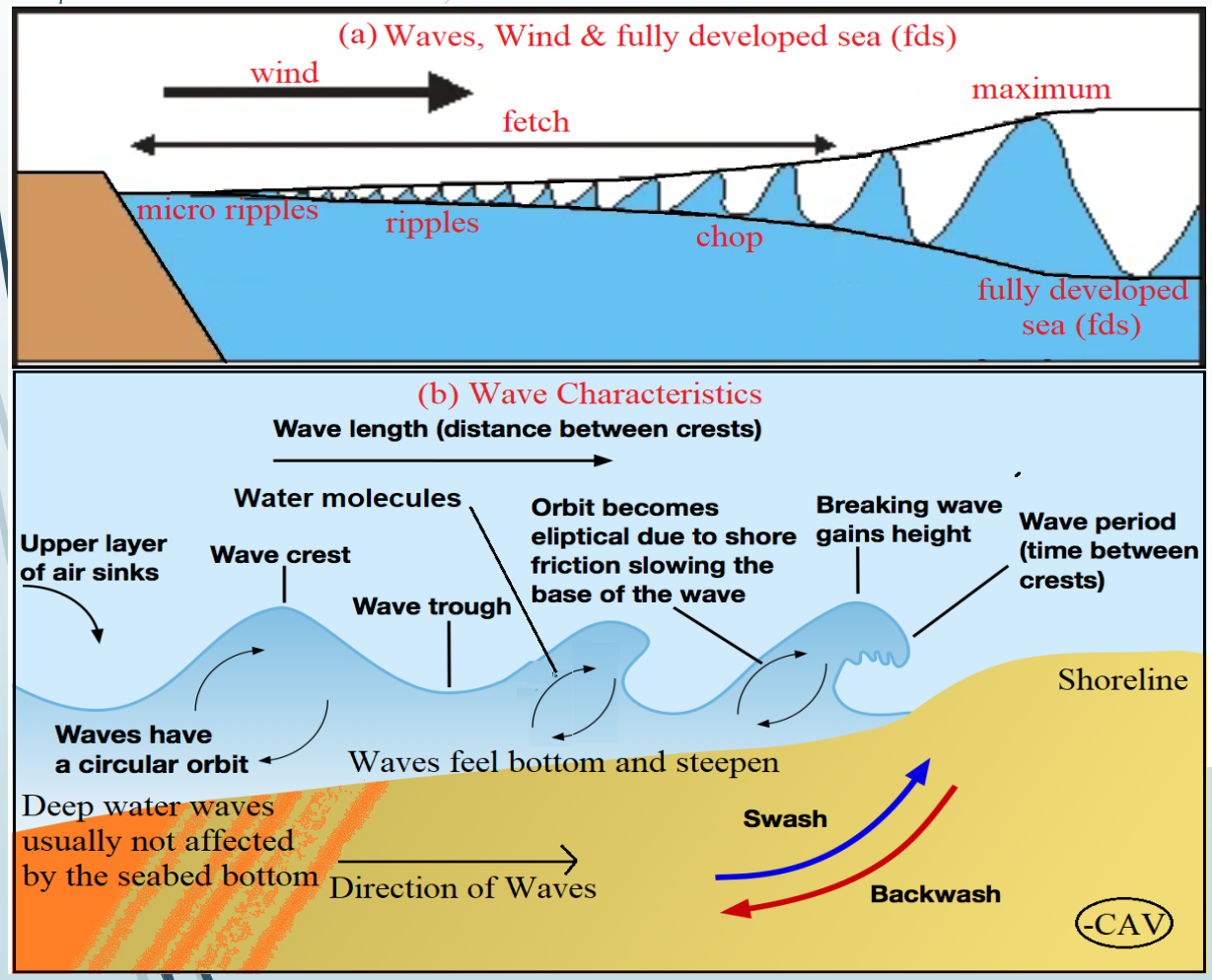


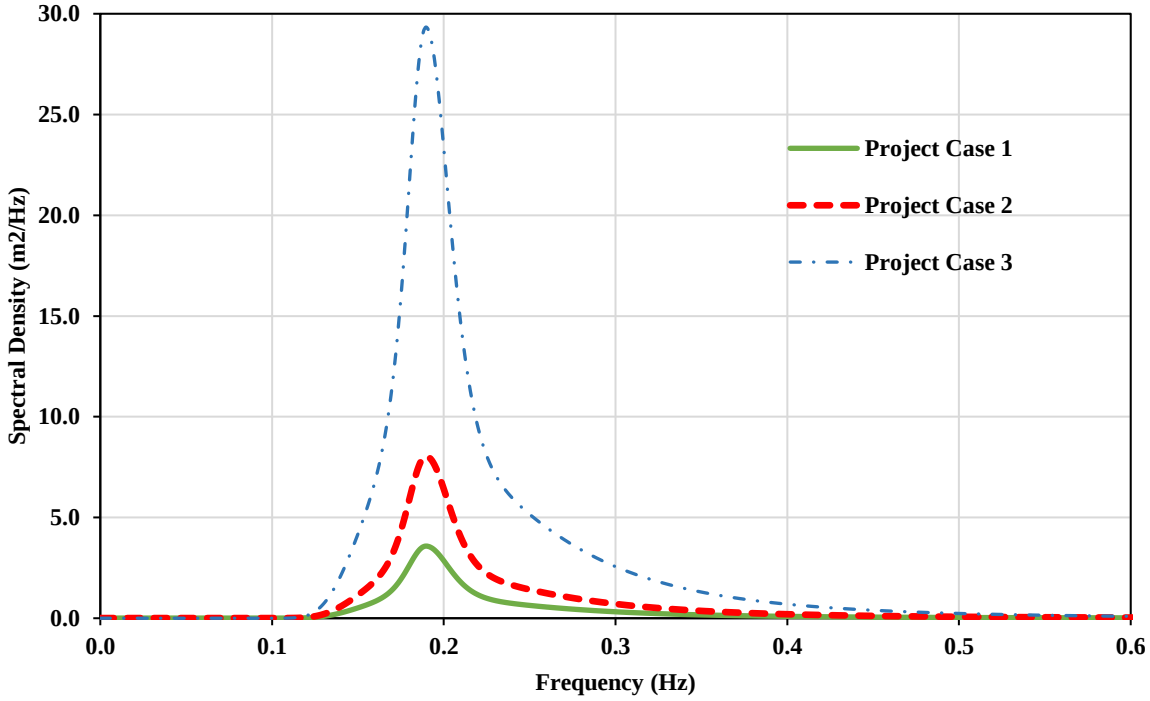


doi: 10.3390/jcs6030079

doi: 10.3390/jmse10020151

Environmental Condition - Wave Spectrum

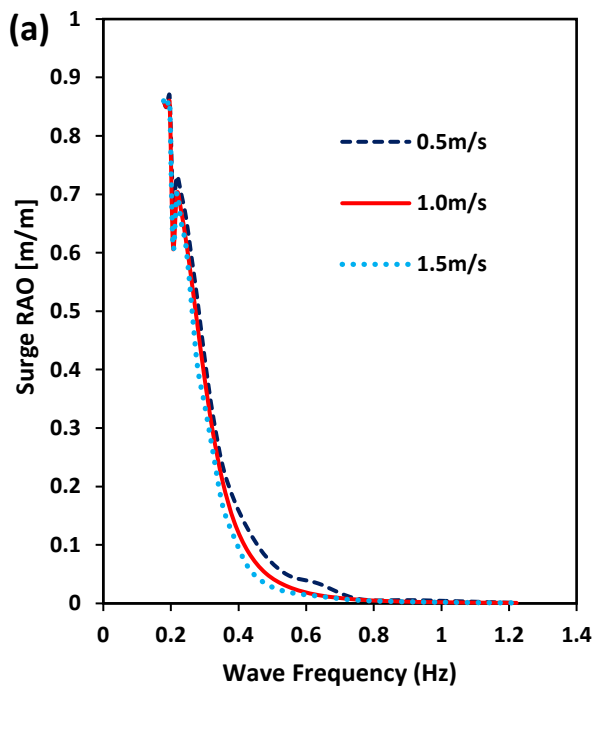


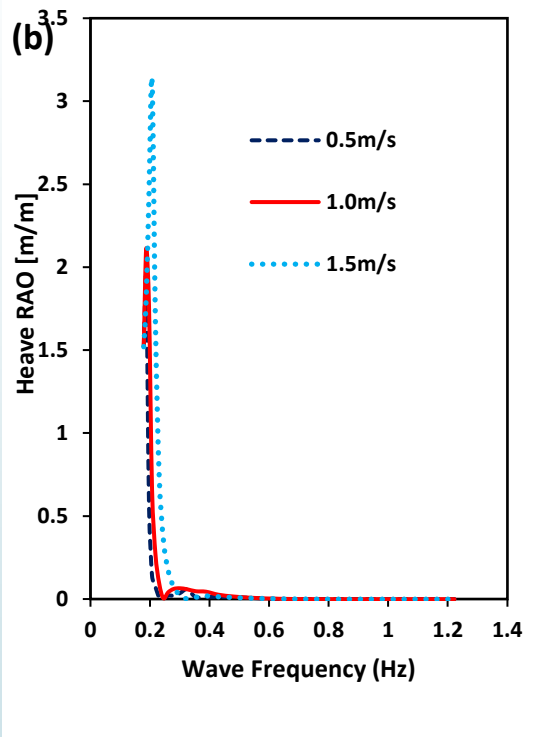


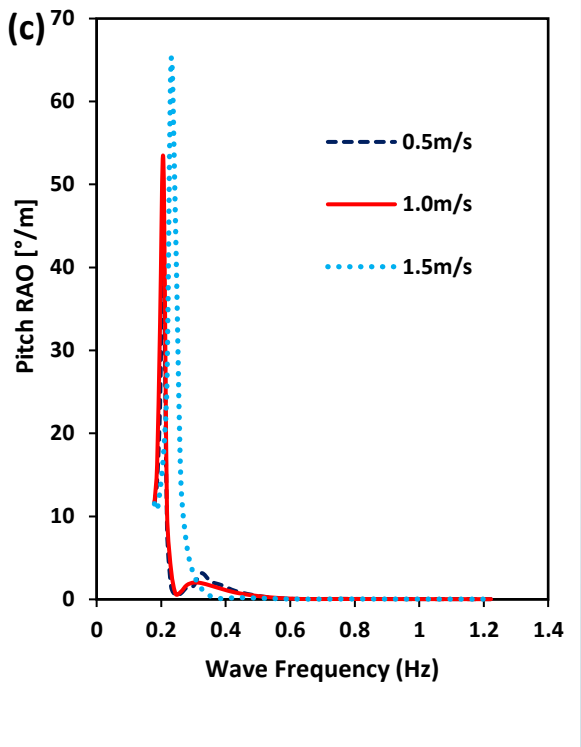
JONSWAP Wave Spectrum

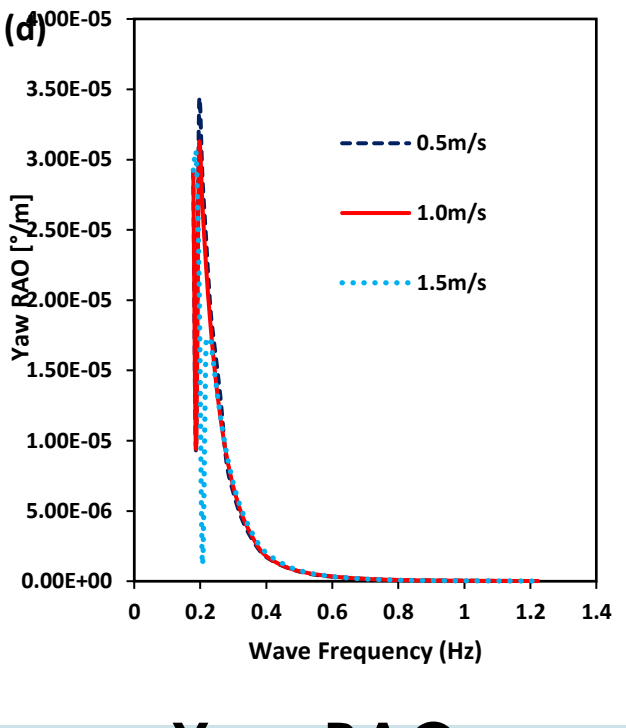
$$S_\eta(\omega) = exp\left[-\frac{5}{4}\left(\frac{\omega_p^4}{\omega^4}\right)\right]\gamma^a$$

Motion RAOs of CALM Buoy









Surge RAO

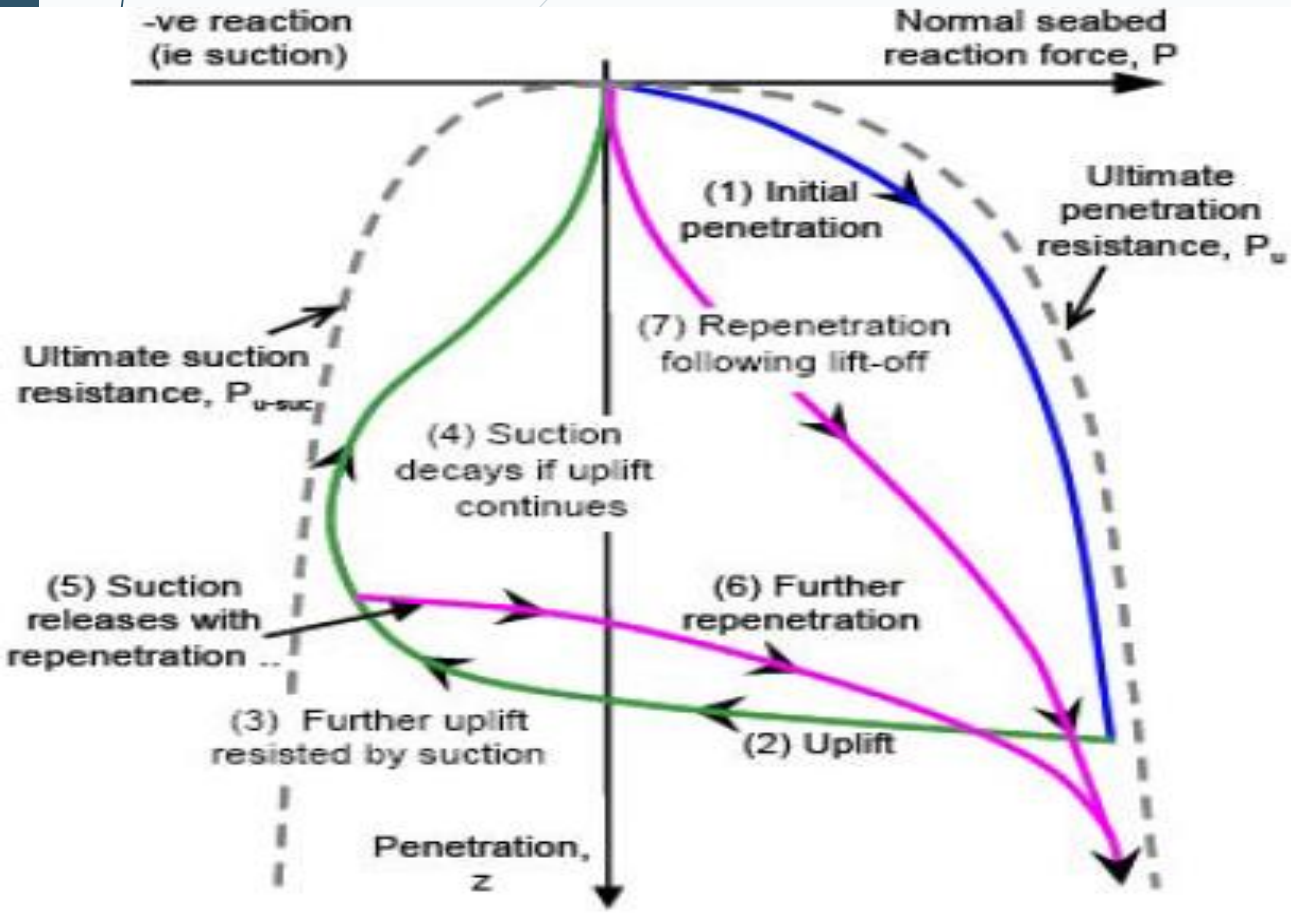
RAO

Pitch RAO

Yaw RAO

doi: 10.3390/jmse10010120

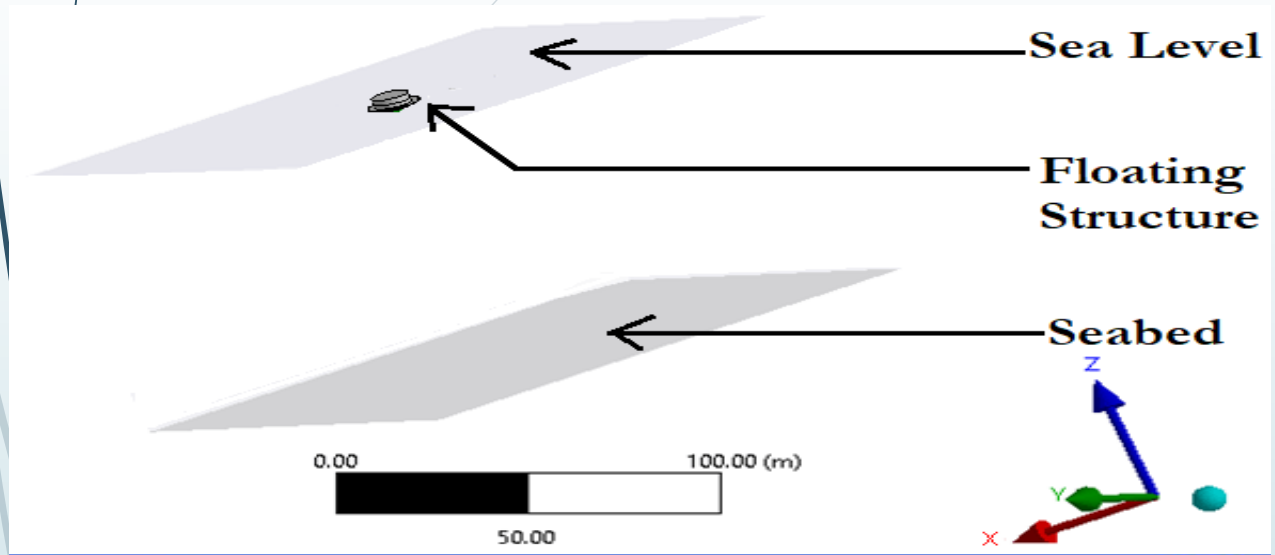
Nonlinear Seabed Model

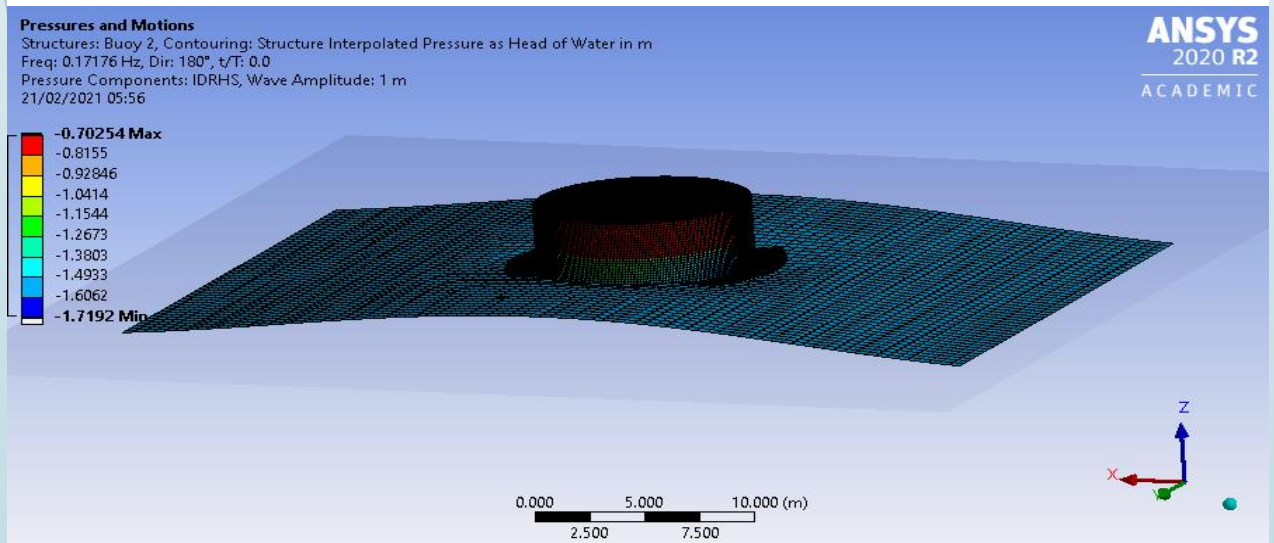


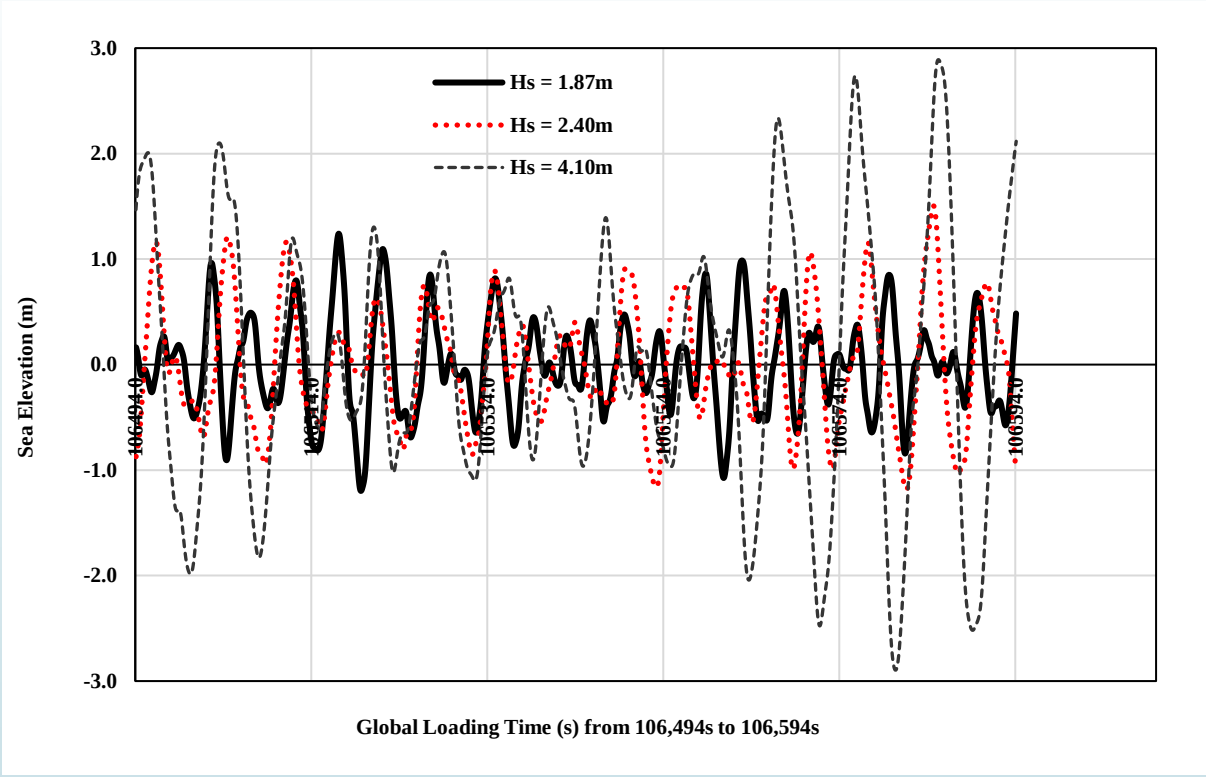
Parameter	Symbol	Value
Mudline Shear Strength (kPa)	S_{u0}	4.5
Shear Strength Gradient (kPa/m)	S_g	1.5
Saturated Soil Density (te/m^3)	ρ_{soil}	1.5
Power Law Parameter	a	6.0
Power Law Parameter	b	0.25
Soil Buoyancy Factor	f_b	1.5
Normalized Maximum Stiffness (kNm^{-1}m^2)	K_{max}	200.0
Suction Resistance Ratio	f_{suc}	0.7
Suction Decay Parameter	λ_{suc}	1.0
Repenetration Parameter	λ_{rep}	0.3

Soil model characteristics showing different modes (Randolph, 2009)

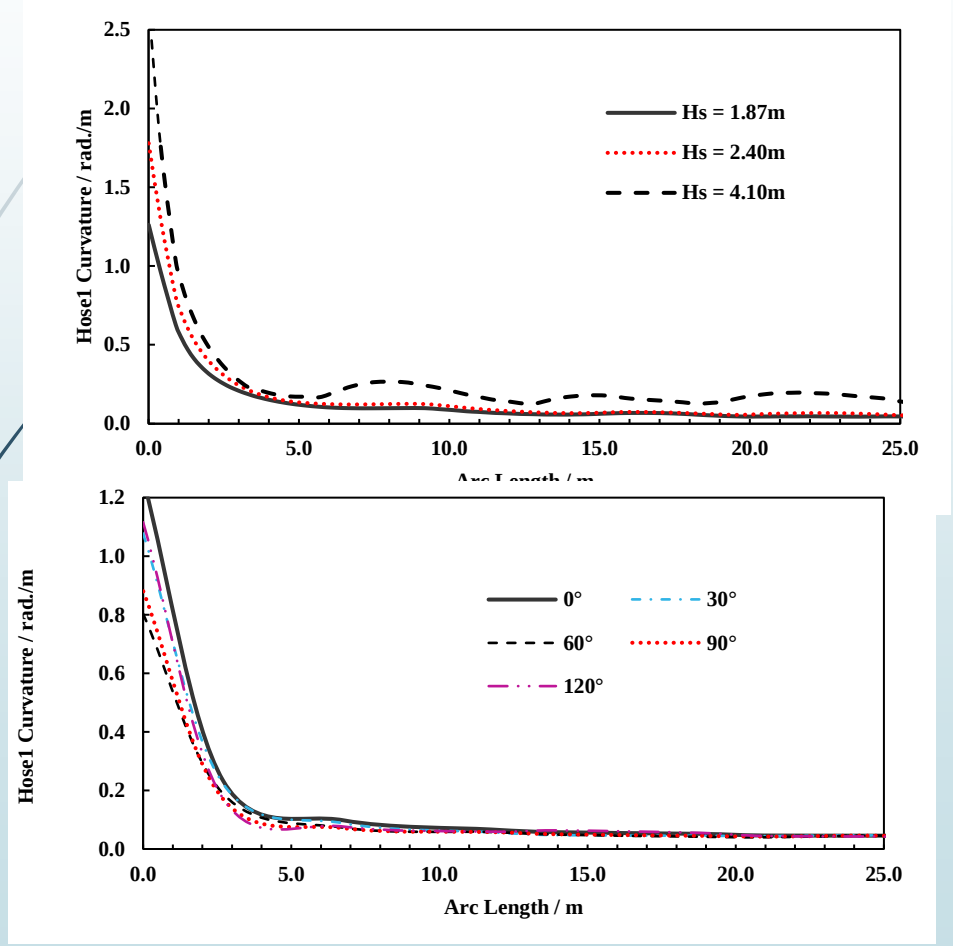
Pressures & Motions Profile of CALM Buoy



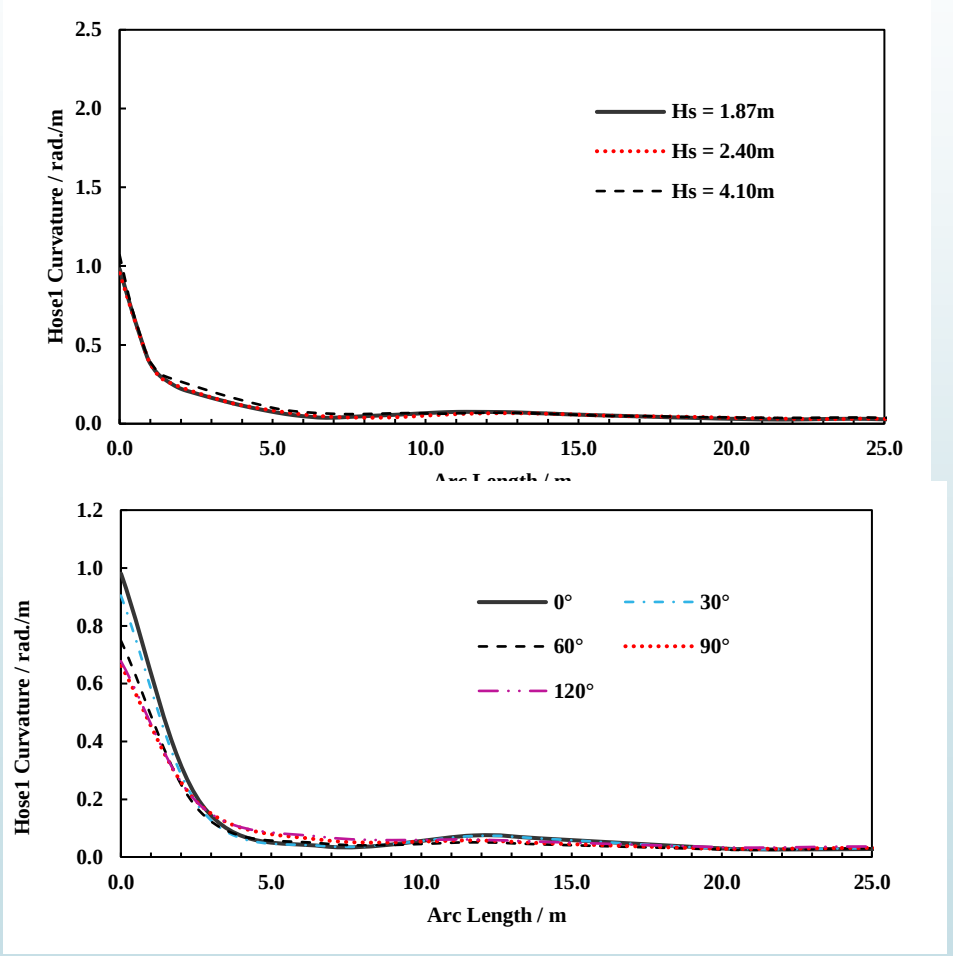




Effect of RAOs for different environmental cases

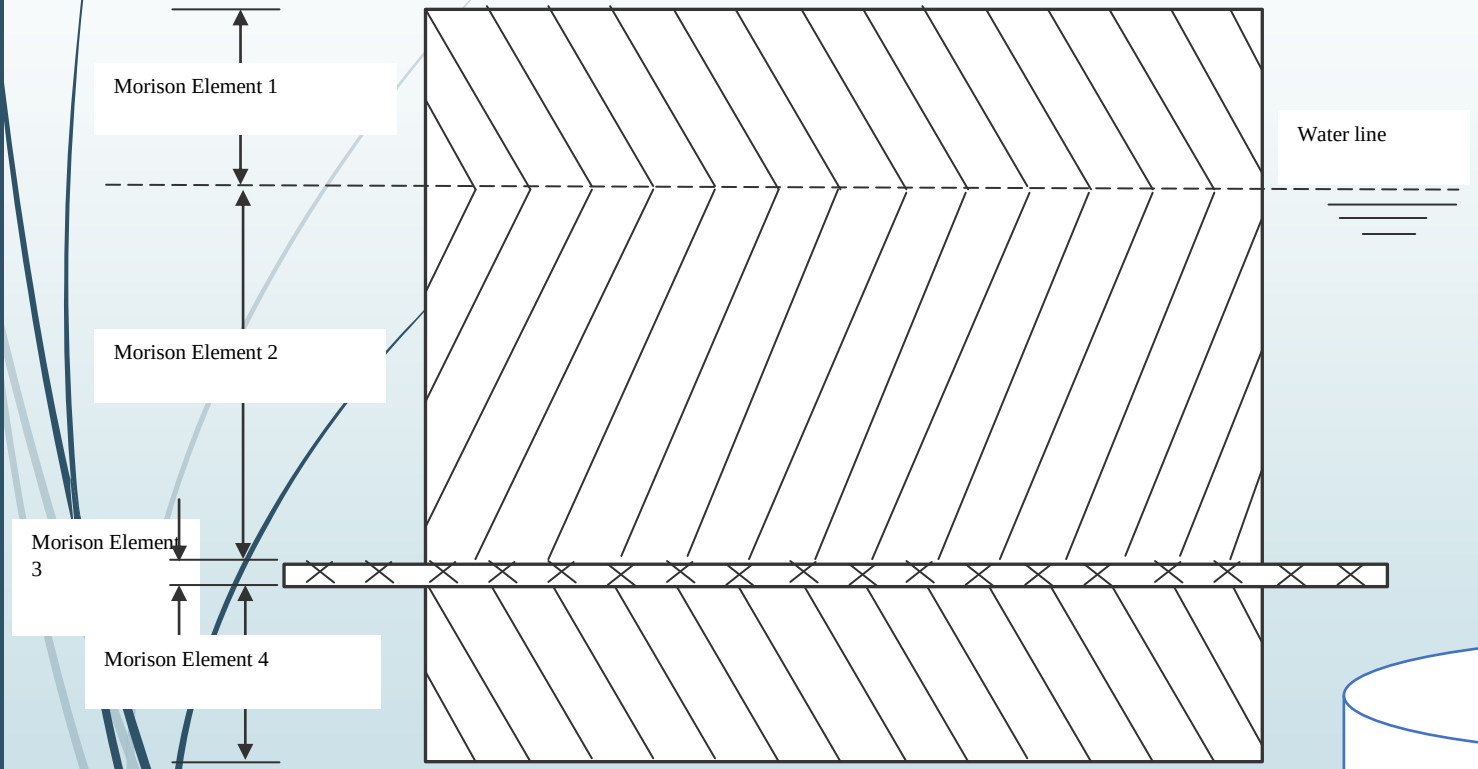


Curvature for Hose1 with hose hydrodynamic load

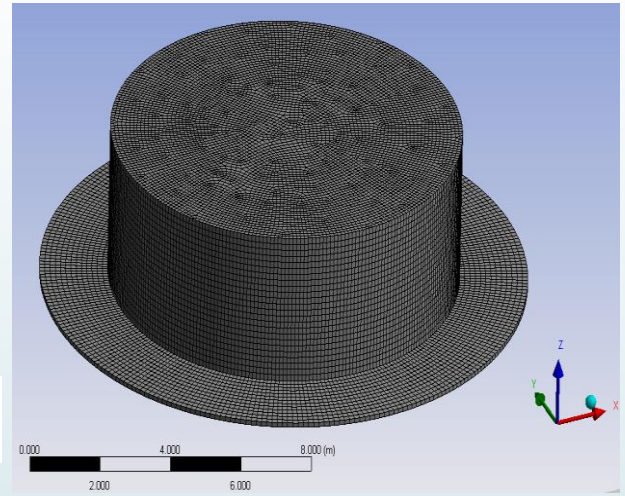


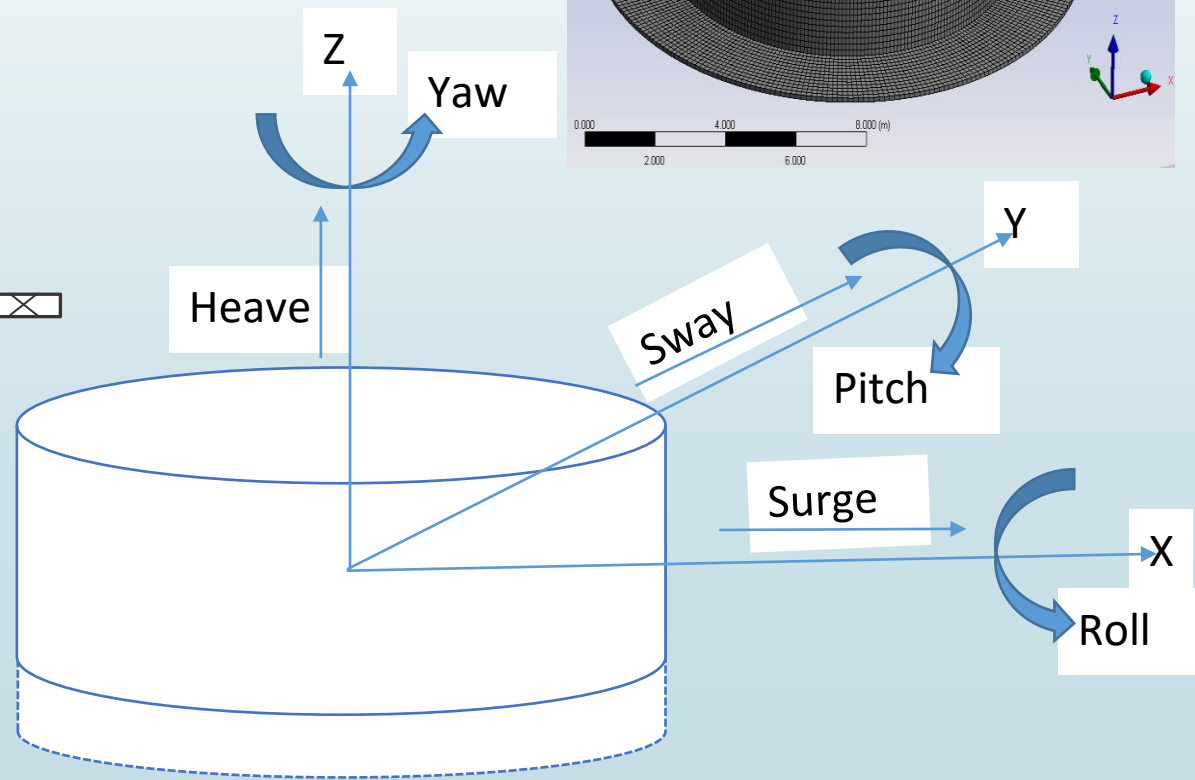
Curvature for Hose without hose hydrodynamic load

Hydrodynamic Panel & 6DoF of a floating buoy

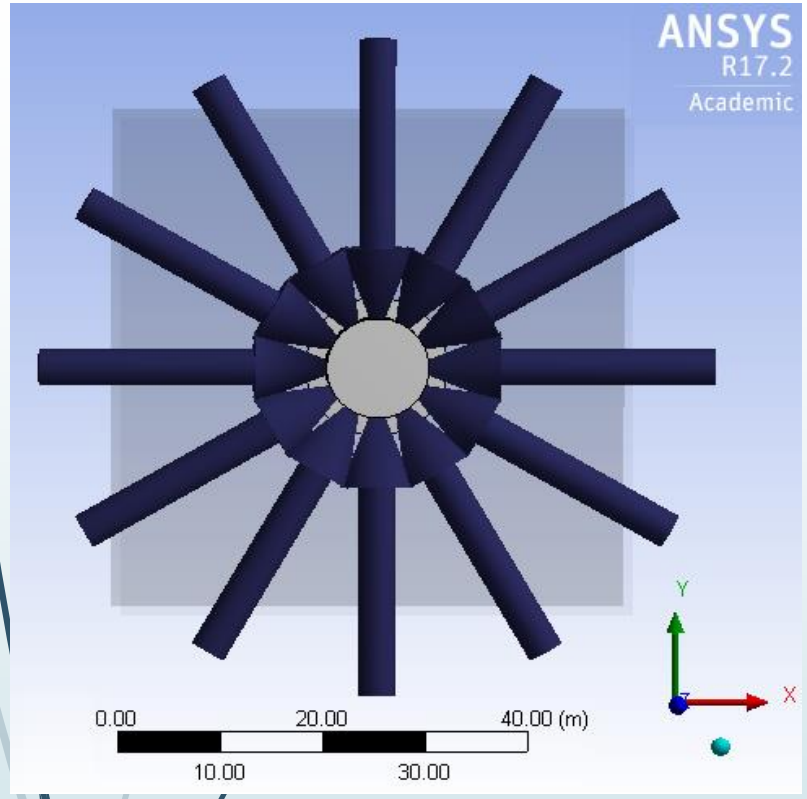


Morison Element for CALM Buoy

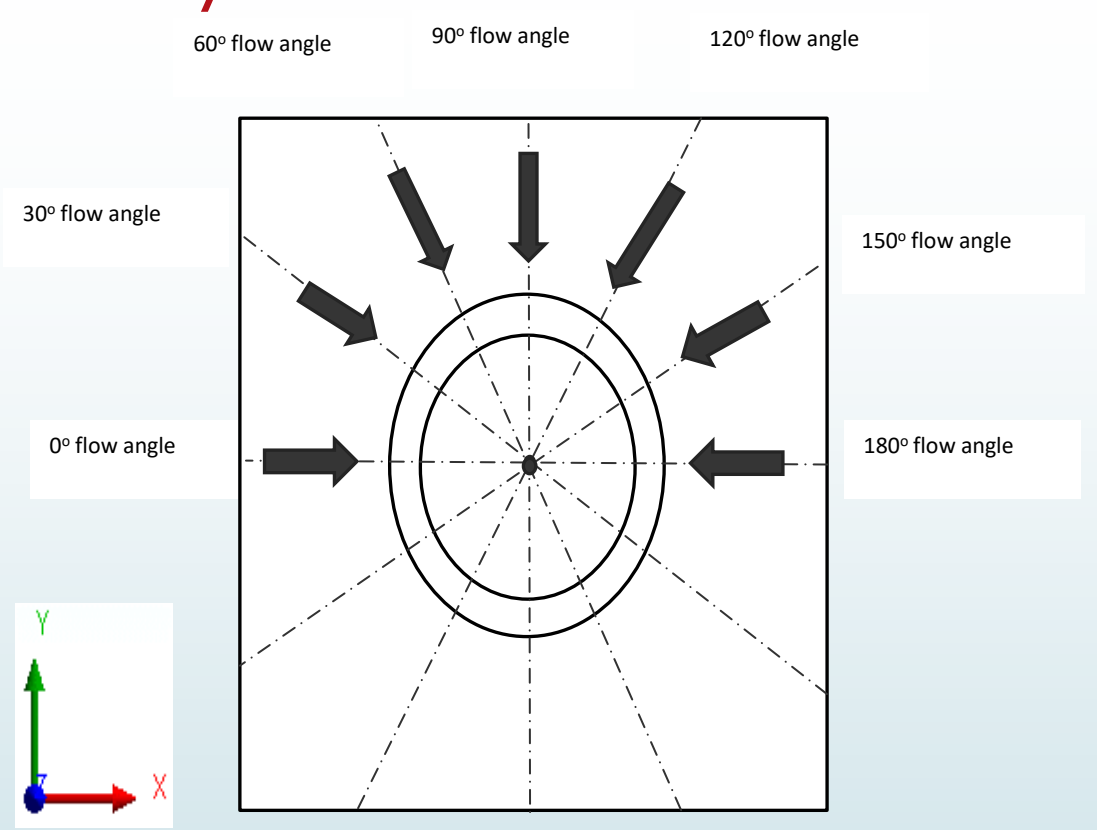


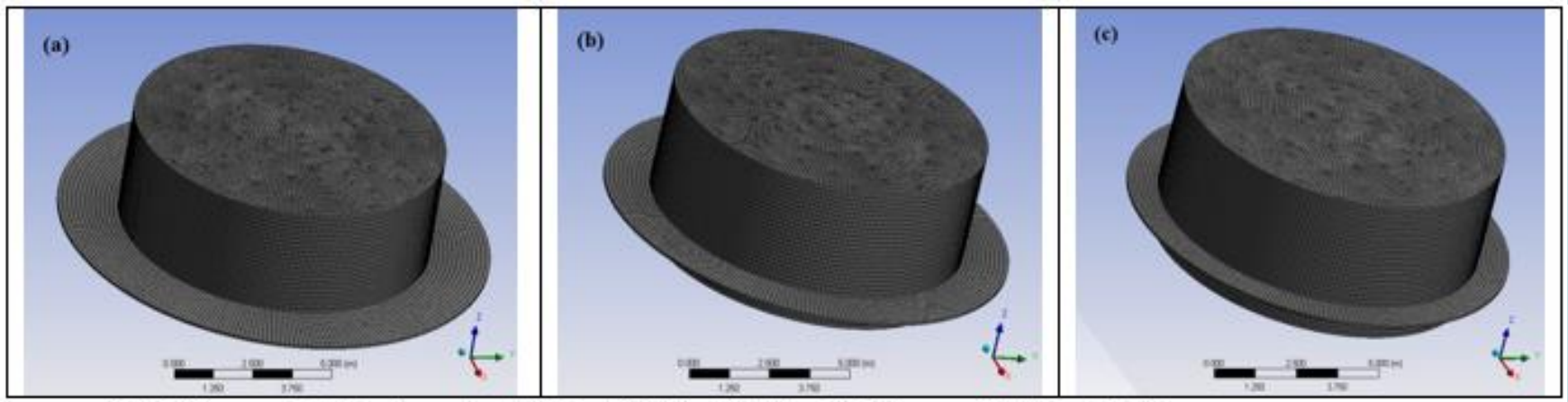


Sensitivity Study of Buoy Skirts



Wave Angles & Flow Angles





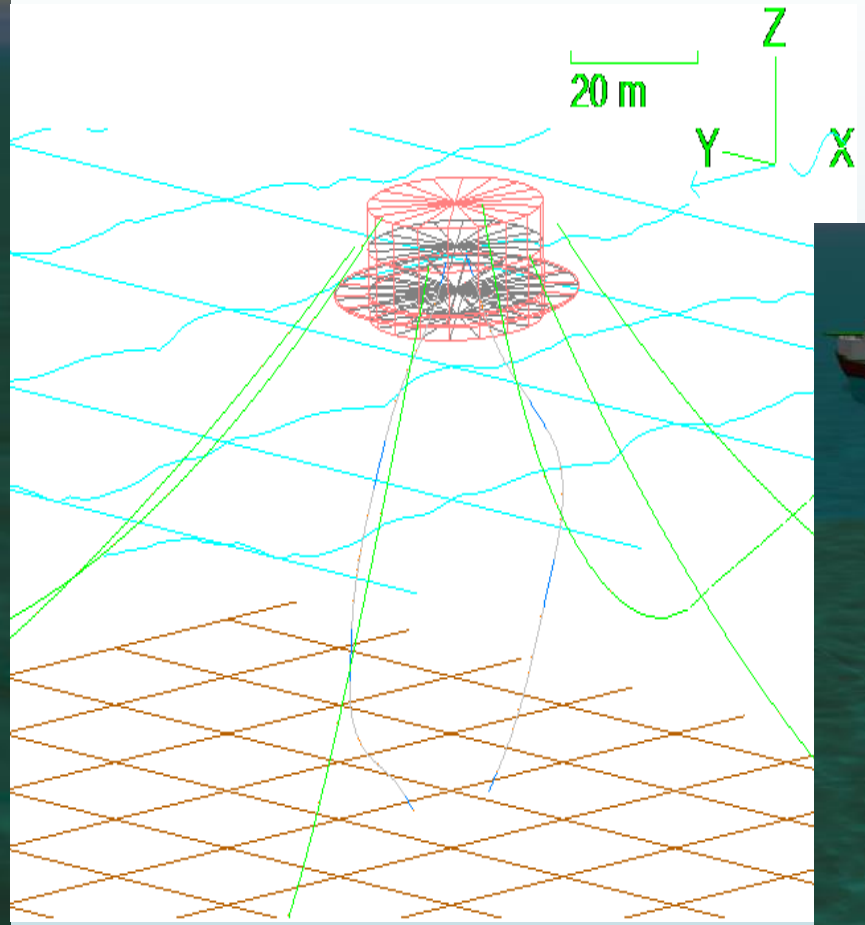
CALM buoy of skirt diameter (a) Ds_1=13.90m (b) Ds_2=12.90m and (c) Ds_3=11.90m

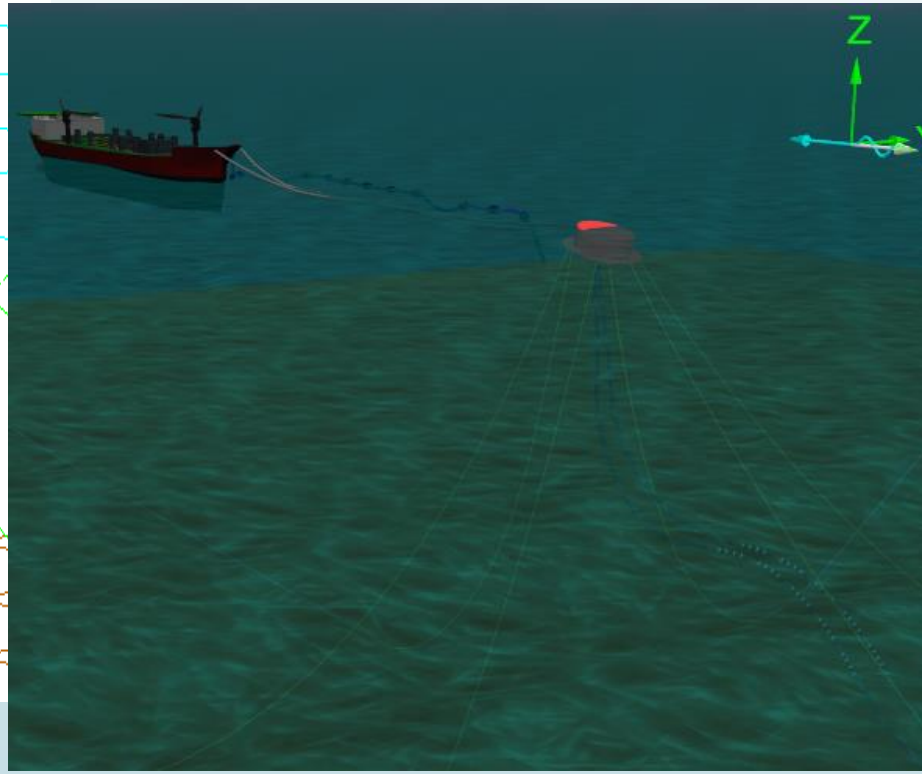
Table showing CALM buoy skirt diameters considered

CALM buoy Skirt Cases	Skirt Diameter, D_s (m)
Skirt 1	13.90
Skirt 2	12.90
Skirt 3	11.90

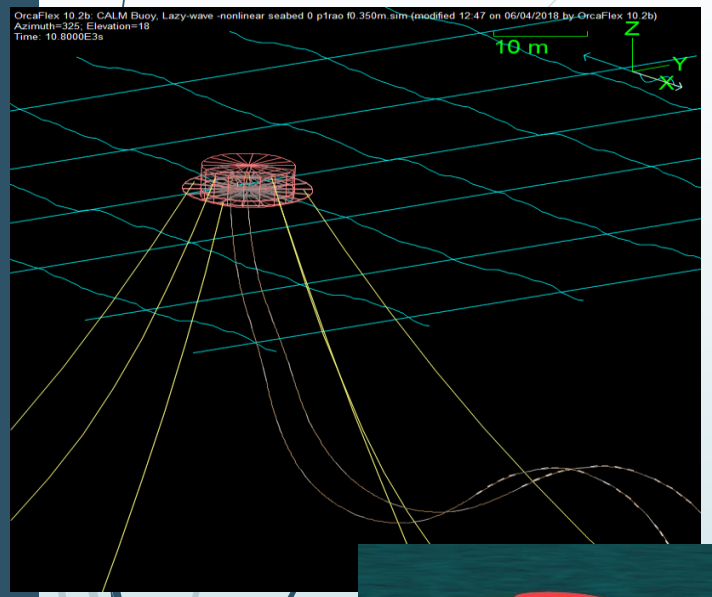
Buoy Diameter, D_b (m)	Diameter Ratio, $D = D_s/D_b$
10.0	1.39
10.0	1.29
10.0	1.19

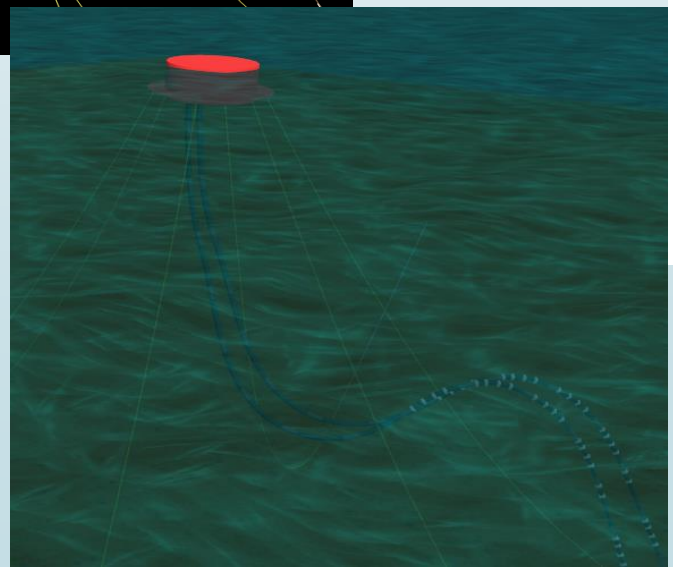
Chinese-Lantern Configuration

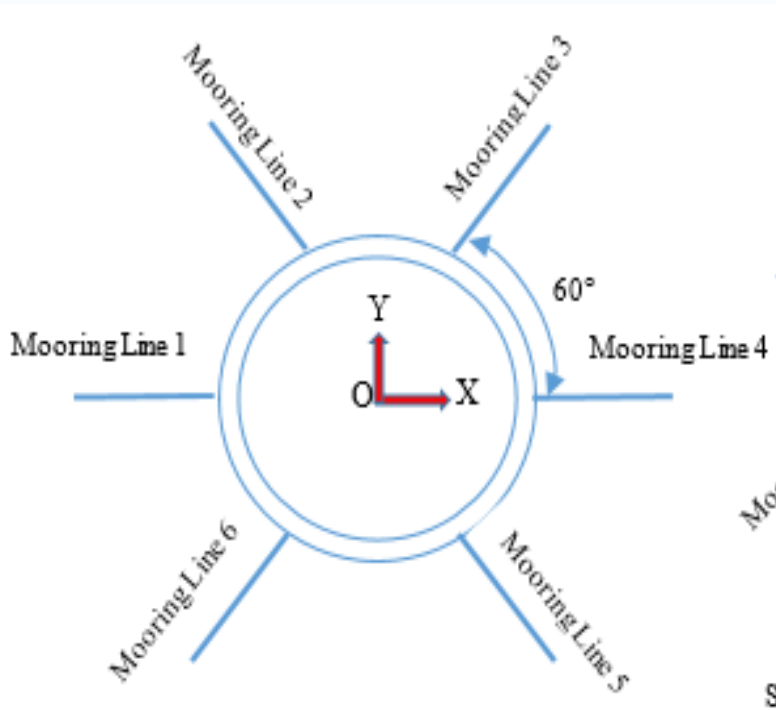




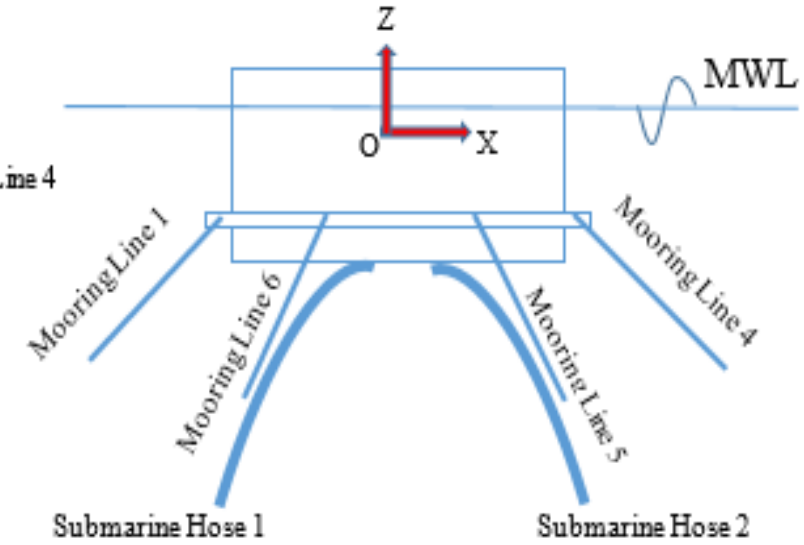
Lazy-wave Configuration & Local Coordinate System for Buoy on flat seabed with Mooring Lines in (a) buoy top view (b) buoy plan







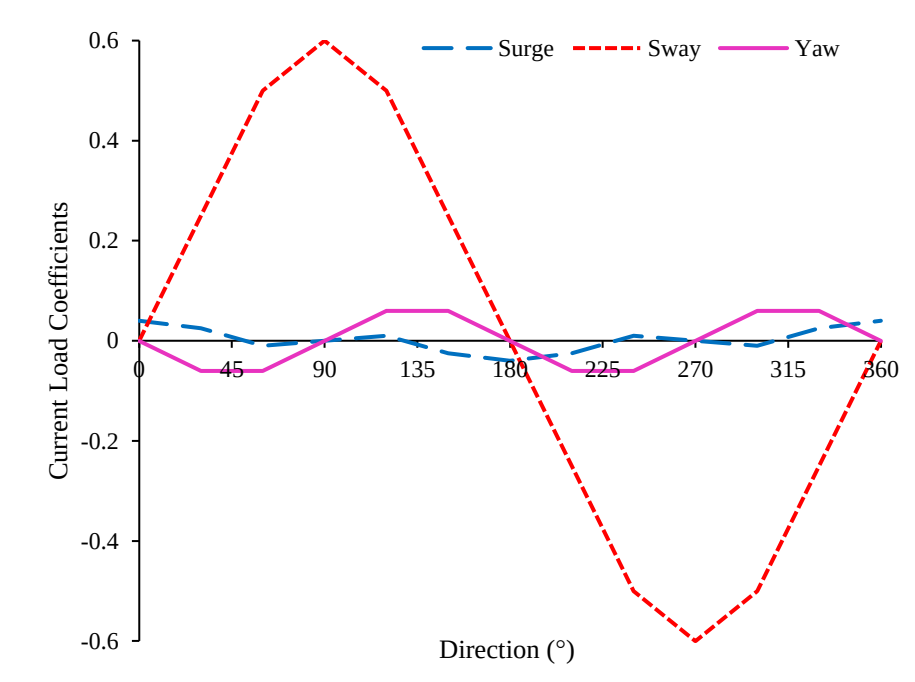
(a) Buoy Top View



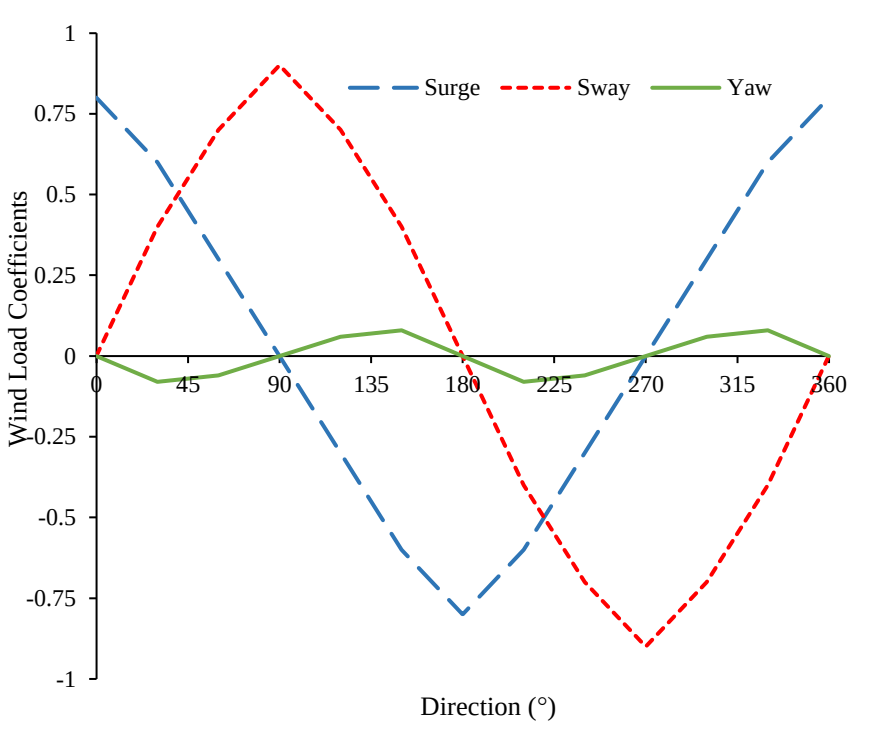
(b) Buoy Plan View

https://doi.org/10.1016/j.oceaneng.2018.11.010.

Current and Wind



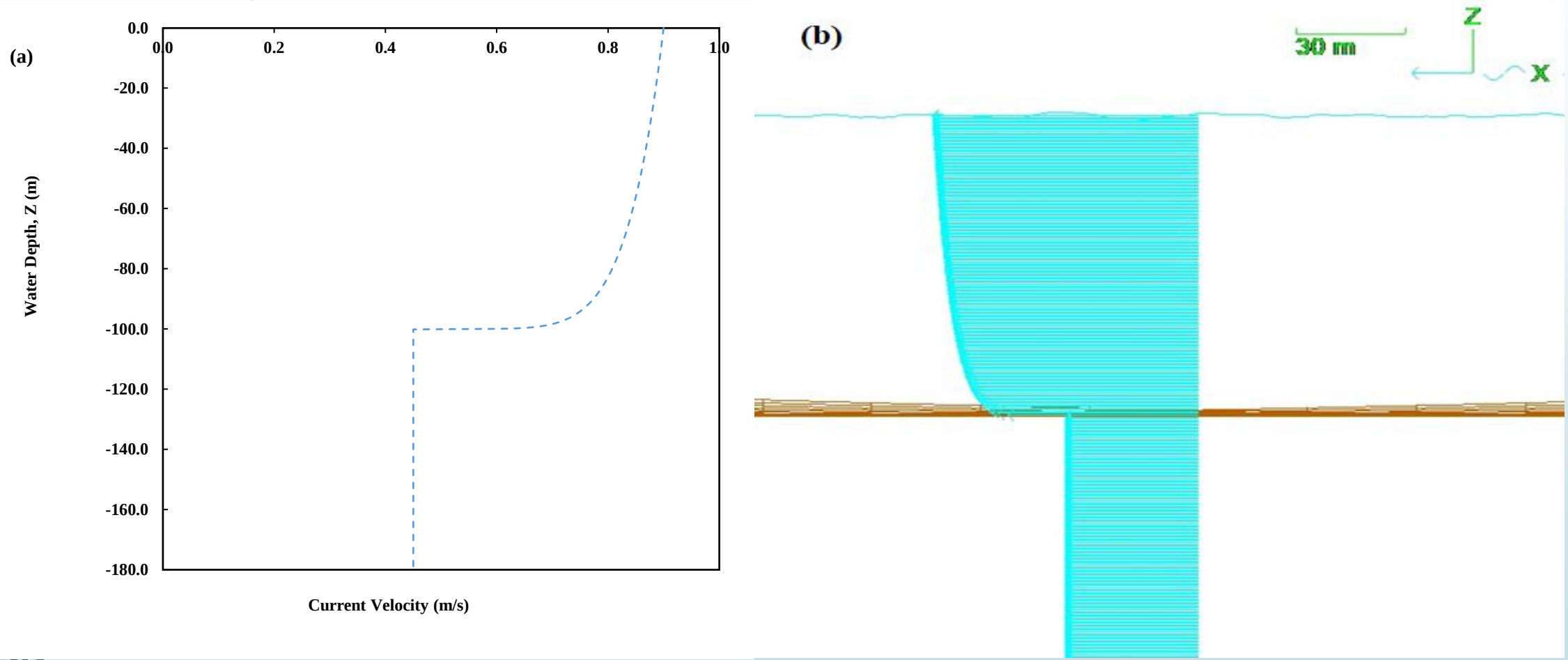
Current Load Coefficient for CALM buoy



Wind Load Coefficient for CALM buoy

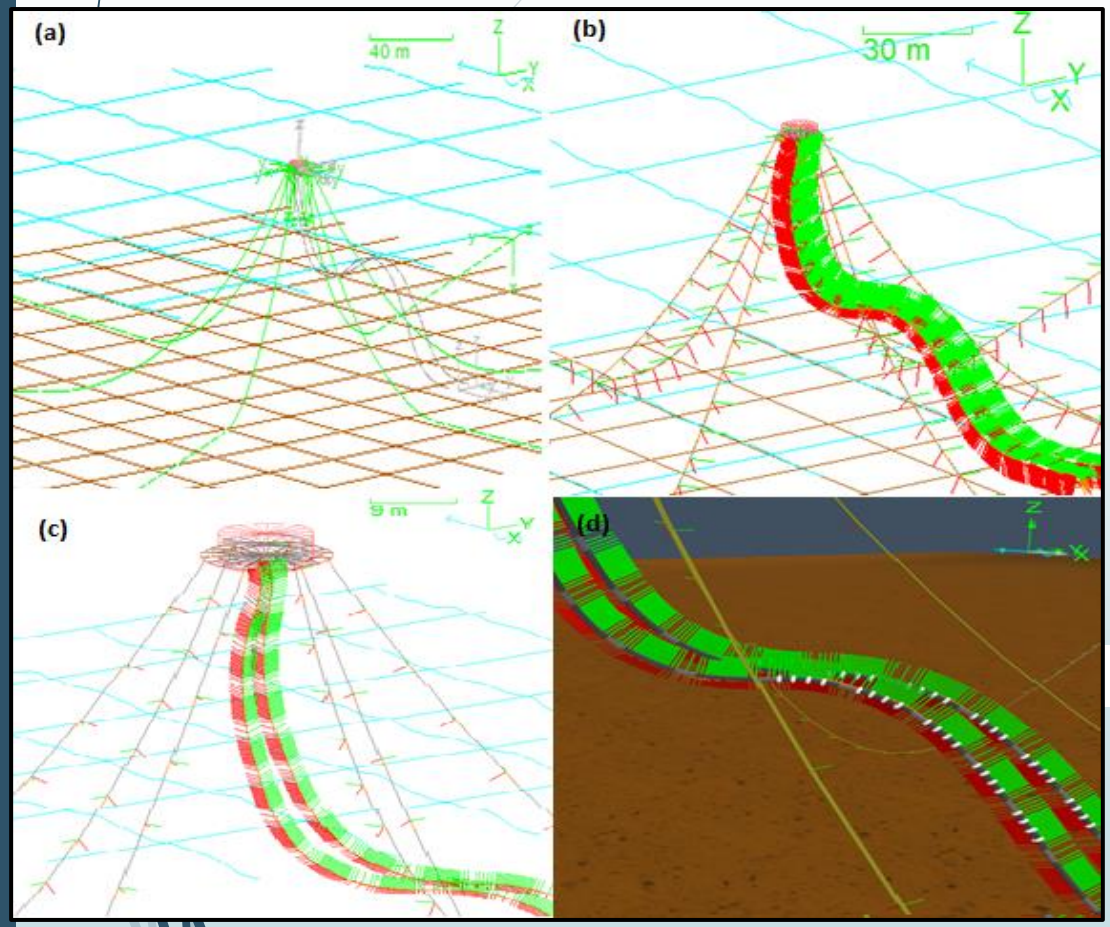
https://doi.org/10.1016/j.oceaneng.2018.11.010.

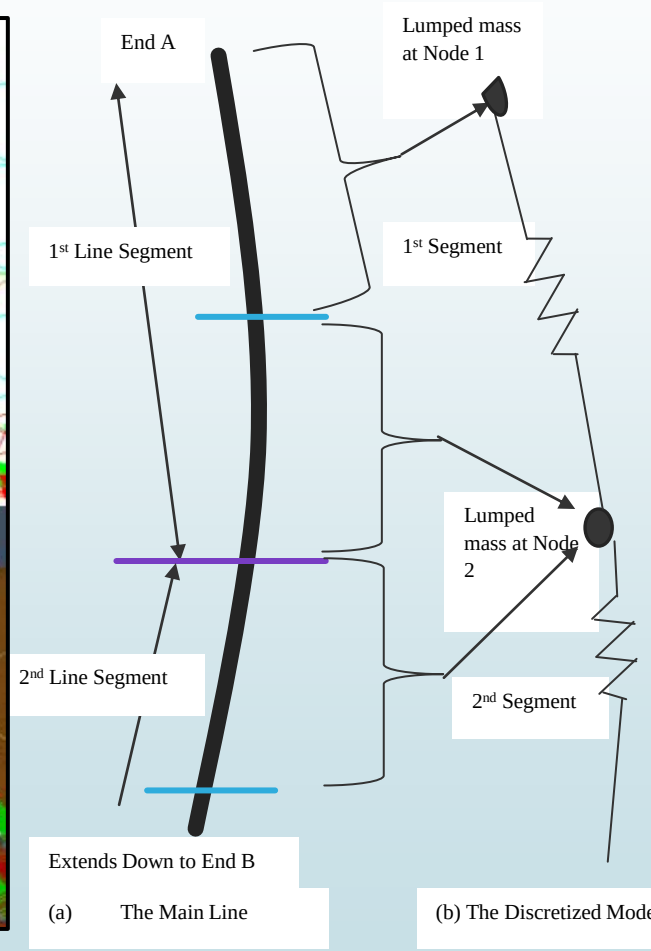
Surface and Seabed Current profiles



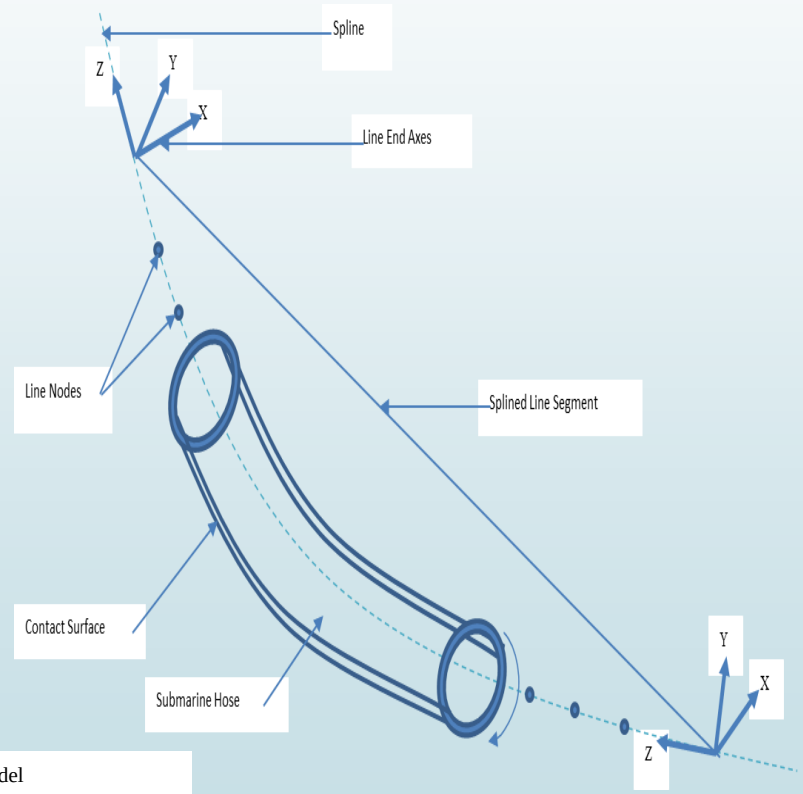
https://doi.org/10.3390/jmse9101130

Typical system with floats attached to submarine hoses





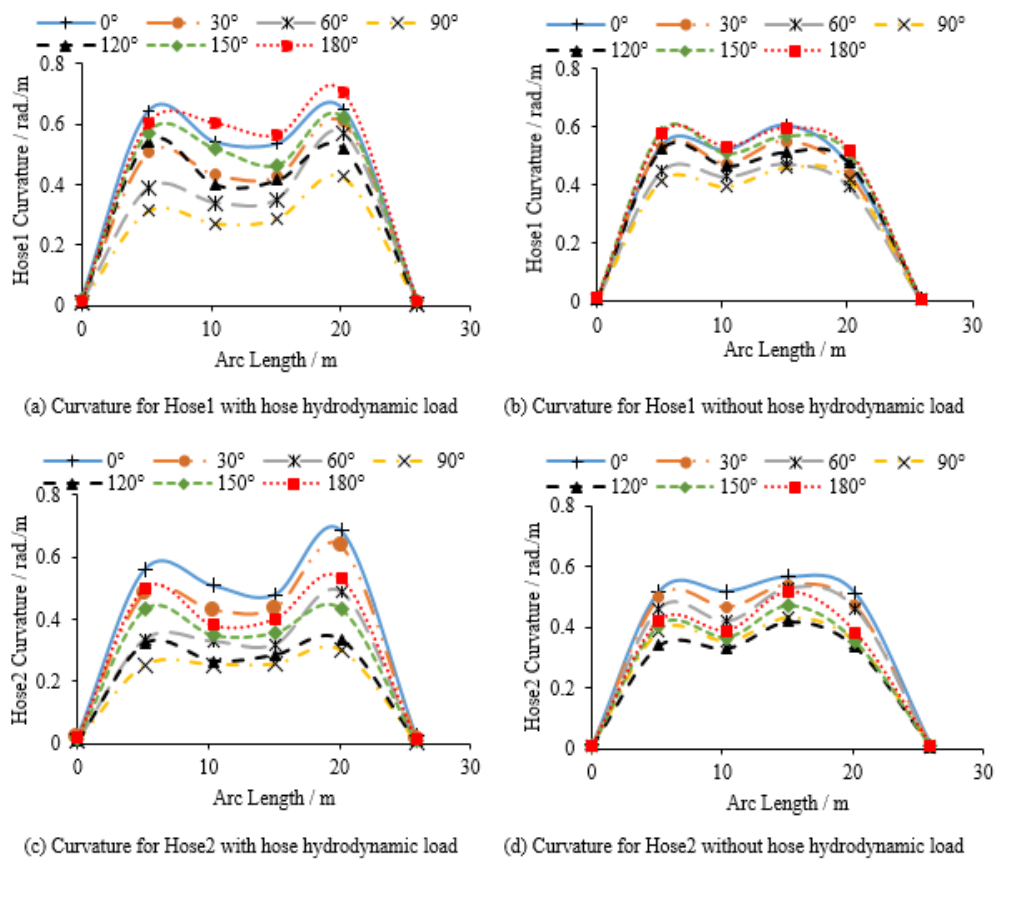
Orcaflex Line Model

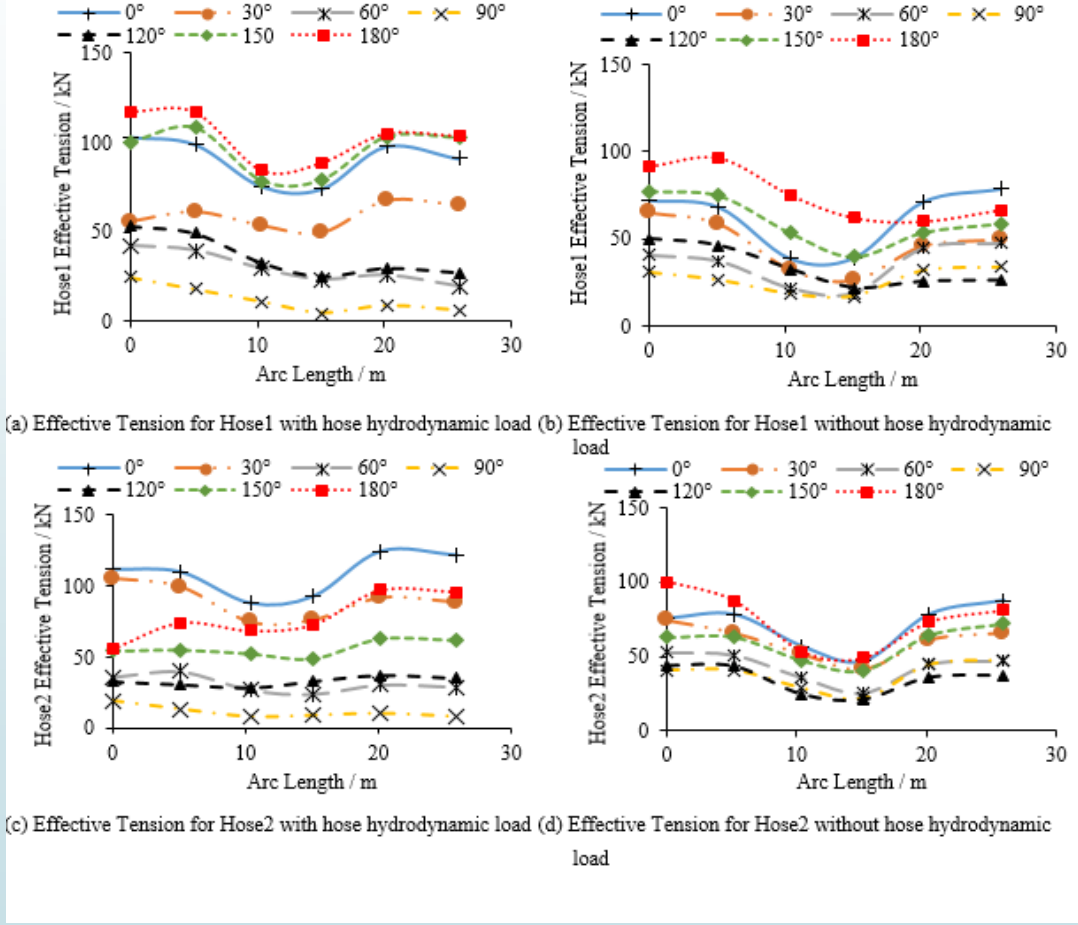


Spline Segment

https://doi.org/10.3390/jmse9101130

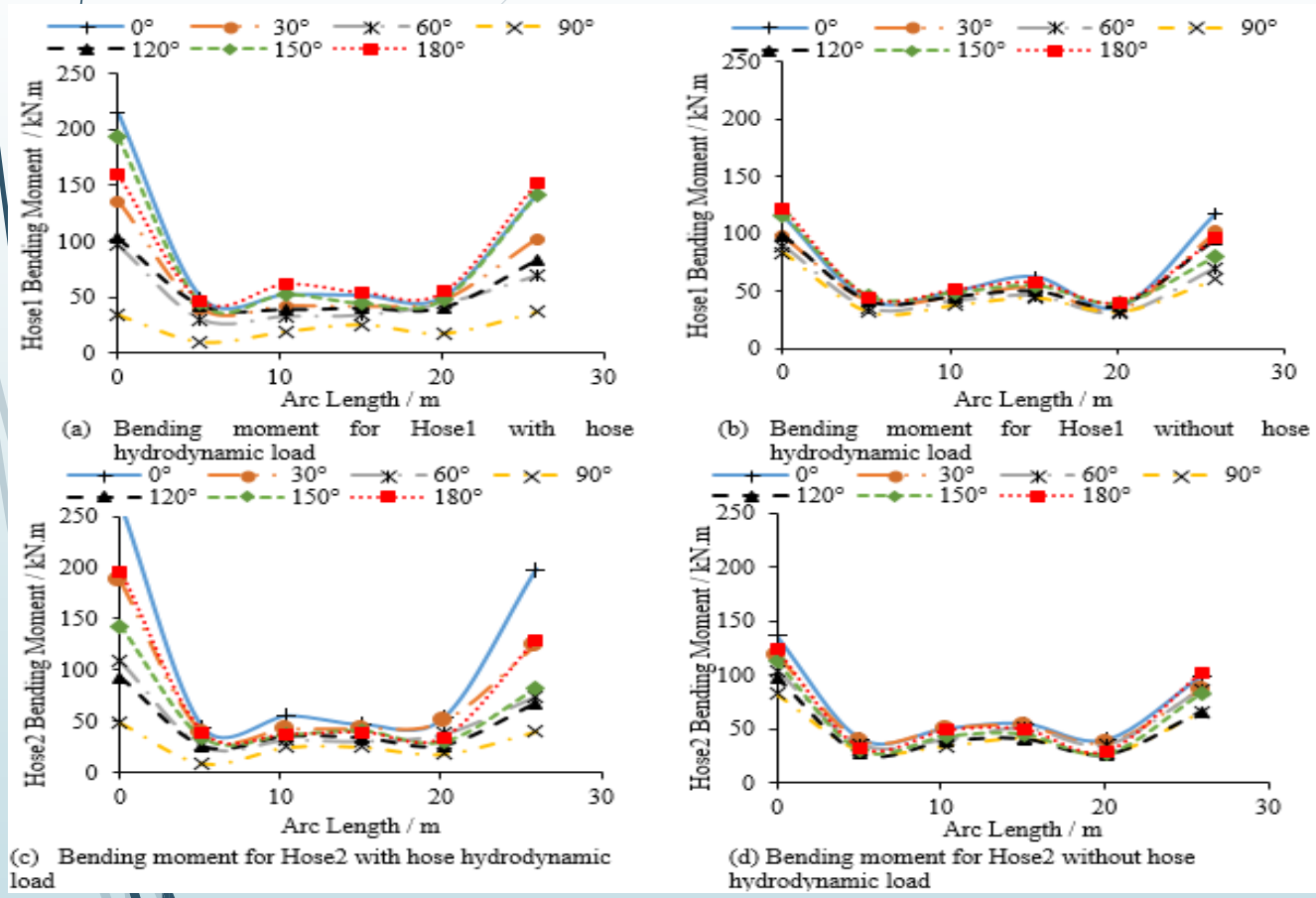
Effect of RAOs on curvature & Eff. Tension

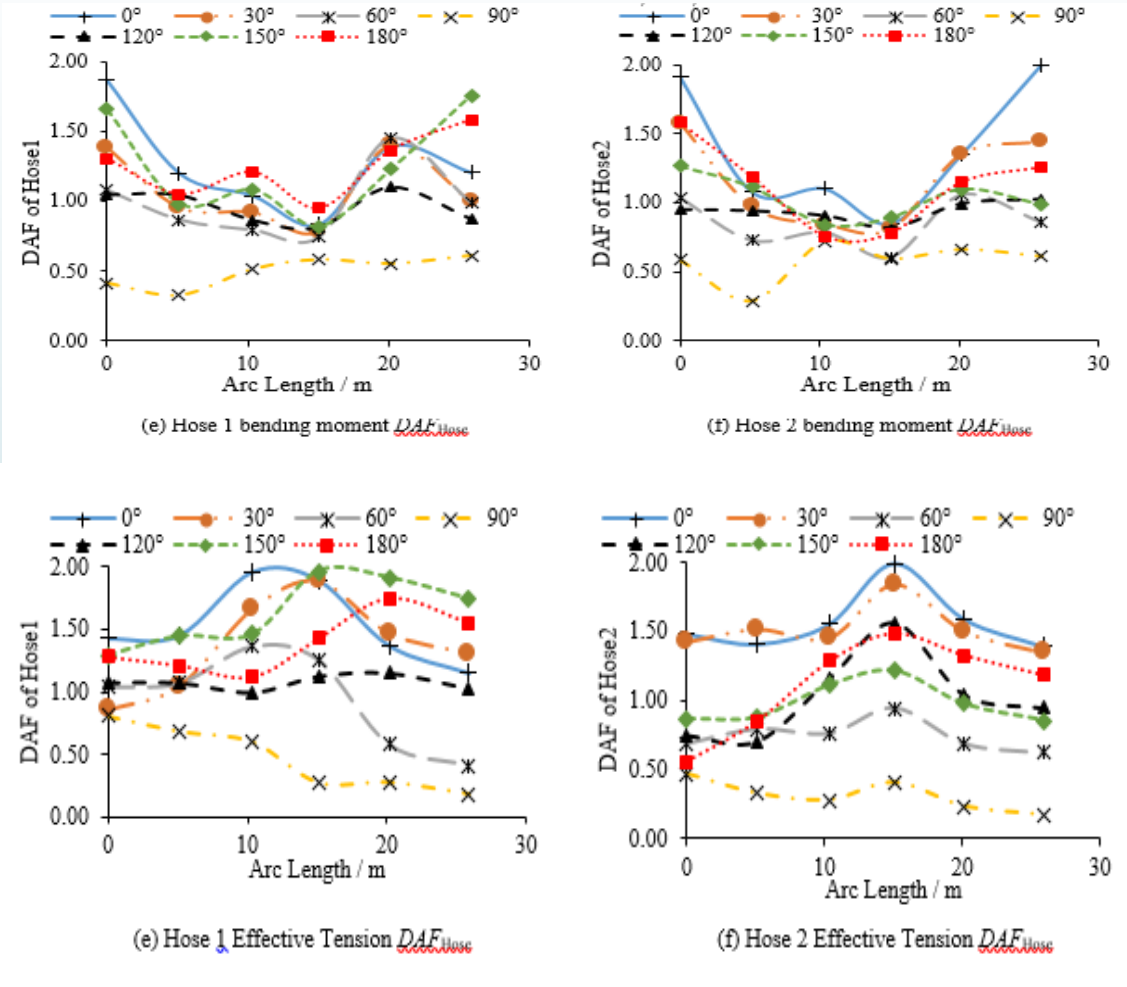




https://doi.org/10.1016/j.oceaneng.2018.11.010.

Effect of hose bending moment & DAF





, https://doi.org/10.1016/j.oceaneng.2018.11.010.

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Understanding the fluid–structure interaction from wave diffraction forces on CALM buoys: numerical and analytical solutions

Chiemela Victor Amaechi [a,b], Facheng Wang [c] and Jianqiao Ye [a]

[a]Department of Engineering, Lancaster University, Lancaster, UK; [b]Standardisation Directorate, Standards Organisation of Nigeria (SON), Abuja, Nigeria; [c]Department of Civil Engineering, Tsinghua University, Beijing, People's Republic of China

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Review

Mathematical Modelling of Bonded Marine Hoses for Single Point Mooring (SPM) Systems, with Catenary Anchor Leg Mooring (CALM) Buoy Application—A Review

Chiemela Victor Amaechi [1,2,*], Facheng Wang [3,*] and Jianqiao Ye [1,*]

1 Department of Engineering, Lancaster University, Lancaster LA1 4YR, UK
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Journal of Marine Science and Engineering

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Review

An Overview on Bonded Marine Hoses for Sustainable Fluid Transfer and (Un)Loading Operations via Floating Offshore Structures (FOS)

Chiemela Victor Amaechi [1,2,*], Cole Chesterton [3], Harrison Obed Butler [4], Facheng Wang [5,*] and Jianqiao Ye [1,*]

1 Department of Engineering, Lancaster University, Lancaster LA1 4YR, UK
2 Standards Organisation of Nigeria (SON), 52 Lome Crescent, Wuse Zone 7, Abuja 900287, Nigeria
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Review on the design and mechanics of bonded marine hoses for Catenary Anchor Leg Mooring (CALM) buoys

Chiemela Victor Amaechi [a,c,*], Cole Chesterton [b], Harrison Obed Butler [c], Facheng Wang [d], Jianqiao Ye [a,**]

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Strength of submarine hoses in Chinese-lantern configuration from hydrodynamic loads on CALM buoy

Chiemela Victor Amaechi[a,c], Facheng Wang[b,**], Xiaonan Hou[a], Jianqiao Ye[a,*]

[a] Engineering Department, Lancaster University, Lancaster, LA1 4YR, UK
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Journal of Marine Science and Engineering

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Article

Numerical Assessment on the Dynamic Behaviour of Submarine Hoses Attached to CALM Buoy Configured as Lazy-S under Water Waves

Chiemela Victor Amaechi [1,2,*], Facheng Wang [3,*] and Jianqiao Ye [1,*]

1 Department of Engineering, Lancaster University, Lancaster LA1 4YR, UK
2 Standards Organisation of Nigeria (SON), 52 Lome Crescent, Wuse Zone 7, Abuja 900287, Nigeria
3 Department of Civil Engineering, Tsinghua University, Beijing 100084, China
* Correspondence: c.amaechi@lancaster.ac.uk or chiemelavic@gmail.com (C.V.A.); wangfacheng@tsinghua.edu.cn (F.W.); j.ye2@lancaster.ac.uk (J.Y.)

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Numerical studies on CALM buoy motion responses and the effect of buoy geometry cum skirt dimensions with its hydrodynamic waves-current interactions

Chiemela Victor Amaechi [a,b,*], Facheng Wang [c], Jianqiao Ye [a,**]

[a] Engineering Department, Lancaster University, Lancaster, LA1 4YR, UK
[b] Standard Organisation of Nigeria (SON), 52 Lome Crescent, Wuse Zone 7, Abuja, 900287, Nigeria
[c] Department of Civil Engineering, Tsinghua University, Beijing, 100084, China

Reference Publications

- **Amaechi, C.V.,** Wang, F., Hou, X., Ye, J., 2019. Strength of submarine hoses in Chinese-lantern configuration from hydrodynamic loads on CALM buoy. Ocean Engineering, 171, pp. 429-442. https://doi.org/10.1016/j.oceaneng.2018.11.010 **Published**
- **Amaechi C.V.,** Wang F., Ye J., 2021. Numerical assessment on the dynamic behaviour of submarine hoses attached to CALM buoy configured as Lazy-S under water waves. *J. Mar. Sci. Eng.* **2021**, *9*(10), 1130; 2021 https://doi.org/10.3390/jmse9101130 **Published**
- **Amaechi, CV,** Ja'e, IA, Reda, A., Ju, X. (2022). Scientometric Review and Thematic Areas for the Research Trends on Marine Hoses**.** Energies, 15(20), [7723]. Doi: **10.3390/en15207723**
- **Amaechi, C.V.,** Chesterton C., Butler H.O., Wang F., Ye J. 2021. Review on the design and mechanics of bonded marine hoses for Catenary Anchor Leg Mooring (CALM) buoys. *Ocean Engineering*. Vol. 242: 110062. https://doi.org/10.1016/j.oceaneng.2021.110062 **Published**
- **Amaechi C.V.,** Wang F., Ye J., (2021). Mathematical Modelling of marine bonded hoses for Single Point Mooring (SPM) systems, with Catenary Anchor Leg Mooring (CALM) buoy application– a review. *J. Mar. Sci. Eng.* ***2021****, 9(11), 1179; https://doi.org/10.3390/jmse9111179* **Published**
- **Amaechi, C.V.,** Chesterton C., Butler H.O., Wang F., Ye J. 2021. An Overview on Bonded Marine Hoses for sustainable fluid transfer and (un)loading operations via Floating Offshore Structures (FOS). *J. Mar. Sci. Eng.* 2021, 9(11), 1236; https://doi.org/10.3390/jmse9111236 **Published**
- **Amaechi, C.V.,** Wang F., Ye J. 2021. Numerical studies on CALM buoy motion responses and the effect of buoy geometry cum skirt dimensions with its hydrodynamic waves-current interactions. *Ocean Engineering*. Vol. 244:110378. https://doi.org/10.1016/j.oceaneng.2021.110378 **Published**
- **Amaechi C.V.,** Wang F., Ye J., (2021). Understanding the fluid–structure interaction from wave diffraction forces on CALM buoys: numerical and analytical solutions *Ships and Offshore Structures*. ***2021****, https://doi.org/10.1080/17445302.2021.2005361* **Published**
- **Amaechi, C.V.,** Wang, F., Hou, X., Ye, J., 2019. Sensitivity studies on offshore hoses on CALM buoy with comparisons for Chinese-lantern and Lazy-S configuration. ASME 2019 OMAE 38th International Conference on Ocean, Offshore & Arctic Engineering, Glasgow, UK. Jun 9-14, 2019. Paper Number OMAE2019-96755.
- **Amaechi C.V.,** Wang F., Ye J., 2022. Experimental study on motion characterization of CALM buoy hose system under water waves. *JMSE*, *10*, 204. doi: 10.3390/jmse10020204
- **Amaechi C.V.,** Wang F., Ye J., 2022. Investigation on Hydrodynamic Characteristics, Wave-Current Interaction and Sensitivity Analysis of Submarine Hoses Attached to a CALM Buoy. *J. Mar. Sci. Eng.* **2022**, , *10*, 120. doi: 10.3390/jmse10010120
- **Amaechi C.V.,** Wang F., Ye J., 2022. Finite element modelling on the mechanical behaviour of Marine Bonded Composite Hose (MBCH) under burst and collapse. *J. Mar. Sci. Eng.* **2022**, , *10*, 151. doi: 10.3390/jmse10020151
- **Amaechi, C.V**.; Chesterton, C.; Butler, H.O.; Gu, Z.; Odijie, A.C. Numerical Modelling on the Local Design of a Marine Bonded Composite Hose (MBCH) and Its Helix Reinforcement. *J. Compos. Sci.* **2022**, *6*, 79. doi: 10.3390/jcs6030079

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