

Floating Wind Solutions

Anchoring FOWTs in shallow to deep water.

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Organized by  



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Presentation Outline

- Introduction
- Drag Embedment Anchors
- Torpedo Piles
- FOWT Challenges

Anchoring Solutions



Seabed Conditions

- Anchor efficiency greatly influenced by seabed conditions
- Large variety of seabed conditions encountered offshore:
 - Soft to hard clays
 - Loose to dense sands
 - Rocks and gravel
- In general, soft soil is typical for deep water, hard soils in shallow water

Seabed Conditions

	Soft clay	Hard clay	Sand	Cemented	Rock
Driven pile	X	X	X	X	X
Suction pile	X	X	X		
Drag embedment anchor	X	X	X	X	
Torpedo pile	X	X	X*		

* Loose to medium dense

Drag Embedment Anchors

Overview

- Suitable for a wide range of soil conditions
- Used for temporary and permanent mooring
- Used in catenary moorings
In soft soils small uplift angles possible
- 1000's of drag embedment anchors in use since the 1970's

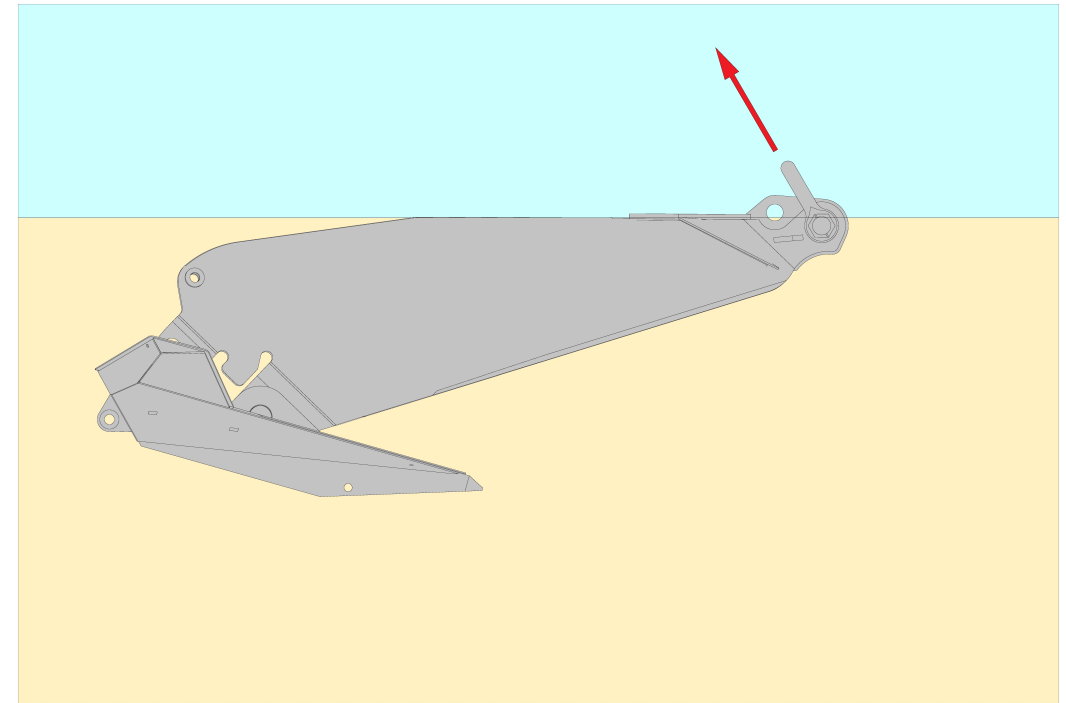


Installation

- Anchor pulled (dragged) into the seabed
- Installation load typically intact design load
- Depending on the installation load, installation using:
 - AHTS
 - Surface tensioner
 - Subsea tensioner

Recovery

- Anchor can be recovered after design life
- Recovery force dependent on seabed conditions and installation load
- Pull backwards on the mooring line



Torpedo Piles

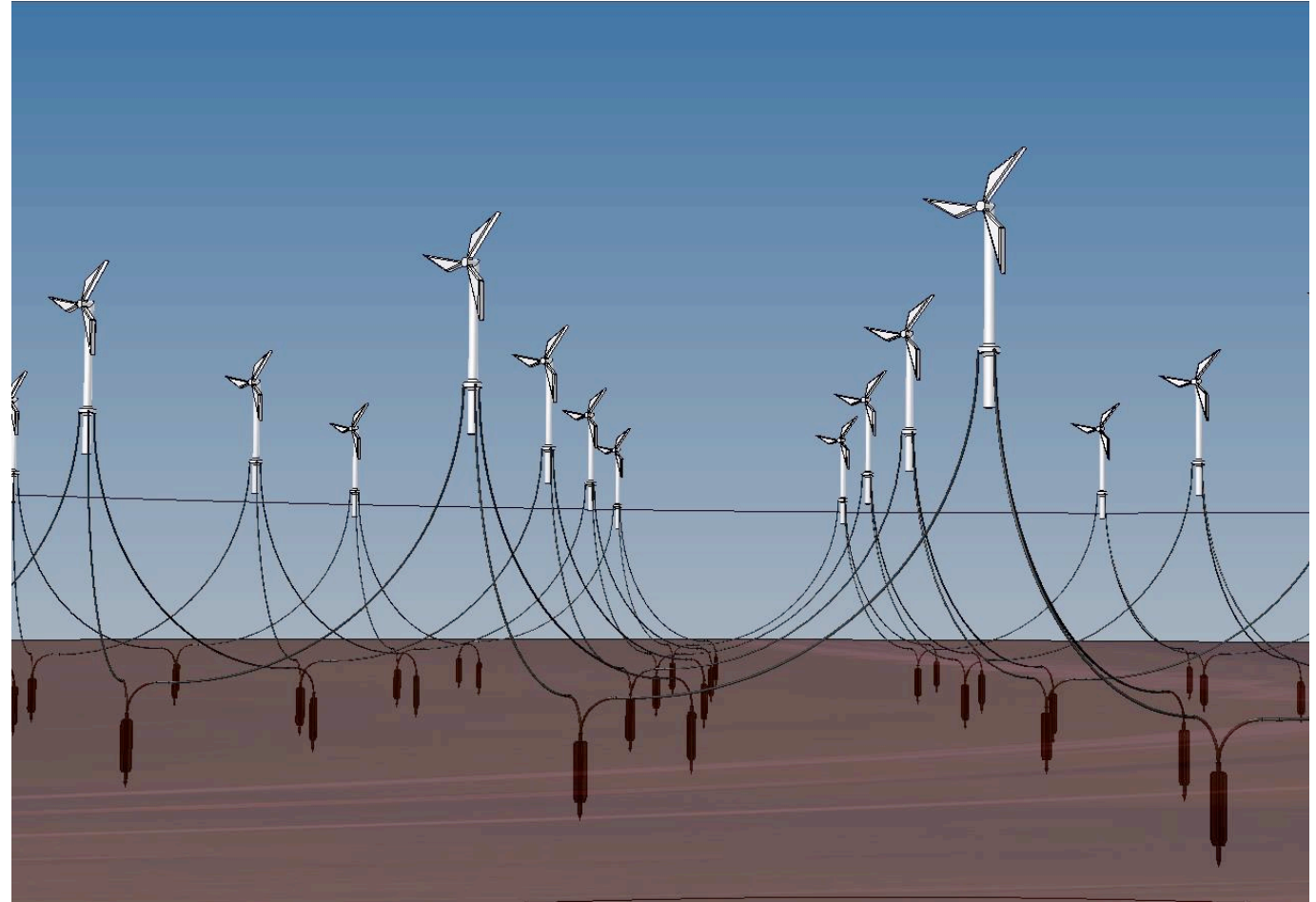
Overview

- Suitable for soft to medium clay soil conditions
- Used mostly for permanent mooring
- Suitable for catenary and taut leg moorings
- Since the 1990's over 2000 torpedo piles installed



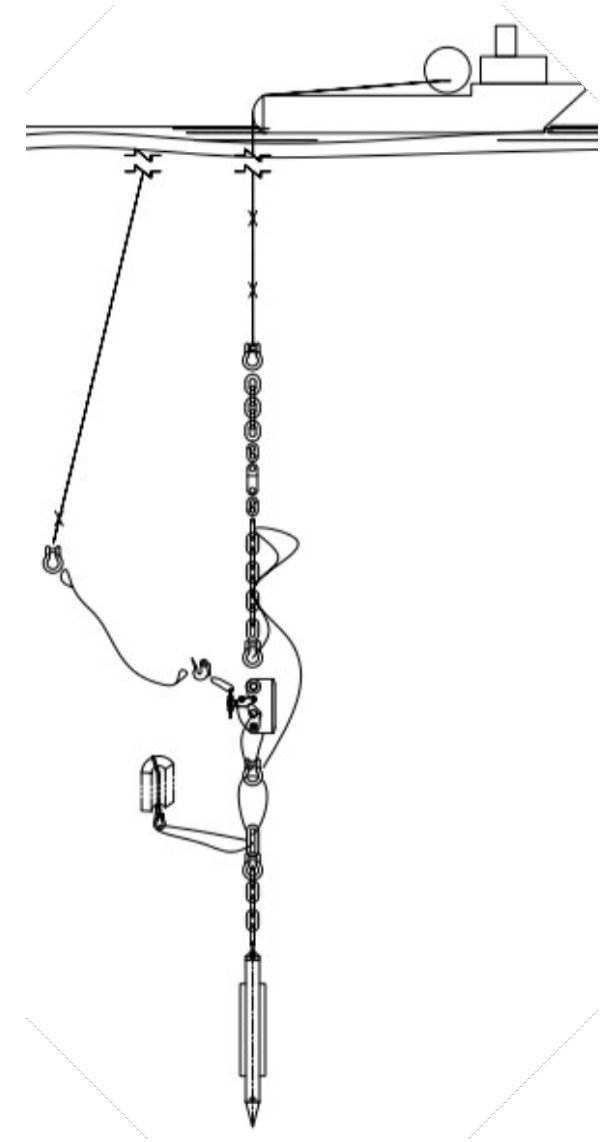
Overview

- Anchor sharing possible
Multiple mooring lines connected to single anchor



Installation

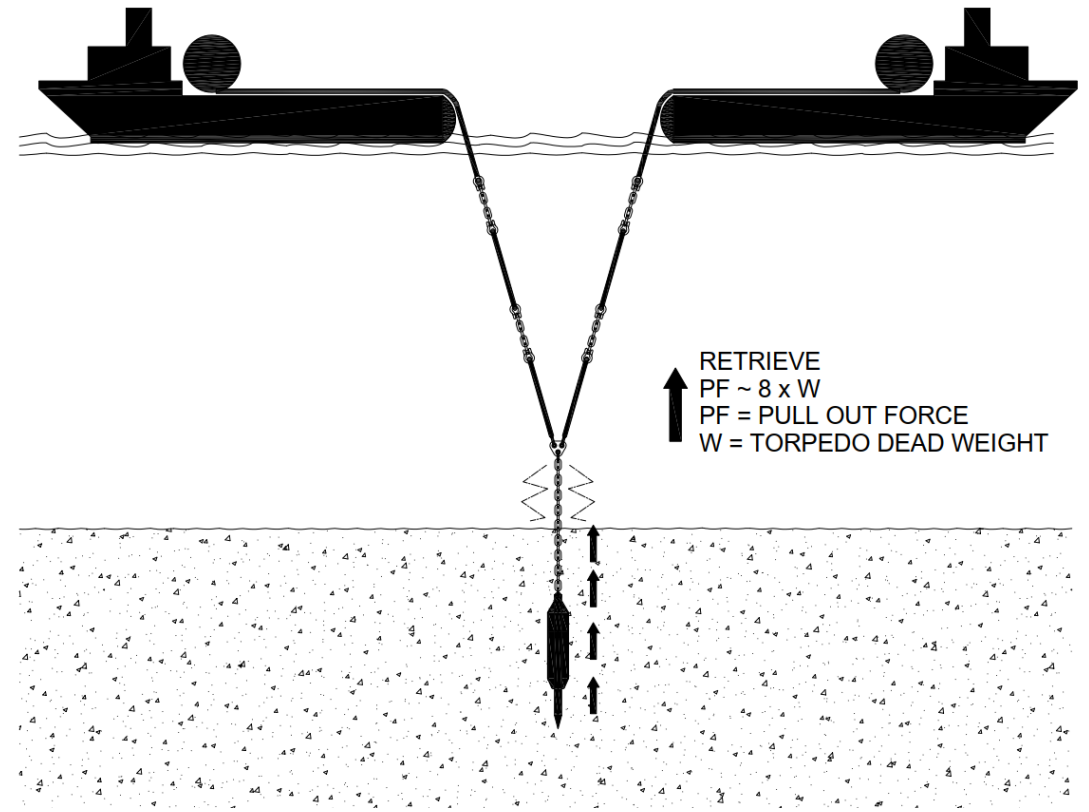
- Deployed from AHTS
- Dropped from predetermined height above seabed
- Accurate positioning



Floating Wind Solutions

Recovery

- After design life, anchor recovery is possible
- Using AHTS, torpedo pile is pulled out of the seabed



FOWT Challenges

FOWT Challenges

- Wind farm with multiple FOWT is located on a large expanse of seabed:
 - Variations in seabed conditions possible
 - Contact anchor designer at early stage of project:
Optimize the requirements for the soil investigation
Optimize the type and number of anchor most suitable for the encountered seabed conditions

FOWT Challenges

- Wind farm with multiple FOWT required large number of anchors
 - Standardize the anchor size
Anchors can be fabricated ahead of time
Simplifies installation
 - Delivery schedule in collaboration with installation contractor

Thank You

