Technology development of floating foundation for offshore wind in Japan

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Wind Power Business Unit
Hitachi Zosen Corporation

1. Introduction of Hitachi Zosen

- **Founded** Osaka Iron Works, April 1,1881 by E.H.Hunter

https://www.hitachizosen.co.jp/english/company/story/hunter-information.html

Energy from Waste Plant

- **Environment & Plants**

  Energy from Waste Plant, Biomass, Water Treatment, Desalination Plant, Petrochemical Plant, etc.

- **Machinery**

  Marine Diesel Engine, Press Machine for Automobile, Pressure Vessel, Container for Spent-Nuclear Fuel, Precision Machinery for Food, Plastic and Pharmaceutical, Sheet Forming System, etc.

Marine Diesel Engine

- **Infrastructure**

  Steel Bridge, Water gates, Shield Tunneling Machine, etc.

Steel Bridge

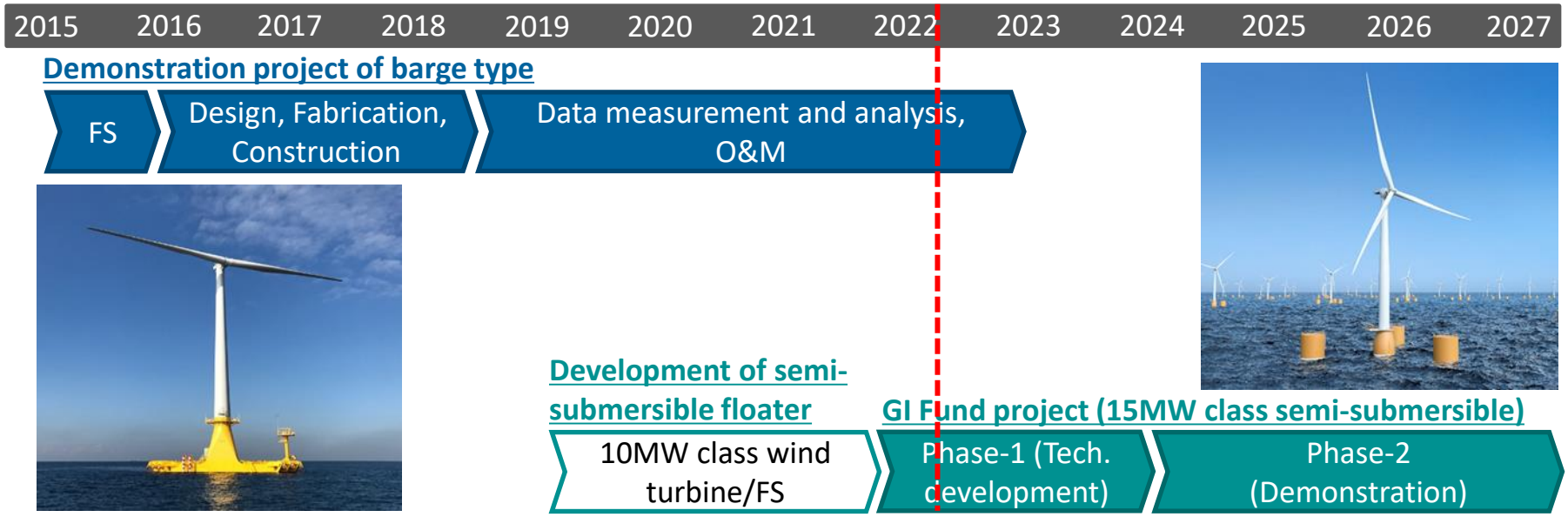
Shield Tunneling Machine

2. History of Hitachi Zosen's wind power business

Wind Power Business Unit

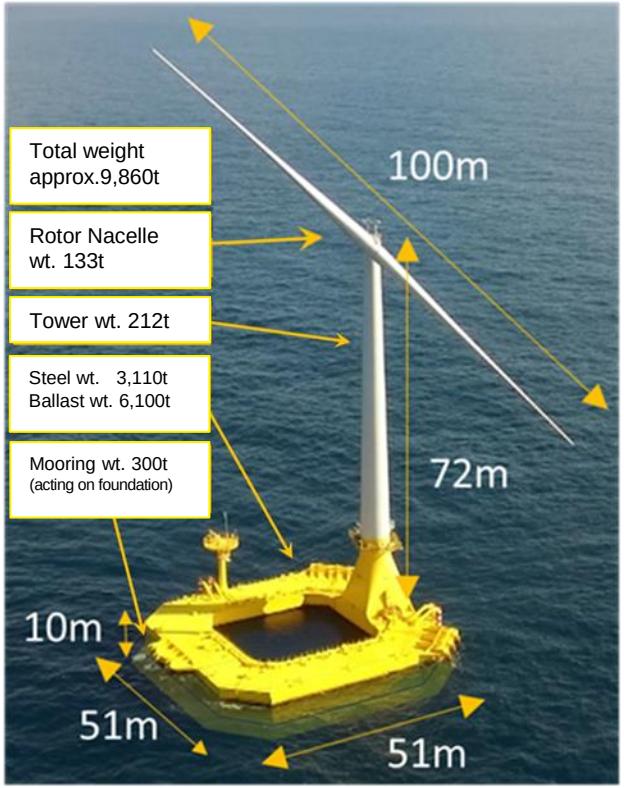
2007 Participated in wind power operation in Aomori
2012 Started study on offshore wind power in Aomori
2014 Established Wind Power Business Unit
2015 Started operation of onshore wind power plant in Akita
2015 Started demonstration project of Next-generation Floating Offshore Wind Turbine commissioned by New Energy and Industrial Technology Development Organization (NEDO)
2021 Started green Innovation fund project / Cost reduction for offshore wind power generation / Technology development project fort basic manufacturing and installation cost reduction for floating wind turbines (NEDO)

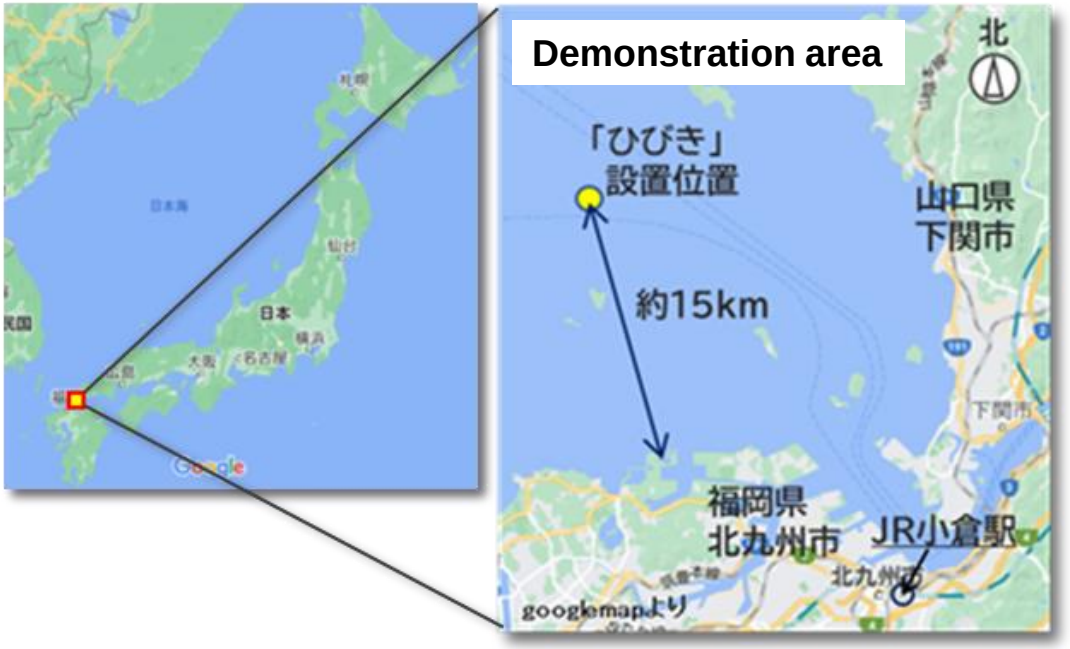
Development History of Floating Offshore Wind



3. Demonstration project of barge-type floating foundation

Outline of FOWT





①Location	Approx. 15km off Kita-Kyushu, 54m deep
②WT	Rated3.0MW, Upwind, 2-blades DD100m, HH72m (above sea level)
③ Foundation	Barge-type, Steel, B51m×L51m×H10m Draft7.5m
④Mooring	Studless-chainφ132mm(R4) + drag anchor 3 directions x 3 lines = 9 lines Length : 522~551m/1 line
⑤Operation	Operation started in May, 2019

Scope of Hitachi Zosen

EPC : Design (Floater, Mooring, Electric equipment), Floater manufacture, WTG assembly, Offshore installation

O&M : Measurement data analysis, Design verification, Monitoring system establishment, Underwater inspection by ROV

3. Demonstration project of barge-type floating foundation

■ Fabrication of foundation (Hitachi Zosen Sakai works)

Steel plate:
Class NK
KA36,KD36,KE36,KF36

Forged steel:
parts of TP
Class NK certificate

Top connector:
forged steel
R4, approx.7ton x 9pcs
Class NK certificate

Named “HIBIKI”

Receiving steel plates

Cutting steel plates

Bending steel plates

Sub assembly

Middle assembly

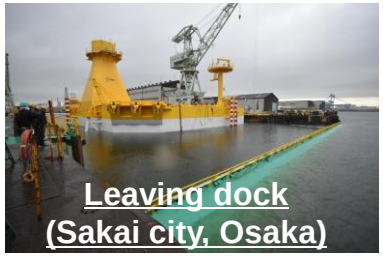
Assembly

TP assembly

Top connector

Painting

■ Towing of foundation (towing distance = 500km)



Leaving dock
(Sakai city, Osaka)

Passing under Seto Ohashi Bridge

Mooring at quay, Kita-Kyushu

3. Demonstration project of barge-type floating foundation

Assembly & mounting of WT @ Kita-Kyushu Port ~ Towing of FOWT

Assembly RNA

Mounting tower & RNA

Towing Foundation

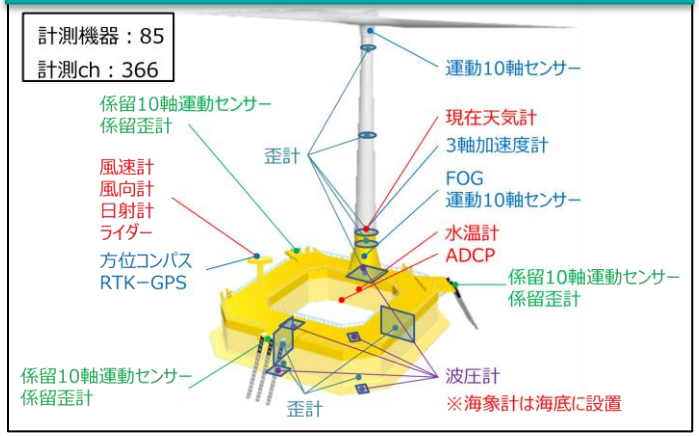
Finished installation

Connecting Chains

3. Demonstration project of barge-type floating foundation

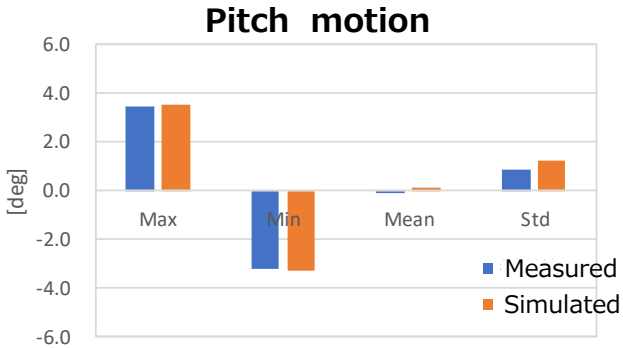
Data observation and design verification

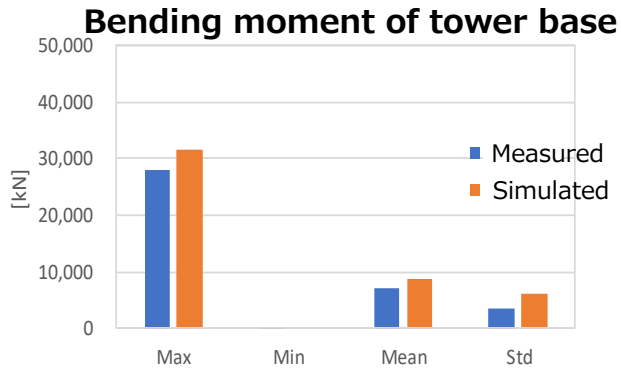
Data Observation



Typhoon Tapah (2019)

Design Verification

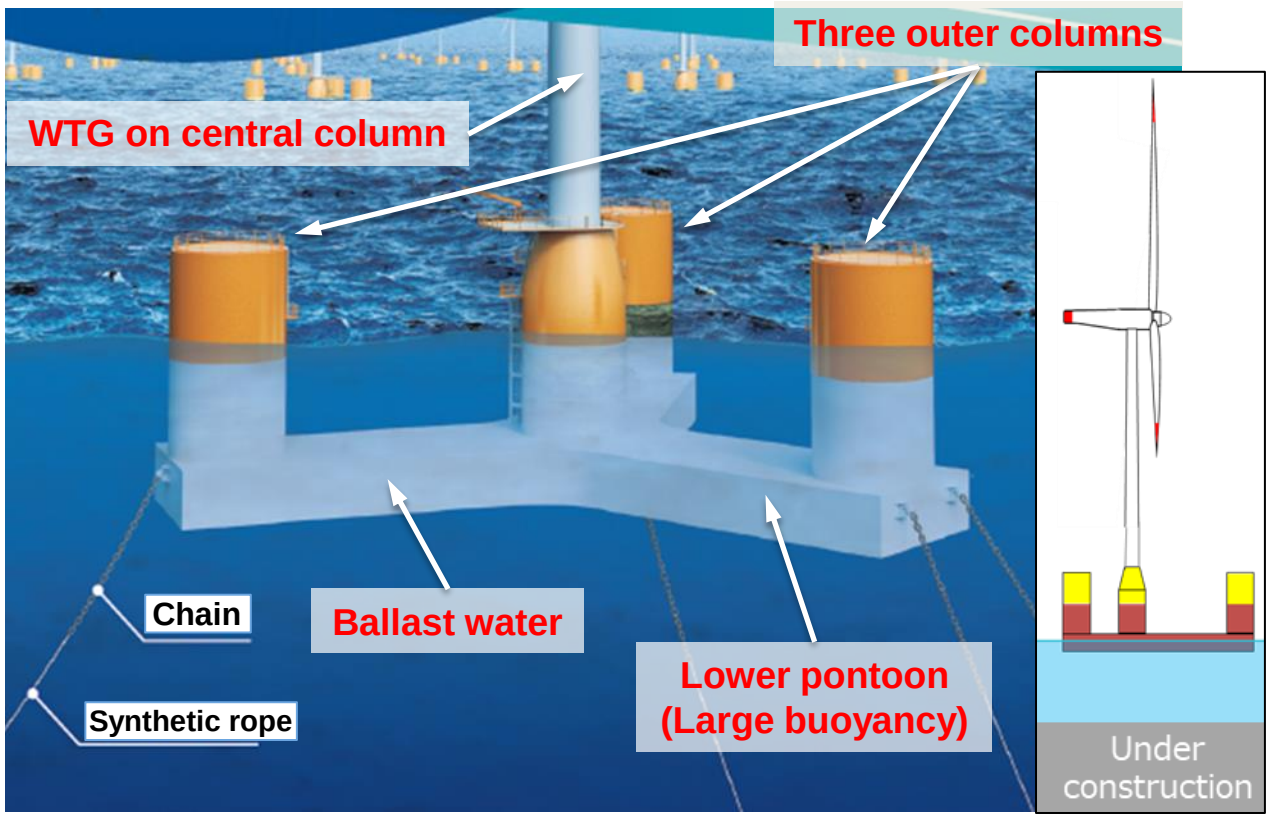




⇨ **Verified the reliability of the design methodology and the safety of floating foundation**

4. Development of semi-submersible floating foundation

Floater Concept



Simple shape
- Low manufacturing costs and short assembly period

Shallow light-weight draft
- WTG assembly, temporary storage etc. in port area

Approx.20m of draft
- Small floater motion, small mooring tensions

Green Innovation fund project (Phase-1 : 2021-2023)

Technical development

① Optimization of floating foundation
② Cost reduction and mass-production technology
③ Hybrid mooring system (chain and synthetic rope)

4. Development of semi-submersible floating foundation

Mass Production Concept

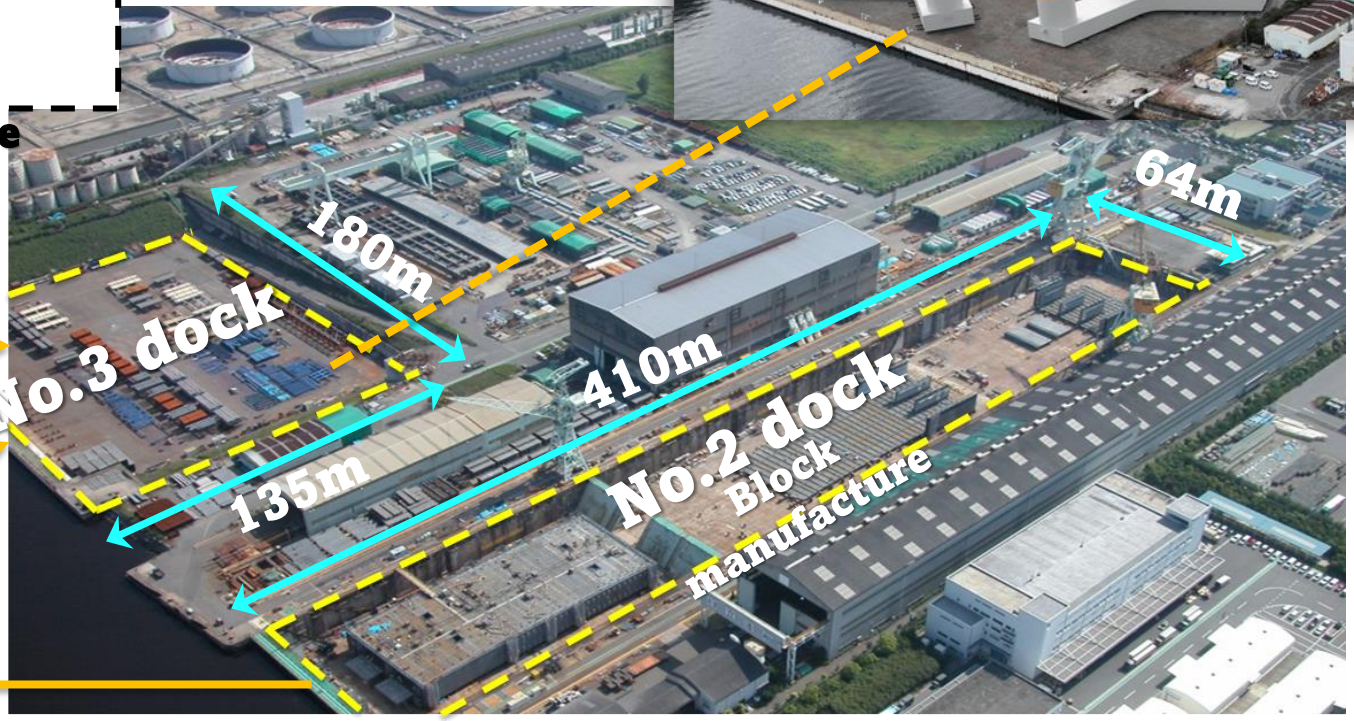
- Hitz Sakai works has 2 docks for offshore structure
- Block manufacture at No.2 dock and Shipbuilding companies
- Assembly of 2 floating foundations at No.3 dock

Utilize Existing facilities

Shipbuilding companies

Block manufacture

Hitz Sakai works



Contribute to growth of FOWT through mass production of floating foundation

Technology for People, the Earth, and the Future

Hitachi Zosen creates links between mother nature and our future

Hitz Hitachi Zosen Corporation https://www.hitachizosen.co.jp/english/