Academic and Research Seminar on Challenges and Considerations in Offshore Wind Power Facility Development

Co-hosted by the Port and Airport Research Institute (PARI) and
the International Press-in Association (IPA), with around 600 participants from 12 countries

On July 4, 2025, the Port and Airport Research Institute (PARI) and the International Press-in Association (IPA) co-hosted an academic and research seminar entitled “Challenges and Considerations in Offshore Wind Power Facility Development.”

As global efforts to achieve carbon neutrality by 2050 accelerate the adoption of renewable energy, offshore wind power has gained international attention as a promising and stable large-scale power source. However, the development of offshore wind facilities presents a range of complex technical challenges—including varied seabed conditions, environmental impact, construction efficiency, and operational safety—necessitating interdisciplinary collaboration and innovative approaches.

This seminar brought together researchers and practitioners from Japan and abroad to discuss the latest research, practical issues, and prospects for applying press-in piling technologies in offshore wind development. A second part of the program included a site tour of PARI’s research facilities, where participants observed experimental facilities and ongoing research activities, fostering active dialogue.

A total of 591 participants from 12 countries—Australia, Brazil, China, Germany, Japan, Malaysia, Singapore, Sri Lanka, Thailand, the United Kingdom, the United States, Vietnam—attended the seminar both in person and online, serving as a valuable platform for international knowledge exchange and professional collaboration.

Seminar Program Overview

Part 1: Seminar (13:00–15:30)

Opening Remarks: Dr. Ruri Shoji

President, National Institute of Maritime, Port and Aviation Technology (MPAT)

The seminar began with opening remarks by Dr. Shoji, President of MPAT, who welcomed participants on behalf of the co-organizers. She emphasized the importance of tackling the technical challenges involved in offshore wind power facility development, and highlighted the crucial role of academic research in advancing practical solutions.

Dr. Shoji expressed her hope that the seminar would serve as a platform to promote collaboration among industry, academia, and government, and acknowledged the generous support of 19 organizations, including relevant government agencies. She also underscored the significance of hosting this seminar with the participation of nearly 600 attendees under such a broad cooperative framework.

Lecture 1: Prof. Kenneth Gavin (Pre-recorded English Lecture)

President, International Press-in Association (IPA); Professor, Delft University of Technology

The Potential Use of Press-in Methods in the Offshore Renewable Energy Industry

In a pre-recorded lecture delivered in English, Prof. Gavin emphasized the critical role of geotechnical engineering in addressing the technical and environmental challenges associated with the expansion of offshore wind power. He presented case studies demonstrating how joint industry projects involving academia and industry have led to innovations in monopile foundation design, significantly improving installation efficiency and cost-effectiveness.

Prof. Gavin highlighted that such technological advancements not only reduce costs but also contribute to delivering broader societal value. He introduced promising new technologies that minimize environmental impact during installation, as well as advancements in ground investigation, soil modeling, and approaches for dealing with complex seabed conditions.

He also discussed the potential of press-in piling technology—a non-vibratory, low-noise piling method—as a viable solution that balances environmental preservation with constructability. He noted that press-in methods may offer advantages in minimizing environmental impact and enhancing installation precision, particularly in challenging ground conditions. Finally, he stressed the importance of smart port and coastal infrastructure and international collaboration, expressing a strong outlook that innovations in geotechnical engineering—particularly those emerging from academic–industry partnerships—will play a vital role in realizing a sustainable society.

Lecture 2: Dr. Kojiro Suzuki

Senior Director for Research, Port and Airport Research Institute (PARI)

Application of Rock Bags for Scour Protection

Dr. Suzuki presented research on scour phenomena occurring around the foundations of fixed-bottom offshore wind turbines. He compared conventional countermeasure methods—such as filter layers combined with armor layers—with rock bag systems, which consist of stone-filled geotextile bags.

He explained that rock bags are simple to fabricate, offer excellent ease of installation, and reduce uplift pressure through the gaps

between stones. This makes them particularly suitable for Japan, where securing high-quality large stones is often difficult.

Using a large-scale wave flume experiment at 1/9 scale, Dr. Suzuki analyzed how wave height, flow velocity, and sediment grain size affect scour depth. The findings demonstrated that incorporating a filter layer in conjunction with rock bags provides enhanced protection against scour. He also noted that winnowing caused by local turbulence and wave-induced turbulence plays a significant role in scour development, and that the selection of experimental scale and sediment properties greatly influences the reproducibility of test results. He concluded by emphasizing the importance of international collaboration and comparative experimental studies among institutions. Such cooperation is essential for developing standardized design guidelines and improving the reliability of scour countermeasures in offshore wind power projects.

Lecture 3: Dr. Kazuki Murata

Senior Researcher, Coastal and Ocean Development Group, Port and Airport Research Institute (PARI)

Developing Impact Assessment Methods for Submarine Landslides and Soil Liquefaction on Offshore Wind Foundations

Dr. Murata presented a study on the potential impacts of submarine landslides and soil liquefaction—triggered by large earthquakes or abnormal wave events—on offshore wind turbine foundations. His presentation combined numerical simulations with geotechnical risk assessments.

In the first part, he used the Moving Particle Semi-implicit (MPS) method to simulate the behavior of liquefied soil flows. By comparing the results with existing centrifuge model tests, he validated the applicability of the model to sandy seabeds. He also conducted three-dimensional simulations to evaluate the impact forces exerted on fixed-bottom offshore wind turbine foundations. The findings showed that denser liquefied soils generate greater inertia, resulting in stronger impact forces and external loads, including surface disturbances, that significantly affect the structural response of the wind turbine.

In the second part, Dr. Murata introduced an approach to identify high liquefaction-risk areas using seismic and soil property data. Coastal regions along the Nankai Trough, characterized by high sediment supply and depositional basins, were identified as particularly vulnerable. Based on borehole-derived soil properties, he demonstrated that the probability of liquefaction can be quantitatively evaluated by combining irregularities and duration of seismic waveforms with soil plasticity indices. He concluded by emphasizing the importance of incorporating quantitative geotechnical risk assessments into offshore wind development and future foundation design strategies.

Lecture 4: Dr. Hiroaki Kashima

Head of Group, Coastal and Ocean Development Group, Port and Airport Research Institute (PARI)

Dynamic Response of Offshore Wind Turbine under Multiple Forces

Dr. Kashima presented a study on the dynamic response of offshore wind turbine foundations subjected to multiple simultaneous external forces—specifically, wind, wave, and seismic loads. While these forces have traditionally been evaluated separately, he emphasized that real-world conditions require an integrated analysis to capture their complex interactions.

Dr. Kashima introduced an enhanced version of the OpenFAST simulation framework, incorporating seismic inputs and a soil-structure interaction (SSI) spring model. The model was used to analyze the response of fixed-

bottom monopile-type offshore wind turbines under the combined action of wind, waves, and earthquakes. The results showed that the dynamic response of the structure is significantly affected by ground stiffness (N-value): soft ground conditions tend to amplify earthquake-induced responses, while stiffer soils result in wind and wave effects becoming more dominant. He also examined how the timing of seismic wave arrival relative to other loading phases affects structural response, identifying this as a critical consideration in design.

Dr. Kashima compared simplified static evaluation methods with dynamic analysis results and noted that static methods can be effective in the preliminary design stage. He also introduced ongoing efforts to verify the reproducibility of the simulations through centrifuge model experiments. He concluded by highlighting future challenges, particularly in the context of floating wind turbines. These include understanding the interaction between mooring systems, floating foundations, and seabed response under seismic loading.

Closing Remarks: Dr. Hiroyasu Kawai

Director General, Port and Airport Research Institute (PARI)

Dr. Hiroyasu Kawai delivered the closing remarks, thanking all participants for attending and expressing his hope that the seminar had been a meaningful and satisfying experience. He noted the importance of strengthening international collaboration in technology development and expressed his expectations for further acceleration in offshore wind infrastructure deployment. His remarks, delivered in both Japanese and English, provided a fitting conclusion to the seminar's internationally focused program.

Group Photo of Seminar Speakers and Chairperson

Speakers (from left): Dr. Kazuki Murata, Dr. Kojiro Suzuki, Dr. Hiroyasu Kawai, Dr. Ruri Shoji, Dr. Hiroaki Kashima, and Prof. Kenneth Gavin (via pre-recorded video).

Chairperson (far right): Dr. Haruo Yoneyama,
Distinguished Researcher, Port and Airport Research Institute (PARI);
Director General, Ocean Infrastructure and Offshore Wind Energy Research Center

Scene from the Seminar Venue

Part 2: Facility Tour (15:40–17:15)

During the facility tour, participants were introduced to a wide range of experimental facilities maintained and operated by the Port and Airport Research Institute (PARI). These included the 3-Dimensional Underwater Shake Table, Hydro-Geotechnical Centrifuge Testing Facility, Intelligent Wave Basin, and the Large Hydro-Geo Flume. The tour showcased ongoing research activities related to ports and coastal areas.

Attendees received explanations on the technical features and applications of each facility, gaining insight into how experimental and analytical approaches contribute to the development and maintenance of coastal and port infrastructure.

Facility Overview

- 3-Dimensional Underwater Shake Table: https://www.pari.go.jp/en/about/facilities/3d/
- Intelligent Wave Basin for Maritime Environments: https://www.pari.go.jp/en/about/facilities/iwbme/
- Hydro-Geotechnical Centrifuge Mark II-R: https://www.pari.go.jp/en/about/facilities/gc/
- Large Hydro-Geo Flume (LHGF): https://www.pari.go.jp/en/about/facilities/dkbjb/

Scene from the Facility Tour – Intelligent Wave Basin for Maritime Environments

Seminar Summary

This seminar was held with the support of 19 supporting organizations, including national government agencies, and brought together approximately 600 participants both onsite and online.

Centered on the technical challenges involved in the development of offshore wind power facilities, the event featured presentations and lively discussions by experts from Japan and abroad. It served as a valuable platform for promoting technical advancement through industry–academia–government collaboration and for sharing international knowledge.

In particular, many of the topics addressed aligned with one of the key focus areas of the Ocean Infrastructure and Offshore Wind Energy Research Center at PARI: research and technical support related to wave-induced responses and foundation performance in offshore wind facilities. The seminar is expected to contribute to future technological development and strengthen international cooperation in this evolving field.

Group photo of seminar participants at the venue

Seminar Information:

“Challenges and Considerations in Offshore Wind Power Facility Development”

- **Date**: Friday, July 4, 2025, 13:00–17:15
- **Venue**: Port and Airport Research Institute (PARI), Yokosuka, Kanagawa, Japan
- **Format**: Hybrid (In-person + Online Streaming)
- **Co-hosted by**:
  - Port and Airport Research Institute (PARI), National Institute of Maritime, Port and Aviation Technology (MPAT)
  - International Press-in Association (IPA)
- **Supported by**:19 supporting organizations
  1. Ports and Harbours Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
  2. National Institute for Land and Infrastructure Management (NILIM)
  3. Agency for Natural Resources and Energy (ANRE), Ministry of Economy, Trade and Industry
  4. Japanese Geotechnical Society (JGS)
  5. Japan Society of Civil Engineers (JSCE)
  6. Japan Port and Harbor Association (PHAJ)
  7. Coastal Development Institute of Technology (CDIT)

8. Port and Airport Technology Research Corporation (SCOPE)
9. Overseas Coastal Area Development Institute of Japan (OCDI)
10. Nippon Kaiji Kyokai (ClassNK)
11. Japan Association for Marine Survey and Technology (JAMSA)
12. Japan Civil Engineering Consultants Association (JCCA)
13. Japan Association of Steel Pipe Pile and Sheet-pile (JASPP)
14. Japan Port and Airport Consultants Association (KOCON)
15. Japan Press-in Association (JPA)
16. Japan Construction Machinery and Construction Association (JCMA)
17. Japan Wind Power Association (JWPA)
18. Floating Offshore Wind Construction Technology Research Association (FLOWCON)
19. Floating Offshore Wind Technology Research Association (FLOWRA)

- **Participants:** 591 total (62 onsite, 529 online)
- **Participating Countries:** 12 countries (Australia, Brazil, China, Germany, Japan, Malaysia, Singapore, Sri Lanka, Thailand, the United Kingdom, the United States, Vietnam)

Organizer Profiles

Port and Airport Research Institute (PARI)

PARI is one of the three core research institutes of the National Institute of Maritime, Port and Aviation Technology (MPAT). It conducts comprehensive R&D to support the development and maintenance of port, airport, and coastal infrastructure. With eight research fields and five cross-disciplinary centers, PARI addresses a wide range of maritime challenges.

It focuses on disaster prevention and mitigation against natural hazards such as earthquakes, tsunamis, and storm surges; the design, construction, and maintenance of port and marine infrastructure; and the advancement of technologies for emerging marine uses like offshore wind power. Through experimentation, observation, analysis, and simulation, PARI contributes to national resilience and the realization of a sustainable society.

Website: https://www.pari.go.jp/en/

International Press-in Association (IPA)

The International Press-in Association (IPA) is a global academic organization dedicated to advancing “Press-in Engineering”—an interdisciplinary field integrating geotechnical, environmental, mechanical, measuring-surveying-monitoring, and data and information processing engineering. IPA aims to combine theory and practice through collaboration among academia, industry, and government to elucidate the mechanisms of soil–structure interaction.

Since its establishment in 2007, IPA has organized international conferences and workshops, published and awarded academic papers, and issued design and construction guidelines for press-in methods as well as case studies of press-in piling technology applications. It contributes to the advancement and dissemination of press-in piling technology by building and maintaining an international network, sharing technical information, and providing venues for presenting research results and practical applications.

Website: https://www.press-in.org/en

Contact

Secretariat, International Press-in Association (IPA)
E-mail: tokyo@press-in.org