WCFS®
World Conference on Floating Solutions
2023 JAPAN
Tokyo

Website

Contact

Registration

WCFS®
World Conference on Floating Solutions
JAPAN 2023
Tokyo

WORLD CONFERENCE ON FLOATING SOLUTIONS 2023

FLOATING SOLUTIONS FOR THE NEXT SDGs

Date: **28th-30th Aug.2023**

Venue: Nihon University Auditorium-1,
College of Science and Technology,

SOCIETY OF FLOATING SOLUTIONS, SINGAPORE
WORLD CONFERENCE ON FLOATING SOLUTIONS 2023 JAPAN

Welcome by Chairman of WCFS 2023 Japan

Welcome by Chairman of Executive Committee

Welcome Message

I would like to extend a hearty welcome to this prestigious international conference that will bring together researchers, architects, and designers in the field of floating structures from around the world. This conference will provide a platform to promote knowledge exchange, build meaningful connections, and work together to shape the future of global environmental solutions through floating structures. The diverse ideas, innovative research, and insightful discussions will undoubtedly inspire and push us to new frontiers. The conference theme, "Floating Solutions for Next SDG's," reflects the pressing issues and opportunities for change facing the world today. We also prepared very attractive special exhibits and technical tours. I hope all the participants will enjoy the conference.

Shigeru Tabeta, Dr. Eng.

Professor
The University of Tokyo

Welcome by Chairman of Organizing Committee

Welcome Message

I would like to thank all participants supporting this years WCFS 2023 JAPAN and welcome everyone to the campus of Nihon University which is the venue for the conference.
WCFS offers opportunities to meet many kinds of researchers in the ocean field.
In particular, it is unique that some architects and architectural engineers are participating and proposing concepts using floating systems to be utilized in seas or waterfront regions.
I look forward to discuss with you all more about new solution to address social issues facing the current world altogether.

Tomoki Ikoma, Dr. Eng.

Professor
Nihon University

Opening Remarks

Soom Lim Heng

Founder President and Senior Advisor to the Society of Floating Solutions (Singapore)

Mr. Lim Soon Heng is the Founder President and Senior Advisor to the Society of Floating Solutions (Singapore). He has extensive experience in the marine industry having spent much of his professional career with Singapore's largest rig building yard, Keppel Offshore and Marine.
In 2019, he organised the first World Conference on Floating Solutions (WCFS) in Singapore. This inspired the convening of a second WCFS in Rotterdam in 2020. Due to the Covid pandemic, the third WCFS was postponed. It is now to be held in August 2023 in Tokyo. The fourth WCFS is scheduled for 2024 in Lyon. It is likely that the fifth will take place in Hong Kong in 2025. The momentum in the series of WCFS augurs well for the world threatened by climate change.
He believes the technological progression of fossil extraction from land to sea offers ideas that may be applied to develop safe and economic solutions for floating nuclear power plants.
Speech title: ***Floating Solutions, a Way Out of the Climate Conundrum***

Sam Tabuchi

Professor Emeritus,
Toyo University
Executive Board UNECE PPP Working Party
Chair, Asia/Pacific Chapter of WAPPP
Advisor, Asia PPP Institute
Advisor, Chodai Company

Prof. Sam Tabuchi leads the promotion of regional economic development through PPP and People First PPP for SDGs around the world through the UN ECE PPP Working Party (served as the Chair from 2018 - 2022), World Association of PPP (WAPPP) and Asia PPP Institute (serves as a director 2011 - 2022).
He also serves as an advisor to one of the top tier engineering consulting firms in Japan, Chodai Co., Ltd. and engaged in the use of PPP for local government management and various overseas projects in Asia.
Tabuchi spent over 30 years in the US working for the Florida Dept. of Commerce, as special assistant to the US Trade Representative and development of Transportation Related Development project in Florida.US.
He completed his undergraduate degree in Rikkio University in Tokyo and obtained his post-graduate degree in Urban and Regional Planning at Florida State University.
Speech title: ***Floating Solutions as a new goal of the next SDGs of the United Nations***

Introduction

World Conference on Floating Solutions (WCFS) aims at providing solutions to mitigate challenges associated with climate change, population growth, renewable energy, food production, etc. by using floating technologies.

The first conference was held in Singapore in 2019 by the "Society of Floating Solutions, Singapore (SFSS) "and the second one in Rotterdam in 2020. We are delighted to announce the third conference, WCFS2023 Japan to be held in Tokyo under the theme of "Floating Solutions for the Next SDGs" as described below.

We encourage you to join WCFS2023 Japan and exchange opinions together to make a step forward to realize sustainable society in the light of Floating Solutions.

Background

In recent years, the safety and security of people's lives around the world has been threatened by frequent floods and rising sea levels attributable to climate change. The COP 26 has set a common global goal of limiting the temperature rise to 1.5 degrees Celsius above pre-industrial levels. It is an urgent task to cope with climate change as well as to utilize decarbonized and renewable energy.
The UN is promoting the SDGs which aim to achieve 17 Goals between 2015 and 2030. However, efforts to reach the Goals will not end in 2030, but will be an ongoing challenge for humanity beyond 2030.
Here, we tentatively call the Goals to be achieved after the SDGs as "Next SDGs".

WCFS2023 Japan aims to pioneer the SDGs and Next SDGs by making the most use of ocean and water. Ocean and water have the potential to provide solutions to the disasters such as flooding and sea level rise due to climate change. In this context, WCFS2023 Japan will position ocean and water as the urban infrastructure and will explore new technology and feasible solutions. In particular, it is necessary to consider urban planning, marine architecture, port planning connecting land and sea, disaster prevention, renewable energy and food production on the sea and water. Further, it is indispensable that knowledge, experience, dream and strong desire to realize these challenges are supported by a diversity of people.

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Japan Society of Civil Engineers
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The Asia/Pacific chapter of World Association of Public-Private Partnership
The Executive Board of the UNECE Public-Private Partnership Working Party
The City Planning Institute of Japan
The Japan Civil Engineering Consultants Association
The Ministry of Land, Infrastructure, Transport and Tourism
The Oceanographic Society of Japan
The University of Tokyo Ocean Alliance
Tokyo Metropolitan government
Yokohama National University

WCFS 2023 Japan Contributors

Conference Executive Committee

Name	Affiliation
Shigeru Tabeta	Chair of Conference Executive Committee, WCFS2023 Japan Professor, the University of Tokyo
Tomoki Ikoma	Vice chair of Conference Executive Committee, WCFS2023 Japan Chair of Organizing Committee, WCFS2023 Japan Professor, Nihon University
Sam Tabuchi	Professor Emeritus, Toyo University Chair of UNECE PPP Working Party in Geneva
Hidekatsu Kikuchi	Executive Manager, Business Strategy and Promotion Department, Chodai Co., Ltd.
Motoko Imai	General Manager, New Business Innovation and Promotion Division, Chodai Co., Ltd.
Toshio Nakajima	CEO, Waterfront Real Estate Co., Ltd.
Yoshihiko Yamashita	Senior Adviser, Waterfront Real Estate Co., Ltd.
Yuki Yamashita(Secretariat)	Chief of Water City, Energy and Environment section, Chodai Co., Ltd.
Ikuo Yoshida(Secretariat)	Manager, Ocean Programs, Emerging Frontier Division, Shimizu Corporation
Donghee Ko(Secretariat)	Manager, Ocean Programs, Emerging Frontiers Division, Shimizu Corporation

Organizing Committee

Name	Affiliation
Tomoki Ikoma	Chair of Organizing Committee, WCFS2023 Japan Professor, Nihon University
Chikako Fujiyama	Associate Professor, Yokohama National University
Daisuke Kitazawa	Professor, the University of Tokyo
Hideyuki Niizato	Technical Research Institute Hitachi Zosen
Jin Sasaki	Renewable Energy Engineer, Arup
Kazuhiro Iijima	Professor, Osaka University
Kenichi Fujita	Associate Professor, Nagasaki Institute of Applied Science
Mitsuhiro Masuda	Associate Professor, Tokyo University of Marine Science and Technology
Motohiko Murai	Professor, Yokohama National University,
Ryo Sugahara	Associate Professor, Nihon University
Shinichiro Hirabayashi	Associate Professor, the University of Tokyo
Takahide Terakuchi	Associate Professor, Nihon University
Takero Yoshida	Researcher, Japan Agency for Marine-Earth Science and Technology
Tomomi Kanemitsu	Institute of Technology Shimizu corporation
Yoshitsugu Kawakami	Professor, Hiroshima Institute of Technology
Yasuhiro Aida	Associate Professor, Nihon University
Yasunori Nihei	Associate Professor, Osaka Metropolitan University

Advisory Committee

Name	Affiliation
Hideyuki Suzuki	Professor, the University of Tokyo
Ken Takagi	Professor, the University of Tokyo
Koichi Masuda	Professor Emeritus, Nihon University
Koichi Maekawa	Professor, Yokohama National University
Takeshi Ishihara	Professor, the University of Tokyo
Takeshi Kinoshita	Professor Emeritus, the University of Tokyo
Tomoaki Utsunomiya	Professor, Kyushu University
Lim Soon Heng	Founder President and Senior Advisor of the Society of Floating Solutions, Singapore
Chien Ming Wang	Professor, University of Queensland

Conference Highlight

Opening Ceremony

Keynote Speech

Paper Presentation

Special Exhibition

Company Exhibition

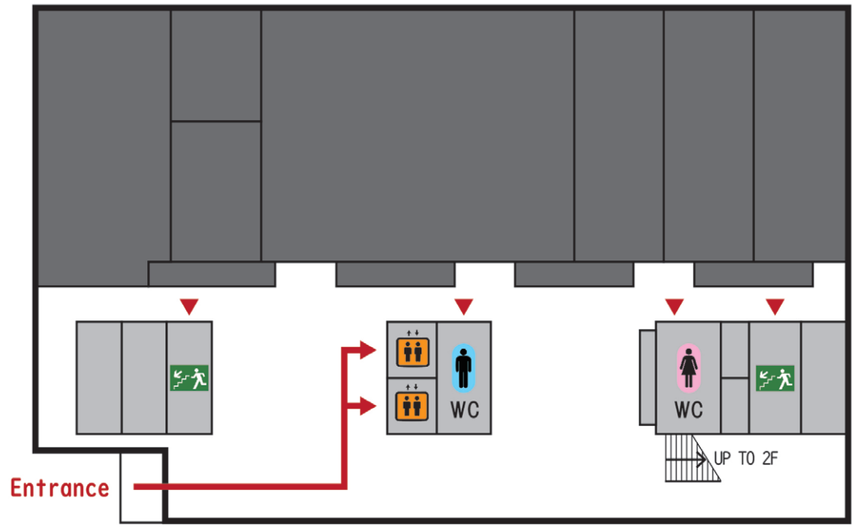
Welcome Reception, Business Forum, Networking Lunch

Banquet at the Hilltop Hotel (Yamanoue Hotel) (optional)

Technical Tour (optional):
Introduction of the Tokyo Bay eSG Project
by Tokyo Metropolitan Government

Floor Maps and Evacuation Routes

1F



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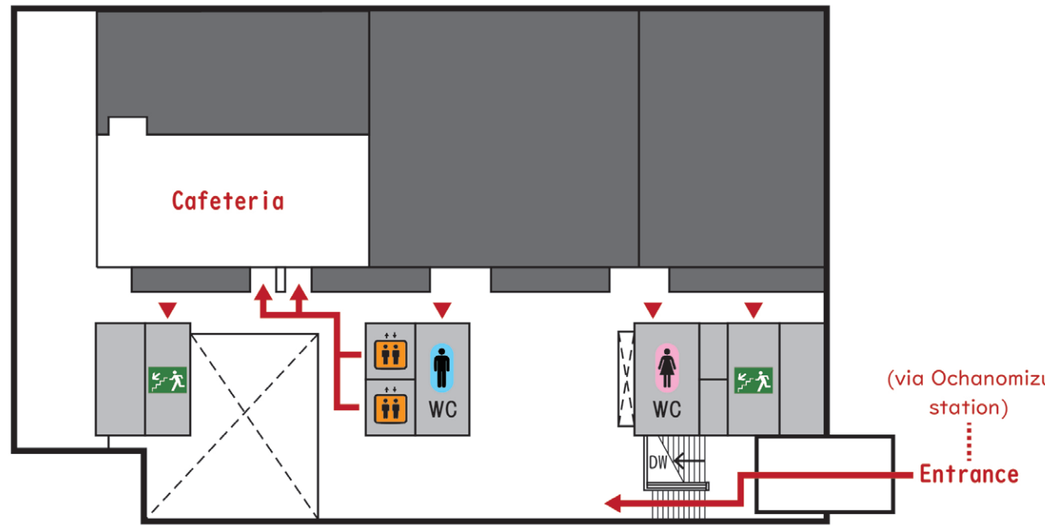

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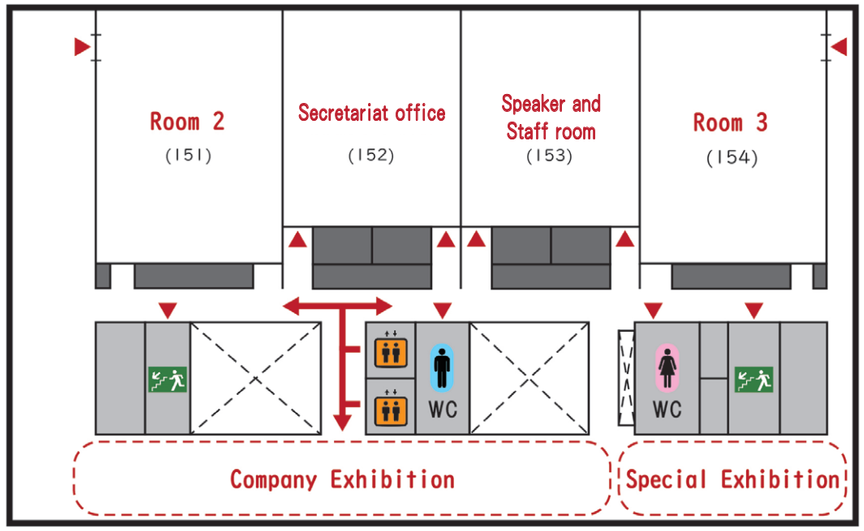

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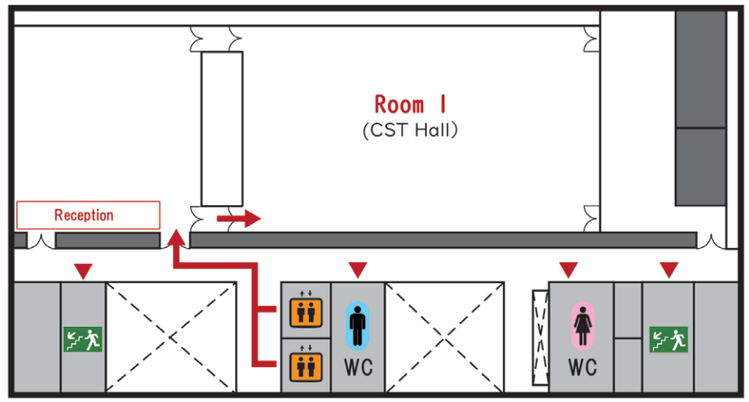


Programme

Day 1 : 28th Aug.

Time	Room 1 (6F)	Room 2 (5F-151)	Room 3 (5F-154)
8:00-9:00	**Registration**		
9:00-9:05	**Welcome by Chair** Shigeru Tabeta		
9:05-9:35	**Opening Ceremony** Soon Lim Heng Sam Tabuchi		
9:35-9:45	**Photo taking of All participants**		
9:45-10:15	Coffee Break		
10:15-11:15	**Keynote Speech** Takeshi Kinoshita Toshio Nakajima		
11:20-12:20	Business Forum		
12:20-13:30	Networking Lunch		
13:30-15:10	**Urban Planning** **Moderator: Ryo Sugahara**	**Technology / Innovation** **Moderator: Yoshitsugu Kawakami**	**Low Carbon Energy** **Moderator: Shinichiro Hirabayashi**
	Developing a sustainable and smart floating structure solution for enhancing liveability in Hong Kong's crowded built environment	The Evolving of floating shipyard and its leagile operation	Case studies of SMR liquefaction for FLNG applications
	Sustainable water city in Singapore - A novel floating solution to overcome both population growth and water shortage -	Experimental investigation for ship motion coupling internal sloshing under wave actions	Case Studies of SMR Liquefaction for FLNG Applications
	Designing floating urban realities: on the urban design of floating high density environments in the Dutch context	Experimental study of free-surface profiles of an aircushion-type floating platform with a moonpool	Innovative modular floating structures for harvesting solar energy in harsh marine environment
	A framework for environmental impact assessment of floating development	A systematic methodological routine for analyzing numerical analysis results: Tools for parametric design routines of floating structures	Floating OTEC plant – A design and coupled dynamics
	North Atlantic floating island. Architecture of the high Seas.	Floating Environmental Deck Structures -Design Construction Challenges	A Basic Investigation of Resonance Characteristics of PW-OWC Type WECs
15:10-15:40	Coffee Break		
15:40-17:20	**Urban Planning** **Moderator: Tomoki Ikoma**	**Technology / Innovation** **Moderator: Kazuhiro Iijima**	**Offshore Wind /Technology Innovation** **Moderator: Chikako Fujiyama**
	Proposal of floating city concept instead of landfill with artificial ground that has a free rebuilding system	Significant wave run-up for large offshore structures due to tertiary interactions	Study of the fairlead connections of a prestressed concrete spar platform supporting a 10 MW floating offshore wind turbine
	From floating prototype to floating community: Designing resilient floating communities by using participatory approaches	Effects of a moonpool on steady wave drifting forces on a floating pontoon	Influence of concrete material property on the failure mode of steel-concrete connection under monotonic load
	Floating urban development – Sustainable growth and affordable housing	Hydroelastic responses of very large floating structures in damage conditions	Numerical Study on Cause and Characteristics of Low-frequency Yaw Motion of a Slack-moored FOWT
	Challenges and success factors of realizing floating projects –from the perspectives of Dutch experts in floating city development	Using interter for offshore floating platform vibration control	Wave response characteristics of a low rigidity FOWT with guy-wire supported tower and single point mooring configuration
	Amid Geopolitical Conflicts, are Floating Nuclear Power Plants Safe?		A Study on Wave Free Configurations and Motion Responses for Advanced-SPAR Type FOWTs
17:20-17:40	Free Time		
17:40-	Welcome Reception		

Day 2: 29th Aug.

Time	Room 1 (6F)	Room 2 (5F-151)	Room 3 (5F-154)
8:00-9:00	**Registration**		
9:00-10:30	**Keynote Speech** Stefan Huebner Rutger de Graaf-van Dinther Koen Olthuis		
10:30-11:00	Coffee Break		
11:00-12:00	**Urban Planning** **Moderator: Jin Sasaki**	**Food & Others** **Moderator: Takero Yoshida**	**Offshore Wind / Low Carbon** **Moderator: Motohiko Murai**
	Development of the legal definition of the floating city: judicial interpretation and case law on the structural characteristics of floating homes and developments	Recent developments in offshore fish pens	Development of a simulation tool for floating offshore wind turbines using MBDyn
	Sustainable floating city production systems – Moving towards industry 5.0	Numerical simulation of the three-dimensional sloshing and internal free surface oscillation control in a closed fish tank using the particle method	Overview of FOWT demo projects cost and analyses of hull design features
	Current status of underwater space utilization and challenges to contribute to a sustainable society	Impacts of sessile organisms attached to artificial floating structures on the surrounding environment: review and update in Tokyo Bay	Basic study of barge type floater for large wind turbine system by using numeral simulation
12:00-13:30	Networking Lunch		
13:30-15:10	**Architecture** **Moderator: Kenichi Fujita**	**Food & Others** **Moderator: Hideyuki Niizato**	**Climate Change / Disaster** **Moderator: Mitsuhiro Masuda**
	A performance-based design framework for floating architecture. Trade-offs and correlations between requirements for multiple criteria decision making optimization.	Conceptual design and comprehensive assessment for an integrated ocean-based climate solution	System and method for proactive and reversible mitigation on storm/ hurricane/typhoon/cyclone
	A study on planning of sustainable floating architecture outside a bay utilizing submerged breakwater reef that sequesters CO2	Survey on the management of marine tourism in Zamami Village, Okinawa, Japan	Amphibious buildings as a response to increasing flood risk - European case study
	Stochastic response evaluation for random wind and wave actions of module-linked floating structures with a wind turbine	Study on the increase in annual maximum significant wave height due to the intensification of typhoons using NOWPHAS wave observation data	Study on applicability of the MPS two-phase flow model to submarine landslide problem and the basic characteristics of impact pressure on mooring anchors of offshore wind turbines
	A design proposal of floating leisure and culture facilities in Saemangeum area	Stakeholder acceptance of large-scale floating developments: Insights from social theory and realized projects in the Netherlands	Fundamental research on tsunami-resistant design for coastal architectures considering hazard chains
		Hydro-structural analysis – Advanced cross-structure calculation for a rigid floating breakwater module	
15:10-15:40	**Architect Kikutake & Floating City Vision** **Coffee Break**		
15:40-17:00	**Architecture** **Moderator: Takahide Terakuchi**		**Climate Change / Disaster** **Moderator: Yasuhiro Aida**
	From Floating Architecture to Seaside Landscape. The case of the Island of Roses.		Numerical study of the variation of the velocity of a tsunami-drifting object in front of a building just before impact at different angles of tsunami incidence
	"SeaSurveyor": An Innovative Floating Solution for Establishing Marine Protection Areas in Shallow International Waters		Study on the tsunami disaster prevention measure by the deep-draft type floating tsunami protection Wharf for a vessel moored at a Wharf
	An innovative design concept of modular pneumatic floating platforms		Proposal of tsunami hazard database for mooring vessels in major ports in Japan
	Multi-body analysis of modular floating islands: optimisation of connector stiffness (to be confirmed)		A study on the layout and structure of the cloister of Itsukushima Shrine from hydrodynamic aspects
17:00-18:00	Free Time		
18:00-	Buffet Style Dinner at the Hilltop Hotel		

Keynote Speaker

Takeshi Kinoshita

Professor Emeritus,
the University of Tokyo

Prof. Takeshi Kinoshita, graduated from the University of Tokyo of 1976, Doctor of Engineering, Naval Architecture and Ocean Engineering. Professor Emeritus at the University of Tokyo.
He had served as a professor at the Institute of Industrial Science, the University of Tokyo, a specially-appointed professor in the Department of Ocean Architecture and Engineering at the Faculty of Science and Technology, Nihon University, and the 19th and 20th President of Nagasaki Institute of Applied Sciences. He also served as the first chairman of the Ocean Energy Association-Japan.
His expertise lies in fluid dynamics and kinematics related to the motion of ships and marine structures, as well as the study of ocean energy, such as offshore wind power. He promotes the utilization of marine renewable energy, which is considered the main energy resources in the future, from the perspective of global warming and national security of energy resources.

Speech title: ***How the sea give us peaceful and rich favor?***

Toshio Nakajima

President, the Waterfront Real Estate Co., Ltd

Dr. Toshio Nakajima, president of the Waterfront Real Estate Co., Ltd. has a unique professional background as the 1st Grade Registered Architect of Japan as well as an offshore engineer. He received the M.S degree from the Univ. of Hawaii, Dept. of Ocean Engineering in 1976 and the Dr.Eng. from the Univ. of Tokyo, Dept. of Naval Architecture in 1981.
He used to be an architectural designer at Kiyonori Kikutake Architects & Associates; an offshore engineer for the research & development of semi-submersible type platforms at the Sumitomo Heavy Industries. He also worked for the RIKEN as an administrative senior official for 13 years and taught at the Tokyo Metropolitan University for 10 years.
He unraveled the dynamics of mooring line using the “lumped mass method”, which has been used widely among practitioners as one of the standard design methodologies of mooring line. In the recent years, he has been working on realization of soft-landed Sustainable Water City which is selected as one of the top 100 Must-Read Articles by Springer (2016).

Speech title: ***A Technical Review of Hawaii Floating City’76 and Floating Platform Technology from 1970s to 1980s***

Stefan Huebner

Senior Researcher, the Asia Research Institute (ARI), National University of Singapore(NUS)

Dr. Stefan Huebner (Hübner) is a Senior Research Fellow at the Asia Research Institute (ARI) of the National University of Singapore (NUS). He is also an Associate of the Harvard University Asia Center, where he has previously been a Fulbright Scholar and SSRC Transregional Research Fellow. Earlier, he was History and Public Policy Fellow at the Woodrow Wilson International Center for Scholars and postdoctoral/doctoral fellow at the German Historical Institute Washington, DC and the German Institute for Japanese Studies Tokyo. He received his PhD from Jacobs University Bremen (Germany).
His current research project is a global history of the industrialization and urbanization of marine regions during the twentieth and twenty-first centuries. His most recent articles address the "sustainable floating city" project in Busan, South Korea, the origins of offshore oil drilling in Asia and North America, offshore rocket launch and landing platforms, and the long-term influences of proposals from the 1950s-1970s to urbanize Tokyo Bay and Hawai'ian waters on present environmentalist and developmentalist thought. His edited volume on "Oceanic Japan" with his chapter on Japan's "platform archipelago" will be released in 2024.

Speech title: ***Earth's Amphibious Transformation. The Tokyo Bay Debate (1950s-1960s) and its Legacy in Global Perspective.***
The keynote lecture analyzes how the transformation of marine regions since the 1920s through mariculture, offshore oil drilling, and more energy-intensive built environments shaped the debate about urbanizing Tokyo Bay and influenced later projects that extended the human habitat to sea surfaces.

Rutger de Graaf-van Dinther

Entrepreneur and researcher, Blue 21

Dr. Rutger de Graaf-van Dinther is an entrepreneur and researcher. He received MSc and PhD (both finished cum laude) of Delft University of Technology as a civil engineer. His mission is to provide floating city technology to hundreds of millions of people who are impacted by climate change and sea-level rise.
With his companies DeltaSync and Blue21, the first stepping stones towards this mission already have been achieved with iconic floating construction projects including the Floating Pavilion Rotterdam and Floating Ecohomes, Harnaschpolder Delft, the Netherlands. Blue21 was design and technology partner in realizing the Innozowa floating solar project in collaboration with TU Delft. Currently, Blue21 is working on upscaling and mainstreaming floating city technology from 'proof of technology' to 'proof of scale'. This will establish an entirely new field of expertise called 'maritime urbanism' to enable the development of floating neighbourhoods and floating cities globally
He expanded his knowledge in various additional fields of expertise resulting in peer-reviewed scientific publications in the fields of technology, sustainability and social sciences. Rutger has been consultant to the Dutch Delta Programme, Topsector Water, City of Rotterdam and international clients including from the USA and various countries in Asia and Europe.

Speech title: ***Upscaling for a climate resilient Floating Future: next steps in technology, design, ecology, governance and business***

Koen Olthuis

Architect, Co-Founder of Waterstudio & Dutch Docklands

Dr. Koen Olthuis is a Dutch architect. He studied architecture and industrial design at Delft University of Technology. With his family roots in shipbuilding, architecture and engineering he founded Waterstudio in 2003 focused on floating architecture. He was ranked #122 in TIME Magazine's readers' poll of "the most influential people of the year".
As a senior researcher Floating Cities and Delta Urbanism at the Delft University of Technology, he and his team is testing the strategies and options for The Netherlands to build on water as the next phase in the evolution of a country below sea level. He advises governments and cities around the world on how to combat the effects of climate change and urbanization. His signature work includes the Floating City in The Maldives, as well as floating parks, houses and theatre for canals, lakes and the open ocean.
Koen is the author of the book FLOAT! and City Apps, which highlight the possibilities for rich and poor communities and to build on water to improve the performance of cities near water.

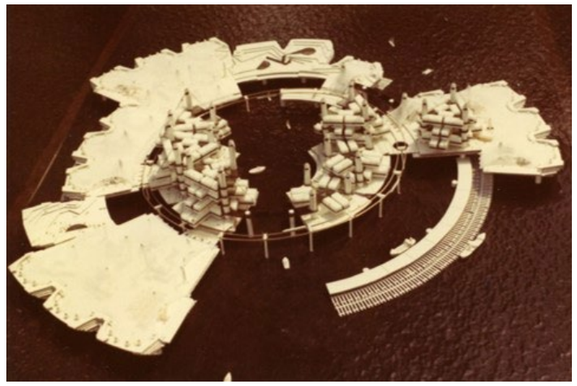
Speech title: ***Floating city roadmap, requirements guiding us from myth to marble.***

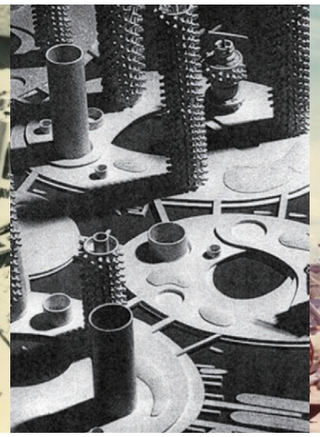
Special Exhibition

Architect Kiyonori Kikutake and Dr. J. P. Craven's Floating City Project

-Hawaii Floating City'76 and Other Endeavors –

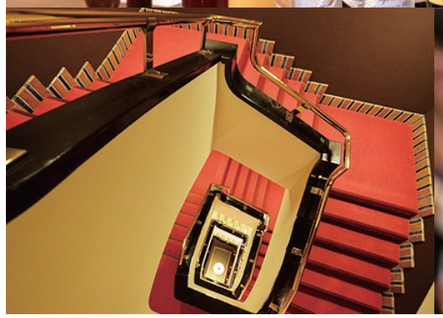
In the WCFS 2023 Japan, a special exhibition of the historic endeavor on realization of the floating community concept will be presented that was carried out in cooperation with engineers, architects and practitioners.
The historic attempt of the 'Hawaii Floating City '76 Concept stared in 1971. In order to realize the concept into realization, the State Government of Hawaii appointed a special team that was led by architect Kiyonori Kikutake and Dr. John P. Craven, system integrator & Dean of the Marine Program, Univ. of Hawaii. Intention of the special exhibition is to introduce significance of this historic challenge and other related endeavors to share treasured information with the conference participants hoping that it may stimulate realization of floating community.





Banquet at the Hilltop Hotel (Yamanoue Hotel)

29th Aug. (optional)

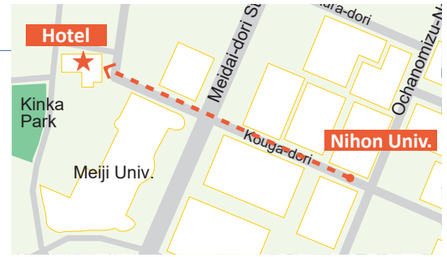


Hotel Location

Address.

1-1, Kanda Surugadai, Chiyoda-ku, Tokyo

Tel.
+81-3-3293-2311



Technical Tour, 30th Aug.

Brief Introduction of the Tokyo eSG Project

“Rather than monopolizing the benefits of economic development, it is important to give back to society in order to enrich the entire country” said Shibusawa Eiichi otherwise known as the “Father of Japanese Capitalism”. Goto Shinpei, who also composed a reconstruction plan for Tokyo after the Great Kanto Earthquake in 1923, promoted urban development envisioning 50 years and 100 years into the future. Today, by carrying on the spirit of the great leaders, we will create a model for a city in the post-Covid era and use cutting-edge “Digital Transformation (DX)” in order to achieve a balance between sustainability, economy and finance, and laying out the vision for the shape of Tokyo 50 years and 100 years into the future.

A city that is pandemic-ready, disaster-ready, and resilient including “human-centered spaces” surrounded by greenery, water, and biodiversity that constantly produces a new value focusing on the world's best talent and knowledge. By succeeding 50 years and 100 years’ vision, Tokyo will include the concept of “Tokyo eSG” in addition to the original concept of ESG (Environment, Social, and Governance). The eSG is an abbreviation of the followings:

e: Environment, Ecology, Economy, Epoch-making (innovative technology that will carve out a new era)

SG: Represent the spirit of Shibusawa Eiichi and Goto Shinpei.

Time Schedule(Subject to Change)

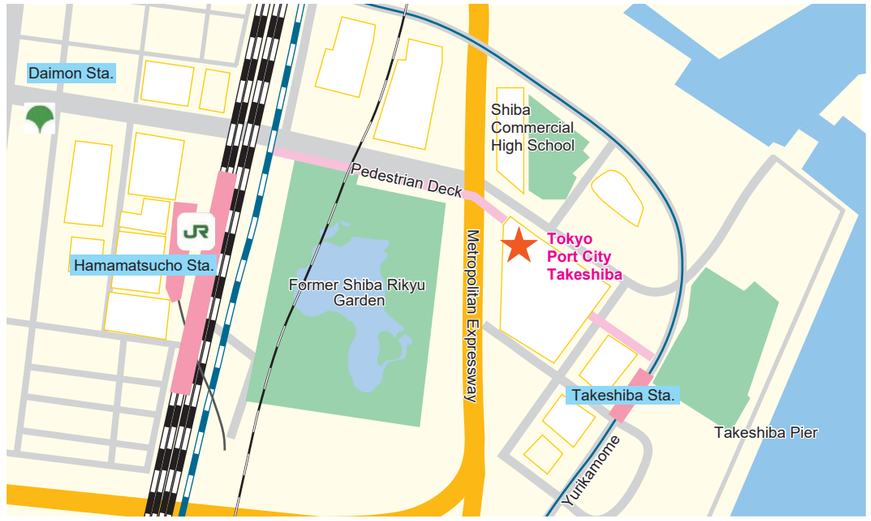
Day 3, Aug.30

Time	Tour Program
10:30	Meet at the gathering spot in Takeshiba Pier
10:30-11:00	Move to the Venue for Briefing of the eSG Project
11:00-11:30	Briefing of the Tokyo Bay eSG Project by Tokyo Metropolitan Government
11:30-13:00	Luch at Takeshiba Area
13:00-13:30	Board on the Electric Ship “Samurai”
13:30-15:00	Cruise to the Floating Restaurant "Terada "
15:00-15:30	Move to the Venue for Introduation of eSG Project
15:00-16:30	Introduction of the Tokyo Bay eSG Project by Private Entrepreneurs
16:30-18:30	Dinner at “Bank 30” Restaurant
18:30	End of the Tour

Meeting Place

Tokyo Port City Takeshiba Office Tower, 3rd Floor, City Plaza

1-7-1 Kaigan, Minato-ku, Tokyo(From:①Takeshiba Sta.250m、②Hamamatsucho Sta. 350m)



Abstract

Urban Planning

Developing a sustainable and smart floating structure solution for enhancing liveability in Hong Kong's crowded built environment

Xiao Lin Zhao, The Hong Kong Polytechnic University
Xiaoli Ding, The Hong Kong Polytechnic University
Chien Ming Wang, The University of Queensland
Jianguo Dai, The Hong Kong Polytechnic University
Rutger de Graaf-van Dinther, Blue21
Brydon Wang, Queensland University of Technology

Embracing new economic opportunities, creating capacity for sustainable growth, and enhancing liveability are the three building blocks encapsulated in 'The Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030'. To fulfil this vision, we must overcome the land shortage in Hong Kong, which is currently estimated to be approximately 3000 hectares. Among the possible solutions suggested by the government, more than one third will be realised through land reclamation. Large-scale land reclamation has played, and will continue to play, an important role in creating land for urban development in densely populated coastal cities like Hong Kong. However, this solution also attracts criticisms relating to threats to the marine environment, the degradation of water quality, the disruption of current flow, the vast cost relating to the lengthy soil consolidation and construction periods, and the shortage of filling materials for land reclamation. Enhancing liveability requires a certain percentage of land (normally 20% to 30%) be used as recreational space and community facilities that are often not in the form of high-rise buildings. These spaces could be achieved by using floating structure solution. This paper presents the vision for a sustainable and smart floating structure solution (S2FS2) in Hong Kong. It will cover the key features of S2FS2 that adopts a hybrid approach, i.e., a combination of floating structure solution and land reclamation. The challenges of such development will be discussed. They include sustainable and cost-effective materials for floating platforms and superstructures in view of the highly corrosive environment in Hong Kong; optimal designs of multi-purpose floating platforms to carry the superstructures with various types of functionalities and sited in different water depths; designing easy-to-install, reliable, and durable connector systems for joining floating modules under the combination of dynamic (impact and fatigue) loading and a corrosive environment; rapid and precise on-site assembly that requires innovative construction technology and construction management for building multi-purpose large floating structures resting on different water levels; active control of dynamic structural movements in the sea with respect to construction and service stages, especially in Hong Kong, where there are typhoons; quantifying the ecological and environment impacts; and obtaining social acceptance. Estimated cost savings using a hybrid approach compared to the conventional land reclamation approach will be presented using Kau Yi Chau artificial island (1000 ha) as an example.

Urban Planning

Sustainable Water City in Singapore - A Novel Floating Solution to Overcome both Population Growth and Water Shortage -

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The challenges that Singapore has been facing are the shortage of water supply, small land space to cope with growing population as well as vulnerability against the sea-level rise due to the climate change.
Singapore largely depends on water supply from the neighboring countries. To mitigate this problem, seawater desalination facilities have constructed despite of the fact that they require large amount of operational cost. Further, so-called NEWater System has developed to produce additional water by recycling sewage into drinking water. Nevertheless, these countermeasures seem not sufficient if water supply from the neighbors stops and water demand increases due to population growth.
When flooding caused by abnormal weather and the rising of sea level due to global warming are taken into consideration, a flat country like Singapore is vulnerable to these natural disasters. Construction of resilient and sustainable infrastructure against climate change is considered as an essential challenge.
This paper introduces a novel concept of a Water City that may mitigate water shortage, population growth and climate change. Namely, rainwater collection system for a resource of drinking water, man-made reservoir for a greywater & drinking water resource, floating complex for housing growing population and countermeasures against water related natural disasters. A potential construction site in Singapore is selected as a case study. The Water City is constructed in an artificial reservoir that can be expanded to other potential areas as needed. Besides an artificial reservoir, the Water City is composed of floating foundation, high-density residential and commercial complex, rainwater collection and supply system, water treatment facilities, lively water park, lifelines, cultural & community space, and other related facilities. When there is an unexpected increase in water level, a floating foundation can easily cope with the change by moving up from the original position. Rainwater can be collected and stored in water tank placed underwater which can be utilized for most of the residential and commercial use. The rainwater inside the rainwater tank is purified and used for drinking purpose whereas the water in an artificial reservoir can be used for drinking as well as greywater for internal use.

Urban Planning

Designing floating urban realities: on the urban design of floating high density environments in the Dutch context

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Integral climate adaptive solutions in urban development are urgently needed to protect the safety and security of people's lives around the world. Especially in delta regions that contain some of the most dense concentrations of cities, such as the Netherlands, there is a large demand for flood-resilient developments. As the Dutch long tradition of fighting against water is expected to soon fall short, a need to adopt alternative strategies that work with water, rather than against it, is finally recognized by the Dutch national government. The recent administrative agreement to make 'water en bodem sturend' (water and soil as a guiding principle) in developments bears witness to this. In delta regions as dense as the Netherlands, flooding threats call for solutions that combine space for water retention with space for other large transitions, such as urbanization, energy and mobility. This forces urban planners and designers to invent new types of living environments where the large transitions are tackled integrally. It requires including socio-economic, ecological and climate adaptive considerations all in one urban environment. The research-by-design explores floating high density urban developments in various Dutch contexts as a fitting solution. This paper discusses the most important findings of the research, that looks for an answer to the question: how to design resilient floating cities in a Dutch context? The research has indicated key urban design principles for the design of floating city development in the Dutch context, following the United Nation's Sustainable Development Goals (SDGs) and preparing for the long-term 'next SDGs'. The key principles address how to achieve a high quality integral urban design in terms of urbanity (density, function mix), inclusivity (affordability, accessibility), ecology and feasibility (financial, constructive). These principles have been developed in close collaboration with experts from various backgrounds, such as construction engineers, ecologists and financial advisors. Together, the principles provide a toolkit for floating developments that can be transferred to multiple location typologies, such as regenerated harbour areas, polder landscapes and lakes or lagoons. These are presented along a handful of case studies: the harbour of Rotterdam, the polders of Utrecht, a water reservoir in Dordrecht and the Markermeer close to Amsterdam.

Urban Planning

A Framework for Environmental Impact Assessment of Floating Development

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Floating (infra)structures are a relatively new way of addressing the challenges posed by land scarcity and sea level rise. Due to the novelty of such structures, they are not fully covered in existing regulatory frameworks for EIA (Environmental Impact Assessment). Moreover, existing environmental approaches (e.g., EU's Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Directives) are focused mainly on minimizing negative impacts and on preserving a given situation in time and often fail to see the potential for strengthening ecosystem resilience.
On a planet that is so far out of balance, there is no likely scenario in which restoration and conservation would be sufficient. The radical changes necessary for the continuity of (human) life have led to alternative worldviews in the way human development and ecological systems are seen in relation to each other. The transition from a mechanistic to a holistic worldview, where humans are seen as part of nature, not separate from it, has shifted the emphasis from reducing negative impacts towards being regenerative. With a regenerative approach as a starting point, this paper proposes a methodology for assessing the environmental effects of floating development. This methodology consists of the following steps: 1) Define 'control zones', assess their current situation, identify habitat types and predict future trends; 2) Analyze the characteristics of the floating built environment proposed for the area, evaluating potential environmental benefits and threats; 3) Assess the ecosystem vulnerability (sensitivity) to potential changes posed by floating infrastructure and the potential to increase its ecosystem services with the project's contribution; 4) Derive input for the spatial planning and recommendations for the engineering decisions and technologies used. To support the comprehensive data collection needs of this framework, examples of high-resolution novel monitoring technologies are also discussed in this work.
The proposed framework can be used to evaluate the effects and regeneration potential of floating projects from the ideation stage through the construction phase and beyond. Contrary to traditional EIA's, it does not limit the environmental analysis to one moment in time but proposes a feedback loop approach using dynamic monitoring to maintain preset benchmarks. The developed framework for EIA of floating structure is demonstrated by applying it to a case study in French Polynesia. Potential threats are identified for different project phases but also opportunities for regeneration. Such opportunities include the creation of new habitats for wildlife and positive effects on water quality.

Urban Planning

North Atlantic Floating Island. Architecture of the High Seas.

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Oceanic architecture is one of the strongest currents in the domain of floating structures. Even though building on the high seas is rightly considered more challenging than on inland or coastal waters, successive generations of designers and planners cannot resist the temptation of creating architecture far beyond its original environment. The social context of 21st-century architecture with its predominant global atmosphere of disruption and crisis is the catalysis of an influx of numerous visions of future floating communities. This paper rather than focusing on the analysis of utopias and designing another one aims at understanding the reasoning and real circumstances that may be relevant to the design, construction, and operation of a human-built floating colony on the high seas. The method of inquiry draws from the historical land-based predecessors, the settlements founded with a single political and construction act to learn from this analogy to identify the key factors for ocean colonization. Due to security and economic reasons, the study is limited to the North Atlantic, the water highway between Europe and America, the area of the vivid ocean economy, and relatively high safety, as a potential location for the North Atlantic Floating Island (NAFI). It analyses the main natural and cultural design constraints encompassing, but not limited to, climate, seabed, winds, currents, ice range, marine life, sea routes, distances to points of interest, fishery areas, and others. As a result of this process, the Corner Rise Seamounts area, halfway between the US coast and the Azores is selected as a potential location. Next, the paper discusses existing deep-sea technology that could be used to anchor and operate the NAFI at this location with special regard to reusing decommissioned oil rigs. Finally, possible purposes or purposes that the structure could be designated to serve, including energy and nutrients production, SAR operations, tourism, and research are presented. As a result of the critical thinking process, all circumstances create a set of forces influencing the design proposal for NAFI. The architectural concept is the subjective design response - a conclusion of the investigation aimed at addressing real needs and facilitating existing solutions.

Urban Planning

Proposal of Floating city concept instead of landfill with artificial ground that has a free rebuilding system

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As a means of expanding the land necessary for human activities, land reclamation has been carried out in coastal areas in addition to clearing flatlands and forests. These human activities have significantly impacted the natural environment and ecosystems.
As the global population continues to grow and the concentration of people in urban areas continues, coastal land needs to be expanded while minimizing the environmental impact. As a solution, floating structures with the functions necessary for cities are being considered. On the other hand, when large-scale land is required, it is impossible to rebuild freely like a reclaimed land with a floating artificial ground designed to integrate the floating part and the building part like a floating building. In order to solve this problem, in this research, we will create a floating artificial ground that has an area comparable to that of a landfill site. We propose a ground system. This is a three-layer structure system in which a load distribution layer and a flexible pit layer are provided on the floating structure layer. The load distribution layer disperses the concentrated load of the building, and the flexible pit layer enables the installation of building foundations and equipment. We also devised a device that allows the foundation of a building to be fixed and detached. Furthermore, it is a system that has a ballast function to correct eccentricity due to the building layout. In this study, static stability was verified by a model that assumed a block of 150m x 150m and arranged three buildings. In addition, We will describe the floating city concept in Singapore, which was conceived as an application.

Urban Planning

From floating prototype to floating community: Designing resilient floating communities by using participatory approaches

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In the overpopulated deltas of the Philippines people live in areas that see floods regularly. The floods are being caused by a combination of tides, heavy rainfall and land subsidence. The demand for safe and affordable housing is immense, yet available dry land is scarce. By implementing floating homes on vacant former rice fields, demanded new building space is becoming available. To come to a sustainable design that fits in the Pampanga Delta, traditional building designs as the Bahay Kubo have been analysed by means parametric building simulations and resulted in a design for a vernacular architecture based prototype house. This floating home has been built and is evaluated on technical performances and on occupants' experiences. This paper describes the process of the creation and outcome of a holistic design framework for a floating neighbourhood design, based on this first prototype home. A participatory approach is used to bring the community to the centre of the design process. Through this co-design process as conducted in the coastal areas of the Philippines, we take a closer look at how co-design can help tackle fragile living situations that emerge from challenging environmental and social conditions and how future scenarios are co-created with residents in the form of visual summaries, boards and relationship maps. These insights are translated into a holistic design framework, where stakeholders can discuss and further iterate on the proposed building solutions that focus on floating housing, floating infrastructure, floating public spaces and floating sanitation.

Urban Planning

Floating Urban Development – Sustainable Growth and Affordable Housing

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The demand for affordable housing continues to increase, driven by population growth and rural migration toward the cities. However, the supply is limited due to the scarcity of urban development space – especially in coastal areas. This interdisciplinary research explores the alternative of urban expansion toward the adjacent marine environment of coastal cities. It focuses on floating residential dwellings from both technological and urban planning perspectives, aiming to include the waterfront of coastal cities as a viable, sustainable, and affordable alternative for urban development. The research takes on one of the most expensive cities in the world, Tel Aviv-Yafo, as a case study for increasing the supply of affordable housing in addition to vital sustainable future growth. Tel Aviv-Yafo provides a unique case study for this research, as Israel, a country with high population density, has the highest rate of population natural increase in the OECD. Further, the Tel Aviv metropolitan area contains 60% of the country's total urban development and accounts for 45% of its population. This is despite the numerous government policies encouraging people to dwell in the rural part of the country.
As a result, the spatial tension between urban development needs, infrastructure needs, and green fields is imminent and affecting not only the costs of housing but mostly the quality of life. Floating urban development can alleviate some of this pressure by creating much-needed space. Located on the shores of the Eastern Mediterranean Sea, Tel Aviv has no natural shelter or bay. Therefore, when considering the adjacent marine environment as an alternative for urban development, it basically means open-water conditions including waves heights up to 4 m, and design wave height of 8.5 m. The interaction between the floating structures and the waves presents the greatest challenge, and it is a crucial factor for both occupant comfort and structure. The current interdisciplinary research combines developed engineering methodologies with urbanism to provide a holistic perspective on the spatial layout and design considerations for the city's additional floating development. The technological aspects of this research are based on physical and numerical studies currently conducted in collaboration between the Ship Hydromechanics laboratory at Delft University of Technology, and CAMERI – Coastal and Marine Engineering Research Institute at the Technion - Israel Institute of Technology. The research motivations and the environmental conditions are not exclusive to the chosen case study, and therefore this research is relevant for other venues in the Mediterranean Sea and elsewhere.

Urban Planning

Challenges and success factors of realizing floating projects –from the perspectives of Dutch experts in floating city development

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Background:The interests and demand for floating city development are growing increasingly worldwide. The IPCC report (2022) included floating for the first time ever, encouraging cities to experiment more with such a viable and transformative adaptation solution.
The most advanced regions for floating developments are in Northern Europe, particularly the Netherlands. The Netherlands has a long history of reclaiming land from the sea, leading to a water-friendly way of life, with boathouses being the traditional place of residence. In recent years, floating residential areas, pavilions and offices have been realised. In addition, research institutions such as MARIN and BLUEREVOLUTION FOUNDATION are taking visionary leadership in creating floating city ecosystems and together proposing advanced research into large-scale floating city development.
It is presumed by the authors that by studying the challenges and solutions of developing floating projects in the Netherlands, a model can be found which could serve as a reference for neighbouring countries. This could potentially open up markets for floating in other regions, such as Asia.
Objectives:This study aims to investigate, collect and present the challenges and solutions for upscaling floating developments in Northern Europe, mainly the Netherlands, building up the foundation of knowledge to realise large-scale floating development in the region.
Furthermore, the authors hope that this paper will stimulate interests in floating structures among developers and policymakers not only in Northern European region, but also in other regions like Asia, so that floating structures can be considered as an alternative to land reclamation.
Methods:First, the status quo of the floating structure market in the Netherlands and the rest of Northern European region is assessed through literature study and field surveys. Next, a survey of the challenges and solutions is conducted. It is essential not only for large floating developments to solve technical problems, but also to approach from the softer side, such as legislation and people's psychological acceptance. Therefore, not only engineering-related companies, research institutions, etc., but also governments, operators and users of existing floating structures will be interviewed. Questionnaires or focus groups will be performed in order to understand the challenges and solutions from their perspective. Data collected and analysed will incorporate the considerations of the authors and be presented. This article will provide insights and information regarding Challenges of upscaling floating development.

Urban Planning

Amid Geopolitical Conflicts, are Floating Nuclear Power Plants Safe?

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Floating nuclear power plants promise an effective pathway to reducing greenhouse emission caused by the use of fossil fuels. This solution is made possible because of advances made in reducing the size (thereby making them transportable) of nuclear reactors and manufacturing under roof to modular (replicable) designs.
Current trends of building such floating power plants in shipyard facilities and deploying them with little consideration for their security requires a major shift in mindset.
The risk of state terrorism is real. Major power plants deployed offshore warrant the highest form of strategic security. A floating nuclear power plant is easy to destroy. What destroyed the Nord Stream pipelines can likewise destroy a floating nuclear power plant. The difference is that the consequences could be a lot more serious.
This paper offers a concept to protect floating nuclear power plants deployed at sea.

Urban Planning

Development of the legal definition of the floating city: judicial interpretation and case law on the structural characteristics of floating homes and developments

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As floating city developments attract further global attention as potential solutions to meet the UN Sustainable Development Goals and to address coastal land pressures, increased flooding and rising sea levels, the complexities associated with permitting frameworks and the legal consequences for deployment of floating city projects are intensifying. However, these floating city proposals are not new phenomenon. Instead, they are part of the resurgence of various floating city developments that held fascination for the international community during the 1950's to the 1970s. Despite this long fascination with floating cities, the volume of floating city proposals did not yield law reform or judicial consideration of the concept of the floating city despite some schemes reaching a level of sophistication to even be granted patents. This paper aims to identify broad legal issues that are emerging in various national jurisdictions by undertaking a global survey of cases involving judicial interpretation of a floating city based on their structural characteristics. It examines case law from the United States, Oceania, UK, Canada and Southeast Asia to articulate how courts have considered various types of floating cities. These judgments consider floating city developments that take shape from a wide spectrum of structural arrangements, such as fixed platforms, floating pontoons to assemblages of barges, with the courts considering whether or not the floating installation falls within the definition of land, vessel or chattel. The paper outlines how judicial interpretation of what is a floating city has legal consequences at the national level, such as impacts on the duty of care of personnel and occupants, property law, and taxation. Further, the legal concept also has consequences for the deployment of offshore floating cities in marine areas beyond national jurisdiction (ABNJ) under the evolving international law around artificial islands and floating structures. The paper concludes with recommendations as to further research and regulatory reform that may facilitate deployment of floating city development inshore; and potential coordination and cooperation between international and regional bodies to provide global oversight on the deployment of floating city developments in international waters.

Urban Planning

Sustainable Floating City Production Systems – Moving Towards Industry 5.0

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It has been more than a decade since the concept of Industry 4.0 was first introduced, yet experts have already begun to talk about what the next revolution will be: Industry 5.0. Over the past years, emphasis has been given to digitalization and the use of disruptive technologies to enhance efficiency and flexibility. Now, Industry 5.0 has shifted the focus to social priorities, being centered on the value of a human-centric industry and its service to humanity. Thus, Industry 5.0 is an extension of the Industry 4.0 paradigm, aiming to create a more conscious and responsible industry. It is focused on areas such as environmental protection, social responsibility, and adherence to fundamental rights. This strategy is not meant to replace the existing Industry 4.0, but rather to complement it into the future, allowing industry to co-exist with societal trends and needs, fostering the development of sustainable, resilient and human-centered systems.
Floating cities present an opportunity to address the values of Industry 5.0, such as taking action against climate change, promoting the use of clean energy, and protecting the environment in order to create a brighter, cleaner, and healthier world. Creating a solution to the expansion of urban areas by exploiting the sea surface is a way to solve the problem of limited living space in coastal cities. Sustainable development in this context is relying on Industry 5.0 principles to ensure progress in threatened areas and improve climate resilience. It is possible to create cities which are powered by renewable energy sources and are in harmony with the environment, leading to lower emissions and improved air quality, offering an adaptive, resilient and sustainable solution to the rising sea levels and a changing climate. Therefore, this article reflects on industrial trends for the development of floating solutions and the synergies that can be created between Industry 4.0 and Industry 5.0 in this context. The floating industry has the particularity of being able to create a symbiosis between these two paradigms. On the one hand, it is essential to improve industrial processes and increase their efficiency to ensure competitiveness and, on the other hand, it is urgent the creation of human-centric, resilient and sustainable systems that are able to respond to the current societal problems, in order to provide better quality of life for future generations.

Urban Planning

Current Status of Underwater Space Utilization and Challenges to Contribute to a Sustainable Society

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The range of human activity has reached approximately the entire land area, leaving little space for development. The outward expansion of human activities has been increasing, and there are attempts to expand the range of human activities to the moon and Mars. In the oceans, floating structures have been widely used as a solution to land expansion and sea level rise in coastal areas. Still, there has been no notable development in underwater space, except for a few experimental facilities built in the 1960s to 1970s.

On the other hand, there have been many ideas on the possibilities of using underwater space to realize a sustainable society. Based on pure scientific research, these include the development of seabed and in-water resources, the utilization of deep-sea organisms, and the production of soft materials under extreme environments. Some are based on current social needs, such as renewable energy, food, water, and carbon removal, while others are niche markets, such as highly energy-efficient and stable underwater data centers and leisure/tourism facilities.

This paper first reviews the progress of underwater space utilization to date. Literature surveys are conducted on the applications, installation environments, and structure of the undersea facilities constructed around the world, then the characteristics are summarized. Next, the ideas proposed for the utilization of undersea space are summarized. Based on these results, the applicability of underwater space to current technology and societal needs is discussed from the perspective of contributing to a sustainable society and summarized as issues to be addressed.

Architecture

A Performance-Based Design Framework for Floating Architecture. Trade-offs and correlations between requirements for multiple criteria decision making optimization.

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Most of the largest cities in the world are located in areas that are vulnerable to coastal erosion and flooding, both linked to climate change and rising sea levels. Nevertheless, more and more people are moving to these vulnerable areas, as coastal cities keep growing. Considering the urgency of safeguarding ecological systems and designing healthy, sustainable and climate-proof models of urban development, the research focuses on floating urban clusters as plug-in extensions of coastal cities. The paper illustrates the structural, technological, morphological, functional, economic, managerial, and environmental requirements that make up the Performance Based Design Framework (PBDF) specifically tailored for floating architecture. The PBDF is conceived as a meta-design tool, a first step towards the development of a decision support system for advancing multiple criteria decision making for floating architecture. As it is expected that floating urban development is mostly likely to take place as extension of coastal areas, the needs and design criteria are definitely more similar to those of the urban environment than to those of the offshore or naval industry. Therefor, the identification and categorization of performance requirements takes the urban-architectural prescriptive and performance-based norms as the starting point, taking the missing aspects from the offshore and shipping regulatory frameworks. This study is carried out through an evidence-based assessment of performance guidelines and regulatory systems that are effective in different countries around the world. The PBDF is further integrated, weighted and validated through a case study analysis in order to merge as much as possible theory and practice. Ultimately the paper outlines the trade-offs and correlations between different performance requirements through logical argumentation methods, supported by literature. This is essential for the development of a Decision Support System (DSS) conceived to guide the user (architect, urban planner, policy maker) through the multiple criteria decision making process, emphasizing the logical interaction between the different potential choices. The DSS is meant for the identification of different scenarios and consequent optimal decisions in the presence of trade-offs between two or more conflicting requirements.
Overall, this paper highlights how floating architecture and floating urban development of coastal cities is not only a viable adaptation measure to the problem of rising sea levels, but especially a practical and feasible solution to energy self sufficiency from renewable sources, food autonomy, decarbonization, sustainable urbanization and urban health, in line with Blue Economy principles and the Agenda 2030.

Architecture

A Study on Planning of Sustainable Floating Architecture outside a Bay Utilizing Submerged Breakwater Reef that Sequesters CO2

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Sustainability goals in developing coastal projects are often missing of carbon neutrality in them or misleading carbon offsetting scheme to merely justify their short-term economic gains, regardless of the timely necessary establishment of carbon-sinks following the below 2-degree Celsius objective of Paris Agreement of United Nations Framework Convention for Climate Change. As a carbon reduction-inspired oceanic and coastal adaptation strategy on nearshore continental shelf, we plan multiple floating architectures positioned in the middle of each articulated bathymetry that shoals waves across artificial and submerged reef. In this study, we present a coastal development plan with both floating architectures and submerged artificial reefs atoll-ing sites and permanently sequestrating in-situ aqueous carbon dioxide.
A floating architecture with 100 meter-diameter is moored at the submerged atoll that covers seabed from 500 and 700 meter in inner- and outer-diameter, respectively. Individual caisson blocks of submerged breakwater are stockpiled on the seabed, deforming its profile prone to significantly shoal the maximum waves across the ridge top.
Each breakwater caisson utilizes in-situ aqueous carbonate and calcium ions in the seawater to acquire precipitated and crystalized calcium carbonate inside. Clean ocean energy of wind and wave generation provides required energy to the site. Sustainable techniques and technologies applicable for design, construction, installation, operation and decommission of the architectures and sites are considered.
Candidate locations of such floating city are found plain nearshore following the East Coast of Korean peninsula over the water depth ranged between 40 and 50 meter. The stack of floating architecture exposed to environmental forcings of seasonal storm wind and storm-induced rolling waves is considered for its optimal shape and structural design to satisfy certain engineering levels. The nature of floating city incorporates its capability to be raised following the long-term sea level rise with its adapted bathymetric profile. To present a carbon reducing coastal development plan that includes modular spatial design and utilization strategy on in-situ materials of ocean, we define the design considerations of a floating architecture surrounded by ex-situ calcium carbonate barrier reef that sequesters CO2 from the ocean.

Keywords: Floating Architecture, Submerged breakwater, Below 2-degree Celsius strategy, Carbon Capture and Sequestration (CCS), Climate Adaptation, Ocean space settlement

Architecture

Stochastic Response Evaluation for Random Wind and Wave Actions of Module-Linked Floating Structures with a Wind Turbine

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Module-linked floating structure is constructed by linking multiple module by connectors. In case detachable joint system such as mechanical joint is used to connectors, shape, scale and arrangement of the structure can be easily varied and it can be to replace of deteriorated or damaged modules. Moreover, independent function such as living, transportation terminal and power generation can be applied to each module. Floating structures such as module linked type may be preferable for long-term use as a sustainable structure.
In the planning and design of offshore floating structures, evaluating the structural strength, motion characteristics and habitability for wave actions is important. Especially, for module-linked system, selection of connector system appropriately is necessary because dynamic response of the global system for wave loads becomes independent and discrete behavior of each module because of connectors between modules. However, when wind turbines are introduced on floating structure, the evaluation for wind is also required.
In this study, an evaluation method of hydroelastic behavior of module-linked floating structures with a wind turbine module is presented. The hydroelastic behavior of the structure is analyzed by using stationary random vibration theory and wet-mode superposition method. The motion of irregular wave and variable wind speed are assumed to follow to an ergodic process with mean value zero. In the hydroelastic analysis, the floating structure is discretized by finite element (FE), whereas the seawater region is discretized by boundary element (BE). In this study, only the structure and sweater interface is discretized by BE because Green function satisfies Laplace equation, free surface condition, seabed condition and Sommerfeld's radiation condition is used. The both elements are combined on the interface. In addition, float is modeled by plate and discretized by quadratic elements, wind turbine and connectors between modules are modeled by beam. The seawater region is discretized by quadratic elements.
In numerical example, the stochastic hydroelastic response for random wind and waves of barge types module-linked floating structure with a wind turbine using a presented method is shown. Moreover, variation of hydroelastic response of the floating structure by difference of location of a wind turbine module in the structure is discussed.

Architecture

A Design Proposal of Floating Leisure and Culture Facilities in Saemangeum Area.

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The aim of this study is to propose the floating leisure and culture facilities in Saemanguem area, the southwest part of Korean Peninsula, which has been reclaimed by long seawall(33.9km) as a national mega project since 1991. The project area(409km^2) under reclaiming has land(291km^2, 71%) and lake(118km^2, 29%) together. Smart and green waterfront city of international cooperation area together with industry-research area, agro-bio area, leisure-tourism area and hinterland city and other facilities is going to be developed in the area. Existing adjacent city, Gunsan city, has not enough leisure and culture facilities. And near islands in beautiful archipelago(Gogunsangundo Islands) have been connected with main land by bridges and visitors are highly increased for tourism. Therefore development of leisure and culture facilities is needed in Saemanguem area. Considering the advantages of floating architecture such as budget reduction & minimization of environment destruction from the artificial reclaiming and responding to climate change, the required facilities can be built on the lake. Inland water space in Saemanguem area is best place for floating architecture due to calm water surrounded by seawall. And also differentiated signature building only in Saemanguem lake could be realized through floating architecture concepts. In this conference, some ideas of architectural plan drawings and images based on floating solution are to be suggested and discussed.

Architecture

From Floating Architecture to Seaside Landscape. The case of the Island of Roses.

Massimo Angrilli, Università Gabriele d'Annunzio

The paper deals with the formation of the Adriatic conurbation by reinterpreting the development of mass tourism starting from the first forms of exploitation of the sea, such as floating platforms and piers suspended over the sea. The historical analysis starts from the so-called invention of the sea (Alain Corbin), which for the Italian Adriatic coast dates back to the 18th century and from the use of marine waters as medical therapy. The first forms of marine architecture are described, such as the bathing establishments of Rimini and the floating platforms of Trieste, but also the equipped piers of Lignano Sabbiadoro, to then reach the Fascist era with the boom of marine colonies, complexes built on the coast for health purposes. Among the cases described, one in particular, the so-called "Island of Roses" of Rimini assumes particular importance for the purposes of the conference. The Island of Roses was the name of a 400 m² artificial platform that was located on the Adriatic Sea, 11,612 meters from the coast, between Rimini and Bellaria-Igea Marina, 500 meters off the Italian territorial waters. Conceived and designed by engineer Giorgio Rosa in 1958 and completed in 1967, on 1st May 1968 it declared itself an independent state. Although it gave itself an official language (Esperanto), a government, a currency, and a postage stamp, it was never formally recognized by any country in the world as an independent nation (see Netflix movie "The Real Story of Rose Island").
The paper continues by describing the identity and the landscape of the cities of the Adriatic coast, in which the contexts of the waterfronts are affected by settlement pressures due to the intense tourist uses. The paper concludes with the description of the recent experience of the "Parco del Mare" in Rimini. The city, protagonist of mass seaside tourism in the last 50 years, has planned a process of rethinking its tourist image and has started the transformation of 15 km of seafront, eliminating the driveway and replacing it with cycle paths, pedestrian walkways, green spaces and sports equipment. The basic idea envisages an urban park developed on a single surface capable of creating continuity between the plot of public spaces, the seafront building and the beach.

Architecture

"SeaSurveyor": An Innovative Floating Solution for Establishing Marine Protection Areas in Shallow International Waters

Joerg Baumeister, SeaCities Lab, Cities Research Institute, Griffith University
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An interdisciplinary team of aquatects comprising of architects, marine engineers, structural engineers, and marine biologists have created an innovative semi-submersible and modular floating platform system that separates buoyancy from the structural form. The new floating platform system offers several advantages over heavy, bulky, and material-consuming traditional platforms, including its rigidity through a space framework and the buoyancy bodies in the space in between, improved transportability, faster assembly on land or at sea, unlimited expandability, reduced wave contact, and adjustable height. The efficient use of affordable marine materials like HDPE in its serial and flexible construction method also results in cost-effective and low-maintenance solutions.
The feasibility of the new platform design was confirmed through comprehensive digital simulations and a patent has been granted. The current model has a size of 110m x 75m and will be showcased at the Floating Solutions Conference 2023 with accompanying technical drawings, simulations, and visualizations. The next steps include physical simulations in a wave flume to finalize the design, the creation of a physical prototype, and eventually, the production and implementation of the modules. The modular design allows for flexibility in terms of size, stability, and seaworthiness, whether it is anchored or a free-floating geostationary platform. The platform also has the capability to produce fresh water, energy and food through aquaculture, which can be especially beneficial in situations where the distance to land-based infrastructure increases costs.
We named the structure "SeaBase" as it serves as the Base for various functions on the Sea. The following scenarios are a few examples of the versatile and almost limitless range of applications: The SeaBase can be used as an "Energy Platform" to capture renewable marine energy from wind, sun, currents, and waves, along with energy storage facilities such as hydrogen plants.
The SeaBase can also provide space for the creation of peaceful communities beyond Exclusive Economic Zones for "Seasteading" or near islands that are at risk from rising sea levels. As a floating base, it can attract economically driven activities such as deep-sea research and mining, promote the development of floating centers for companies specializing in aquaculture (which is 3-10 times more efficient than traditional agriculture), and establish floating container ports along maritime trade routes. SeaBase can also serve as an autonomous platform of "Floating Blue Helmets" for unmanned UN peacekeeping efforts such as remote surveillance and protection of boundaries within Exclusive Economic Zones and marine areas established by the United Nations Convention on the Law of the Sea to safeguard and preserve international waters.
The SeaBase platform aligns with several sustainable development goals outlined by the UN, including supporting the evolution of aquatecture for zero-hunger (goal 2), promoting good health and well-being (goal 3), and fostering responsible consumption and production (goal 12). Its use as an energy platform for clean, affordable energy aligns with goals 7 and 9, while its potential for communities in floating sustainable cities aligns with goal 11.
Additionally, the structure's design allows for the colonization of marine environments (goal 14) and emphasizes the importance of partnerships for achieving these goals (goal 17) which is one of the reasons for our participation at this Floating Solutions 2023 conference.

Architecture

An Innovative Design Concept of Modular Pneumatic Floating Platforms

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So-called Mega-Float structure is constructed by connecting many small barge type floating units by welding. However, a very large floating platform (VLFP) of barge type like Mega-Float has a structural flaw, such as slamming in rough waves. In order to avoid collapse due to the slamming force acting on the bottom of the VLFP, it has been proposed that the movable joints such as hinges are used for connecting barge type or semi-submersible type units. Though the safety of a VLPF having hinges is ensured even in rough waves, it may not be suitable for a floating airport or a floating city since it deforms due to the movable joints.
This paper presents an innovative design concept of the pneumatic floating structure that can be used for a VLFP like floating city as it can reduce rocking in rough waves and reduce tilting caused by strong winds as well. Each pneumatic floating module has an open bottom and is surrounded by a horizontal top wall and side walls extending downward from a peripheral edge of the top wall. The rigid connection unit such as 3D truss beam connect adjacent floating modules in which the open space can be used for housing lifeline.
The pneumatic floating modules control their buoyant force by adding or reducing inner air pressure so that they can cope with variable loadings on the modules. Accordingly, any buildings having different weights can be built on a floating platform without the stress differences between 3D beams connecting floating modules. The modules can be disconnected and moved to another place for reuse or added to cope with new demand in a sustainable manner. Experimental studies conducted in a wave tank at the University of Tokyo are presented as well for the confirmation of seakeeping characteristics of the proposed pneumatic floating platform.

Architecture

Multi-body analysis of modular floating islands: optimisation of connector stiffness

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The work presented in this paper focuses on the optimisation of the connection stiffness of modular floating islands. The connection system is described by an equivalent system consisting of linear springs whose stiffness is the objective of optimisation. A rigid-body flexible-connector approach to the problem is assumed and therefore the deformations are concentrated on the connections. The aim is to find an optimal spring stiffness solution that is compliant with dynamic constraints of human comfort and that minimises the loads acting on the connections. Acceptable human comfort values of accelerations and displacements, required by structures for residential purposes, pose new and unique challenges for the design of modular floating islands (MFIs) and plays a significant role in the design feasibility. The system has been simulated both in regular and irregular waves.

Technology / Innovation

The Evolving of Floating Shipyard and its Leagile Operation.

Ahmed Samir Ghowel, International Maritime Industrial

The Floating Shipyard [F-Yard] is still an idea that different entities try to puzzle out before actual investment occurs. In this Paper, the author evolves this idea to the next level with the Korean research team that is an expert in floating structures. The model arrangement and its main components will be illustrated in a 3D model. The main parts of it are the floodable Light Modular Causeway Sections-LCWS, which was initially invented by the army for a wet gap crossing, and then developed as a floating platform. And the other component is a heavy lift vessel or self-propelled floating dock for resource optimization. Along with these mains, using economic technologies is essential for adding value to the operation stream and overcoming the challenges like space, supply chain, and environment.

A unique and tailored operation method is vital for F-Yard, that in return, works as the main engine for running it. This operation methodology seeks excellency and the pursuit of perfection in all aspects, like a hybrid of Lean and Agile in a Leagile methodology in the Supply chain & Operation Planning (S&OP), which plays a significant role in the tactical decisions for the uncertain scope of repair. Another is ensuring a robust supply chain, like the Early Supplier Involvement (ESI) is energetic to overcome the high percentage of unforeseen scop. This strengthens the principle of Just In Information (JII) rather than a physical warehouse. Along with the 3D printer. The IoT and digital twin are essential in resource optimization and project control.

Eventually, the author believes F-Yard is a solution for Green Shipyards that, in return, serve sustainability and decarbonization as it seeks to have an environmental impact for both energy use and pollution of null to allow it works in different countries. Aside from that, it is a way out for developing countries to unify their resources through one solution in such an economic climate condition.

This Paper discussed the evolution of a Floating Shipyard and its proper operation approach to achieve its economic outcome through a case study that elaborates on the technical and financial feasibility of the proposal.

Technology / Innovation

Experimental investigation for ship motion coupling internal sloshing under wave actions

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The coupling sloshing action of a three-dimensional FLNG-type barges with three partially-filled prismatic tanks is analyzed according to the experimental measurement and potential flow simulation methods. According to the observations in laboratory tests, the internal sloshing flow is able to generate the restoring and overturning moments at low- and high-filling conditions, respectively, leading to the resistant and enhanced effects on the ship rolling responses. Potential flow model can perform the quantitative analysis for the influence of sloshing flow action on ship motion natural periods. The negative sloshing-induced restoring matrix is the major reason for the increase of ship motion natural periods when considering the internal sloshing flow action. With the increase of filling depth, the ship motion natural period decreases at low-filling conditions because the sloshing-induced added mass decreases. As for high-filling depth, the increased filling depth can increase the rolling M44 and decrease the restoring force coefficients at high-filling conditions, leading to the decrease of ship motion natural period. In sum, the coupling sloshing action shows the opposite behavior on ship roll motion responses between low- and high-filling conditions in this study.

Technology / Innovation

Experimental Study of Free-surface Profiles of an Aircushion-type Floating Platform with a Moonpool.

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A new type of floating platform supported by aircushion units is studied by experimental tests. The platform consists of six hexahedron aircushion units encircling a moonpool in the central. The side walls of aircushion units are extended in to the water and the bottom of aircushion is entirely open to the water.
Three kinds of floating platform models, full-aircushion-type platform, full-barge-type platform and mixed-type platform, each of which has the same shape are tested in regular wave conditions.
The free-surface elevation inside the aircushion chambers and moonpool are also measured simultaneously as well as the motion responses of the models. The motion responses and the free-surface profile are analyzed in this paper. The results show that the motion behaviors of the hexagonal aircushion-type platform are better than those of the barge-type platform in short wave conditions, while behaviors in long wavelength are almost the same. Moreover, the amplitudes and profiles of free-surface elevation of the front aircushion, moonpool and rear aircushion are different depending on the types of platforms and the wavelength conditions.

Technology / Innovation

A Systematic Methodological Routine for Analyzing Numerical Analysis Results: Tools for Parametric Design Routines of Floating Structures

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Roy Gafter, Coastal and Marine Engineering Research Institute

Modern design processes of offshore and floating structures involve an increasingly large number of numerical analysis routines. The amount and complexity of these routines, inflates in cases where First-Principal Design approaches are incorporated, and preliminary designs are proposed in high uncertainty conditions. While computerized design tools solve the mathematical model of the physical system efficiently, they offer limited post-processing and comparative tools for their outputs. In many cases, designers visually inspect the effects of correlating parameters on the structure using tables, linear diagrams, and color mappings. The choice of parameters to be compared is often arbitrary, based on the designer's subjective experience, and on preliminary assumptions regarding features that may influence the system. The process of reviewing the results, and drawing conclusions from them, is still a major bottle-neck in floating structures design. This fairly heuristic method has several limitations that impede the reliability of conclusions drawn. Unfamiliarity with advanced visualization tools leads to low intelligibility of diagrams and tables, forcing designers to estimate features one at a time- instead of as interacting components of a dynamic system. The use of erroneous visualization techniques influences the choice of parameters held constant, binning methods, and projection field analyzed. Even in cases where designers choose the correct visualization tools, the process still remains tedious and time consuming. Moreover, it is not consistent or replicable, since it often relies on non-methodical decision-making rules.
Our work offers a systematic methodology, based on statistical guidelines, adapted for the design of floating structures. The methodology includes the following steps: (a) An agile and flexible wrangling and preprocessing scheme for the computerized analyses outputs; (b) A guide for choosing the correct visualization tools for the preliminary inspection of the results; (c) A set of 'red-flags' and trend detection tools for enhanced post-processing analysis; (d) A toolbox of analytic procedures for the comparative analysis of the results; (e) Guidelines for avoiding common pitfalls and biases in the process of eliminating designs and choosing the correct parameters for later stages; and, (f) An overview of reporting standards that enhances quality assurance and replicability. The use of such methods is crucial in all stages of engineering design processes, from concept and preliminary stages to advanced stages of detailed design and optimization. We demonstrate the routine by applying it on a Boundary-Element routine of a new concept of VLFS, and present our agile code package for the procedure.

Technology / Innovation

Floating Environmental Deck Structures - Design Construction Challenges

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Kyaw Myint Lay, Ellen Engineering Pte Ltd,
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Near shore floating structures allow marine spaces to be used for social purposes in urban and industrial areas as well as in infrastructure development. Although near shore floating structure technology is well-established, such structures are largely developed using steel or FRP composite material. In contrast, post-tensioning and reinforced concrete are extensively used for industrial and infrastructural applications, such as deep offshore marine and coastal protection structures.
This presentation shall discuss the environmental impact, design and construction challenges of Singapore's first floating concrete environmental structures. It shall also highlight the advantages of these structures and the various possible applications.
The presentation is expected to promote understanding of how floating structures using structural post-tensioned concrete in any desired direction can resist stress from heavy and complex loads.
Knowing how these structures work is increasingly crucial given their cost, durability and sustainability, as well as the need to innovate in the use of structural concrete in marine environments.
Overall, the presentation of Singapore's First Residential Floating environmental deck aims to provide innovative technology for coastal nearshore development which adapts to sea level rise to address land shortages and the threat of climate change is expected to contribute to the development of floating structure development in Singapore.

Technology / Innovation

Significant wave run-up for large offshore structures due to tertiary interactions

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Large offshore structures become more and more popular, e.g. floating cities, floating airport and breakwaters. These offshore structures will experience large wave loading. It has been engineering practice to consider the linear wave-structure interactions and sometimes second-order nonlinearities, for the design of the offshore structures.
Recently, it has been found that the wave surface elevations could be amplified up to 5 times the amplitude of the incident waves for large offshore structures. This has been demonstrated to be a tertiary effect using experiments with regular waves (Molin et al 2005) and could occur even in unidirectional random waves (Zhao et al. 2019). This is an important observation only for the scientific research, but also for engineering practice.
In this study, we will present demonstrate this phenomenon using simple regular wave testing results, and then focus on the heading effects of the floating structures and the effects of directional spreading, which is more realistic sea state.

Technology / Innovation

Effects of a Moonpool on Steady Wave Drifting Forces on a Floating Pontoon

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Kento Suzuki, Nihon University
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In order to understand the effect of the moonpool on the wave drift forces acting on the floating body, the water surface fluctuations and steady wave drift forces in and around themoonpool were calculated using an 8-node quadratic isoparametric element hybrid-type boundary element method that solves the external region using the eigenfunction expansion method and the internal region near the floating body using the boundary element method. The influence of the moonpool on the wave drift forces acting on the floating body is discussed from the results. From the results of the near-field method calculations, the frequency bands in which the wave drifting force increases and those in which it is reduced by the moonpool are shown, indicating that the run-up term has a large influence among the terms that make up the wave drifting force. The water level fluctuation results show that the water level difference between the front and back of the floating body is large in the frequency band where the wave drifting force increases, and that the water level difference between the front and back of the floating body is small in the frequency band where the wave drifting force is reduced. From these results, it is concluded that the wave drift force fluctuations acting on a pontoon-type floating structure with a moon pool are greatly influenced by the difference in water levels before and after the floating structure, and that the wave drift force reduction is caused by the forces canceling each other out before and after the floating structure.

Technology / Innovation

Hydroelastic Responses of Very Large Floating Structures in Damage conditions

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Due to the scarcity of land space and resources, very large floating structures (VLFS) has been proposed to utilize marine resources, which has a wide range of application prospects, including floating airports, floating bridges, floating farms, etc. In reality, in-service damages may occur in offshore platforms and potential floating structures because of long-term erosion by seawater and wave actions. Existing research studies on hydroelasticity mainly focus on intact VLFS, while hydroelastic responses of VLFS in damage conditions are rarely investigated. This paper performs hydroelastic analyses on damaged VLFS to evaluate dynamic motions and structural stresses induced by wave actions. Mathematical formulation for the hydroelastic analysis is briefly introduced and hybrid finite element method (FEM) – boundary element methods (BEM) python code is developed accordingly, in which the damage condition is tentatively modeled with stiffness reduction method, torsion spring method and additional flexibility matrix method. Critical parameters are selected to assess the performances of VLFS in damage conditions, including crack depth, stiffness reduction coefficient, torsional spring rate, etc. The effectiveness of the proposed methodology is verified by comparing with test results in existing literature and sophisticated models developed with commercial software. Research outcome indicates that the degree of damage conditions significantly affects the dynamic responses of VLFS. The deflection profile may vary and structural stresses will increase with the distribution of damages, which should be handled with caution in the design.

Technology / Innovation

Using interter for offshore floating platform vibration control

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Offshore floating platforms (OFPs) are widely used in the offshore industry for oil exploration adnexploitation. Harsh environmental loads such as wind and sea wave may induce excessive vibrations to OFPs and endanger their safety. Inerter, which can produce a considerable apparent mass that is much larger than its physical mass through an amplifying mechanism by translating the linear motion into high-speed rotational motion, has been adopted for structural vibration control recently. The authors proposed using ineter for OFP vibration control. This paper will summarize the corresponding research works carried out by the authors in this area. In particular, analytical and experimental studies will be reported in detail.

Food & Others

Recent Developments in Offshore Fish Pens

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Offshore fish farming has its environmental challenges (deep water, unknown seabed condition, exposure to harsh environment of strong waves, current and wind, uncertain environment for fish welfare and growth), operational challenges (difficult working environment for workers due to the strong waves, vessel collision with fish pens, larger marine animal invasion; expensive infrastructure for offshore fish farming such as utility vessels, power supply; lack of evidence of economic sustainability for operations including material selection) and design challenges (lack of experience in designing mega/submerged offshore fish pens, lack of standardized and comprehensive design guidelines/codes). Nevertheless, it is gaining traction for more sustainable and high-quality fish production due to larger water space, better water quality, stronger water dynamics and deeper water to dilute waste and avoid coastal ecosystem degradation often seen in nearshore fish farms.

Recently, many offshore fish pen design concepts have been proposed and some have been built over the last few years. Owing to the high energetic offshore environment and deep water, two design philosophies for offshore fish pens have emerged. One design philosophy is to make the fish pen very large and robust to be able to withstand the strong waves, currents and winds. The other design philosophy is to submerge the fish pen to an appropriate water depth to move away from the strong surface waves, especially during extreme storms. This paper will present various offshore fish pens that have been built as well as newly proposed conceptual designs that are based on these two design philosophies. Also, key observations on offshore fish pen developments will be highlighted.

Food & Others

Numerical Simulation of the Three-Dimensional Sloshing and Internal Free Surface Oscillation Control in a Closed Fish Tank Using the Particle Method

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An ambitious aim of aquaculturists is to mitigate the impact of aquaculture on the marine environment, in order to achieve an environmentally sustainable marine aquaculture system. In terms of the ecological preservation of the marine aquaculture environment, closed fish cages have attracted more and more attention. In this study, a simulation of the closed fish cage tank sloshing using the three-dimensional particle method is introduced. First, the accuracy validation of the sloshing of a rectangular tank was done through comparison with the results from the previous experiments. Then, we investigated the three-dimensional sloshing characteristics of free water inside a cylindrical closed fish cage. In the numerical simulation, the inhibitory effects of the horizontal plate and netting panel on free water sloshing were also examined, respectively. It is found that the swirling phenomenon in the closed fish cage tank was confirmed in the first mode and the second mode. When the external excitation period was equal to the natural period of the first mode, the rotational motion of the internal free water surface was more obvious, and the position of the highest water surface level was at the side wall. When the external excitation period was equal to the natural period of the second mode, the position of the highest water surface level was at the distance of 1/3 from the center of the cage to the wall. It was observed that the resonance point shifted to the low-frequency side when the horizontal plate was placed. Regarding the flow velocity distribution, it was found that when the restraining plate was installed, the movement of the fluid was mainly limited to the vicinity of the water surface and the bottom of the cage, and most of the fluid did not move much from the depth of the water where the horizontal plate was located. In addition, under the condition of setting netting panels in the closed fish cage, it was observed that the run-up height of the water was also significantly reduced. In the future, we will explore the influence of water inflow and outflow on the flow velocity distribution inside the fish cage.

Food & Others

Impacts of sessile organisms attached to artificial floating structures on the surrounding environment: review and update in Tokyo Bay

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Kotaro Tabata, Sanyo Techno Marine,Inc. Kuniaki Okumura, Sanyo Techno Marine,Inc.

The surface of artificial structures such as offshore wind turbines and very large floating structures provide habitats for sessile organisms. Particularly, floating structures, which have the bottom surface, provide larger habitat for sessile organisms than the other structures. When the artificial structures are constructed in the sea, biofilm appears on their surface and then animals such as blue mussels and barnacles attach to them. These animals grow by filtering suspended organic particles, consuming oxygen and releasing waste in the surrounding water. The sessile organisms accumulate as they grow but eventually fall to the seabed due to their own weight and hydrodynamic force. Since these processes affect the surrounding environment, it is indispensable to evaluate the impacts before construction of artificial structures. Moreover, these impacts can vary depending on the specific organisms, the structure, and the location. However, it is not clear to what extent scientific investigations have been carried out for this problem. The purpose of the present study is to investigate the existing scientific papers to elucidate the environmental impacts of sessile organisms attached to artificial structures. As a result of the investigation, the impacts of sessile organisms on the surrounding water quality through filtration of particles, consumption of oxygen, and release of waste have been investigated by field measurement and numerical simulation. The impacts of the biodepositions of sessile organisms have been investigated for environmental impact assessment of aquaculture of bivalves. However, the processes of attachment and detachment of sessile organisms to and from artificial structures have not been examined well. Also, the research on the environmental impacts of sessile organisms that fall to the bottom on the benthic ecosystem. Not only dead sessile organisms but live ones fall to the sea bottom, and the live ones continue living on the sea bottom. These phenomena should be elucidated scientifically for the comprehensive environmental impact assessment of artificial structures.

Food & Others

Conceptual Design and Environmental-Economic Assessment for An Integrated Ocean-based Climate Solution

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As the impacts and damages caused by global warming become more and more severe, the ocean-based climate solutions are gaining increasing attention. The typical approaches, such as enhancing the natural carbon sink by preserving and restoring coastal ecosystems, and utilizing ocean renewable energy to replace fossil fuel consumption, are well examined and taken into practices. However, the necessary long period for natural process to sequestrate carbon barriers it to be a quick solution. As for the ocean renewable energy, relative high transmission cost of conventional utilization, in which electricity generated in ocean area is to be transmitted onshore, becomes the bottle neck of large-scale applications. New approaches including ocean CCS and sea water engineering are studies recently, but the impact on ocean environment becomes a new concern.
In order to provide an integrated climate solution, this paper proposed a floating system combining ocean energy utilization, offshore aquaculture, and biological productivity enhancement. The conceptual offshore platform consists of a central semisubmersible floating structure and multiple barge type ones surrounding. The facilities on the platform include an ocean thermal energy conversion (OTEC) system, and a microalgae processing and fish feed fabrication facility on the central float, a photobioreactor microalgae cultivation system on the barge floats, and multi fish aquaculture cages under the barge floats. The concept of the whole system is to cultivate microalgae for feed production, then carry out offshore fish aquaculture, and all the necessary energy will be provided by the OTEC system.
Comprehensive assessments of the assumed applications of the system in different locations from east to southeast Asian Seas were performed based on the Inclusive Impact Index calculations. Combining the environmental benefits of utilizing ocean renewable energy and microalgal feed, adding the biological productivity enhancement by deep ocean water, the estimations resulted high performance of climate change mitigation. At meanwhile, taking the advantages of using ocean energy and feed replacement, the system could also be self-sustained economically.

Food & Others

Survey on the Management of Marine Tourism in Zamami Village, Okinawa, Japan

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Marine tourism is an important part of the tourism economy, an industry related to traditional fishing, and a different industry. Marine tourism is a new industry that utilizes marine resources, motivates tourists to travel, and meets the needs of modern people. However, marine tourism development has invited problems such as ecological destruction, environmental pollution, and lack of facilities. Therefore, we focused on marine tourism management and empirically examined regional management in Zamami Village, particularly the objective tax policy.
This paper conducted a literature review to collect and analyze data on Zamami Village. In addition, a field survey was conducted to understand the environmental problems that have emerged with the development of marine tourism and their countermeasures, as well as the effects and impacts of regional development policies in Zamami Village and the Churashima Tax as a regional management strategy. Based on the above, we analyzed the various regional management strategies related to the operation and management of marine tourism, paying particular attention to the Churashima Tax. We have shown the actual conditions and results of Zamami Village's regional management, verified how such expected effects are functioning in reality through empirical analysis of the Churashima Tax in particular, and discussed the issues involved. The results indicated that the village will continue to fulfill its wise regional management in the future.

Food & Others

Study on the Increase in Annual Maximum Significant Wave Height due to the Intensification of Typhoons using NOWPHAS Wave Observation Data

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Tomoki Ikoma, Nihon University

It has been reported that the annual maximum significant wave height, which is important for the calculation of design waves for long-term offshore structures, is increasing year by year due to the intensification of meteorological disturbances caused by global climate change.
Therefore, the objective of this study was to identify the type of meteorological disturbance when the annual maximum significant wave height was observed, and to clarify the causes of the intensification of meteorological disturbances through analysis and discussion, based on a reanalysis of wave observation data in Japan up to 2020. Increased annual maximum significant wave heights were observed at 89% of the wave observation sites on the Pacific side of Honshu. Among these, the meteorological disturbance that caused the increase in the annual maximum significant wave height was mainly typhoons, especially at the stations located south of the mouth of the bay, where typhoons sometimes renewed the previous maximum significant wave heights. Analysis of the RSMC Best Track data showed a decreasing trend in the number of typhoons per year, but an increasing trend in the intensity of individual typhoons. Since typhoons are strongly influenced by sea surface temperatures, the 100-year increase in sea surface temperatures in the southern Japanese archipelago was compared with the global average and confirmed to be twice the global average. Therefore, the intensity of typhoons is expected to increase in the long term, and the annual maximum significant wave height on the Pacific side of Honshu is expected to increase accordingly.

Food & Others

Stakeholder Acceptance of Large-Scale Floating Developments: Insights from Social Theory and Realized Projects in the Netherlands

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The potential of floating structures to provide climate resilient living space has recently been acknowledged by the United Nations and the IPCC. The technical feasibility of small-scale floating structures has already been demonstrated in many projects all over the world. These projects support many different functions such as housing, recreation, and energy production. What is lacking to apply this technology at a larger scale, are the required integrated governance, technical, social and ecological insights for upscaling, to address societal challenges such as land scarcity and climate impacts. These insights are needed to move from 'proof-of-concept' to 'proof-of-scale'.
Although the technical challenges of upscaling floating structures have already received attention in the international research community (e.g. Space@Sea project) and some research results have been published about the ecological impacts recently, the social aspects and stakeholder acceptance of large-scale floating developments are still considered a knowledge gap in the international research literature. This article therefore explores the social conditions that would enable the stakeholder acceptance of large-scale floating developments.
By a scientific literature review we will investigate which insights and lessons can be derived that influence stakeholder acceptance of large-scale floating developments. Theoretical frameworks that will be studied include: transition theory, and theories on social value, community building, resilience and governance. Additionally, we will draw lessons from realized projects in the Netherlands by expert interviews and discussions of the Thinktank 'Governance of Floating Cities'. While these projects still have a relatively small scale, we expect that some of the success factors are also relevant for the upscaling of floating structures. Finally, based on the results, we will draw up recommendations for future research on this topic.

Food & Others

Hydro-Structural Analysis – Advanced Cross-Structure Calculation for a Rigid Floating Breakwater Module

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In many cases, breakwaters are key components for offshore operations. As a permanent or as a temporal wave protection, they play principal role in enabling ocean space utilization by means of offshore floating structures. The current research contributes to the development of a novel floating breakwater system, constructed entirely from end-of-life large commercial ships – which are repurposed to this end. To improve the wave attenuation capacity of the floating breakwaters system, twin-hull configuration (two ships, rigidly connected side by side) has been selected as the primary module design. However, while most of the structural elements in this floating seawall concept consists of decommissioned ships, the cross-structure connection is among one of the main structural mechanisms designed and constructed outside the circular economy approach. In addition, the complex hydrodynamic loads, and the uniqueness of the floating breakwater system, limits the use of common rule-based design, and calls for more rigorous first-principal approach and direct calculation. Furthermore, the modularity of the floating breakwater (the ability to add sub-structures for additional wave protection) depends largely on the connection design and its capacity to endure its structural integrity in extreme environmental conditions. The current research focus on the structural aspects presented by these unique megastructures, and their external cross-structure connections. For the design and evaluation of the rigid connection, we conducted a combined hydrodynamic-structural analysis for the acquisition of wave loads and evaluation of the structural response. ANSYS-AQWA, a potential flow solver with Boundary Element Method (BEM), is used for the hydrodynamic analysis, and ANSYS-APDL is used for the structural, Finite-Element (FE), analysis. In addition, a cross-structure connection is designed with accordance to classification rules – for reference and evaluation. The main objective in this, on-going, study is to evaluate the design of the external cross-structure and to improve its efficiency. The research will present the complete hydro-structural methodology, obtained results, and the consequential design.

Low Carbon Energy

Case Studies of SMR Liquefaction for FLNG Applications

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Recently, global carbon dioxide emissions into the atmosphere have reached a historically high level, and the marine sector's emission is one of the contributions. The current effort to change the alternative energy source of LNG (Liquified Natural Gas) fuel is one of the cleanest fossil fuels due to lower carbon emissions. The world's energy needs for LNG are overgrowing as well,
The LNG marine industry forecasts that the increasing demand for FLNG (Floating liquefied natural gas) vessels will accelerate the research on the system process analysis and optimisation of the liquefaction system. The rapid growth in equipment and processes of FLNG development is the response to weight and space limits challenges.
This paper proposed a small-scale liquefaction process with a refrigerant cycle, a single mixed-refrigerant SMR-PRICO process as an example, using sensitivity analyses of the parameter to get optimisation. In addition, to study the influence of different process parameters on the solution of the optimisation problem. The parameters studied include natural gas supply at different pressure. The case study model is based on a process model presented by Black & Veatch developed a more straightforward SMR process called the PRICO process (Aspelund et al., 2010, Xu et al., 2013).

Low Carbon Energy

Review of recent research and developments on wave energy production

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Covering more than 70% of the Earth's surface, the ocean has abundant renewable energy resources including solar, wind, wave, tidal, and ocean thermal energies. Among these aforementioned sources of marine renewable energy, wave energy has a high energy intensity and wave power can be generated up to 90% of the time which is much higher than 20-30% of the time for offshore wind or solar power [1]. Global wave power within 50 km from the coast is estimated to provide 18500 TWh (almost equal to the 2009 global electricity consumption [2,3]). Harvesting wave energy can help meet increasing energy demand due to population and economy growth as well as significantly reduce carbon emissions as compared to traditional energy production from fossil fuels. Despite great efforts in research and developments on wave energy over the last 50 years, most wave energy device proposals failed to reach the commercialization stage, and only few wave energy conversion devices are currently in operation as pilot studies such as the Eco-wave power in Gibraltar and Israel and the Sharp Eagle in China. Early studies show that the levelized cost of electricity generated from ocean waves is a few times higher than that for offshore wind. This prompted researchers and engineers worldwide to develop more cost-effective solutions for wave energy technologies. This paper aims to give an overview of recent research and developments on wave energy production. It includes the opportunities and challenges of wave energy sector; different types of wave energy devices; cost breakdowns for some past wave energy projects; promising solutions for reducing electricity costs and improving survivability of wave energy devices in storms; recent trials of wave energy devices and integrated systems between wave energy devices and other purpose marine structures; and methods for modelling the fluid-structure interaction and estimating power production.

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[2] Gunn, K., Stock-Williams, C., 2012. Quantifying the global wave power resource. Renew. Energy 44, 296–304.
[3] IEA, Electricity Consumption, 2020. https://www.iea.org/data-and-statistics?country=WORLD&fuel=Energy consumption&indicator=Electricity consumption.

Low Carbon Energy

Innovative modular floating structures for harvesting solar energy in harsh marine environment

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The use of floating structures for harvesting clean solar energy on water bodies has become popular thanks to the technological advancement that has led to more energy- and cost-efficient photovoltaic panels and the availability and environmental benefits of large-scale water bodies. Built on the successful experiences of floating solar farms on inland and coastal waters, research and development activities are now oriented toward floating large-scale solar farms on offshore waters where the space is abundant. At the same time, harsh environmental conditions make it challenging in almost every aspect of the lifecycle, including the design, construction, onsite installation, operation and maintenance, and decommissioning. This paper presents the conceptual development of an innovative soft-connected lattice-structured modular floating solar farm for use in open offshore environments. Technical feasibility assessments involving hydrostatic and hydrodynamic examinations were carried out to ensure that the proposed concept fulfills the design requirements . Based on these, scaled model tests of both a small array comprising 6 connected standard floats and a large array of 216 floats were conducted. The experimental study showed that the proposed concept can perform well under operational conditions and survive extreme conditions with wave heights above 10 meters.

Low Carbon Energy

Floating OTEC Plant – A Design and Coupled Dynamics

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Ocean Thermal Energy Conversion (OTEC) is a system that produces clean energy from the temperature differences in the ocean. Its power production is very stable and is expected to be implemented as a base-load power supply, despite using the natural energy source. In addition, this energy source would provide an attractive integration with other industries such as an aquaculture with ocean nutrient enhancement, desalination, deep seawater cooling and hydrogen production.
A floating OTEC plant is currently in development toward a commercial-scale deployment. The floating plant is configured with a floating platform, mooring system, seawater intake pipe/inlet and discharge pipe/duct. In particular, a Cold Water Pipe (CWP) is the most challenging component in a commercial scale OTEC. For a 100 MW-scale CWP, the length is 600-1,000 m, and the diameter is over 10 m to transport deep seawater of approximately 200 m3/s. Due to this size, the dynamic coupling between the floating platform and the mooring is strong. Therefore, we need a coupled analysis and an integrated design method with other components.
On the other hand, the present authors have proposed a 100 MW-net OTEC plantship for Indonesia. In order to reduce the capital cost, the platform uses a converted pre-owned ship. For the preliminary design of a mooring system and CWP, a coupled dynamic analysis is performed in this paper. A sensitivity analysis of the dynamic responses of the floating platform and CWP to the design parameters is also performed. The results are used to discuss the dynamic characteristics and design method for an OTEC floating plant. We believe that this discussion will be useful for improving the reliability and further development of this floating structure concept.

Low Carbon Energy

A Basic Investigation of Resonance Characteristics of PW-OWC Type WECs

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This paper describes resonance characteristics of water regions of OWC type WEC models installed with projecting-walls, which is called as a PW-OWC device. We can easily improve PTO performance of an OWC type WEC device by installing projecting walls on in front of it. One of the reasons of it is that such as the device can have multi-resonance frequencies. Behaviours of the resonances is complex because we can change the resonance characteristic by varying a damping effect which decides a PTO characteristic. The thing would be that we can easily optimize the characteristic to a sea wave condition. However the resonance characteristics have not clarified yet. The paper shows the resonance behaviours of OWC and a water region surrounded by the projecting-walls.
The paper adopted two theoretical approaches to predict the resonance characteristic. One is an approximate method in which a tuned mass damper model with two mass points. Another one is a potential theory based model which can directly take into account of a damping effect due to PTO in a boundary integral equations of the velocity potentials to be solved. The tuned mass damper model was very convenient to predict motion behaviours of water regions and PTO performances.
The paper shows validation of both calculation approaches by comparing each other. As a result, there were two cases which are that one was a case with two resonance frequencies and another case had only one resonance because of damper magnitude as PTO. Besides, the paper considers effects of motions as a floating system.

Offshore Wind / Low carbon

Study of the fairlead connections of a prestressed concrete spar platform supporting a 10 MW floating offshore wind turbine

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This study aims to design the fairlead steel-concrete connections and investigate the fatigue life of a prestressed concrete spar supporting a 10 MW floating offshore wind turbine. The numerically studied using finite element code COM3 is performed to investigate the nonlinear behavior of the concrete structure induced by coupled hydrodynamic and aerodynamic motions of the wind turbine under operation. The dominant case's tower base forces and mooring tensions are applied to the finite element model investigating stress-strain localization. Two types of fairlead connections are designed for the finite element model installed tower connections and applied prestressing forces obtained from the previous study. Finally, the fatigue life estimation of concrete structure is investigated according to the model code restriction. The analytical results show that the designed fairlead connections can withstand large tensile forces transfer from mooring lines to the spar concrete. In both types, the fatigue life of concrete under tension is longer than the restriction. However, for the concrete under compression, the plate-plate model obtains shorter fatigue life than the prediction of the model code.

Offshore Wind / Low Carbon

Influence of concrete material property on the failure mode of steel-concrete connection under monotonic load

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To promote the installation of offshore wind turbines, the method for mass production and design achieving required structural safety under offshore environment needs to be considered. This study focuses on concrete material as offshore wind turbine floater and investigates how the connection between concrete floater and steel tower behaves under the different loading condition using partial anchoring model. The ordinary portland cement concrete, geopolymer concrete and gravel concrete are examined in this study. Finite Elements (FE) analysis was also conducted with the same condition as experiment, by using software, COM3 which can trace non-linear behavior of concrete and analysis result was verified by the experimental result.

Offshore Wind / Low Carbon

Numerical Study on Cause and Characteristics of Low-frequency Yaw Motion of a Slack-moored FOWT

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A loose-moored floating offshore wind turbine (FOWT) in irregular waves may experience slow-drift resonances. In fact, in the Fukushima FOWT demonstration project, the slow-drift resonances were observed not only in a storm but also at relatively calm sea states. This indicates the necessity of understanding the amplitude of the slow-drift resonances at relatively calm sea states.
Previous studies on slow-drift resonances have explained that slow-drift resonances occur when the long-periods derived from two wave periods in irregular waves are close to the natural periods of a loose-moored floating body. Furthermore, in our previous study, it has already been found that the slow-drift surge resonance also occurred when the long-period, derived from not only two but also three wave periods, was close to the surge natural period. This implies that the slow-drift resonances may occur frequently in irregular waves, and the slow yaw resonance derived from three wave periods also may occur.
In this study, to investigate the amplitude of the slow yaw resonance at relatively calm sea states with the resonance derived from three wave periods, numerical simulation on a loose-moored 15 MW FOWT is conducted. The investigation on the occurrence of the slow yaw resonance will provide a deeper insight into the nacelle control of a FOWT and the transfer from a crew transfer vessel (CTV) to a FOWT and so on.

Offshore Wind / Low Carbon

Wave Motion Characteristics of a Low-Rigidity FOWT with a Guy-Wire Supported Tower and Single-Point Mooring Configuration

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In Japan, because of the depth of the sea, FOWT (Floating Offshore Wind Turbine) is gathering attention to achieve decarbonization in the energy sector. Commercialization of FOWT is steadily approaching, but one of the challenges is cost. Optiflow is a new type of FOWT designed to reduce cost with two identities: guy-wire supported towers and single-point mooring. However, this type of floater has several points to discuss, such as nonlinear behavior and elastic deformation with the body consisting of thin and extended parts, guy wires, and single-point mooring behaviors. So, this study focuses on the technical feasibility of the Optiflow concept through wave tank experiments and numerical methods.
The tank experiment was conducted with a 1/60 scale segmented backbone model that applies geometric and elastic similarity rules at the same time. By wave tank experiments, it was revealed that the motion of Optiflow had nonlinearity to wave height caused by viscous effect and waveless response at a particular wave period. On the other hand, elastic deformation becomes large in two wave periods, the longer one was caused by inertial force by rotation, and the relationships between the length of the body and the wave caused the shorter one.
For the numerical method, UTWind was used, which is a turbine-floater-mooring coupling response analysis program developed in OSPL. In this study, the guy-wire tension calculation part was newly developed by considering calculation errors by rotation in UTWind. By comparing the results of the experiment and UTWind, it was confirmed that the calculation was accurate except for the resonance period. This was because the viscous effect is large when motion is significant, which UTWind can't consider correctly. Furthermore, by numerical method, it was found that upwind guy-wire was affected by Pitch and Heave; on the other hand, downwind guy-wire was affected by Pitch and Roll.
For wave angles, by comparing the results with slightly different wave angles, it was found that the bending moment of the lower hull becomes slightly large in a specific wave period. The amplitude of the bending moment significantly changed in response to a small difference in wave period and wave angle in the short wave period. Additionally, it was revealed that Heave motion differed depending on whether the wave came from the front of the floater or behind by comparing the results with different wave angles. These facts are essential for designing FOWT.

Offshore Wind / Low Carbon

A Study on Wave Free Configurations and Motion Responses for Advanced-SPAR Type FOWTs

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Important subject in solving energy problems in Japan is to achive the best mix of energy including renewable energy and atomic power generation. Wind power seems to be the most promising renewable energy source. However, the land topography of Japan is not always suitable, so it is important to develop an offshore wind turbine generation system. In particular, improving the seakeeping performance of the supporting floating body of the wind turbine is an important research subject.
Therefore, in the present research, we took up a wave-free float with two-waveless point , clarified the systematic numerical calculation of its seakeeping performance, and considered its usefulness as a supporting float for offshore wind power generation.

Offshore Wind / Low Carbon

Development of a Simulation Tool for Floating Offshore Wind Turbines Using MBDyn

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For design of Floating Offshore Wind Turbines (FOWTs), numerical simulations for a large number of Design Load Cases (DLCs) are required. Now, several numerical tools have been developed and available, such as Bladed and Orcaflex; however, the number of licences may limit the efficiency of the analysis. In this paper, we report on the latest progress of the development of a simulation tool for FOWTs using MBDyn. MBDyn is an open source software of Multi Body Dynamics. We have developed several user-defined modules that extend MBDyn to be used for dynamic analysis of FOWTs. Using this tool, we will be able to run many simulations simultaneously without limit of the number of software licences. Several numerical examples will be given as comarison with the results obtained by ADAMS.

Offshore Wind / Low Carbon

Overview of FOWT Demo Projects Cost and Analyses of Hull Design Features

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In any industry, many novel concepts are buried in history when no one invests their time and money in them. Those concepts that made it through managed to gather attention and persuade the audience, to Floating Offshore Wind Turbines (FOWT). It was done by successfully completing a demonstration project. TaidaFloat, a new semi-submersible FOWT floater is not the first of its kind, but with its many slight innovations, it needs to be supported by a demo project. This paper provides data and an in-depth analysis of how other demo projects were born and what made some of them successful, and ideas for a demo project in Taiwan are proposed. Furthermore, an example platform is created with a parametric design approach, constraining the floater's heave and pitch motions. The problems of scaling down a project to a demo size are shown and dealt with. The floater is designed with local supply chain capability in mind. Since Taiwan doesn't have many anchor handling tugs of sufficient capacity, a mooring system is designed with line weight reduction as a priority. Summarizing these parts, this paper provides insight into how a demonstration project can be carried out in Taiwan or locations with similar conditions across Asia-Pacific.

Offshore Wind / Low Carbon

Basic study of barge type floater with large wind turbine system by using numeral simulation

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Ocean renewable energy is one of the most important sectors to achieve "Zero emission". Generally, ocean wind power generation is already developed mainly in the shallow water area as the bottom fixed (foundation) type. Nowadays, floating offshore wind turbine system (FOWT) is also growing for deeper water. "Spar", "Barge", "Semi-submergible", and "Tension leg platform" is well known as typical types. Each type is unique and has both merit and demerit.

In this study, we have focused on "Barge type" and done some basic parametric studies based on numerical simulation. Generally, it is mentioned that the "Barge type" has difficulty in large motion in waves compared to other typical types.

Based on the above backgrounds, we designed four types of "Large size Barge type" floaters (for 15MW wind turbine) with a combination of naval architecture and civil engineering basis.

Type-1: Simple rectangular type (base for comparison)

Type-2: Rectangular type with moon pool

Type-3: Rectangular type with moon pool and flow channel from internal to external area

Type-4: Revised Type-3, which has some flow path and divided moon pool

The basic design concept is that all floaters are met intact stability criteria mentioned in Japanese government guidelines on the same level. It means all floaters have almost the same hydrostatic characteristics and can withstand the same environmental conditions (extreme wind, etc.).

To evaluate the motion in waves, we analyzed hydrodynamic characteristics by using numerical simulation (Frequency domain). As a result, different heave characteristics were identified for each floating type.

As for Type-2 to Type-4, the RAO of heave motion is almost 20-40% reduced at below harmonic wave period range compared to Type-1. This effect is due to the smaller water plane areas, leading to less hydrostatic damping. However, Type-2 floater has not only a harmonic heave period due to the floater itself but also other harmonic phenomena due to moonpool piston motion. This phenomenon is drastically reduced with water channels in Type-3 and Type-4.

In conclusion, especially Type-3, Type-4 (and Type-2 in some cases) may be applicable when the site's environmental condition is suitable.

Climate Change / Disaster

System and Method for Proactive and Reversible Mitigation on Storm/ Hurricane/Typhoon/Cyclone

Frank Chen, Frank Chen Research Institute

A system comprising very large floating structures will be used to regulate the water vaporization rate at selected locations on the hurricane/typhoon corridor. Through such placements, the fuel (water moisture) for a tropical storm to gain strength to become a hurricane, for example, can be mitigated so is the storm and the hurricane.

By combining very large surface floating structure technology, bio-engineering technology, and photovoltaic system technology, green energy, food and carbon neutrality can be addressed.

Principle reasoning, critical scale down data and design models will be presented in this talk.

The author has been notified recently that his PCT patent application has been approved for meeting the novelty, inventive step and industrial applicability requirements.

Climate Change / Disaster

Amphibious Buildings as a Response to Increasing Flood Risk - European Case Study

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Flood risk in Europe, where high population density is combined with the danger of coastal, river or flash flooding, has increased over the last five decades, becoming the second biggest cause of losses, both economic and social, caused by extreme events induced by climate change, as reported by IPCC, 2018, Nowadays, adapting vulnerable urban areas has therefore become a priority objective in the political and legislative management of cities. Architectural measures for adapting the private space of cities include amphibious buildings (AB), which are a solution closely related to floating structures in terms of floatation and anchoring but located on land instead of water. During flooding, the floating foundation of AB allows it to rise from the ground and float on the surface of flood waters. The anchoring system secures AB in place both in regular and flood conditions. Despite the concept of AB being known worldwide, especially in North America and Asia, it is not very familiar in Europe, where, according to available sources, there are only four realized AB projects. The aim of the article is to present the relevance of amphibious solutions in the European context. The article covers a thorough review of the existing literature on the construction and implementation of ABs through the cataloging of AB topics by the parameters of safety, purpose, aesthetics, technology, sustainability, utilities, and cost-efficiency. The AB projects are analyzed in the comparative case studies. The SWOT analysis of the AB concept for Europe summarises the research. We consider that through the orderly classification and cataloging of the state of the art of AB buildings, it is possible to define new paths for architectural and urban implementation in order to respond to the need for urban adaptation to extreme water events.

Climate Change / Disaster

Study on Applicability of the MPS Two-phase Flow Model to Submarine Landslide Problem and the Basic Characteristics of Impact Pressure on Mooring Anchors of Offshore Wind Turbines

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The authors focus on the MPS particle method and evaluate the applicability of its two-phase flow model to submarine landslide phenomena through the reproduction calculations of past model experiments and consider the numerical parameters for treating the submarine landslide flow as the model. Then we study the basic characteristics of impact pressure exerted on the mooring anchors of the offshore wind turbine by submarine landslides occurring in coastal areas.

Climate Change / Disaster

Fundamental research on tsunami-resistant design for coastal architectures considering hazard chains

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In this paper, the most important research issues for tsunami-resistant planning and design of coastal buildings located in port cities are as follows: 1) From the initial event to the result event, that is, considering the hazard chain establishment of a design process that 2) At the same time, considering that tsunami disasters are sudden, low-frequency catastrophes that are characteristic of tsunami disasters, the development of simulation methods that consider the hazard chain is also an extremely important issue. 3) To clarify the characteristics of the tsunami impact load caused by the tsunami run-up with drifting objects, and at the same time to develop a practical numerical analysis method that can predict the impact load rationally and quantitatively.
As mentioned above, this paper summarizes some of the results of the research conducted for the above-mentioned three subjects.

Climate Change / Disaster

Numerical study of the variation of the velocity of a tsunami-drifting object in front of a building just before impact at different angles of tsunami incidence

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When a tsunami run-up on land, containers, large vehicles, ships and other objects become drifting debris and collide with buildings. However, it is known that the backwater created by the run-up flow in front of relatively large buildings makes it difficult for drifting debris to collide with the sides of the buildings.
The purpose of this study is to clarify how the velocity of drifting debris immediately before impact changes with the ratio of the width of the building to the width of the drifting debris for each tsunami incidence angle, after confirming the characteristics of the flow field in front of the building by changing the width of the building and the incidence direction of the upwelling flow.
A uniform flow field was reproduced in a numerical tank using the MPS method, one of the particle methods. When the flow field was stable, drifting objects were dropped from the air and hit the buildings with sufficient acceleration time and distance. In the case where the tsunami incidence angle was small and the width of the building was greater than the width of the drifting object, the velocity of the drifting object just before impact was reduced due to the backwater in front of the building. On the other hand, in the case where the tsunami incident angle was 45°, the velocity of the drifting object just before impact was almost unaffected by the backwater in front of the building. These results suggest that the impact force of drifting objects is greater at the corner where the building columns are located than at the building wall. From the point of view of protecting buildings against tsunami-drifting debris, it is thought that damage can be reduced by placing trees and other structures at the corners of buildings in the direction of tsunami impact.

Climate Change / Disaster

Study on the Tsunami Disaster Prevention Measure by the Deep-draft Type Floating Tsunami Protection Wharf for a Vessel Moored at a Wharf

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Huge earthquakes with tsunamis are more likely to occur, such as the Nankai Trough earthquake, the Japan Trench earthquake, and the Chishima Trench earthquake; therefore, effective tsunami protection measures are needed for moored vessels in Japanese ports. The floating tsunami protection wharf (FTPW) has been proposed as a tsunami protection measure for vessels moored at wharves. The FTPW is a floating pier with a tsunami disaster prevention function, which can prevent the breaking of mooring lines and the grounding at a wharf by floating together with moored vessels when a tsunami hits. Although the FTPW has been proposed as a floating pier without a specific size or shape, previous studies have mainly demonstrated the tsunami disaster prevention performance of the FTPW with a shallow draft. This study proposed the use of a deep-draft type floating tsunami protection wharf (DFTPW), which has an even deeper draft than the previous FTPW, and the FTPW and the DFTPW moored to 3,000 DWT class vessels were verified and compared for their disaster prevention performance using the 3-dimensional moving particle simulation (MPS) method. Our results show that both the FTPW and the DFTPW can prevent tsunami damage to moored vessels for the leading waves, whereas the DFTPW has superior disaster mitigation performance than the FTPW for the backwash, and combined methods using DFTPW and strengthening of mooring forces are more effective.

Climate Change / Disaster

Proposal of Tsunami Hazard Database for Mooring Vessels in Major Ports in Japan

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Chiaki Tsutsui, Tokyo University of Marine Science and Technology
Kiyokazu Minami, Tokyo University of Marine Science and Technology

When a tsunami attacks a coastal area, vessels moored at the wharf suffer serious damage. More than 20,000 vessels have been damaged, such as landing on a wharf, drifting, or colliding due to the tsunami caused by the Tohoku earthquake in 2011. Tsunamis are significant disasters in Japan. Many researchers have studied the prediction of tsunami damage and tsunami damage protection measures. However, there are various approaches for studying tsunami damage prediction and tsunami protection measures for each researcher. This means that the tsunami damages and tsunami protection measures are evaluated using various methods in each area and port. Accordingly, when tsunami damages are considered, there is currently no unified evaluation method in Japan. This study proposes a tsunami hazard database for major Japanese ports using the unified evaluation method. The moving particle simulation (MPS) method was used as a tsunami hazard simulation method. The target ports are 23 major Japanese ports. The landing on a wharf and breakage of mooring lines were evaluated as hazard cases for the mooring vessel. In evaluating the landing of vessels on a wharf, the tsunami height in each port, the draft of vessels, and the crown heights by the difference in tidal levels were considered. The tsunami hazard database was constructed based on these results. Finally, tsunami hazards in major Japanese ports were evaluated using the tsunami hazard database.

Climate Change / Disaster

A study on the layout and structure of the cloister of Itsukushima Shrine from hydrodynamic aspects

Yasuhito Aida, Oceanic Architecture & Engineering. College of Science and Technology, Nihon University
Akio Kuroyanagi, Oceanic Architecture & Engineering. College of Science and Technology, Nihon University
Koichi Masuda, Oceanic Architecture & Engineering. College of Science and Technology, Nihon University

Based on the findings of various previous studies on Itsukushima Shrine, this study focuses on the 'cloister', which contributes greatly to the creation of the shrine's headland landscape and the mitigation of natural disasters brought by the sea. This paper reviews and re-examines previous discourses and discussions on landscape creation and responses to natural disasters. The paper reviews the history of the construction of the sea shrine pavilions at Itsukushima Shrine and examines the measures taken to mitigate the impact of the sea on the shrine pavilions, including the cloister, based on the sea conditions.
As a result of this study, it was found that the screened corridor contributes to mitigating the buoyancy caused by the rising sea level during the storm surge by about 6%, and the wave transmission coefficient is about 0.3 for a wave with a period of 3.5s, if the floor of the corridor is considered as a submerged flat plate and the screen is ignored. Therefore, the floorboard of the corridor is expected to reduce the energy of the short-period transmitted waves to the main building behind the corridor. However, it is difficult to accept the idea that the floorboards of the corridor were designed to reduce the energy of the waves.

Information

Conference Venue

Nihon University Auditorium-1, College of Science and Technology, 1-8-14, Kanda-Surugadai, Chiyoda-ku, Tokyo

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Waterpolitan Initiative

WATERFRONT REAL ESTATES CO. LTD.

The Waterpolitan Initiative was established in November 2018, after more than 10 years of extensive research and development on the inland Water City. Based on knowledge gained through such activities related to the construction of the Water City, we became aware that we are obliged to take an initiative to realize the Floating City for a prosperous future.

2018年11月、今後の安全で快適な社会を実現するために、超大型浮体構造物を活用した水上都市・海上都市を実現する"Waterpolitan Initiative" が "Waterfront Real Estate Co., Ltd." の実施部隊として設立されました。

☐ Waterpolitan initiative

Vision

Realize the Inland Water City and the Seaborne City (collectively called "Floating City") as a new way of living in future through creation measures for land areas vulnerable to natural disasters resulting from global warming.

私たちのより良い安全で快適な生活の場となりうる水上都市・海上都市が世界中で期待されております。特に、地球温暖化による自然災害に悩み続ける陸地における状況を一変させるためには、水上都市・海上都市によるパラダイムシフト・重要な手段になると私たちは考えます。

Mission

- Advocate initiatives on the Inland Water City and the Seaborne City
- Create networking and collaboration among concerned parties
- Initiate development and construction of the Inland Water City as a mile-stone for realization of the Seaborne City

今後の活動

- 「水上都市・海上都市」の実現を目指す。
- 実現に向け、他企業との連携ネットワークを図る。
- 「海上都市」実現に先立ち、まず、陸上での「水上都市実現」に向けた活動を行う。

English

Japanese

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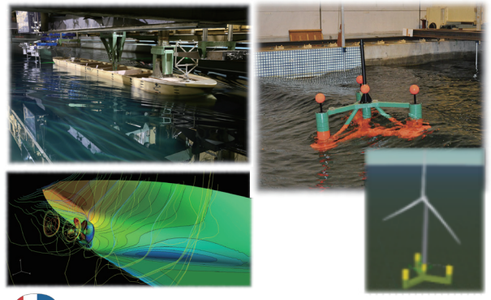

Akishima Laboratory

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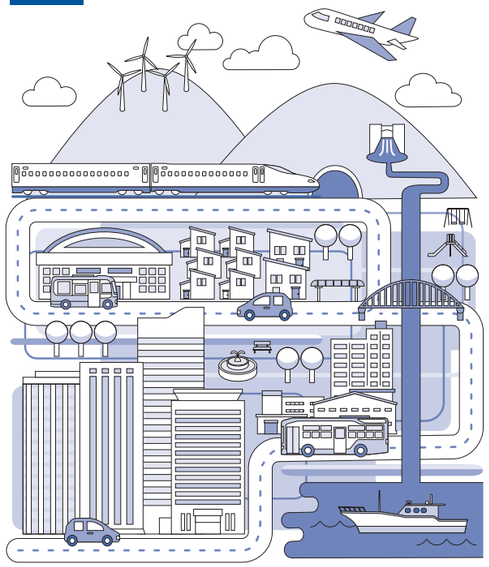

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