rethink*rotor
ローターの再考

Workshop
WASEDA University x **h_da**

26 MAY 2025

WASEDA University

h_da darmstadt university of applied sciences faculty architecture

member of EUT+ EUROPEAN UNIVERSITY OF TECHNOLOGY

OX2 architekten®

rethink rotor

TOKOROLABS® RESEARCHERS

WORKSHOP | SCHEDULE

rethink*rotor
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TOP 1 **Opening Remarks**

- short round of introductions of the individual parties

TOP 2 **Presentations**

- Professor Kang (Seoul National University)
- Professor Kamiya (Waseda University)
- Professor Carla Susana Assuad (Norwegian University of Science and Technology)
- Professor Marcin Orawiec, Ina-Marie Orawiec (h_da / OX2architekten)

TOP 3 **Lunch**

TOP 4 **Students Presentations**

- students from h_da / OX2architekten
  rethink*rotor // current projects // Energy on the Water // power**stage*
- students from Waseda University

TOP 5 **Closing Remarks**

TOP 6 **Campus Tour**

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TOP 2

Presentations

発表

Darmstadt
University of Applied Sciences

Hochschule Darmstadt

DARMSTADT | GERMANY

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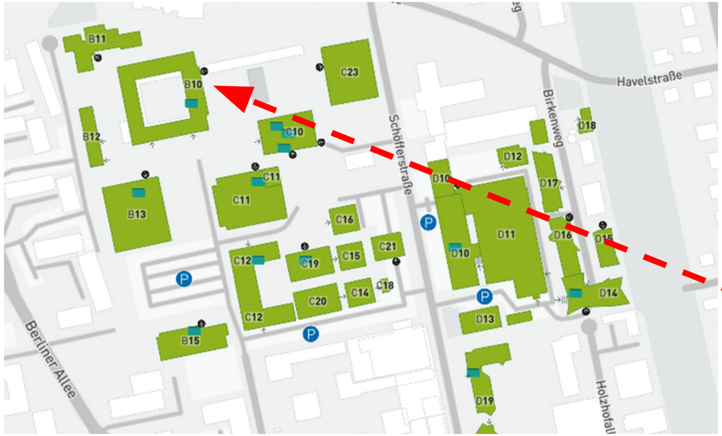

Department of Architecture (B10)

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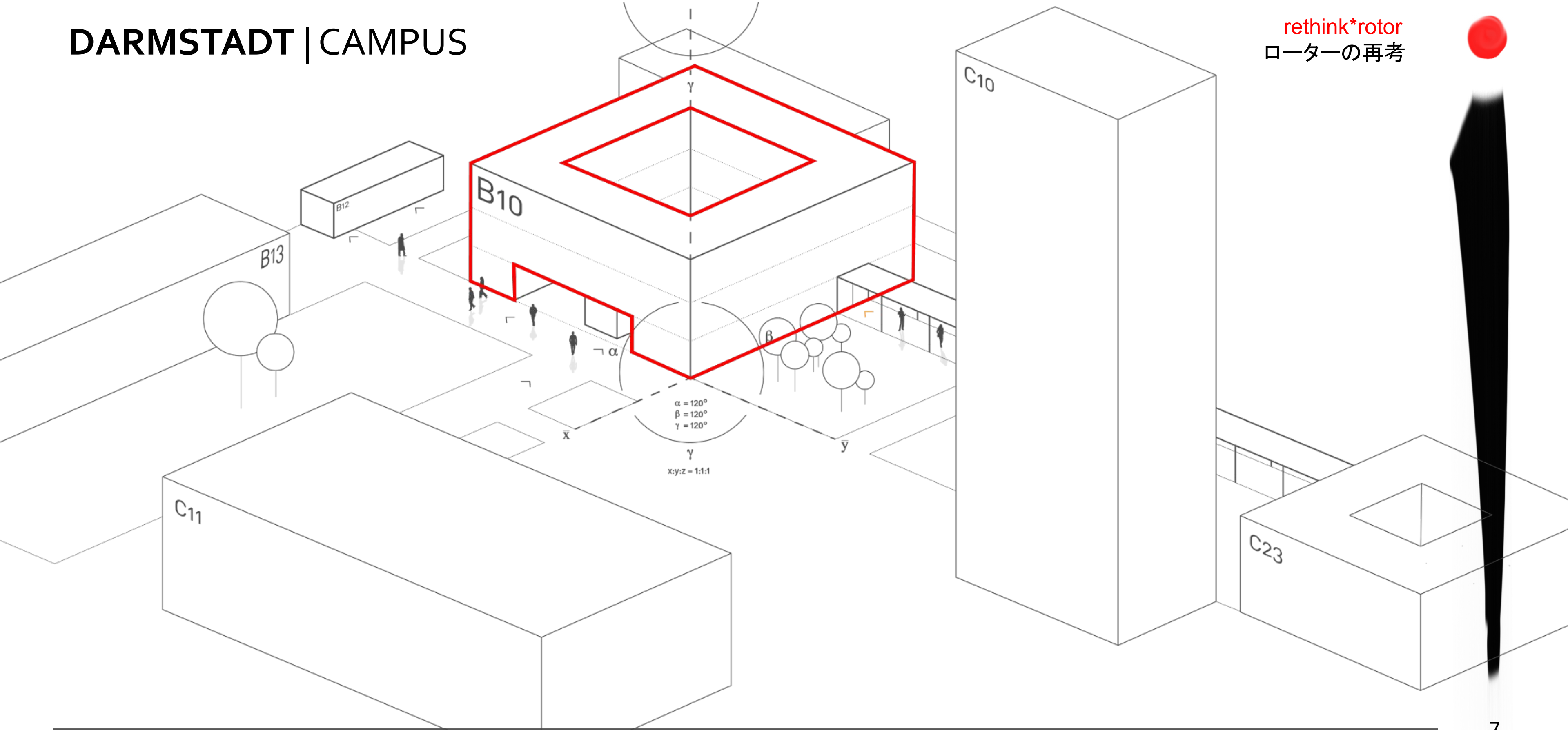

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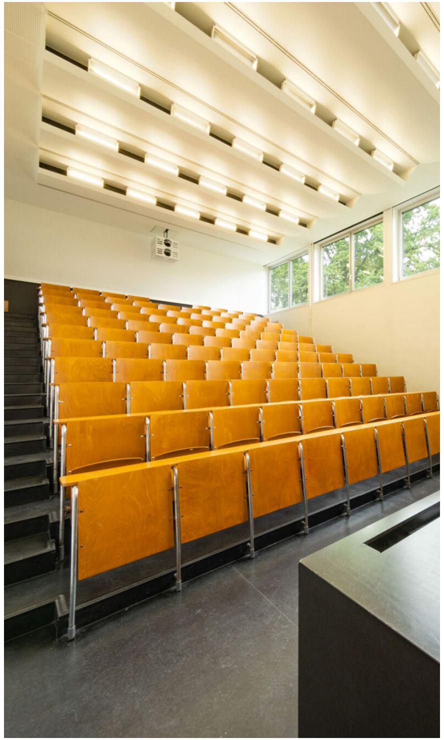
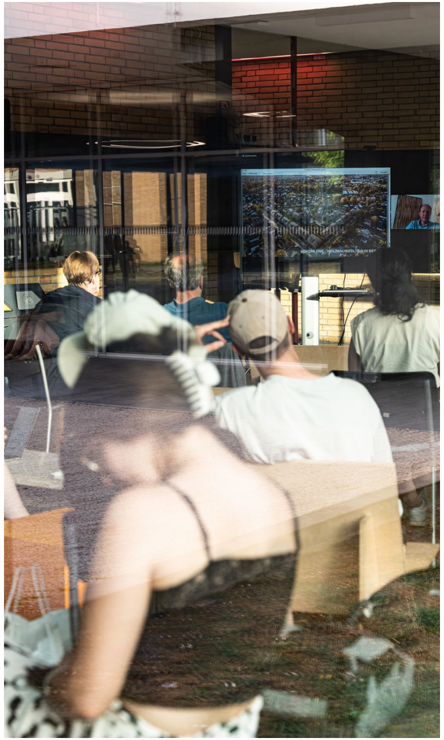


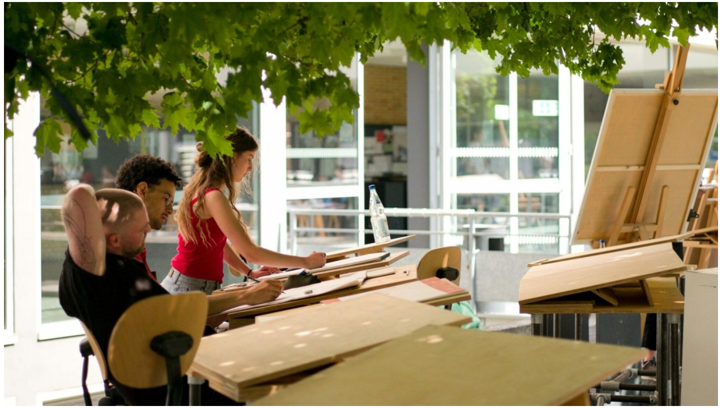
Impressions from our
Department in Darmstadt

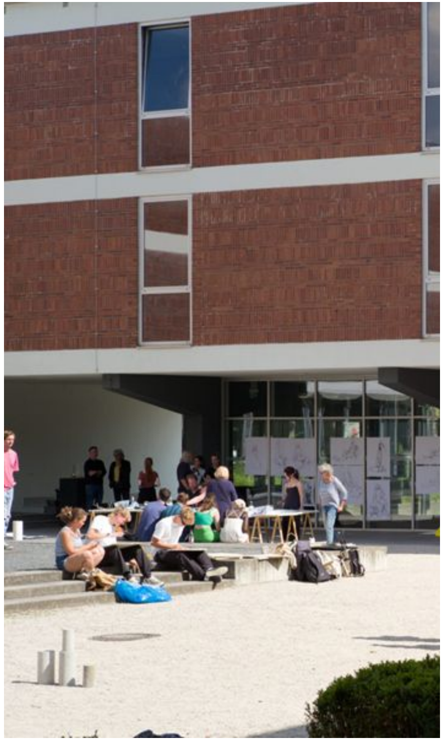
DARMSTADT | CAMPUS

Impressions from our Department in Darmstadt



DARMSTADT | CAMPUS

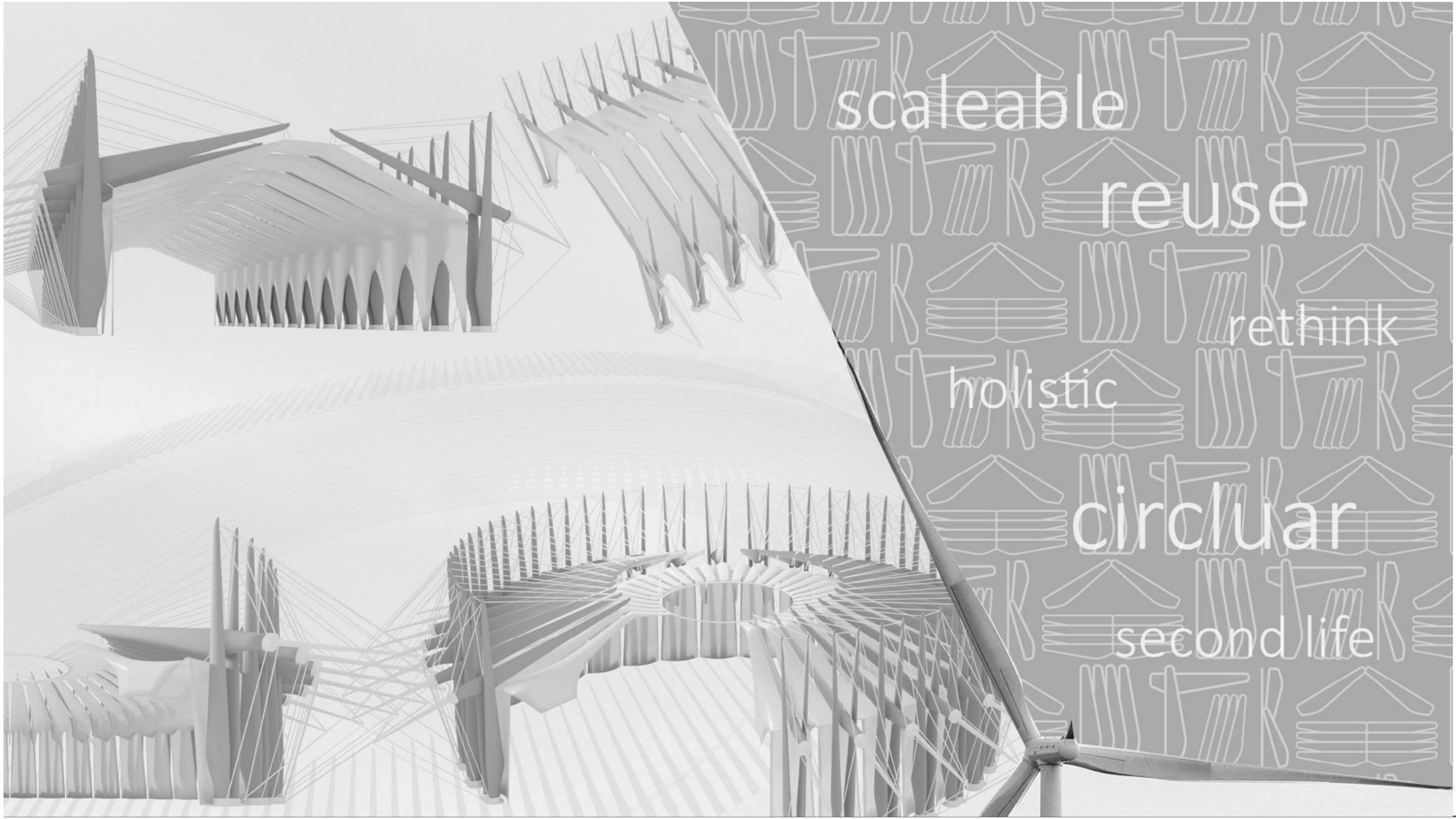




Impressions from our Department in Darmstadt

CreativeLAB
rethink*rotor

Hochschule Darmstadt - OX2architekten


scaleable
reuse
rethink
holistic
circluar
second life

TOP 3

Lunch Break

昼休み

TOP 4

Student Presentations

学生発表

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Student Concepts
rethink*rotor

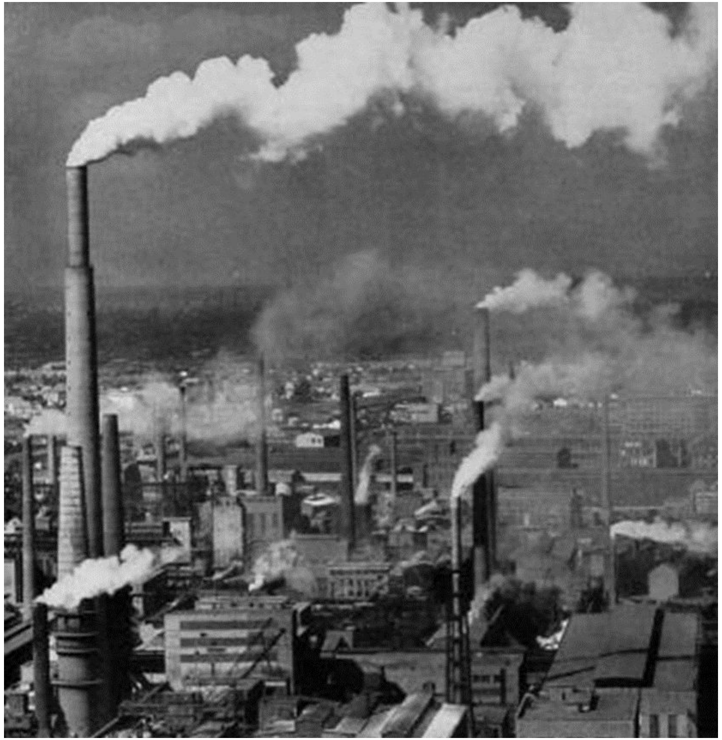
past and current integration into academic studies

Inhalte zum Thema Integration der Forschung in die Lehre (Thomas)

rethink*rotor
blade*stage

Draft project at h_da

blade*stage | Historical Context



- Start of coal mining in the Ruhr area in Germany in the early 1820s
- Since then coal burning is extremely harmful to the climate
- Powerful companies use lobbyism and financial loopholes

blade*stage | Environmental Impact

- Destruction of entire villages and displacement of residents
- Irreparable holes left in the landscape
- Permanent use of pumping stations to keep the area dry

blade*stage | Political Shift

- Recognition of the dangers of climate change
- Shift from coal-facilitating laws to greener solutions
- Demonstrations to save villages from being destroyed

blade*stage | Political Shift

What does this have to do with rotor blades?

blade*stage | Kimiko Festival Aachen

- Collaboration with rethink*rotor for a new stage design
- Spontaneous decision and initial renderings for the festival

blade*stage | Kimiko Festival Aachen

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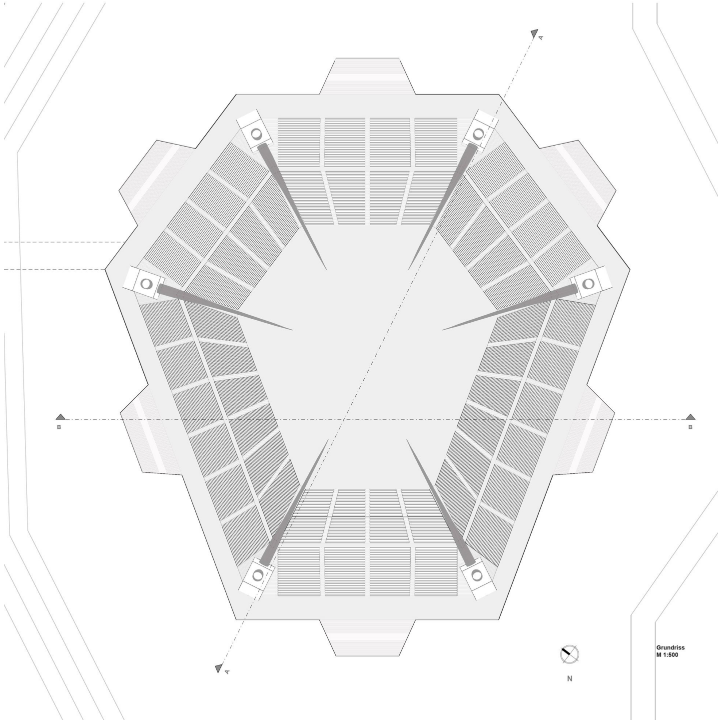
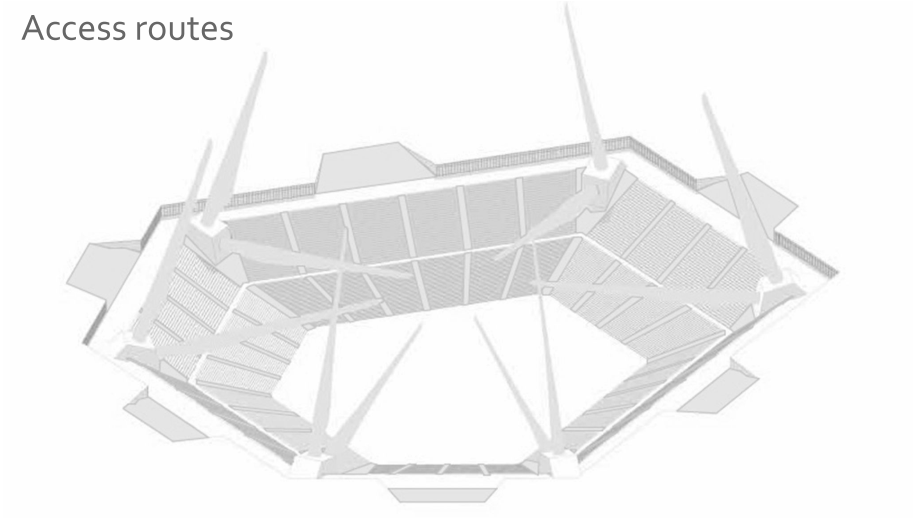
blade*stage
Concepts

blade*stage | blade stadium 12 60

blade*stage | blade stadium 12 60





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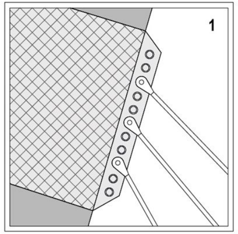
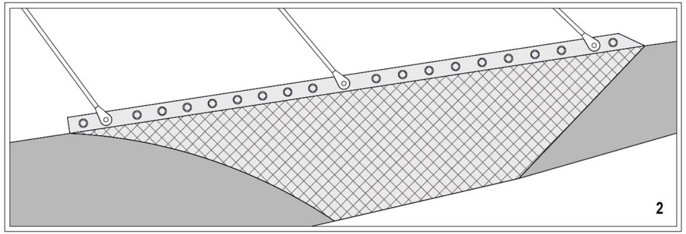
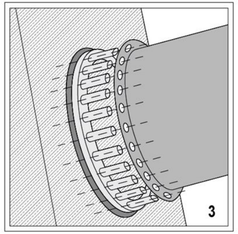
blade*stage | blade stadium 12 60

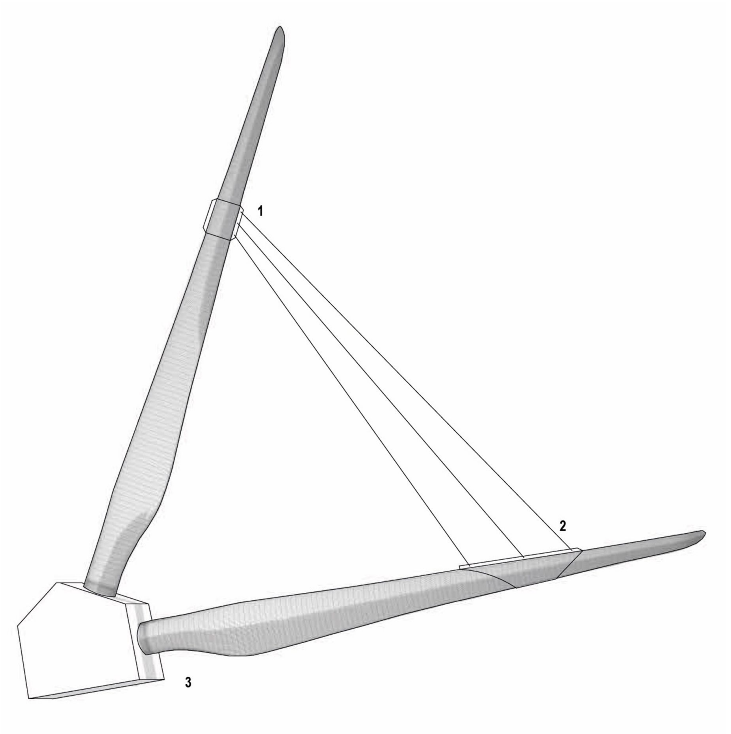


Die Rotorblätter werden mit je einer Halterung aus einem Kunststoff-Metall Verbundgewebe ummantelt. Halterung 1 besteht aus zwei formstabilen Hälften, die an den Enden miteinander verschraubt sind und gelenkige Zugseilanschlüsse besitzen. Halterung 2 hingegen ist einteilig und wird nur an der Oberseite verschraubt und mit Anschlüssen versehen. Die Innenseiten sind mit einem elastischen Kunststoff gefüttert.



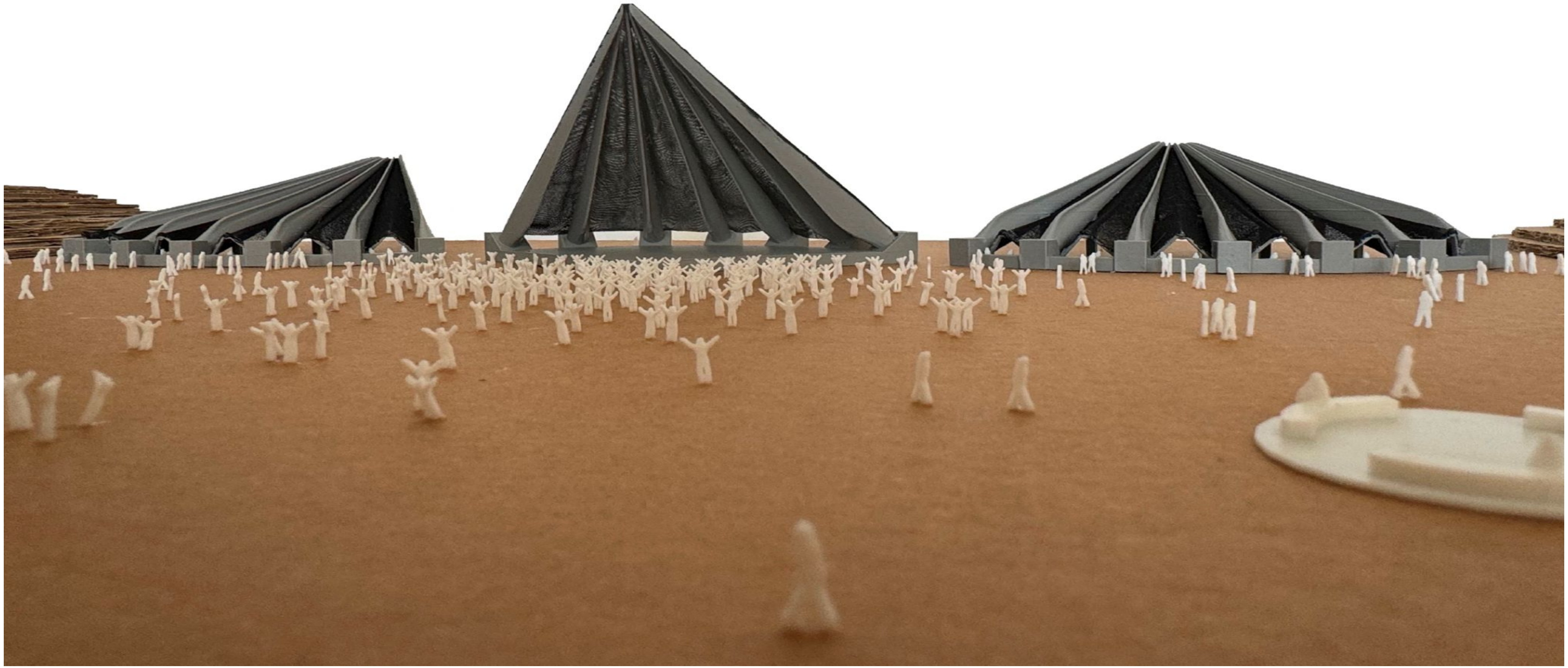


Die "Wurzel" des Rotorblattes wird genau wie bei einem Windrad an einem Gegenstück mit Bolzen befestigt und verschraubt. Bei diesem Anschluss sind Mängel leicht zu erkennen und gut zu erreichen. Das Gegenstück, ein Ring aus legiertem Vergütungsstahl, ist mit der Armierung des Betonfundamentes verbunden und garantiert so eine feste Verankerung.



blade*stage | blade wave

rethink*rotor
ローターの再考



blade*stage | blade wave

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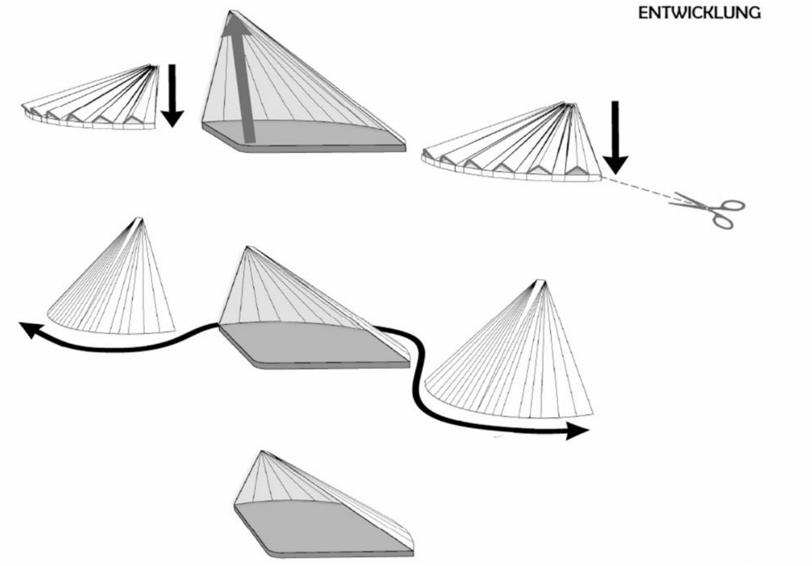
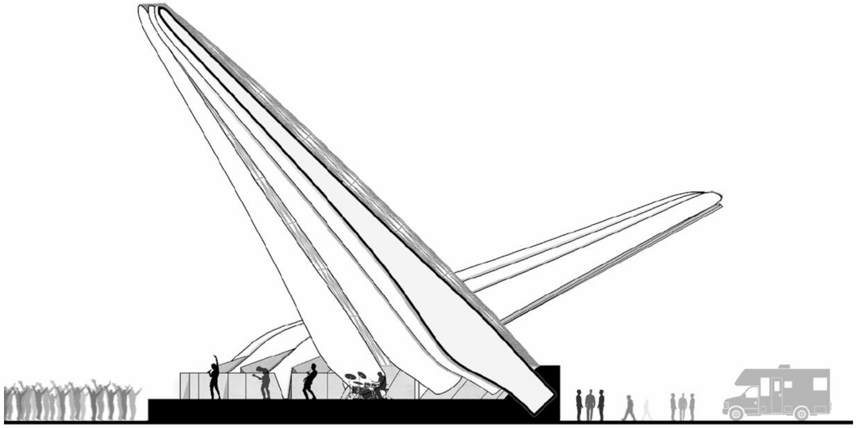
ローターの再考





blade*stage | blade wave

rethink*rotor
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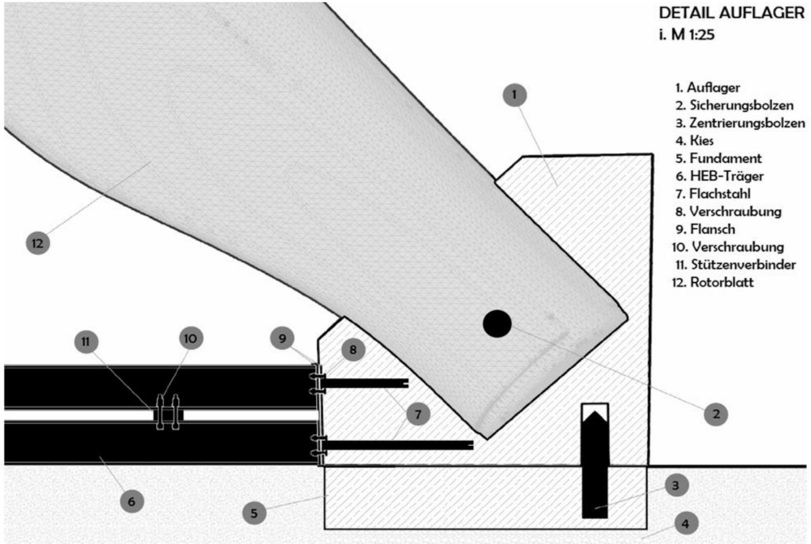
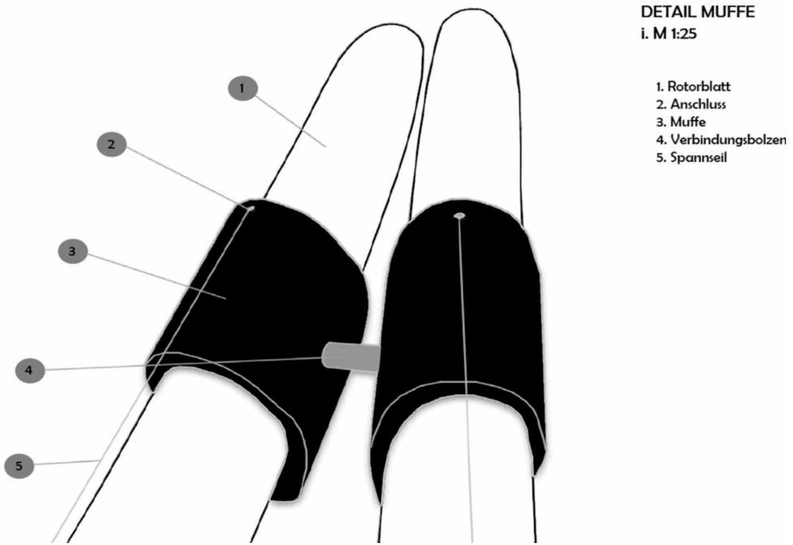




Research Project
power*stage inspired by **rethink*rotor**

current integration of research into academic studies

power*stage | project description

Projektbeschreibung power*stage.

power*stage

Tools of research

power*stage

Urban planning & Sociology

Inhalte zum Thema power*stage
Städtebau und Soziologie
(Vincent und Ina-Marie)

power*stage

Design, Construction & Sustainability

power*stage inspired by rethink*rotor

Architecture – Construction – Structural Design – Sustainability – Energy

Fields of Study: Mechanical Engineering, Civil Engineering, Architecture, Environmental Engineering

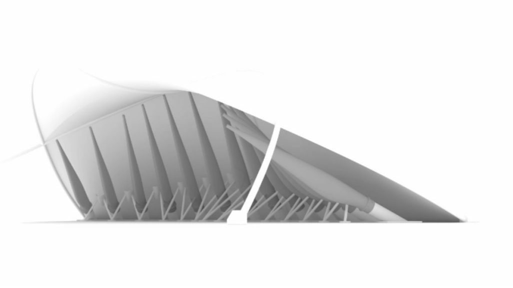
Members:

- Lina Achilles
- Prof. Dr. Andreas Büter
- Savino Daragone
- Michael Freudel
- Niklas Haderlein
- Friedolin Herter
- Jamil Khoder
- Rick Opgenoorth
- Dr. Matthias Oppe
- Sercan Tozan

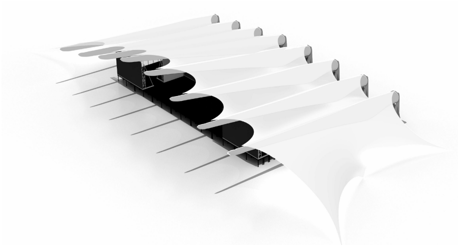
Construction | Analysis

power*stage | Analysis - Student Drafts as fundamental models

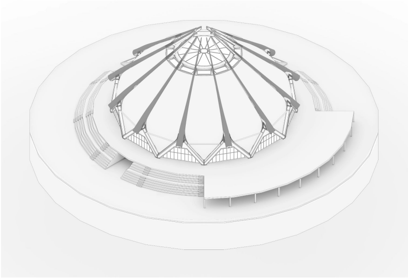
1 - "Fan"



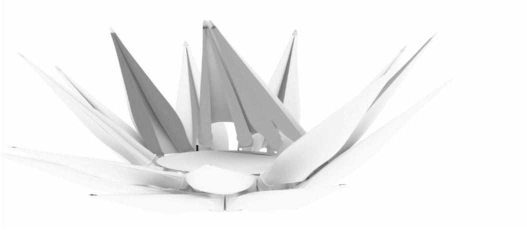
3 - "Seashell"



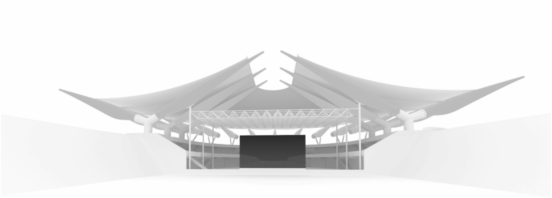
5 - "Dome"



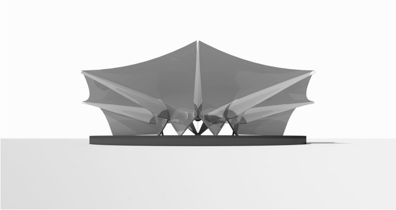
2 - "Water Lily"



4 - "Mine"



6 - "Kite"



power*stage | Subject-specific analysis of stage concepts

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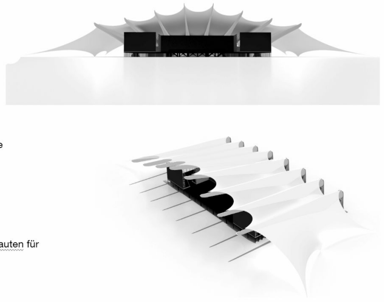
1. Grundlagen/ Ermittlung/ Methodik (M1)
1.2 Analyse Grundlagenmodelle
1.2.1 fachspezifische Analyse der Bühnenkonzepte

Bühne 3 – Muschel - Architektur
(Freier Kragarm)



Vorteile:
- Interessante Dachform
- Grungen vorhanden
- ggf. Beweglich ausführbar gut integrierbare Bühne, Stage, Backstage Bereiche
- regengeschützter Bereich
- gut erweiterbar
- Platz für Aufführ
- guter Infield Bereich

Nachteile:
- Statisch nur mit hohem Aufwand durch Rückverankerungen machbar (Carbonauten für Co2 sparenden Beton)
- Konzeption nicht ganz so auffallend (architektonisch)
- Windangriffsfläche sehr groß
- Maximaler Beton erforderlich
- ab 7 bufor, gefährlich (Bühne muss heruntergefahren werden)
- Fixierungspunkte an den Flügeln über eine „pressbare" Klammer/ Hülse?
- Die Bühne muss viel mehr können, da sie komplett nutzt genutzt werden wird.
- Seitenwände sind Windangriffsfläche (herunterfahrbar)

power*stage 2. Konsortionaltreffen_6. März 2025_online 30

Analysis of the fundamental Model No. 3
"Seashell" - pros and cons list

Department of Architecture

Membrane "linearly supported"
Rotor blades then as "bending beams"

Department of Civil Engineering

Membran ´linienförmig gestützt´

- Rotorblätter dann als „Biegebalken"

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power*stage | Evaluation matrix

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	Ökologische Kriterien				Ökonomische Kriterien	
Bühnenmodell	**Materialnutzung**	**Energieverbrauch**	**Abfallmanagement u. Recycling**	**Umweltbelastung vor Ort**	**Kosteneffizienz**	**Ressourceneffizienz**
	u.a. Anteil recycelter Materialien, Verwendung nachwachsender oder erneuerbarer Rohstoffe, Materialeffizienz (designbedingte Minimierung von Abfällen), Umweltverträglichkeit der Materialien (entstehende Schadstoffe bei Herstellung u. Nutzung)	u.a. Energieaufwand in der Herstellung, ggf. Transportemissionen, Energieeffizienz im Betrieb (Beleuchtung? Integration von Solarenergie etc.)	u.a. anfallender Abfall während des Bauprozesses, Recyclingfähigkeit der verwendeten Materialien, Demontagefreundlichkeit	u.a. Einfluss auf den Standort (z.B. Bodenversiegelung), Emissionen während der Nutzung	u.a. erwartbare Herstellungskosten (Materialien, Konstruktion etc.), Betriebs- u. Wartungskosten, Lebensdauer	u.a. Kosten-Nutzen-Verhältnis, Modularität (Anpassbarkeit der Bühne)
Fächer	Anteil recycelter Materialien: - Geplant Einsatz als konstruktives Element (im 3d Rotorblatt nicht als tragendes Element erkennbar Nachwachsend u. erneuerbar: - ggf. Membranmaterial ? Materialeffizienz: - zusätzlicher Materialbedarf für Membranhülle und steife Unterkonstruktion Umweltverträglichkeit: - benötigt große Betonfundamente durch flache Neigung - Erhöhter Stahlbedarf für die Membran Unterkonstruktion (Stahlspangen plus Fundamente) - ggf. Einsatz von CO2-sparendem Carbonauten-Beton denkbar	Herstellung: - ggf. höherer Energiebedarf bei Installation und Verankerung bedingt durch hohe Zugkräfte in den Baugrund -erhöhter Energieaufwand bei der Montage, durch wachsende Zahl an Rotorblättern. im Betrieb: - Dunkelzone an der Basis	Abfälle in der Herstellung: -Erhöhter Erdaushub (Entsorgung), bei der Fundamentierung - Anpassung der Membranfolie (Verschnitte / Ausschnitte) Recyclingfähigkeit v. Materialien: - Membranenmaterial je nach Art Demontagefreundlichkeit:	Einfluss auf Standort: - größerer Platzbedarf, durch geringere Neigungswinkel der Rotorblätter (am Fußpunkt "tote Zone") Emissionen in d. Nutzung: -	Herstellungskosten: - negativ: komplexe Konstruktion, Individuelle Fußpunkte, wenig Wiederholungen, viele Einzelanfertigungen. - Mehraufwand (Zeit) bei der Montage bzw. zur Herstellung der Fußanschlusses, Anschlusspunkte. positiv: Kostenreduzierung durch zusätzlichen Auflagerpunkt (Kragarmverkürzung) Betriebskosten: - Kosten für Wartung und Instandhaltung der Membran-Sicherung/Befestigung - Regenwasserführung einfach gehalten Lebensdauer: -	Kosten- Nutzen: -Erweiterbarkeit eingeschränkt machbar (Ring für Membran, Grundform) - Einsatz von Carbonauten-Beton könnte langfristig z.B. durch Förderungen für den Einsatz nachhaltiger Materialien Kosten reduzieren Anpassbarkeit: - Bühnengröße durch Neigungswinkel der Rückseite eingeschränkt
Seerose	Anteil recycelter Materialien: - viele Rotorblätter recycelt - Nachwachsend u. erneuerbar: - ggf. Membranmaterial?? - Materialeffizienz: - Rotorblätter ohne strukturelle Funktion - massive Stahlunterkonstruktion benötigt Umweltverträglichkeit: - Wenig Membranmaterial erfoderlich - Kompaktes Bühnendesign - Kompakte Gründungsmöglichkeiten, da die Flügel sich gegenseitig Statisch entlasten	Herstellung: - ggf. reduzierter Energieaufwand für zusätzliche Verankerungen, wenn gegenüberliegende Flügel stabile Konstruktion ermöglichen (Gegenseitige Entlastungen) im Betrieb: - Viel Tageslicht, somit ggf. weniger Kunstlicht erfolderlich. - bei beweglichen Flügel könnte mechanischer Aufwand zu erhöhtem Energieverbrauch führen	Abfälle in der Herstellung: - Materialverschnitte in der Fassaden / Hüllenherstellung (Verschnitte, Anpassungen) Recyclingfähigkeit v. Materialien: - Membranmaterial je nach Art Demontagefreundlichkeit: - Gesteckte Systeme Denkbar	Einfluss auf Standort: - Kompaktes Bühnenkonzept - Wenig Flächenversiegelung - Nutzungspraktikabilität fraglich? Emissionen in d. Nutzung: -	Herstellungskosten: - Recycling vieler Rotorblätter, dadurch weniger Materialkosten im Vergleich zu virgin material - massive Stahlunterkonstruktion ist kostenintensiv Betriebskosten: - bewegliche Flügel können zu höheren Wartungskosten durch Verschleißteile führen -Regenwasserführung fraglich - Erhöhter Verschleiß von Bühne und Technik (Da nicht überdacht) Lebensdauer:	Kosten- Nutzen: - Erweiterbarkeit stark eingeschränkt durch Flügelanordung. - Überdachungen fehlen weitestgehend, somit erhöhter Wartungsaufwand Anpassbarkeit: - sternförmiges Design schränkt Erweiterungsmöglichkeiten ein -
Muschel	Anteil recycelter Materialien: - sinnvolle Wiederverwendung der Rotorblätter dank Membranüberzug möglich - Nachwachsend u. erneuerbar: - ggf. Membranmaterial ??? - Materialeffizienz: - massive Stahlunterkonstruktion an Fußpunkten benötigt - Hoher Stahlbetoneinsatz durch freien Kragarm ohne Auflagerpunkte. Umweltverträglichkeit: - ggf. Einsatz von CO2-sparendem Carbonauten-Beton denkbar -	Herstellung: - große Windangriffsfläche erfordert möglicherweise stärkere Verankerungen u. dadurch höheren Energieaufwand für Herstellung und Aufbau im Betrieb: - evtl. Beeinflussung der Lebensdauer der Rotorblätter durch flache Neigungswinkel, Beanspruchung durch Wind und Membran -	Abfälle in der Herstellung: - durchdachte Membrangeometrie reduziert Abfallmenge bei Herstellung - Anpassung der Membranfolie (Verschnitte / Ausschnitte) -Erhöhter Erdaushub (Entsorgung), bei der Fundamentierung Recyclingfähigkeit v. Materialien: - Membranenmaterial je nach Art - Demontagefreundlichkeit: -	Einfluss auf Standort: - positiv (keine "toten Zonen" gut Nutzbare Bereiche für Technik- und Backstagebereiche) - großer Flächenbedarf durch großes Bühnenkonzept. Mehr überdachte Bereiche (Flächenversiegelung) durch flache Neigung. Emissionen in d. Nutzung: -	Herstellungskosten: - massive Unterkonstruktion und Verankerungen erhöhen Kosten - negativ: komplexe Konstruktion, Individuelle Fußpunkte, wenig Wiederholungen, viele Einzelanfertigungen. - Mehraufwand (Zeit) bei der Montage bzw. zur Herstellung des Fußanschlusses, Anschlusspunkte. Betriebskosten: - Lebensdauer: - höhere Beanspruchung der Rotorblätter könnte ihre Lebensdauer reduzieren - komplexe Regenwasserführung, Entwässerung	Kosten- Nutzen: - Einsatz von Carbonauten-Beton könnte langfristig z.B. durch Förderungen für den Einsatz nachhaltiger Materialien Kosten reduzieren - Erweiterbarkeit gut realisierbar, durch Addition Anpassbarkeit:
Grube	Anteil recycelter Materialien: - sinnvolle Wiederverwendung der Rotorblätter dank Membranüberzug möglich - viele Rotorblätter werden reused und neu eingesetzt. Nachwachsend u. erneuerbar: - ggf. Membranmaterial ??? Materialeffizienz: - massive Stahlunterkonstruktion benötigt - Hoher Materialeinsatz für Tribünen - punktförmige Befestigung der Membran an Rotorblättern reduziert Materialbedarf, da weniger Verankerungspunkte notwendig Umweltverträglichkeit: - voraussichtlich weniger Fundamentierungen erforderlich als in	Herstellung: - große Windangriffsfläche erfordert möglicherweise stärkere Verankerungen u. dadurch höheren Energieaufwand für Herstellung und Aufbau (voraussichtlich zusätzliche Halterungspunkte an den Tiefpunkten der Membranen erforderlich) - Weniger hoher, Aufwand für die Einleitung von Kräften in den Baugrund, da zusätzliche Auflagerpunkte geschaffen werden. im Betrieb: -	Abfälle in der Herstellung: - Hoher Aufwand für die Herstellungen der Membranen erforderlich (komplexe Konstruktion) Recyclingfähigkeit v. Materialien: - Membranenmaterial je nach Art Demontagefreundlichkeit: - Tribühne könnte Modular aufgebaut und abgebaut werden.	Einfluss auf Standort: - große Grundfläche dadurch hohe Flächenversiegelung Emissionen in d. Nutzung: -	Herstellungskosten: - Aufwändige Bühnenkonstruktion / hoher Materialeinsatz - Betriebskosten: - **Lebensdauer:** - komplexe Regenwasserführung, Entwässerung (schlechte Lage der Entwässerungspunkte) - Hohe Windlasten an den Membranen / höherer Verschleiß	Kosten- Nutzen: - Hoher Ressourcenaufwand beim Bau der Tribünen - Aufwändige Konstruktion im Außenbereich, ggf. unnötig große Überdachung nach außen. Anpassbarkeit: - gute Anpassbarkeit, könnte zu einem Stadion erweitert werden.
Dome	Anteil recycelter Materialien: - Nutzung vieler Flügel Nachwachsend u. erneuerbar: - Holzbauteile Materialeffizienz: - Hoher Materialverbrauch der Stahlkonstruktion - Bühnenkonzept ähnlich Amphitheater somit erhöhter Materialbedarf für Tribühne Umweltverträglichkeit: -	Herstellung: - Fundamentierung über Streifenfundamente, Schraubfundamente oder Punktfundamente möglich - Aufrichtung der Flügel ab 3 Stück einfach, da dann der innere Ring durch die bereits installierten Flügel fixiert wird - Voraussichtlich einfache Herstellung durch Wiederholende Struktur im Betrieb: - gut geschützter Innenbereich, sogar beheitzt möglich	Abfälle in der Herstellung: - positiv durchdachte Membrangeometrie reduziert Abfallmenge bei Herstellung Recyclingfähigkeit v. Materialien: - viele Materialien wie Stahlteile - Bühne könnte Modular aufgebaut werden Demontagefreundlichkeit: - Erhöhter Rückbauaufwand je nach Fundamentierung	Einfluss auf Standort: - relativ große Grundform in Höhe und Flächenversiegelung Emissionen in d. Nutzung: - wenn beheizt, Heizkosten - muss voraussichtlich immer mit Kunstlicht betrieben werden.	Herstellungskosten: - Aufwändige Bühnenkonstruktion / hoher Materialeinsatz Betriebskosten: - Heizkosten, Stromkosten für permanente Beleuchtung, ggf. Lüftungsanlage erforderlich Lebensdauer: - Das flexible Design könnte sich Lebensdauer verlängernd auswirken - voraussichtlich geringe Windlasten, und einfache Regenwasserführung	Kosten- Nutzen: - Hoher Ressourcenaufwand beim Bau der Tribünen - sehr hohe Deckenhöhe, die ggf. nicht zwingend notwendig wäre. Anpassbarkeit: - Dome kann erweitert oder reduziert werden und ist damit an verschiedene Eventgrößen anpassbar - Events auch im Winter, bei Regen, Schnee gut machbar, da beheizbar
Drachen	Anteil recycelter Materialien: - Nachwachsend u. erneuerbar: - Holzbauteile Materialeffizienz: - dank mehrerer Auflager wenig Fundamentierung nötig Umweltverträglichkeit: -	Herstellung: - Fundamentierung über Punktfundamente - Zweites Auflager reduziert den Gründungsresourcenaufwand im Betrieb: -	Abfälle in der Herstellung: - durchdachte Membrangeometrie reduziert Abfallmenge bei Herstellung Recyclingfähigkeit v. Materialien: - je nach Fundamentierung Demontagefreundlichkeit: - Die Flügel können einfach zurckgebaut werden, da sie lediglich verschraubt und lose aufgelegt sind.	Einfluss auf Standort: - Emissionen in d. Nutzung: -	Herstellungskosten: - Modulare Fertigung möglich. - Betriebskosten: - Lebensdauer: - Auskragende Membran dadurch geschützte Bühnenbereiche , Einfache Dachform erhöhen die Lebensdauer	Kosten- Nutzen: - - Anpassbarkeit: - kann erweitert und dadurch an verschiedene Nutzungen angepasst werden

- Evaluation matrix developed as part of a research project
- Supports selection and optimization of stage design models
- Based on ecological and economic sustainability criteria
- Applicable in architecture, urban planning, and engineering contexts

power*stage | Advanced evaluation matrix

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ローターの再考

- Advanced evaluation matrix based on the first qualitative matrix
- Systematic assessment and selection of stage models
- Uses a quantitative approach with weighted scores
- Allows for more objective comparison between different designs

Vergleich der Bühnenmodelle

Kriterium		Gewichtungs-faktor	Fächer Punkte	Fächer Ø pro Kategorie	Seerose Punkte	Seerose Ø pro Kategorie	Muschel Punkte	Muschel Ø pro Kategorie	Grube Punkte	Grube Ø pro Kategorie	Dome Punkte	Dome Ø pro Kategorie	Drache Punkte	Drache Ø pro Kategorie
Ökologische Kriterien	Materialnutzung	1.5	2	2.80		0.00		0.00		0.00		0.00		0.00
	Energieverbrauch	1.5	2											
	Abfallmanagement u. Recycling	1.0	3											
	Umweltbelastung vor Ort	1.0	5											
Ökonomische Kriterien	Kosteneffizienz	1.0	5	3.00		0.00		0.00		0.00		0.00		0.00
	Ressourceneffizienz	1.0	1											
Soziale Kriterien	Nutzerfreundlichkeit	1.0	2	3.00		0.00		0.00		0.00		0.00		0.00
	Bildungswert	1.0	3											
	Sicherheit	1.0	4											
Technologische Kriterien	Innovationsfreundlichkeit	0.5	5	4.00	3	1.75	4	2.50	4	3.00	4	2.50		0.00
	Energietechnik	1.0	5		2		3		4		3			
	Strukturelle Eigenschaften	0.5	1											
Architektonische & konstruktive Kriterien	Maschinenbau	1.0	2	3.00		0.00		0.00		0.00		0.00		0.00
	Statik	0.5	3											
	Design	1.0	4											
Übergeordnete Kriterien	Lebenszyklusbetrachtung	1.5	5	4.00		0.00		0.00		0.00		0.00		0.00
	Nachnutzbarkeit	0.5	1											
Gesamtbewertung	Ø aller Kategorien			3.30		0.29		0.42		0.50		0.42		0.00

Architektur-Konstruktion-Tragwerk-Nachhaltigkeit-Energie

Kriterium		Gewichtungs-faktor	Fächer Punkte	Fächer Ø pro Kategorie	Seerose Punkte	Seerose Ø pro Kategorie	Muschel Punkte	Muschel Ø pro Kategorie	Grube Punkte	Grube Ø pro Kategorie	Dome Punkte	Dome Ø pro Kategorie	Drache Punkte	Drache Ø pro Kategorie
Design	Innovationsfreundlichkeit	1.0	3	4.20	5	5.40	2	4.10	3	5.00	3	5.20	5	6.60
	Soziale / Soziologische Aspekte	1.0	3		4		2		3		3		5	
	Architektursprache	1.5	3		5		3		4		4		5	
	Bildungswert	1.0	3		3		3		4		5		5	
	Reuse / Recycling	1.5	2		3		2		2		2		3	
	Funktionalität	1.5	3		2		4		4		4		4	
Analyse Tragkonzept (Planerischer Teil)	Innovation	1.0	3	3.10	4	3.80	2	3.20	4	3.60	3	4.00	4	4.10
	Material- / Recourcenverbrauch	1.5	3		4		2		2		2		3	
	Konstruktive Tragfähigkeit Rigging (Anhängen Boxen etc.)	1.0	1		1		5		5		5		4	
	Abhängigkeit von Batteriemasse	0.5	3		3		3		3		3		4	
	Komplexität der Kräfte Dachhaut / Tragwerk	0.5	2		4		2		2		4		3	
	Komplexität der Kräfte-/Massenverteilung	1.0	3		3		2		2		4		3	
	Bedarf zusätzlicher Tragwerke (Planungsaufwand, Sonderlösungen)	0.5	3		3		3		3		3		3	
ktive Anforderungen (Praktische Planung / Reali	Tragfähigkeit	1.0	2	6.00	3	6.40	2	5.70	3	5.40	4	7.70	3	6.60
	Festigkeit	1.5	3		3		3		3		5		3	
	Bauingenieurwesen / Tragwerksplaner	1.0	3		3		2		3		4		3	
	Strukturelle Eigenschaften	1.0	3		3		2		2		4		2	
	Integrierbarkeit von Rigging (Montage Abhangsysteme) Anschlagpunkten	1.5	2		1		4		3		4		3	
	Bedarf Stahlbau (Nachhaltigkeit)	1.0	3		4		2		2		1		3	
	Bedarf Betonbau (Nachhaltigkeit)	1.0	2		4		1		2		3		3	
	Komplexität der Strukturelemente (Anschlusspunkte an Rotorblätter)	0.5	4		2		4		2		4		4	
	Komplexität der Montage (Montage Vor-Ort, Montage Bauteile)	1.0	3		2		4		2		4		2	
	Reuse / Recycling	1.5	3		4		2		2		2		4	
Energietechnik	Innovationsfreundlichkeit	1.0	2	3.60	1	4.70	2	8.40	4	8.80	3	7.90	4	6.70
	Verfügbare Solarfläche Membran	1.0	3		1		5		5		4		4	
	Verfügbare Solafläche Rotorblätter	0.5	1		1		5		5		4		3	
	Zugänglichkeit zu Solarflächen	0.5	2		1		4		4		3		3	
	Bauraum für Solarelektronik	0.5	1		3		5		5		5		3	
	Zugänglichkeit Solarelektronik	1.0	2		3		4		4		4		3	
	Komplexität der Batterieintegration	1.0	1		3		4		4		4		2	
	Integrationsraum / Batteriegröße (Verfügbares Volumen für Batterien)	1.0	1		3		4		4		4		2	
	Zugänglichkeit Batteriesystem	1.5	1		3		4		4		4		3	
	Integrierbarkeit zentraler Betriebsraum (Verteiler, Räumlihckeiten, extern / intern)	1.0	1		1		4		4		4		2	
	Reuse / Recycling	1.5	3		3		4		4		3		5	
Flexibilität	Skalierbarkeit (Bühnengröße, Zuschauer	1.5	2	4.10	2	4.60	4	4.80	3	4.60	2	4.20	5	6.50
	Funktionale Erweiterbarkeit (im Design, Integrierbarkeit Technik, Erweiterbarkeit Speicher etc.)	1.0	2		2		4		4		3		3	
	Rückbaufähigkeit	1.5	3		4		1		1		1		4	
	Standortflexibilität	1.5	4		4		2		2		2		4	
	Nutzbarkeit / Events	1.5	2		2		5		4		5		4	
	Nutzungsvariabilität	1.0	2		3		2		4		3		4	
Gesamtbewertung	Ø aller Kategorien			4.20		4.88		5.53		5.60		5.95		5.98

Inhalte zum Thema power*stage
Städtebau und Soziologie
(Arbeitspaket 1)

Construction | Structural Concept

power*stage | Structural Principles

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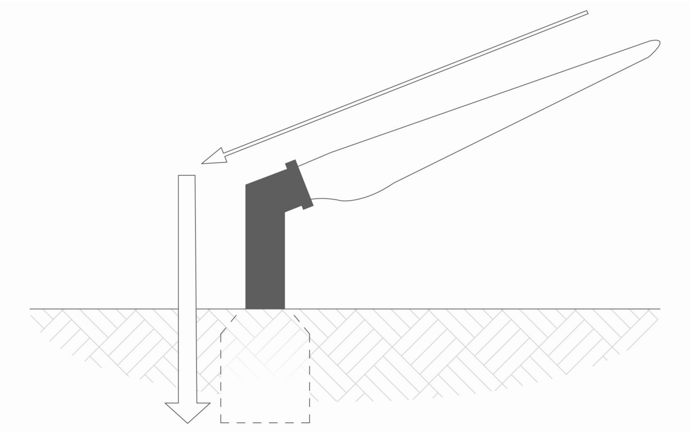
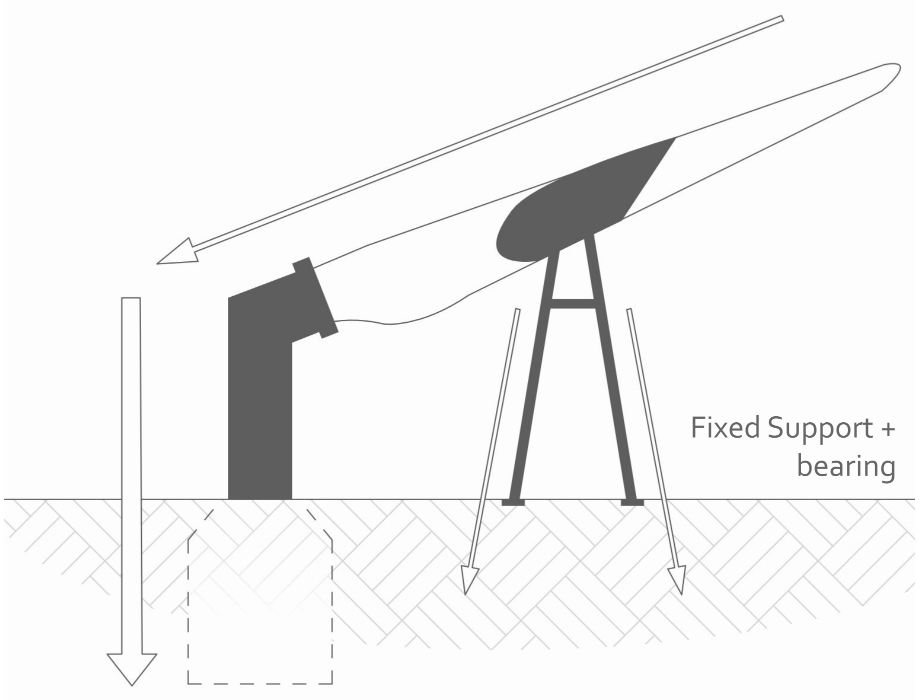


Cantilever Structure with
Fixed Support



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power*stage | Structural Principles

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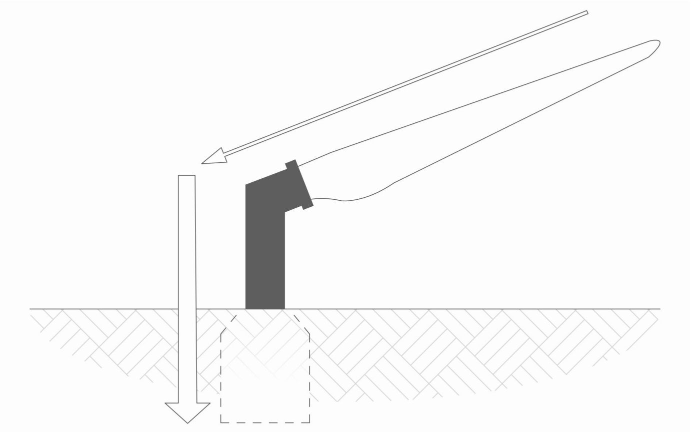
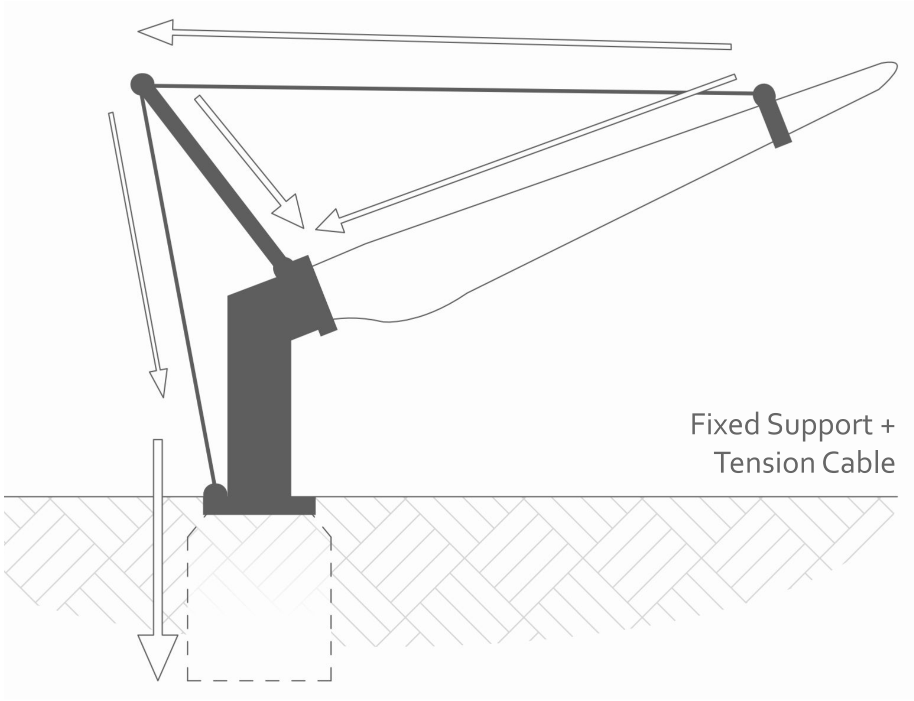
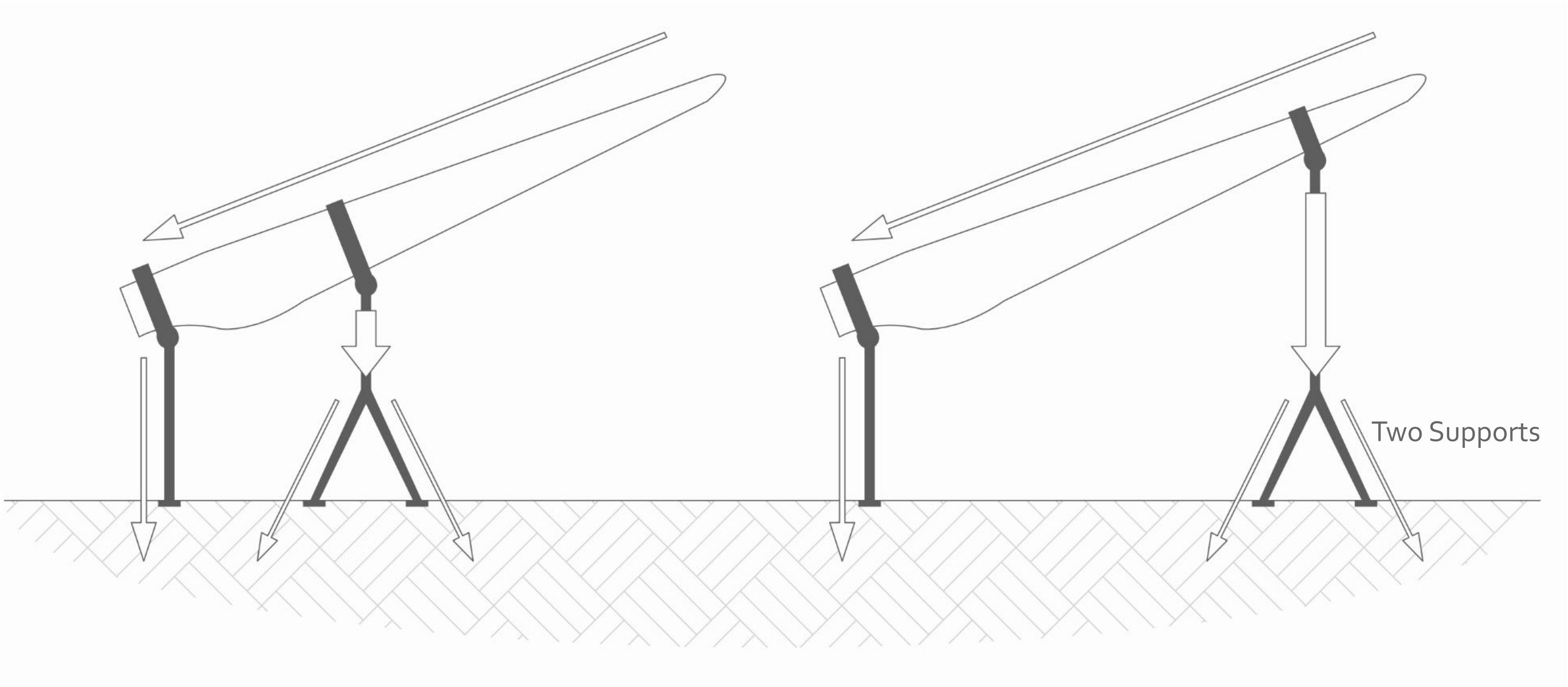




Cantilever Structure with Fixed Support

power*stage | Structural Principles



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Departure to Rotopia

Master draft project at h_da

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Departure to Rotopia | Master project

Departure to Rotopia | The Location

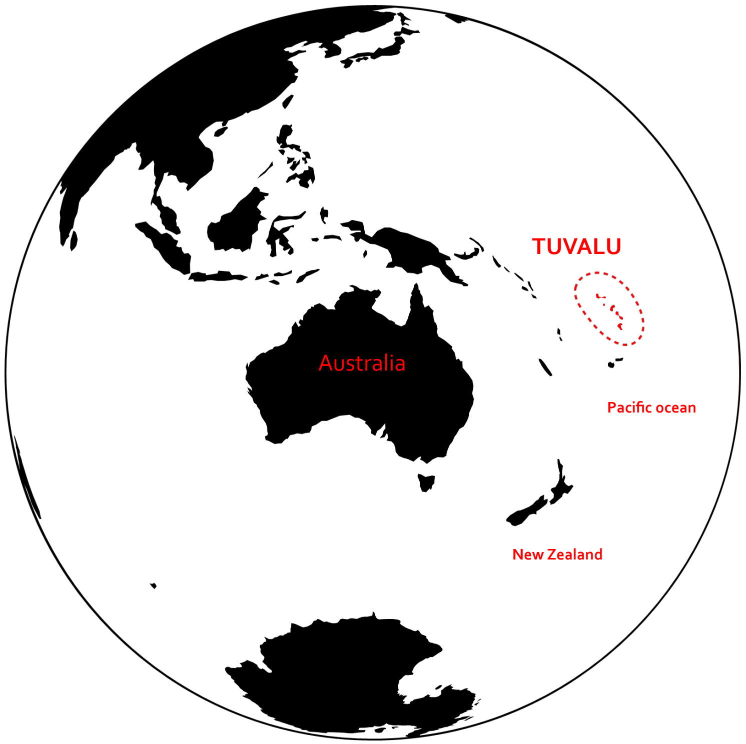
Tuvalu

- Archipelago, consisting of 9 islands
- „fourth smallest country in the world“

Departure to Rotopia | The Location

Tuvalu

- approx. 3700km from Australia
- approx. 26km2 total area
- approx. 10,000 inhabitants with a density of 431 inhabitants/km2
- Parliamentary monarchy represented by King Charles 3.

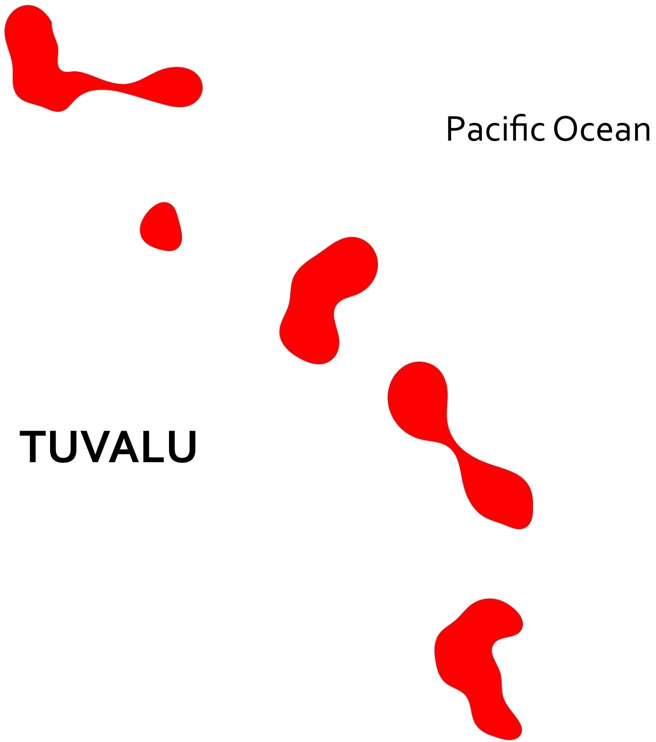


Departure to Rotopia | The Location

- The highest elevation is less than 5 meters. Due to rising sea levels, this state is also in danger of sinking.

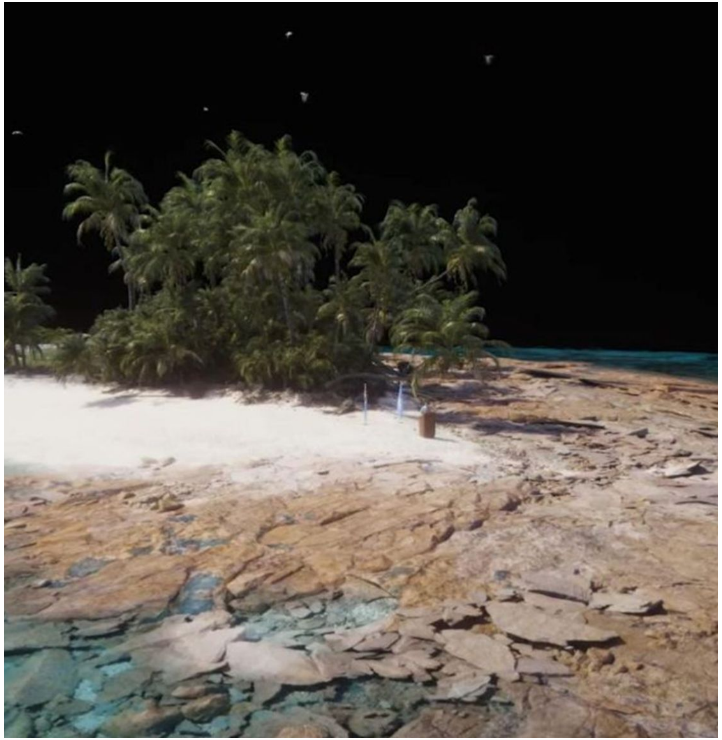
- Due to the circumstances, the government tried to apply for asylum for the inhabitants of Tuvalu in Australia and New Zealand.

- Around 300 people were to be resettled each year. However, the application was rejected.



Departure to Rotopia | The Location

Departure to Rotopia | The Location



TUVALU

Can we design an adequate replacement for the residents?

TUVALU

Rotopia Concept

Resident Design | Rotopia

by Sara Sürmeli Priscilla, Hussaini Fatma, Kübra Gülseven

Rotopia | Concept Visualisation

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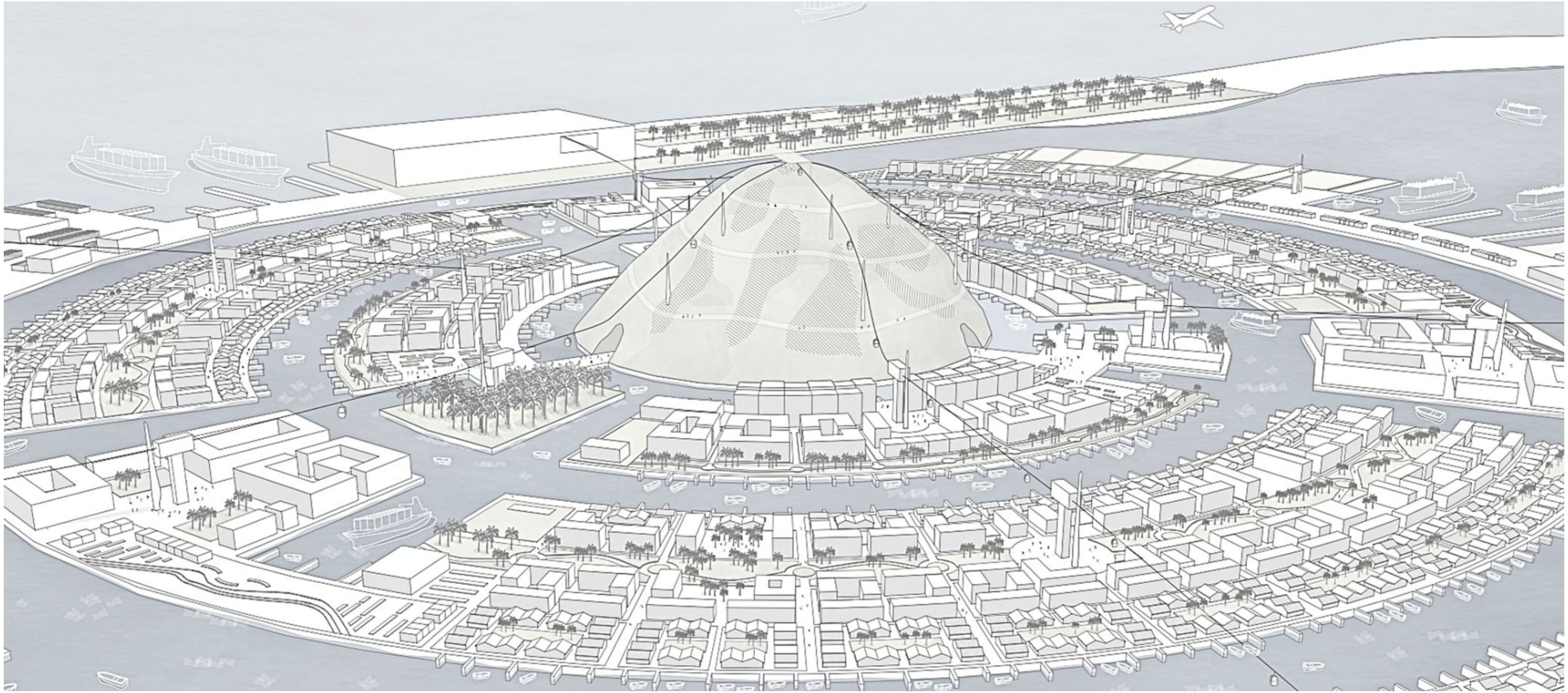
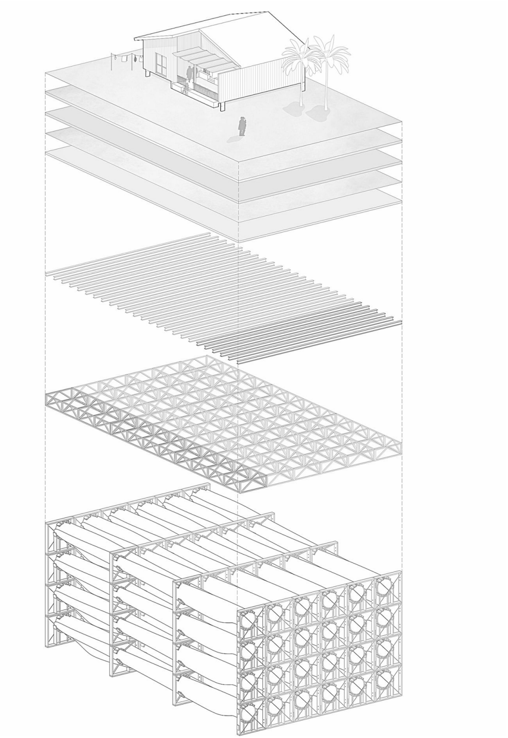
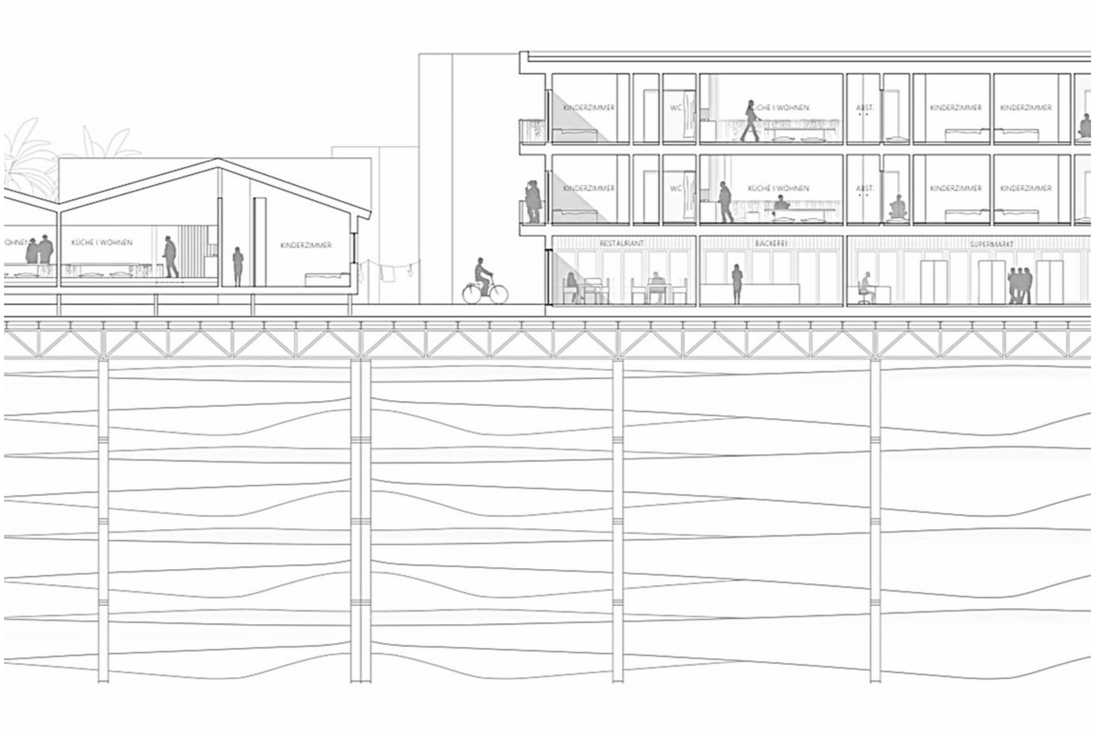
ローターの再考



Rotopia | Modularity





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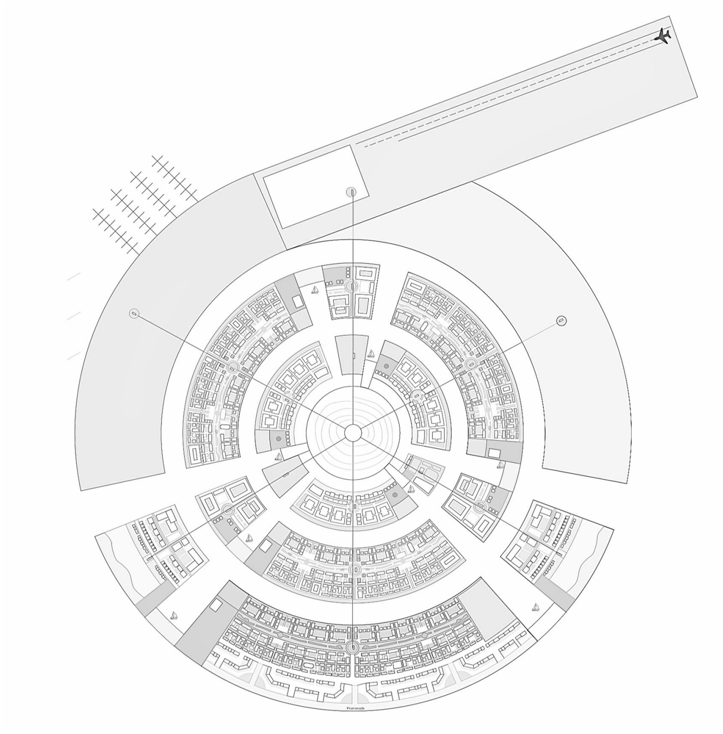
Rotopia | Urban planning



Applied strategies:

- appropriate culturally urban planning
- structured zoning
- accessible to all
- lively city edges
- integration of the airport
- representative mountain

TUVALU

Arche Tuvalu Concept

Resident Design | Concept Arche Tuvalu

by Felizitas Dochantschi, Giulia Migliorini, Lesley Saszawa

Arche Tuvalu | Concept Visualisation

Arche Tuvalu | Concept Visualisation

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ローターの再考

2023

2040

2100

Arche Tuvalu | Masterplan

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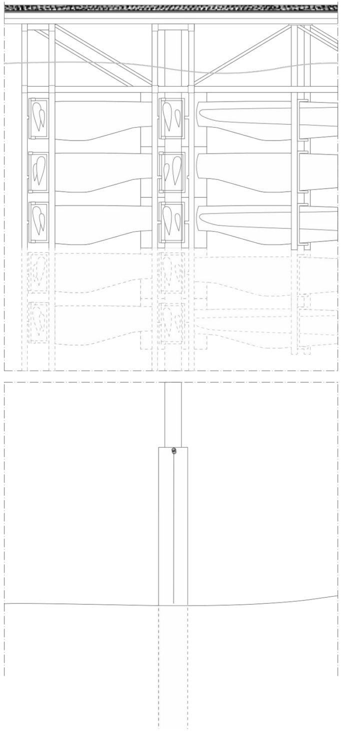
Arche Tuvalu | Island Construction

Square	
Plates	4 cm
Filter fleece	
Gravel fill	40 cm
Geo fleece	2 mm
Drainage plate	25 mm
Marine plate	10 cm
Grid	40 cm

Lawn	
Lawn	5 cm
Substrate	1 m
Granules	15 cm
Geo fleece	2 mm
Drain Plate	25 mm
Marine Plate	10 cm
Grid	40 cm

Living	
Bottom slab	80 cm
Blinding layer	5 cm
Capillary breaking layer	40 cm
Drain plate	25 mm
Marine plate	10 cm
Grid	40 cm

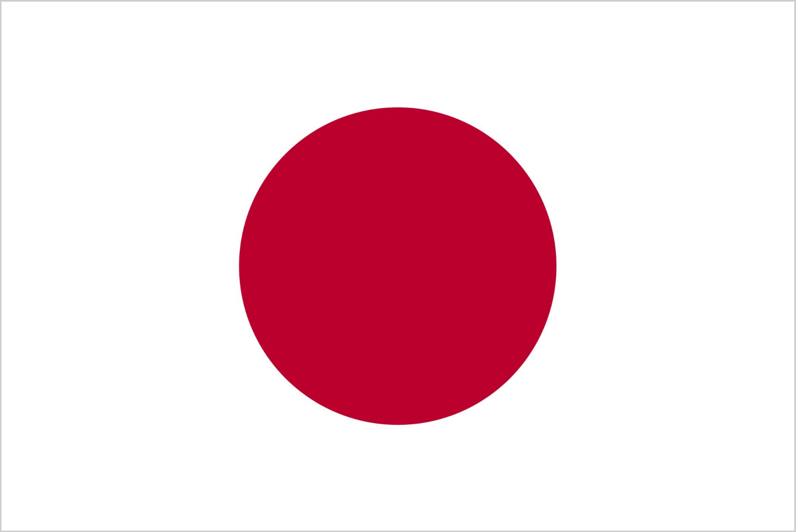


A new life for rotor*blades
Energy on the water

Elective subject at h_da

Energy on the water | WASEDA University x h_da

rethink*rotor
ローターの再考

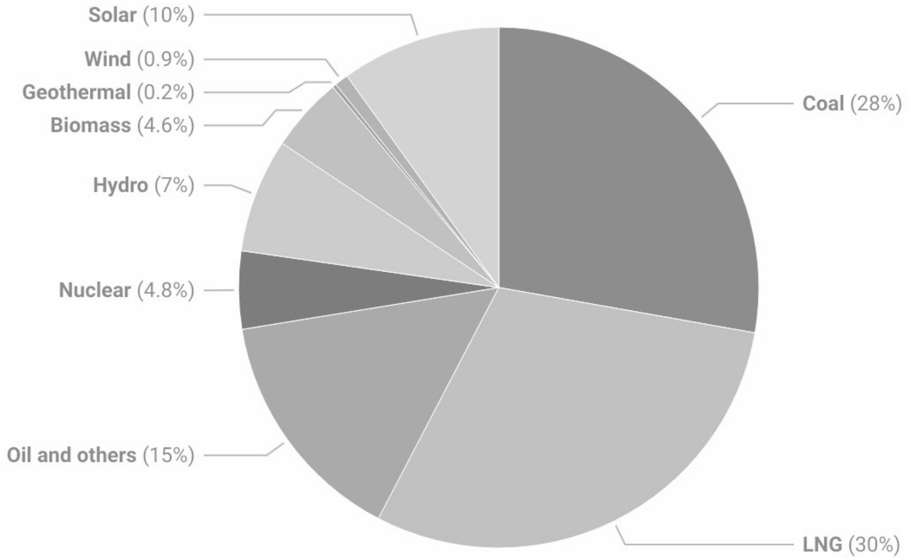


Energy on the water

Analysing the energy supply in Japan

Energy on the water | Energy supply in Japan

- heavily dependent on energy imports (has hardly any natural raw materials of its own
- covers its energy needs with a combination of different energy sources
- vulnerable to price fluctuations and geopolitical risks
- makes the country susceptible to global market changes



Energy on the water | Investment in Renewable Energies

- Plans to make renewable energies as its main source by 2040
- Investing heavily in green hydrogen to partially replace crude oil
- Focus on recycling, circular economy, recovery of metals, further development of raw material extraction in the deep sea areas
- huge potential for geothermal energy due to its volcanic activity
- Basic Energy Plan (2021)
  - Reduction of fossil fuels: share of coal and gas to fall to 41% by 2030
  - Increase in renewable energies: Target: 36-38 % by 2030
  - Nuclear energy revitalisation: In the long term, it should once again account for 20-22 % of the energy mix
- Japan is committed to becoming climate neutral by 2050

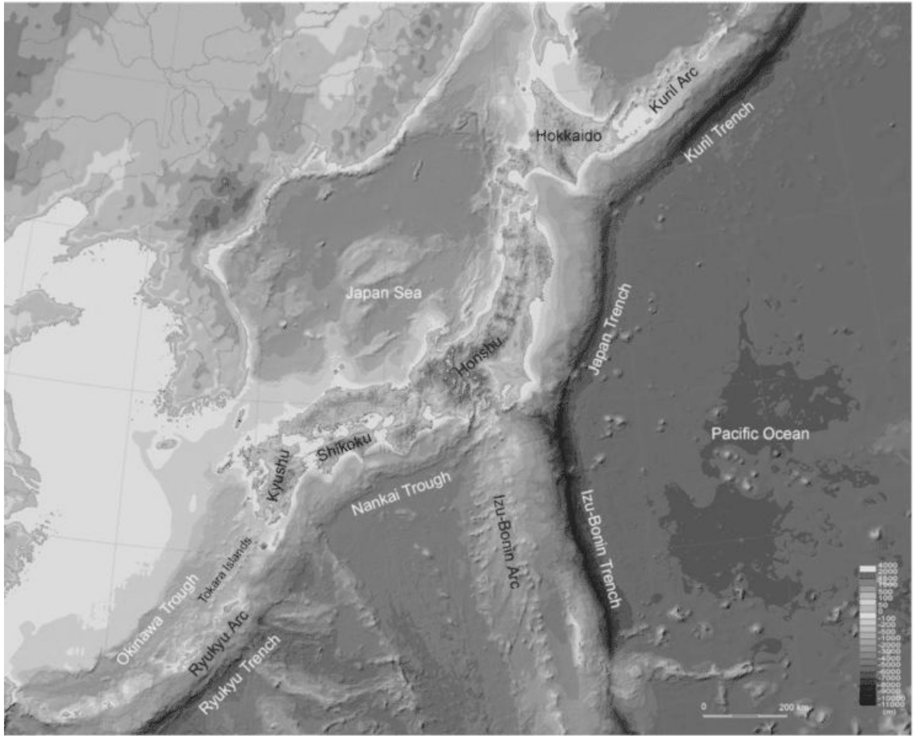
Energy on the water | Comparison

- Philippines
  - Geothermal energy and hydropower approx. 82% of electricity generation
  - Solar and wind energy still underdeveloped
- Indonesia
  - fossil resources (coal)
  - only utilises geothermal potential to a limited extent
- Taiwan
  - High Import dependency (~98 %)
  - Planned phase-out of Nuclear energy by 2025
  - growing share of renewable energies (lack of space)
- South Korea
  - similar Import dependency to Japan (~90 %)
  - Nuclear energy and fossil fuels
  - growing investment in renewable energies

Energy on the water

Analysing geographical, political and technological conditions

Energy on the water | Geographical Framework conditions



- Interface of several tectonic plates, causes high level of seismic activity
- High risk of earthquakes, tsunamis, flooding of coastal areas, land-/rockslides

Energy on the water | In connection with wind power

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ローターの再考

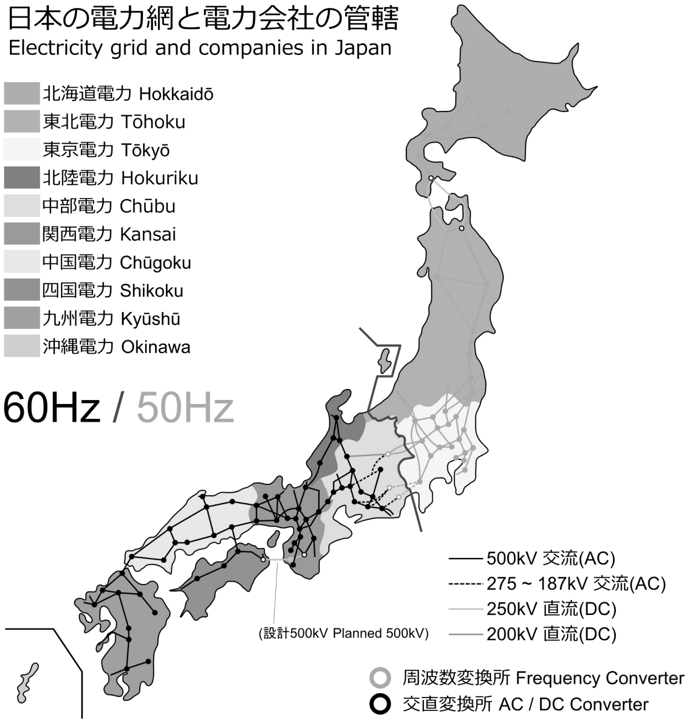
- Steep, by mountains characterised Landscape and Natural Disasters makes construction of onshore wind turbines difficult
- Ideal conditions for offshore wind power in coastal regions

- Theoretical potential of over 9,000 terawatt hours per year from offshore wind energy

Energy on the water | Political Framework conditions

- Heavy criticism of Nuclear power after disaster in Fukushima (2011)
    - shut down of many Nuclear power pants
    - Increasing dependence on fossil fuels, energy imports
    - recommissioning of nuclear power plants, to stabilise the energy supply
- Plan is to, shut down nuclear power plants completely and expand renewable energies
- Increased focus on diversifying energy sources in order to minimise geopolitical risks
- Possible solution: Offshore wind power, expansion of hydrogen technology

Energy on the water | Technological Framework conditions



- electricity grid was not originally designed for a high feed-in of renewable energies
- Network infrastructure requires modernisation
    - energy storage, smart grids, load management

Energy on the water | In connection with (Offshore) wind power

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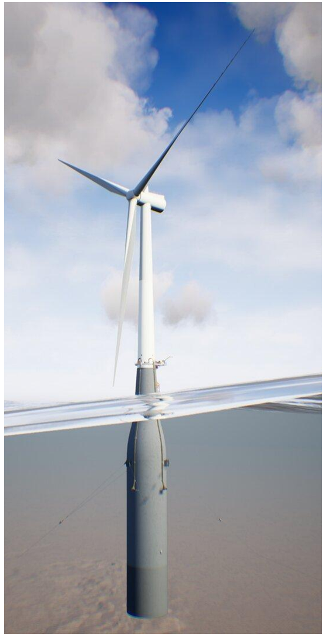
ローターの再考

- Increased Investment in offshore wind power, as the technology becomes more mature
- Floating wind turbines, can be installed in deep waters where fixed foundations are not possible
- Could play a central role in Japan's energy supply

Energy on the water
Evaluation of existing concepts for floating platforms

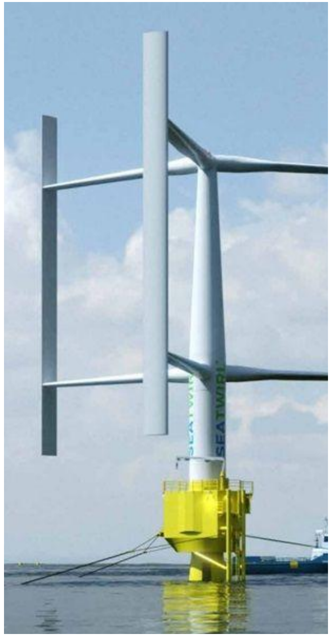
Energy on the water | Evaluation of existing floating platforms

WindFloat
(Principle Power)



Hywind (Equinor)

Fukushima Mirai
(Japan)

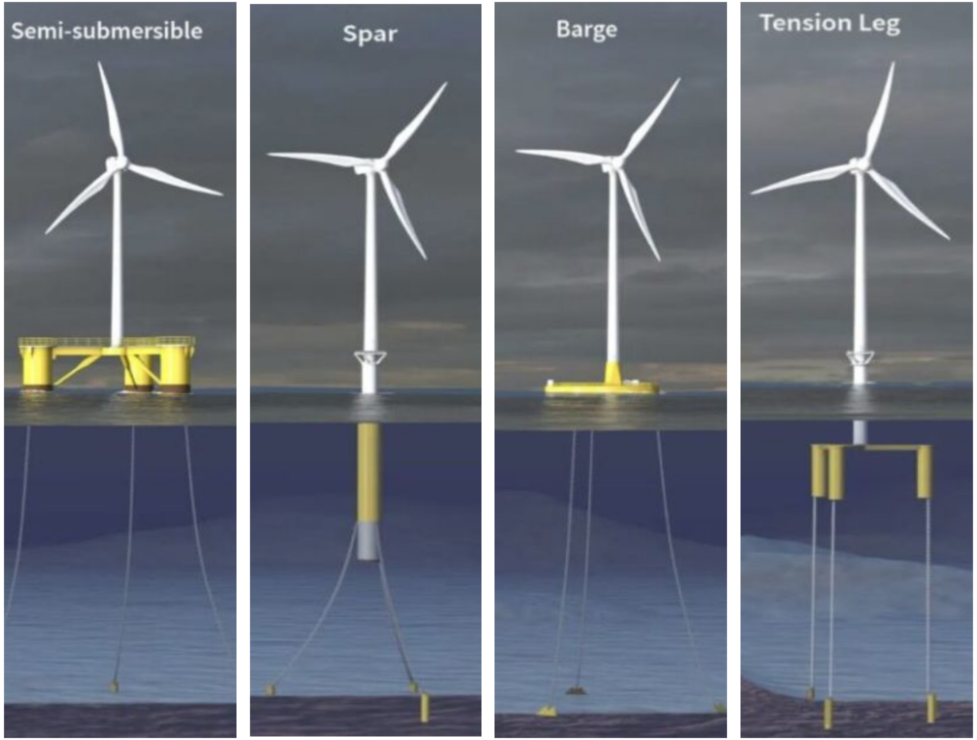


Sea Twirl

Blue SATH

Energy on the water | Floating Platforms: Key Types

- Semi-Submersible Platforms
- Spar Buoy Platforms
- Barge Platforms
- Tension-leg Platform



Energy on the water | Required wind turbines to fully power Japan

- Annual consumption Japan - approx. 950 TWh

= around 31,667 offshore wind turbines, each with a capacity of 8 MW

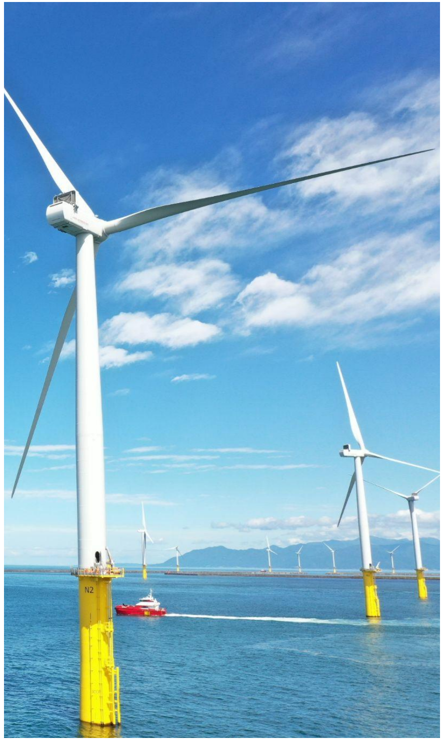
(calculations depend on Weather conditions, wind speed, efficiency)

Wind farms in Japan

for rotor blade recycling

Energy on the water | Existing wind Farms in Japan

- Setana Wind Farm (Hokkaido), since 2004
- Sakata Offshore Wind Farm (Yamagata), since 2005
- Wind Power Kamisu (Ibaraki), since 2008
- Fukushima Floating Wind Turbine (Fukushima), since 2013
- Noshiro Port and Akita Port (Akita), since 2022
- Ishikari Bay (Hokkaido), since 2023



Energy on the water

Student Concepts

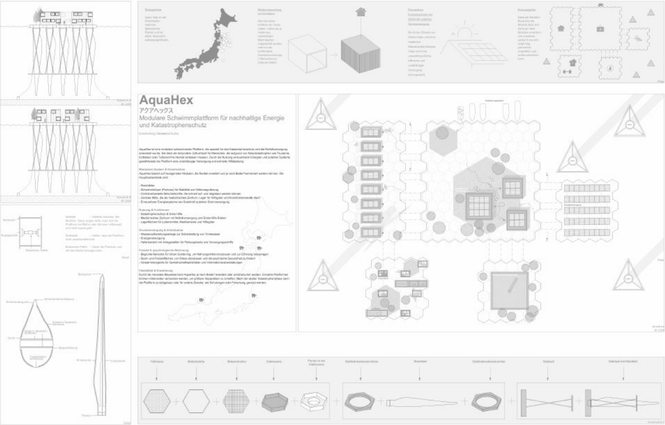
Energy on the water | Windfarms

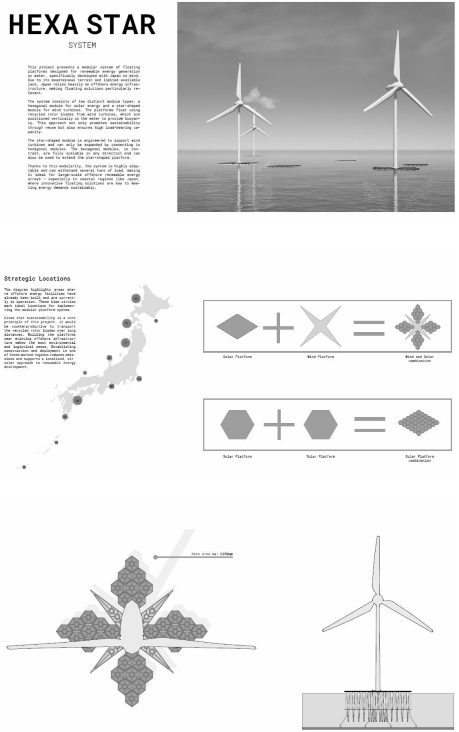
Jil Laske, Nadine Köpke Carrizalez

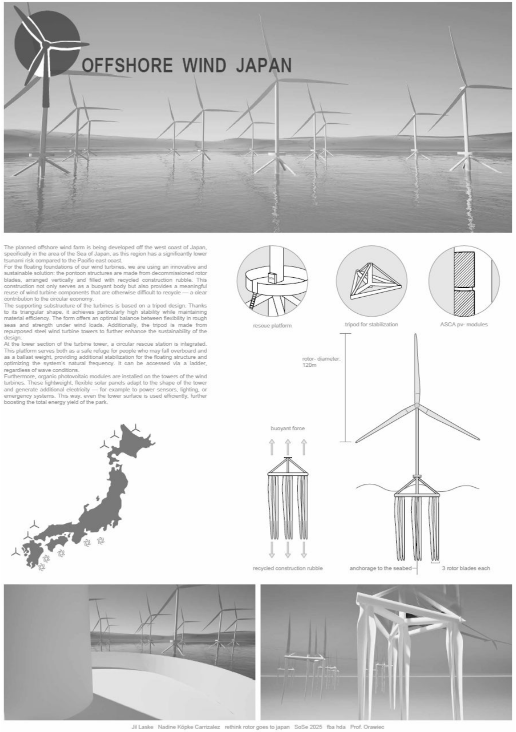
- Offshore wind farm off Japan's west coast, with lower tsunami risk
- Floating foundations made from decommissioned rotor blades and recycled rubble
- Dual function as buoyant structure and reuse of wind turbine components
- Triangular shape for stability and efficiency
- Integrated circular rescue station for safety and frequency optimization

Energy on the water | Student Concepts

rethink*rotor
ローターの再考



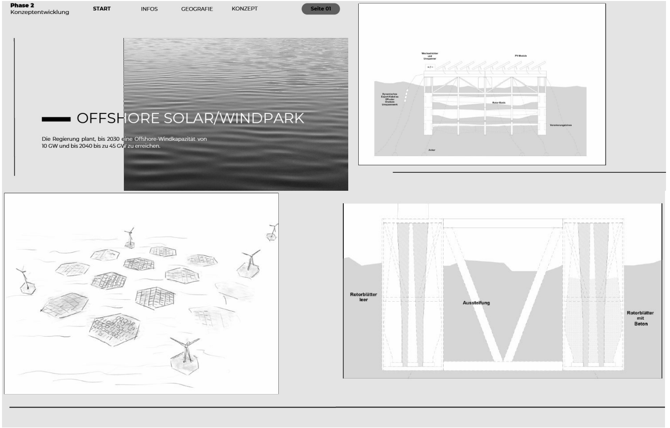


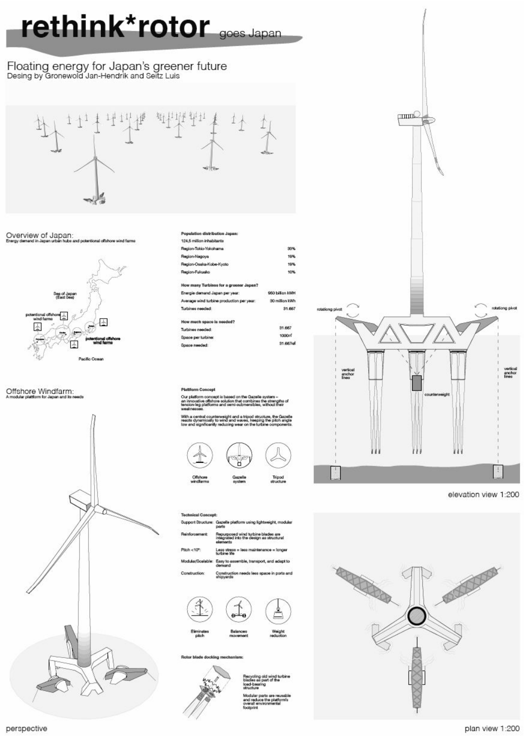


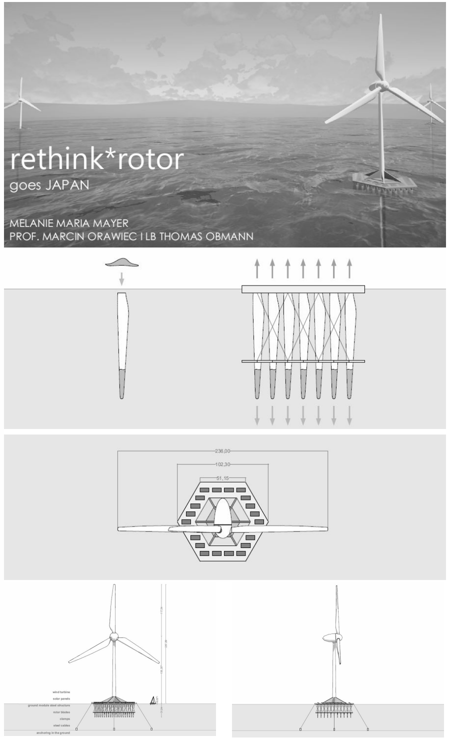
Overview of Student Work from the Course

Energy on the water | Student Concepts

rethink*rotor
ローターの再考



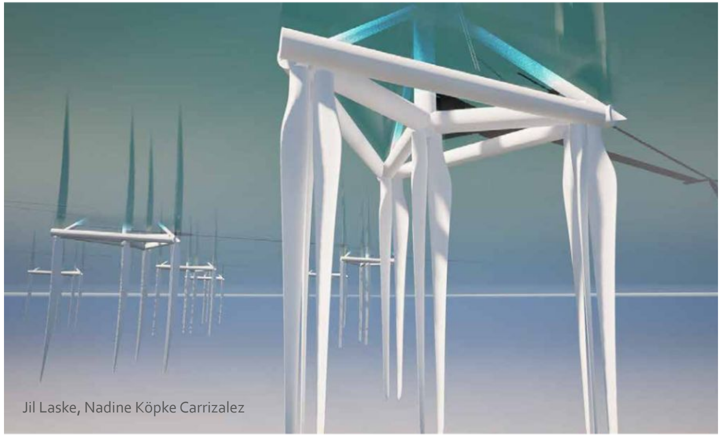




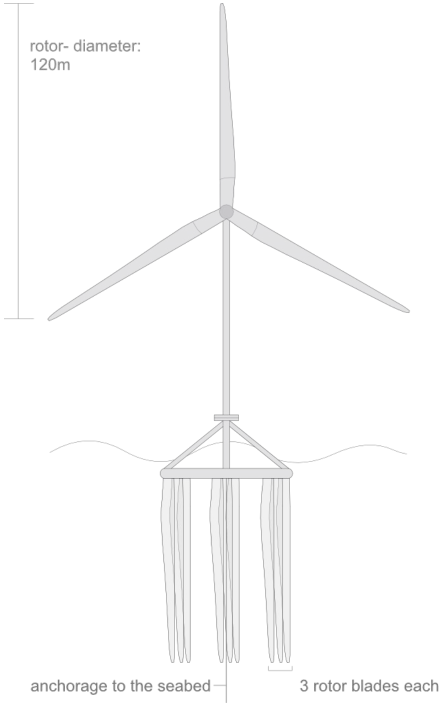
Overview of Student Work from the Course

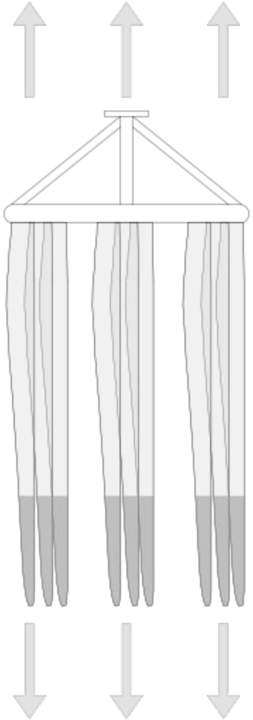
Student Concepts | Tripod Design

Energy on the water | Offshore Concept: Tripod Design



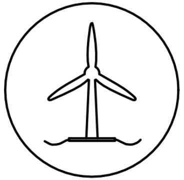
The supporting substructure of the turbines is based on a tripod design to achieve high stability and low material consumption



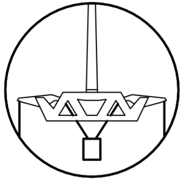


Jil Laske, Nadine Köpke Carrizalez

Energy on the water | Offshore Concept: Tripod Design

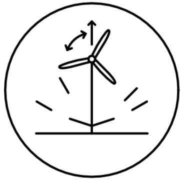


Offshore windfarms

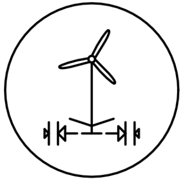


Gazelle system

Tripod structure

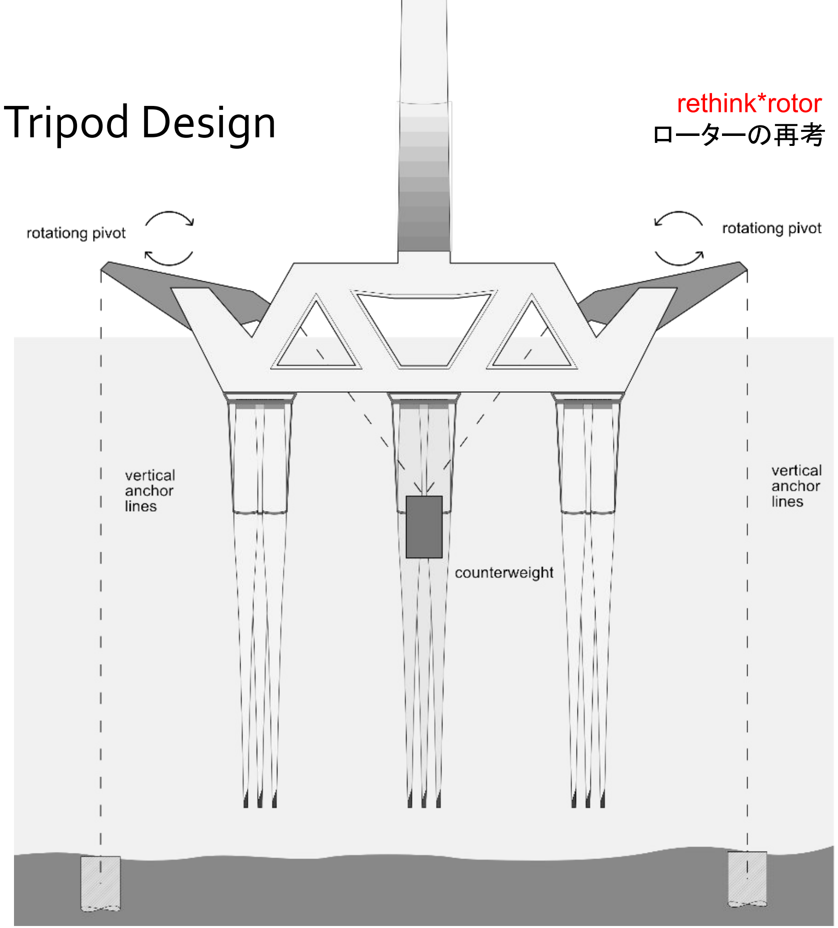


Eliminates pitch



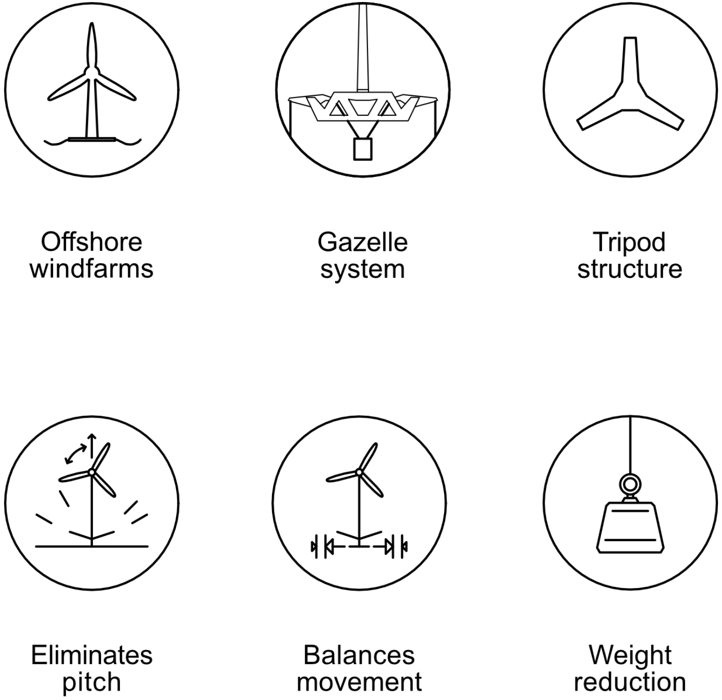
Balances movement

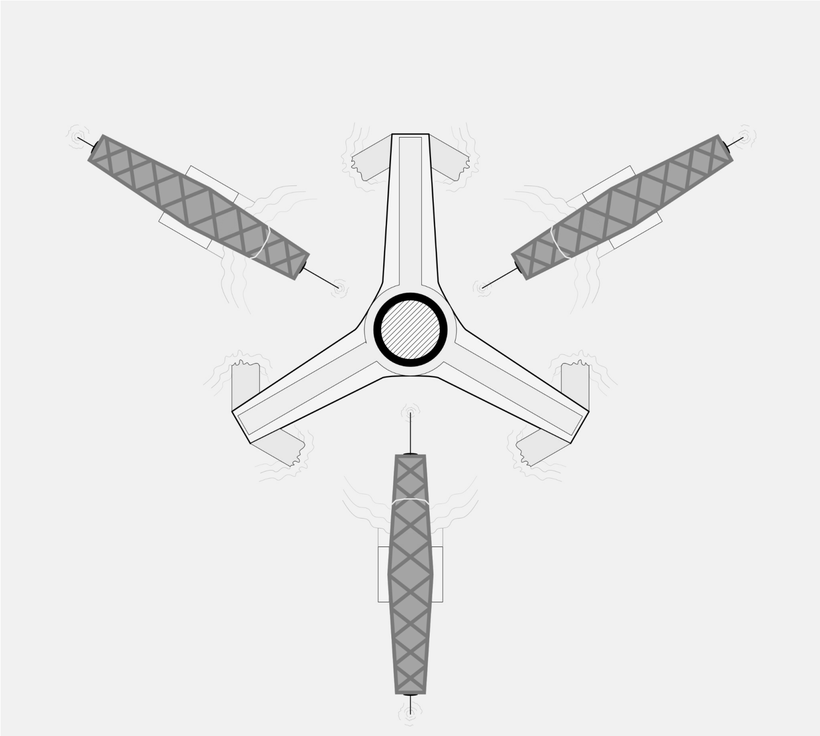
Weight reduction



Jan-Hendrik Gronewold and Luis Seitz

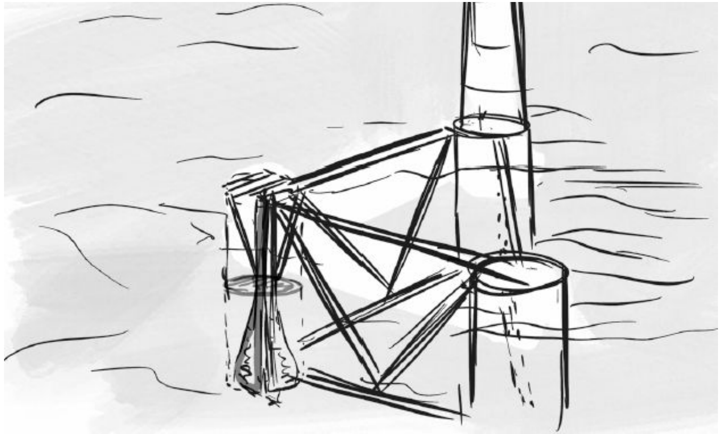
Energy on the water | Offshore Concept: Tripod Design

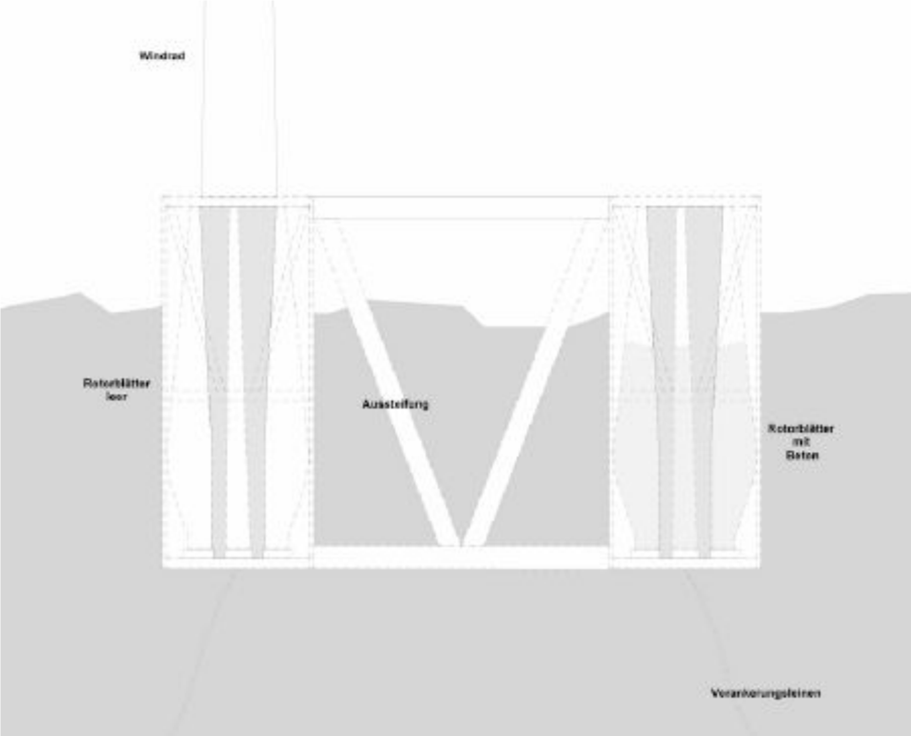




Jan-Hendrik Gronewold and Luis Seitz

Energy on the water | Offshore Concept: Triangular Design





- Typhoon-resistant design
- Reduced surface for wind/wave impact
- Tsunami and earthquake resilience

- Tsunami and earthquake resilience
- Reduced surface for wind/wave impact

Fatima Ismail, Charlotte Seip

Student Concepts | Hexagon Design

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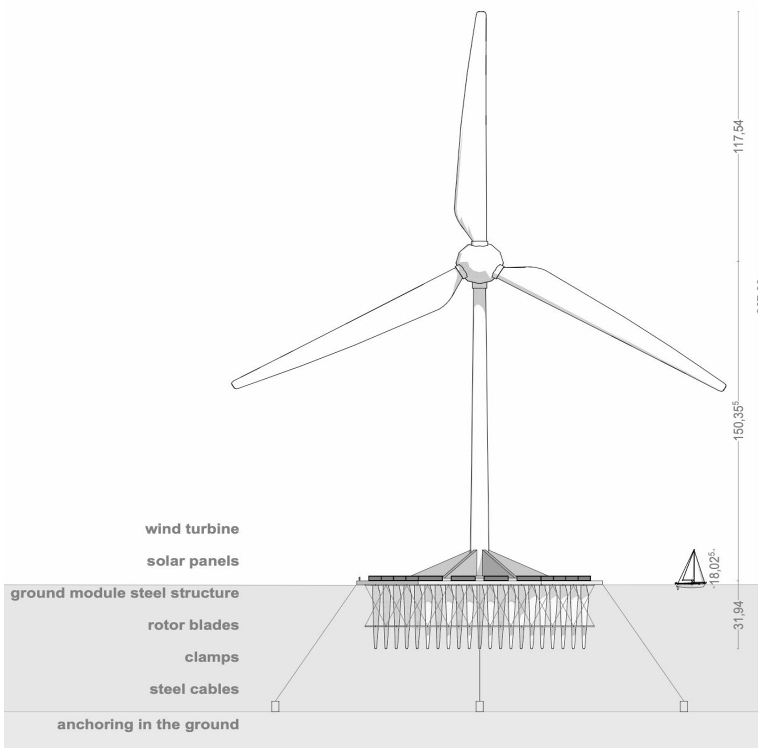
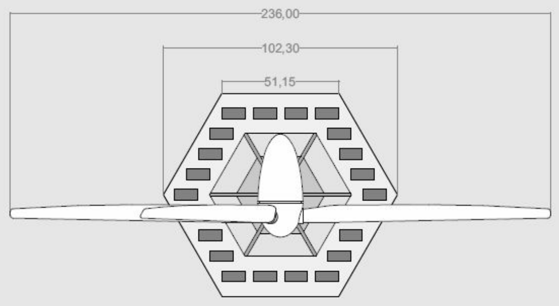
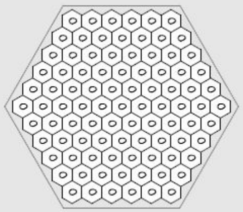




1 wind turbine

22 solar panels

91 rotor blades for lift



91 rotor blades with 94 tons of lift each = 8,554 tons of lift

weight of wind turbine = 2,815 tons

Melanie Maria Mayer

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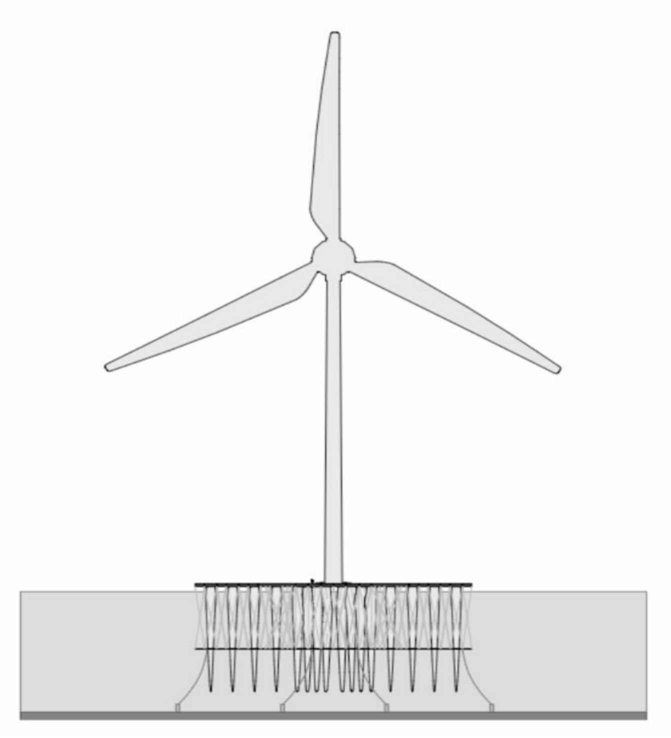
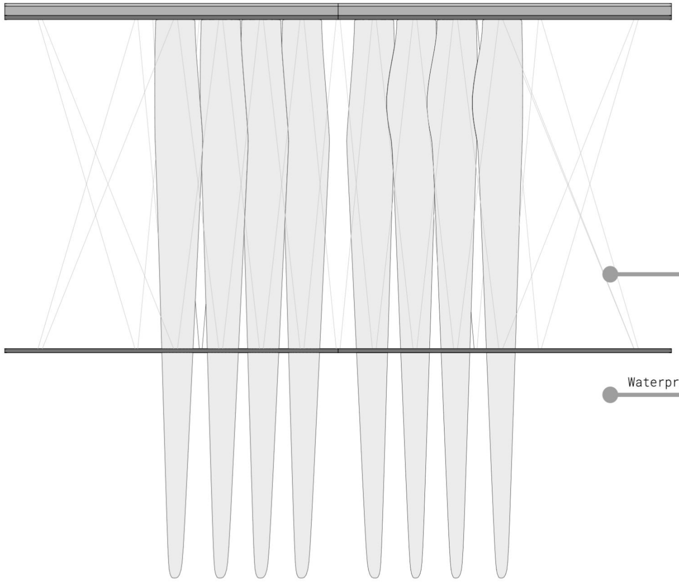
Energy on the water | Offshore Concept: Polygonal Design

Marius Noé

Energy on the water | Offshore Concept: Polygonal Design





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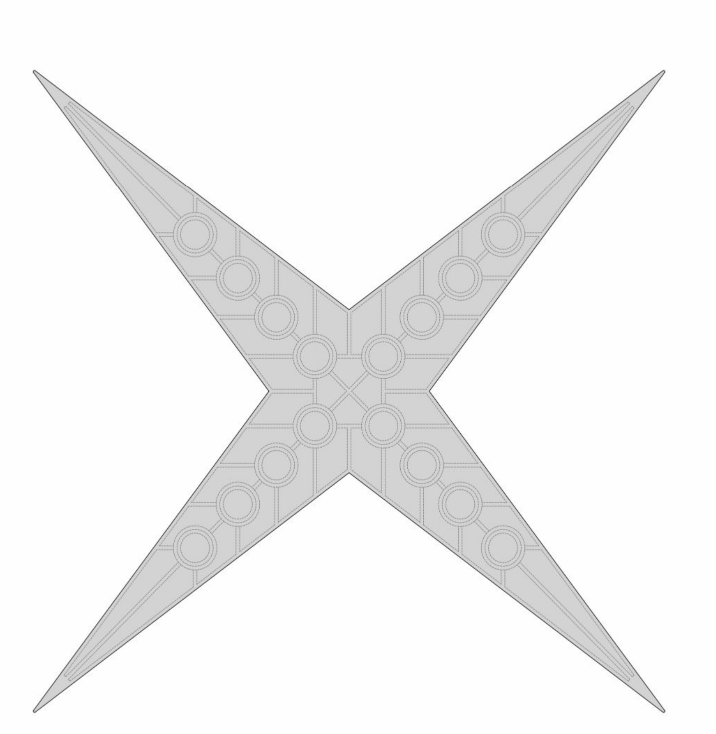
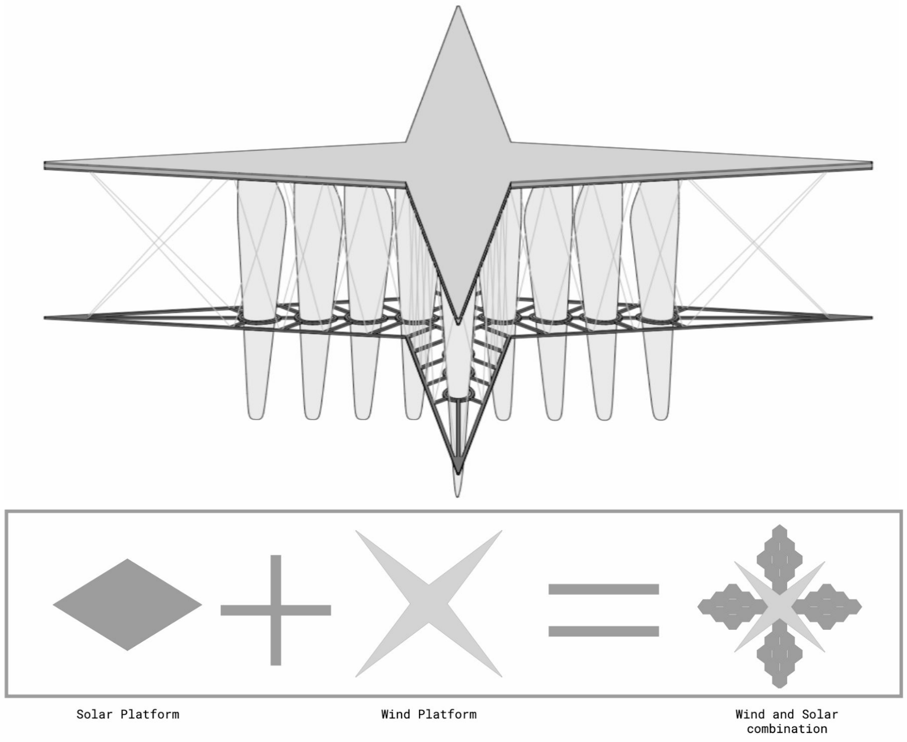
Energy on the water | Offshore Concept: Polygonal Design

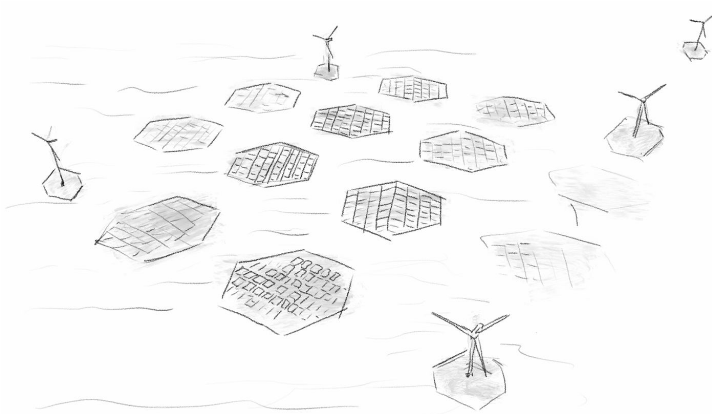




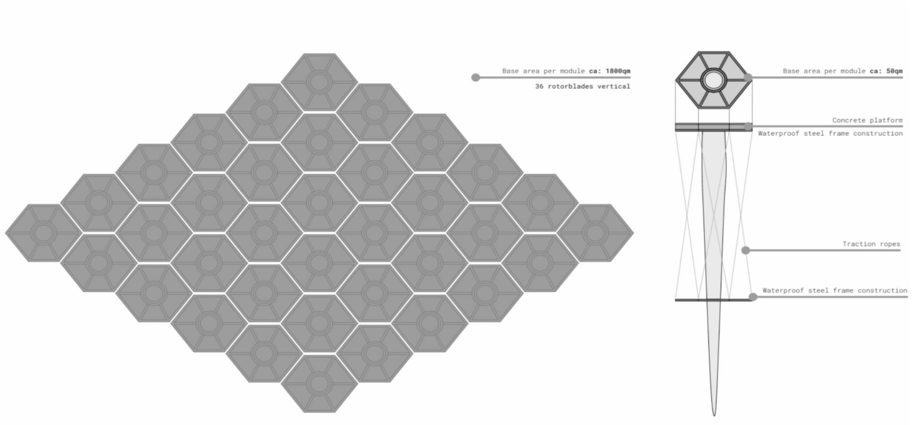
Marius Noé

Student Concepts | Hydrogen - Hexagon

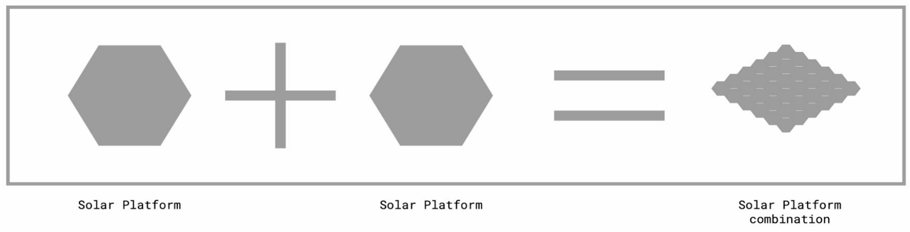
Energy on the water | Student Concepts: Hexagon Platforms



Fatima Ismail, Charlotte Seip

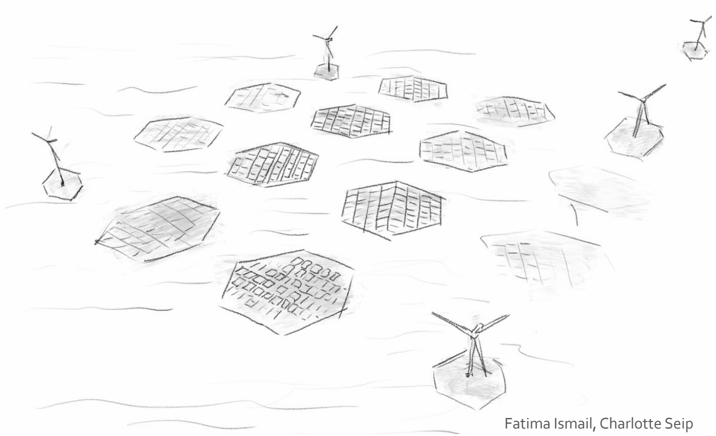


Hexagonal modules can be flexibly expanded and combined as needed.

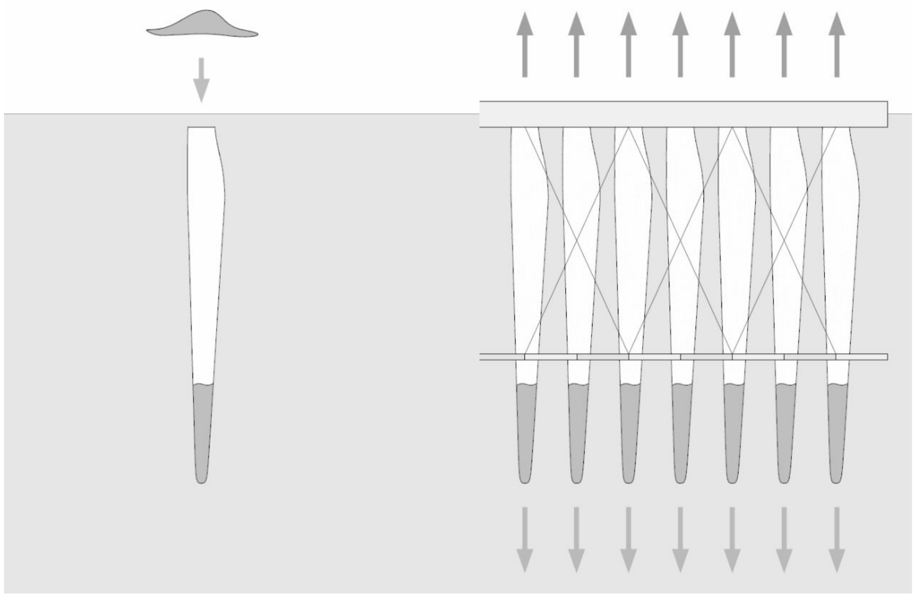


Marius Noé

Energy on the water | Student Concepts: Hexagon Platforms



Fatima Ismail, Charlotte Seip



Melanie Maria Mayer

The main components include Rotor blades,- Floating bodies (pontoons) for stability and height regulation.

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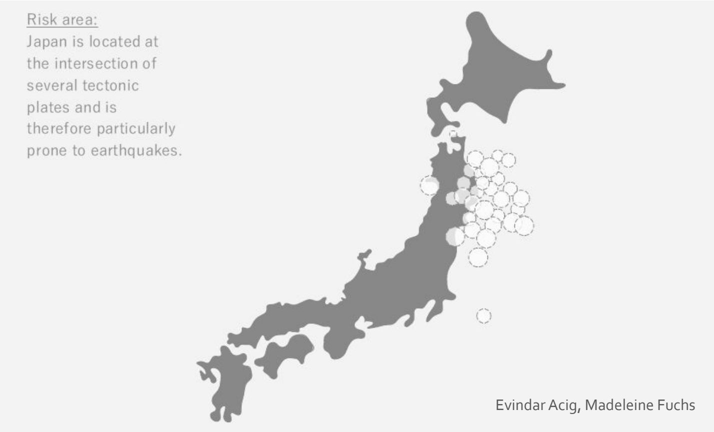
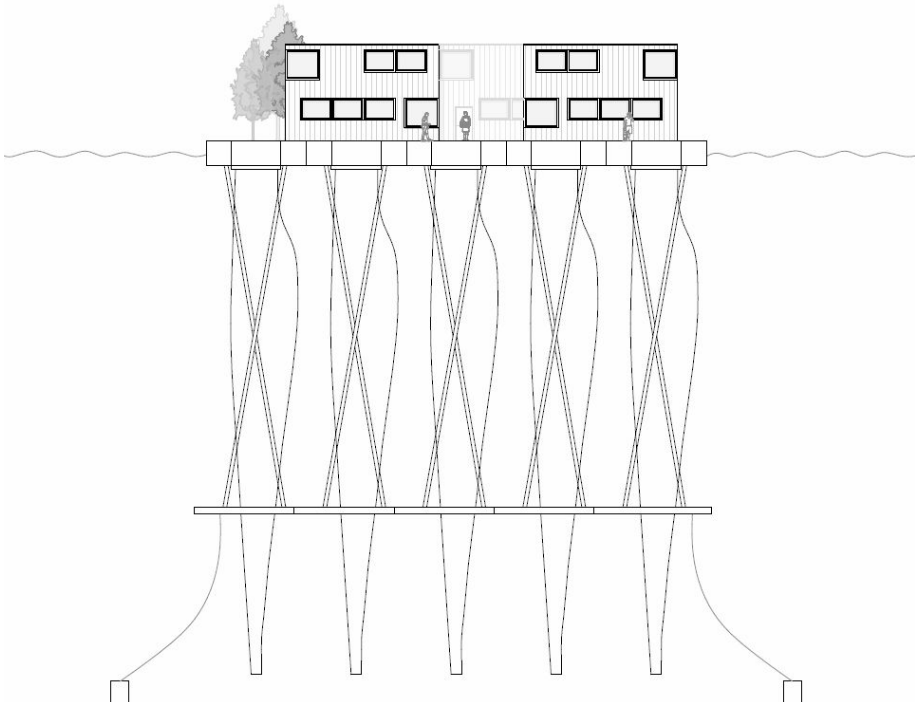
Energy on the water | Student Concepts: Hexagon Platforms



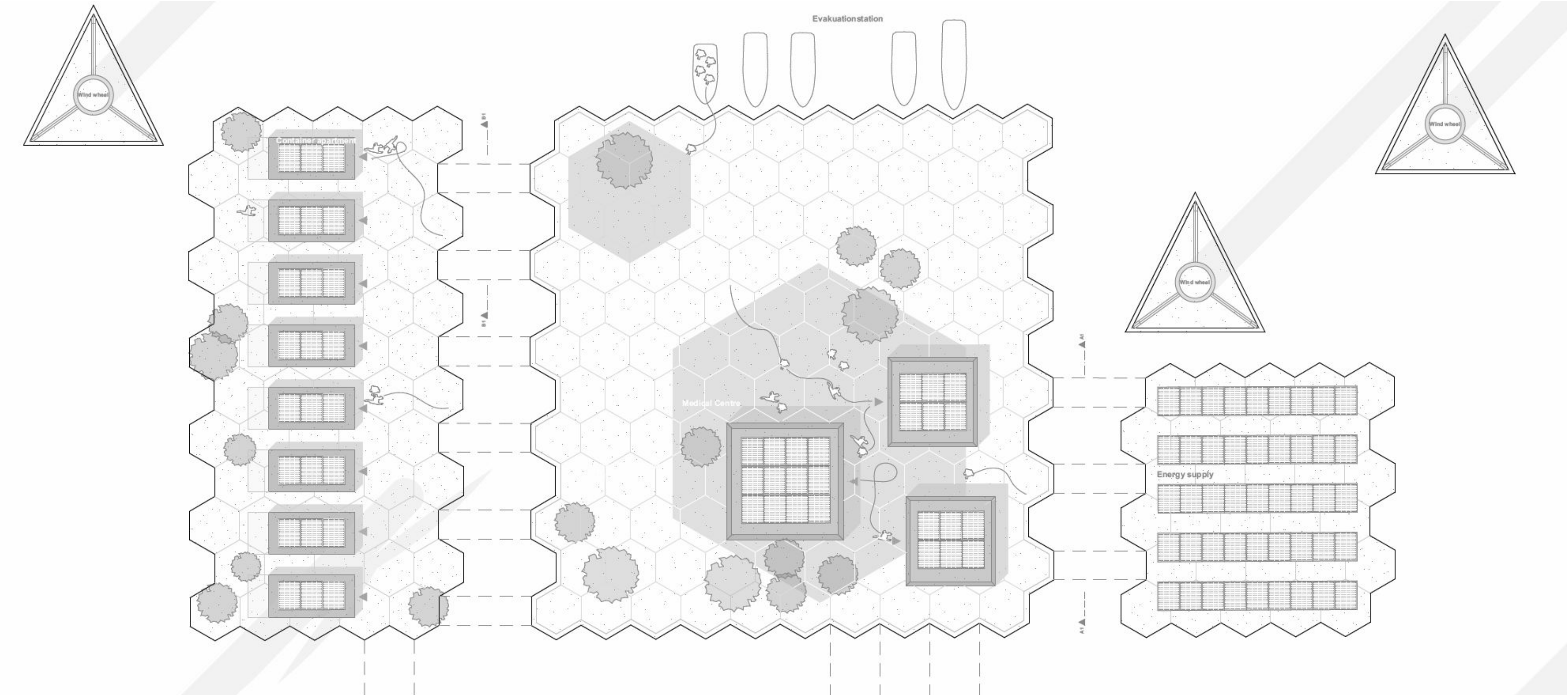
Evindar Acig, Madeleine Fuchs

A modular floating platform was specifically designed for disaster relief and emergency response.



Evindar Acig, Madeleine Fuchs

Energy on the water | Student Concepts: Hexagon Platforms



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Energy on the water | Student Concepts: Hexagon Platforms

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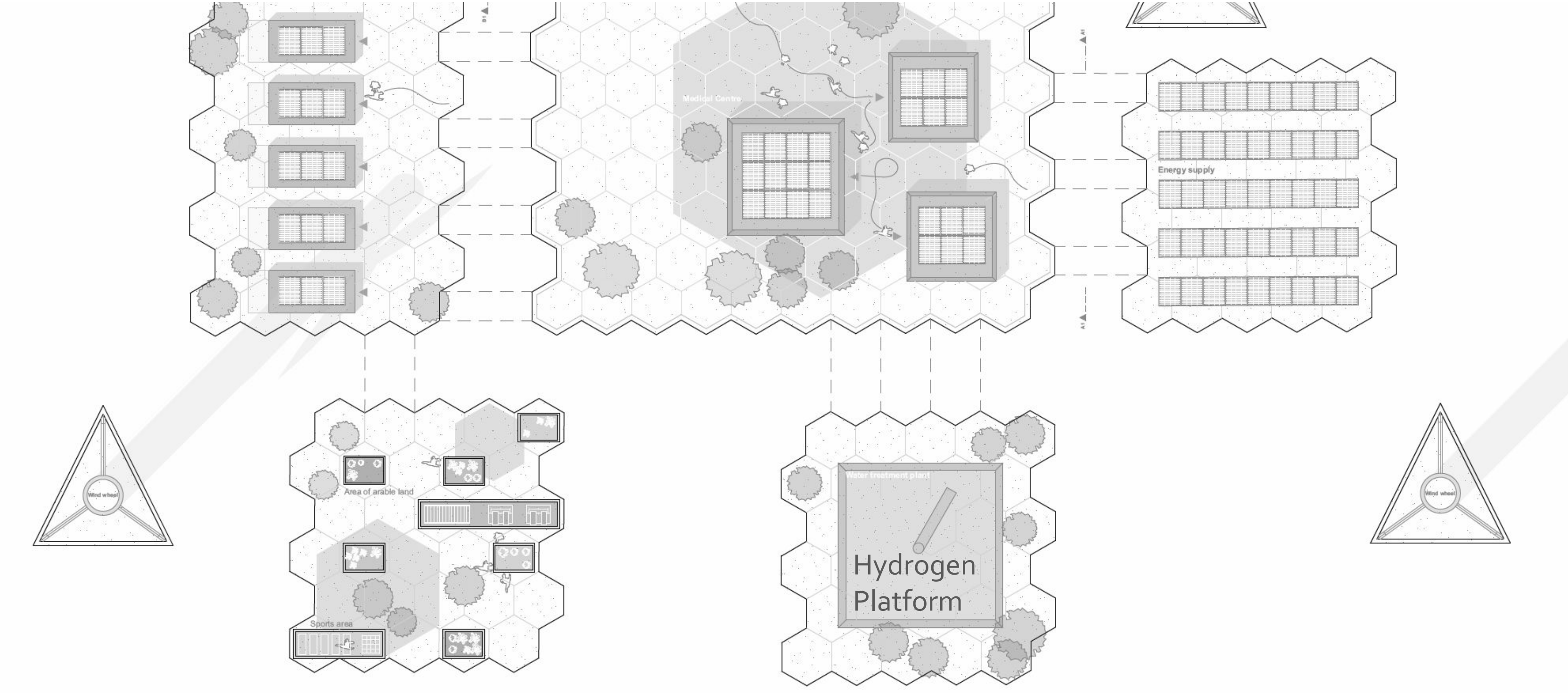

Evindar Acig, Madeleine Fuchs


Jil Laske, Nadine Köpke Carrizalez

質問はございますか？

Do you have any questions?

rethink*rotor goes

JAPAN

ありがとうございました！

Sources:

1. analysis of the energy supply in Japan and comparable regions with similar challenges:

https://www.gtai.de/de/trade/japan/specials/energie-energiemix-wird-gruener-797112
https://aenert.com/de/laender/asien/energiewirtschaft-auf-den-philippinen/
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2. analysis of geographical, political and technological framework conditions:

https://diercke.de/content/japan-rohstoffabh%C3%A4ngigkeit-978-3-14-100800-5-267-3-1
https://diercke.de/content/japan-naturrisiken-978-3-14-100770-1-150-1-0
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blade stadium 12 60 | Concept

by Lorenz Hoellerl

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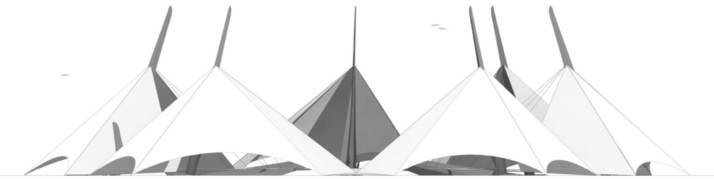
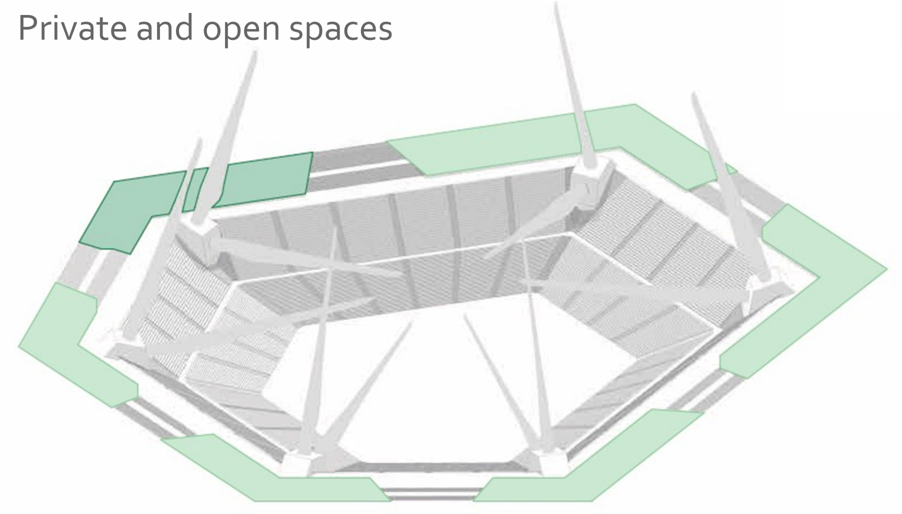
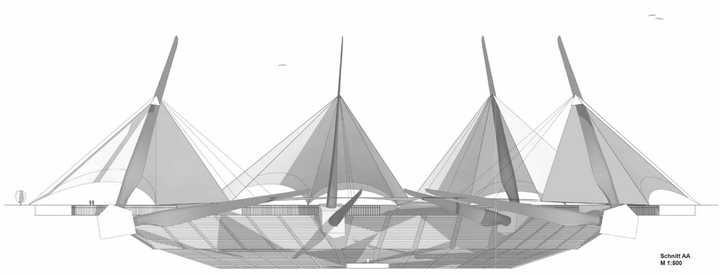
blade*stage | blade stadium 12 60

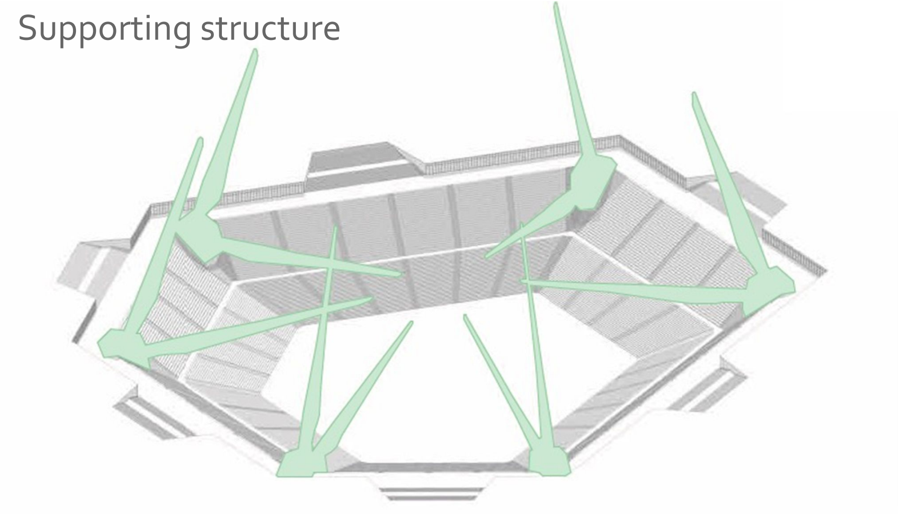


Private and open spaces



blade*stage | blade stadium 12 60

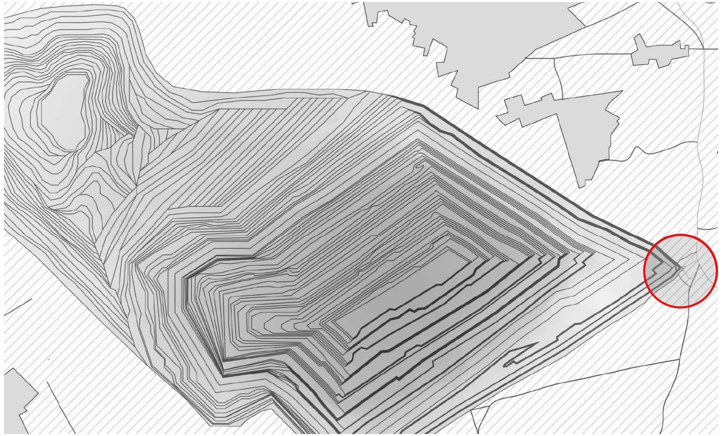




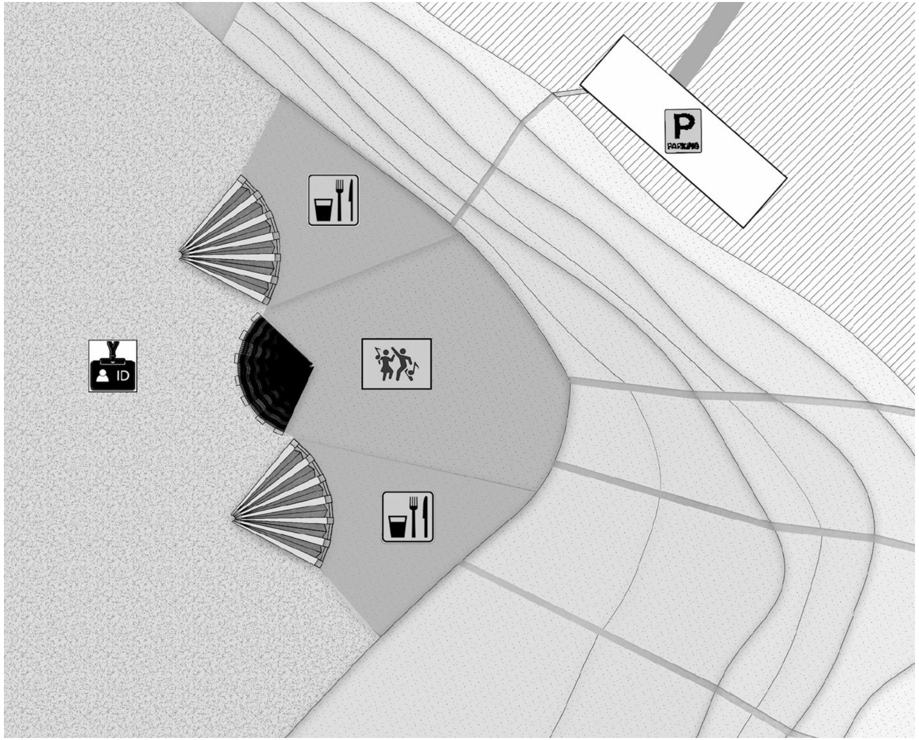
blade wave | Concept

by Luke Eißner

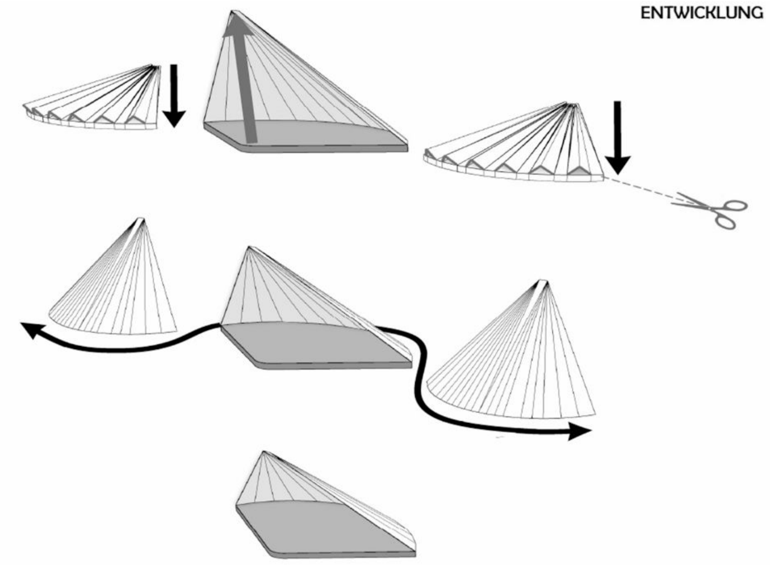
blade*stage | blade wave

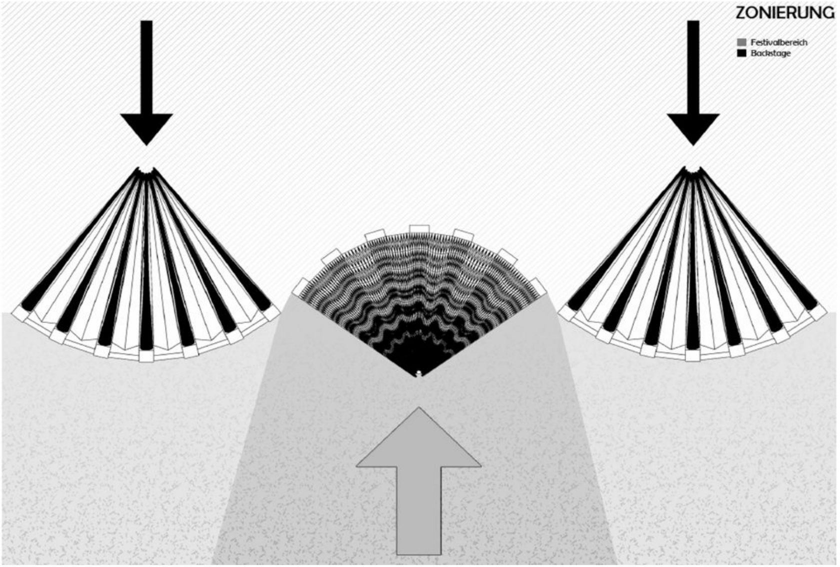


location in the open-pit mine



blade*stage | blade wave

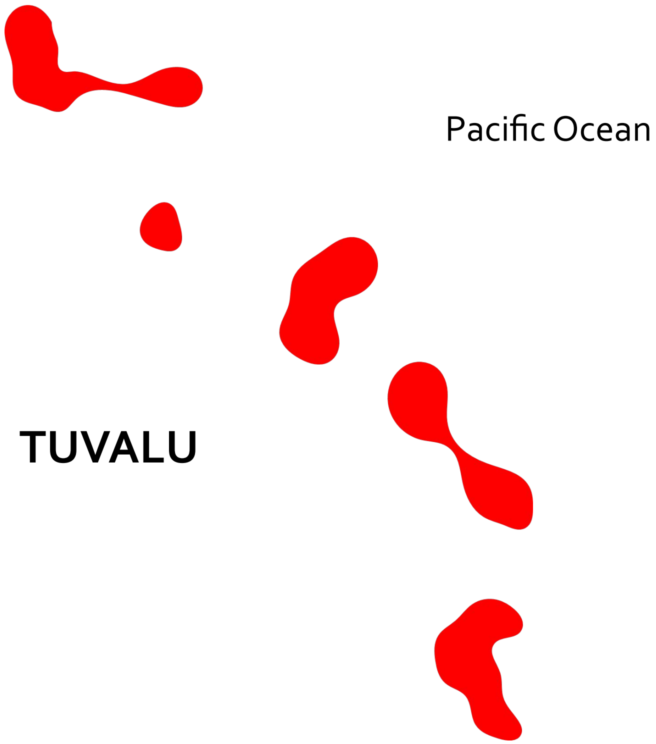




Departure to Rotopia | The Location

- The most important economic sectors are fishing, tourism and exports.

- With only 3600 tourists per year, it is the least visited country in the world.



Departure to Rotopia | The Location

To draw attention to rising sea levels, Foreign Minister Hon. Simon Kofe gave a distinctly unusual speech.

Departure to Rotopia | The Location

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Standing knee-deep in water, he demonstrated what "powerlessness in the face of climate change" feels like.

The island itself is now looking into land reclamation technologies, as well as solutions that could be used in the event of total land loss, resulting in resettlement.

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Departure to Rotopia | The Location

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METAVERSE

“While our country is disappearing, we have no choice but to become the first digital nation”.

The land, ocean and culture are the nation's greatest treasure, he said. “To protect them from harm, no matter what happens in the physical world, we will move to the cloud.”

METAVERSE

A first step in this process is the digital copy of the country. If it disappears into the sea, Tuvalu should at least continue to exist in the digital world.

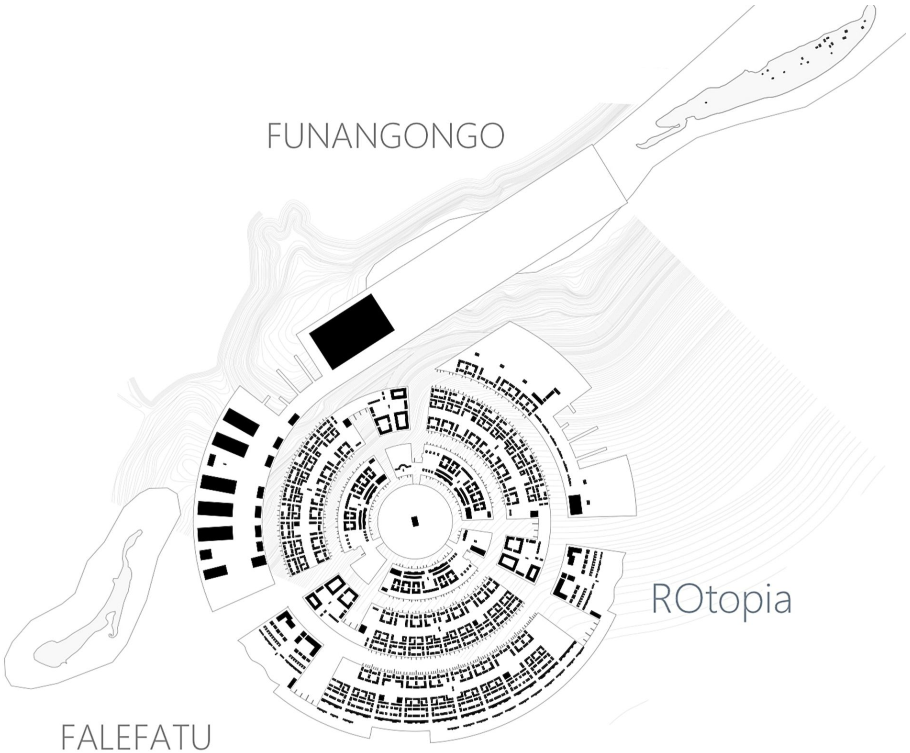
“For us, it's about maintaining our status as a state, our sovereignty and our borders” in order to be able to continue to exist without a real country.

TUVALU

for the climate refugees

a climate innovation

Rotopia | Design



MAIN GOALS

- functionality
- social equality
- staying true to Tuvalu's urban planning
- providing a sustainable future

Rotopia | Urban planning

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ローターの再考

How many offshore wind turbines are needed to fully supply Japan ?

1. Annual consumption Japan - approx. 950 TWh
2. Japan would need around 31,667 offshore wind turbines, each with a capacity of 8 MW, to fully supply itself with wind power.
   Of course, this figure can vary depending on the actual wind speed and efficiency.

➢ Problem: invoice requires optimal weather conditions

Calculation of Japanese energy supply from wind turbines

To find out how many offshore wind turbines Japan would need to fully supply itself with the 950 TWh of electricity per year, we proceed as follows:

1. Average output of an offshore wind turbine:
   A modern offshore wind turbine has an output of around 8 MW. This means that it produces around 30 million kWh per year under ideal conditions.

2. Calculation of energy requirements:
   Japan has an annual electricity consumption of around 950 TWh, or 950 billion kWh.

3. Calculation of the required number of wind turbines:
   - 1 offshore wind turbine produces approx. 30 million kWh per year
   - 950,000,000,000 kWh (Japan's annual consumption) divided by 30,000,000 kWh (production per wind turbine) equals around 31,667 offshore wind turbines.

Result:
Japan would need around 31,667 offshore wind turbines, each with a capacity of 8 MW, to fully supply itself with wind power. Of course, this figure can vary depending on the actual wind speed and efficiency.

„AquaHex“ | Concept

by Evindar Acig and Madeleine Fuchs

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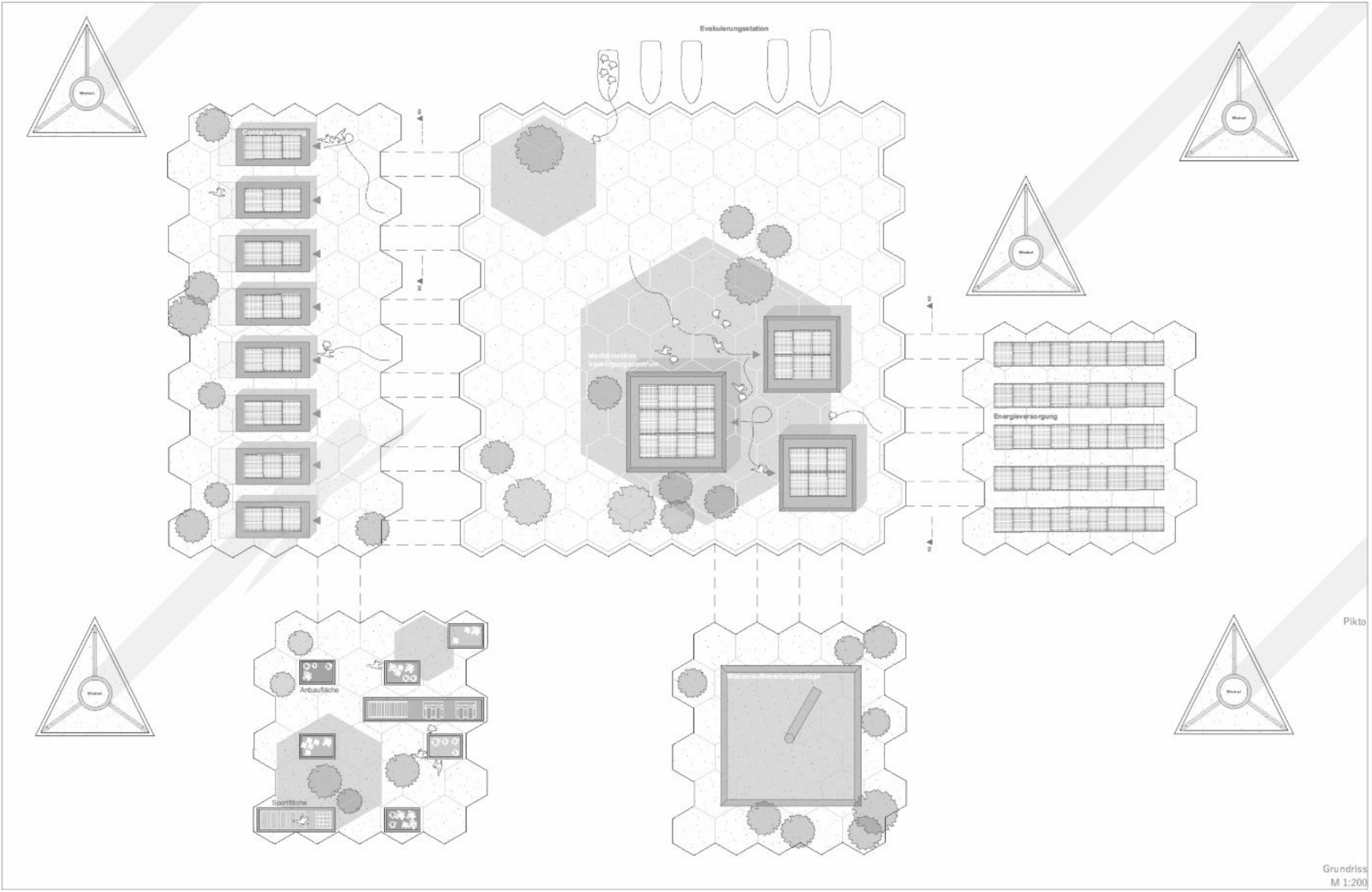

OFFSHORE SOLAR/WINDPARK

Designed by Fatima Ismail & Charlotte Seip

Typhoon-safe design
- Reduced attack surface
- Pitch control

Tsunami and earthquake safety
- flexible routing of power cables
- far enough away from the coast

Offshore wind power:
- East coast (e.g. Chiba, Ibaraki, Fukushima)
- North coast (e.g. Aomori, Akita)

Solar energy:
- Kyushu and Okinawa
- Shikoku
- Hokkaido

Combination
- East coast (Fukushima)
- Okinawa

Strategic Deployment Sites

- Existing offshore facilities marked as ideal locations
- Blue circles = potential sites for modular system use
- Local production avoids long-distance rotor blade transport
- Reduces emissions and supports circular economy
- Efficient, sustainable deployment near existing infrastructure

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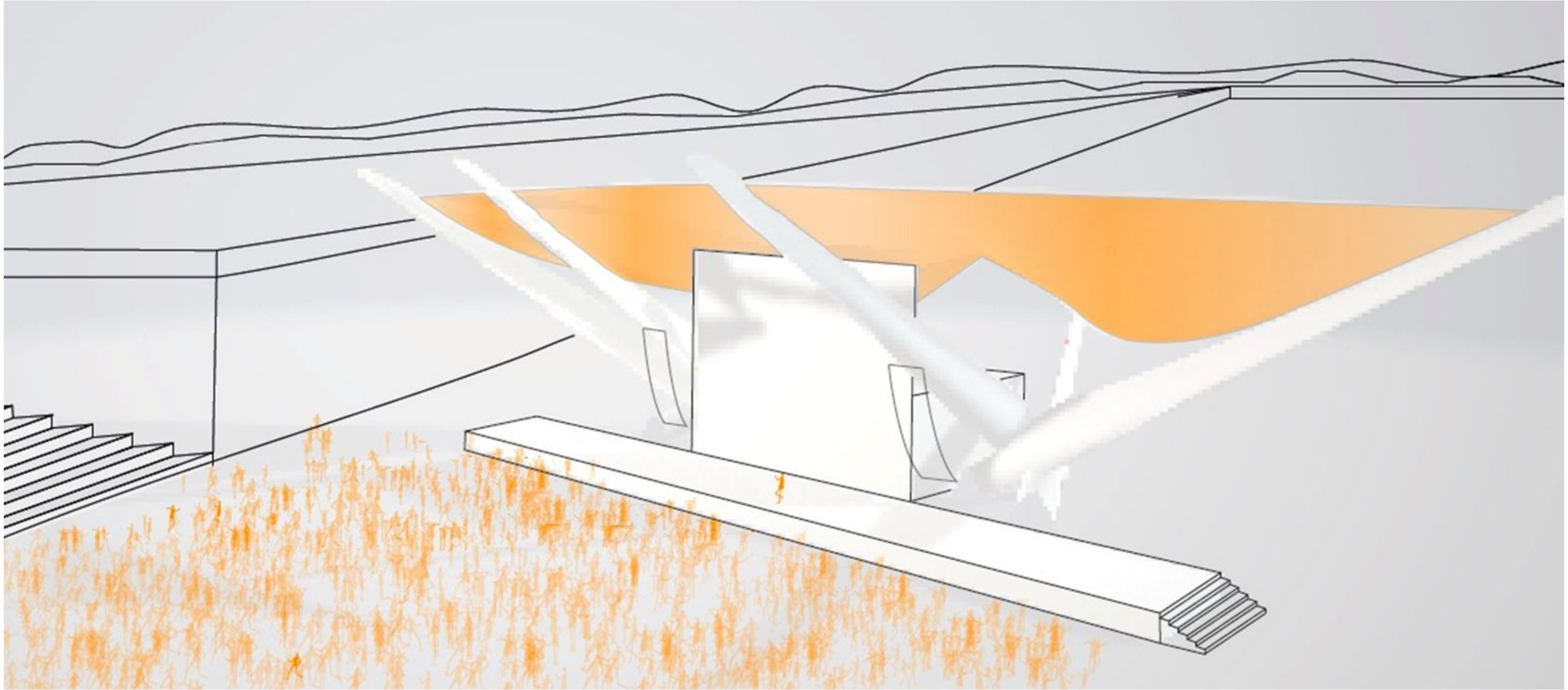
„Music of the future“ | Concept

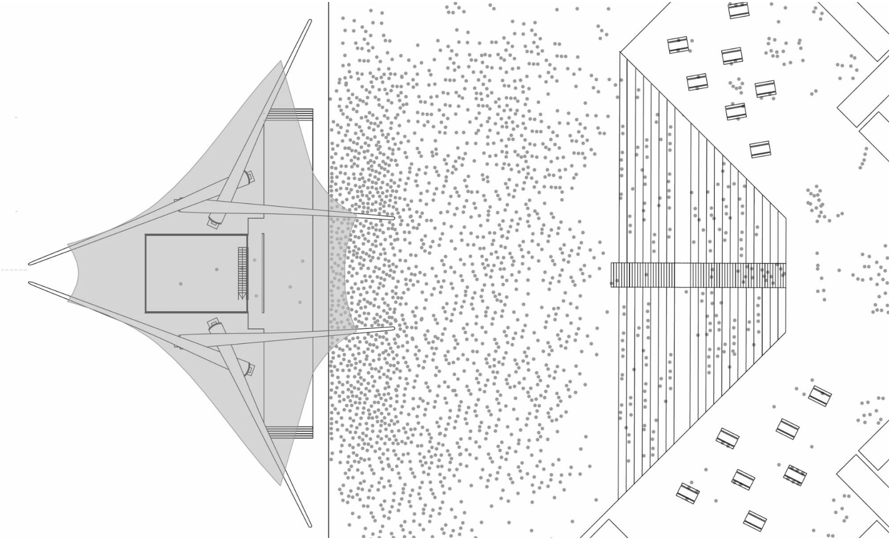
by Janna Fee

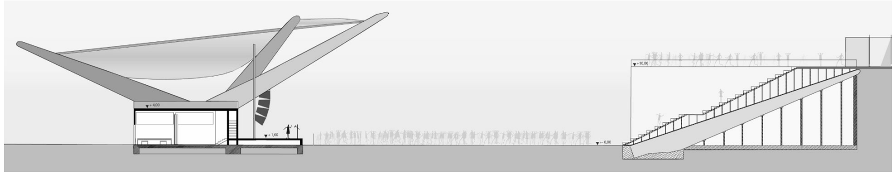
blade*stage | Music of the future



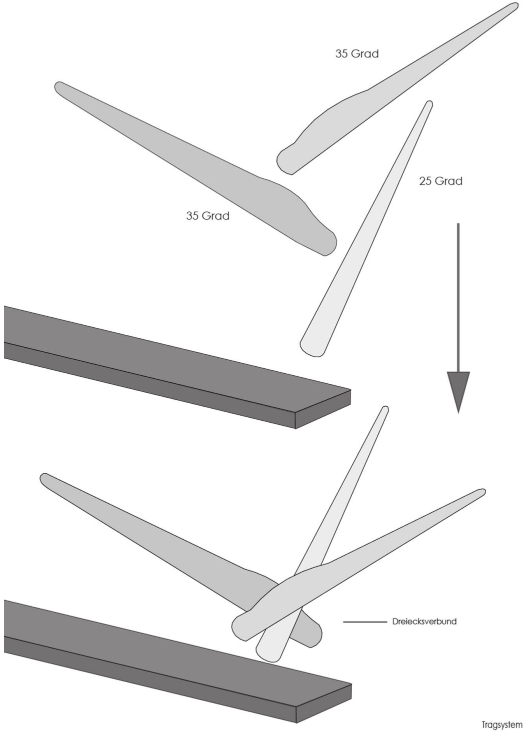
blade*stage | Music of the future

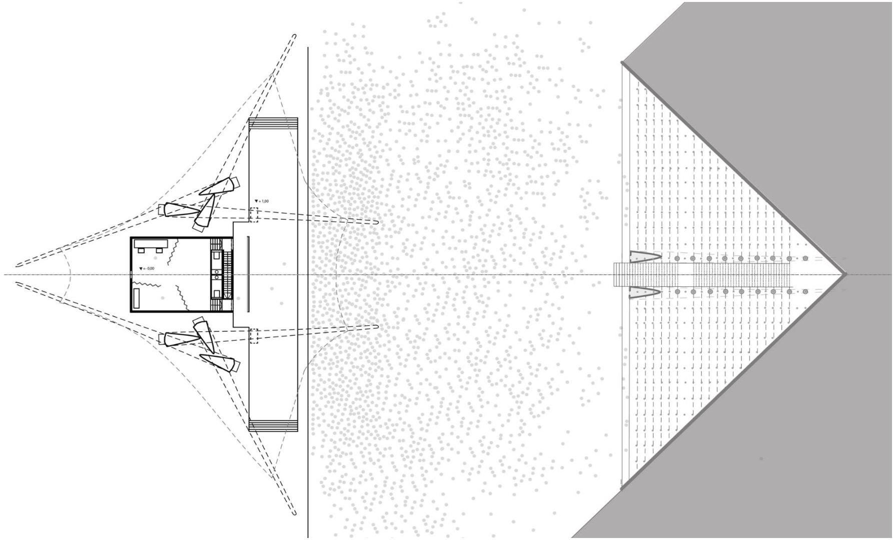
rethink*rotor
ローターの再考

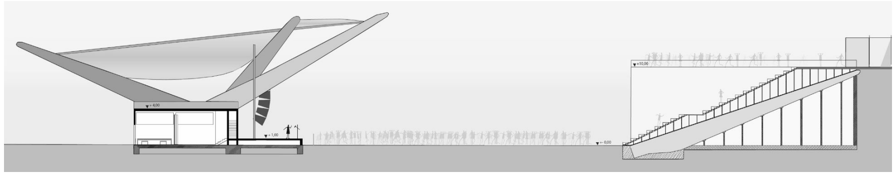




blade*stage | Music of the future







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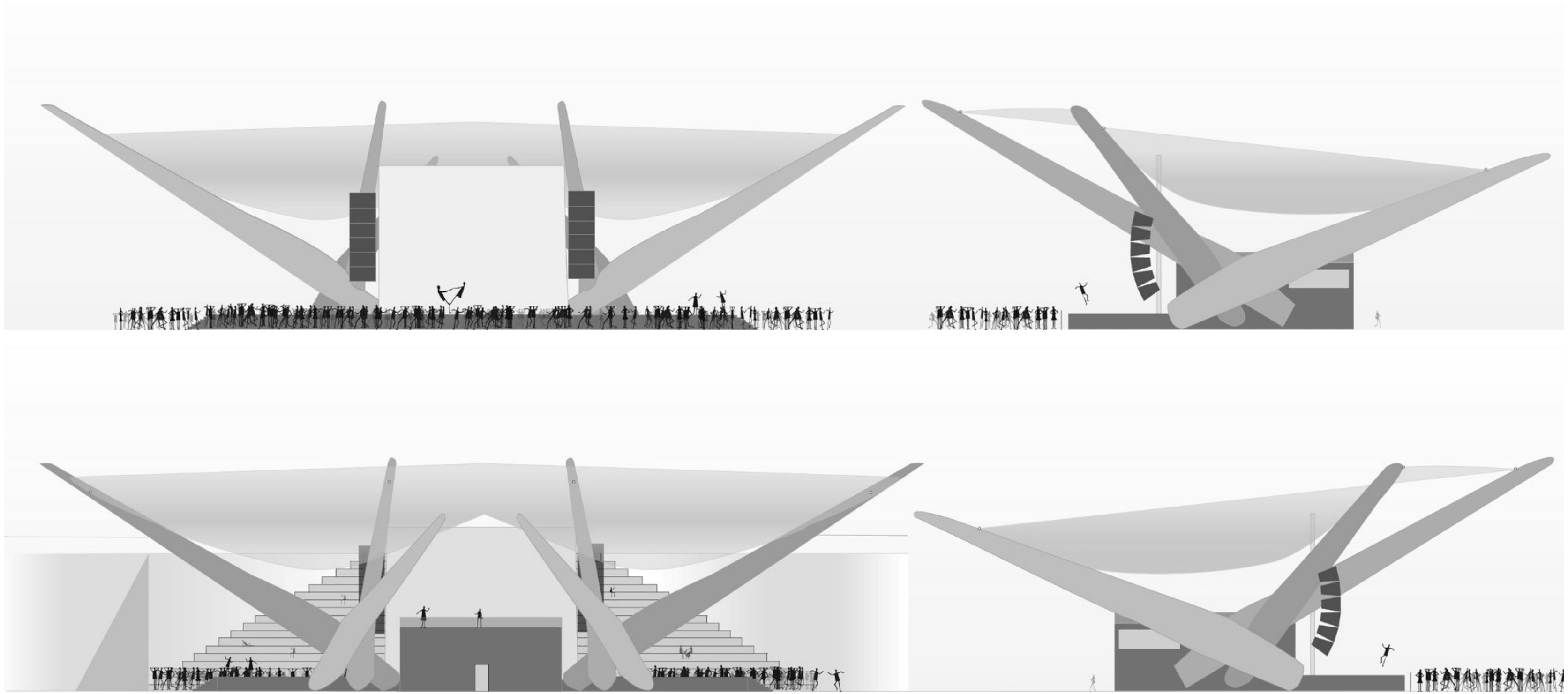
blade*stage | Music of the future



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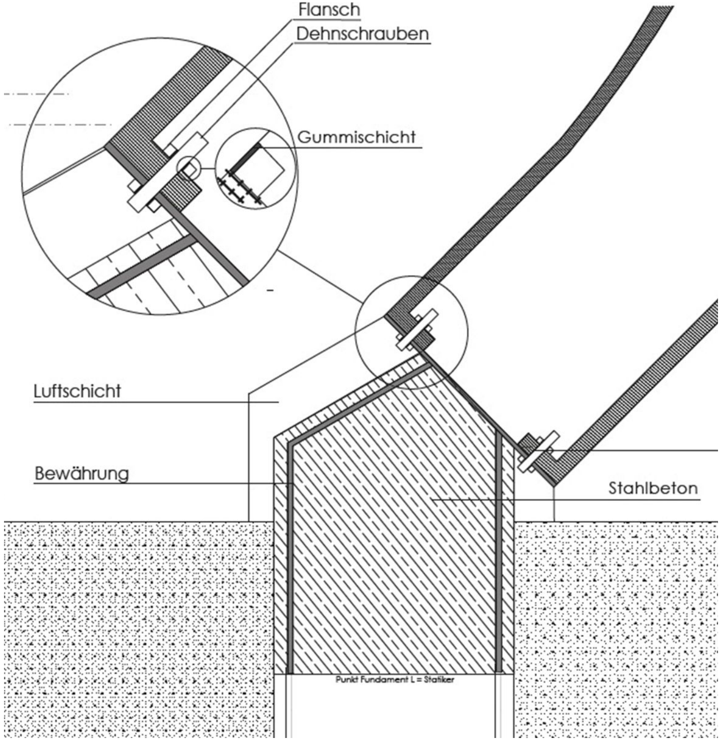
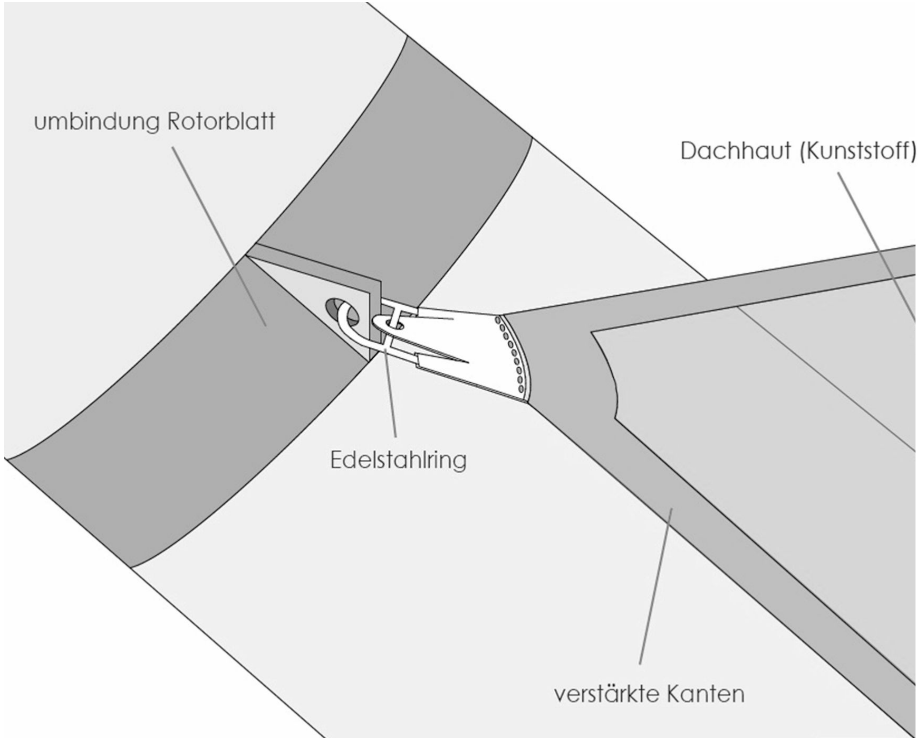
blade*stage | blade wave





Investigation of the energy supply

Energy supply in Japan

- Japan is the third largest economy in the world and is heavily dependent on energy imports
- The country's energy supply is affected by geography, political conditions and natural disasters
- Japan covers its energy needs with a combination of different energy sources

- Energy source:
    - Coal: 31.0 %
    - Natural gas (LNG): 27.6 %
    - Crude oil: 7.4
    - Nuclear energy: 6.9
    - Renewable energies: 19.8 % (hydropower, solar, wind, geothermal)
- Dependence on natural gas, coal and oil makes the country vulnerable to price fluctuations and geopolitical risks

Renewable energies

- Japan is investing heavily in renewable energies (solar and wind power)
  - Offshore wind power is seen as a key technology for the energy transition
  - The government plans to achieve an offshore wind capacity of 10 GW by 2030 and up to 45 GW by 2040
- Existing challenges such as limited space for large wind and solar parks and high investment costs
- Plans to make renewable energies such as wind and solar its main source by 2040
- Japan is committed to becoming climate neutral by 2050

Renewable energies:

- Japan is increasingly focussing on renewable energies in order to make its energy supply more diverse and sustainable
- The geographical conditions in Japan offer limited space for solar and wind power plants
- Japan has the potential to utilise solar and wind energy on a large scale in order to reduce its dependence on fossil fuels

Basic energy plan (2021)

- Reduction of fossil fuels: share of coal and gas to fall to 41% by 2030
- Increase in renewable energies: Target: 36-38 % by 2030
- Nuclear energy revitalisation: In the long term, it should once again account for 20-22 % of the energy mix

Investments in hydrogen & ammonia

- Japan is investing heavily in green hydrogen to partially replace crude oil
- Major partnerships with Australia and the Middle East for water imports
- Pilot projects with ammonia power plants, as ammonia could replace coal as a low-emission fuel

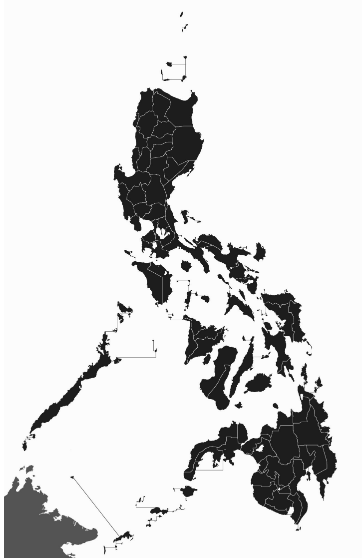
Geothermal energy

- Japan has huge potential for geothermal energy due to its volcanic activity
- Areas lie below tourism regions
- Areas are located in national parks or protected nature reserves
- Cultural, regulatory and economic hurdles slow down expansion

Energy supply study in comparison

Philippines

- one of the leading countries in the utilisation of geothermal energy
- Geothermal energy and hydropower approx. 82% of electricity generation
- Solar and wind energy still underdeveloped

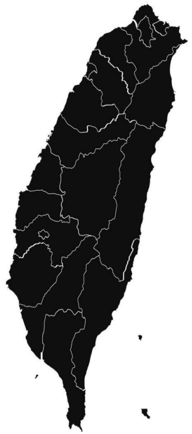


Indonesia

- has fossil resources (coal)
- However, it only utilises geothermal potential to a limited extent

Taiwan

- plans to phase out nuclear energy by 2025 and increase the share of renewable energy
- Import dependency: very high (~98 %)
- Nuclear energy: planned phase-out by 2025
- Renewable energies: growing share, offshore wind power
- Challenges: Lack of space for renewable energy projects



South Korea

- Nuclear energy and fossil fuels
- Offshore wind farms, which have not yet had a major impact, but are expected to increase by 2030
- Import dependency: similar to Japan (~90 %)
- Nuclear energy share: higher than in Japan (~30 %)
- Renewable energies: only ~8 %, growing investments
- Challenges: High energy consumption, geopolitical uncertainties

From where ?

Japan: 1,700 - 2,600 wind turbines = min. 4,800 rotor blades in the next 10 - 30 years

China: approx. 153,000 wind turbines = approx. 459,000 rotor blades in the next 10 - 30 years

South Korea: approx. 455 wind turbines = approx. 1,365 rotor blades in the next 10 - 30 years

Taiwan: approx. 865 wind turbines = approx. 2,595 rotor blades in the next 10 - 30 years

India: 14,900 - 22,400 wind turbines = at least 44,700 rotor blades in the next 10 - 30 years

USA: approx. 44,000 wind turbines = approx. 132,000 rotor blades in the next 10 - 30 years

How ?

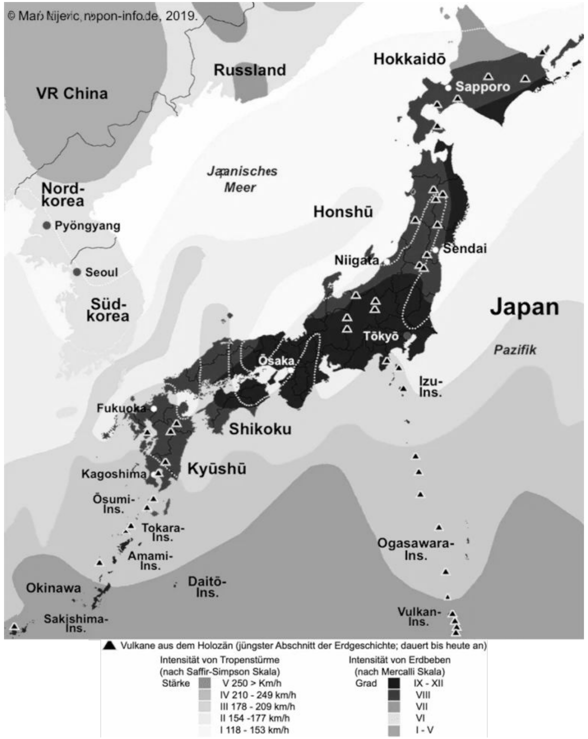
As individual parts with heavy-lift or semi-submersible ships.

Best option:

Possibility of utilising the buoyancy of the rotor blades to transport large quantities of energy efficiently by sea.

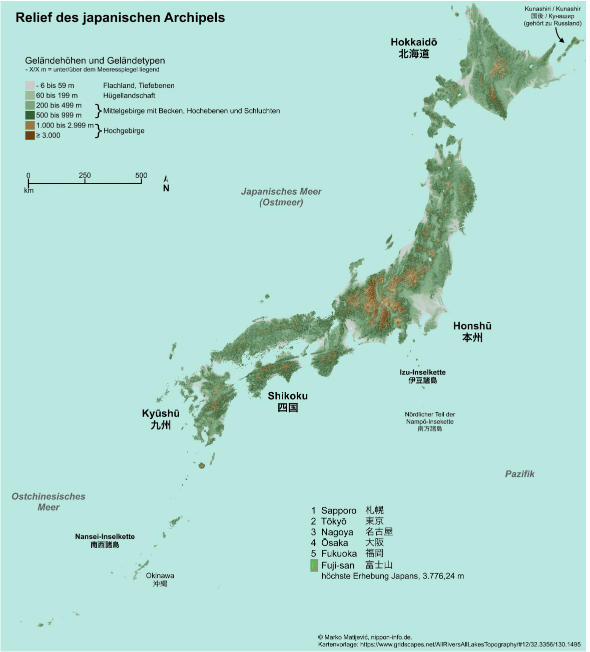
Earthquakes and plate tectonics

- Interface of several tectonic plates (Chinese, Pacific and Philippine plates)
- Constellation causes a high level of seismic activity (around 1,450 earthquakes per year)
- Make construction projects more difficult, especially for large-scale infrastructure
- High risk of tsunamis, flooding of coastal areas



Topography and wind power

- Landscape is characterised by mountains and steep slopes, which makes the construction of onshore wind turbines difficult
- High risk of land-/rockslides
- Coastal regions offer ideal conditions for offshore wind power, especially on the north-east coast, where constant wind speeds prevail



- Japan has a theoretical potential of over 9,000 terawatt hours per year from offshore wind energy, a multiple of the forecast electricity demand

Raw material shortage

- Japan has hardly any natural raw material deposits and has to import most of its energy sources and industrial metals
(Oil, natural gas and coal, mainly from the Middle East, Australia and USA)

- Although Japan discovers rare earths in its territorial waters (e.g. at Minami-Torishima), mining them is technologically challenging

Nuclear power, after Fukushima

- Heavy criticism after the nuclear disaster in Fukushima (2011)
- Many nuclear power plants were shut down, increasing dependence on fossil fuels and energy imports

- In recent years: Recommissioning of decommissioned nuclear power plants with strict safety requirements, in order to stabilise the energy supply

- The aim now: Shut down nuclear power plants and expand renewable energies

Dependency on energy imports

- Japan imports around 90 % of its primary energy

  → makes the country susceptible to global market changes

- Increased focus on diversifying energy sources in order to minimise geopolitical risks
- Offshore wind power and the expansion of hydrogen technology should help to reduce dependence on imports in the long term

Progress in wind power technology

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- Increased Investment in offshore wind power, as the technology becomes more mature

Offshore wind Farms:

- Floating wind turbines, can be installed in deep waters where fixed foundations are not possible
- Could play a central role in Japan's energy supply in the long term, due to technological innovations

Challenges of grid integration

- The Japanese electricity grid was not originally designed for a high feed-in of renewable energies
- The fluctuating feed-in of wind energy requires modernisation of the grid infrastructure

- Solutions such as energy storage, smart grids and load management are necessary to ensure a stable power supply

Strategies for securing resources

- Focus on recycling and the circular economy to compensate for its shortage of raw materials
- Recovery of metals from electronic waste, in order to make domestic production more sustainable
- Further development of own raw material extraction in the deep sea areas

WindFloat (Principle Power)

Technology: Semi-submersible design with three floats

+ Advantages: High stability even in deep waters; proven technology with projects worldwide
– Disadvantages: High production and installation costs; complex maintenance

Suitable for deep offshore locations on Japan's coasts, especially in the north-east, where constant wind speeds prevail.

Hywind (Equinor)

Technology: Floating economy buoys that are stabilised with anchor ropes.

- \+ Advantages: Efficient in deep water; lower material costs
- – Disadvantages: High technical effort for transport and installation

Ideal for deep waters like in Japan, but with adaptations necessary to withstand earthquakes and typhoons.

Fukushima Mirai (Japan)

Technology: Part of the Fukushima Offshore Wind Consortium; hybrid floating platform

+ Advantages: Specially developed for Japan's conditions; experience with seismic activity and typhoons
– Disadvantages: Still in the pilot phase; high investment costs

Particularly relevant for Japan, as already adapted to local requirements.

Sea Twirl

Technology: Vertical wind turbine on a floating platform.

+ Advantages: Fewer moving parts, therefore less maintenance; simpler design
– Disadvantages: Lower energy yield than horizontal turbines

An option for Japan as a possible supplement for offshore projects, but not a preferred solution for large offshore wind farms.

Blue SATH

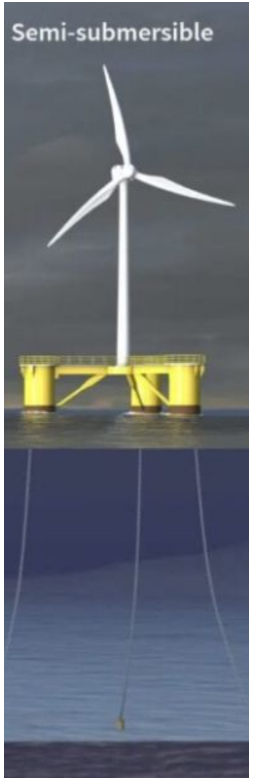
Technology: Floating catamaran design with horizontal turbines

- Advantages: Cost-effective and scalable; suitable for medium-deep waters
- Disadvantages: Less stable in very deep waters or in extreme weather conditions

Only suitable for Japan to a limited extent, as typhoons and strong waves could lead to challenges.

1. Semi-Submersible Platforms

Partially submerged structures stabilized by ballast tanks.
These platforms offer high stability in moderate water depths of 50-200 meters.



Advantages:

- High stability in rough sea conditions (strong waves and typhoons)
- Suitable for large turbines (ideal for commercial-scale projects)
- Modular design allows for cost-effective scaling

Applications in Japan:

- Japan’s Akita and Aomori offshore wind projects

2. Spar Buoy Platforms

Tall, cylindrical structure that extends deep below the water surface. Design relies on a low center of gravity for stability, making it ideal for deep waters exceeding 100 meters.

Advantages:

- Exceptional stability, even in harsh weather conditions
- Reduced motion compared to other platform types
- Minimal environmental footprint during installation

Applications in Japan:

- Interest in this technology is growing
- Study on Success of Norway’s Hywind project to inform future domestic deployments
- More commonly used in international projects

3. Barge Platforms

Flat structures designed for shallow waters (20-50 meters).
They are anchored using mooring lines and stabilized by heavy ballast.

Advantages:

- Cost-effective construction and deployment
- Easy to manufacture with existing shipbuilding technologies

Applications in Japan:

- Less common in Japan due to rough ocean conditions
- Option for more sheltered offshore sites.

4. Tension-leg Platform

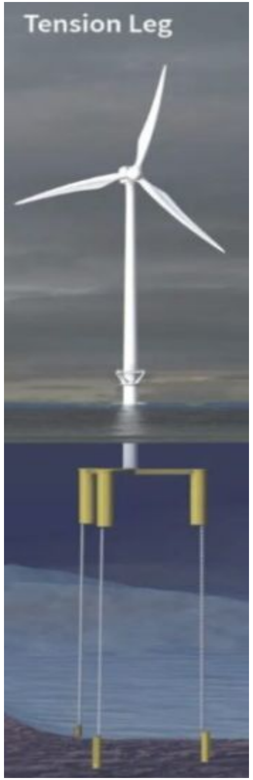
A Vertically moored floating structure normally used for the offshore production of oil or gas.
Particularly suited for water depths greater than 200 metres

Advantages:

- Exceptional vertical stability (but stiff)

Applications in Japan:

- Can be used in very deep waters, but would have to be dampened to reduce motion in the event of a tsunami



Setana Wind Farm

- Hokkaido
- In operation since 2004

https://www.shimz.co.jp/en/works/jp_ene_202011_setanaosato.html

Sakata Offshore Wind Farm

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- Yamagata
- In operation since 2005

https://commons.wikimedia.org/wiki/File:Sakata_wind_farm_2937988170.jpg

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Wind Power Kamisu

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- Ibaraki
- In operation since 2008

https://commons.wikimedia.org/wiki/File:Wind_Power_Kamisu_10.jpg

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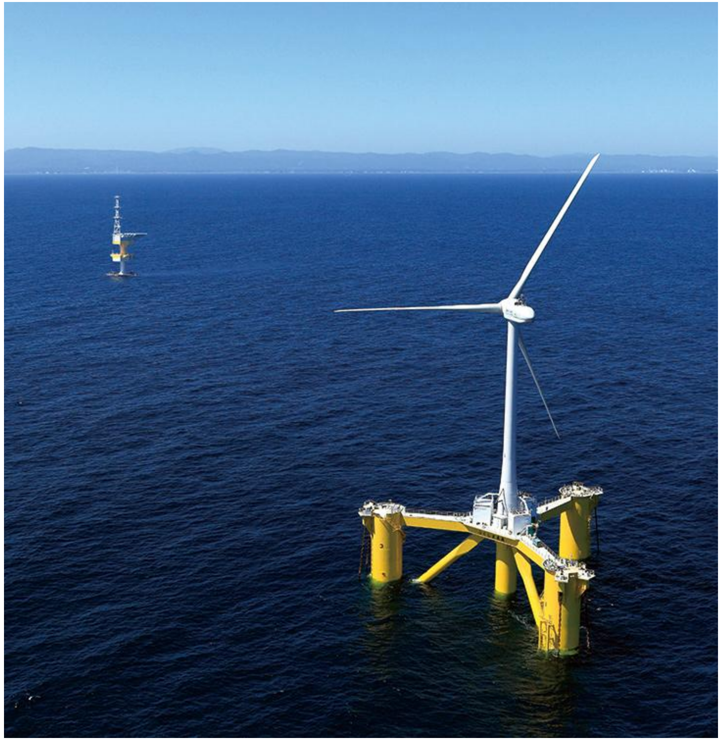
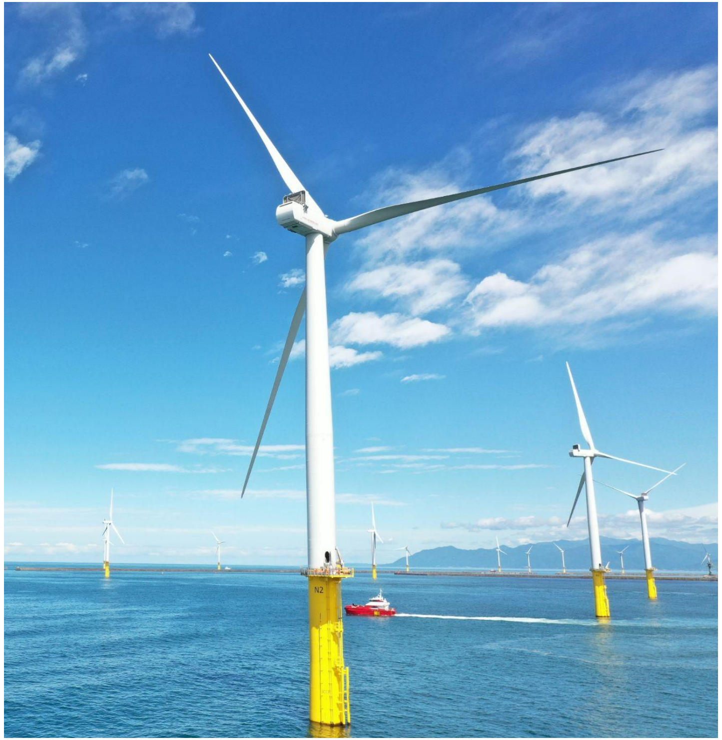
Fukushima Floating Wind Turbine



- Fukushima
- In operation since 2013

https://www.shimz.co.jp/en/works/jp_ene_201311_fukushima.html

Noshiro Port and Akita Port



- Akita
- In operation since December 2022

https://aow.co.jp/en/eventa/item.cgi?pro&73

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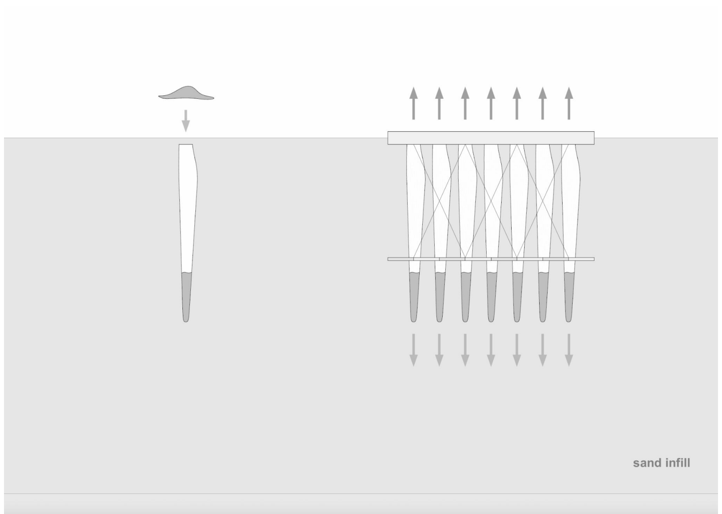
Ishikari Bay

- Hokkaido
- In operation since 2023

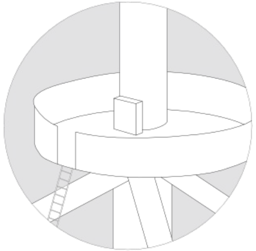
https://www.windindustrie-in-deutschland.de/unternehmensmeldung/japan-s-largest-offshore-wind-farm-goes-into-operation

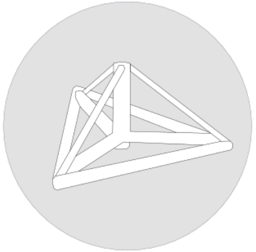


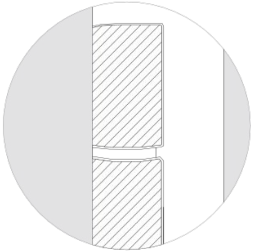
Rated Power: 15,000.0 kW
Rotor Diameter: 236.0 m
Rotor Area: 43,742.0 m^2
Number of Blades: 3
Rotor Material: Glass and carbon fibre-reinforced epoxy

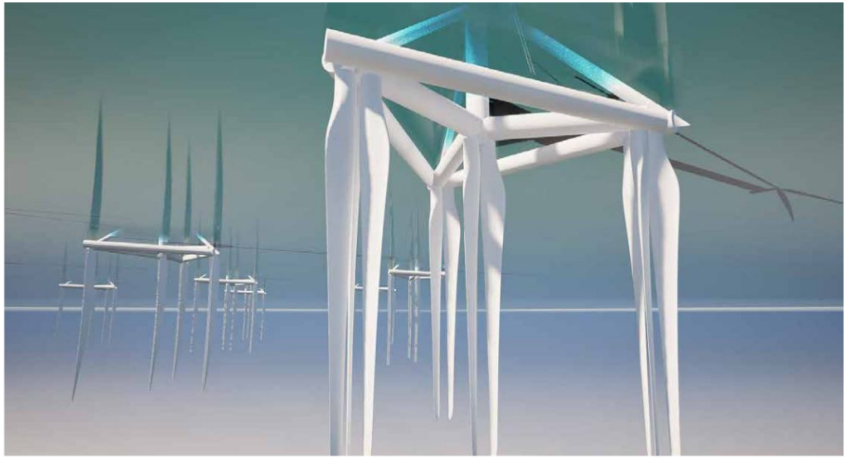
Weight:
Rotor Blade: 55 tons per blade
Hub and Generator: 650 tons
Tower: 2,000 tons
Total: 2,815 tons

Example 4: offshore wind farm

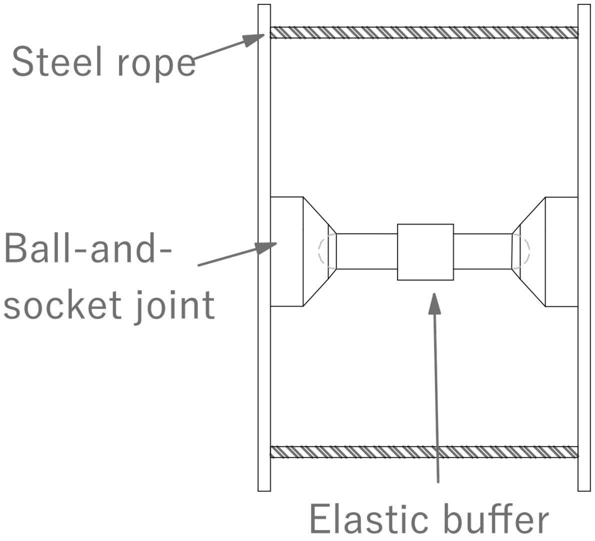

rescue platform


tripod for stabilization


ASCA pv- modules



Example 3: Floating Village



Joints → Joints between the modules. These ensure that the square shape moves with waves or storms or does not break

Steel cable → Helps that the square does not break apart

Elsatic buffer → Elsatic buffer, so that the platform can move with the waves

Example 5: floating farm platform