



## Geïntegreerd offshore aquacultuur windmolenpark ontwerp

Multi-aquacultuur in een offshore windmolenpark Samen met onderzoekslaboratorium en museum



P5- 06-07-2017  
1558528

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Jirka Berka

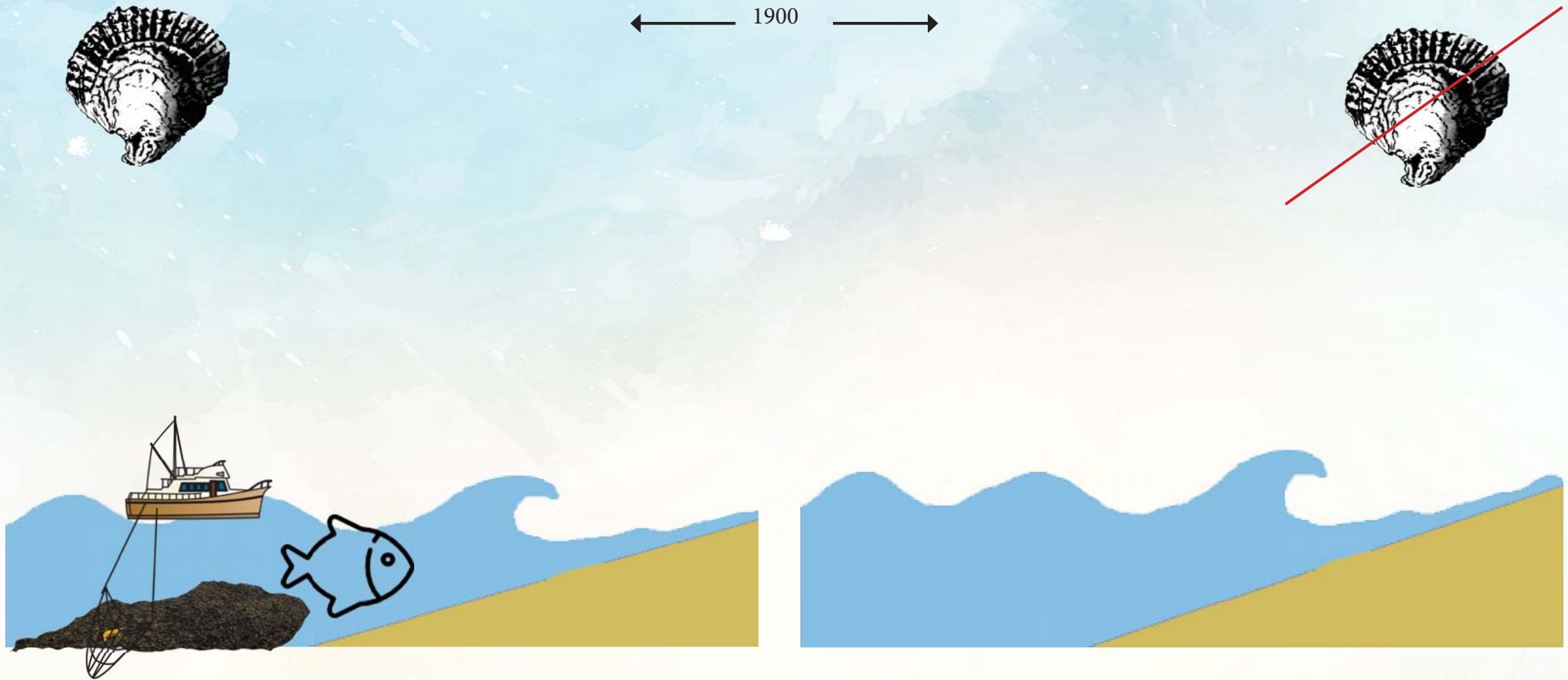
TU DELFT - FACULTY  
OF ARCHITECTURE AND  
THE BUILT ENVIRONMENT  
DELTA INTERVENTIONS

## Inhoudsopgave

3	Onderzoek/probleemstelling
7	Locatie
8	Concepten
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## probleemstelling

- Rond de 1900 waren de laatste oesterbanken in de Noordzee verdwenen door **overbevissing**. Oesterbanken zorgen voor voedselrijke ecosystemen, daarnaast filteren zij het water in een groot gebied. Het verlies van de oesterbanken zorgden voor een grote **achteruitgang in het ecosysteem**, ook zorgden de oesterbanken voor **bescherming van de Nederlandse kust**.





Hoofd-onderzoeksvraag;

- Op welke manier kan een geïntegreerd wind molenpark-aquacultuur-ontwerp bijdragen aan de verbetering van het zeewater en een eerste stap kunnen zijn naar het terugbrengen van de oesterbank.

Deelvragen;

- Wat heeft een duurzaam laboratorium gericht op onderwaterleven nodig
- Hoe kan een windmolenpark bijdragen aan een gezond ecosysteem
- Welke Hydrodynamische gevolgen spelen een rol?

windmolenpark+aquacultuur  
+laboratorium



verbetering  
waterkwaliteit



terugkomst  
oesterbank?



Benodigheden  
duurzaam laboratorium



Windmolenpark+ ecosysteem

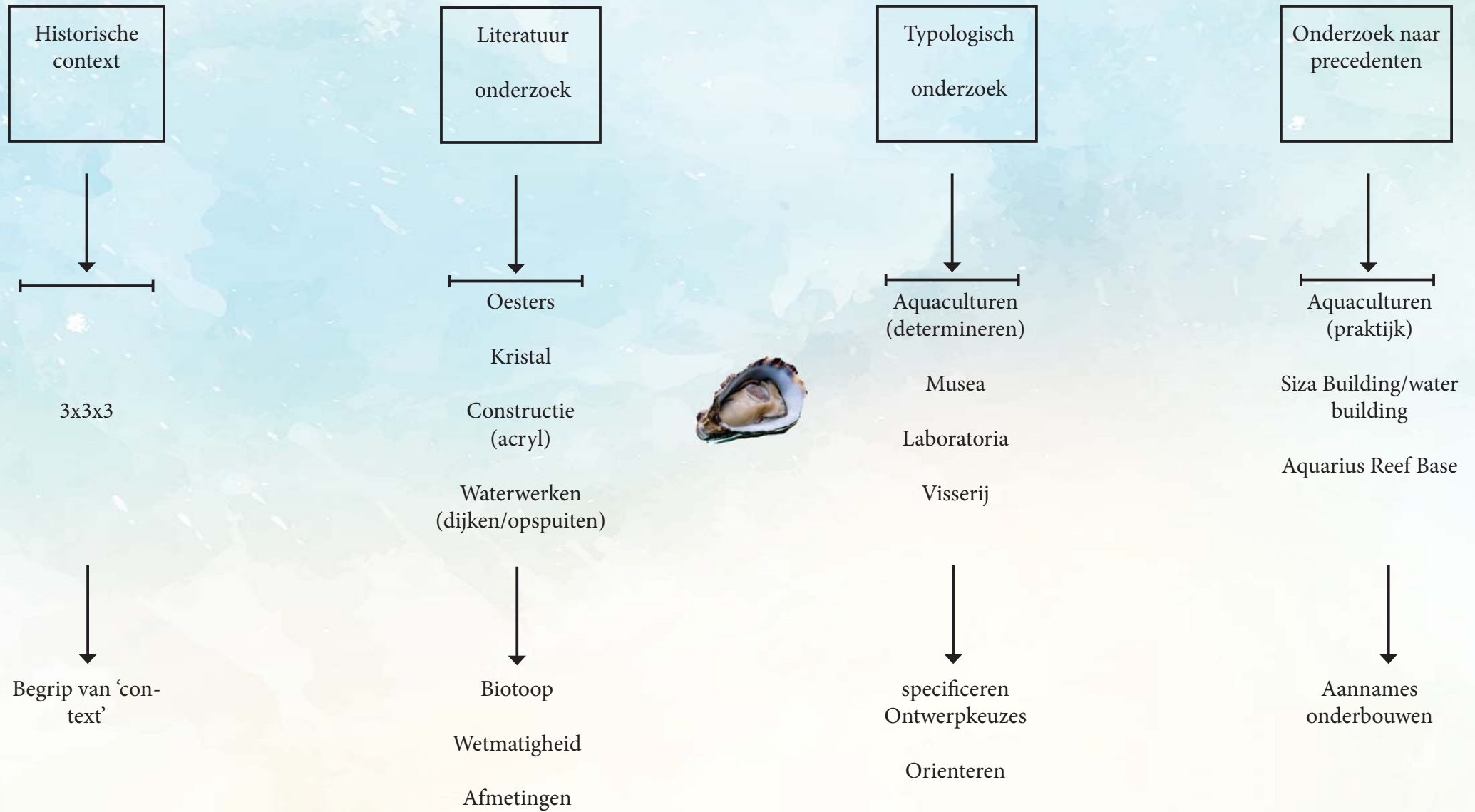


Hydrodynamica





Onderzoeksmethoden;



Relevantie;

Sociale relevantie;

- Het creëren van meer begrip en maatschappelijk draagvlak voor Duurzame energie Aqua culturen, techniek, laboratoria en de herkomst van vis en schelpdieren zien.

Eigen relevantie;

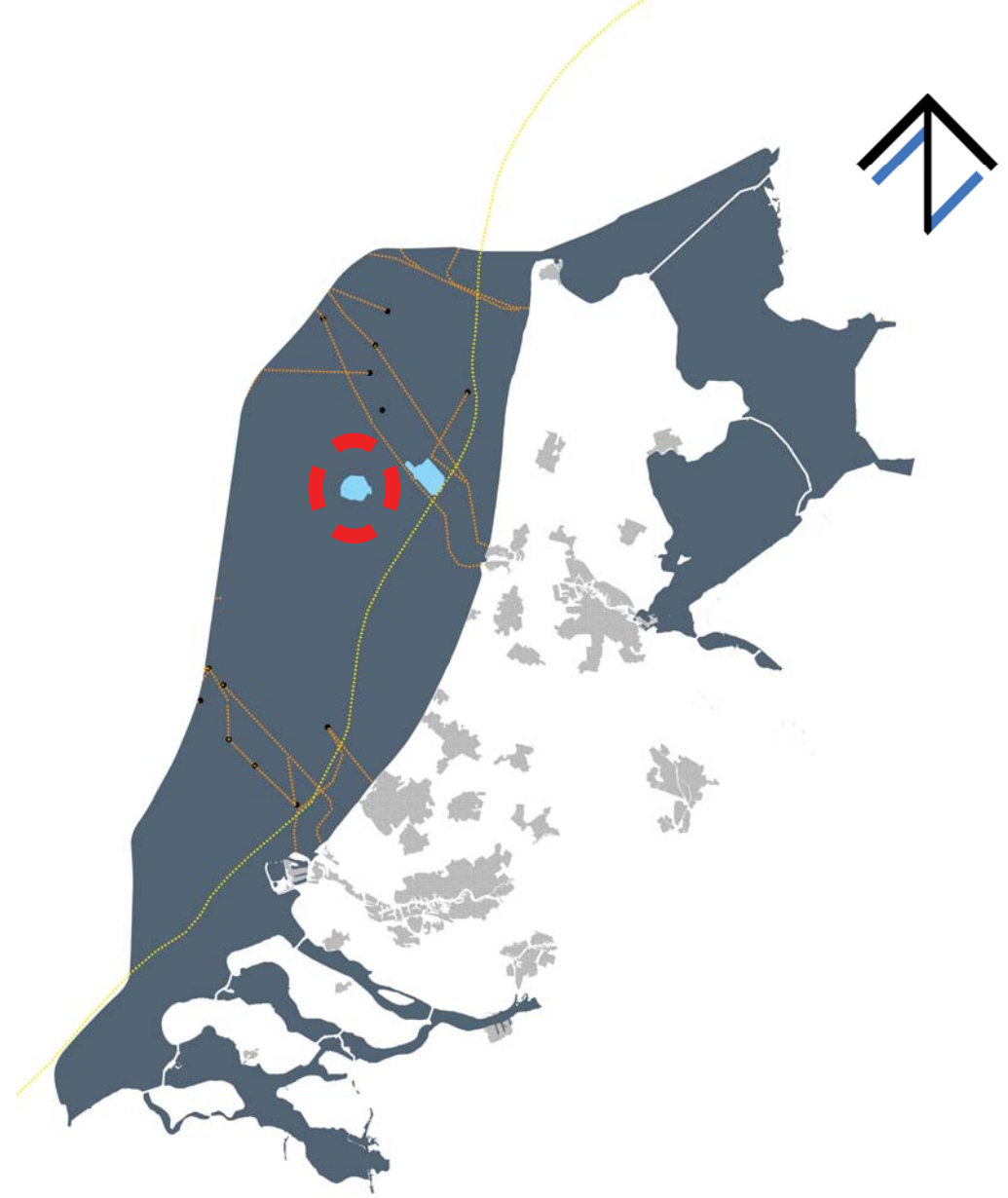
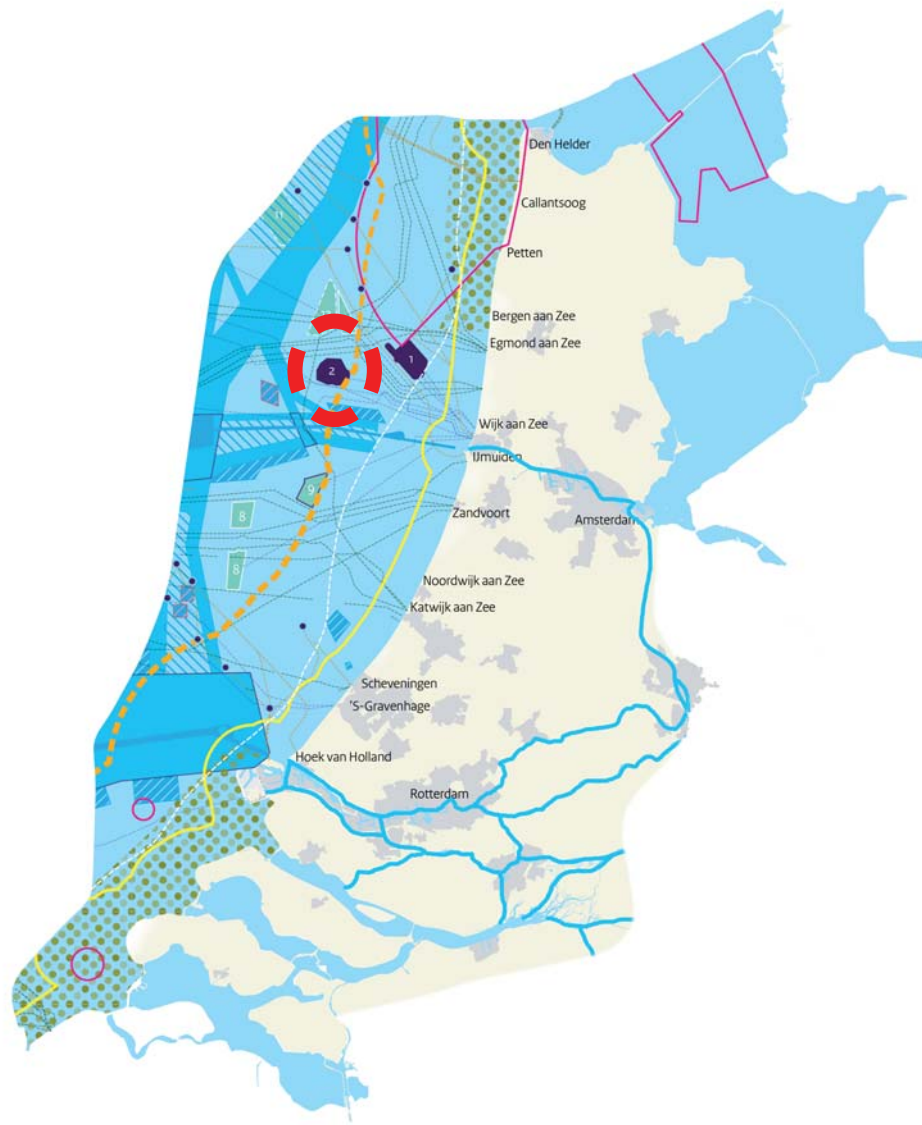
- Interesse voor techniek, waterbouwkunde, duurzame energie en lekker eten

Waarom is het nodig?

- Natuur, duurzaamheid en techniek moet meer aandacht krijgen

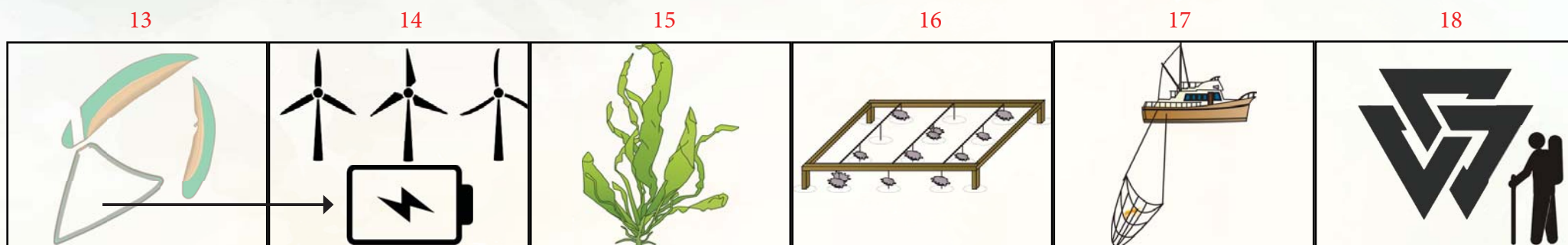
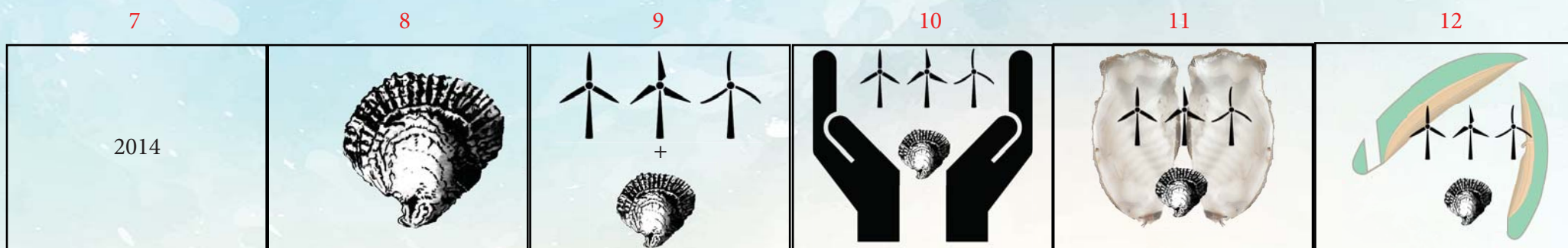


Locatie





Chronologische uitleg uitleg concept Amalia archipel



## Chronologie

- Vertrek vanaf Amsterdam





## Chronologie

- Vertrek IJmuiden



10-72

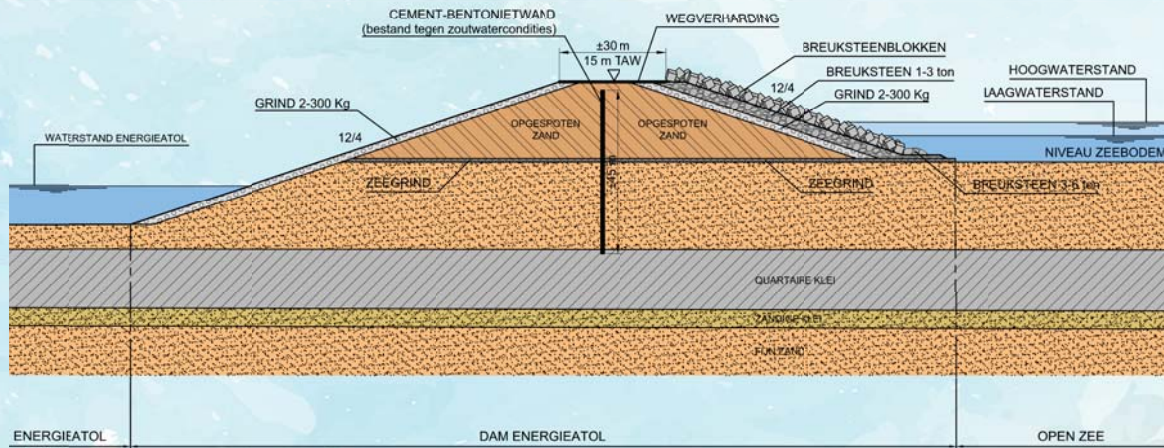


## Chronologie

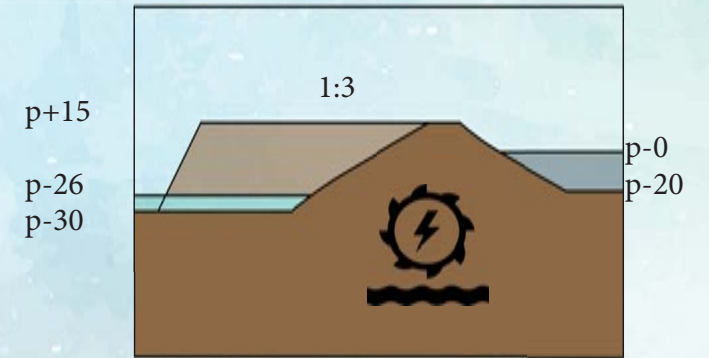
- Onderweg naar het bestaande Prinses Amalia windpark



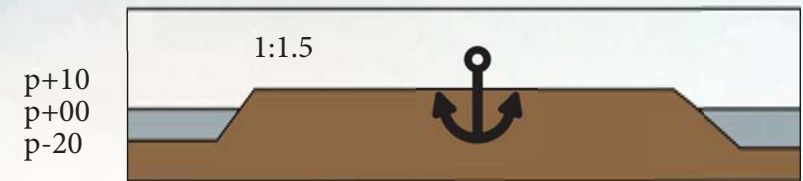
# Doorsnedes van dijken



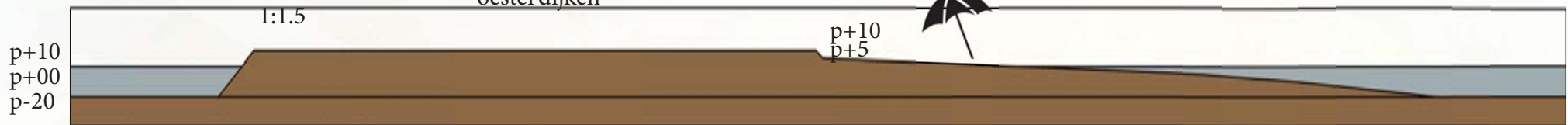
Valmeer



Ringdijk



'oester'dijken



## Chronologie

- Boottocht naar de nieuwe Amalia Archipel 10:30

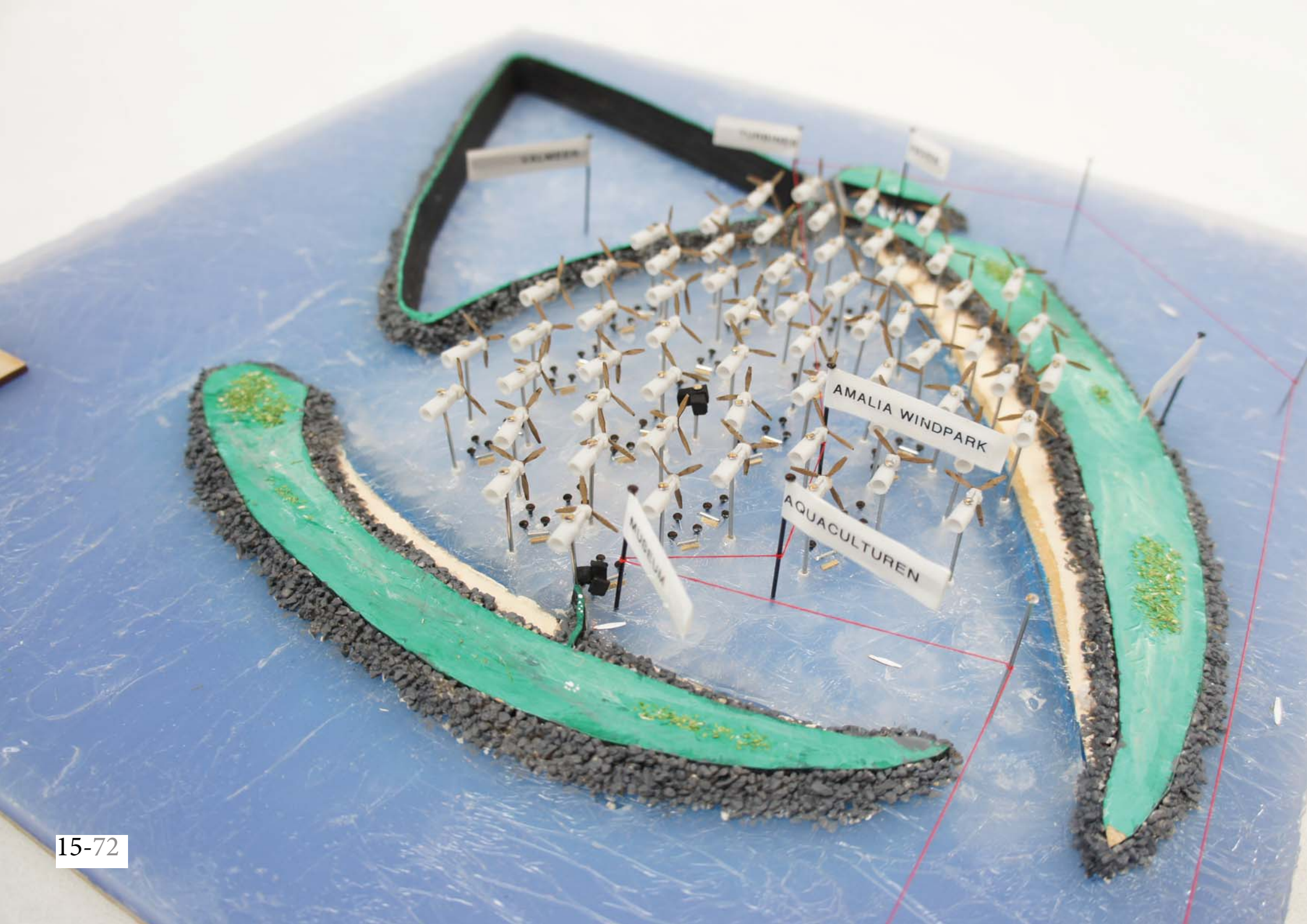




Chronologie

De eilanden rondom het Amalia windpark...





WILHELM

THOMAS

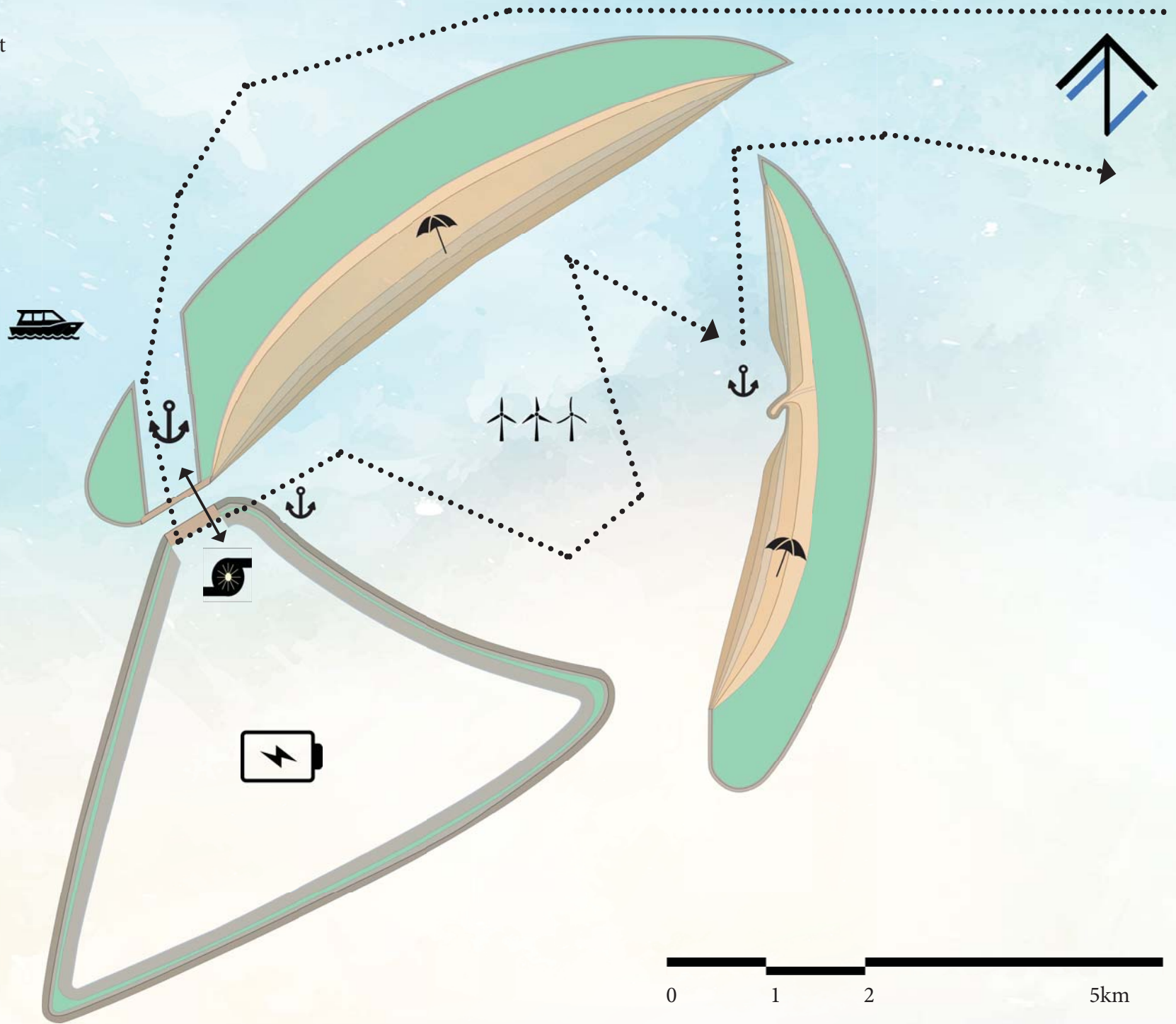
THOMAS

AMALIA WINDPARK

AQUACULTUREN



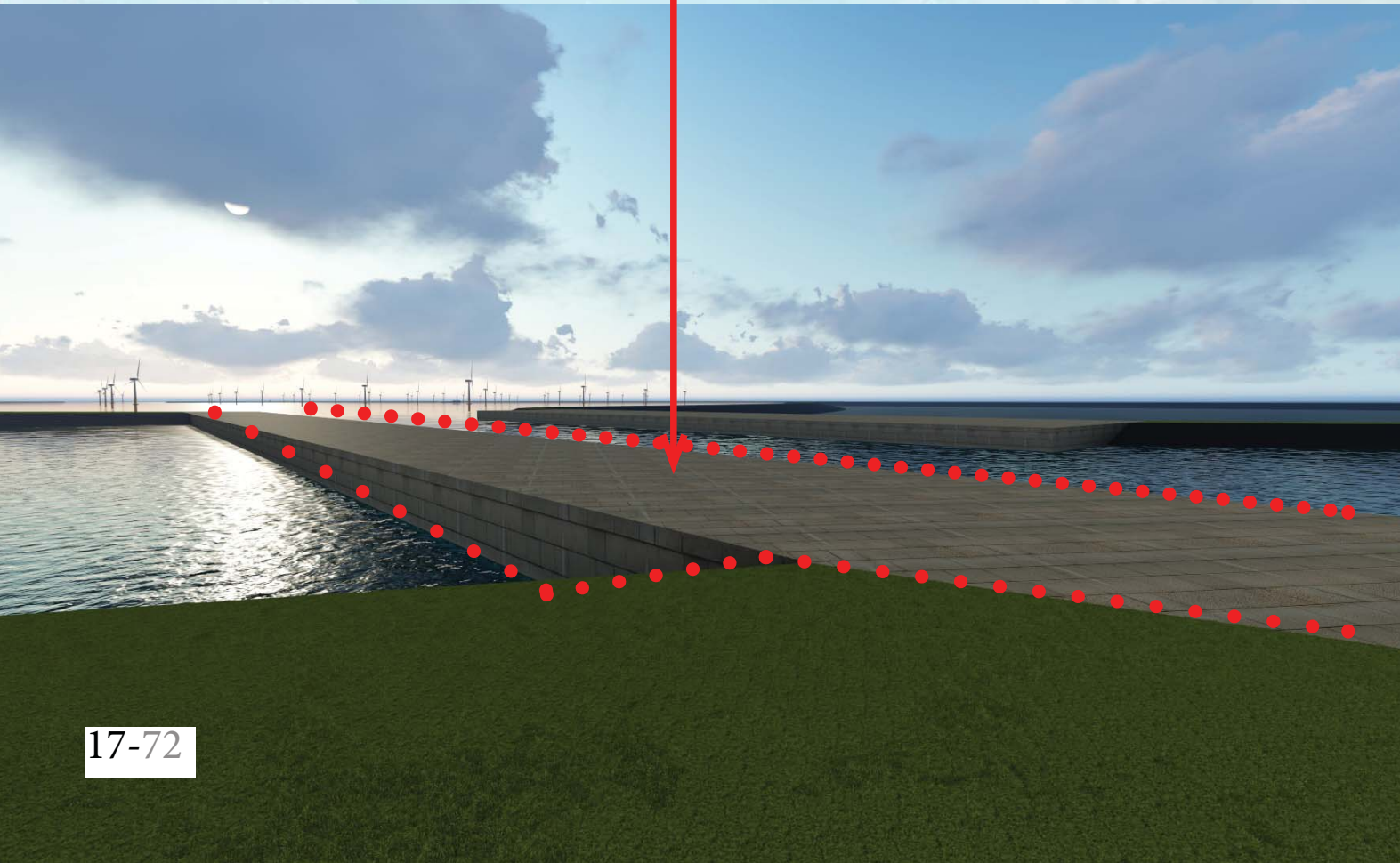
Locatie en de aangepaste context



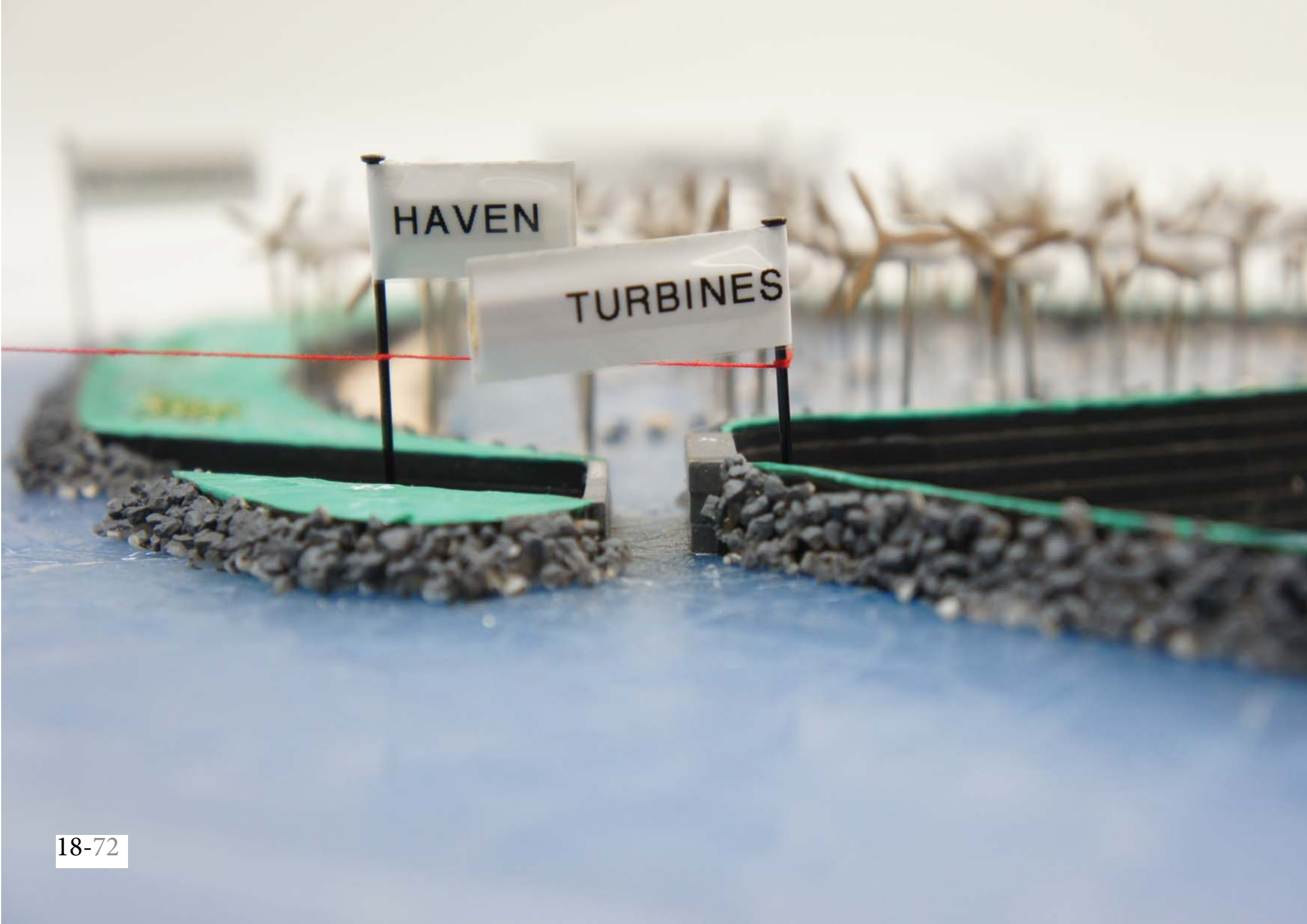


# Chronologie

- Looptocht naar west-turbineruimte



Turbineruimte



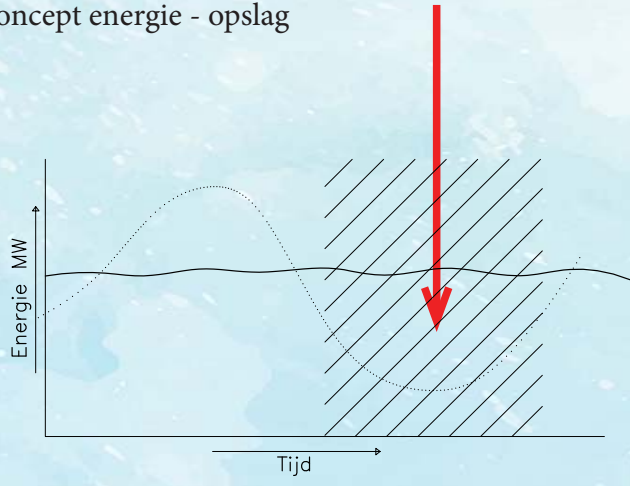
## Chronologie

- Afdaling naar tunnel onder het 'Kanaal'

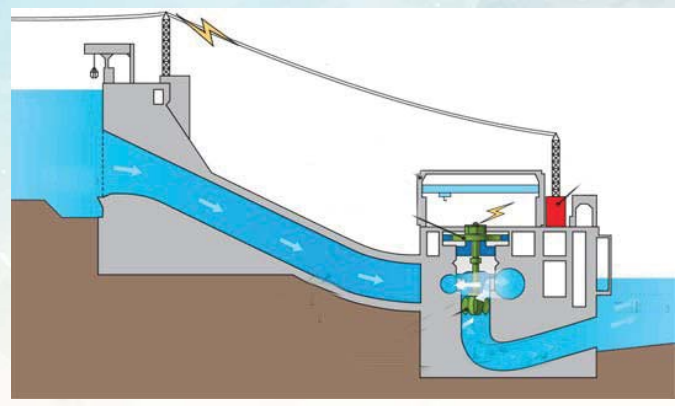




# Concept energie - opslag



..... energieverbruik  
—— opbrengst Amalia windpark

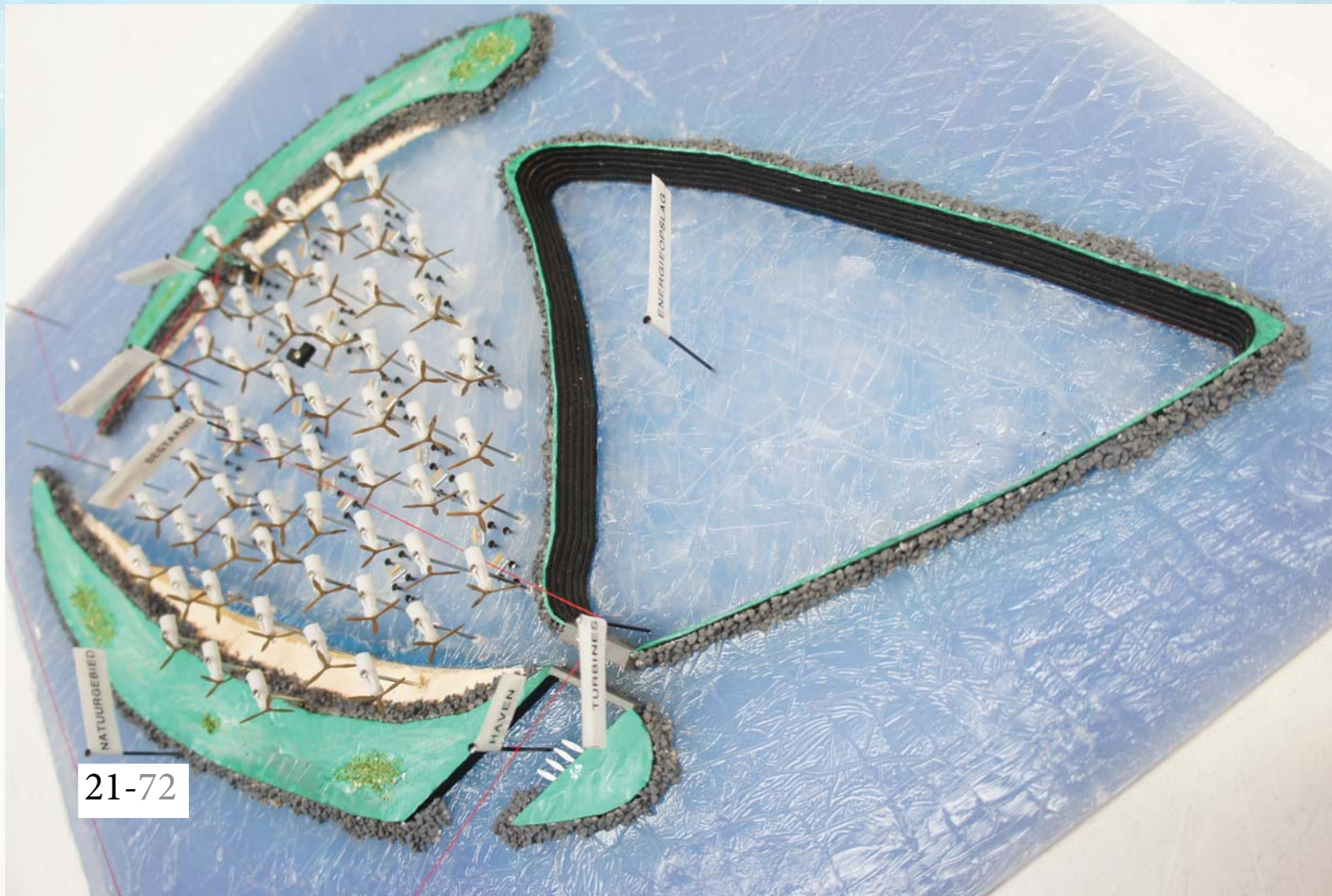


## Chronologie

- Rondleiding turbineruimte en uitzicht over Valmeer 11:30



- Het waterpeil in het valmeer kan tot 26m lager dan het NAP komen te liggen
- Bodem van het valmeer ligt 10m lager dan zeebodem
- Oppervlakte 12km<sup>2</sup>



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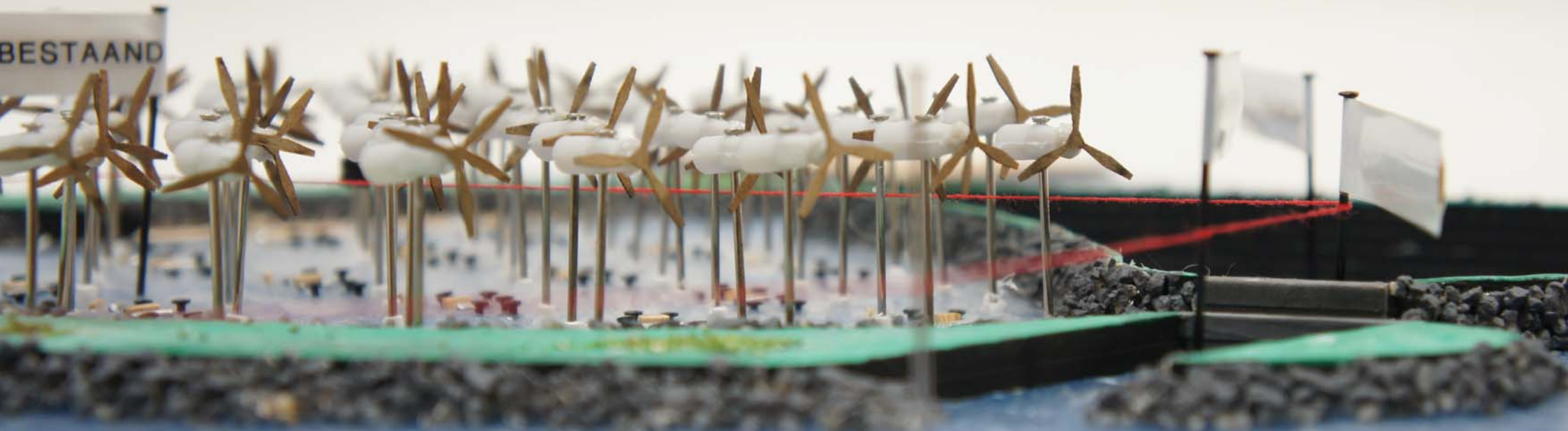


Chronologie;

- Tocht door windmolenpark en aquaculturen. Er zijn reeds 60 windmolens.







Ecologie concept

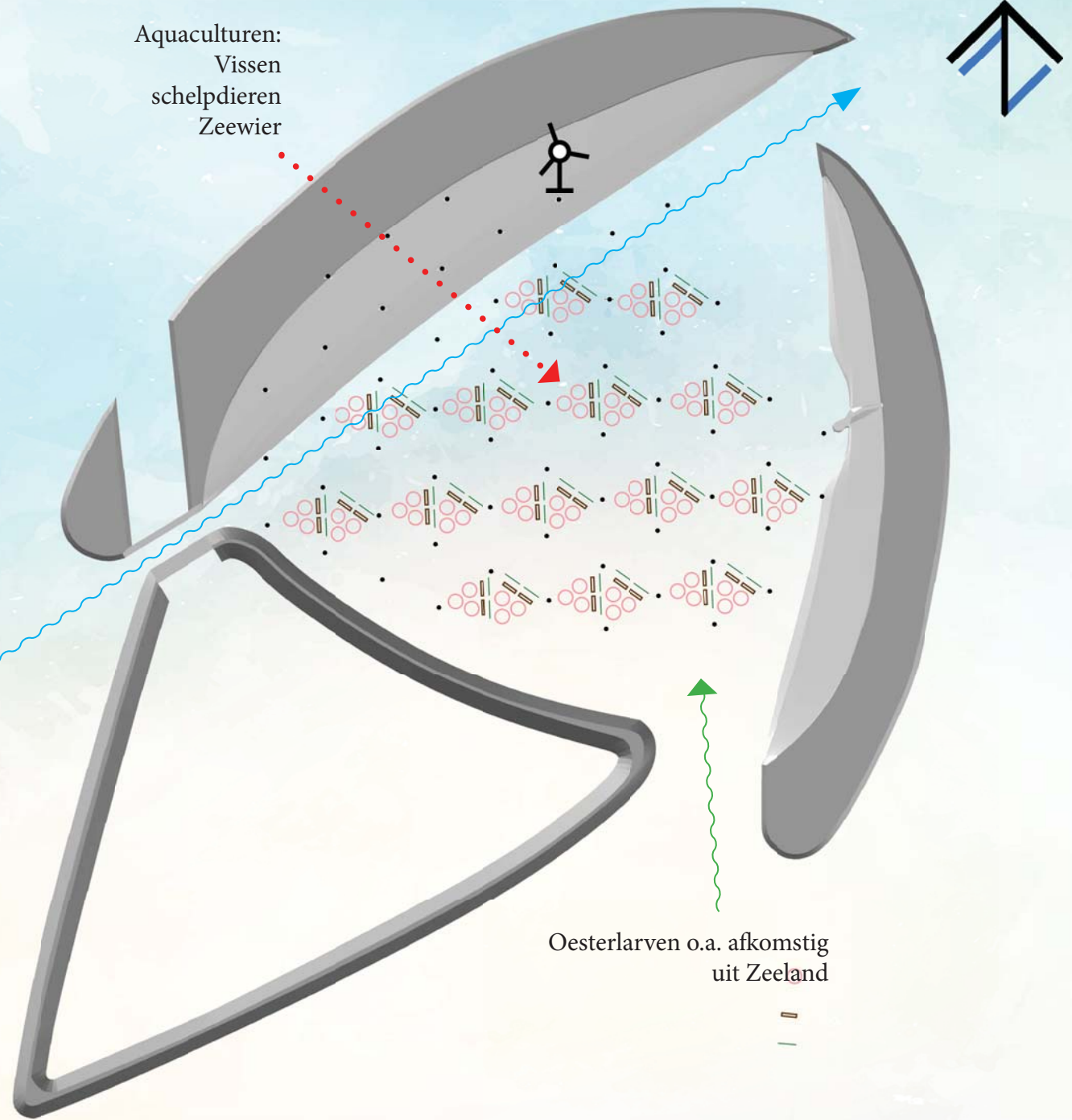
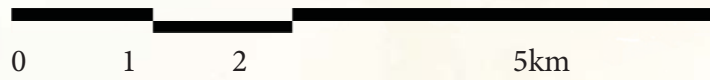
- Aquaculturen

Aquaculturen:  
Vissen  
schelpdieren  
Zeewier

Oesterlarven

Stromingsrichting van de zee

Oesterlarven o.a. afkomstig uit Zeeland



Chronologie;

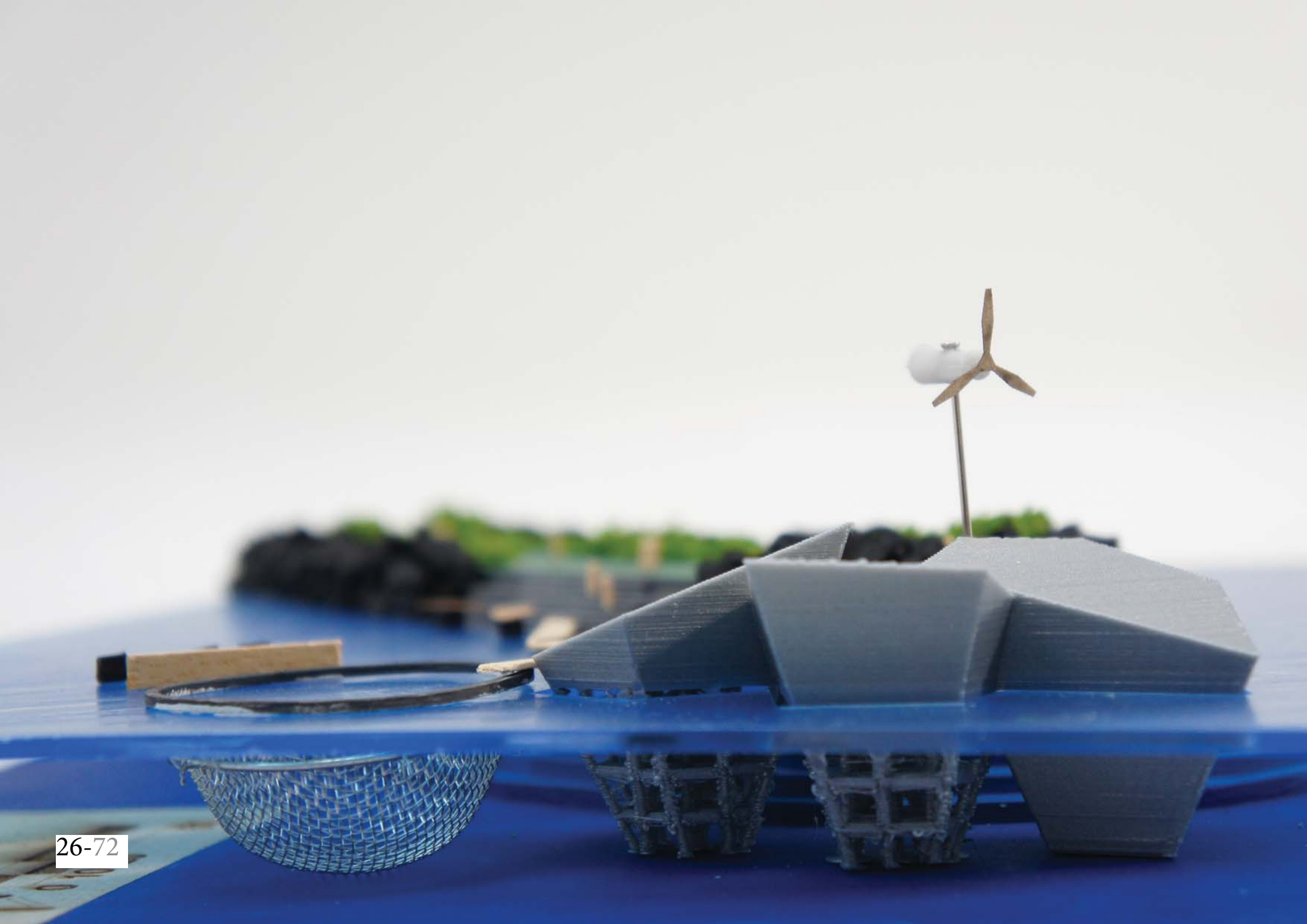
- Aankomst bij museum



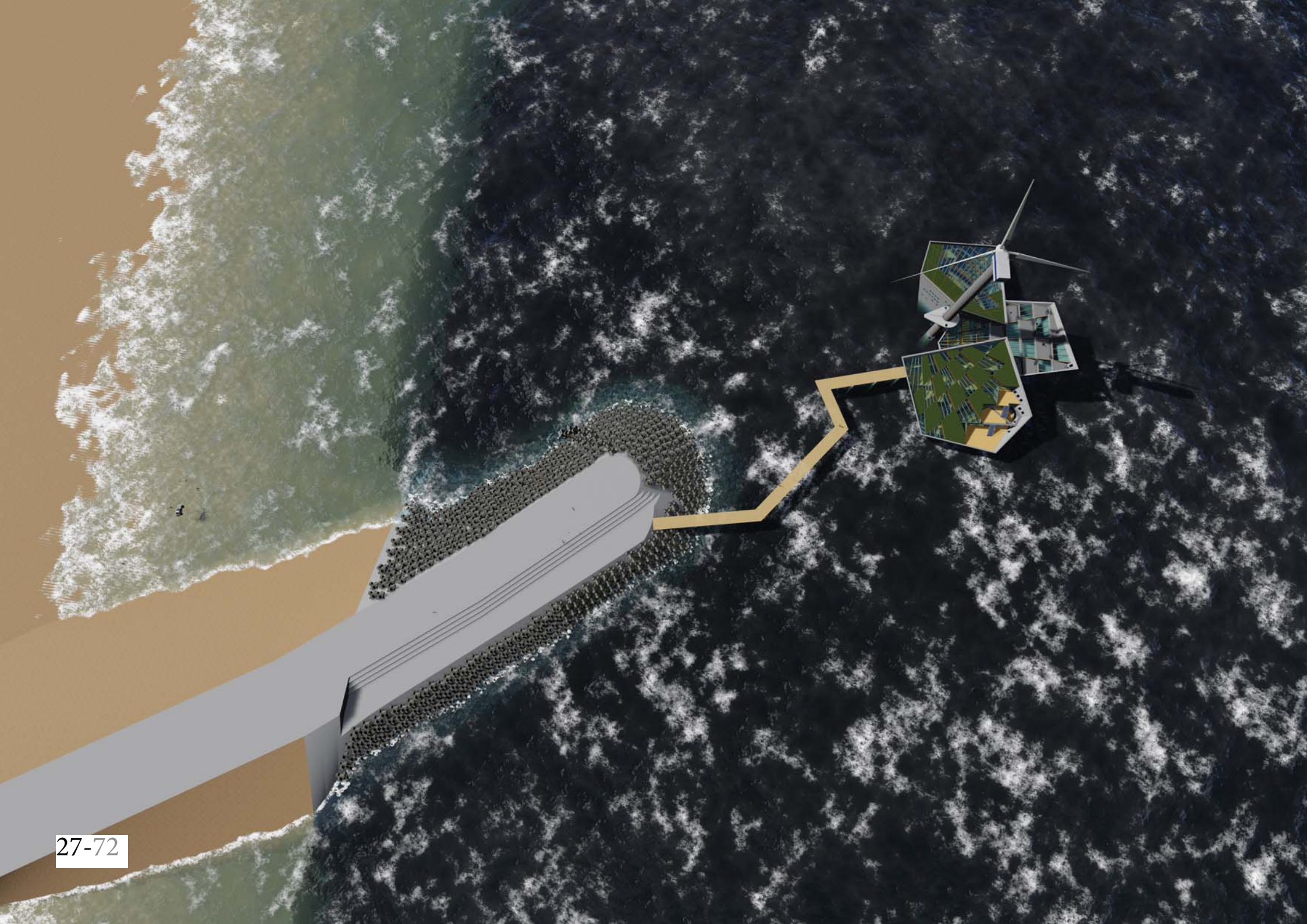
Aquaculturen

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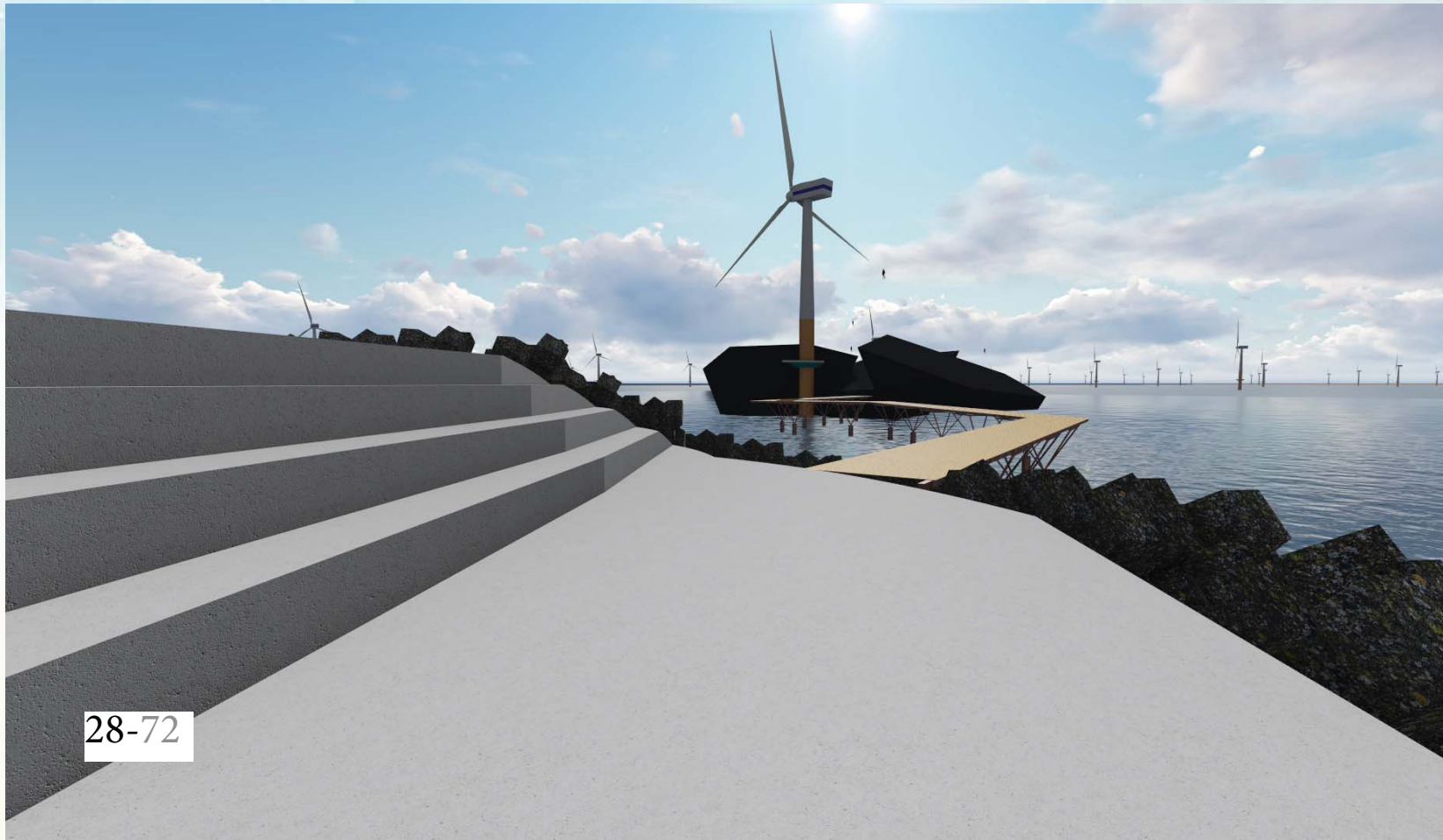








Locatie van het museum

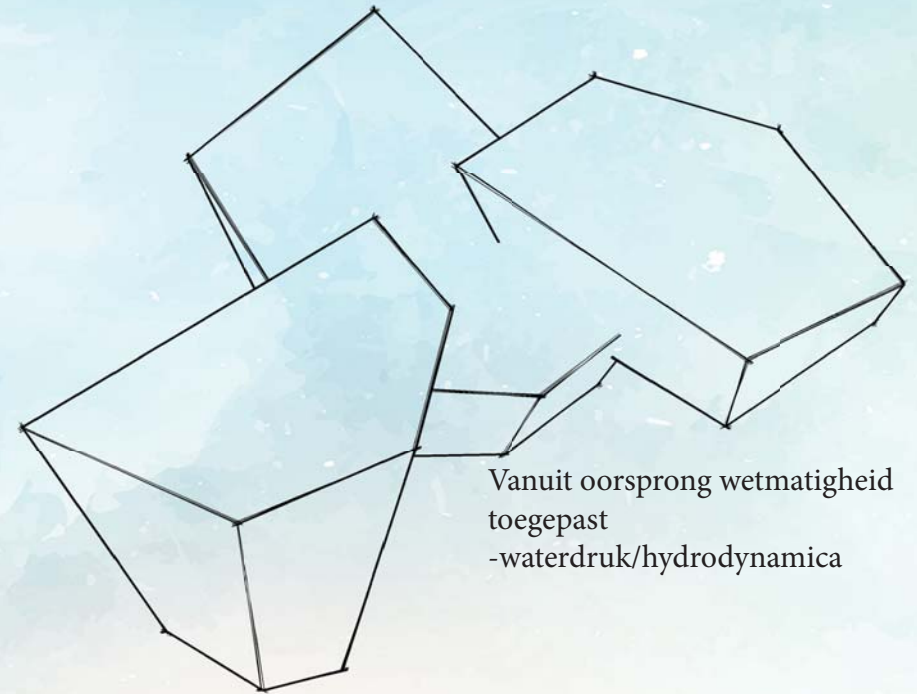
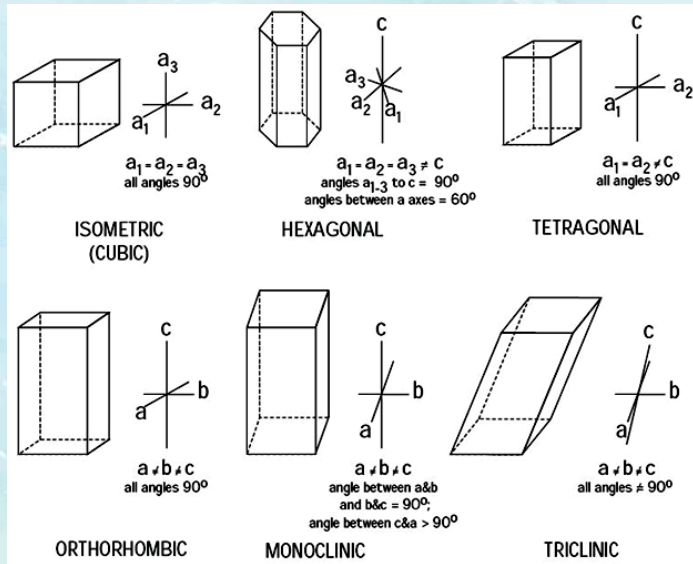


28-72

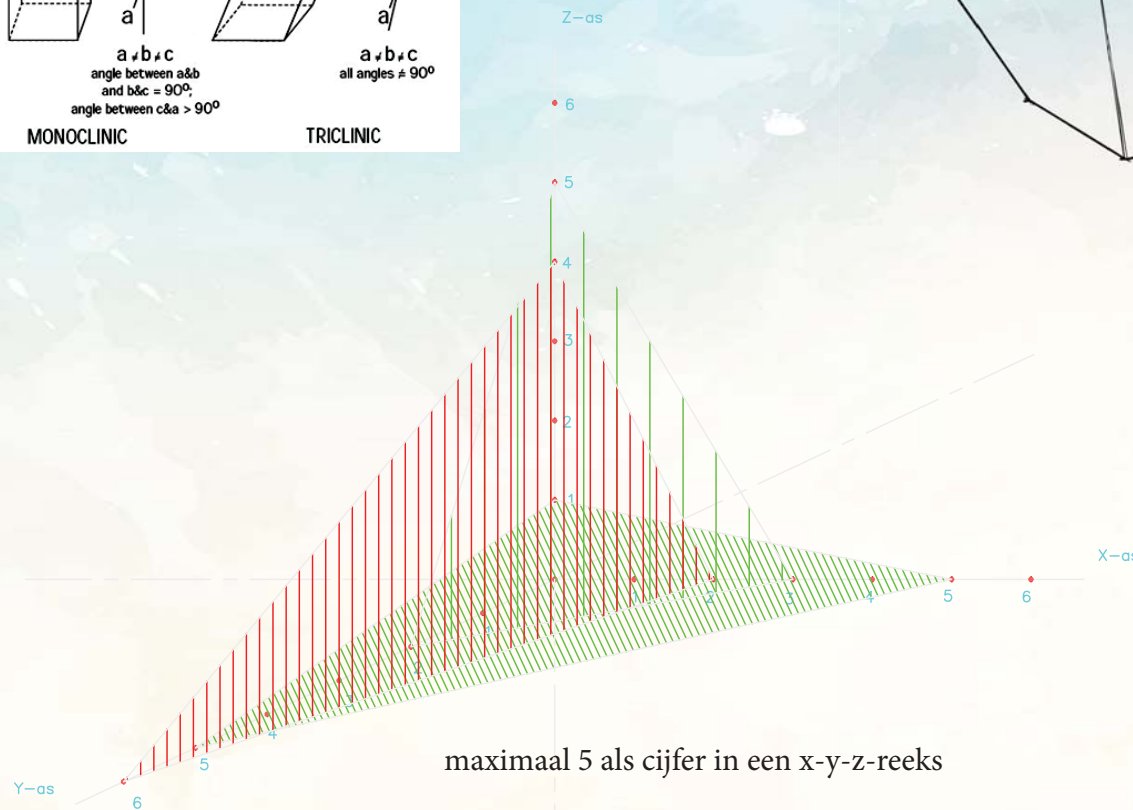


# Uitkomst vormenstudie

## Wetmatigheid; kristallografie



Vanuit oorsprong wetmatigheid  
 toegepast  
 -waterdruk/hydrodynamica



Magnetiet







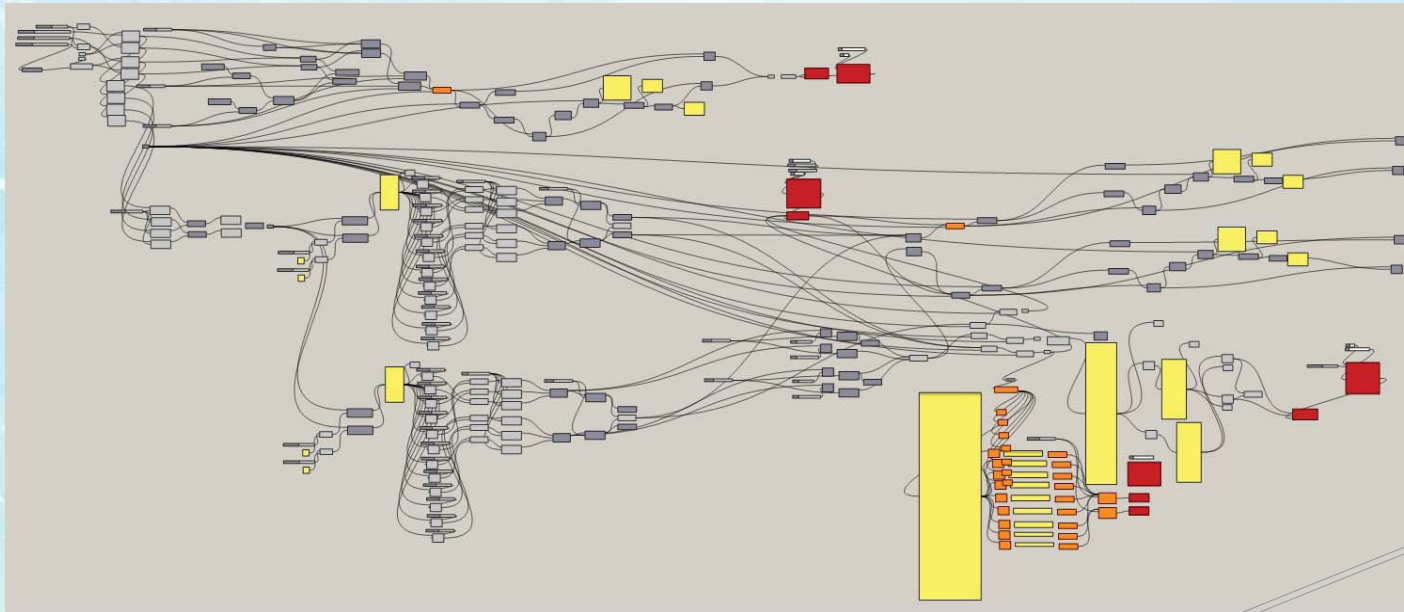
30-72





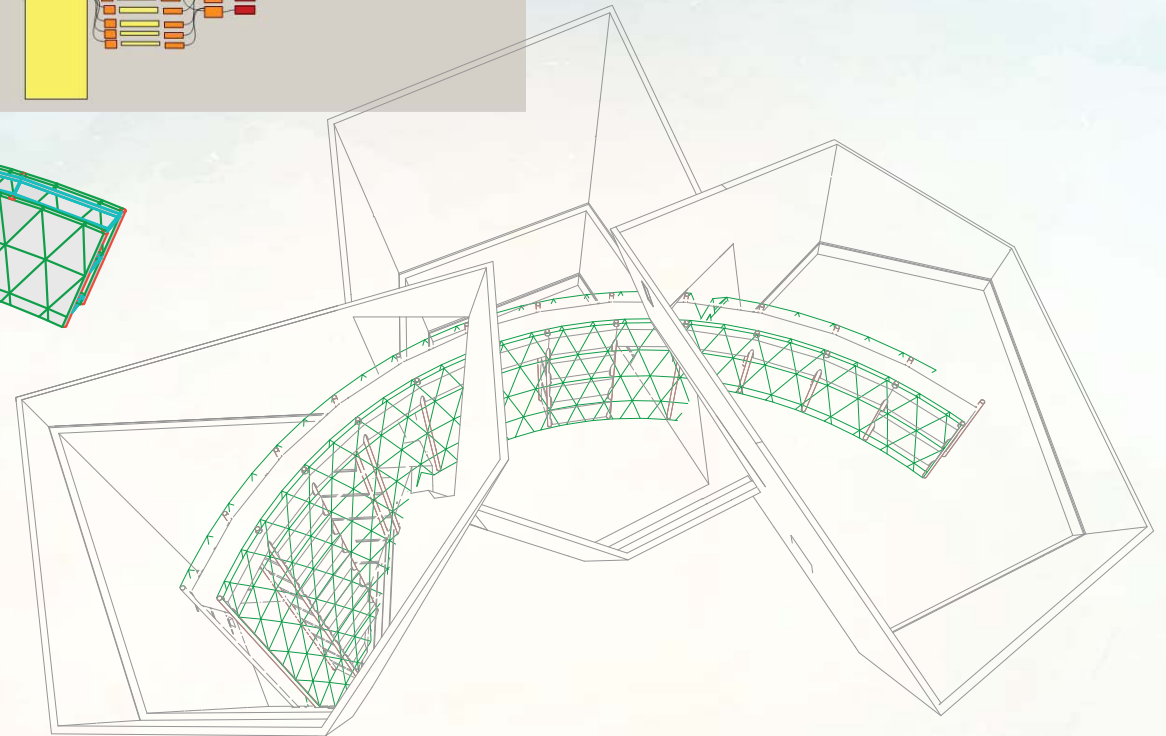
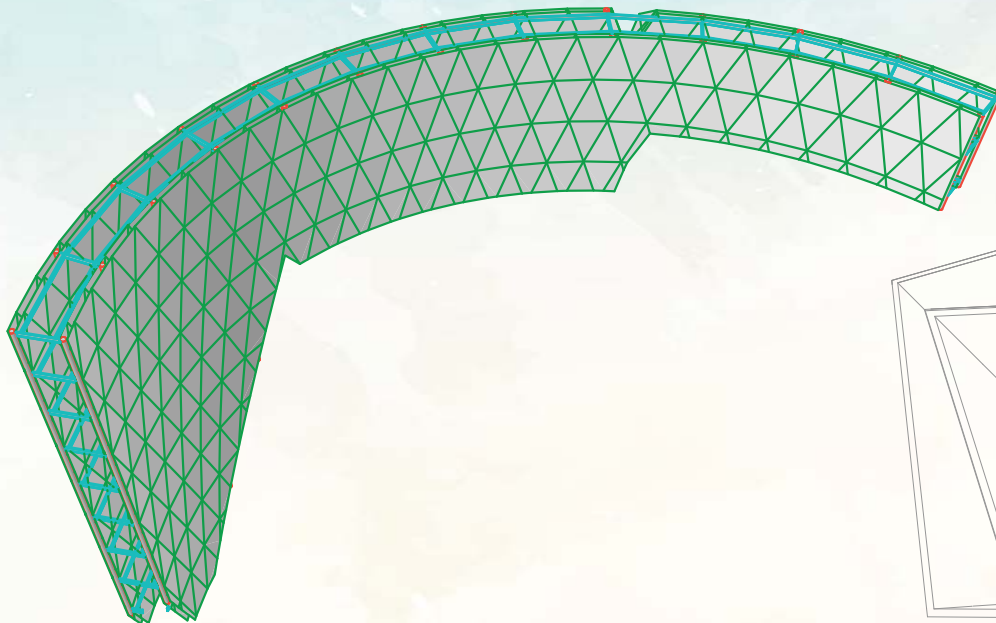


Middenvolume ter oriëntatie van de bezoeker



Grasshopper variabelen;

- Diameter onder/boven
- Dikte van wand
- Aantal verdiepingen/gevelementen/vlakken
- Materiaaleigenschappen



# Plattegronden

V.-7 P-20m

V.-6 P-18m

V.-5 P-15m

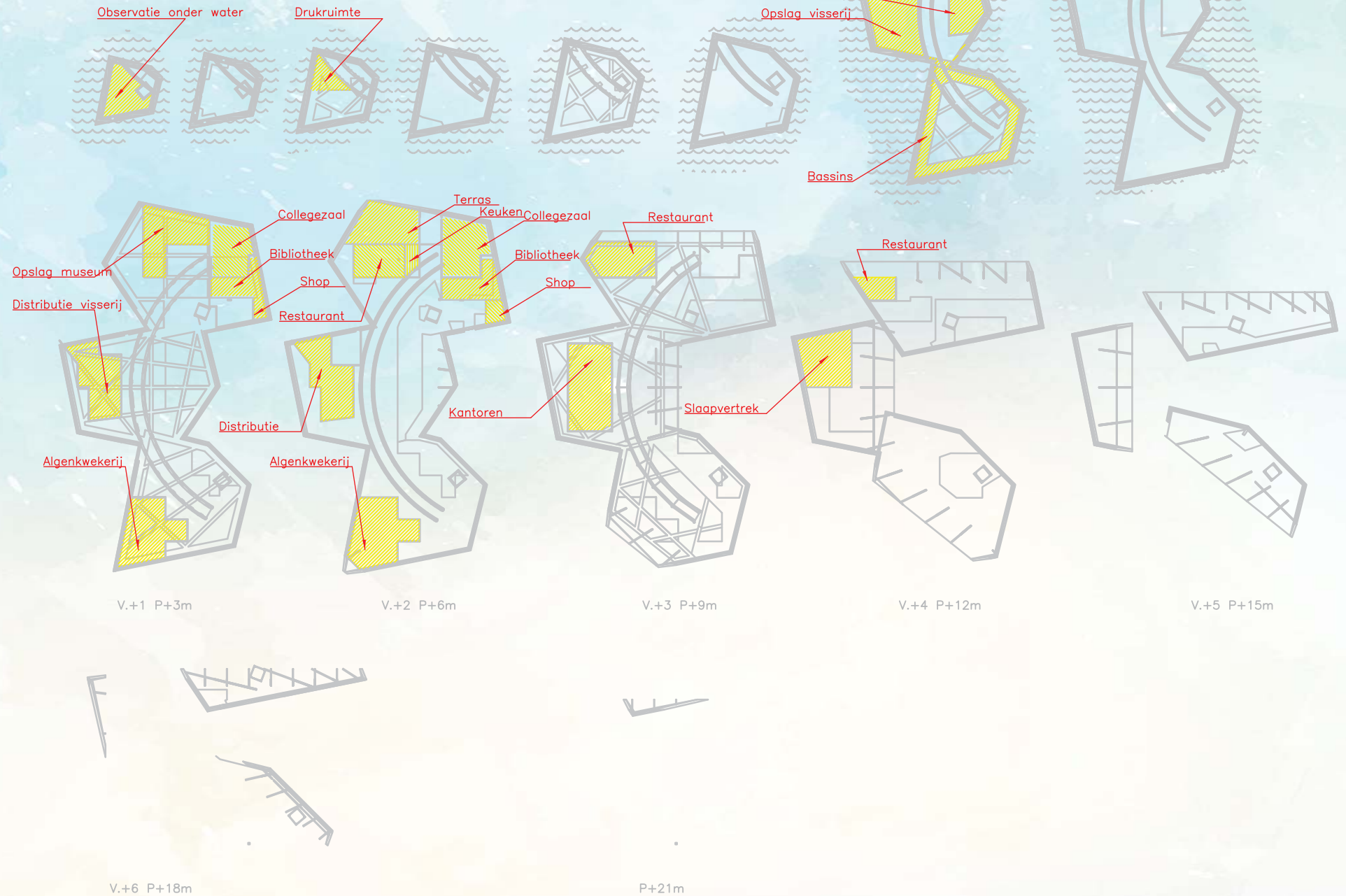
V.-4 P-12m

V.-3 P-9m

V.-2 P-6m

V.-1 P-3m

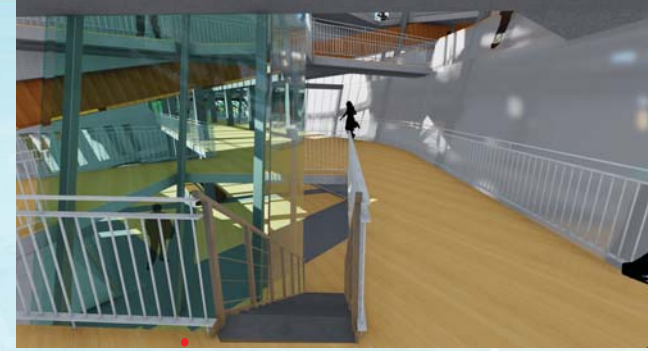
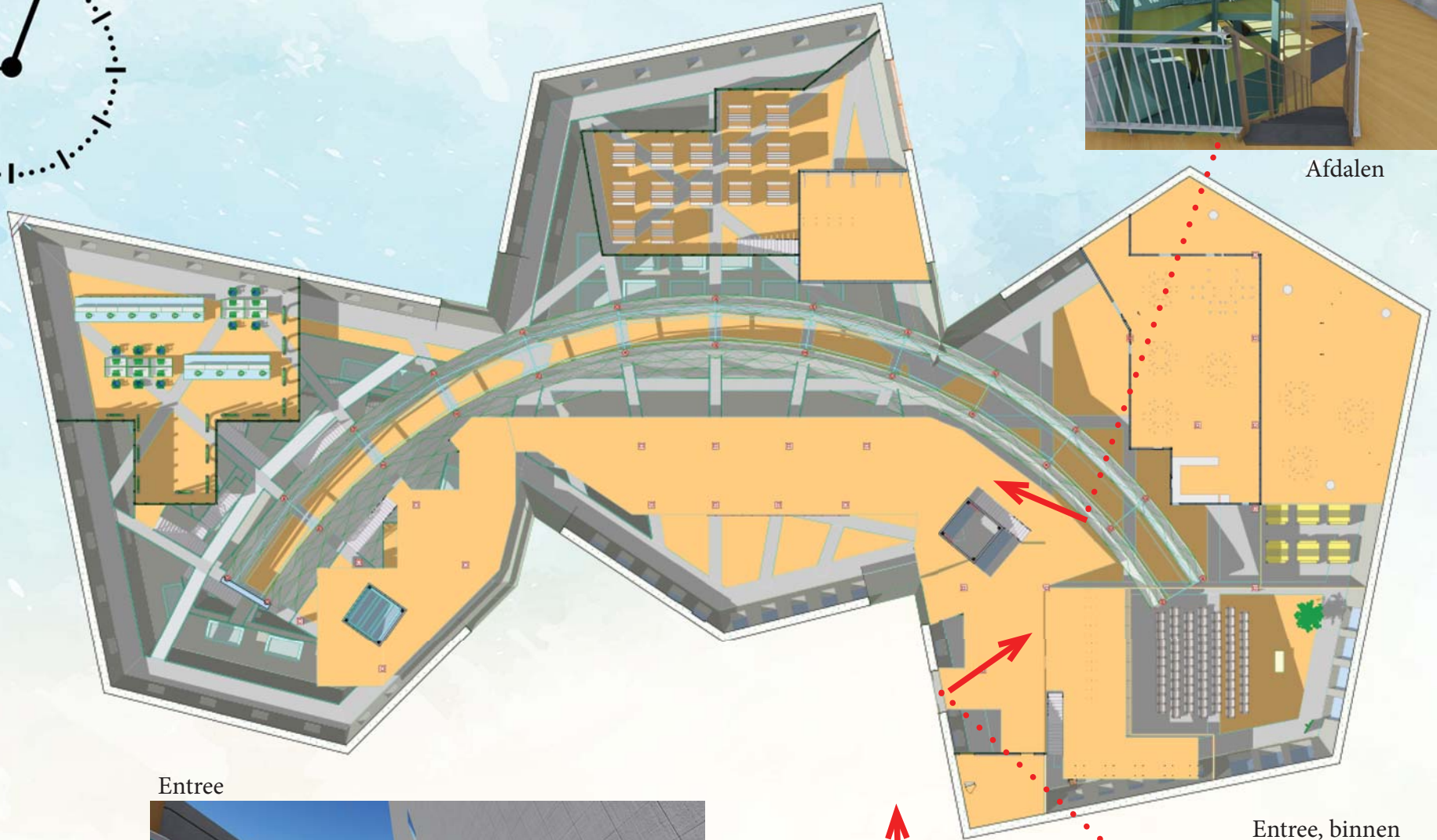
V.-0 P+0m





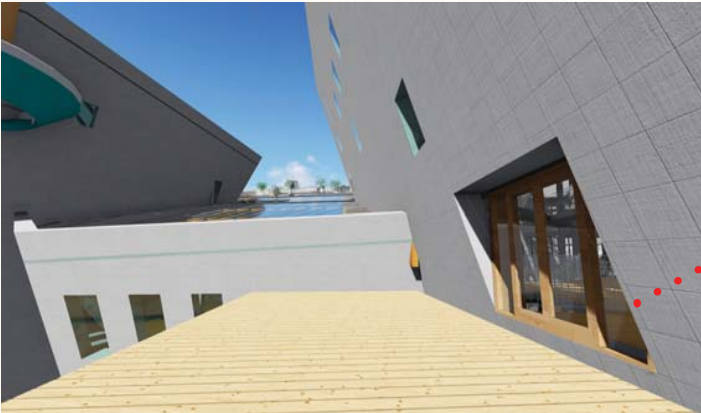


V.+2 P+6m

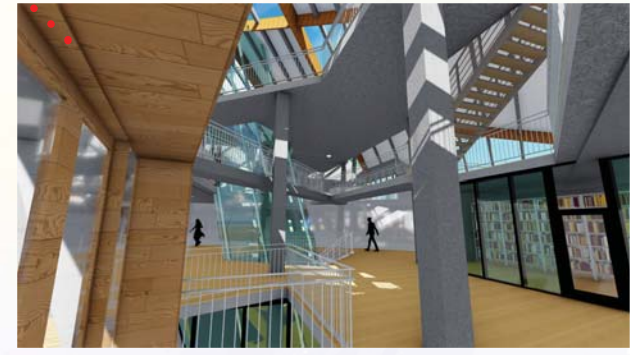


Afdalen

Entree



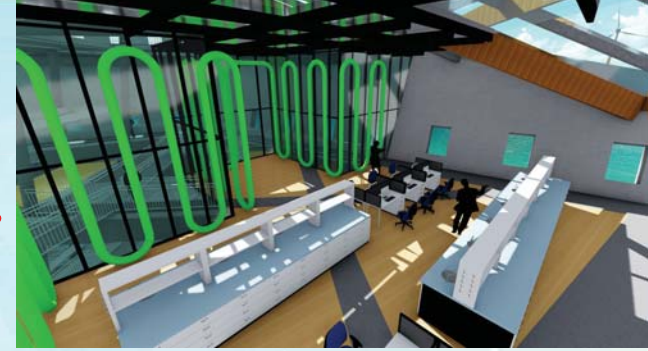
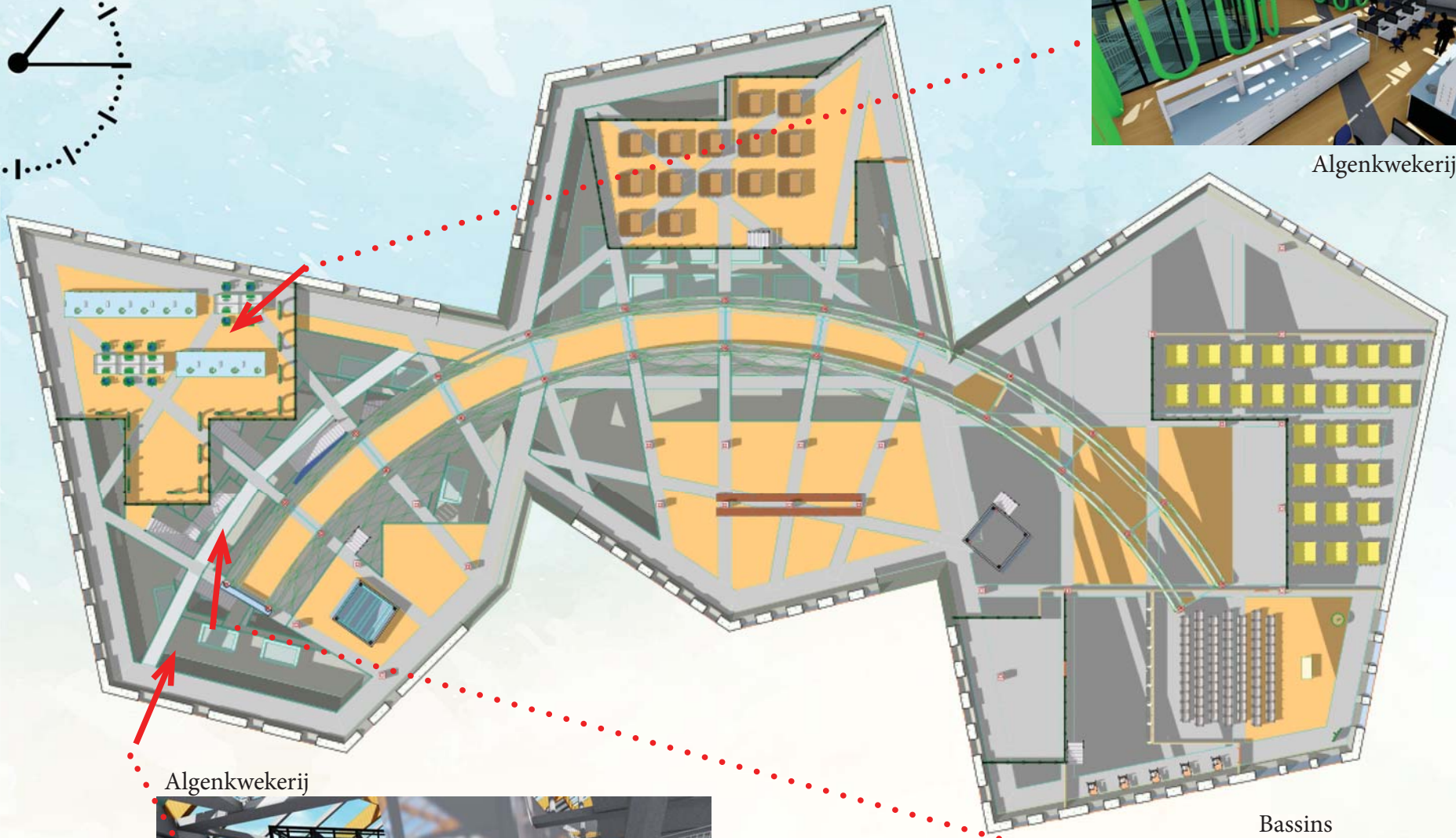
Entree, binnen



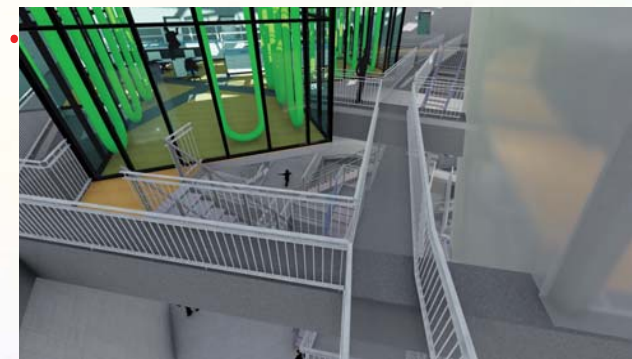
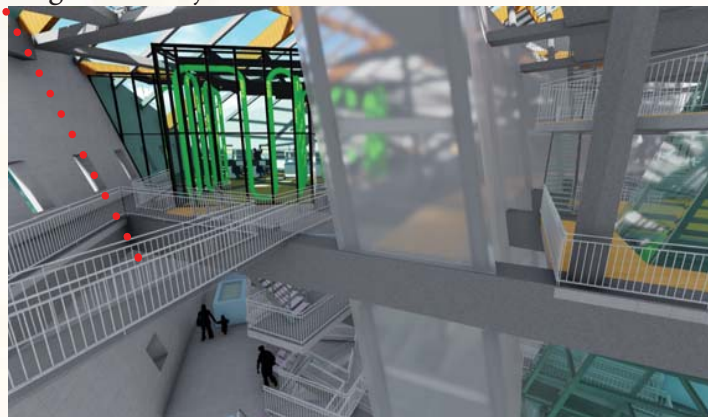




V.+1 P+3m



Algenkwekerij



Bassins



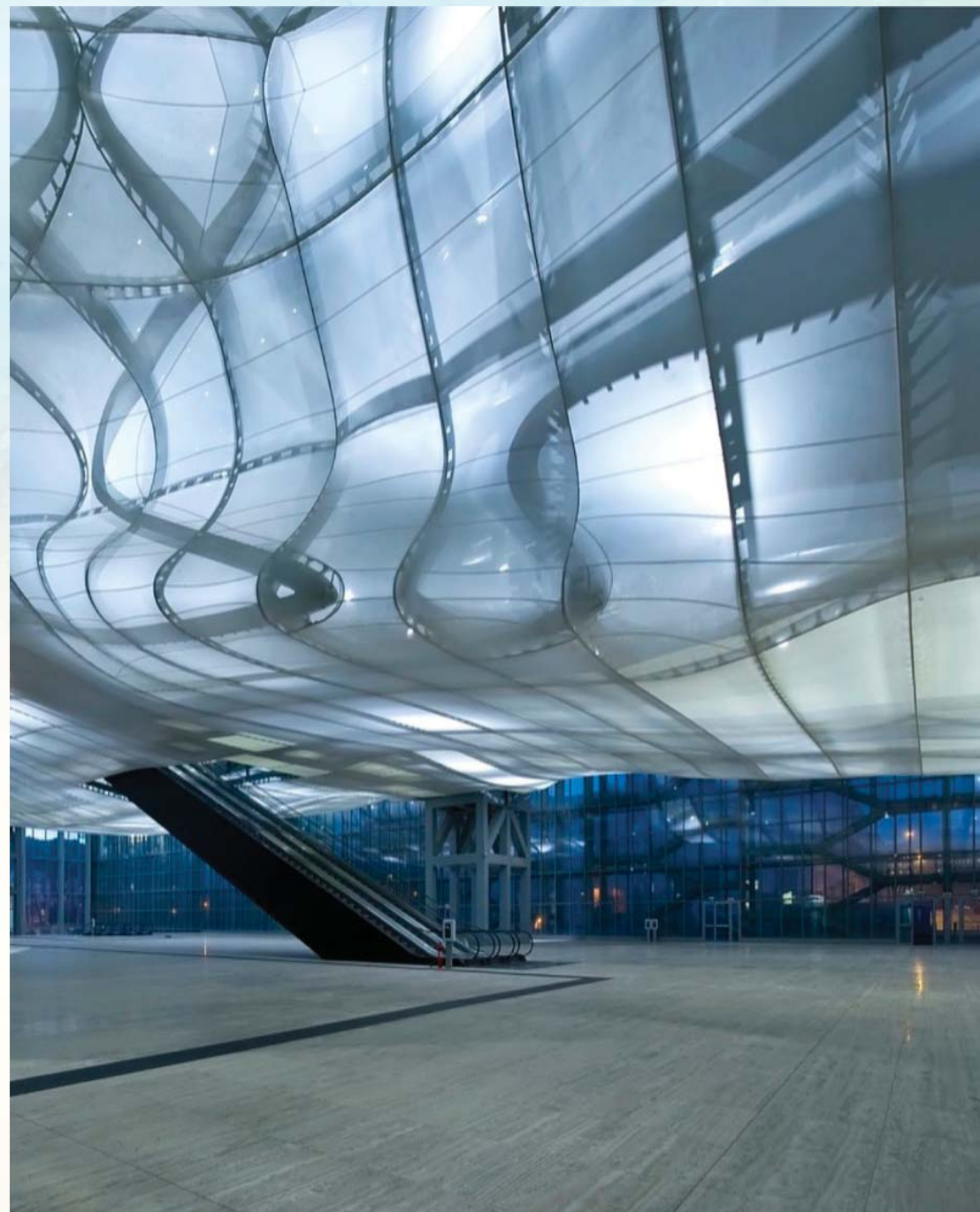
Verlichting vanuit volume;

Tussen de twee lagen polycarbonaat bevinden zich LED strips..

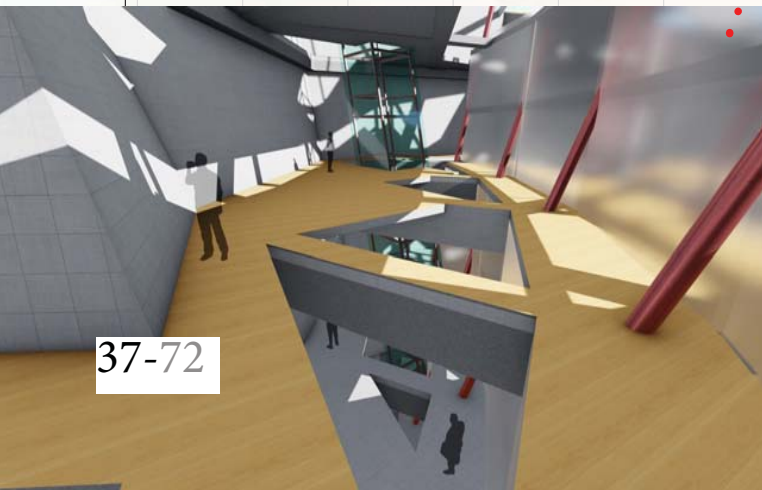
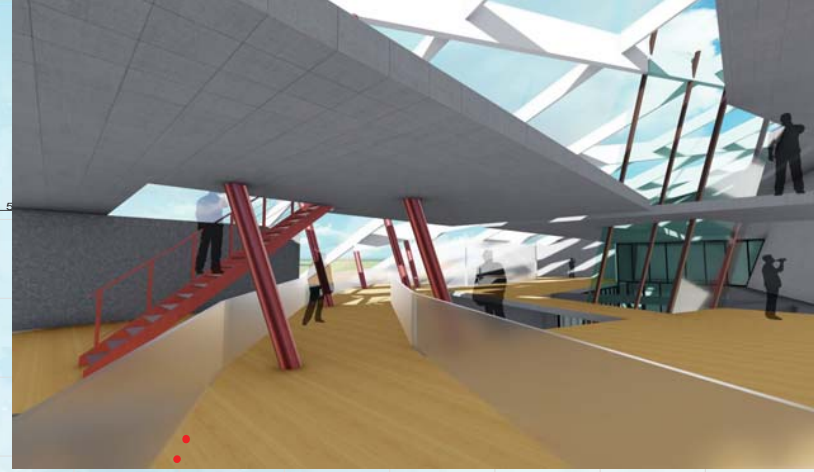
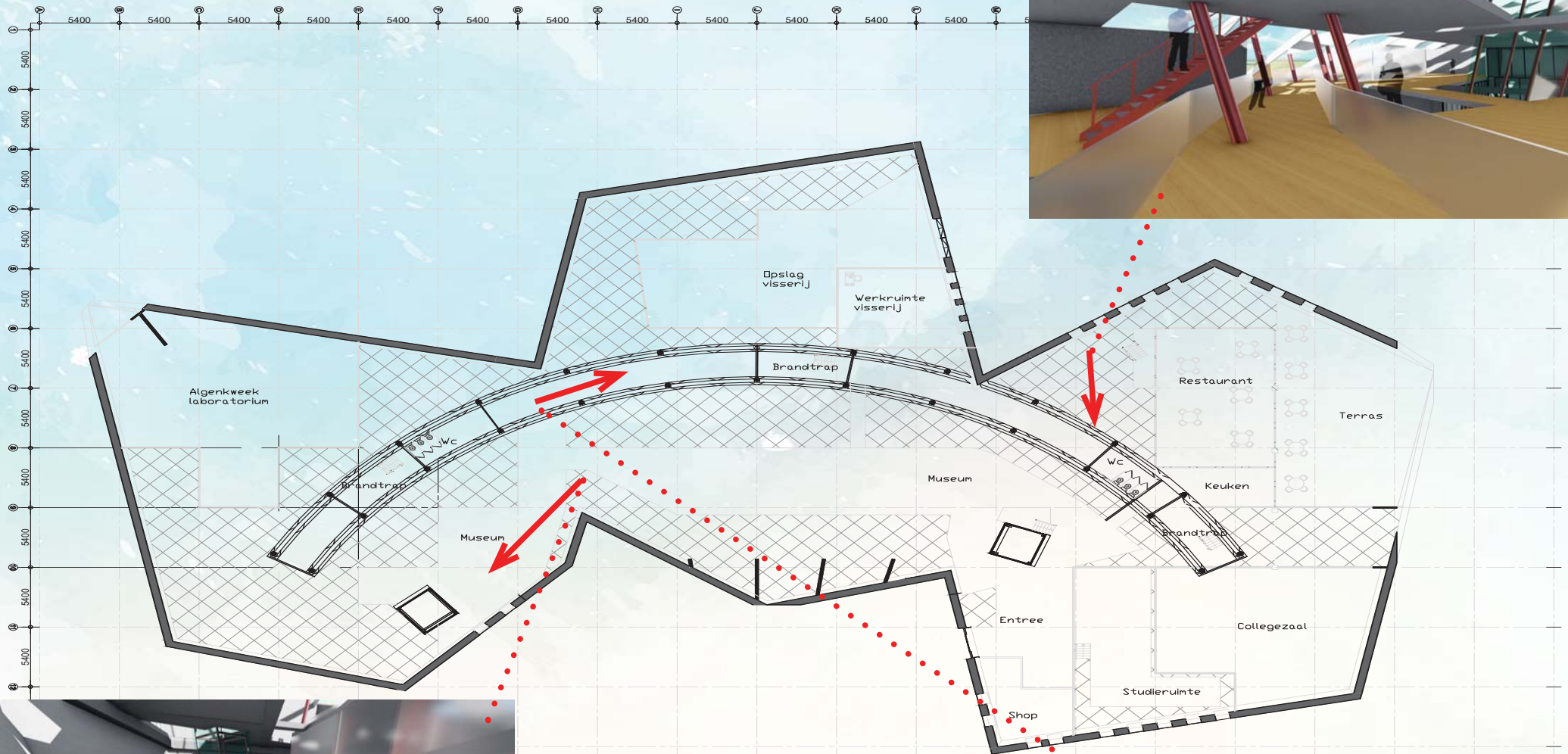


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the cloud; studio fuksas, rome



# Plattegrond

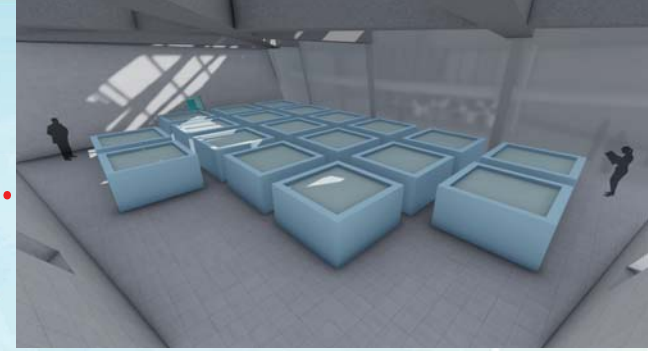


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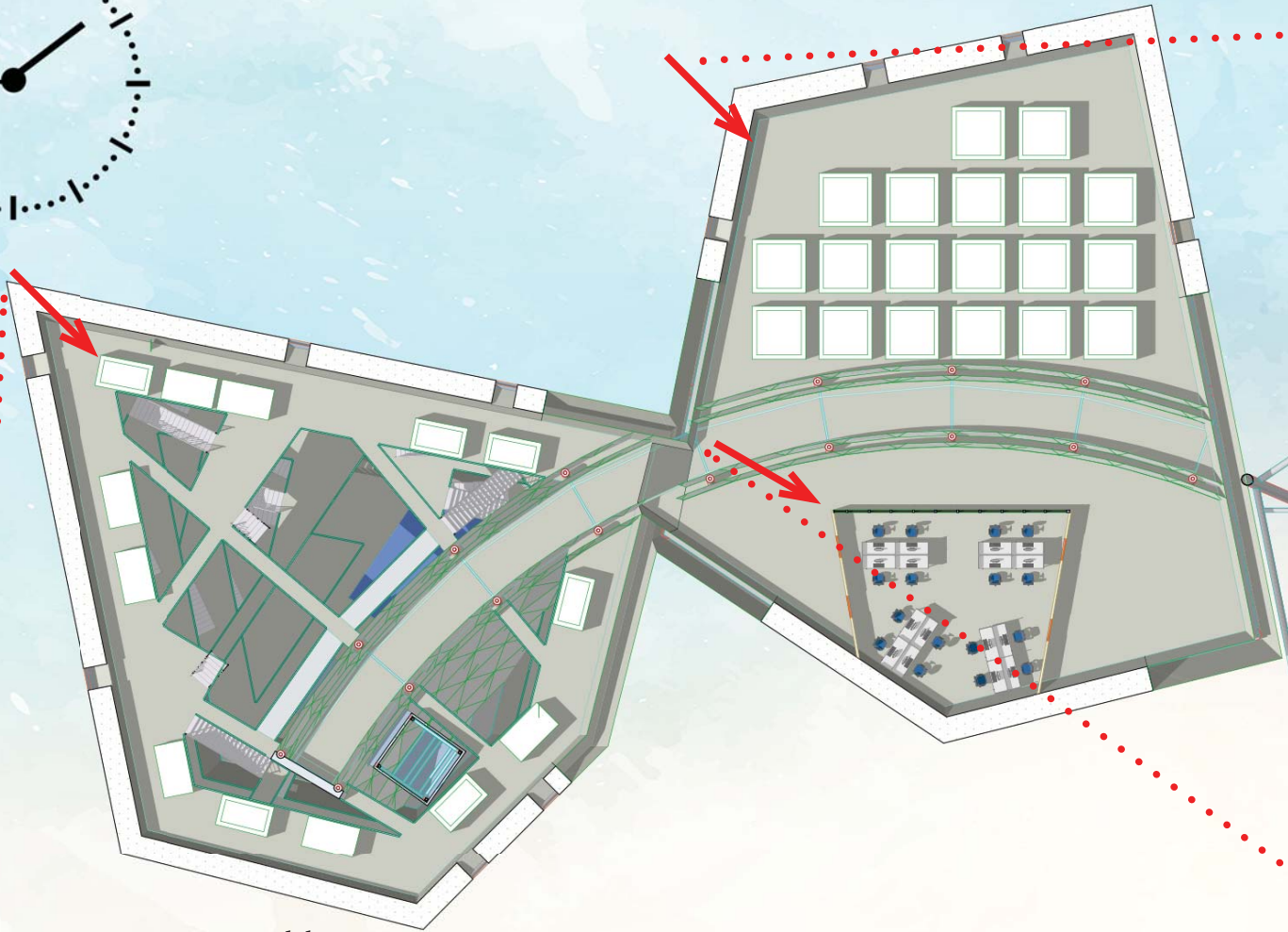




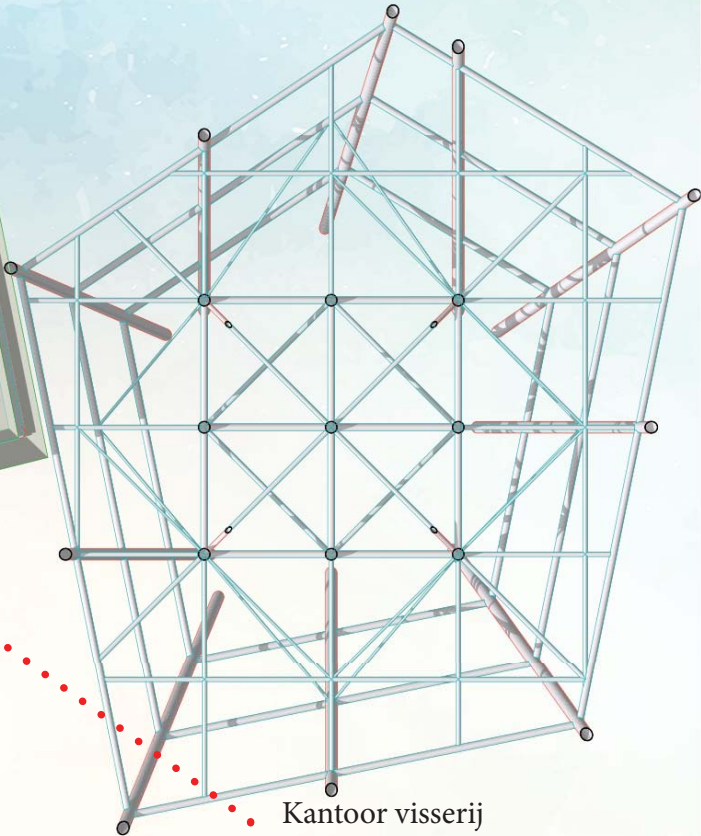
V.-1 P-3m



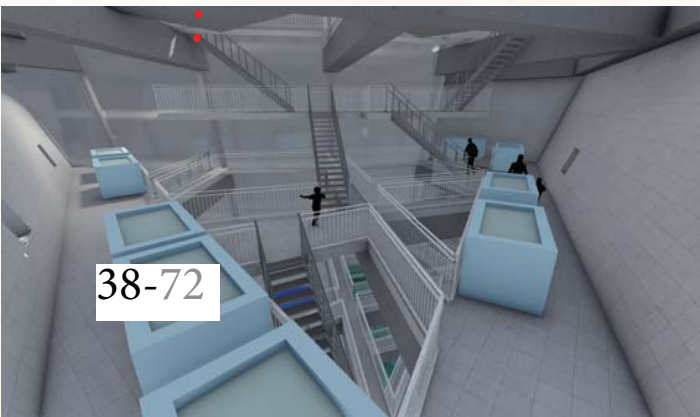
Bassins visserij



Bassins laboratorium



Kantoor visserij



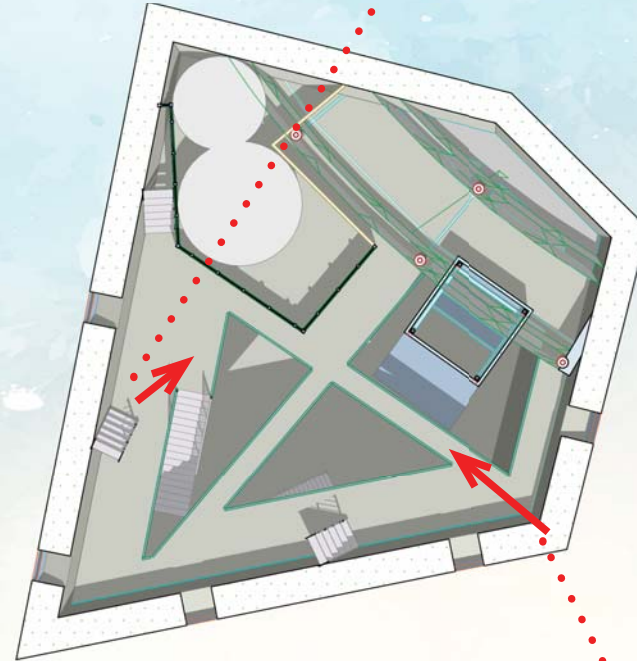
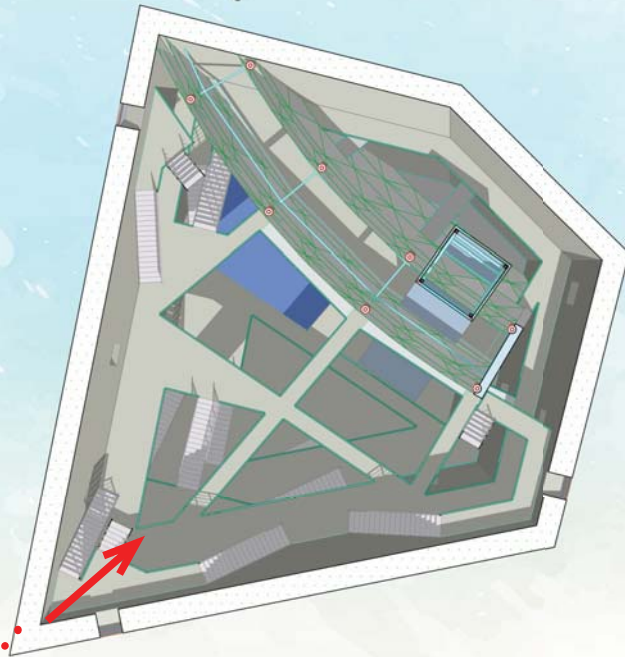


V.-2 P-6m

V.-5 P-15m



Zicht omhoog



Diepte 6m onder peil

Drukruimte



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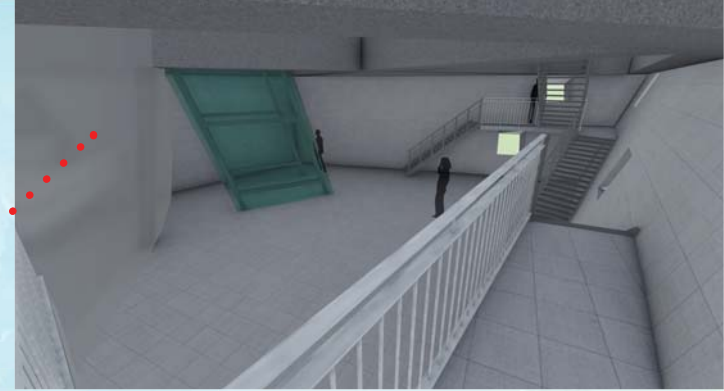




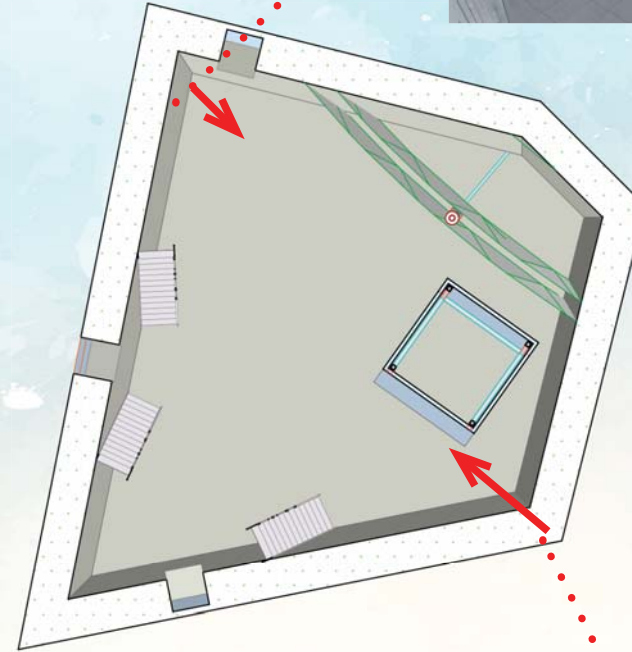
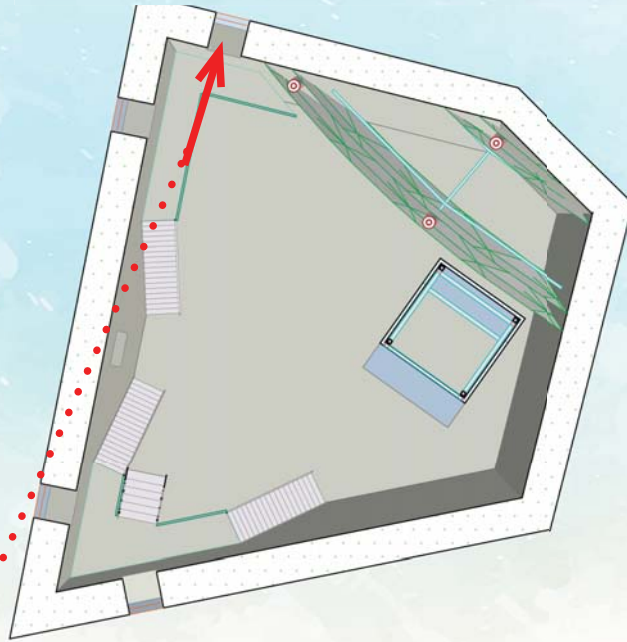


V.-6 P-18m

V.-7 P-20m

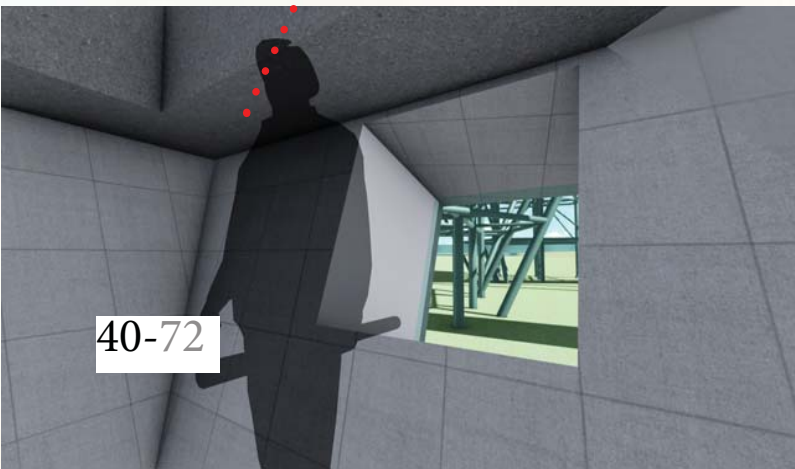


Onderwater observatorium

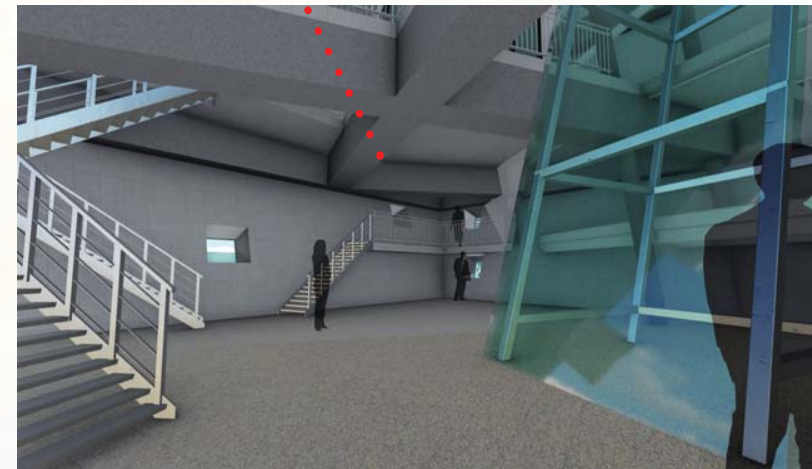


Bodem zee P-20m

Zicht op onderwaterconstructie

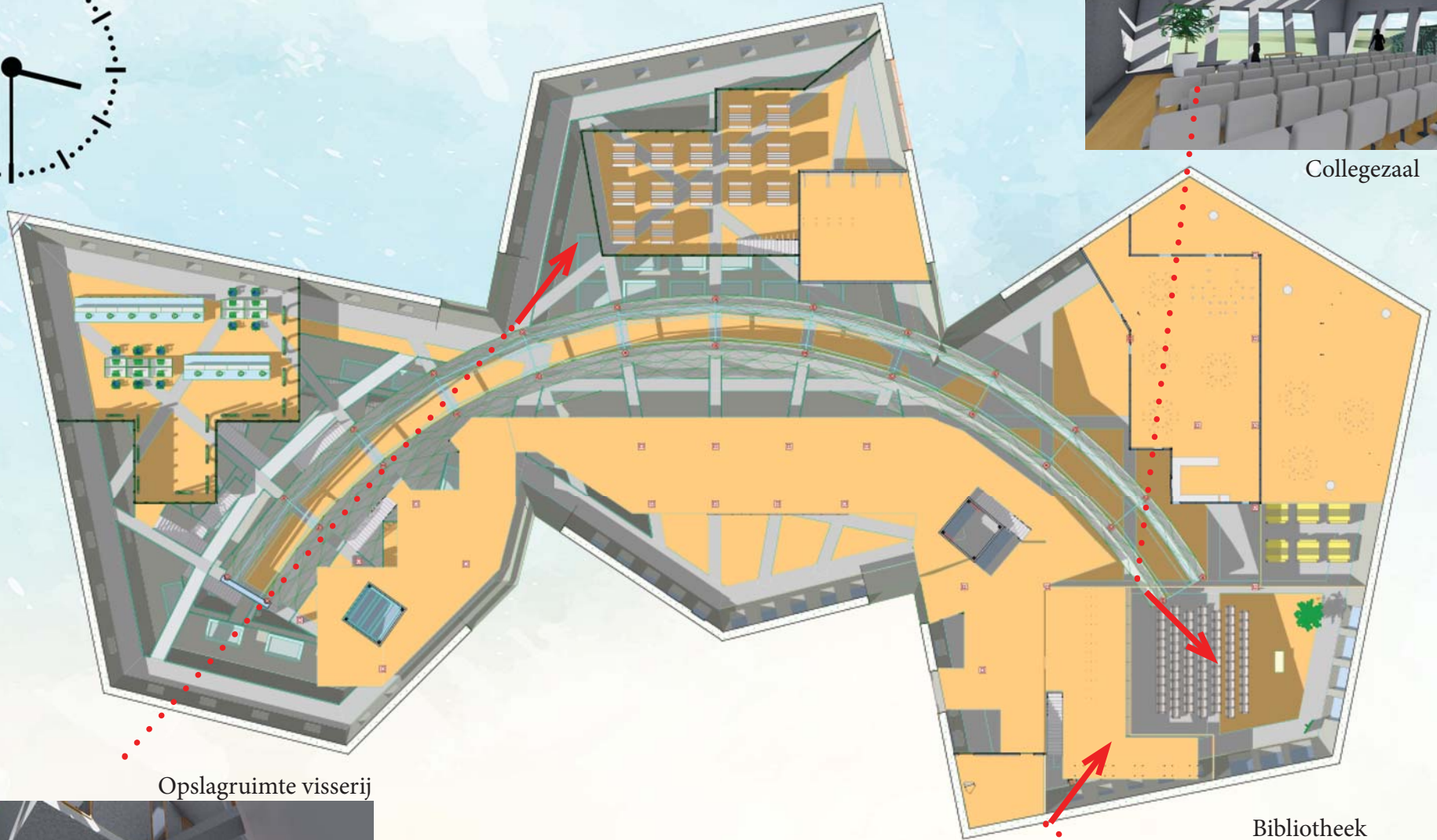


40-72





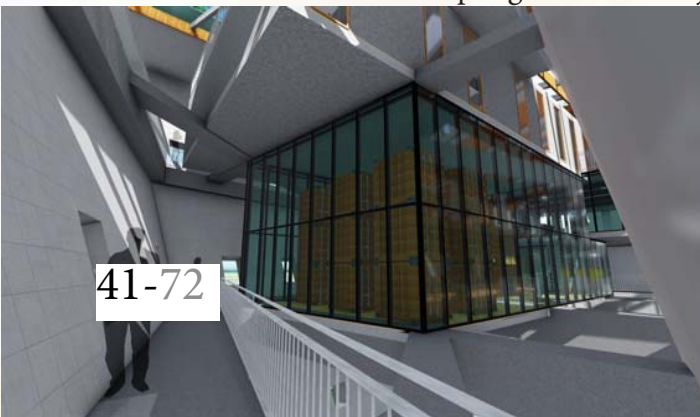
V.+1 P+3m



Collegezaal

Opslagruimte visserij

Bibliotheek



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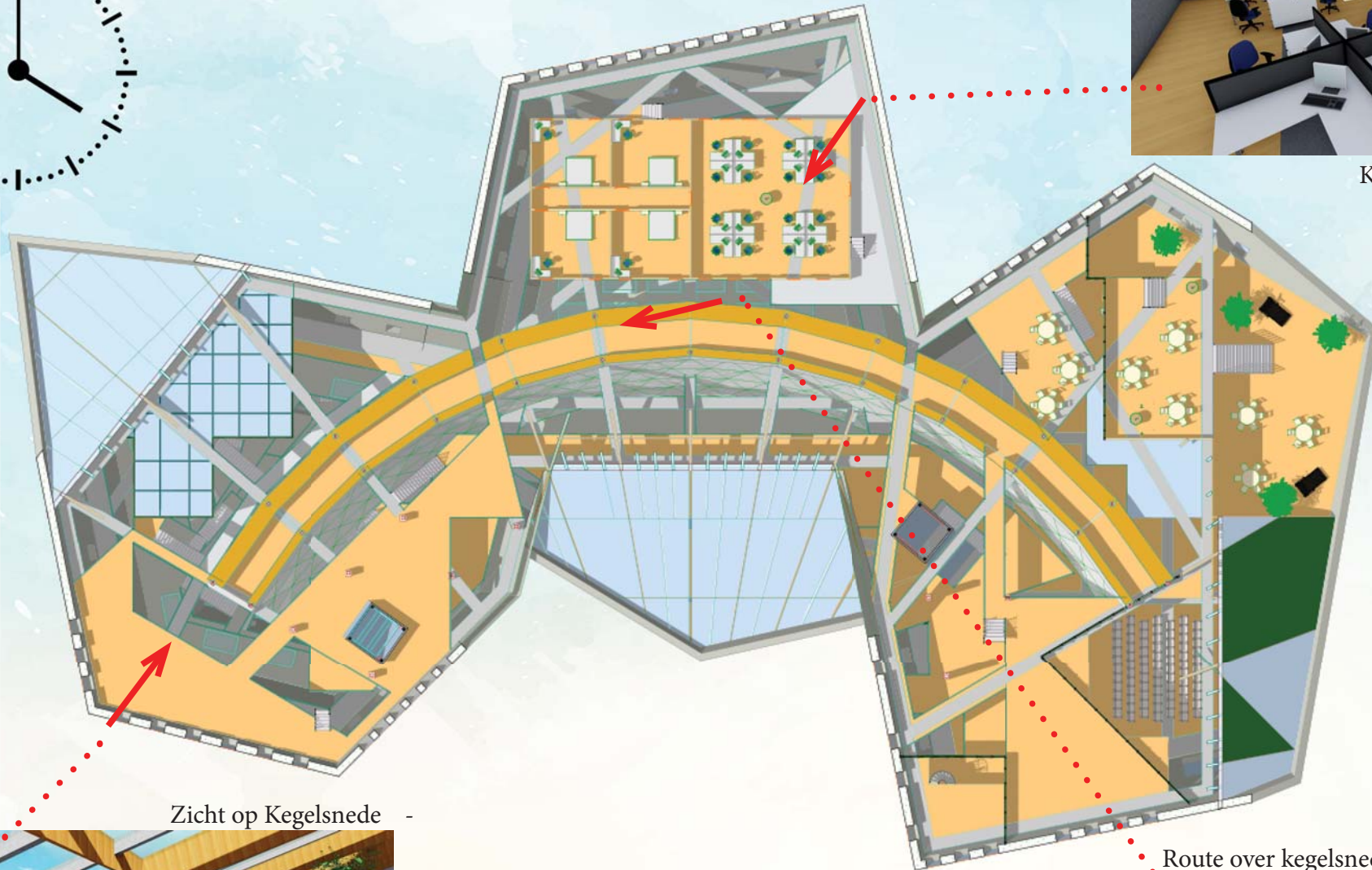




V.+3 P+9m

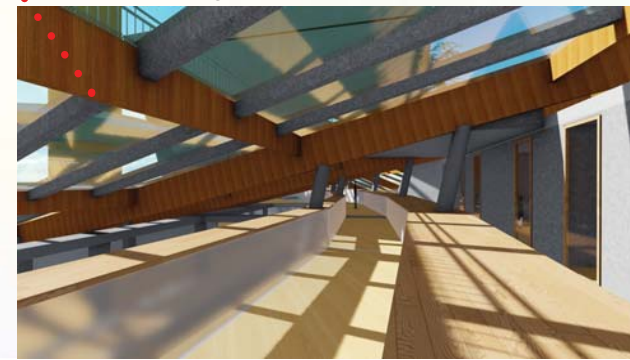
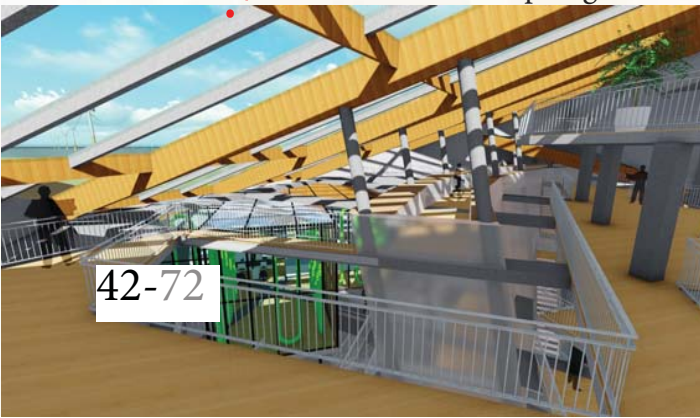


Kantoren



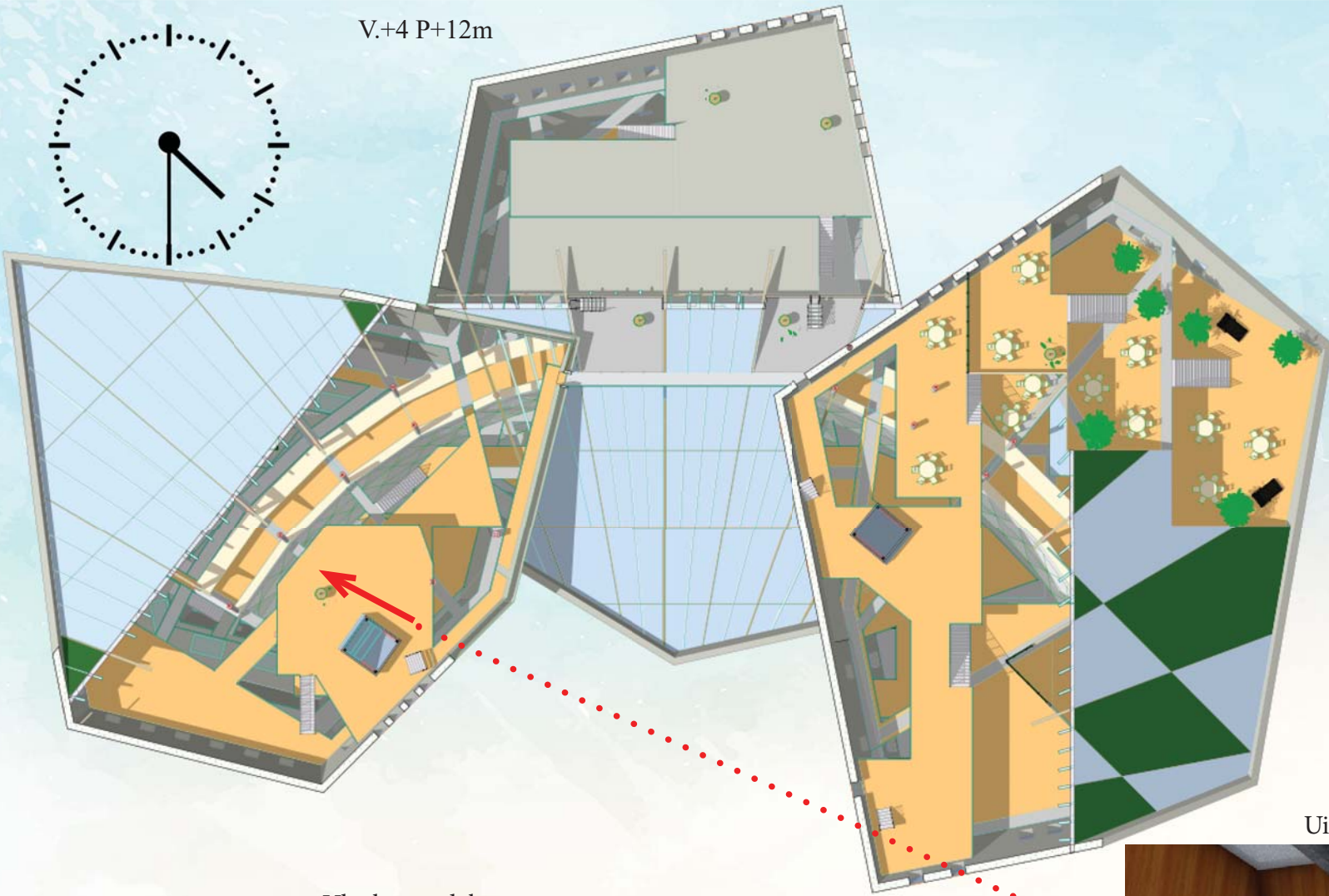
Zicht op Kegelsnede -

Route over kegelsnede

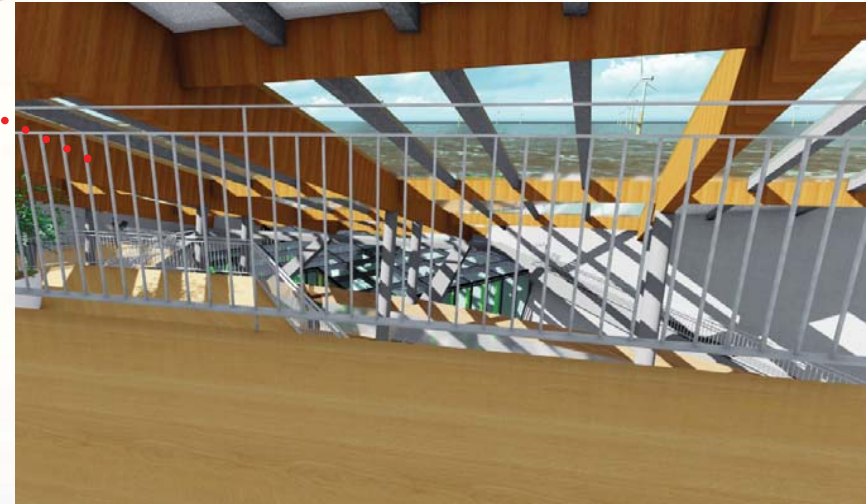




V.+4 P+12m



Uitzicht over windmolens



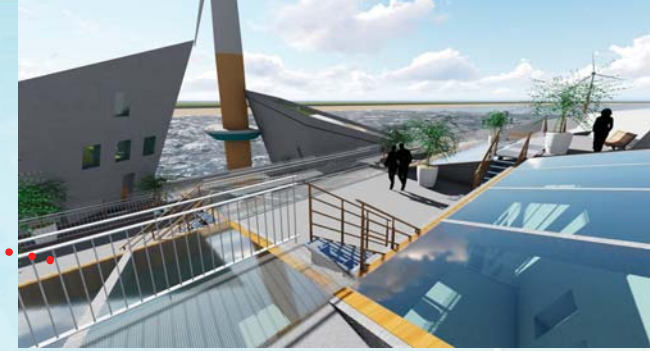
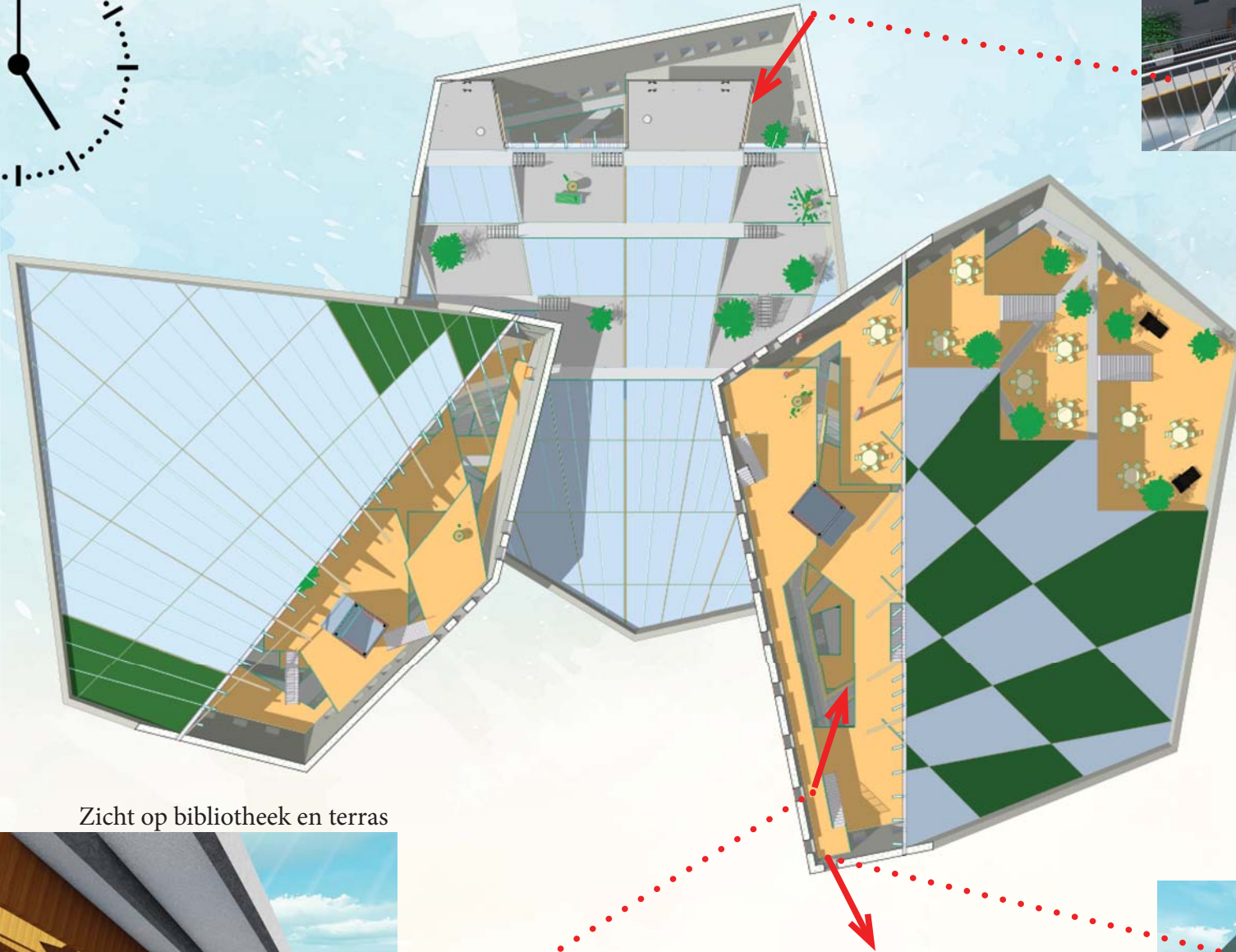
Vluchtweg dak



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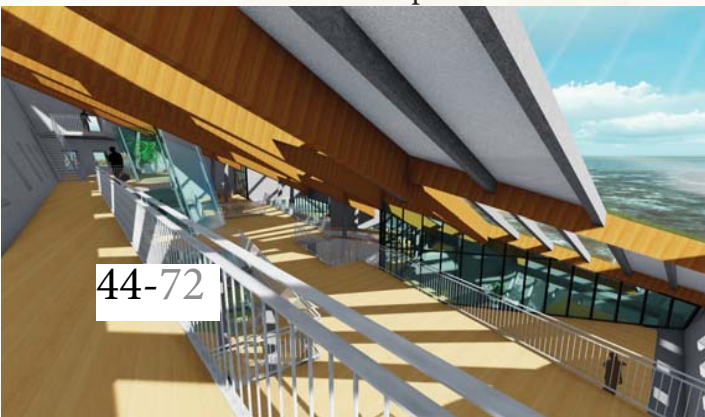


V.+5 P+15m



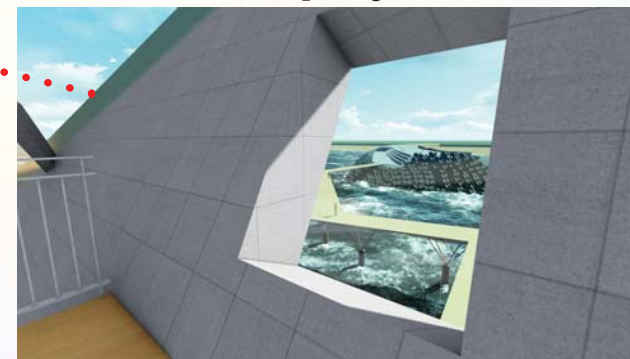
Beloopbaar dak

Zicht op bibliotheek en terras

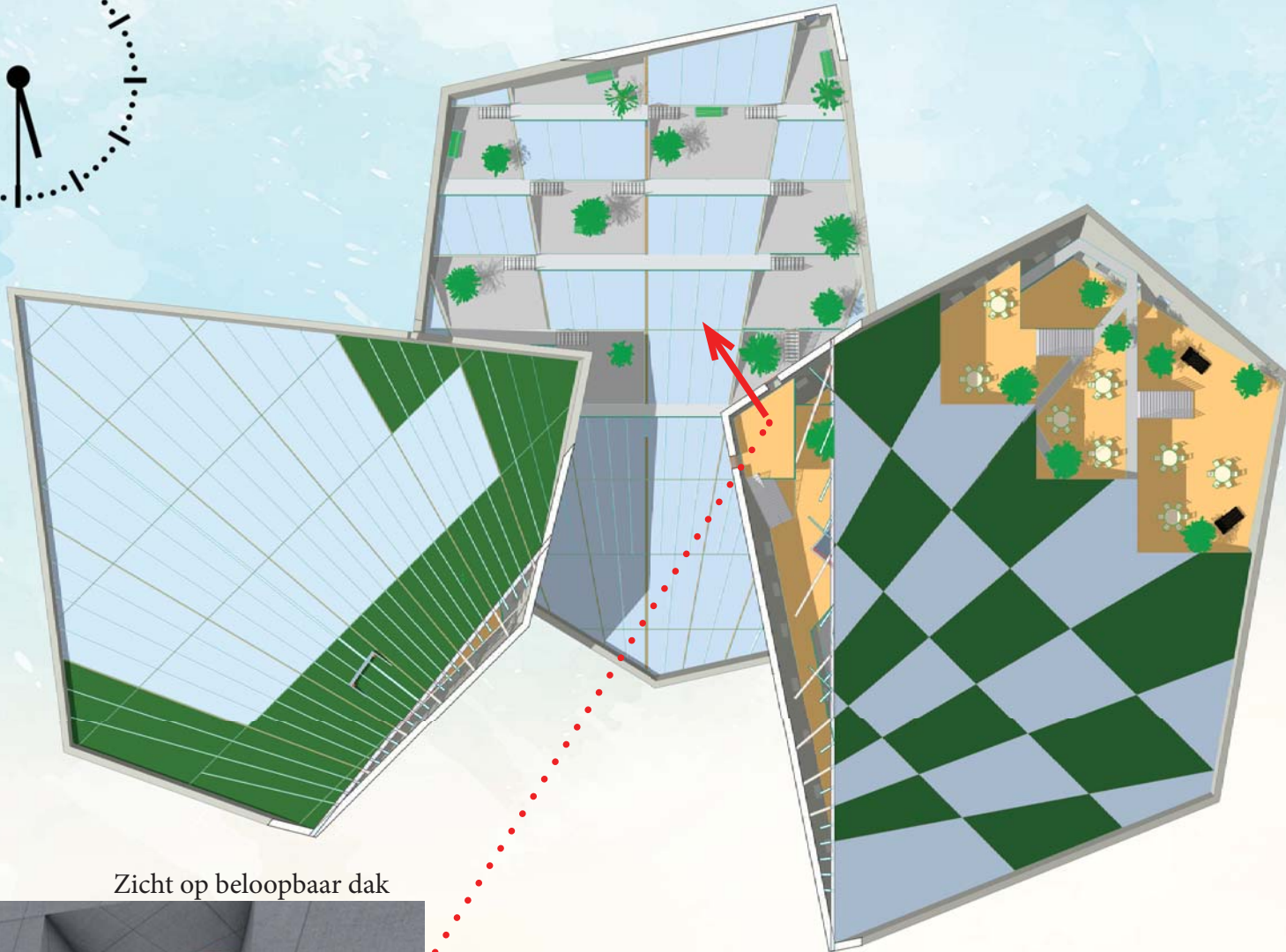


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Zicht op steiger



V.+6 P+18m



Zicht op beloopbaar dak

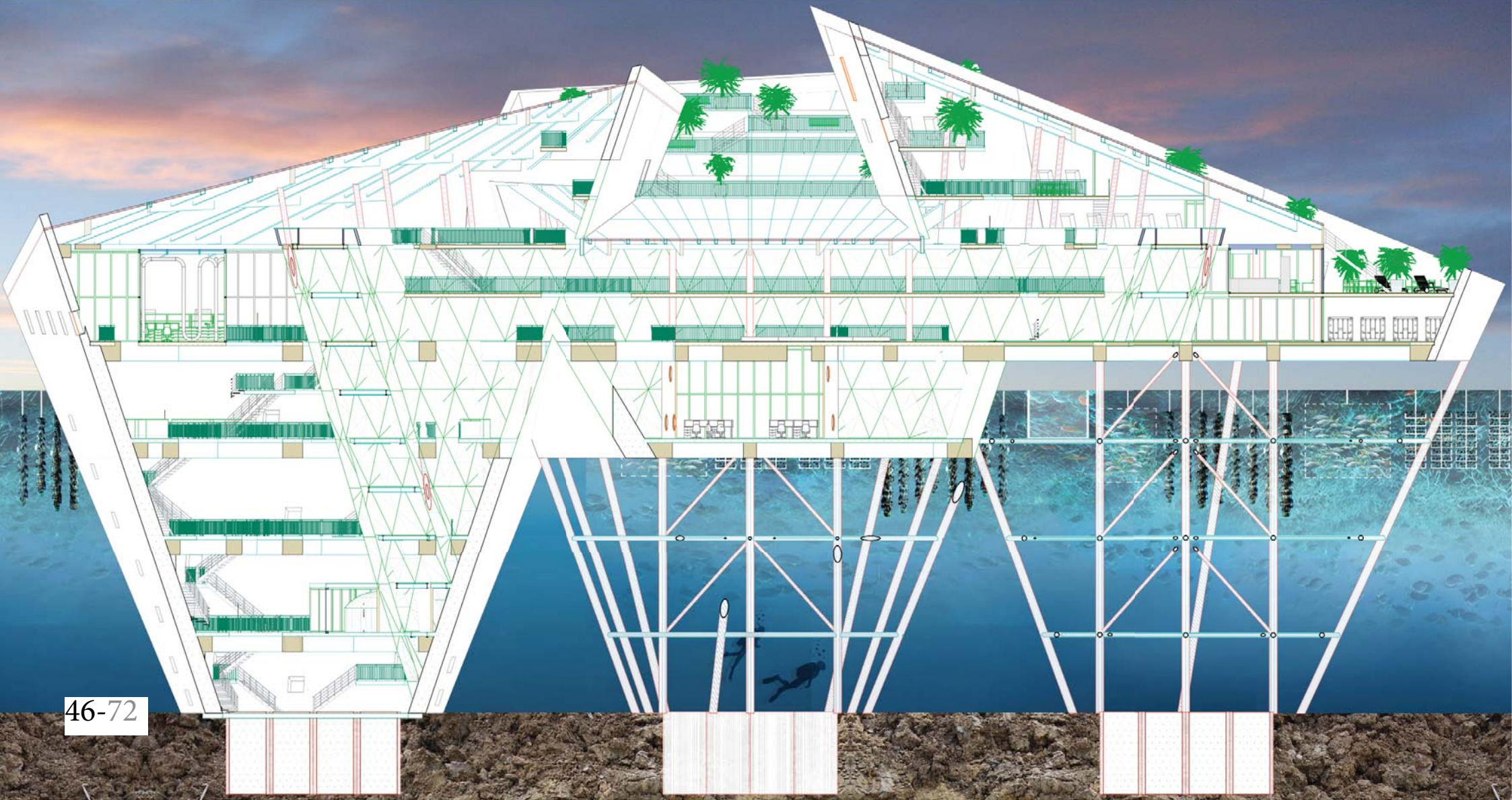


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## Doorsnede noord-zuid

- De trapsgewijze afdaling vanaf rechts in het bezoekersgedeelte, dan het visserijgedeelte en als laatste het laboratorium-gedeelte.

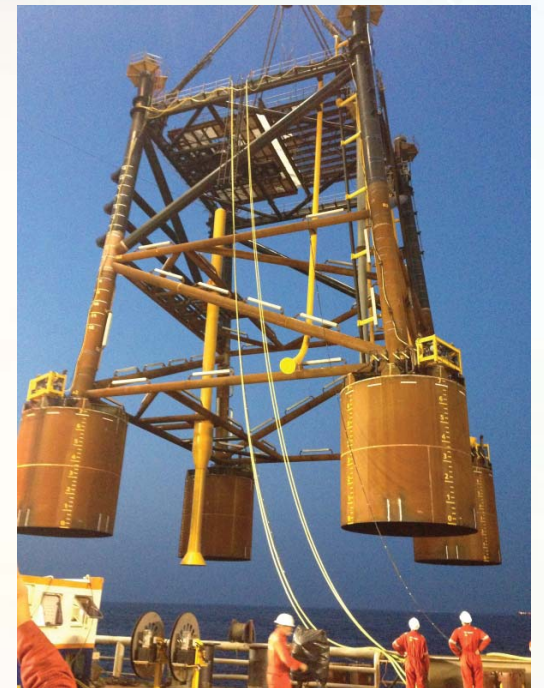
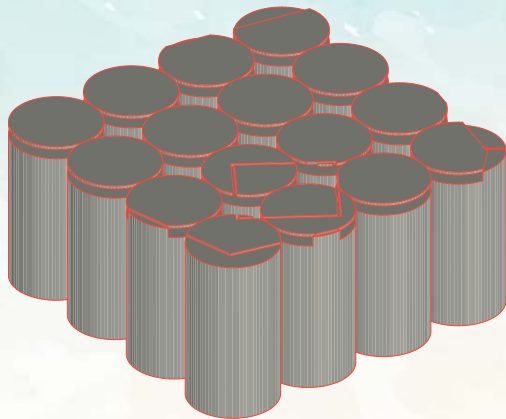
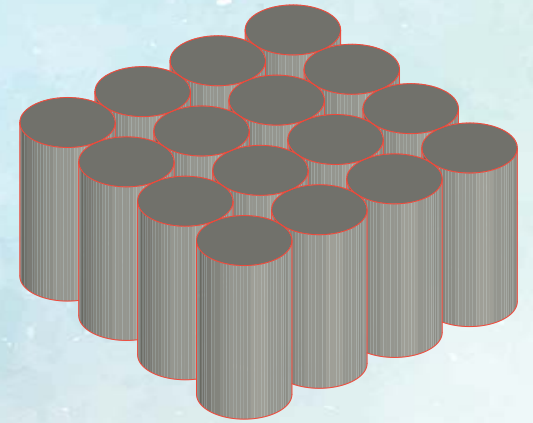
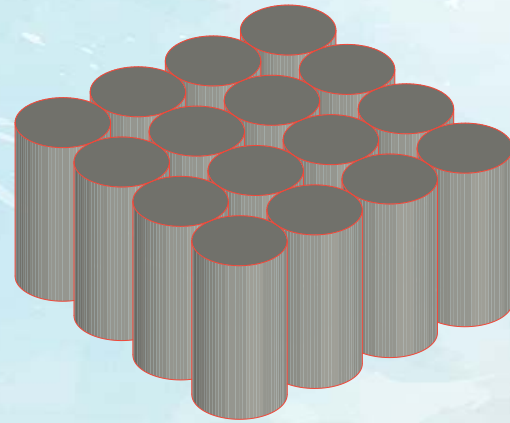


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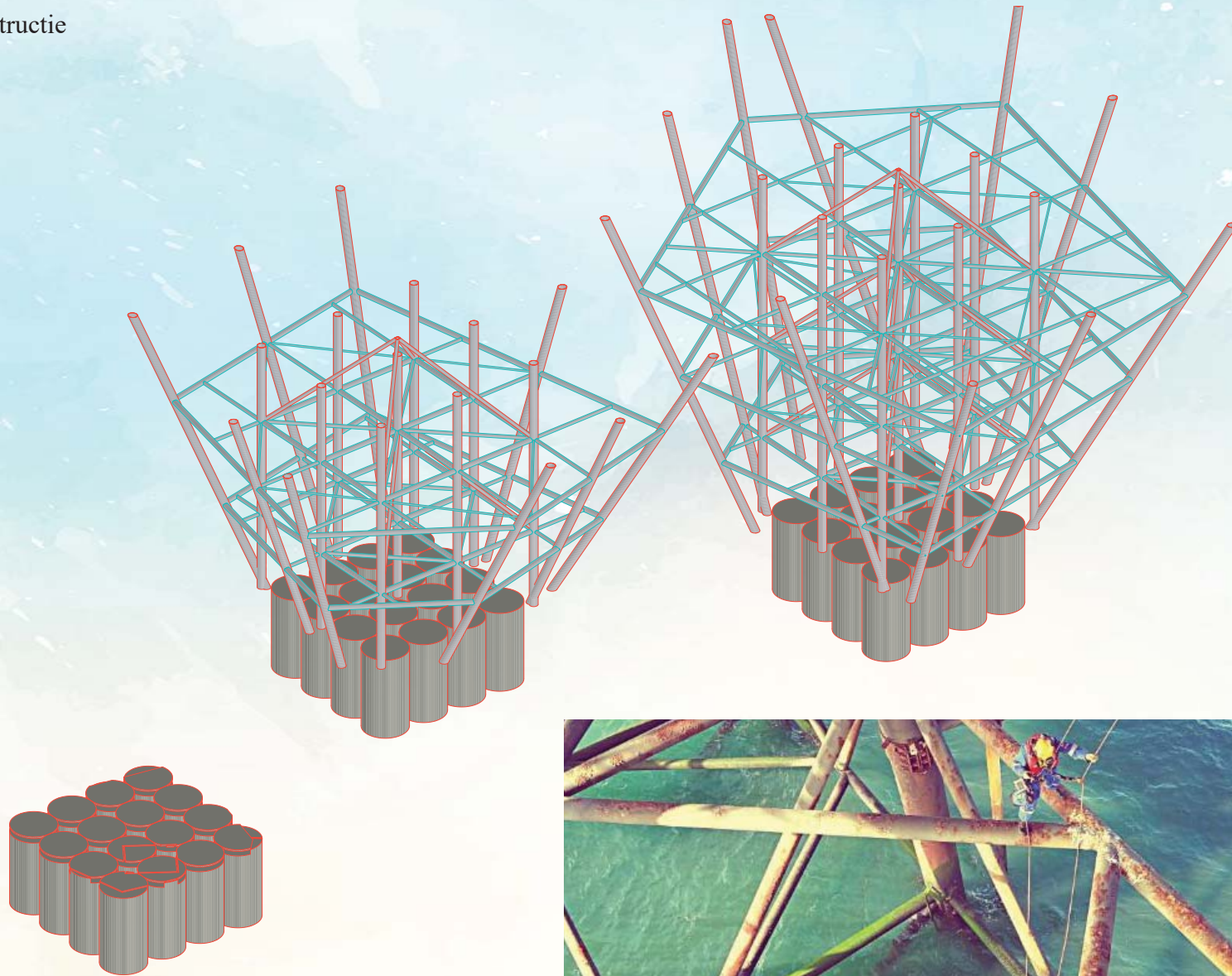


Constructie en bouwwijze

- Suction piles

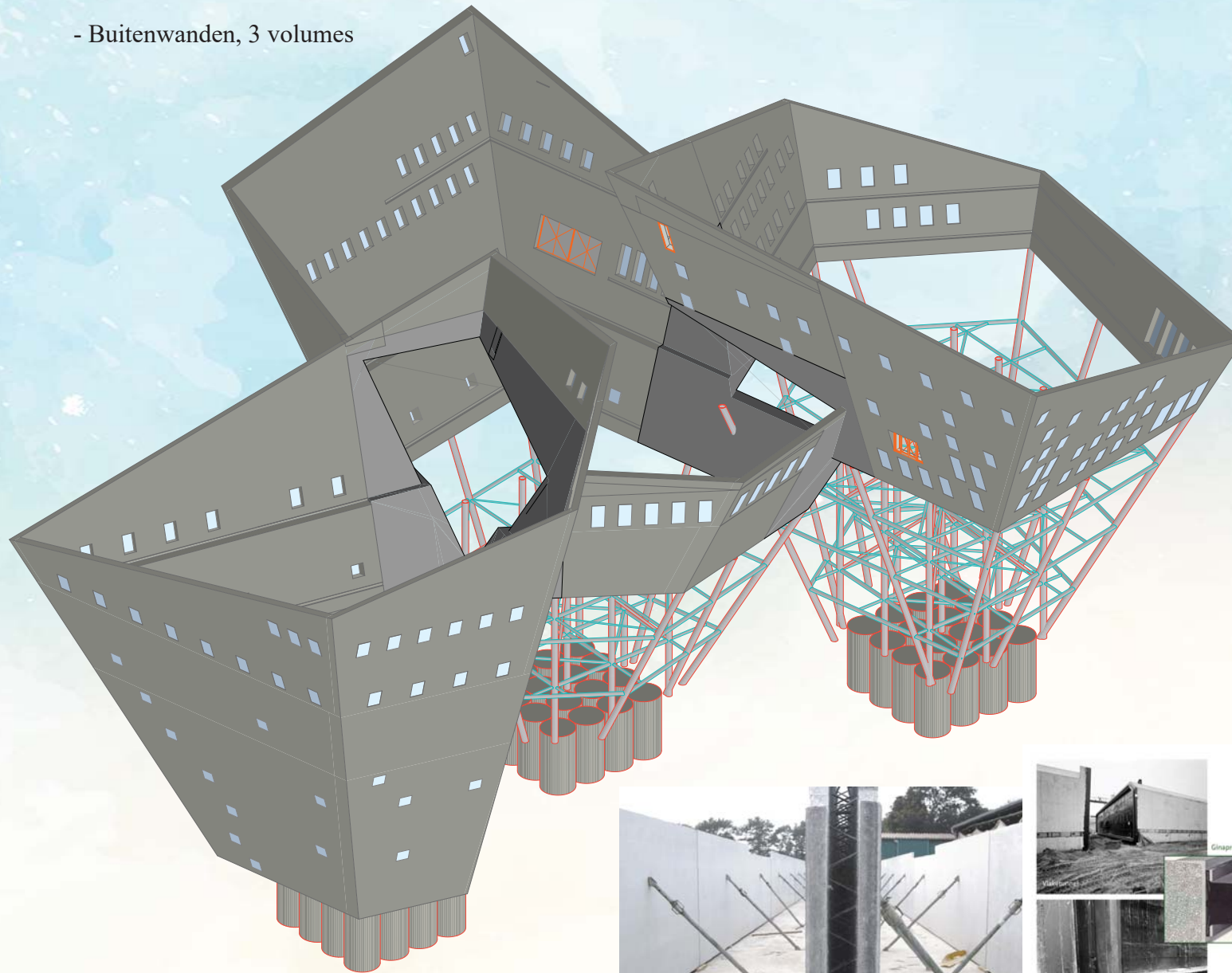




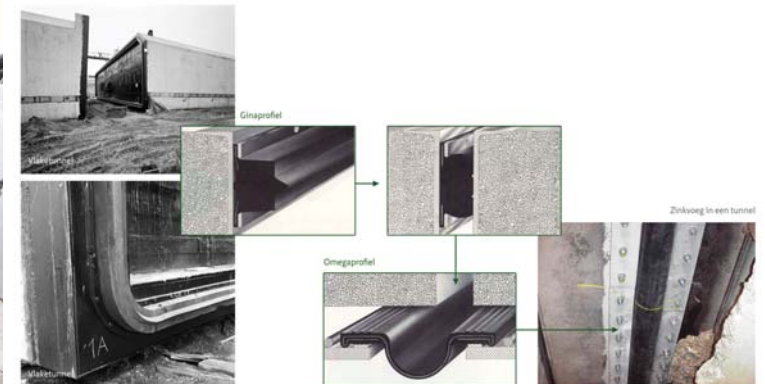


# Constructie en bouwwijze

- Buitenwanden, 3 volumes



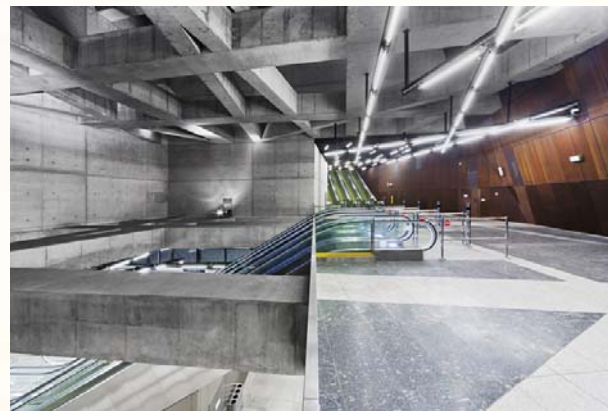
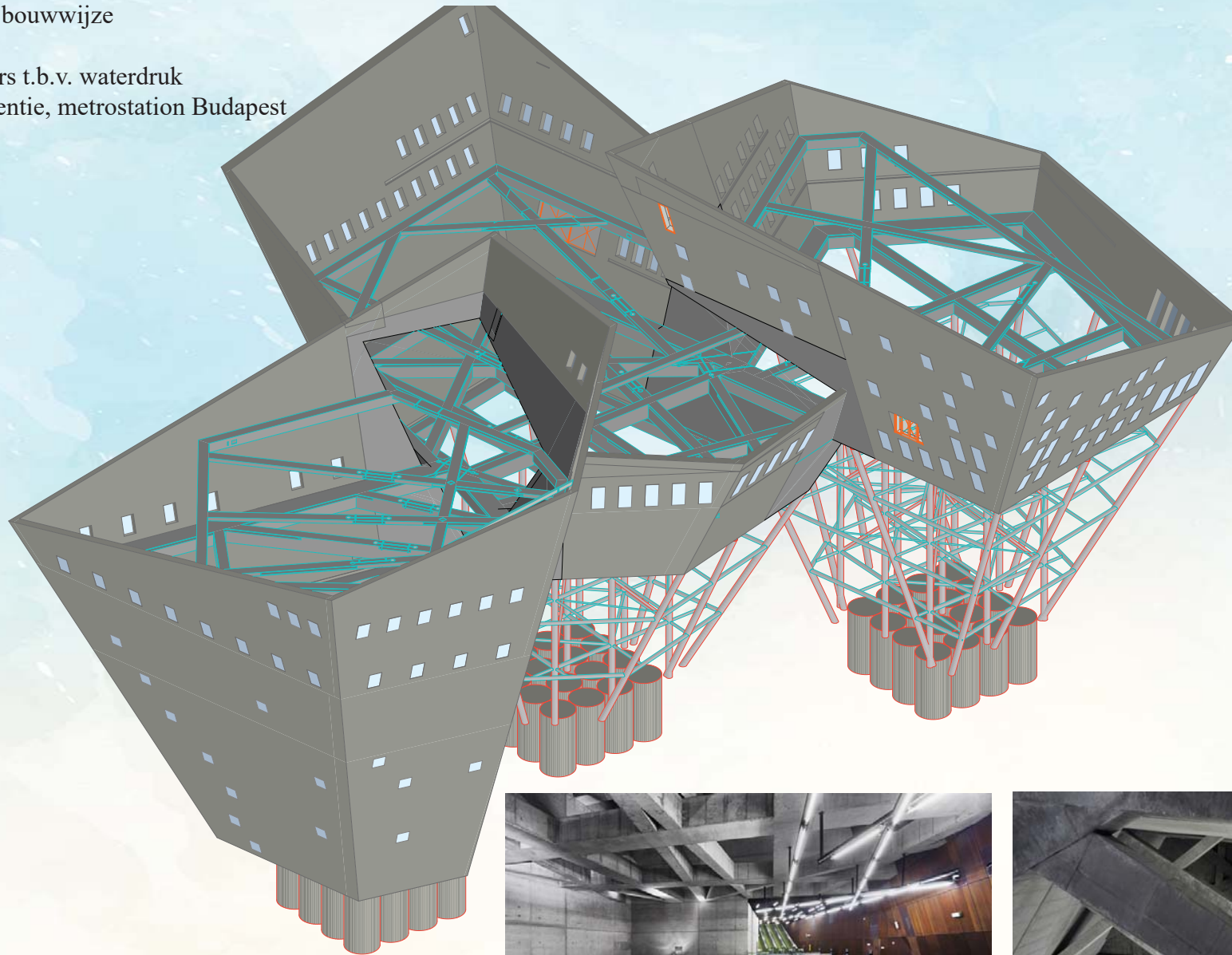
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## Constructie en bouwwijze

- Liggers t.b.v. waterdruk
- Referentie, metrostation Budapest

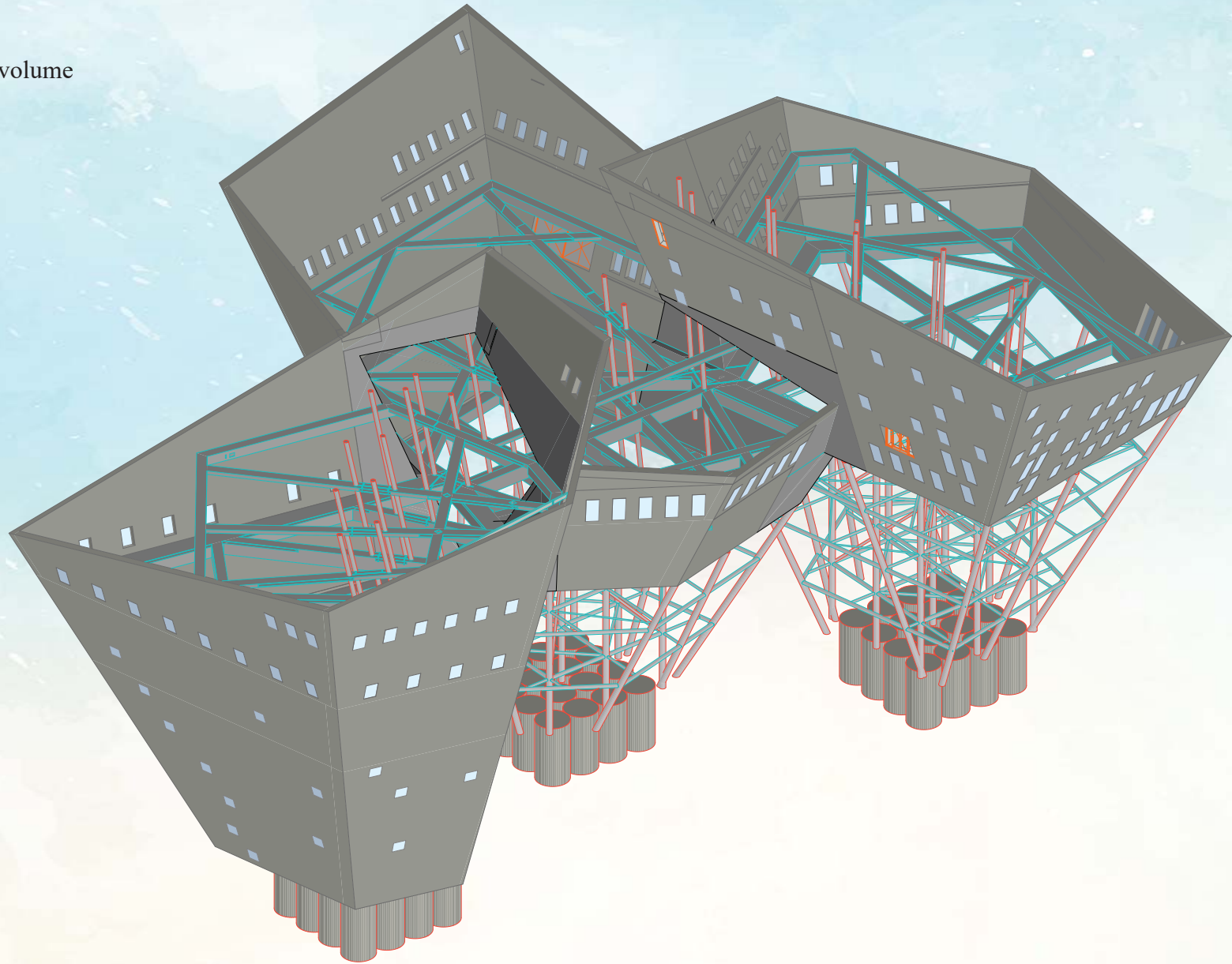




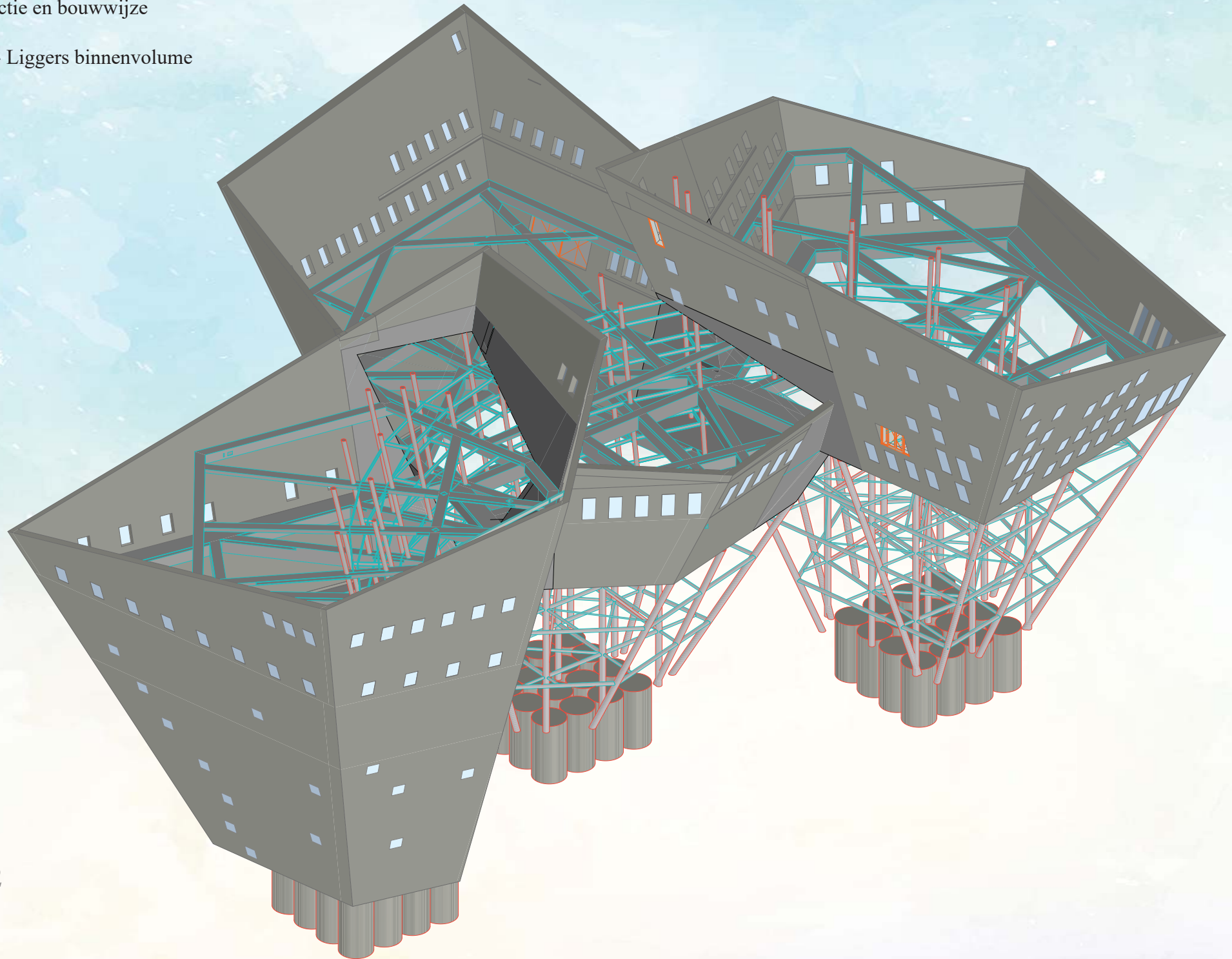
51-72

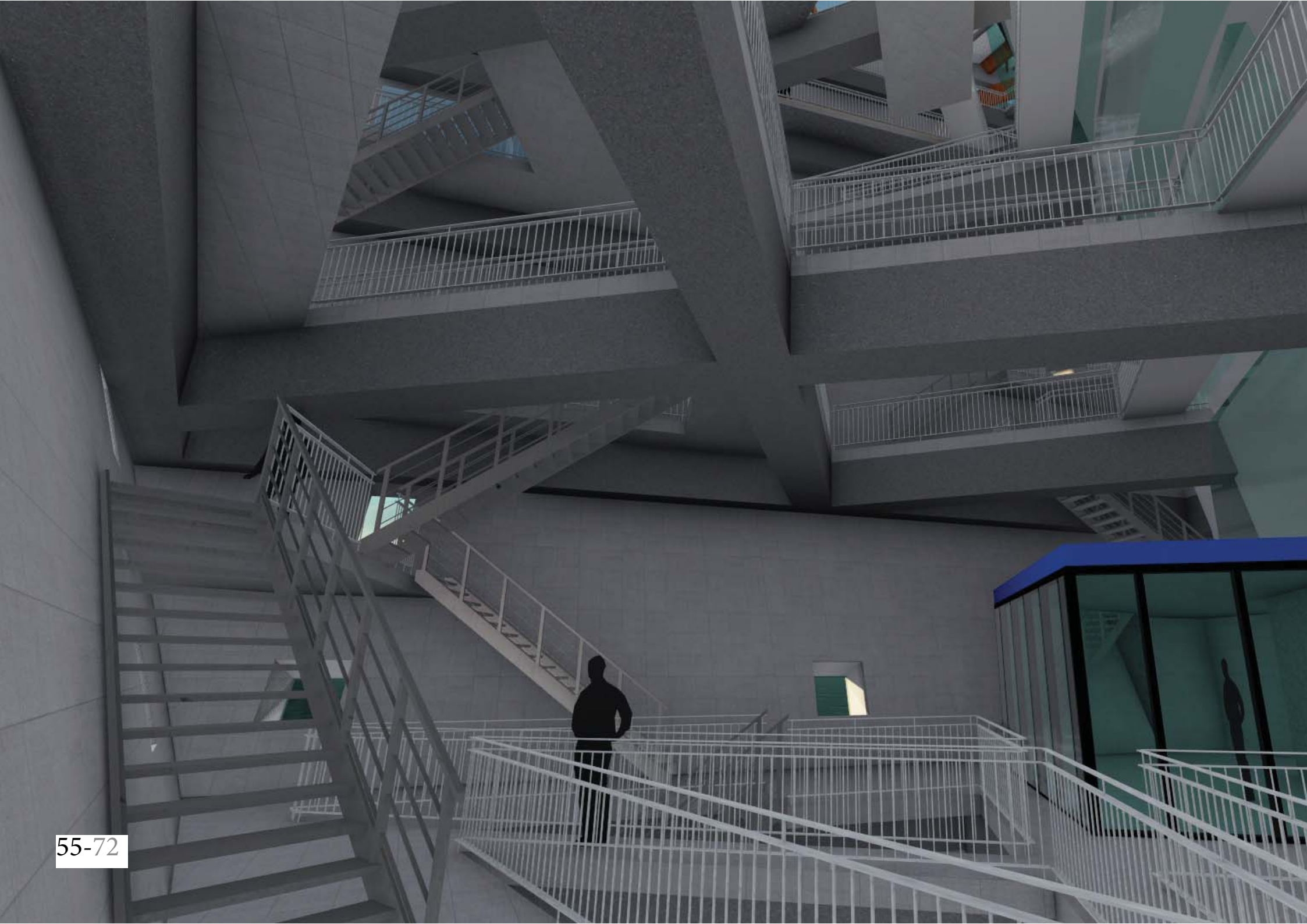








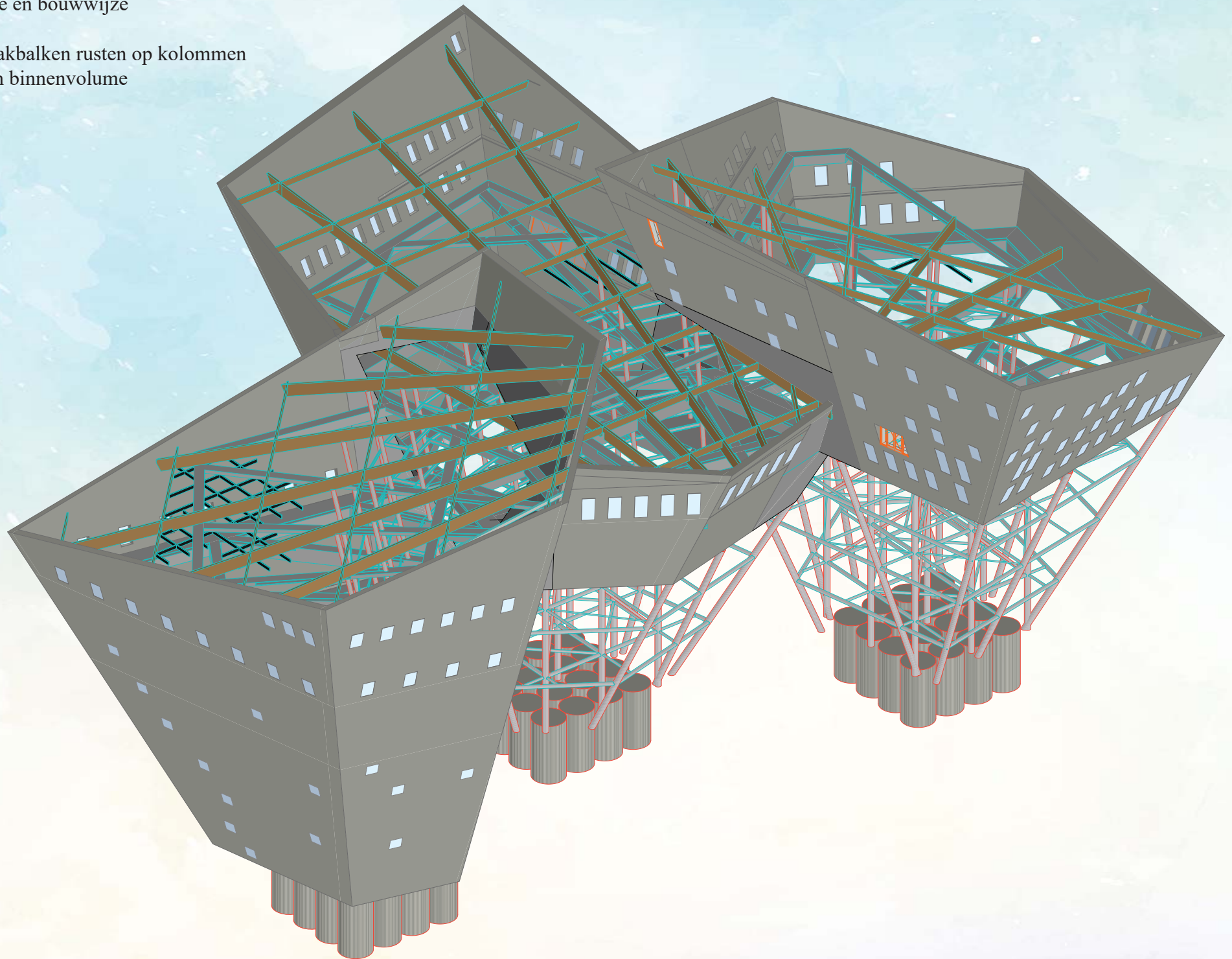




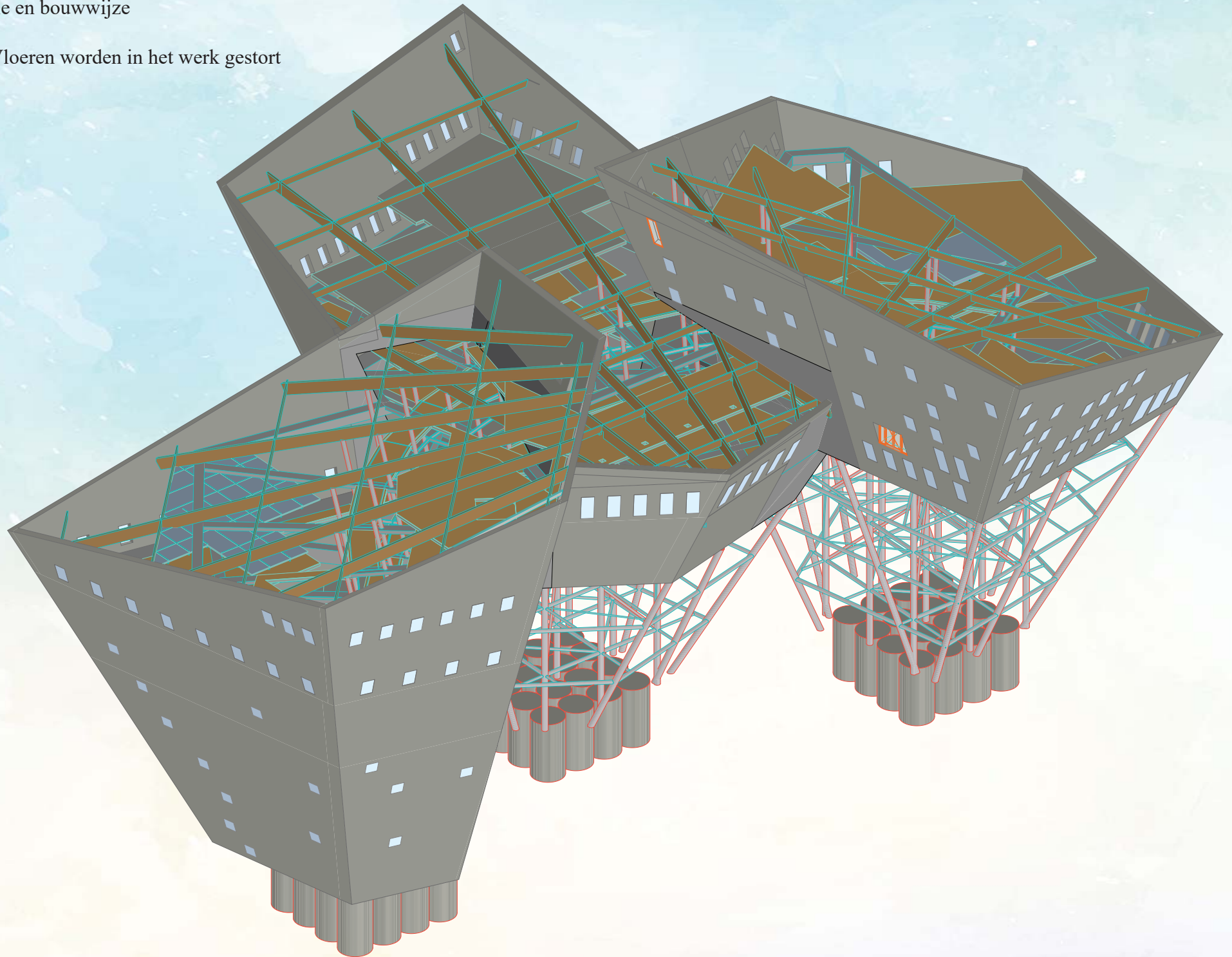


## Constructie en bouwwijze

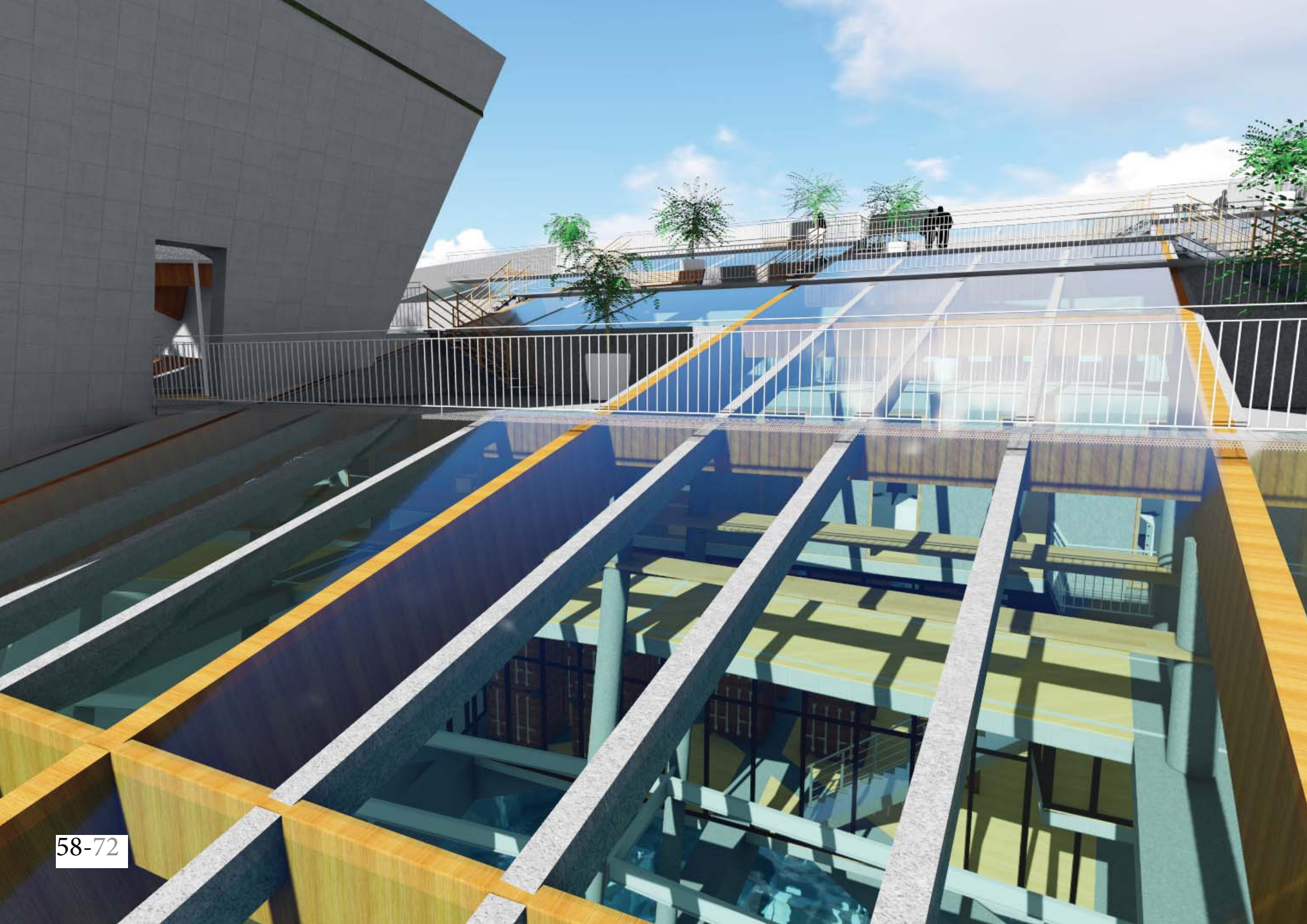
-Dakbalken rusten op kolommen  
van binnenvolume



- Vloeren worden in het werk gestort

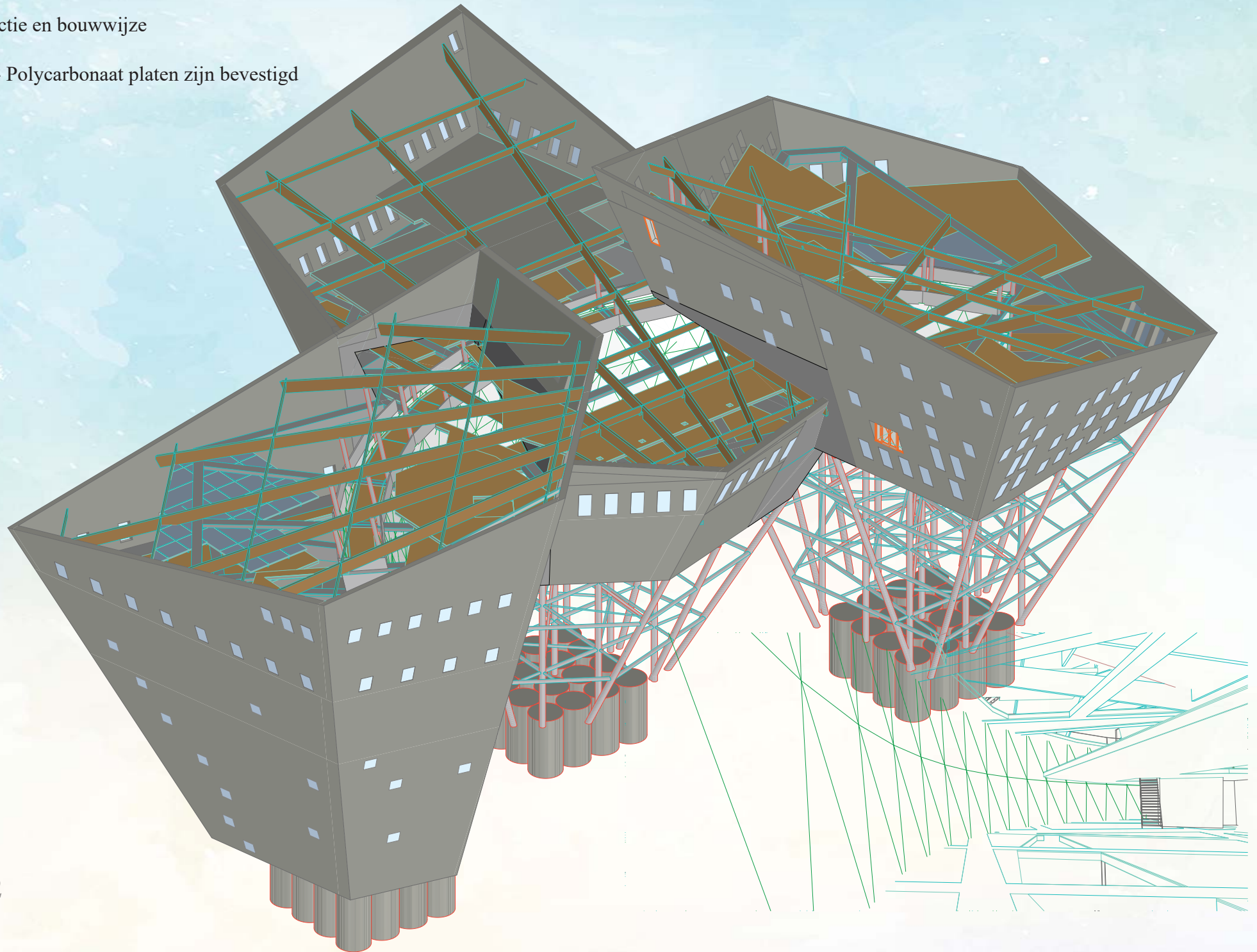






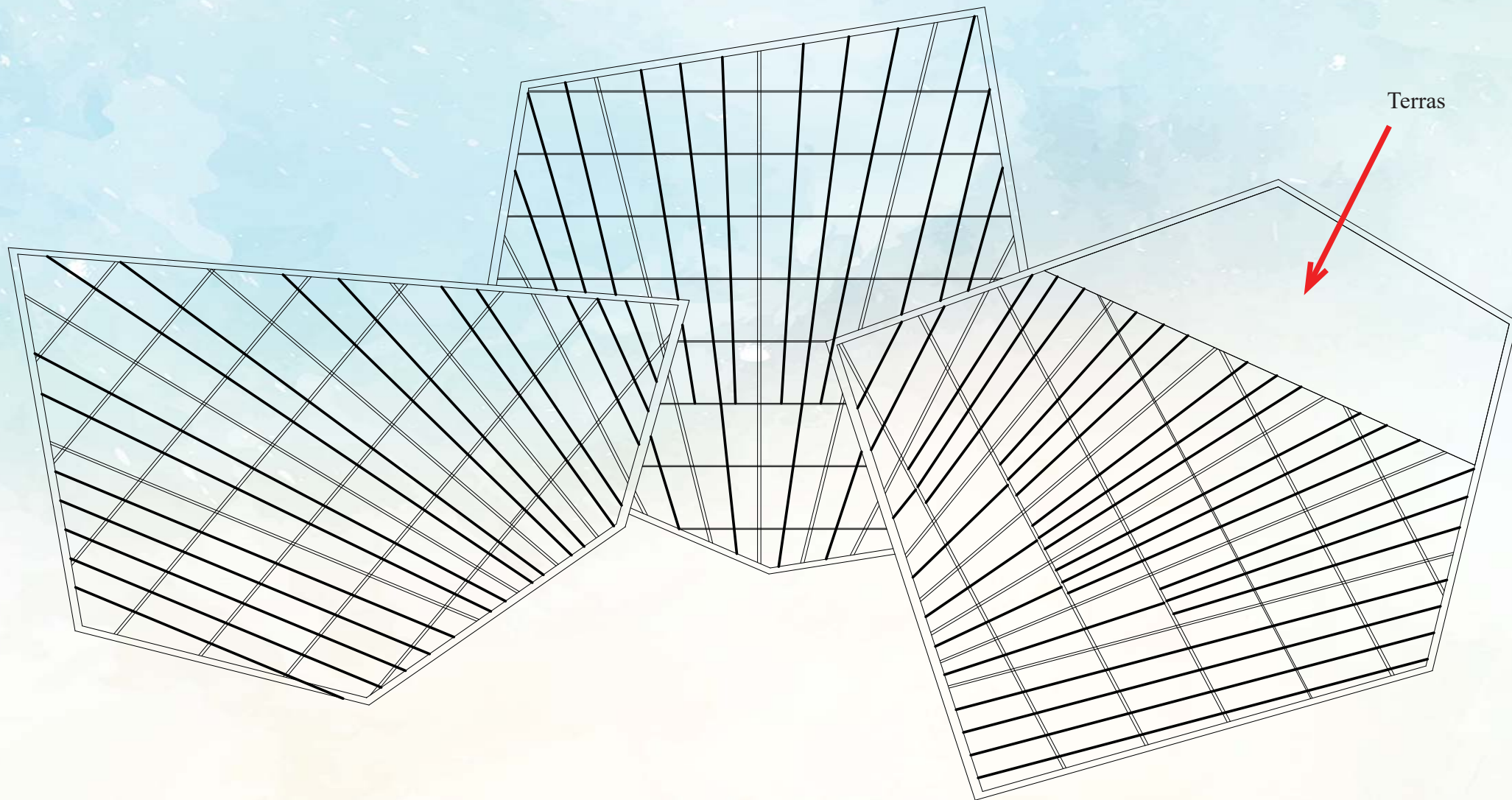


- Polycarbonaat platen zijn bevestigd

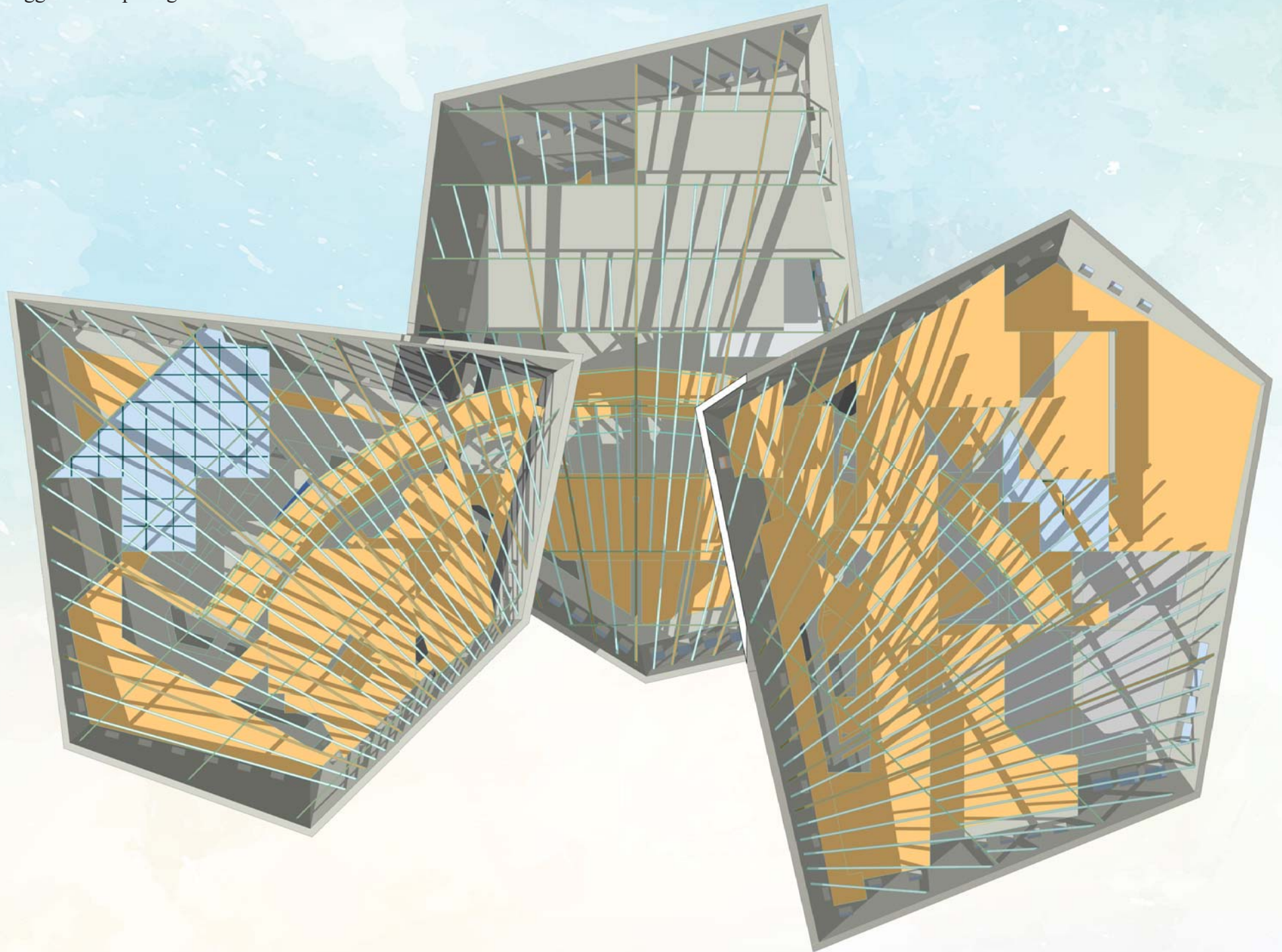




Dakplan met liggers voor glazen dak

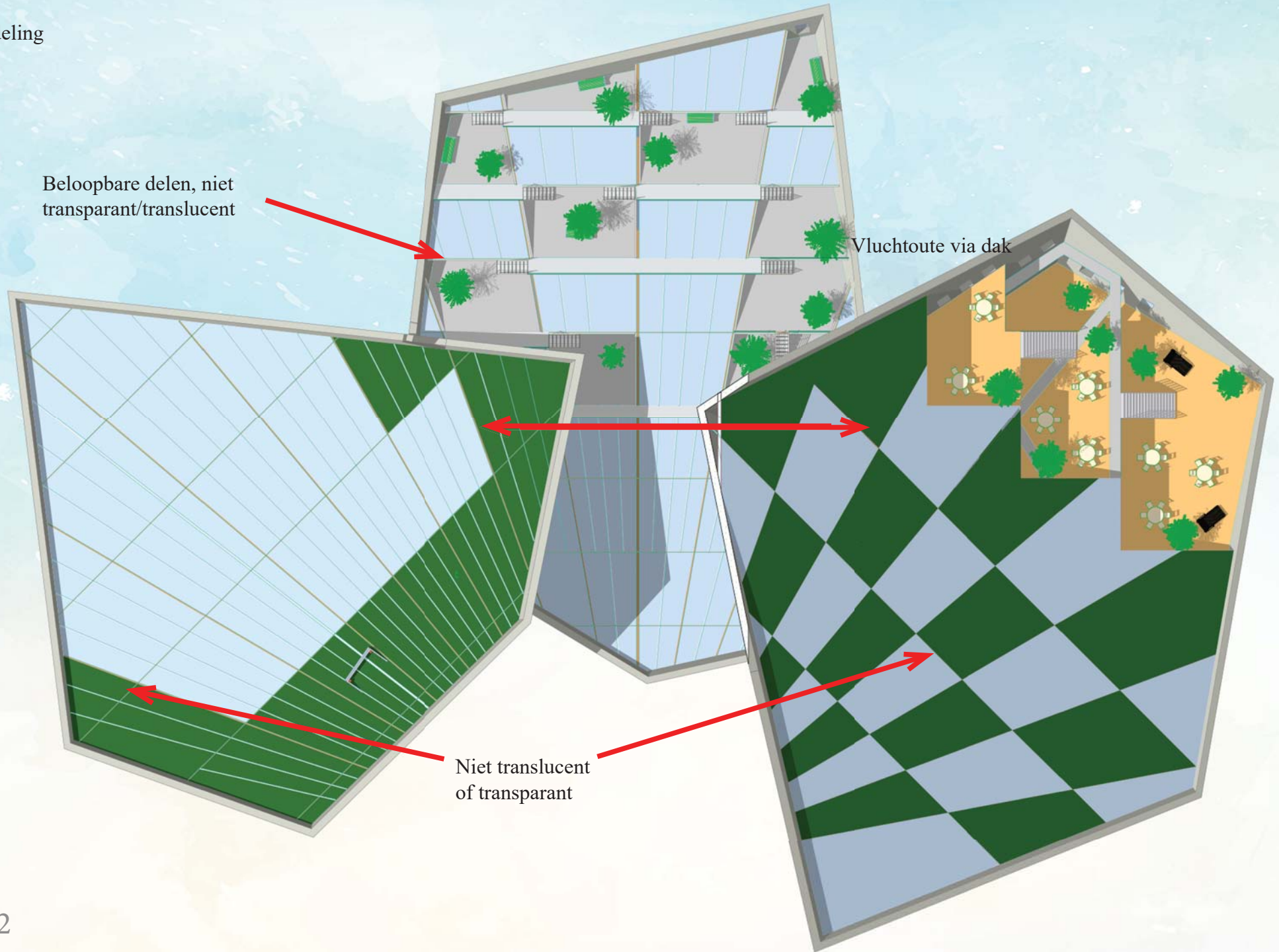


Dakplan met liggers met sparingen





Dakindeling

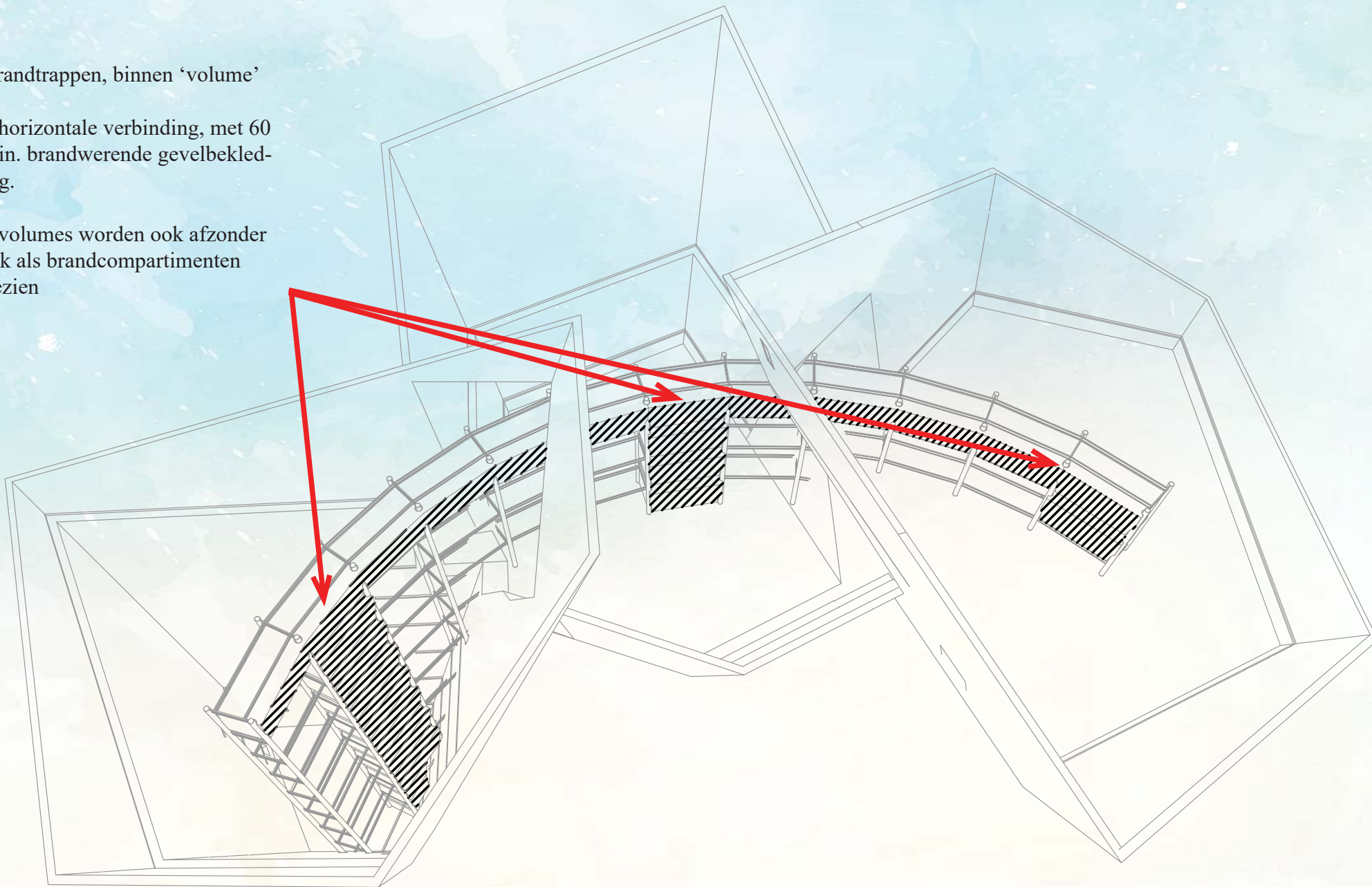


## Brandcompartimentering en brandpreventie

### Brandtrappen, binnen 'volume'

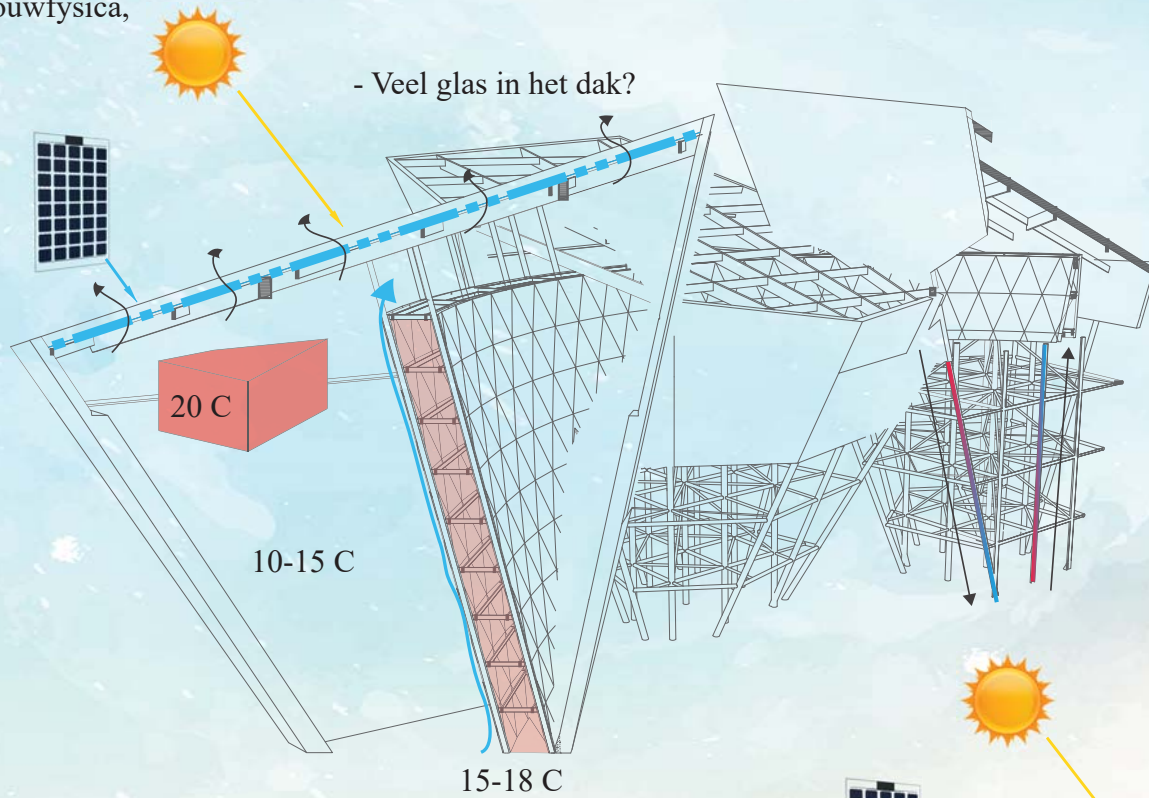
1 horizontale verbinding, met 60 min. brandwerende gevelbekleding.

3 volumes worden ook afzonderlijk als brandcompartimenten gezien





Bouwfysica,



Zomersituatie,

maximale temp. 28.6 C

$U=1,8 \text{ W/m}^2/\text{K}$  van betonnen wanden

$U=1,1 \text{ W/m}^2/\text{K}$  van beglazing

Ventilatievoud = 2

m<sup>2</sup> ramen is terug gebracht

warme lucht afgevoerd door dak

Koeling door warmtewisselaar in onderwaterconstructie.

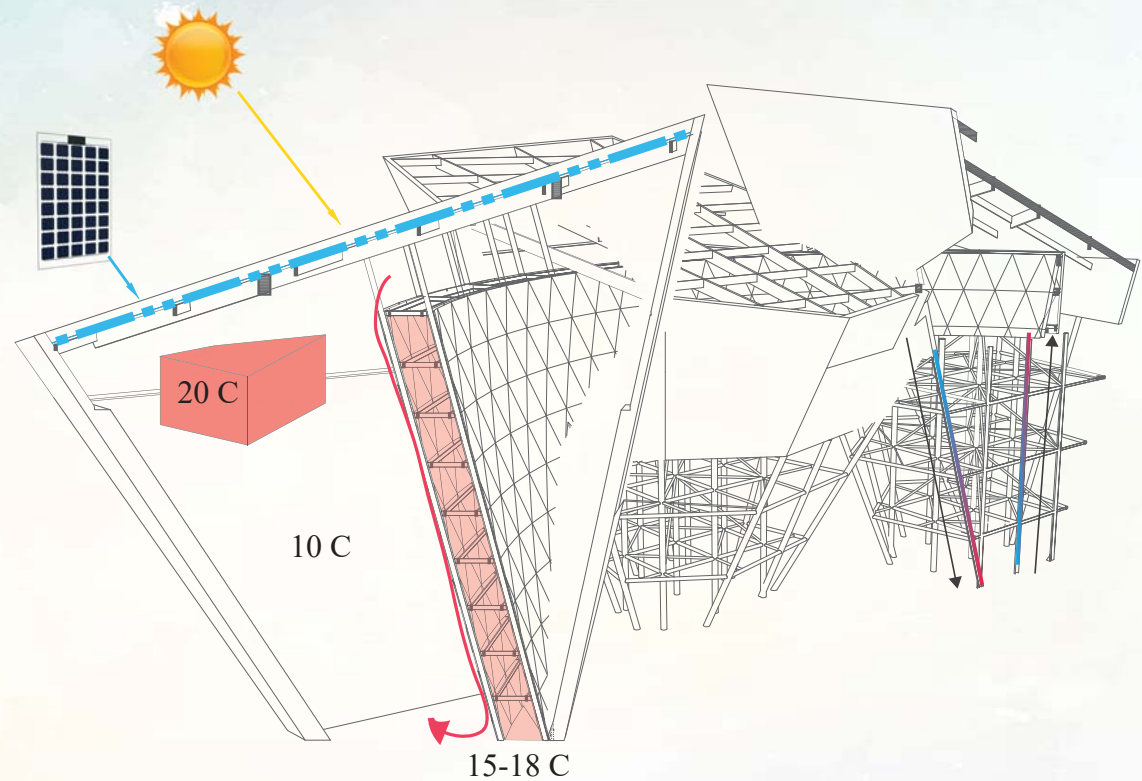
Koude lucht van NAP-20 naar boven via kolommen

Werkruimtes afzonderlijk verwarmd

Wintersituatie

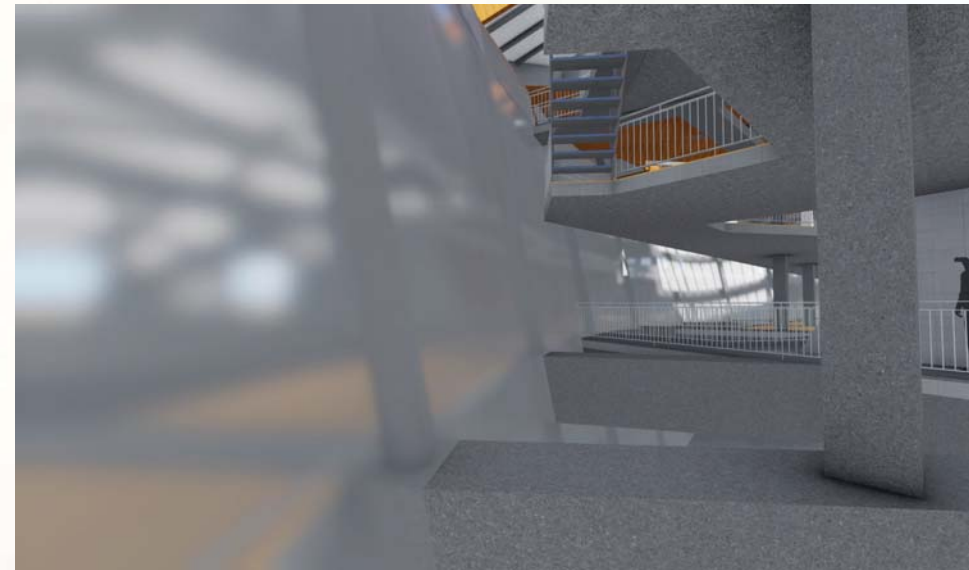
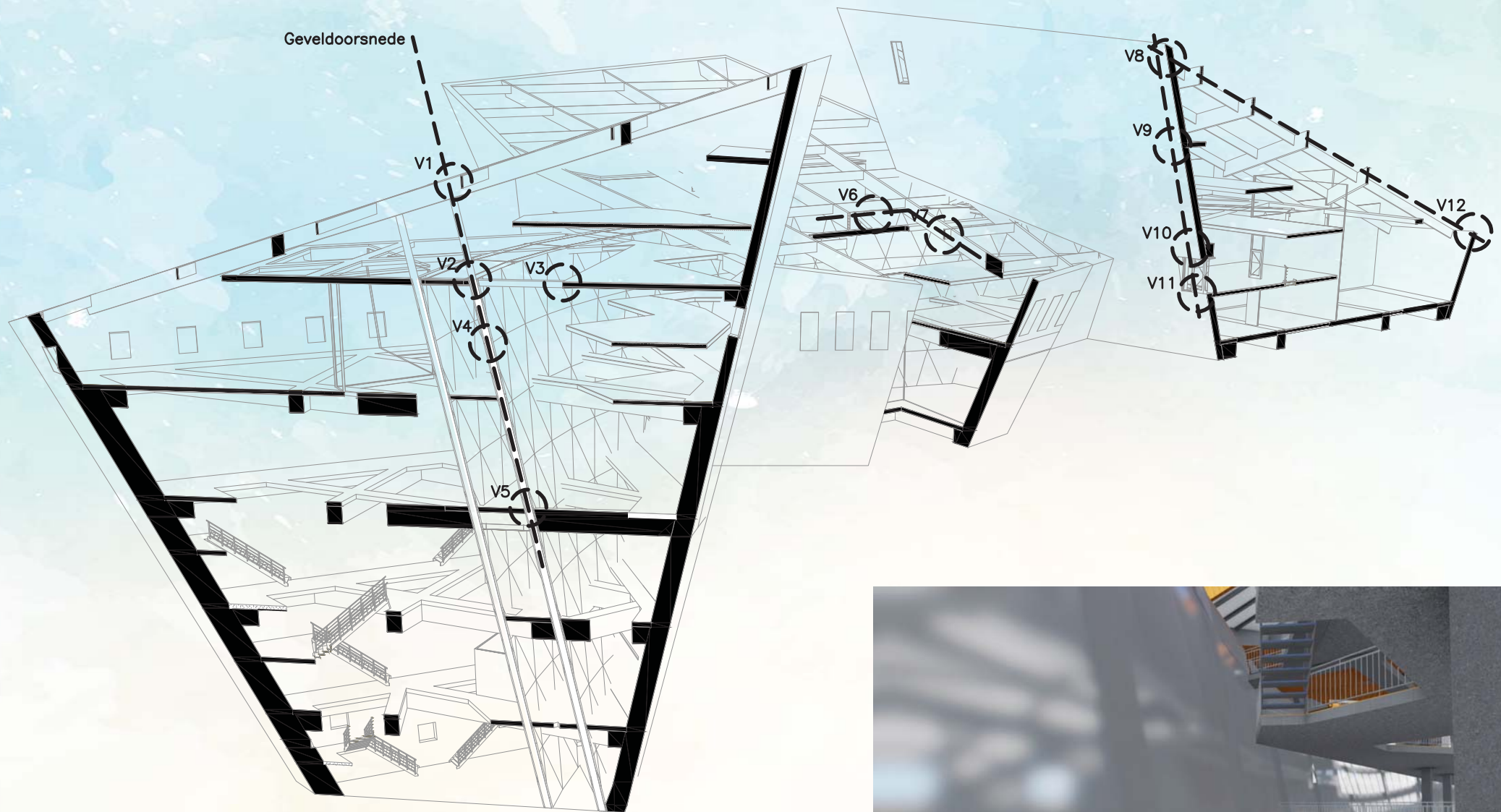
Warme lucht bovenin wordt getransporteerd naar lagere ruimtes via kolommen.

warmtewisselaar in onderwaterconstructie is nu omgedraaid.



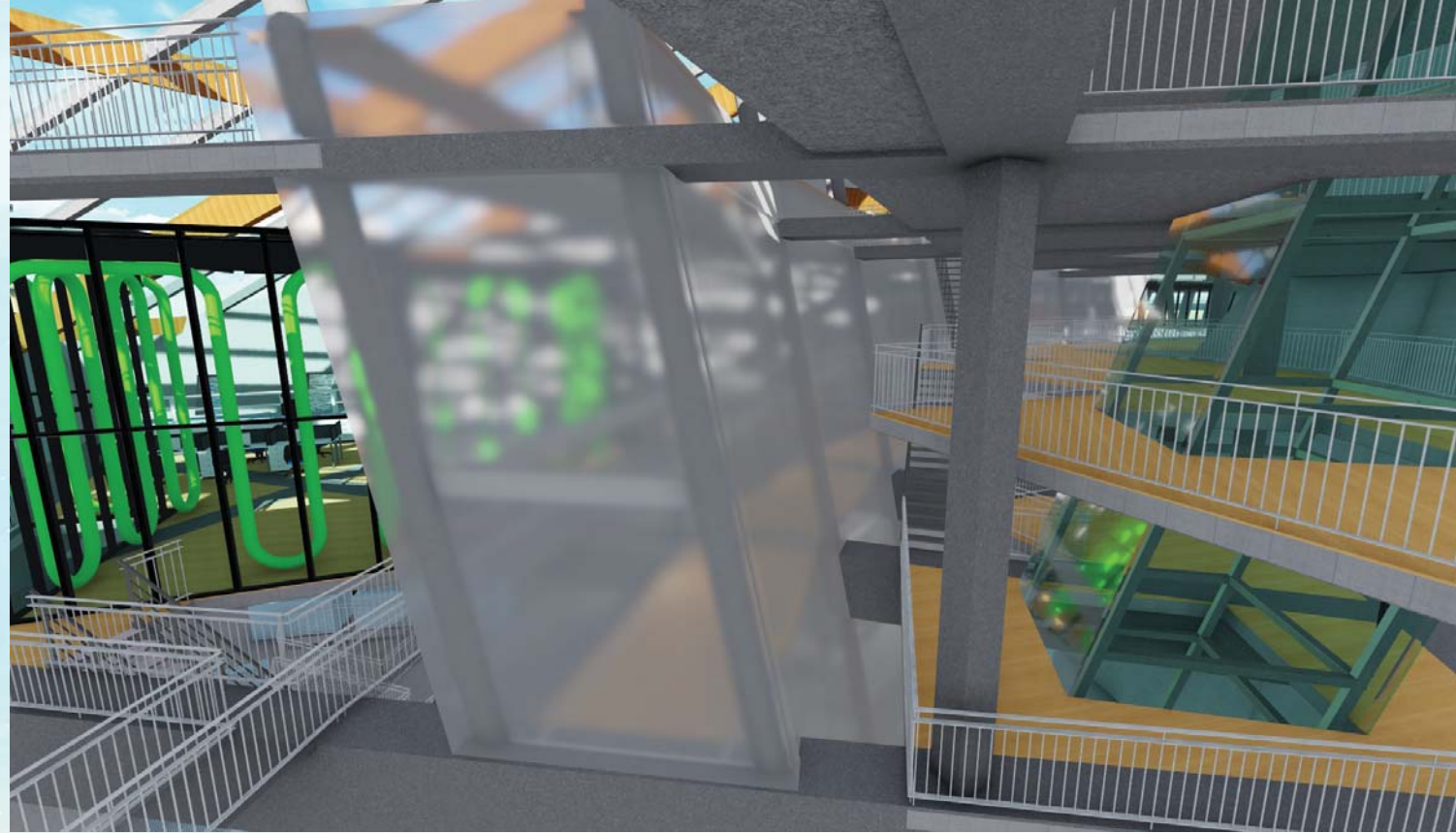
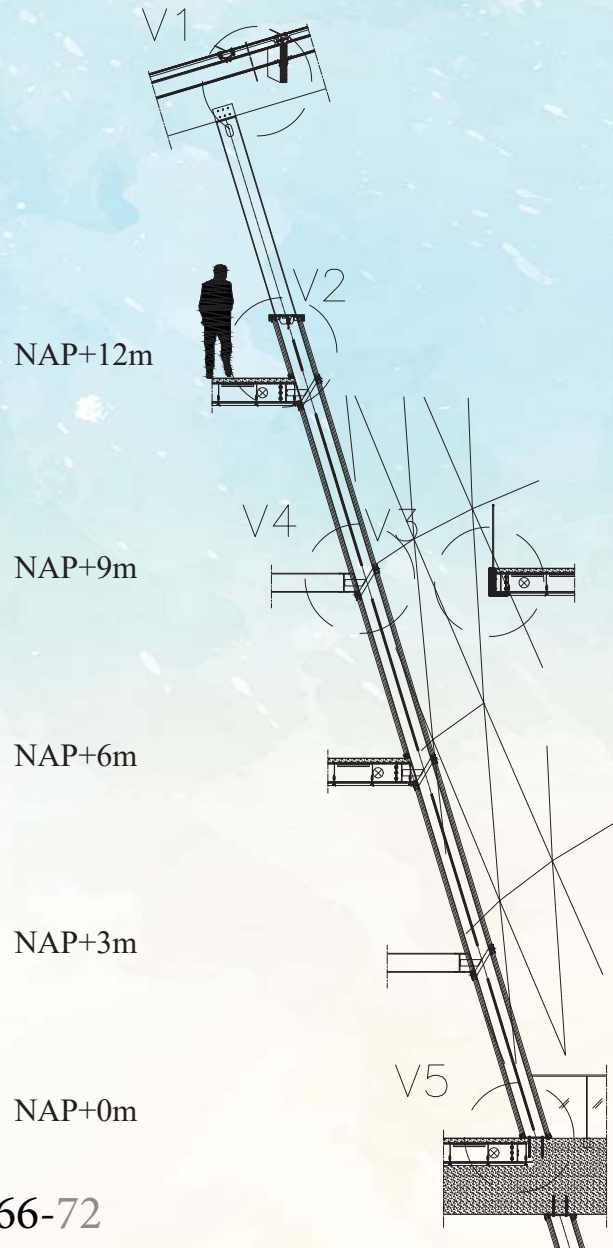
## Doorsnede tpv detaillering

- Het detail V2 is interessant vanwege de complexiteit van het knooppunt.





# Gevelfragment

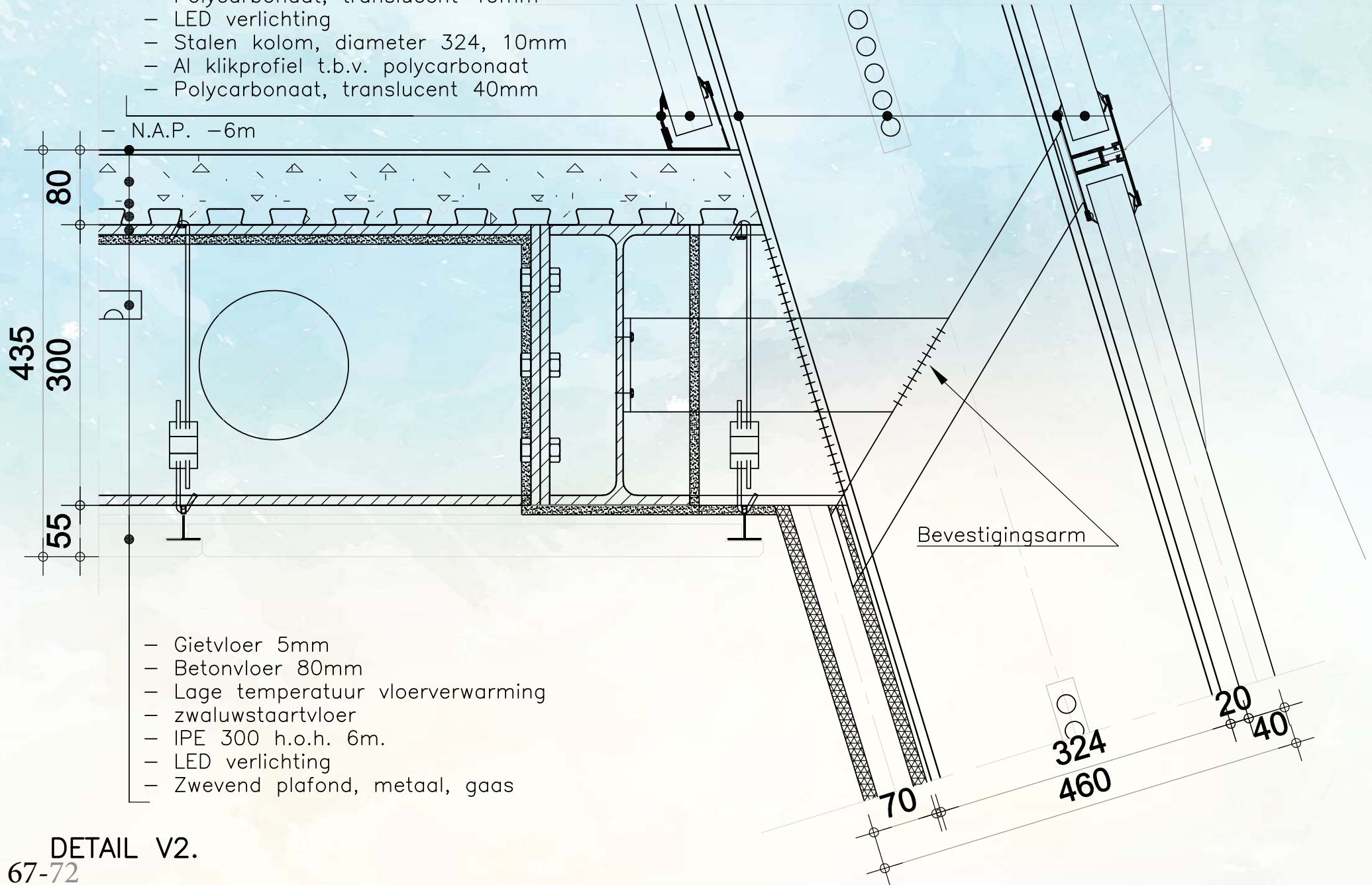


Het gevelfragment is afkomstig van een binnenwand.

Buitenmuren zijn ongeïsoleerd en bestaan alleen uit beton.

Detail V2

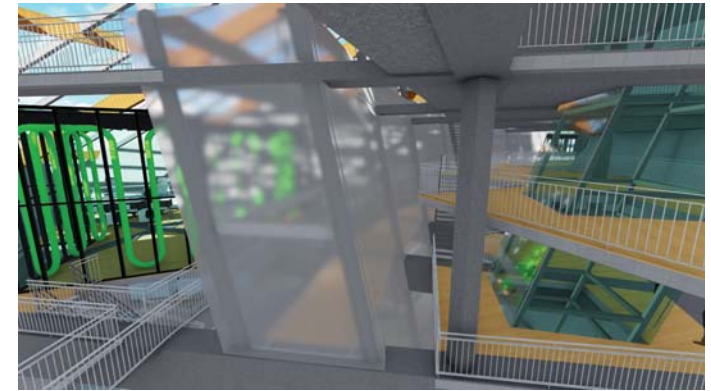
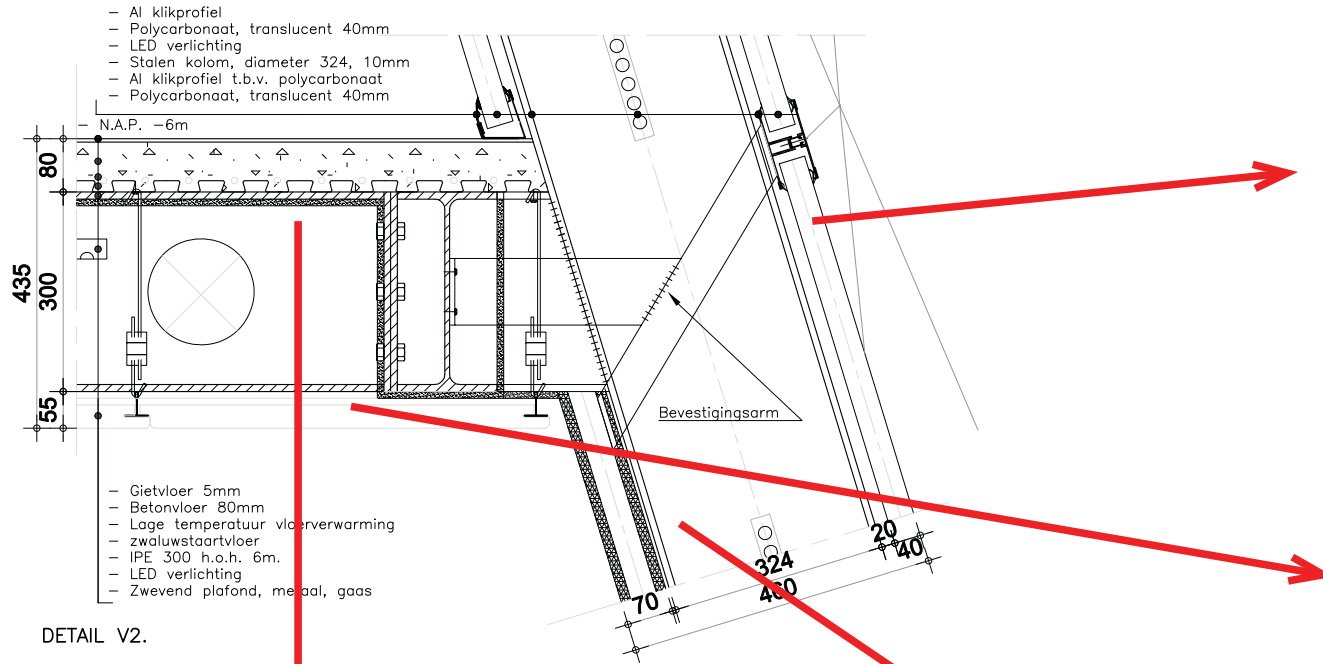
- Al klikprofiel
- Polycarbonaat, translucents 40mm
- LED verlichting
- Stalen kolom, diameter 324, 10mm
- Al klikprofiel t.b.v. polycarbonaat
- Polycarbonaat, translucents 40mm



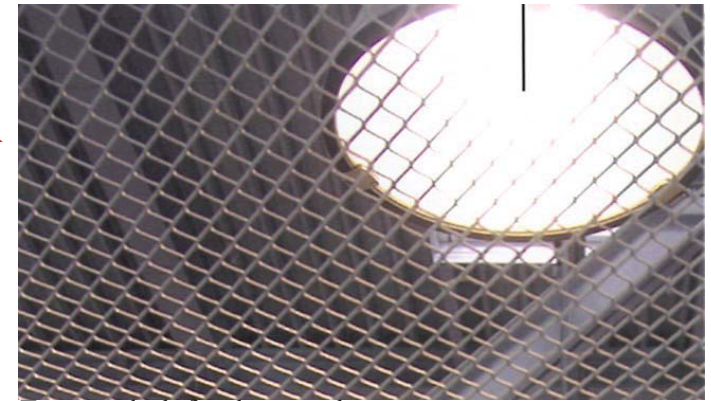
DETAIL V2.  
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## Materiaalgebruik en structuur.

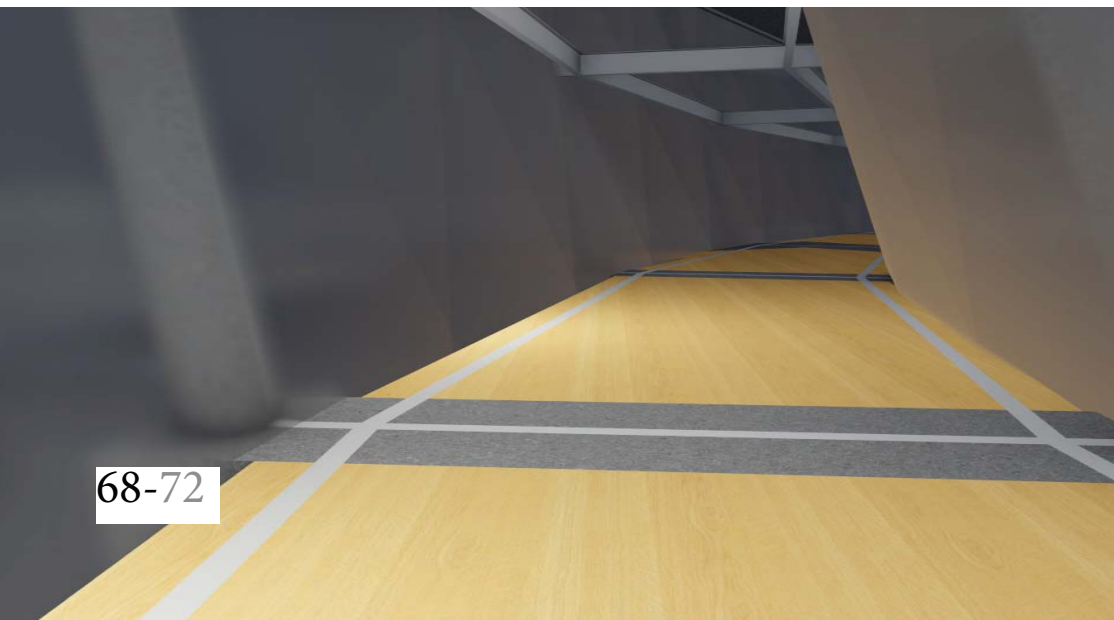


Polycarbonaat wand, translucient



Zwevend plafond, metaal gaas

Liggers zichtbaar in vloer

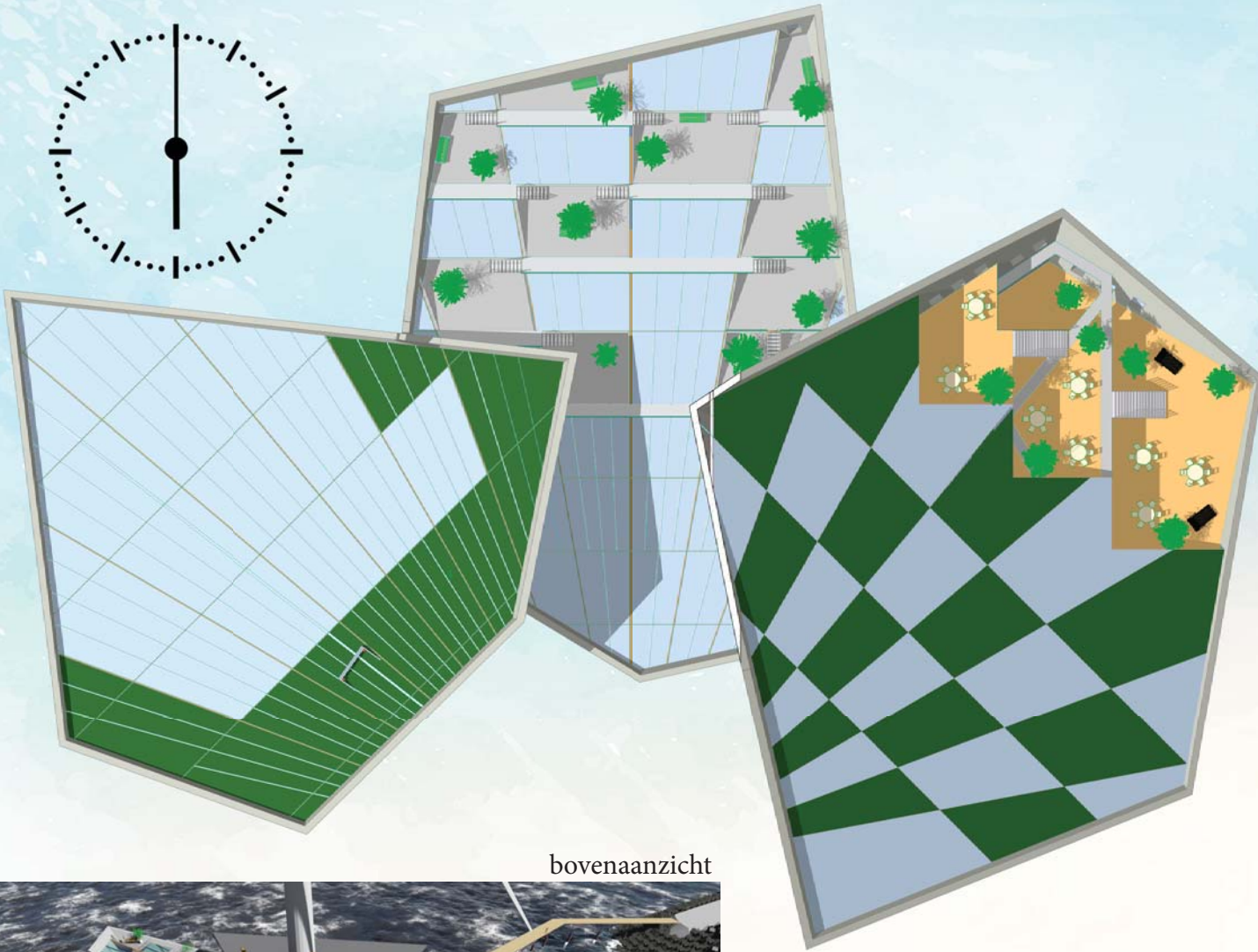


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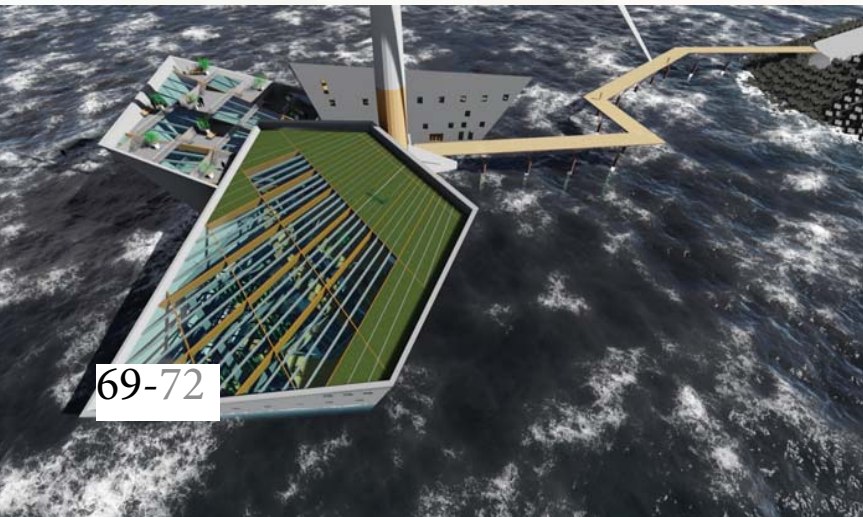
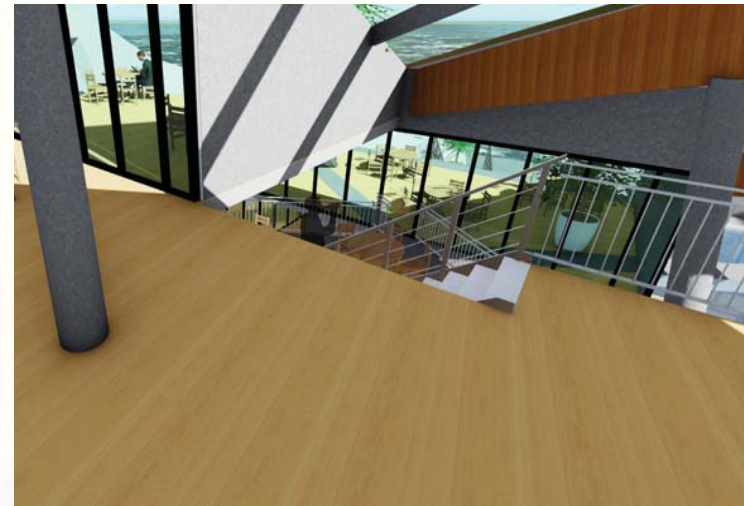


Gyproc, 60 min brandwerend





bovenaanzicht

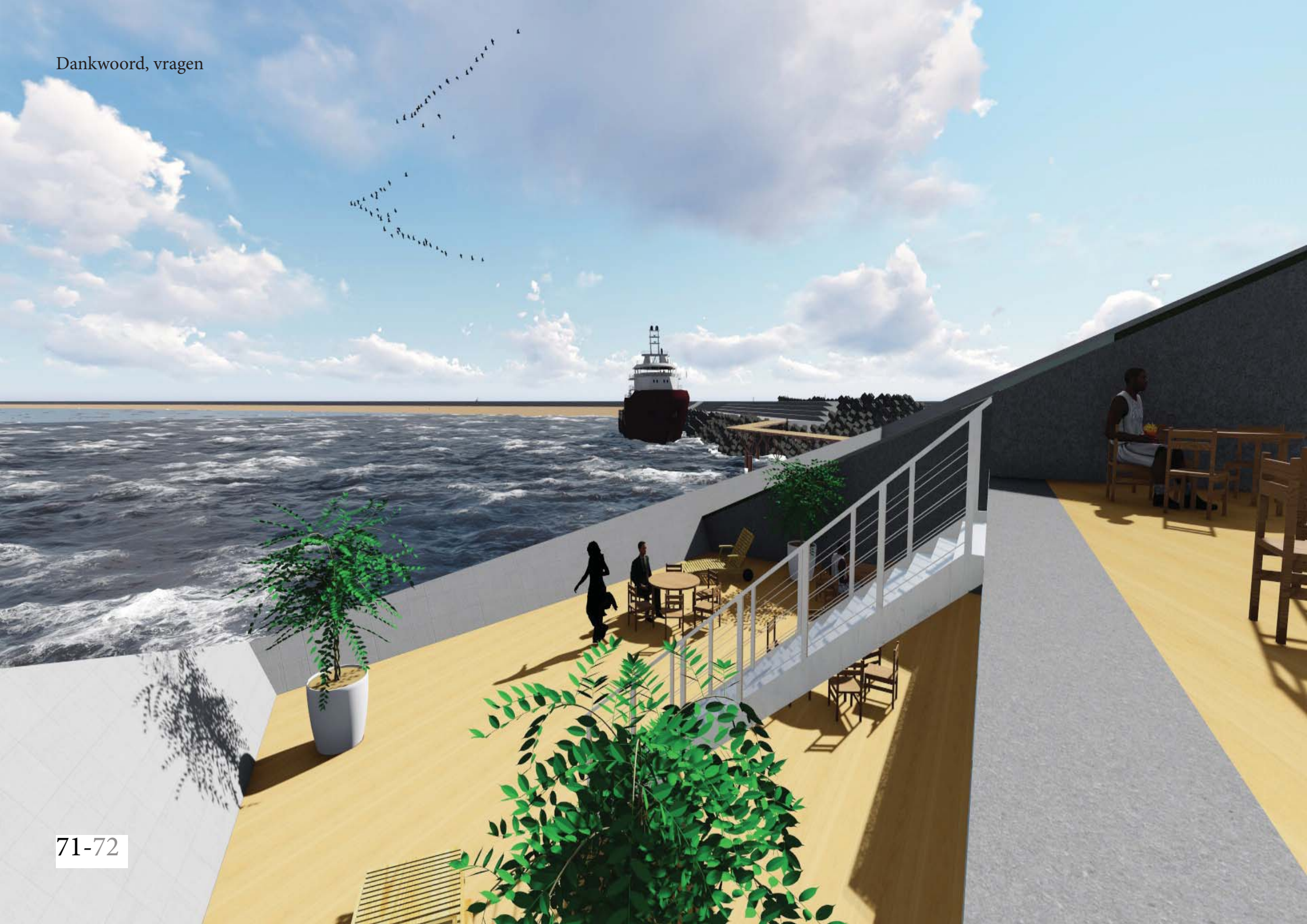


69-72











Terugblik en reflectie op project

- Leermomenten

Concretiseren, flexibele planning, harde deadlines.