Building with dunes; A year round beach pavilion
Graduation plan

Stagnating grow coastal area

In the interdepartmental study of Kust op Koers is pointed out:
The grow of the coastal areas is stagnating, as a perspective to come out of this down going spiral we have to increase the quality of the existing building boundary, by stimulating the own character of these coastal area’s and to stimulate innovation of the touristic sector.
Graduation plan

Stimulate year round pavilions on the beach..

Strandpaviljoen Take five - Zandvoort
Graduation plan

Problem 1: Sand sedimentation blocking
- stagnating grow of coastal area's
- government stimulates year round beach pavilions on the beach
- pavilions in front of the dunes blocks the sand
- dunes cant grow / repair itself
- dunes will get weaker
Graduation plan

Problem 2: storm erosion

- Water reaches the dune in times of storm
- Waves collapsing on the dune causes dune to deform
- Dune loses height and mass

Storm erosie Egmond aan Zee 6 december 2013
Solution

Pavilion that can move up and down

Sand can get to dune underneath the building

By dividing the building into two elements, different parts of the dune are blocked periodically while still having a connection to the ground

Can use the mass of the downgoing part as counterweight for the upgoing part

In times of storm both parts are brought down to block incoming waves

Reduces the impact force of the water on the dunes
Mechanical inspiration

Jack up rigs

Basic principle of how the pavilion should move up and down

works on hydraulics
Hydraulic principle

Use weight of one part to move the other part

Pump to produce the pressure that is still needed and for control

Valves to block the system

Hydraulic fluid supply

Hydraulic pressure
Stairs

stairs connecting the two parts of the pavilion

- steps connected to a bar at the bottom and to a hinge at the top

- this causes the steps to remain horizontal when moving up or down

- one part of the construction can move back and forth in order to absorb the horizontal movement
Two functions

Dune protection  VS  Beach pavilion

Breaking waves  lounge and party environment

Closed exterior  Open exterior

Strong construction  Light atmosphere

Watertight

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Open vs Closed

Closed during storms

On average about 4 storms a year with wind speed of 9 or higher

the facade is pushed against the roof and floor element by hydraulics making it watertight

Open in the rest of the year

Protection facade opens up by hydraulics

Open character

Transparant / translucent facade underneath

Protection facade can be used as terrace
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Situation: Egmond aan zee

Main wind direction W - Z/W
Rough shape of the building is that of a dike

Fits the function of wave breaking

Talud reduces the force of the water on the facade

shape still reminds of dune protection when opened up

Less corners makes water tightness easier

has big flat surfaces so the protection facade can easily be put against the building

Construction on the outside of facade

The protection facade has to rest against it in times of storm
Facade

Material facade: ETFE

Canvas suits the beach

Open character

A lot of light in the building

Facade can light up to create a good atmosphere

Changeable colour to indicate what weather it is going to be or if it is safe to swim

Sunshading can be regulated with air pressure and a third layer in between the other two layers

![Facade Diagram]
Building is in a struggle of what it wants to be, a solid dike or an open beach pavilion.

ETFE takes the shape of the dike, but is trying to open up for the transparent curtain wall underneath.

As a result, pressure lines in the ETFE construction are noticeable.

The facade reflects the dunes and the sea by these waves.

Columns amplify the angled shape of the building.
Facade

3 facades with ‘danger’ from the sea

3 facades have a talud with ETFE

Building opens up to the dunes

Facade facing the dune is ‘cut off’ and has a vertical curtain wall
Round shapes in the interior to amplify the rectangular shape of the facade

Left part of the building has a restaurant function

Right part has a bar/lounge function
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Impression
Construction

bottom part: hydraulic part can move up and down

top part: construction around the building

Facade and insulation placed at the inside of construction

stiff floor and roof elements
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Manually adjustable foundation to overcome uneven groundlevel

Hydraulic column elements overlapping each other for about 2m to create clamp

Columns

Columns are clamped at the bottom
Castellated beams

1200mm high castellated beams to get a clamping connection on the columns.
Floor beams

Floor beams connected to castellated beams

Protection plates placed on the outside of the construction in between the floor beams with a width of 2m because of transport.

Roof plates placed on top of the beams; floor plates underneath construction.
Facade columns

Facade columns placed on top of castellated beams
Protection facade / terrace

hydraulic system connected to castellated beams

same lifting principle as a truck door

Upper part of the building will get torsion

This will uneven the line in which the hinges of the hydraulic system are placed

protection facade divided into smaller segments to absorb the torsion
Dune profiles

Mean low water

Mean high water

Highest measured

1/10000 year safety factor

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Water height at building

Hb = 0.78 \times Db \quad (\text{Wave generally brakes when the height of the wave is 78\% of the depth of the water underneath it})

Hw building = (0.2 + 0.58 \times (Dw building/Db)) \times Hb

Hw building = (0.2 + 0.58 \times (5.2 / 6.4)) \times 5) = 3.4 \text{ meter}
Forces on the building

\[
\begin{align*}
F_{wo} &= 0.5 \cdot p \cdot g \cdot Hw\ building^2 \quad [N/m] \\
F_{stau} &= 0.5 \cdot p \cdot g \cdot Db \cdot Hw\ building \quad [N/m] \\
F_{wu} &= p \cdot g \cdot Hw\ building \cdot Dw\ building \quad [N/m] \\
F_{stat} &= 0.5 \cdot p \cdot g \cdot Dw\ building^2 \quad [N/m] \\

Hw\ building &= 3.4 \quad [m] \\
Dw\ building &= 5.2 \quad [m] \\
Db &= 6.4 \quad [m] \\
g &= 9.8 \quad [m / s^2] \\
p &= 1000 \quad [Kg / m^3] \\

F_{wo} &= 56600 \text{ N/m} = 56,6 \text{ KN/m} \\
F_{stau} &= 106600 \text{ N/m} = 106,6 \text{ KN/m} \\
F_{wu} &= 173000 \text{ N/m} = 173 \text{ KN/m} \\
F_{stat} &= 132500 \text{ N/m} = 132,5 \text{ KN/m} \\

= 468,7 \text{ KN/m}
\end{align*}
\]
Materialization

Steel-Concrete-Steel sandwich panel

- Marine technology
- Relative lightweight
- Can resist up to 900KN
- Only 100mm thick
- Designed to resist punchloads

Fig. 4 Example of usage of SCS sandwich system. (a) Offshore structures in arctic region; (b) blast barrier wall; (c) free standing automobile barrier
Facade columns

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L = 7m

\[ q = 470 \text{ kn/m} \]

\[ l = 3.2 \text{ m} \]

\[ F = 3.2 \times 468 = 2340 \text{ KN} \]

\[ W = \frac{5ql^4}{384EI} = 210000 \text{ Mpa} \]

\[ I_{Ipe500} = 48200 \times 10^4 \text{ mm}^4 \]

\[ W = 103 \text{ mm} \]

\[ Ubij = 0.003 \times L \]

\[ Ubij = 0.003 \times 7 = 21 \text{ mm} \]

\[ W \text{ is 5 keer te groot} \]

Kolom nodig met een 5 keer zo hoge Iwaarde

\[ 48200 \times 10^4 \times 5 = 194000 \times 10^4 \text{ mm}^4 \]

HE550M voldoet
Solar shades

Solar shading construction in between facade columns; connected at the top of these columns moveable by hydraulics

at the end connected to a telescope pole which is connected to the end of the terrace keeping the solar shading in place and supports the terrace

telecoopstang is fixed after construction is in place

transparent windscreen foil around the terrace in between the telescope poles
Section A

Doorsnede 1:50

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Details:
- Double glazing
- Aluminium extrusion
- Parquet
- Air tightness membrane
- Insulation
- Watertight membrane
- Wooden beam
- S355 steel beam
- Cladding
- Wooden framework
- Concrete steel
- Concrete sandwich panel
- Sealing
- Parquet
- Airtightness membrane
- Insulation
- Watertight membrane
- Wooden beam
- S355 steel beam
- Cladding
- Wooden framework
- Concrete steel
- Concrete sandwich panel
- Sealing
Vertical detail 4

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Diagram:
- Triple layered ETFE
- Aluminium extrusion
- Double glazing
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Horizontal details 1 & 2

**Horizontal details 1:5**

*Detail 1 Glass - glass corner*

**Horizontal details 1:5**

*Detail 2 Glass - ETFE*
Horizontal details 3 & 4

**Horizontal details 1:5**

*Detail 3 ETFE - ETFE*

- S355 Steel facade column
- ETFE construction
- Tripple layered ETFE

*Detail 4 ETFE - ETFE corner*

- ETFE construction
- Tripple layered ETFE
Horizontal detail 6

Horizontal details 1:5

*Detail 6 EFTE - Curtain wall corner*
Horizontal detail 5

**Horizontal details 1:5**

*Detail 5 Curtain wall - Column*

- Plasterboard
- Airtight layer
- Insulation
- Watertight layer
- Cladding

- Aluminium extrusion
- S355 steel column

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