- well-known for its beaches: half season
groeten uit Scheveningen
Major attractions Scheveningen

Mass tourism:
- Pier
- shopping center Palace Promenade
- Holland Casino
- Sea-Life
- Harbor area events
- Musical Theatre
- Pathe cinema
- (Vitalizee)

- Cultural level:
- Museum Beelden aan Zee
- Increase dune involvement of Scheveninger and tourist
- Increase dune involvement of Scheveninger and tourist
- Interact with the changing environments
- Increase dune involvement of Scheveningen and tourist
Increase dune involvement of Scheveninger and tourist?
PROGRAM
Open Air Theaters in the Netherlands

- 39 theatres associated
- about 75 total in Netherlands
- 270,000 visitors annual and counting (2010) *

- some very successful mixed programs, best of all:

with 100,000 estimated visitors...

*DNO: Vereniging Nederlandse Openluchttheaters

Dutch open air theaters with above 5,000 annual visitors
Focus area

- Parktheater The Hague is understatement for size of the city
Focus area

- Parktheater The Hague is understatement for size of the city
- Scheveningen in the middle of high population density
Focus area

- Parktheater The Hague is an understatement for the size of the city.
- Scheveningen is in the middle of high population density.
- Within half an hour's drive of:

**Rotterdam**
- 600,000 inhabitants
- 30 min. drive
- 30 min. public transport

**Zoetermeer**
- 122,000 inhabitants
- 25 min drive

**Leiden**
- 118,000 inhabitants
- 30 min drive

**Delft**
- 100,000 inhabitants
- 20 min drive

**Den Haag**
- 600,000 inhabitants
- 20 min drive
Limitations in Dutch climate

- cancelled performances
- short season
- temporary roof construction
- permanent roof construction

Open air theatre ‘De Doolhof’ Tegelen, 3500 covered seats

Parktheater The Hague

Theatre Hertme, covered audience
To far away?
Too far away?
just one peer: 400 meters!
connexion Scheveningen with dunes
connexion Scheveningen with dunes

- existing paths: poor connexion
connexion Scheveningen with dunes

- existing paths: poor connexion
- conflict situations tram / car / bicycle
connexion Scheveningen with dunes

- existing paths: poor connexion
- conflict situations tram / car / bicycle
- abrupt end boulevard
connexion Scheveningen with dunes

new connection!
remains WOI1
remains WOII

Atlantic Wall
remains WOII

Atlantic Wall
- 2685 km
- Spain till Norway
remains WOII

Atlantic Wall
- 2685 km
- Spain till Norway
- Scheveningen becomes Sperrgebiet
- 140,000 people had to abandon their homes
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remains WOII

Atlantic Wall
- 2685 km
- Spain till Norway
- Scheveningen becomes Sperrgebiet
- 140,000 people had to abandon their homes
- stützpunktgruppe Batterie Nord
- well preserved bunkers of 10,273 total built
remains WOII
- regained interest in war period
- bunkers are municipal monuments, likely to become national monuments *
- ‘bunkerploeg Den Haag’

remains WOII
- regained interest in war period
- bunkers are manucipal monuments, likely to become national monuments *
- ‘bunkerploeg Den Haag’

- make history publicly accesilbe and let the devoded people maintain it by subsidy
- copy succes IJmuiden and Noordwijk with similar historical situations: make then publicly accesilbe!

Focus on beach
- amphitheater 350 seats

Focus on dunes
- cafe/ restaurant year round
- serving museum, cyclists, walkers, own public

SITE PROGRAM RESEARCH BUILDING
OUTDOOR THEATER SITUATION SITE DESIGN PRINCIPLES
RESEARCH
SCHEVENINGEN

WIND, SUN, RAIN

OPEN AIR THEATER

SEA VIEW

KINETIC

DUNE

SITE PROGRAM RESEARCH BUILDING

KINETIC ARCHITECTURE INTERACTION LEVELS CONCLUSION RESULTS
What is Kinetic architecture?

- Embedded
- Dynamic
- Deployable

(Kinetic typologies by Fox and Yeh)
Analysis kinetic architecture

Often
Conclusions
- often retractable roof
- anticipating on rain and sun
- wind avoiding
- two configurations: open and closed
Goals

- anticipate to WIND, sun and rain
- maximize site experience

site specific wind calculations

WIND PRESSURE CALCULATIONS

<table>
<thead>
<tr>
<th>Product</th>
<th>dimensions (mm)</th>
<th>kN output</th>
<th>stroke (mm)</th>
<th>V (mm/s)</th>
<th>references</th>
<th>DUTY CYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINAK LA 35 (acme)</td>
<td>85</td>
<td>0.011</td>
<td>1.5</td>
<td>500</td>
<td>outdoor equipment</td>
<td>10% or 2 min cont. with 18 min break.</td>
</tr>
<tr>
<td>AIA5 Acme</td>
<td>80</td>
<td>0.012</td>
<td>3.5</td>
<td>600</td>
<td>indoor (hospital)</td>
<td>10%</td>
</tr>
<tr>
<td>Phoenix Mecano LAMBDA</td>
<td>94</td>
<td>0.012</td>
<td>6</td>
<td>600</td>
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<td>0.010</td>
<td>10</td>
<td>600</td>
<td>outdoor equipment</td>
<td>5-20%</td>
</tr>
<tr>
<td>Phoenix Mecano LZ 80</td>
<td>114</td>
<td>0.031</td>
<td>12</td>
<td>1005</td>
<td>mainly indoor</td>
<td>10-100%</td>
</tr>
<tr>
<td>Raco Tbc6 acme</td>
<td>138</td>
<td>0.055</td>
<td>12</td>
<td>1000</td>
<td>in 3 stages</td>
<td>25%</td>
</tr>
<tr>
<td>Phoenix Mecano SLZ 90</td>
<td>145</td>
<td>0.050</td>
<td>24</td>
<td>1200</td>
<td>in 3 stages</td>
<td>25%</td>
</tr>
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Goals
- anticipate to WIND, sun and rain
- maximize site experience

Site specific wind calculations

Wind Pressure Calculations

WIND PRESSURE CALCULATIONS

wind velocity (m/s)  pressure on surface (kN/m²)  loads on actuator (kN)

Industrial common elements:
Actuator research
- hydraulic
- pneumatic -> cushioning
- electric (spindle)

ACTUATOR RESEARCH

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<tbody>
<tr>
<td></td>
<td>with</td>
<td>height</td>
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<td>volume (m³)</td>
<td></td>
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<tr>
<td>LINAK LA 35 (acme)</td>
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<td>6</td>
<td>600</td>
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<tr>
<td>LINAK LA 36 (acme)</td>
<td>60</td>
<td>148</td>
<td>1083</td>
<td>0.010</td>
<td>10</td>
<td>600</td>
</tr>
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<td>1436</td>
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<td>1005</td>
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<tr>
<td>Raco T60-6 acme</td>
<td>138</td>
<td>264</td>
<td>1350</td>
<td>0.055</td>
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<td>1000</td>
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<td>Phoenix Mecano SLZ 90</td>
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<td>1283</td>
<td>0.060</td>
<td>12</td>
<td>1000</td>
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Goals

- anticipate to WIND, sun and rain
- maximize site experience

site specific wind calculations

Structural kinetics will deal with a deployable geometry

1-D bars

DEPLOYABLE STRUCTURE ANALYSIS

folded plates

pantographs for double curvature

double layer pantographs pantographs for double curvature
tensegrity structures based on tension of fabric and cables
Conclusions

- often retractable roof
- anticipating on rain and sun
- wind avoiding
- two configurations: open and closed

- pneumatic actuators have damping and inaccuracy

- the more complex the mechanism and geometry, the less rigid and capable of dealing with bigger forces, and perform in more then two positions
Conclusions

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- SIMPLE MECHANISM, LITTLE WEIGHT
Using fabrics:

- anticlastic shapes research
- folded membranes
Using fabrics:

- anticlastic shapes research
- folded membranes

Tensile architecture

- basic shapes
- anticlastic surfaces
- membrane is constructive element
- you will need either:
  ~ sufficient curvature
  ~ make ‘waves’ (Sony Center Berlin)
- fabric that can handle folding
- principles of Frei Otto
- PTFE: Sefar Tenara 40% translucency
- fabric that can handle folding
- principles of Frei Otto
- PTFE: Sefar Tenara 40% translucency

- folding principle
artist lounge
artists wing
technical services
restrooms
office wing
boardroom

Built-up theater + 8400 level - toilets theater - toilets cafe - installation/technical support

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technical services
restrooms
office wing
boardroom
concrete foundation auditorium

stage

remains 'Atlanticwall'
Built-up theater + 8400 level
- toilets
- theater
- toilets
- cafe
- installation/technical support
- service ramp/supplies

Glass facade
Terrace
Sound insulation theater
steel trusses
gebogen raatliggers
Built-up theater

isolated roof cafe
ruimtelijke vakwerkliggers
PV panels
profiles aluminium roofplates
'cold roof' construction
glass strip
hinged profiles
pneumatic actuators
PTFE fabric
sizes
+ 1350 FLOORPLAN

Auditorium
- specs:

area: 280m²
13 rows
350 seats
outdoor climate
low temperature seat heating
generally publicly accessible
concrete seats, pillows provided

Cafe restaurant:
250 m²
all year round
dune orientated
+ 1350 FLOOR cafe/ restaurant

Auditorium
- specs:
  - area: 280m2
  - 13 rows
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  - low temperature seat heating
  - generally publicly accessible
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Cafe restaurant:
  - 250 m2
  - all year round
  - dune orientated
Office wing
200m²
theater and restaurant management
includes first bunker

Theater artists wing
200 m²
artist dressing rooms
includes lounge in second bunker

Theater backstage/ decor
180m²
Office wing
200m²
theater and restaurant management
includes first bunker

Theater artists wing
200 m²
artist dressing rooms
includes lounge in second bunker

Theater backstage/ decor
180m²

Public refreshment
Toilets men: 4, 5 urinoirs, 45m²
Toilets women 8, 54m²

Technical installations/ storage
95m²
+ 5000 FLOORPLAN

performance backstage
materials
routings
acces to level 8400 (-1)
closed theater situation
closed theater situation
closed theater situation
ANIMATION SLIDING WALLS
section AA'
cafe/ restaurant interior
section DD’
- low temperature floor heating
- natural ventilation inside cold roof construction
- profile detailing
Force calculations
Force calculations
- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge

\[ F_{\text{wind}} \]

1/3

2/3
Force calculations

- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge

$F_{\text{wind}}$
Force calculations
- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge
- closed position force flows
Force calculations

- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge
- closed position
  force flows

- Three positions
Force calculations
- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge
- closed position
  force flows
- Three positions
- position 1; just open
Force calculations

- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge
- closed position
  force flows

- Three positions

- position 1: just open
- position 2: half open
Force calculations

- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge
- closed position focus flows

- Three positions
  - position 1: just open
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Force calculations

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Force calculations
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- 2/3 below hinge
- closed position: forces flows

- Three positions
  - position 1: just open
  - position 2: half open
  - position 3: fully open
  wind suction
Force calculations
- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge
- closed position
  force flows

- Three positions
- position 1; just open
- position 2: half open
- position 3; fully open
  wind suction

2 pneumatic actuators:
- 80 mm piston
- 80kN peak pressure
- 10 bar operating pressure
- 2000 mm stroke
Force calculations

- designed for biggest profile
- 1/3 above hinge
- 2/3 below hinge
- closed position force flows

- Three positions
  - position 1; just open
  - position 2: half open
  - position 3; fully open wind suction

2 pneumatic actuators:

- 80 mm piston
- 80kN peak pressure
- 10 bar operating pressure
- 2000 mm stroke
- 20 sec loaded opening

- mounted at 2m
- generating 320kN combined

CONVERTED: 9,5 M/S (bft 5)
SITE PROGRAM RESEARCH BUILDING
CONSTRUCTION BUILT-UP FLOORPLANS AND SECTIONS FRAGMENTS AND DETAILS FACADES
ANIMATION PNEUMATICS
ANIMATION POSITIONS
Southwest facade
Southeast facade
southeast perspective view
Northeast facade
from intimite enclosed....
ANIMATION AUDITORIUM AND BEACH
special thanks to:

Overall guidance
Jan Engels
Tjalling Homans

Technical guidance:
Mauricio Morales Beltran

advise hydraulics and pneumatics
Jean-Paul, Metal Work Nederland B.V.

Advisor tensile and membrane constructions
Harmen Werkman, Tentech BV Utrecht

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