INTRODUCTION
CURRENT WAY OF MOUNTING SOLAR PANELS ON ROOFS IS A GOOD DEVELOPMENT, BUT **NOT FED BY AN ARCHITECTURAL APPROACH**;
Instead of focusing on producing energy, the first steps should be to **reduce and reuse** existing energy (i.a. artificial lighting);
noon: high peak

CURRENT SITUATION
noon: less high peak
GOOD
noon: less high peak
morning/afternoon: higher efficiency
BETTER

kWh $\rightarrow$

$\text{t} \rightarrow$

$\text{t} \rightarrow$

$\text{t} \rightarrow$
Instead of absorb the produced energy peaks (otherwise the power grid get overloaded), prevent them.
current situation
=  
adding solar panels
constant energy

++

diffuse daylight

++

architectural interest
OVERALL DESIGN QUESTION

In which aesthetic and eco-efficient way, solar energy and daylight can be integrated in a roof-mounted system, using an existing building on the Marineterrein in Amsterdam as a test subject?
RESEARCH
DAYLIGHT
The Weather Project

Artist: Olafur Eliasson
Tate Modern, London - 2003
HUMAN BENEFITS

![Bar chart showing human benefits with daylight]

- Productivity for employees: +15%
- Effective learning for students: +7 to 18% ≈ +13%

Legend:
- Light blue: no daylight
- Blue: daylight
AVERAGE ENERGY USE - OFFICE BUILDING

- Heating: 41%
- Cooling: 6%
- ICT: 19%
- Ventilation: 3%
- Lighting: 22%
- Other: 9%

- Lighting: Blue
- Ventilation: Dark Blue
- ICT: Light Blue
- Heating: Orange
- Cooling: Light Orange
- Other: Grey
stimulate biorhythm of users
ADVANTAGES

- decrease in lighting / electricity costs
summer: overheated by greenhouse effect
DISADVANTAGES

winter: high heat losses through glass
stimulate biorhythm of users

summer: overheated by greenhouse effect

winter: high heat losses through glass

sun glare on screens

decrease in lighting / electricity costs

ADVANTAGES

roof daylight

DISADVANTAGES

roof daylight

sun glare on screens

SUNSHADING SYSTEM

YES < diffuse radiation (D)

NO < beam/direct radiation (B)
DIFFUSE RADIATION

rebound

reflection

filtration
VVVV-1 software analyzes points of lightness
CONCLUSION DATABASE

TH LOW [0.60-0.75] ; TO HIGH [HIGH-LOW]

TH MEDIUM [0.76-0.86] ; TO MEDIUM [HIGH-LOW]

TH HIGH [0.87-1.00] ; TO LOW [HIGH-LOW]
SOLAR ENERGY
Rotterdam Central Station

Architect: Team CS

Rotterdam, The Netherlands - 2014
SOLAR TRACKING SYSTEM

++ Constant energy production

++ Allows comfortable, diffuse light
integrate solar energy and daylight system

“1 + 1 = 3”

more value with less impact
MODEL RESEARCH

SUNFLOWER MOTION
horizontal grid

SUNFLOWER MOTION
diagonal grid

LOTUS MOTION
diagonal grid
DESIGN
HEROS DAYLIGHT SCHOOL
BUILDING #39
office / education Marine

BUILDING #34
sportschool and -fields Marine
VMBO-t
active education
eye for ‘boy talents’
80% doing and 20% sitting/listening
every morning sports outside school (no gym); related to mental strength and discipline
shops runned by the students; provide engagement with society and skills in entrepreneurship
school is school and home is home; no homework (books stay in school)
parents highly involved in student progress
TRANSFORMATION BUILDING #39
REUSE EXISTING
- façades
- foundation
- ducting systems
NEW INTERIOR
- columns & beams
- flexible system
SOLAR / DAYLIGHT
ROOF SYSTEM
- monocrystalline solar cells
- total output: 140,000 kWh/year (including output roof pavilion)
- equal to 40 average households
MILKGLASS
- 70% transparent glass
SOLAR PAVILION
- student shops
- electric car charging point
Heros Daylight School

Aula / sporttribune
Heros Daylight School

Aula / sporttribune
Roof detail 1
1:10
rectangular tube profile;
sloped, 4 degrees/meter;
white, reflective coating
glass;
double, insulating HR++
Raico Stahl profile;
welded on tube profile
rotation axis solar panels;
double shaft, ball-bearing

Roof detail 2
1:10
glass;
double, insulating HR++
monocrystalline solar cell;
61 cells/panel;
output 210 kWh/year / panel
rigid, triangular panel;
aluminum honeycomb, white coated;
placed on aluminum profile
rainwater drainage;
protected with filter
rotation axis solar panels;
double shaft

Interior detail 1
1:10
IPE 300
steel plate;
white, reflective coating
cement;
floorheating/-cooling pipes
carpet;
natural sisal
glass;
acoustic insulated

Interior detail 2
1:10
IPE 300
steel plate;
white, reflective coating
cement;
floorheating/-cooling pipes
carpet;
natural sisal
glass;
acoustic insulated

Daylight School
1:50
hammock;
knitted structure

Façade detail 1
1:10
IPE 300
steel plate;
white, reflective coating
cement;
floorheating/-cooling pipes
carpet;
natural sisal
glass;
acoustic insulated

Façade detail 2
1:10
IPE 400
existing façade;
brick, light beige
milkglass;
70% transparent, HR++
supporting structure;
structural glass
roof covering;
sloped, 2 degrees/meter
ceiling board;
white, reflective coating
stone edge finishing;
attached to existing façade
Roof detail 1

- 1:10
- Rectangular tube profile;
- Sloped, 4 degrees/meter;
- White, reflective coating
- Glass;
- Double, insulating HR++
- Raico Stahl profile;
- Welded on tube profile
- Rotation axis solar panels;
- Double shaft, ball-bearing

Roof detail 2

- 1:10
- Glass;
- Double, insulating HR++
- Monocrystalline solar cell;
- 61 cells/panel;
- Output 210 kWh/year / panel
- Rigid, triangular panel;
- Aluminum honeycomb, white coated;
- Placed on aluminum profile
- Rotation axis solar panels;
- Double shaft

Interior detail 1

- Façade detail 1

- Façade detail 2

- IPE 300
- Steel plate;
- White, reflective coating
- Concrete;
- Floor heating/cooling pipes
- Carpet;
- Natural sisal
- Glass;
- Acoustic insulated
- Balustrade;
- Structural glass,
- Blind assembly

Façade detail 2

- 1:10
- IPE 400
- Steel plate eave;
- White, reflecting coating
- Concrete;
- Floor heating/cooling pipes
- Carpet;
- Natural sisal
- Glass;
- Acoustic insulated
- Milkglass;
- 70% transparent, HR++
- Steel plate eave;
- White, reflecting coating
- IPE 300
- Existing façade;
- Brick, light beige
- Milkglass;
- 70% transparent, HR++
- Supporting structure;
- Structural glass
- Roof covering;
- Sloped, 2 degrees/meter
- Ceiling board;
- White, reflective coating
- Stone edge finishing;
- Attached to existing façade

Daylight School

- 1:50
- Hammock;
- Knitted structure
- IPE 300
- Steel plate;
- White, reflective coating
- Concrete;
- Floor heating/cooling pipes
- Carpet;
- Natural sisal
- Glass;
- Acoustic insulated
- Milkglass;
- 70% transparent, HR++
- Steel plate eave;
- White, reflecting coating
- IPE 300
- Existing façade;
- Brick, light beige
- Milkglass;
- 70% transparent, HR++
- Supporting structure;
- Structural glass
- Roof covering;
- Sloped, 2 degrees/meter
- Ceiling board;
- White, reflective coating
- Stone edge finishing;
- Attached to existing façade
CURRENT SITUATION

noon: high peak

noon: less high peak

morning/afternoon: higher efficiency

BETTER
CURRENT SITUATION

noon: high peak

GOOD

noon: less high peak

morning/afternoon: higher efficiency

BETTER

noon: less high peak

morning

noon

afternoon
afternoon
**CURRENT SITUATION**

- **noon:** high peak
- **morning/afternoon:** higher efficiency

**GOOD**

- **noon:** less high peak

**BETTER**
noon: less high peak
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DECENTRAL/AUTONOMOUS ENERGY SYSTEM

- Inverter
- Combi
- Central
- Electricity
- Grid

E-car owned by building & rented by building users

E-car owned by city residents of Amsterdam

E-car owned by event visitors

Common
- Weekdays
- Weekend

Special Event
- Evening
+2  STUDY GARDEN
+1  LIBRARY / LANGUAGE LABS
 0  COURSE SPECIFIC CLASSROOMS

AULA / SPORTTRIBUNE

+1/2  TEACHER / STAFF AREA
 0  FACILITIES
+2 STUDY GARDEN
+1 LIBRARY / LANGUAGE LABS
0 COURSE SPECIFIC CLASSROOMS

→ AULA / SPORTTRIBUNE

→ +1/2 TEACHER / STAFF AREA
0 FACILITIES
+2  STUDY GARDEN
+1  LIBRARY / LANGUAGE LABS
 0  COURSE SPECIFIC CLASSROOMS

AULA / SPORTTRIBUNE

+1/2  TEACHER / STAFF AREA
 0  FACILITIES
Heros Daylight School
Study garden
ABSORBING
- warm, character, existing

REFLECTING
- cold, serene, new

NEW MILKGlass FACADE
- White Coated Surfaces
- Soft Diffuse Daylight
- Soft Textures
- Natural Sisal Carpet

EXISTING BRICK FACADE
- Rough Textures

MATERIAL MAP
TIMELAPSE

Sun-motion during a day
TIMELAPSE

Sun-motion during a day

Roof system adapts constantly
TIMELAPSE

Sun-motion during a day

Roof system adapts constantly

Stimulating biorhythm of the school life
ARCHITECTURAL GOAL

The visitor experiences a constantly *changing architecture* that has the ability to alter our understanding of space and place, as well as *calling attention* to the enduring relationship between architecture and the environment.
SECTION MODEL
QUESTIONS
DAYLIGHT SCENE 1
- equinox 21 march/sept.
- 17.00 h / afternoon
- second floor

DAYLIGHT SCENE 2
- equinox 21 march/sept.
- 17.00 h / afternoon
- first floor
HEROS SCHOOL
  glass triangles

HEROS PAVILION
  glass structure
The difference in reflective surfaces has more influence on the light intensity in the building, than the difference in type of sunshading system (rebound, reflection or filtration);
Reflective walls have more effect on the light intensity than a reflective floor.

This indicates to the designer: keep the walls as light in color as possible and use the floor surface for deep colors or character-giving patterns;
To create an interesting interior with a pleasant light intensity, the sunhading system has to be composed of several different layers.