I. Introduction to THE GREEN WALL solution as a general approach to build sustainable human friendly structure especially dedicated to a hot and dry regions of the world - philosophy that stands behind the project.

In order to understand ideas which stand behind "THE INFINITE GREEN" project opened 28^{the} August 2015 in the city of Wroclaw, Poland) I want to introduce "The Green Wall" and "The Expanding Nature Series" projects which are combination of natural and cultural world on which we depend and are a part. The projects deal with the notion of space with the underlining idea of our need to cooperate with nature.

Plants seems to be most part of our human world and also it serves the same other living organisms. Ecosystem cannot function properly without sustainable balance between inanimate matter and world of living organisms. The role of a man is not to spoil that balance as long as possible on this planet. So partly that's the reason I'd like to incorporate plants into building structure because our coexistence is extremely important for both parties and for our survival in general.

The idea is to build a structure that interacts with the environment. Plants are incorporated into the overall shape of the structure referring to organic forms of life. This project is mostly dedicated to "DESERT HOUSE" (http://youtu.be/ZMTFYCQVNEs) which essentially combined the shape of a house and a tree. This concept also works well with other projects. An underlying concept included in these types of projects, is the practical idea of constructing layered structures containing plants which can be useful in hot climates. It is possible to design a structure that can protect its interior from the elements while maintaining a micro-climate with higher humidity and lower temperature inside the structure. Such a structure can support nearly any shape from geometrical to organic. This solution might be useful in small architecture structures and in larger, public utility structures as well. Interior space will be lighted with skylights. Light also enters through the structure's layers. If the scale is not too large, these structures can be constructed entirely with waterproof plywood. Wooden blocks are used as spacers between layers. Larger scale structures could be constructed with steel supports with an Eco roof membrane (however it's not necessary at all). This relatively thin membrane contains the soil in which the plants grow and is placed on every layer of the structure. I used this membrane at The CLOUDY THOUGHTS sculpture in Museo Brasiliera ESCULTURA in Sao Paulo, Brazil, 2013.

The concept of a living sculpture include different kinds of plants which are placed onto the structure. The structure is then placed into the public sphere. This requires only watering and trimming which might be even provided by spectators or volunteers. This effort produces a type of public ritual, instilling the feeling of empathy and a sense of responsibility within the community. This living organism requires care and attention so that it doesn't perish and will not become a symbol of desolation.

A work of art evoking social reaction and care is a certain requirement of our times. We must look after and care for the natural and cultural environment. Such is today's requirement. Sculpture, especially in a social, urban context, cannot be a piece of "beautifying" matter, but often litters the urban and non-urban landscape. The work of art as a symbolic instrument (not a tool) ..., on which one can play as well as with which one can play (for the meaning of our humanity) - creating art as non-perfect creation of life.

This sculpture, especially in the classic Urban Jungle, is an important symbol of a necessary bond, which must be of particular importance in the mind of the architect or artist today. This bond is a last refuge. We must remember that this seemingly obvious bond connects us with nature. It's nonsense to build cities where hundreds of thousands or millions live in an artificial, grounded space. The city of the future must be adapted to the natural environment within which we make the right solution in terms of aesthetics, energy, and function.

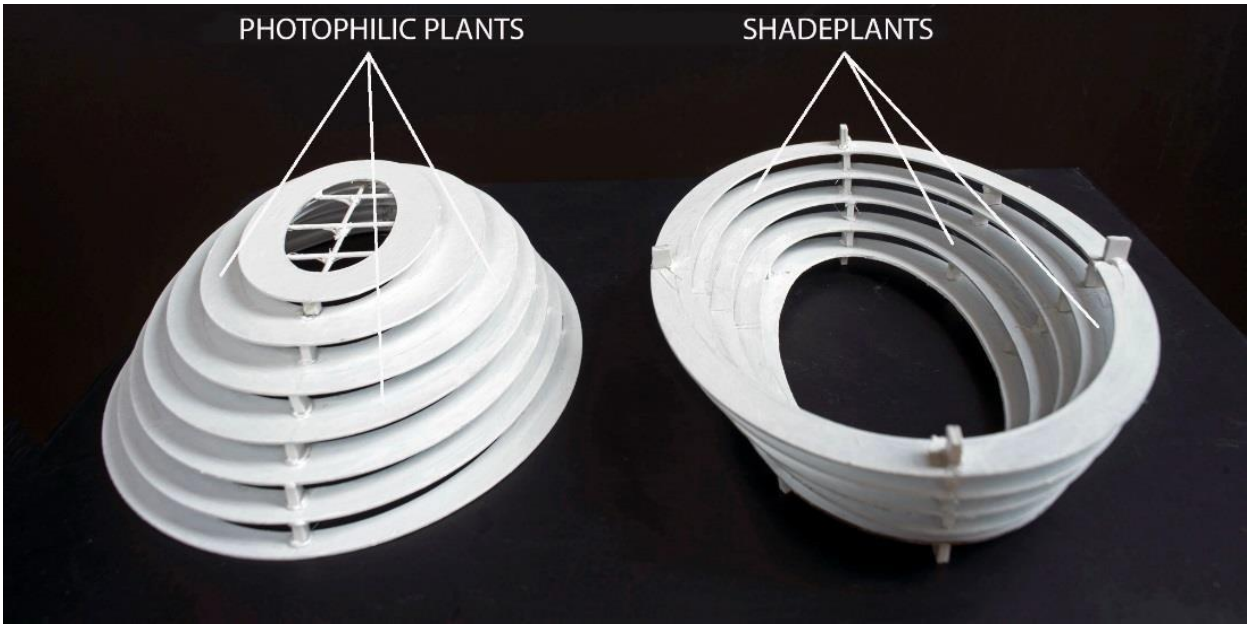
II. "THE GREEN WALL", experimental structure in Botanic Garden in Poznan, tested in August/September 2014

There are two reasons to use the "green wall" concept in a layered, semi-closed structure with an Eco roof system containing vegetation. One reason is to lower the temperature at least 15-20 degrees Fahrenheit inside the structure and the other is to increase the humidity approximately 15 percent. This is especially important in hot and dry regions of the world. Two types of plants are utilized in the project. Succulent plants are employed outside the structure. These plants are resistant to hot temperatures and drought conditions. They maximize their quantity of water inside their massive base while losing little to the soil. Inside the structure, especially on the lower, inner regions, plants which like dim light and which pass some humidity into the environment are favored. These plants such as Nephrolepis, Asplenium, Davalia ,and Polypodium) .teridium), (Peperomia, Hedera) or from family: Araceae: Syngonium, Aglaonema, Philodendron, scindapsus reside in moist, tropical forests.

Simulation showing how the structure could be placed in a desert environment. Succulents shown in the desert. A skylight is located in the upper part of the structure providing the main source of light inside the structure during the day. Plants will completely occupy the space between the layers thereby limiting water leaving the structure. The electricity required for lighting, forced air flow and drip irrigation is derived from solar cells mounted on the upper portion of the structure. Additionally, LED lighting is installed under the layers which provide extra light for plants located in the lower, inner parts.

The example of simple design of a structure where THE GREEN WALL solution may be provided and which will be appropriate to produce friendly environment for a man inside.

Example of simple layered structure; Distance among layers approx. 35 cm



Bipolar rule of implementation the plants on the construction

Experimental structure testing THE GREEN WALL concept at the Botanic Garden in Poznan;Work in progress, August/September 2014. Facebook official site of the project: https://www.facebook.com/pages/The-GREEN-Wall-Zielona-%C5%9Aciana/787821941261183

"The Green Wall" is a system which dynamically interacts with the environment and can be applied within any building structure. This may take the form of various shapes from organic to simple geometric. Broad changes in the desert day and night temperatures causes dew to form on the structure's layers each morning. This provides an additional source of water for the plants Begonia as an example of shade plant. We want to test vegetation of different species of plants and different soil mix according to internal and outer parts of the structure.

Next, different plant species and soil mixtures will be studied as they are placed on various parts of the structure to determine their overall effectiveness. Humidity, temperature, and inside light intensity data will also be collected until the project is completed in September, 2014. Video: http://youtu.be/GbnP-u0Zdrk.

Plants used in experiment hold in Botanic Garden in Poznan from the top of a structure:

LEVEL I, II

Photophilic species of cactus family (Cactaceae): Cleistocactus, Echinocereus, Echinofossulocactus, Aylostera, Bolivicereus, Lobivia, Melocactus, Moravetzia, Thelocactus, Astrophytum, Opuntia

More than 60 pieces of plants on the item and approx. 30 pieces per item II.

LEVEL III and IV

Succulents of the following: Crassula, Kalanchoe, Sedum, Dudley, Delosperma, Carruanthus, Glottiphyllum, Abromeitiella, Puya, Aloe, Agave, Sansevieria, Streptocarpus, Acanthostachys, Plectranthus, Sedum, Sempervivum, Jovibarba

There are more than 40 plants on level IV.

LEVEL V Luzula, Geranium, Hedera, Vinca, Teucrium

LEVEL VI, VII and VIII

Shade-loving species of the following: Hedera, Tradescantia, Epipremnum, begonia, Ruelia, Alternanthera, Hemigraphis, Fittonia, Campelia, Peperomia, Plectranthus, Callisia,

Coleotrype, Commelina, Cyanotis, Hypoestes
Approximately 127 species of plants are used in the experiment.

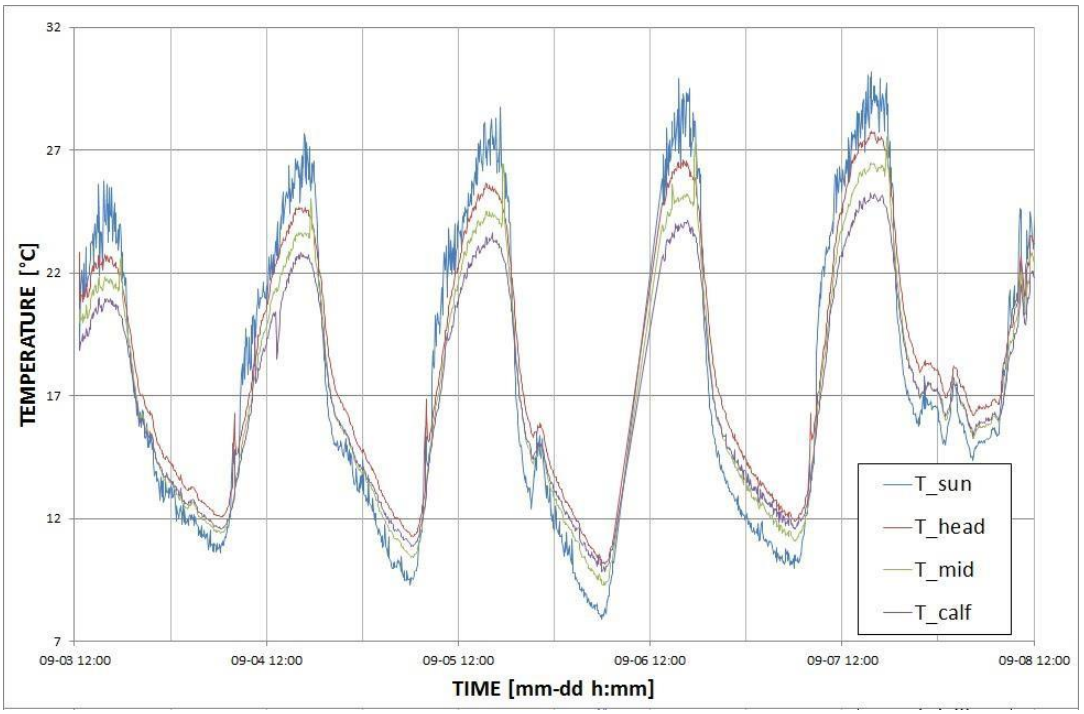
Interior of THE GREEN WALL structure; inside shade plants are visible

Inside the structure, lower layers, shade plants, detail.
Interior of THE GREEN WALL structure at Botanic Garden in Poznan; visible humidity and temperature controller installed under the layer.

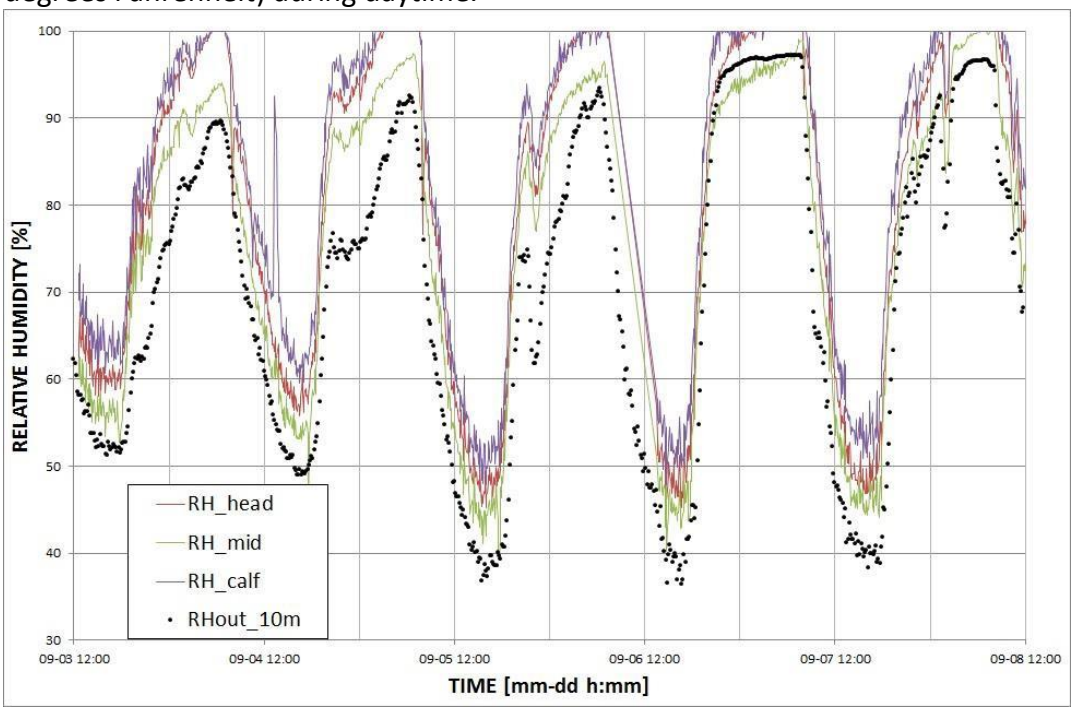
Structure visible from the outside; Succulents on upper layers, August 2014.

Plants of two basic groups: SUCCULENTS for external parts of a structure and SHADE PLANTS for internal parts of it. In experimental structure produced in Botanic Garden in Poznan 127 species of plants were used.

SHADE plants on lower parts of a structure THE GREEN WALL, metal supports in the background; Botanic Garden in Poznan, August/September 2014.



Record of temperature taken by Poznan Polytechnic in the beginning of September 2014. There were four temperature sensors installed inside THE GREEN WALL project in Botanic Garden in Poznan. One was put outside (color blue) and three inside, (color red) on the level of 72" above the ground, (color green) 40" above the ground and (color violet) 7" above the ground. The range between highest and lowest temperature is around 5 degrees Celsius (9 degrees Fahrenheit) during daytime.



Record of humidity taken by Poznan Polytechnic in the beginning of September 2014. There is 15 % difference of humidity between external and internal part of the structure. Inside humidity is higher than outside no matter day or nighttime.

According to relatively small volume of a structure and low range of temperatures in September in Poland we can assume that difference between temperature and humidity outside and inside of a structure will be higher in more extreme weather conditions

especially in a hot and dry climate. I would like to continue this research in real desert like conditions so there would be possibility to install sensors measuring humidity, temperature and light conditions during exposition of the sculpture in a desert like conditions. I think that these records might be very interesting additional material which I believe will confirm my thesis that THE GREEN WALL structure might have some practical impact over our life in an extreme climate.

Study made by:
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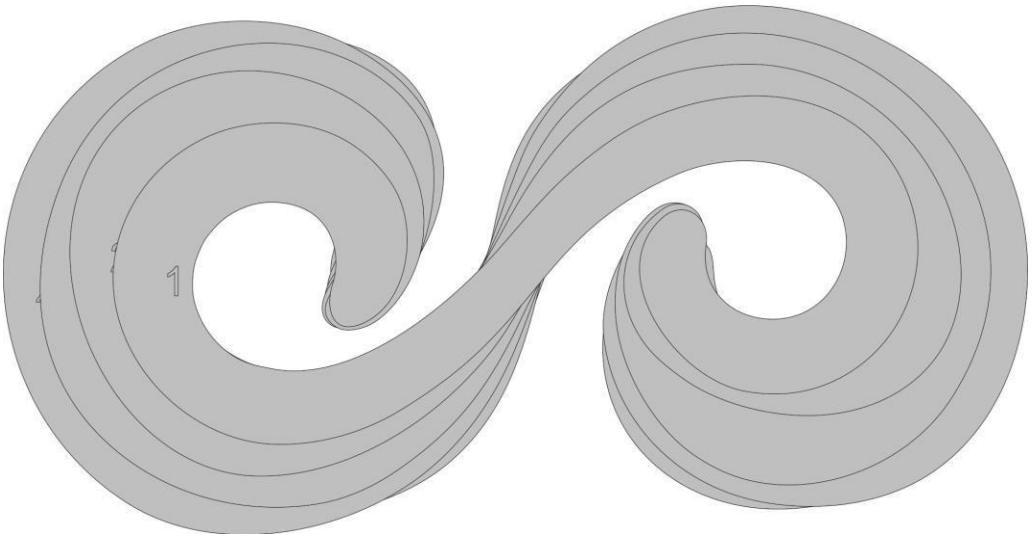
III. "THE INFINITE GREEN" – project for a "green sculpture".

"THE INFINITE GREEN" is an example of a „green sculpture" which is a combination of steel and wood construction, soil and vegetating plants. Sculpture may remind graphic symbol of infinity especially observed from point of view of a bird perspective. Viewer has an access into interior of the structure. Additional aspect of the sculpture may be a color of plants: many shades of green color appear while different species are planted on 110 m2 on 7 shelves-levels of a sculpture. They also blossom in a different time of a year. Only perennials in quantity of 100 species (around 3000 plants altogether) have been applied here. Water is delivered 4 times a day by automatic water system installed on every layer of the sculpture.

Records of temperature and humidity inside in compare to the vicinity of a structure are be taken periodically during the project is on together with Poznan Polytechnic.

Plants survived winter time in Poland 2015/2016 (it happens that we have around 15 degrees minus Celsius in a winter time) on 15 cm of soil substrate only which is provided on each layer of the structure which I believe is a great success. Around the project big community gathered already which is monitoring the project and want to keep it as a permanent one. This is very important social impact of the project.



"THE INFINITE GREEN" – shape of a model may reminds symbol of infinity seen from bird view perspective.

Project shall achieve 3 objectives:
- artistic
- social
- cognitive

Materials: Steel construction, plywood, soil, plants, watering system. 1000x360x500 cm. In this sculptural structure my concept called THE GREEN WALL is applied.

Infinity (symbol: ∞) is an abstract concept describing something without any limit… http://en.wikipedia.org/wiki/Infinity and in this case symbolizes eternality and importance of living nature for human beings as a necessary factor for survival of human race. The form incorporates symbol of infinity into sculptural structure project my authors' concept THE GREEN WALL solution is provided. This solution may be addressed to a hot and dry regions of the world.

Link to the project hold in The Botanic Garden of Adam Mickiewicz University in Poznan, Poland produced in 2014 were tropical and desert plants were planted.
https://www.facebook.com/pages/The-GREEN-Wall-Zielona-Ściana/787821941261183

There are two reasons to use the "green wall" concept in a layered, semi-closed structure with an Eco roof system containing vegetation. One reason is to lower the temperature at least 15-20 degrees Fahrenheit (around 5-10 degrees Celsius) inside the structure and the other is to increase the humidity approximately 15-20 percent. This is especially important in hot and dry regions of the world. Two types of plants are utilized in the project. Photophilic plants are employed outside the structure. These plants are resistant to hot temperatures and drought conditions. They maximize their quantity of water inside their massive base while losing little to the soil. Inside the structure, especially on the lower, inner regions, plants which like dim light and which pass some humidity into the environment are favored.
This concept has a practical issue in mind; to produce habitual structure in a hot and dry climate which may hold friendly environment for a man: interior space of lower temperature and increased humidity in compare to dry and hot surroundings of the structure. The construction of a structure is relatively simple where plants plays active role as a factor increasing humidity and lowering temperature inside of it. Gaps between shelves and skylight allows natural ventilation process and plants will completely occupy the space between the layers thereby limiting water leaving the structure. A skylight is located in the upper part of the structure providing the main source of light inside the structure during the day. Some simple automatic irrigation system is applied on each layer. Less dose of water is required by Photophilic plants and bigger quantity are needed by shade plants.
I believe the idea that architectural structure may come together with vegetating plants which carry some ecosystem (artificially created but structurally coherent) to change notion of habitation within earth environment which obviously is a dynamic live system where plants existing in possibly polymorphic way are the key to nearly everything concerning human survival..

"THE INFINITE GREEN" , August 30th2015, general view, Wroclaw, Poland.

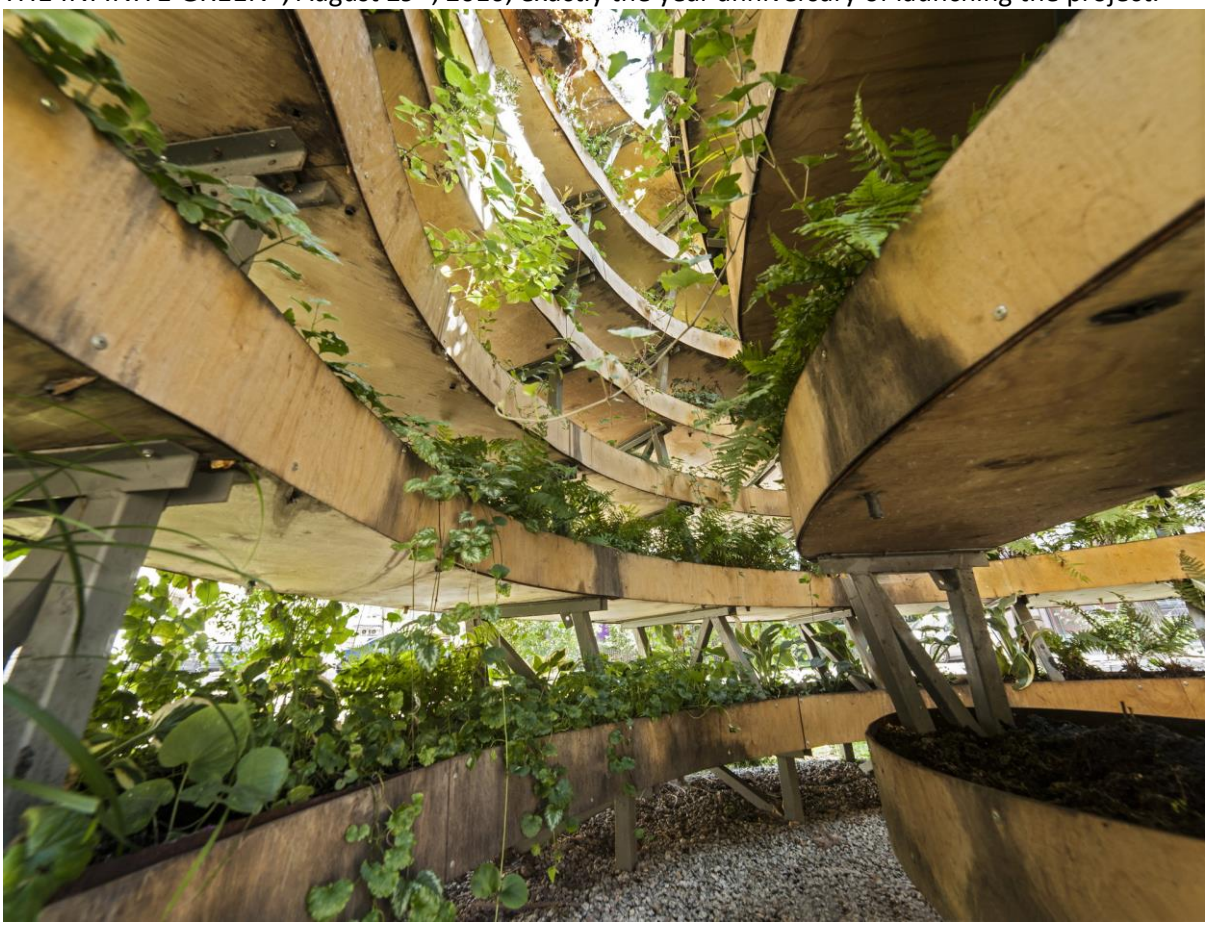
There is important linkage between issues like: MAN-plants-building structure-URBAN SPACE-CLIMATE while we are aware these days that our cities cannot expand anymore according to old mode of reproducing the manner of growth of a city which was produced around 100 hundred years ago.

Links: https://www.facebook.com/theinfinitegreen
https://picasaweb.google.com/105373447986292523149/THEINFINITEGREENNIESKONCZONYZIELONY?authuser=0&feat=directlink

IV. DESCRIPTION OF "THE INFINITE GREEN" – some material issues and production.

The structure shown here consist of 7 layers where distance from 30 to 36 cm is kept between each of them (it means space between surface of the soil and upper layer). The layer of soil is around 15 cm thick surrounded by 16-17 cm wall which goes around each layer. Every 100cm along each shelf 18mm in diameter holes are drilled for water perspiration (short pipes are put in the holes). Polyethylene foil is put before soil is disposed on the shelves. Two different families of plants are used in the project. Some photophilic plants are implemented into most sun exposed spots of the structure generally from the outside and shade plants are put mostly on inner parts of the layers. 23 steel profiled poles are cemented in the ground to carry up to 15 tons of overall weight of the structure together with soil and plants. Installed water system delivers necessary quantity of water to the plants on daily basis. All species of plants used in the project shall survive winter conditions which happens in this part of Europe. Species of plants shall be chosen according to the climate zoon when structure is installed at particular location. Viewers are able to enter inside both parts of the structure and enjoy higher humidity and cooler temperature in compare to the vicinity of the object.

"THE INFINITE GREEN", August 29th, 2016; exactly the year anniversary of launching the project.



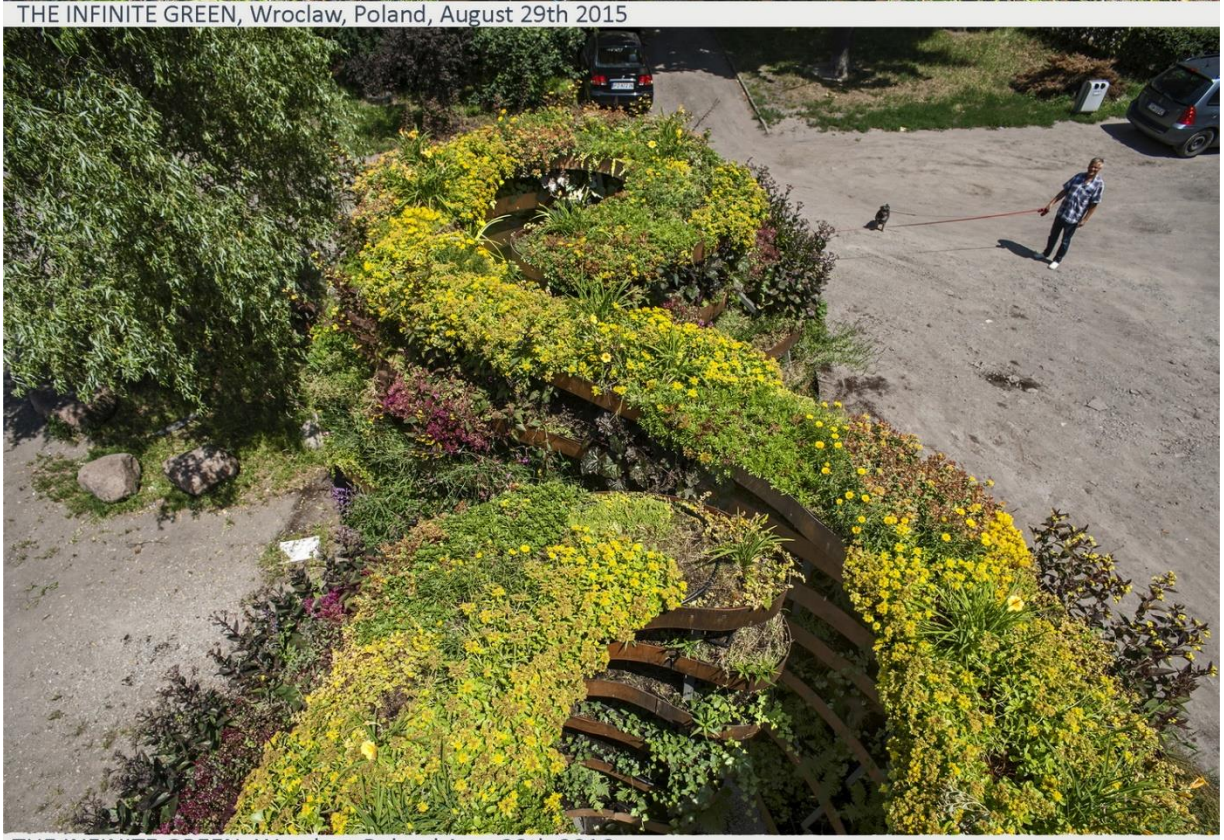
"THE INFINITE GREEN", August 28th, 2015; interior view. Shade plants inside the structure are still small and they need to expand so after couple of months they will fill up spaces among layers more completely.

THE INFINITE GREEN, Wroclaw, Poland, August 29th 2015

THE INFINITE GREEN, Wroclaw, Poland, July 29th 2016

COMPARISON OF THE PLANTS GROWTH IN SPAN OF 10 MONTH

THE INFINITE GREEN, Wroclaw, Poland, August 29th 2015



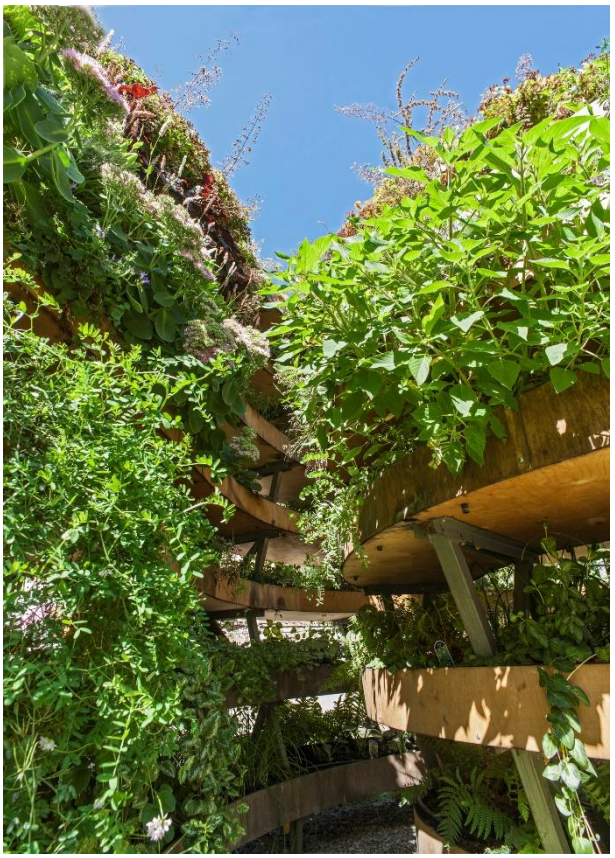
THE INFINITE GREEN, Wroclaw, Poland, **June** 29th 2016

COMPARISON OF THE PLANTS GROWTH IN SPAN OF 10 MONTHS

"THE INFINITE GREEN" , August 28th, 2016. interior view. The year anniversary.

"THE INFINITE GREEN", June 29th, 2016. Shade plants on the lower internal parts of the structure. 10 month after project was launched.

“THE INFINITE GREEN” , June 29th, 2016. View of the skylight from the inner lower part of the structure.



"THE INFINITE GREEN", August 29th, 2016

"THE INFINITE GREEN", August 28th, 2015

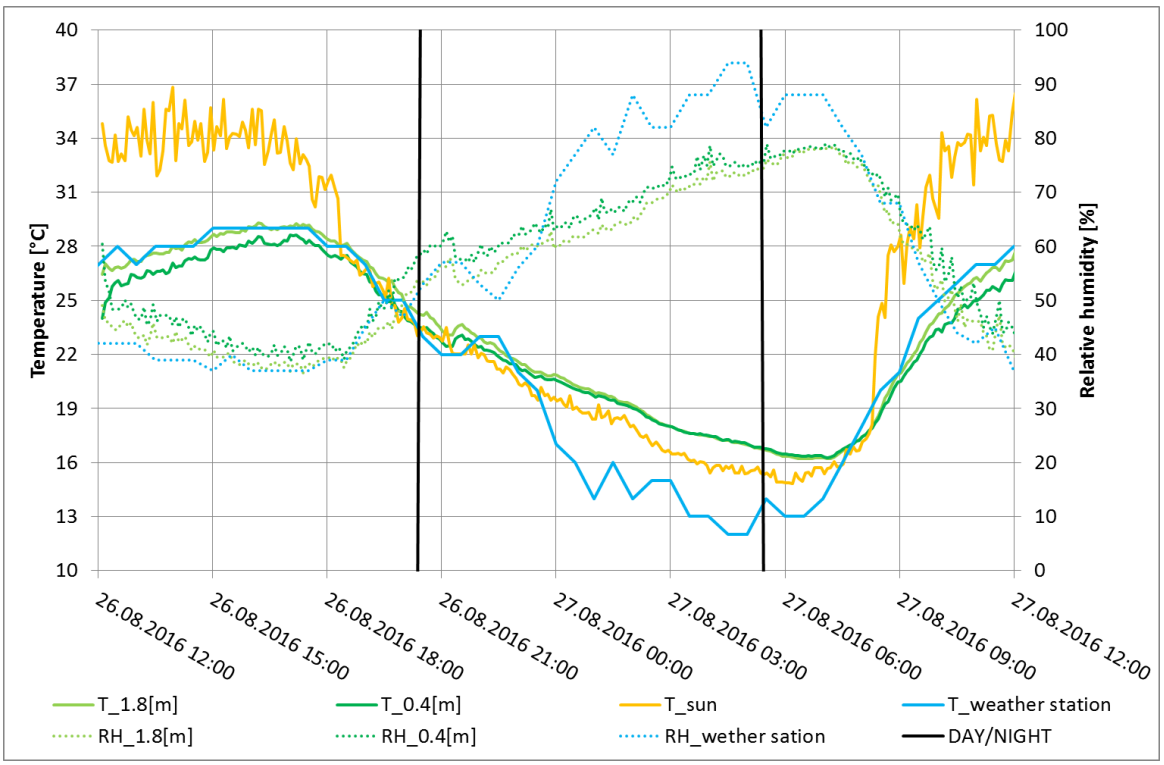
"THE INFINITE GREEN", August 29th, 2016

"THE INFINITE GREEN", June 29th, 2016. View from top of the structure

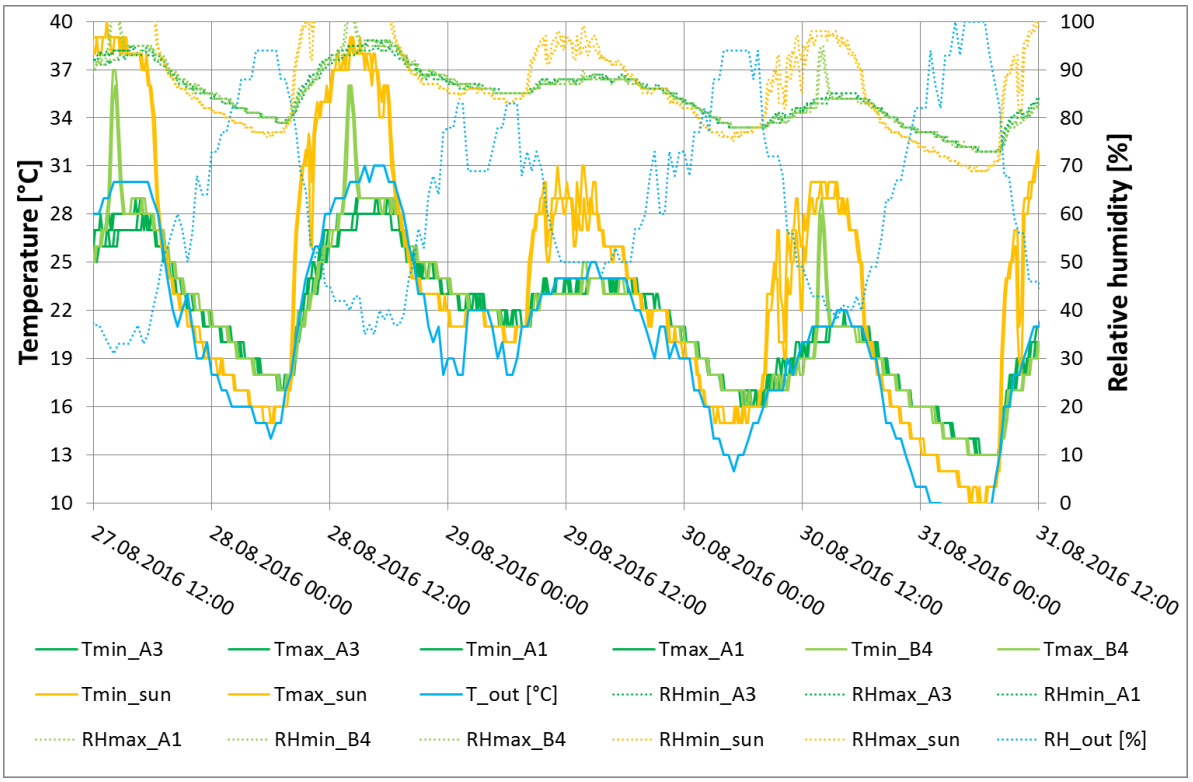
"The infinite Green" August 29th, 2016; FRONT VIEW

"THE INFINITE GREEN", June 29th, 2016.. Subsequent layers of the structure seen from the top where photophilic plants are implemented.

"The infinite Green" August 29th, 2016; top layer of the structure. Water system pipes visible.



Data of temperature and humidity. Results of the first temperature and humidity measurements: (12:00AM-12:00AM), taken on August 27 th 2016 at THE INIFNITE GREEN in Wroclaw, Poland.



Results of the second temperature and humidity measurements: 27-31 Aug 2016 (12:00AM-12:00AM). Letter A and B in series description signify two half of structure (two circuit of the infinity sign). Karol Bandurski M. Sc. Faculty of Civil and Environemntal Engeneering Division of Heating, Air Conditioning and Air Protection, Poznan University of Technologywww.put.poznan.pl/~karol.bandurski

"THE INFINITE GREEN", August 29th 2016. Photophilic plants on top layers (external parts).

"THE INFINITE GREEN", August 29th 2016. Shade plants on lower layers (external parts)

V. Links and bibliography of the project:

2015 http://www.designboom.com/architecture/infinite-green-eco-sculpture-adam-kalinowski10-20-2015/

2015 http://inhabitat.com/the-infinite-green-is-a-living-looping-sculpture-covered-in-over-3000-plants/

2015 http://ecourbanlab.com/the-green-wall-the-infinite-green/

2015 http://www.contemporist.com/2015/10/21/the-infinite-green-by-adam-kalinowski-is-a-public- sculpture-covered-in-plants/

2015 http://wroclaw.wyborcza.pl/wroclaw/1,35771,18647520,mieta-lawenda-i-gozdziki-nowa-instalacja-na-olbinie-wideo.html; (Hard copy)

2015 https://www.codaworx.com/project/the-infinite-green-wroclaw-european-capital-of culture

2015 http://www.experimenta.es/noticias/miscelanea/the-infinite-green-jardin-eco-escultura-adam-kalinowski/

2015 Wroclaw. "Wejście od Podwórza"; the Festival Centre IMPART Wroclaw 2016; 117p. (Hard copy)

2015 http://www.fubiz.net/2015/10/28/infinite-green-sculpture/

2015 http://fractalestudioarquitectura.blogspot.com/2015/10/the-infinite-green-por-adam-kalinowski.html

2015 http://www.maxitendance.com/2015/10/infinite-green-sculpture-adam-kalinowski.html

2016 TOUCH DÉCOR, JAN-APRIL 2016 issue; www.touchdecor.com; (Hard copy)

2016 http://www.bryla.pl/bryla/7,85301,20515866,wroclaw-nieskonczony-zielony-czyli-co-moga-rosliny.html; Bryła, GW, Warszawa.

2016 "The Infinite Green", DECO Magazine 4F No.96, Sec. 1, 167 edition, 2016. Taiwan. (Hard copy); www.decomag.com.tw

2016 http://www.wroclaw2016.pl/the_infinite_green

2016 http://inspirowaninatura.pl/co-moga-rosliny-niezwykly-eksperyment-na-wroclawskim-podworku/

2016 http://sztuka-krajobrazu.pl/2684/slajdy/quot-nieskonczony-zielony-quot

2016 http://zielonainfrastruktura.pl/nieskonczony-zielony-zielona-rzezba-we-wroclawiu/

2016 "The Infinite Green", PUBLIC ART REVIEW, November issue 55, USA. www.ForecastPublicArt.org (Hard copy).

2016 http://www.german-architects.com/architektur-news/hauptbeitraege/Wroclaw_Mittelalter_und_Moderne_6800

2016 http://adamkalinowski.com/assets/deco-167-taiwan-2016.pdf

2016 https://www.tygodnikpowszechny.pl/nieskonczony-zielony-146079

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https://www.facebook.com/theinfinitegreen

VI. Some examples of artistic projects where THE GREEN WALL solution can be applied.

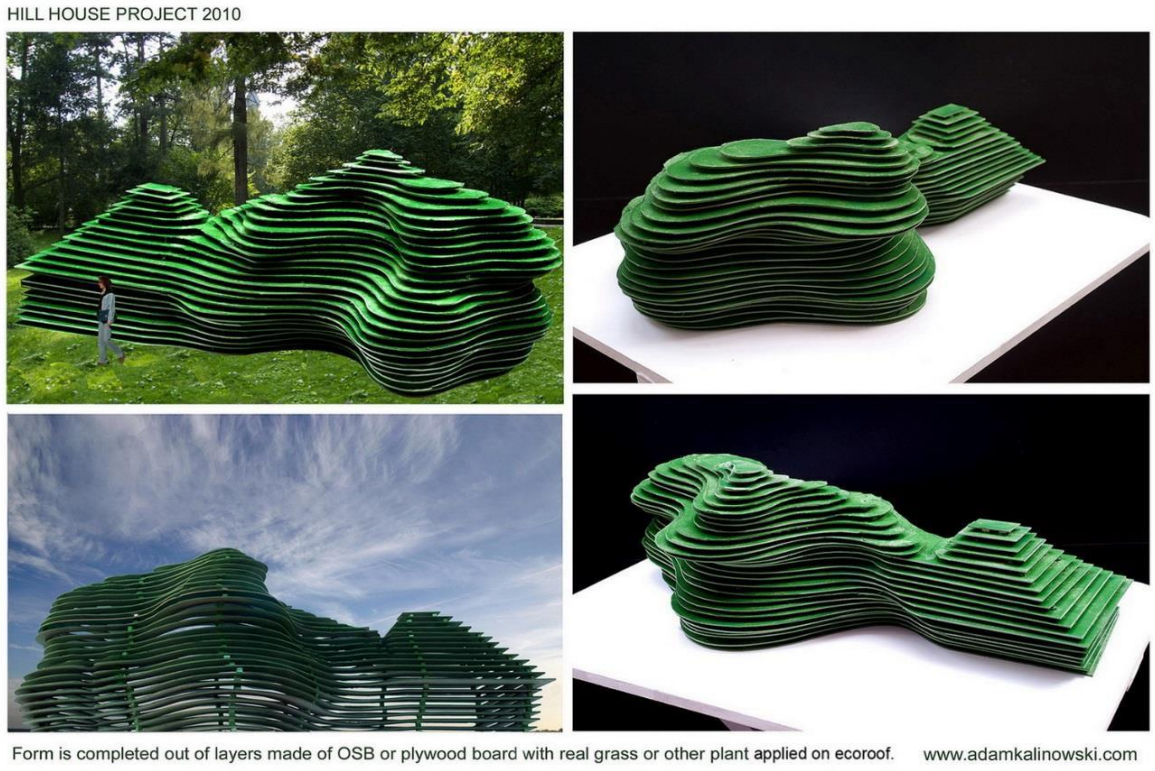
Some examples of more advanced projects where THE GREEN WALL solution may be applied

DESERT HOUSE 2011; application of different species on all layers based on bipolar rule — simulation.

www.adamkalinowski.com

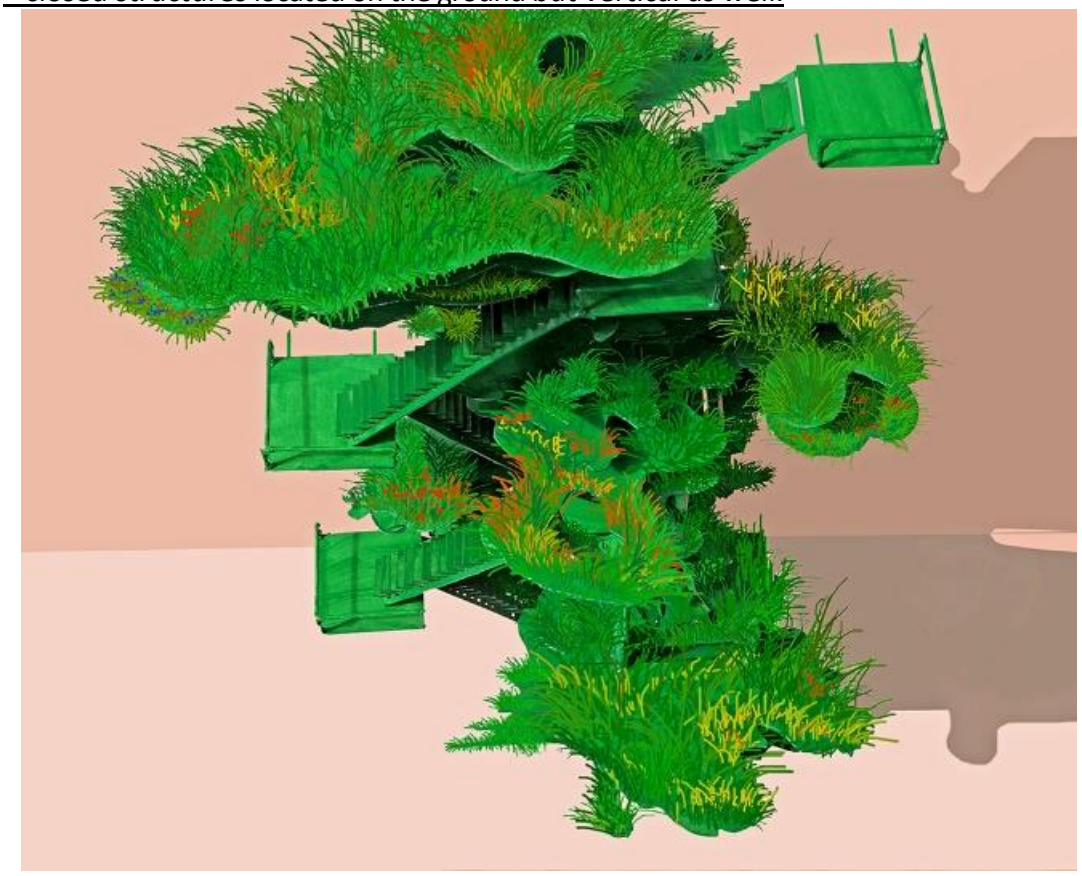
Example of the artistic project DESERT HOUSE where THE GREEN WALL solution shall be used. On all layers plants are implemented on bipolar principle.

Video illustrating the project: http://youtu.be/ZMTFYCQVNEs

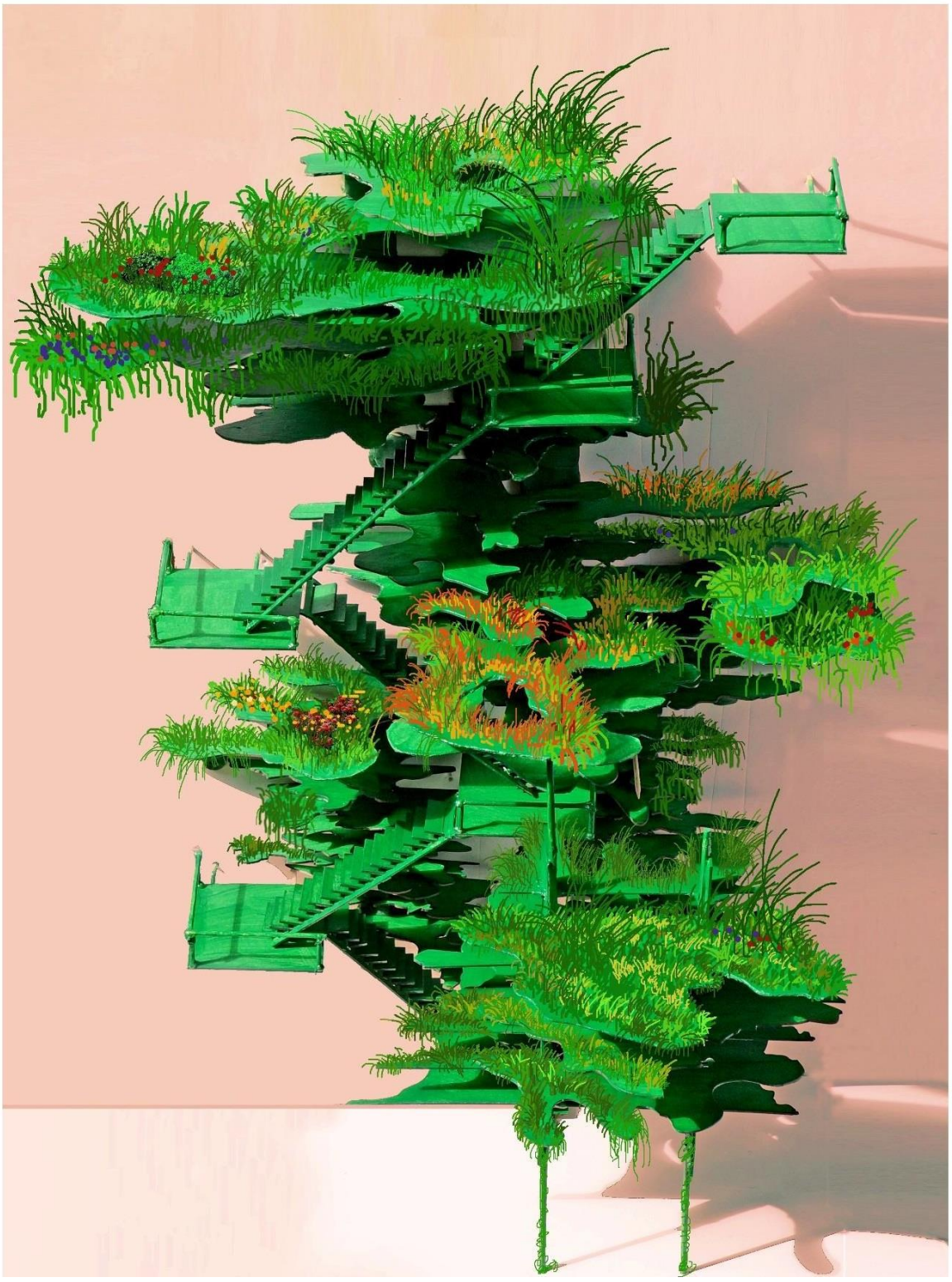


"HILL HOUSE", 2010 model. On all layers plants are implemented on bipolar principle.

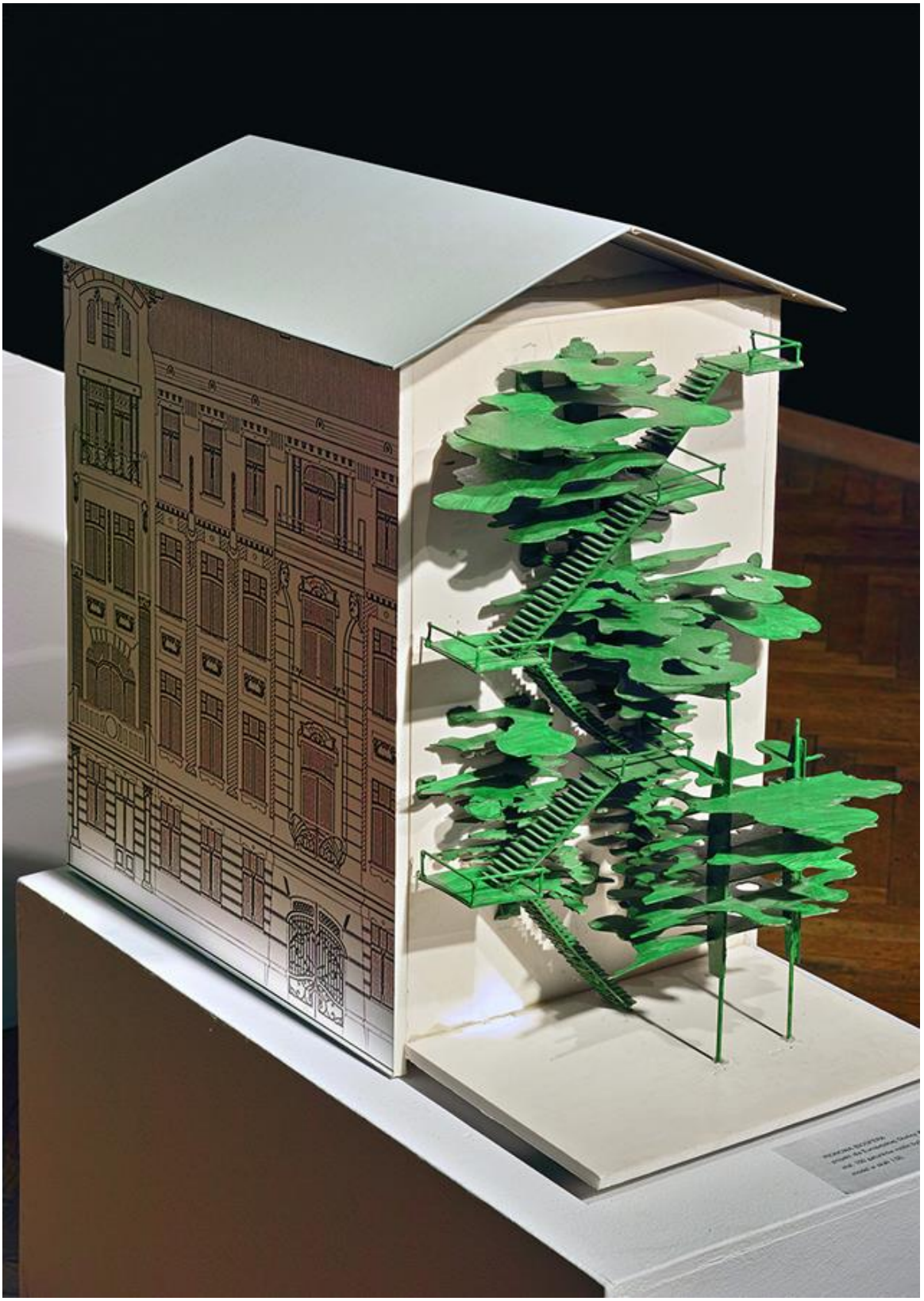
Structures, where The Green Wall solution might be used, include not only open or closed structures located on the ground but vertical as well.



Vertical biosphere – model 2014;



Model of a vertical biosphere installed against the wall of a building where visitors will be able to climb and rest on special platforms to experience variety of plant vegetation. Project 2014. Adam Kalinowski



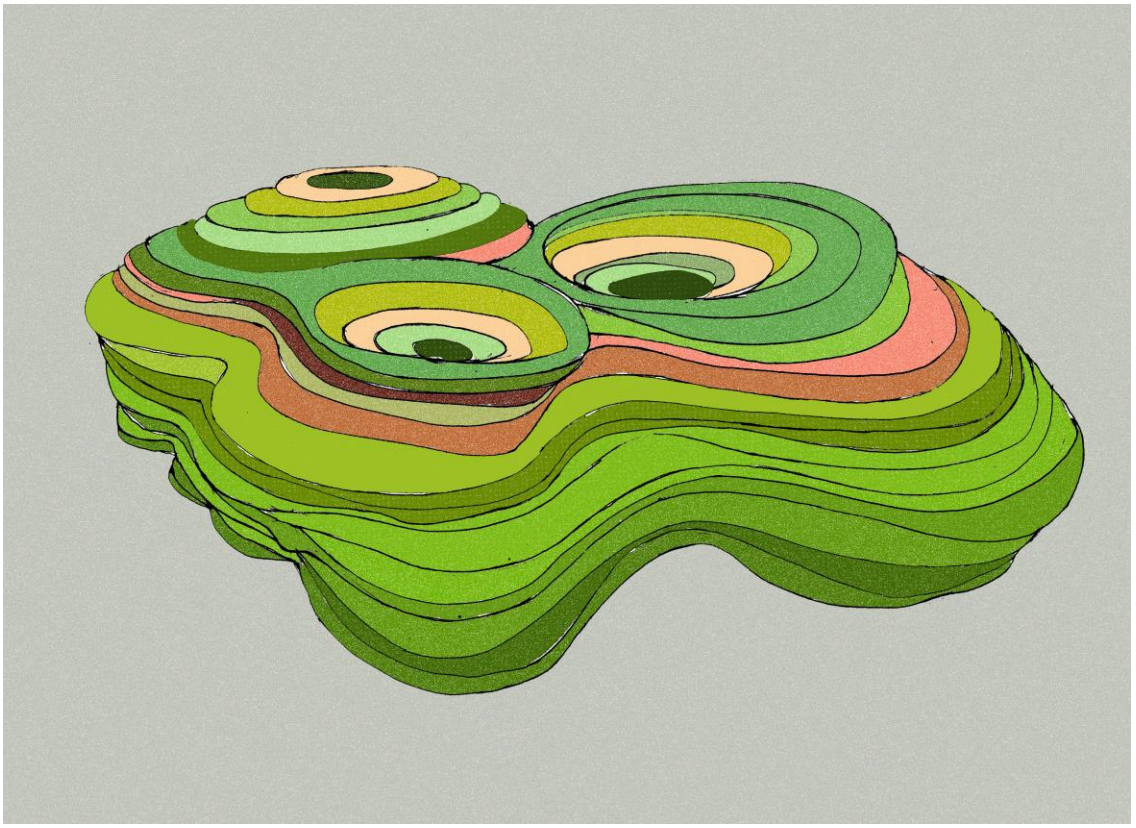
Model of a vertical biosphere installed against the wall of a building. Model 2014.

Simulation of a „green container” in space, 2016.

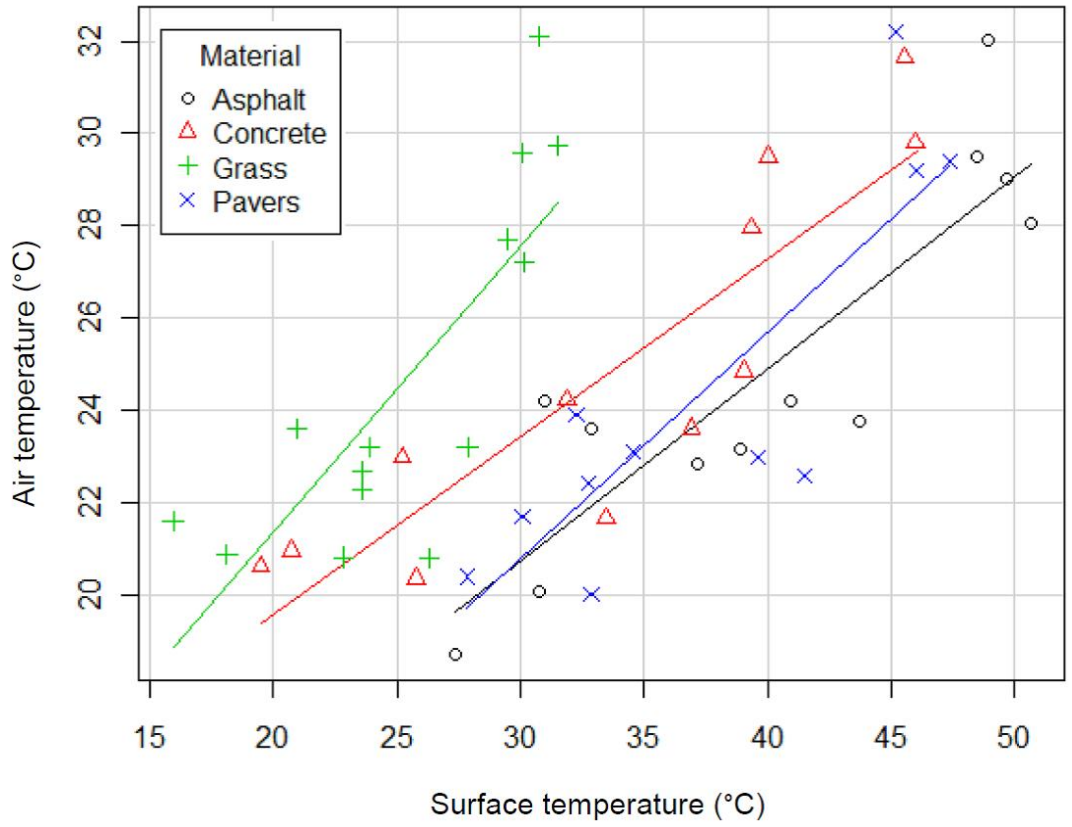
„Green container”, model 2016. On all layers different species of plants will be implemented. Viewer will be able to enter inside the structure to stay in a friendly environment.

„Green container”, model 2016. This version has two possibilities of usage depending time of a year: during a hot summertime viewer will be able to hide in a central part of an object to experience friendly environment for a man – lower temperature and higher humidity in compare to the vicinity. During colder days he may absorbs sunlight staying surrounded by plants in one of two parallel parts of an object visible from both sides.

„Green container”, model 2016. On all layers of a structure plants are incorporated on bipolar principle.



„Green container”, sketch 2015.



Correlation between surface temperature and air temperature depending on ground material.

An example of a habitual unit put inside layered structure which protects the module against extensive sun exposition, dust, rain etc..

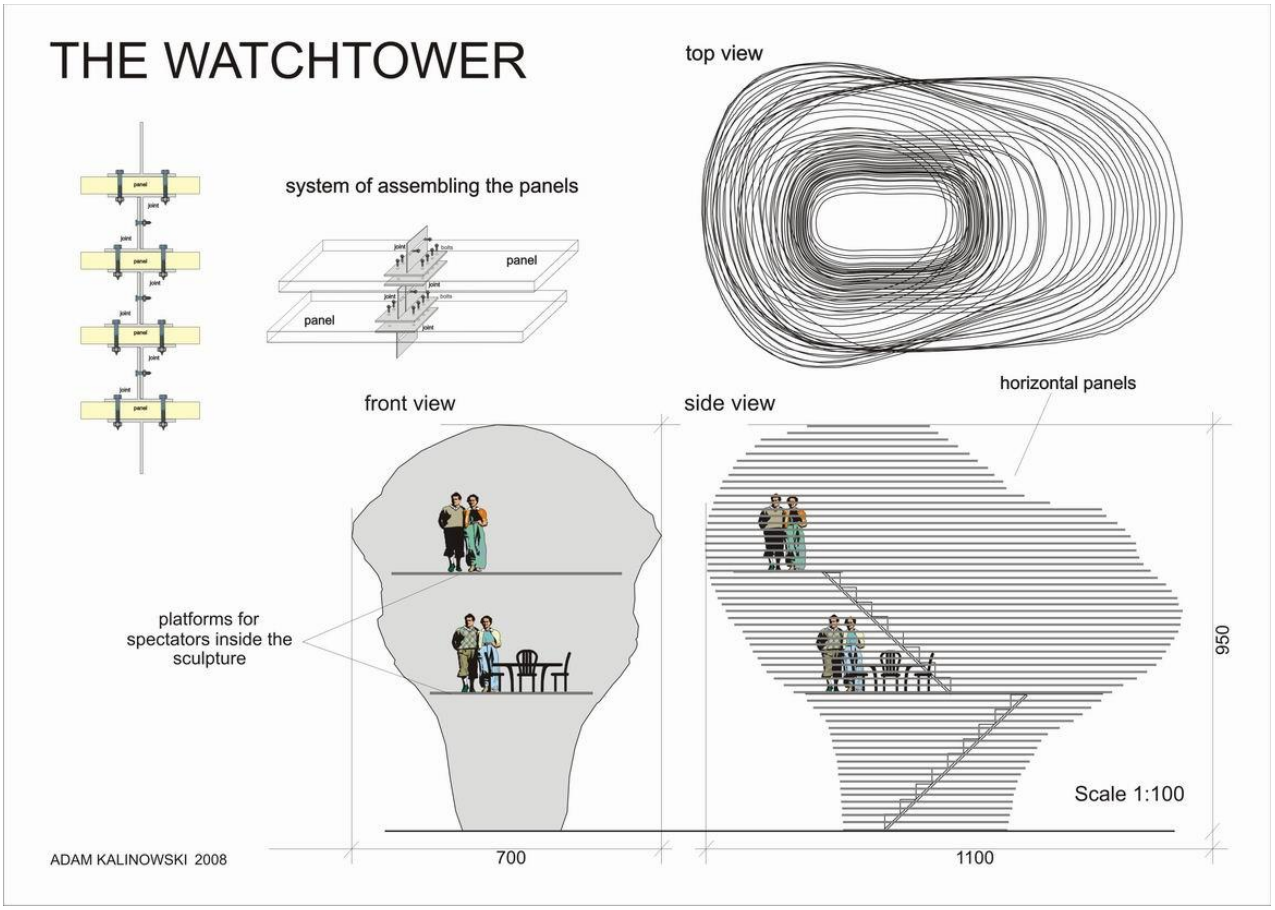
Housing solution dedicated especially for a hot climate where outer structure covers interior against blazing sun, rain etc. Model 2007. Design by Adam Kalinowski, All Rights Reserved.

This simple structure can be more sophisticated in terms of design and can take any form from geometrical to entire sculptural. Model 2007. Design by Adam Kalinowski, All Rights Reserved.

There is no problem with ventilation of this structure so external structure fulfils two basic goals - visual and functional. On the highest panels of the structure skylights are installed. Model 2007. Design by Adam Kalinowski, All Rights Reserved.

View of internal module from inside. Model 2007. Design by Adam Kalinowski, All Rights Reserved.

Watchtower, project for Titanic Quarter, Belfast, model 2007.



Watchtower, project for Titanic Quarter, Belfast, model 2007.

All projects and ideas presented here are produced by ADAM KALINOWSKI

Text by: ADAM KALINOWSKI 2016

http://www.adamkalinowski.com/