

Sensual Sculptural Sustainable Spaces

..and innovative technology to produce them

By Ivar Moltke august 2009

Cloud Gate, Chicago by Anish Kapoor

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To the pioneers

Sensual sculptural sustainable spaces are brain children of CAD and has with few exceptions a two decade short history in a 5000 years old building sector.

Imagine that you would be more inspired, innovative, happy and healthy if you lived in sensual sculptural spaces. What difference would that make to your life? I have visited a lot of sculptural buildings and town spaces and I have even designed and build a few myself. I described the most fascinating here and testify that they truly make a difference.

Quality is both in the building, in the person sensing the building and in the relation between the person and the building. Ecology = Living organisms interaction with their environment. We interact and communicate with our build environment, and it interacts with plants, animals, water, atmosphere and natural resources.

Sensuality is about stimulation and effect. It is about getting new impression and adventures when you experience the building in different light, weather, and at different times of day passing through or walking around the spaces. It is like seduction and love: Building up excitement and affection

If only I could afford living in sensual shapes I would do it. So this is also a quest for sustainable building technologies to produce these spaces at no extra cost, maybe even inexpensive. In fact I believe biometric shapes uses less material, are easier to build with fully automated technology and that they save energy. Sustainable buildings will cost you less in the long run, and, who knows, could save us from a global melt down.

I am writing about spaces rather than architecture because I want to include the spaces between the houses and because these spaces are defined by shapes filtering privacy and interfacing encounters.

Flemming Skude and I have an evaluation scale

1. Published by postcard, magazine, newspaper or book
2. Interesting enough to make you go there
3. Better in real life than on pictures
4. So attractive that you convince friends to go there

Most of the following buildings and towns are places I have been, spaces that are better in real life and spaces I hereby try to persuade you to experience.

Enjoy

Photos:

1. Itsukushima Shrine, Japan
2. Olympic aquatic stadium, Beijing by PTW architects
3. Temple Church, Helsinki, by Timo Suomalainen
4. Lockout tower Helsinki zoo by Avanto Architects
5. Cloud Gate, Chicago by Anish Kapoor
6. Truss wall house, Tokyo by Ushida Findlay

Checklist for sensual, sculptural, sustainable spaces

*Each of the great innovative buildings, towns and technologies in this book has contributed to the 100 point checklist below with **Inspiration**. This inductive approach has been verified in my many hundred sculptural design processes. Sensual sculptural sustainable spaces checklist is about extra challenges on top of all previous functionality, building code and technical performance checklists*

Honesty

- *Use biomimic structures with skeleton (compression), muscles (tension) fat (inflations) and skin (membranes)*
- *The interior shapes and spaces should relate to the exterior*
- *Art design should be holistically from detail to entirety*
- *The functionality of the building projects variation into shape*
- *Build continuous shapes in continuous materials*
- *Or triangulate everything in the building system*

Layout

- *Entrance through the canyon or*
- *Entrance up the MD 80 stairs into the belly of the shape*
- *Space between the torque ellipses is as good as within them*
- *The curly maze*
- *Curved facades, stairs and ramps guide you*
- *A succession of sloping ramps/stairs*
- *A deck plan like a Philippine terraced paddy field*
- *Platforms and spaces within spaces*
- *Don't slice spaces with partition walls or decks*

Shapes and spaces

- *Soft organic joyfully dancing shapes and spaces*
- *Inspired by flower bodies, flower petals and waves*
- *The clean curves are better than "car wreck" like surfaces*
- *Folded asymmetrically to hit the ground in some 3 points*
- *Dynamically heading in one direction*
- *The artistic triangulation is more inspiring than the uniform*
- *Equality between the transparent and the opaque surfaces*
- *Changing shapes by moveable structures, windows and doors*

Glazing

- *Glaze beneath. above and between the shapes*
- *Glaze the entire roof of the torque ellipses*
- *Glaze between the petals*
- *Windows separating walls and roof make the roof weightless*
- *Tentacle windows growing out of the surface (Kunsthaus)*
- *But never cut large holes for doors and windows*
- *Skylights enhance the mirror effects in the material*
- *Invisible glass enhances the beauty of the curved spaces.*
- *Truly double curved triangulated windows*
- *Small embrasure windows in thick walls*
- *Symphonic patterns of relatively small windows in all sizes*
- *Curtains mediate the borders between walls and voids*
- *Deck plans of triangulated glass surfaces should be curved*
- *Structures filtering light*

The sensation of shapes and spaces are enhanced with:

- *Reflecting and mirroring surfaces enhance shapes*
- *Nano deep color mirror stainless steel (Gehry, Seattle)*
- *White curved walls on dark or transparent background*
- *White and light colors*
- *Direct sunlight and skylights*
- *The depth of greening white glass is beautiful also when dirty*
- *Imperfections in the shapes are very visible and disturbing*
- *Curved patterns on the shapes enhance the perception (Hadid)*
- *Avoid sloping straight lines, they make people sea sick*
- *The curved patterns in the roof creates 3D illusion*
- *Spaces designing acoustics*

Shapes

- *Any durable material goes*
- *Broken tiles are better than square tiles for curved mosaics*
- *Facade shapes and surfaces in the interior next to skylights*
- *Soft surfaces on the opaque interior parts*
- *Playful artistic decorations and sculptures*
- *Greenery conquering the facades, balconies and roofs*

Light

- *Illuminate the interface between floor and curved walls*
- *Theater spotlight*
- *Multimedia light beneath the translucent surface*
- *Dimmed light next to glazing*

Furniture and installations

- *Free form furniture fitting the building*
- *Move double beds to a loft, they don't fit the curved shapes*
- *Octopus ventilation ducts*

Membranes, molds and shells

- *You can produce molds in any shape with 3D milling*
- *The mold can be insulation between plaster shell surfaces*
- *ETFE is a membrane alternative to glass*
- *Tensile structures can be translucent even when insulated*
- *All membrane shapes can be insulated, fireproofed and transformed into stiff shells by the Monolithic dome concept*
- *The tensile membranes can be composed, combined and include partition walls and columns*
- *Vacuomatics molds can be shaped free style and re-used*
- *Robots can plaster any surface accurately also without molds*
- *Vacuum injection molding saves materials, weight and molds*
- *Helicopter distribution of light carbon fiber technology house*
- *Highly insulated membranes are easily transform to boats*
- *Floating structures distributed by sea can be produced in a factory without limitations on dimensions*
- *Buildings composed from torque ellipses prefab modules*

Design and communication process

- *3D milled molds and computer cut membranes as drawings*
- *Digital information throughout the process and value chain.*
- *Almost square windows can build double curved glazing*

Energy

- *Switchable mirror glass avoid overheating of glazed spaces*
- *Switchable mirror glass can focus light on PV*
- *Highly insulated membranes have no thermal bridges*
- *Town scale focused solar, waste oxyfuel cogeneration*

Sensual, sculptural buildings have so far only been solitaire focal points. The big challenge in the future will be to build sensual, sculptural towns. Fortunately there is a lot of inspiration available in the fortified medieval town with the curved streets and houses

Townscapes

- *The town is perceived a giant building with doors (gates), corridors (streets), squares (rooms)*
- *Confined and separated from the surrounding sprawl*
- *Entrance through a few gates concentrating flows and creating main street*
- *Pedestrian streets in entire townscape*
- *Winding streets and squares were each square has an attractive focal point*
- *Always at least 2 choices at intersections to enable loops*
- *Leave gates as “windows” to parks, lakes, canals and fountains at the end of the streets so that each square has a view and people have access to gardens and water*
- *Re-integrate residential, work, production and service to create synergy and life in the townscape 24/7*
- *Stratify functionality horizontally instead of on city level*
- *Pave the streets like an outdoor floor rather than a road*
- *Design the town with continuous facades and a harmonic (but not uniform) choice of material, scale and style.*
- *Keep the building height to 3-4 floors, enough to create density and low enough to let sunlight in*
- *Make the facade of each apartment narrow to increase density*
- *Light the outdoor spaces like we would light a room, enhancing the architecture, focusing on places to stay and places of interest and keeping the light distributed and indirect in order to avoid that people in the streets are silhouettes*
- *Furniture in the street “rooms” in order to make people stay*
- *Attract neighborhood people with easy accessible parking.*
- *Concentrate shops to main street and restaurants to squares*
- *Create synergy with offices and schools at street level*
- *Build high quality user centered architecture and design*
- *Roof gardens, stepped lush balconies, back court gardens and large trees on the squares*



SENSUALLY FOLDED SPACES

Based on study trips to USA 2008 and Bilbao , Spain 2004

Photos:

1. Hotel Marques de Riscal by Gehry
2. MARTa Herford by Gehry
3. Chapel, Saint Mary of the Angels by Mecanoo
4. Tenerife concert hall by Calatrava
5. Issey Miyake, New York by Gehry
6. Guggenheim Bilbao by Gehry

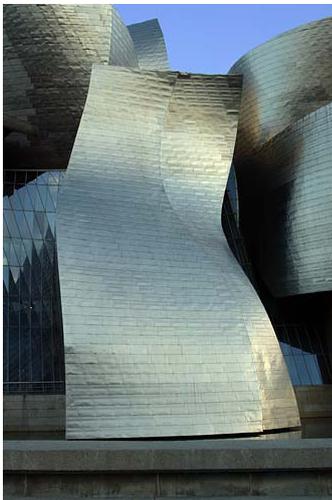


Guggenheim Bilbao by Gehry

It was a pilgrimage for me to travel to Frank O Gehry's Guggenheim Bilbao. No building had ever had that kind of magic attraction to me. I had seen hundreds of photos before I finally saw it through the windshield coming out of tunnel. This river side exterior is amazing.



The entrance on the town side down a lot of stairs next to a rather conventional office building is less convincing. But you forget that, when you enter the gothic cathedral like hall running through all the floors to the top lantern in a sweeping dancing sculptural way. Much like the Ginger and Fred building in Prague. That space is out of this world sensual and you tend to forgive that the details about the glass, windows and patterns of the marble tiles are somewhat rough and unfinished. The lift rides through this room and is a gateway to heaven.



You access all the exhibition rooms from the hall. Most of them are dark and completely detached from the geometry of the magnificent exterior. They could be just any other art museum. But the large room to the right has an interior that follows the geometry that relates to the exterior. The exhibition of Richard Serra more than matches the building. I was stunned to realize that I had been driving for 7 straight hours to see the building of my dreams and yet the Serra exhibition made even more impression on me. Serra had crafted the very complex geometry, the simple way. Back home I read that he had invented a new geometry of torqued ellipses. While the titanium sheets in the Guggenheim Bilbao museum doesn't really fit the geometry, they do in Serra's shapes.



After hours of exploration of the Serra universe I left the museum and walked around it to watch it from every possible angle, from the same side of the river and from the opposite side of the river, from the bridge integrated in the shape, from the stairs, from the opposite bridge. And it is amazingly beautiful from all angels seen from the river side while i am less impressed seeing it from the town side.

The shiny titanium sheets are really nice. They look different from whatever angle you see them and maybe the imperfection of the way they are joined is an advantage. This less than perfect job gives the eternal material something to resemble patina.



Inspiration:

- *The interior shapes and spaces should relate to the exterior*
- *Organic shapes like petals and long waves are more beautiful*
- *The surfaces should be joyfully dancing*
- *Reflecting surfaces enhances all impressions*



Richard Serra

From the moment I entered Serra's sculptures "The Matter of Time" I was lost in space and time. The amazing continuity in the shape and space drag the visitors into them. They are like a curly maze without corners. You pass through narrow canyons into larger spaces. The walls are both curved and sloping and they change when you pass by. And their snake-like continuity is somewhat centrifugal encouraging you to follow the edges of space.



After a few hours in this Serra universe I realized the beautiful simplicity in the complex shapes. Imagine such a house size sculpture without any frames or support. They are folded in 3 cm thick cor-ten steel, but you can make them in many materials.



In 1998 Richard Serra invented this new geometry called "Torqued ellipsis". Cylinders and elliptical shaped cylinders are well known. Imagine that you torque and twist an elliptical cylinder. That is what Serra did and he thus invented a new geometry.

Serra went to some of Gehry's geometrical experts and asked them to help calculate and design the geometry on CATHIA CAD. In real life they are not twisted or torqued. They are cut in the exact right shape and then folded between some giant rollers Serra bought from a shipyard. The sculptures are shaped with an exactly horizontal bottom edge so they seal a space in a very building-like manner.



That experience changed my professional life. I spend the rest of my vacation folding paper and fixing it in strange shapes by putting it down the sand of the Costa Brava beach. And I spend the next years designing buildings based on Richard Serra's geometry

Inspiration:

- *The curling maze*
- *Entrance through the canyon*
- *Cut the shapes free and open it to the sky*





villALIVE, Herning Messecenter by Moltke&Skude



Flemming Skude and I confess our inspiration and admirations for both Gehry and Serra. We have also visited Gehry buildings in Los Angeles, Seattle, Bilbao, Basel, Herford, Berlin and Prague and we have seen a lot of photos of his other master pieces. Most of these buildings are large and with very few windows.

Our pioneering challenge was to domesticate the spaces of Serra and Gehry in a small exhibition house. We had a budget of a few hundred thousand kroner, a tight schedule and a lot of enthusiastic support from the client Herning Messecenter and their construction staff.



villALIVE is composed from 4 torqued ellipsis room modules around a fifth space between them. Most of the windows are situated between the torque ellipses but there is also one skylight and one window in each of the torque ellipses. Each of the modules is prefab and has been moved in and out for 3 different exhibitions. This is first sculptural torque ellipses prefab container ever.

villALIVE is designed for a building exhibition and the different volumes were sponsored by different construction material industries. The house is thus a catalogue of potentials, showing that many different materials can be used to construct the torque ellipses. But also that shapes and spaces like this can handle diversity and sensuality without becoming chaotic.



You enter a beautiful space between the torque ellipses which is amazingly complex baring in mind that the only four pieces of information needed was: the distance between the ellipses centers, the length of the string used to draw it on the floor, the height and the angle between the two ellipses. The wellness bathroom with skylights was almost meditative. It was even better without the roof when it was like Serra's "wall only" sculptures.



The bedrooms were not convincing. The sloping boards and windows made people seasick and it was difficult to divided the rooms for bathroom, wardrobe etc. So our experience is definitely that you should not mess the space with partition walls. The torque ellipses have to be "clean" and composed rather than subdivided. And the windows and doors should have been where the shapes are folded rather as a hole in the wall.



Inspiration:

- *The space between ellipses is as good as within the torques*
- *Glaze the entire roof of the torque ellipses*
- *Avoid sloping straight lines, they make people sea sick*
- *Move double beds to a loft, they don't fit the curved shapes*
- *Buildings composed from torque ellipses prefab modules*



Business lab for Tryg by Moltke & Skude

You enter between the two bow like edges of the folded serpentes and walk down a sloping wooden floor in a narrow canyon towards the sky light center.

The partition walls are sculptured with a height where you are private when seated, and yet connected with everybody when standing.

All the square walls and the ceiling are covered with sound absorbing red Ecophon.

A lot of special light effects and sound effects add to the theater dimension.



I guess this is the first time a storage cellar of a large office building has been transformed into a truly sensual sculptural space.



The bottom line is that this innovative space for innovation has proved very successful. From the moment the employees enter the room they know by instinct that this is not a room for “Business as usual” as the rest of the offices in the insurance company. And in fact all these offices are now being changed to more innovative workplaces.



The walls are constructed in masonry and that proved to be a fast building process using thin wires attached to floor and ceiling as guidance. As one bricklayer put it “This is the first time people have asked me to build uneven walls”



Inspiration:

- *Illuminate the interface between floor and curved walls*
- *Figure ground effect between the white walls and the dark background*
- *Brick make superb curved walls*
- *Theater spotlight enhances the effects*





Experimental Music Project Museum, Seattle by Gehry

This museum for Jimi Hendrix and science fiction is Gehry “full throttle”. I saw it first time through the window of my hotel room right next to the Space needle. It reminded me of the traveling circus tents of my childhood. So colorful, so oddly shaped, so out of this world. I couldn’t wait and spend the next morning before breakfast sitting many places around this building. Just watching and “tasting” the geometry and the materials.

The museum really isn’t one building. It is a collage of buildings, a composition of spaces. The shape is very complex towards the street. Particularly the bronze part is like the bulbous bow of a ship, while the light blue reminds me of a Cadillac from the fifties. The most amazing material is the colored stainless steel surface on the Space needle side. It is changing colors depending on light, shadow, sky, sun angle. It is true to the experimental spirit of the museum. And oddly the “plain” stainless steel surface almost looks conservative in this building.

When I finally entered the buildings after many hours I was stunned by the similarly fantastic interior. I was like entering a town square in an imaginary city with Gehry buildings all around. You are surrounded by curved shapes, and mirroring materials. It’s show time. They call it a museum but it is alive like no museums elsewhere.

The construction is very much like a ship. Curved steel frames with thousands of sheets of metal cut in exact geometry. And that is also obvious on the inside where you can see the frames and the back side of the construction. But it fits this building because it is a theatre, it’s dark, it’s full of spotlights and mirrors and above all, the middle of the building is a new flashing facade drawing the attention away from the outer walls.

This building is full of humor, provocations and experiments, just like music and science fiction. It’s honest, it’s for fun, and yet strangely enough it becomes a kind of Noah’s ark floating with memories from the late 60 ties. A time machine reminding me of the psychedelic cover of The Beatles album “Sergent Pepper”

Inspiration:

- *The nano deep color mirror stainless steel is awesome*
- *Facades in the interior*
- *The clean curves are better than “car wreck” like surfaces*



Disney concert hall by Gehry

Disney concert hall is the most finished Gehry building ever. The shapes look like the single curved geometry of Richard Serra's, and they are "clean" and perfect like nothing I have ever seen in a building. Almost as perfect as the wings of new Airbus. And yet more artistically complete almost like a Henry Moore sculpture. And it is the first of his sculptural buildings without leaks in the roof

Gehry offered Disney's widow a "Rose" and she got one. A flower in the middle of the surrounding urban desert.



Gehry never really solved the conflicts between the windows and the beauty of the undisturbed shapes until in this building, where the windows are situated between and beneath the petals of the rose in a geometry defeating gravity.

Well inside the hall I came to think about Alvar Alto's Finlandia concert hall, and later I learned that Alto actually is one of Gehry's very few idols.



At your right hand side is a small concert hall and that is the most beautiful calm interior he had ever made, and the first where the outdoor shape is repeated indoor with a great finish folded wood wall. That room is everything he tried to do in his other building and finally succeeded doing.

You walk up between the petals and enter the different levels of the concert hall. The concert hall is amazing too, but not as good as the Jean Nouvel design in Copenhagen (next page). And the fabric on the chairs is awful like something from a camper.



I left the building on the fire escapes walking down the many canyons between the petals overlooking the entire building and downtown LA. No doubt, this is the most beautiful fire escape in the world. On the way down I passed an outdoor amphitheater and even more Canyons and it is fantastic. For once you can have a 3D experience inside the outside of a building and it is even accessed for free.

Disney concert hall is actually a lot like a giant Serra sculpture. Gehry is a friend of Serra's, computer nerds from Gehry Technologies collaborate with Serra making the CAD files for his sculptures and Serra's sculptures are part of Guggenheim. So this house is a fruitful result of shared minds of the two genius artists.

Inspiration:

- *Flowers and petal shapes are ideal*
- *Pass through reflecting canyons*
- *Curved wood is beautiful*





DR concert hall by Nouvel

The entrance hall to DR concert hall looks like they ran out of money before it was finished, and they did run out of money. The concert hall cost more than twice the budget but in return they got the most fantastic concert hall in the world.



You enter through sound absorbing gates and suddenly you are in a canyon of beautiful curved shapes made in beautiful curved and carved wood shaped to reflect the sound optimally.

The shapes are flowing like the music, almost like a waltz. They are dancing, waving and both energetic and relaxing.



During the pause I walked and climbed the entire space and passed through the canyon connecting the floors and balconies and the impression is magnificent and different from any single place in this large 1500 seat room.

The more you are in this room the happier you get.

Below is a smaller concert hall for rhythmical music. It is more like a jazz club, more intimate and with a more box shaped geometry only enhanced by moving sound reflectors.



The smallest concert studio is all red with a wall that can change reflection/absorption by turning the wall elements.

And from the outside: Well that is just a cube covered in some dark blue net fabric that does not work well with the projection because it absorbs the light and which makes the glass look dirty from the inside. What a contrast to the magnificent interior



Inspiration:

- *Spaces design acoustics*
- *A deck plan like a Philippine terraced paddy field*
- *Light enhancing the shapes and wood surfaces*
- *Different from every seat in the room*





SENSUAL BIOMETRIC SPACES

**Based on a study trip to Germany and Austria July 2009
And a study trip to Holland April 2009**



**Photos:
1-3 Nordpark by Hadid
4-5 Crematorium in Kakamigahara by Toyo Ito**



Innsbruck Nordpark railway station by Zaha Hadid

Nordpark's 4 railway stations are unique. They are large sculptures in glass and I could watch them during the day, the evening, the night and next morning and still get new impressions. Magnificent!. They were intended to be like glaziers and they are very icy with the greenish white color, the deep mirroring surfaces and the very organic shapes. They are beautiful. Every time you would stand waiting for the train the time would seem short if you enjoy this building

Each pane of glass is produced individually. First a piece of steel is shaped like in a ship yard. Then the glass is heated, and when sufficiently hot it gives way to gravity and fall down on the surface of the steel. Each uniquely shaped piece of glass needs its own piece of steel to be formed on and they are all cut in different shapes. Each glass is furthermore covered with a white coating on the back side. Fittings are glued to the back side and each glass is mounted on a steel frame construction. The picture bottom left shows that the glasses don't fit perfectly together, that the sealant has fallen out and that the entire construction is no longer sealed towards, water, ice and particularly drifting snow.

The next challenge is the relation between the curved structure and the foundation and surroundings. The bottom station is sub-terrain and that is by far the most beautiful. On the next station next to the river, the station for no reason runs high above the ground exposing the concrete rail structure. At the next Alpen zoo station it is even worse as the sculptural roof is placed on a tall tower in concrete. The top station is partly cut out of the cliff, and here too, the concrete platforms conflict with the glass canopy. The collision between the light canopy and the steel and glass lift is also unfortunate.

A canopy is not a real space as they are open but they could be enclosed by glass in the same way as Toyo Ito chapel shown at the bottom of previous page.

Inspiration:

- *The depth of glass and the greenish white is beautiful also when dirty*
- *The shapes are folded asymmetrically to carry in 3 points*
- *The shapes are dynamically heading in one direction*
- *Patterns on white color enhance the perception of the shape*
- *Skylights enhance the mirror effects in the material*



Glass cube for Leonardo by 3deLuxe

From the outside this box shaped building definitely doesn't qualify to be in this report. But this design has avoided the collision between curved spaces and windows by keeping the curved spaces far inside the glass box.



The interior is an amazingly beautifully organic space, probably one of the best of them all.

Right inside the glass wall is a corridor running around the entire building. The glass is painted with an abstraction of the surrounding landscape and the colors in the glass "paints" the white floor.



In the corners of this corridor are some strange supports looking like magnified brain cells. They are made with excellent finish in 3D. Behind them, some cave like spaces, or rather spaces like underneath the canopy of an oak tree, are defined by a curved wall covered on the outside with a thin transparent and suspended textile curtain. Shapes are carved out in the wall but not in the curtain, and that creates an amazing effect. Curtains are furthermore suspended beneath the ceiling in these corner caves and the curved sofas add to the holistic effect.



Between the 4 corner caves is an atrium in the deck to the exhibition space below. Curved bridges link the spaces together on the entrance floor while curved stairs lead to the floor below. The curved bridges and ramps guide your movement through the room.

The entire ceiling has curved patterns and the amazing thing is that it (together with the corner caves and canopies) creates the impression of a double curved ceiling. But in reality the ceiling is flat except for the edge next to the window. That is clever done to create a 3D impression from a flat surface.



This building is reasonable easy to build. 4 corner caves carrying the entire flat roof. A almost invisible wall of 6 x 3 m windows made from the largest available glass sheets and with diminutive framing. And within this simple box everything is curved, artistic and amazingly convincing.

Inspiration:

- *Invisible glass enhances the beauty of the curved spaces.*
- *Curtains mediating the borders between walls and voids*
- *The curved patterns in the roof creates 3D illusion*
- *Curved bridges and ramps guide you through the room*





Kunsthau Graz by Peter Cook

Kunsthau Graz is shaped like a giant balloon hovering over a glazed entrance hall. The balloons surface is reflective and it is beautiful both daytime and during the night when the transparent surface is backlit by circular lights. These lights can present rolling text and moving pictures and it is impressive.



The exterior is exiting with double curved acrylic sheets mounted on a triangulated steel frame structure.

Just like in Innsbruck, the sheets don't fit very well together but that problem is less obvious because the double curved sheets are mounted far apart, far higher than the pedestrians, and with a black roof underneath.



You enter the balloon through stairs folded down from underneath the belly of the balloon like aft on a MD 80 plane or as the aliens do in the movie "Close encounter" That is great.

From the inside the triangulated structure is visible and the triangles are covered with a mesh. All except one of the special roof windows were blinded dark when I visited the building but that single window was too much contrast. The tentacle shape is great.



As always, there is a conflict between curved shapes and flat floors. It is OK on the top floor, but on the middle floor the slice of the balloon doesn't make much sense.

On top of the building is a glazed view platform from which you can watch the river, the castle and the UNESCO world heritage city center. I understand why they wanted this view but this addition is architecturally colliding with the balloon. They don't fit together and they are yet another example showing that it is not easy to put flat square windows in double curved shapes.



In USA monolithic domes produce very large concrete structures with a technology where you start with the inflation of a balloon, then you cover it inside with PUR insulation and then you cover it in the inside with reinforced concrete. The balloon is kept and could be paint to a gloss surface. To the left you can see Rem Koolhaas's inflated construction for Serpentine gallery.

Inspiration:

- *MD 80 airplane aft stairs leading up the belly of the balloons*
- *Tentacle windows growing out of the surface*
- *Multimedia light beneath the translucent surface*





The Mur island in Graz by Vito Accondi

This artificial island is dramatically situated in the middle of the river Mur, which is rushing by, just a little below floor level. The river current is so strong that it actually shakes the building, making you feel like being onboard a ship.



The entire structure is in stainless steel triangles. The triangulation of the curved shape is all over and compared to many other solutions this very obvious triangulation of all the windows avoid the collision between the curved shape and the windows because everything is windows. Windows with glass, windows with mesh and windows with nothing. For some strange reason there are actually two layers of triangulations: An outer load bearing structure, and an inner window structure. It would be great to have frameless triangulation using the frames of the double glazing. Leonardo can do it the cube, so it could be done in 3D as well



On this small artificial island is an open amphitheater, a playground of the kind you know from IKEA with a slide and things to climb in and finally a combined café and night club. It is difficult to imagine how this combination came about, but it feels OK when you visit.



The night club is the most house like part of it, and great efforts have been put into producing double curved sofas swinging up as canopies over the entrance, an octopus like ventilation ducts and a toilet shaped like the inside of an Alto vase. The toilet made my son seasick but except from that the place is very pleasant and adventurous.

I was in the building both at daytime and at night and it was actually great in both situations. I was a little afraid that the many different reflections of the glass surface would be problematic but the reflections were not a problem, maybe because there was a spotlight on the building's exterior competing with the dimmed light inside.



A great building, a sensible structure and a good solution to put windows in curved spaces

Inspiration:

- *Truly double curved triangulated windows*
- *Dimmed light*
- *Octopus ventilation ducts*
- *Free form furniture*





Hessing Cockpit by Oosterhuis

This car dealer sells Rolls Royce, Lamborghini and Ferrari in a shop integrated in the noise barrier along the busy motorway around Utrecht

The triangulated construction continues in the several km long noise barrier made in the same materials. The construction is quite similar to Mur Island but with one important difference. It is mainly curved in the cross section, not in the plan. And that really makes a difference because the many triangles obstruct the view in this more cylindrical version. The lesson learned is that if you convert a structure into triangles it is much better to use a more double curved structure.



The opposite side is covered with textiles and that is a beautiful solution.

And the floor is designed with ramps providing access for the cars and exhibiting the cars in an impressive way. The more surprising thing is that these ramps happen to be exactly what this kind of buildings need. As mentioned in the section about Kunsthaus in Graz, it is always disappointing with floors cutting slices in double curved structures. The ramps solve this problem.



The access to the building was however very strange, You enter next to repair shop and walk up several flights of stairs in a narrow stair case.

Inspiration

- *Deck plans of triangulated surfaces should be curved*
- *Soft surfaces on the opaque interior parts*
- *A succession of sloping ramps/stairs*
- *Use platforms and spaces within spaces rather than slicing big shapes with decks*





SCULPTURAL BUILDINGS

Experienced on trips to Southern France, Berlin, Barcelona and Vienna

Photos:

- 1 Sidney Opera house by Utzon
- 2 TWA airport in New York by Eero Saarinen
- 3 Burj al Arab, Dubai by Tom Wright
- 4 Einsteinurm by Mendelsohn
- 5 Price residence, Corona del Mar by Bart Prince
- 6 Office, Vienna by Coop Himmelb(l)au

Ronchamps by Le Corbusier



Coming to church in Ronchamps is definitely also a pilgrimage. You approach this amazing sculptural building on a zigzag path giving you a glimpse of the building on your way to the top of the hill where you finally see the entire sculpture.



And it is worth the efforts. Corbusier, the man that all his previous life had invented and advocated stringent modernism leading to the disastrous concrete apartment suburbs of any town and city in the world, designed this beautiful building contradicting everything he had earlier stood for. I hope it gave his soul peace and him absolution.



The building shows us the artistic side of Corbusier. The stain glass windows are decorations handmade by himself. The doors handles are special and there are a lot of other small very artistic details.

And when you enter the church, the roof is actually hovering separated from the walls by windows. The extremely thick walls have elaborated window holes with some windows in the outdoor plane of the wall and some windows on the indoor plane. And all the holes for the windows are cut in angles to increase sunlight and diffuse it. That is world class.

Everything looks very massive, but the walls are in fact thin plaster. It is a kind of membrane with plaster solution as the innovative technologies we return to in the next chapter



Inspiration

- *Small embrasure windows in thick walls*
- *Windows separating walls and roof make the roof weightless*
- *Symphonic patterns of windows in all sizes and colours*





Casa Batlló by Gaudí

My favorite Gaudí building is Casa Batlló.

It is one giant sculpture. The windows, doors, ceilings, balconies and stairs are sculptural. Everything single thing, even the furniture, the lamps, the stain glass are sculptural. The facades are covered with a mosaic of ceramic tiles. The story behind this is that a friend of Gaudí's offered broken ceramic tiles for free, so the facades are in fact recycled material big time. The entire building is a renovation of an older house built 1877.



Casa Batlló is now a museum and I entered it after I had seen:

- Sagrada Família where the original part of church is fabulous, but the things built after Gaudí died are kitsch
- Parc Guell with its beautiful mosaic benches and the kitsch doll house like houses and
- Casa Mila with its impressive balconies and sculptural roof terrace.



Glad I came to Casa Batlló as the last place because it has all the qualities of the other buildings. The mosaics of Parc Gruell, the architecture of Casa Mila, the ornamentation and the portrait format of Sagrada Família. Everything fits together and makes the kitsch disappear.



I come from a Nordic, modernist architectural education and tradition and ornamentation and rococo is usually not the name of the game. But all that does not apply to Gaudí's buildings. They are vivid sculptures to live in.

Gaudí is among the very few architects who have their buildings preserved by UNESCO world heritage list

Inspiration

- *Art design should be holistically artistic from detail to entirety*
- *Mosaics of broken tiles are beautiful on the curved surfaces*





Candela

I saw one of Candela's structures in a park in Oslo as a student 30 years ago and was fascinated by the thin beautiful structure and I have been fascinated ever since.



Candela invented a way of producing the double curved geometries using straight wood boards. Just as I am now struggling with the use of membranes to build very complex double curved spaces, he was struggling with wood boards supporting very basic and exact mathematical shapes and he succeeded. He constructed very thin membranes and most of them are beautiful.

At that time no one could calculate the structures, so they were tested the hard way building one example for load test.



Candela used his umbrellas for factories and the more artistic spaces for churches and just before he died he built an Oceanographic museum in Valencia together with Calatrava (next page).



I am critical on this very mathematical shape when it comes to space. Buckminster Fuller invented the triangulated domes, Monolithic domes invented the light concrete domes and Calatrava made the sea shell shaped figures. But they are too symmetrical. If you have seen one, you have seen them all. There is nothing left to explore, nothing to tease your fantasy. Candela's much more asymmetrical church looking a little like a sea lion is more beautiful.

The church at the bottom has the beautiful tree like shapes inside the room, but the outer walls are not integrated in the design.



Inspiration

- *Concrete membranes*





Calatrava

The most fascinating building at the World Expo in Sevilla 1992 was Calatrava's Kuwait pavilion. It was the first building I saw that was alive, moving the large palm leaves. They could open and close an outdoor space and combined with changing light, shadows and illumination made a different experience when I returned many times during my stay at the expo in spite of the fierce competition from the many pavilions.



In Denmark Calatrava is most famous for the Turning Torso, in Malmø, and though way better than other high rise apartment buildings. It is not even close to the extraordinary quality of his "City of arts and science" in Valencia. I have not yet seen the many exiting buildings in Valencia but it is definitely on my short list to go there.



Calatrava plays with structures and the most impressive yet is . . . fantastic art museum in Milwaukee (photos bottom left) where the giant bird wings can move and open and close around the building.



Calatrava is maybe the most biometric architect in the world. His shapes are like giant skeletons from birds or leaves from palm trees and they are very artistic and elegant. He is a master of structure.



For better and for worse the structures are dominating your impression of the building. In the best of his designs the structures are the buildings but in some of the buildings the structures are pure decoration and that is a little "too much" for me. And the skeleton is the structure of a body, somewhat unfinished without muscles and skin.



Inspiration

- *Biomimic structures*
- *Movable wings and palms*
- *Self supporting shapes*
- *Structures filtering light*





Hundertwasser

Hundertwasser was very engaged in both art and ecology and he designed a lot of buildings with gardens on roofs, balconies and even on the walls. He designed Hobbit like cities where the houses were partly underground.



I have seen his two most famous buildings in Vienna. They are so famous that there is a “Hunderwasserhaus” stop on the light rail passing by. They are truly great and humorous.

His buildings look like his paintings. He was a great painter and resembling his painting is very impressive. But after his death, a German architect has continued building Hundertwasser buildings and they are kitsch and look like something from a movie for 4 year old kids.



So what separates the real Hundertwasser builds from the Mumi buildings. Is it only the knowledge who designed them, or is it the artistic talent. I tend to believe the difference is Hundertwasser. Just like there is a profound difference between the real Gaudi Sagrada familia and the fake kitsch design in the never part of the cathedral.



Hunderwasser’s dream was to build a real artistic sustainable environment right down to the smallest details and he succeeded. The interior is as much Hundertwasser as the exterior. I share his dream.

Inspiration

- *Greenery concurring the facades, balconies and roofs*
- *Playful artistic decorations and sculptures*





Jewish Museum in Berlin by Liebeskind

I had watched the construction of the building and next time I came to Berlin I went into Liebeskind's museum with great expectations without really knowing what to expect.

I entered the building and walked down stairs to the far end of the corridor and into a very high room symbolizing the oven in the concentration camp.



The amazing challenge in the Jewish Museum in Berlin is to create an impression of Horror. And with all the sharp edges and zigzag spaces Liebeskind succeeded. It is a horrifying place. A symbol of the terror Hitler brought on the Jews.

The building is creating strong emotions, both on the Jewish side and in Germany's capital which used to be the center of Nazi government.



He has built several Jewish museums since, of which I have seen those in Copenhagen and Seattle. They are just built with weird angles but without the gloomy horror of the museum in Berlin.

He won the competition about the symbolic buildings at ground zero, again a very controversial and symbolic assignment.

No doubt Liebeskind has succeeded as a communicator, and as an artist.



But I am not very happy with his spaces. They are significantly more odd than beautiful. They are sharp where I like them soft, they are aggressive where I want them welcoming. They horrifyingly cold where I want them warm.

Inspiration

- *Soft organic shapes are warm and friendly, while sharp surfaces can be horrifying*





Serpentine pavilion by Toyo Ito

This pavilion was only exhibited for one brief summer at the Serpentine gallery in Hyde Park in London, and I never saw it. Too late.

Toyo Ito's genius idea is to mix the opaque and transparent triangles in the triangulation.

Ordinary buildings have walls and roofs with windows as holes in the walls and roofs. Glass buildings have basically all walls in glass with some insulated wall areas hidden behind the glass

Usually either walls or glass is dominant. But in this pavilion they are equal .for the first time in history.

This building is totally box shaped, and never the less very sensual and sculptural. And it is this very simple trick that does the difference.

The pattern of the triangles based on a mathematical principle developed by Cecil Balmond from Arup is of course essential. A simple triangulations like on Saxo bank in Copenhagen, doesn't do the same thing to the building.

Cecil Balmond also designed the structural concepts for the Olympic swimming stadium and the main stadium as well as the Chinese TV building in Beijing. They are all examples of mastery in 3D structures and I can only dream of a structure where the Serpentine pavilion concept is used on an organic shape and the pattern is related to functionality in the building.

Maybe a changing pattern could be possible with switchable mirror glass

Inspiration

- *The artistic triangulation is more inspiring than the uniform*
- *Equality between the transparent and the opaque surfaces is exiting*





SENSUAL GREEN TOWN SPACE

Based on a study trip to Dubrovnik, Regensburg, Graz, Wurzburg, and earlier trips to Angkor Wat, Sienna, Venice, Valetta, Beijing, Lucca, Mt. Saint Michelle, Port Grimaud, New Orleans, Assisi, Perugia, Tallin

Photos:

- 1 Angkor Wat, Cambodia
- 2 Angkor Wat, Cambodia
- 3 Sienna, Italy
- 4 Djenne, Mali
- 5 Assisi, Italy
- 6 Tallinn, Estonia



Imagine that streets / squares are rooms in a house

This summer I visited Dubrovnik and after two days in the city I suddenly got this vision: Imagine that the city is not a lot of houses with streets between them but on the contrary that the houses are extremely thick partition walls between the “rooms” of streets and squares in a mega-building. Imagine that the facades are the “walls” of these “rooms” and the street pavement is the “floor” and the open ends of the streets are the “windows” and the open sky above is the “skylights”. In some of the best old towns with many squares the streets are even gates or “doors” between the squares.



The Dubrovnik “mega-building” has one common facade, the fortress wall. The entire city is made from the same sandstone material. All the roofs are tiled and the hierarchy is easy to perceive. There is only one common entrance door like in a home. You enter into a “hall” (the wide center street) with access to a lot of “corridors” (side streets) and in the far end of the “hall” is a wider square and an a “back door” to the private harbor. The “corridors” start with the “living rooms” (shops and restaurants) close to the “hall” and lead to gradually more domestic and private rooms upstairs. And the streets are covered with marble as smooth as on a floor. I guess that this metaphor is nowhere as obvious as in Dubrovnik. That city is a mega-building or rather “my castle is my home”. Except for the city wall I miss circulation in the street layout. Somehow you always end up on main street.



In fact most cities on the UNESCO World Heritage List are made according to this concept. I know the concept is developed from a defense rationale, but never the less it has become the idol city. Clear boundaries, narrow pedestrian streets, no cars, harmonic building with diversified architecture, beautiful (decorated) facades, and a rich system of winding streets connecting squares, crowned by a church tower or similar focal points.



Some 10.000 people are needed to support a sufficient diversity and service. Such boundaries are of course a limitation to development, but in Angkor Wat that problem was solved by adding the next walled city and the next until it became the world largest city.



Sienna is the “art nouveau” version of the same concept. In Sienna the streets are curved and the town hall square is shaped like a giant shell. These true 3D shapes and the many choices of loops add to adventure and surprise but also make it more difficult to find your way. Sienna has a very distinct town hall focal point and a surprising black and white dome church on the other major square. One of the benefits of curved streets is that you see the facades when you walk down the street. Another is that there is always reason to continue to see what is next.





Even though Venice has no outer wall and half the streets are canals the concept is same. The isolated defensive position in the lagoon confines the space, and the Canal Grande is like the rivers passing most of the UNESCO cities. The streets linking the bridges become main streets, and the waterfront buildings around Canal Grande, Marcus square and the other squares have a rich architecture and decoration



Jerusalem, Tallinn, Valetta and the Forbidden city in Beijing are from different cultures but still built on the same concept and have the same qualities



The townscape advantage of the walled city is that it concentrates the flow of people through gates into the main street. All the inhabitants will walk as long as possible along the main street and then turn down a narrow side street. This way there is a maximum life and activity on Main Street and optimal chances that people will meet and create a social life and neighborhood community. It also enhances the survival chances for a diversity of shops and services.



Another advantage is density and confinement. Suburban sprawl will never feature these townscape qualities.



All these cities are old and some are older than planning and architecture. The most beautiful towns were made before architecture, plans and straight lines were introduced. Maybe the sculptural and spatial capacity of CAD could bring back the qualities in an entirely new truly 3D spacious design.



New urbanism



I visited the most fantastic malls in Las Vegas, Caesars Forum and Grand Canal in the Venetian Hotel temples and they have many of the qualities mentioned above except that there is no view out to either sky or surroundings, no people living there and unlike a city they are closed outside opening hours. If you separate the city and the mall you never get a city life. The mall must be the main street of the city, they must be integrated, unified, and open 24/7, or the city life dies.

50 year old Port Grimaud in France is inspired from both nearby Saint Tropez and Venice. You even park outside and enter through a gate. It does however not have density and size to have a wide choice of shops and restaurants. But it comes very close to my city idol and it is very attractive to the residents as each apartment has both access to water on one side and a green square on the other. It was great to be there and I keep thinking about this new town.

40 years old Seaside is known from the movie "Truman show" with Jim Carrey growing up in an artificial world. The critics make fun of the ideal city concept but Seaside is very popular and the idea has spread to a "new urbanism" movement leading to for instance 20 year old "Celebration" at Disney world, "Jakriborg" in the south of Sweden and Egebjerggård in Denmark. I have not visited "Seaside" and "Celebration" yet, but judging from photos they score high on my checklist (page 37) except that the density is too low, the buildings too separated and suburban and there are cars all over. "Celebration" has workplaces and offices related to nearby Disney World.

Charter of the New Urbanism states: "We advocate the restructuring of public policy and development practices to support the following principles: neighborhoods should be diverse in use and population; communities should be designed for the pedestrian and transit as well as the car; cities and towns should be shaped by physically defined and universally accessible public spaces and community institutions; urban places should be framed by architecture and landscape design that celebrate local history, climate, ecology and building practice"



Sustainable townscape synergy

I want to take towns one step further from post modern new urbanism to something even more sustainable and communicating.

- Getting people together in a more social space meeting the demands of children, singles and senior citizens
- Growing more plants and produce more vegetables and fruit than farmers would do on the same land
- Recycling and purifying waste water and rain water
- Producing renewable energy to make the town CO² neutral utilizing focusing solar furnace producing hot water for cogeneration of heat and electricity. Imagine a controllable mirror on every roof focusing on the landmark “church tower” of this new era, the solar towers
- Saving commuting fuel by integrating workplaces in the town
- Saving heating and cooling with “passive house” technology
- Building learning buildings with eternal structures and building envelopes combined with adaptable interiors and plug and play installations
- Saving building cost and material by creating synergy with work places and institutions
- Creating modern sensual sustainable sculptural spaces in townscape and interiors.



Offices and workplaces are essential to such a new town because there is a potential for synergy on town scale. Restaurants can create synergy as office cantinas in day time. Conference rooms can double as cinema and event space outside office hours, excess energy from the workspace cooling can be used for domestic hot water and parking space for offices can be used for the residents and guests outside working hours. Schools and daycare centers have playgrounds and facilities for sports creating a lot of synergy with the community outside opening hours. So instead of dividing the city into functional areas for working, living, shopping etc. I want everything re-united.



We need a new town planning legislation and a new approach to building towns.

- First the municipality could support the town by placing schools and day care services in the town space.
- Next the municipality should build the basic infra structure of main street mall, parking garage foundation and utilities offering the sites with this structure. .
- This part of the concept could be built in collaboration with mall developers like Steen & Strøm.
- Next could all the apartments be built by different developers and when the heavy building process is finished the translucent pedestrian streets could be added and the city is finished





Green privacy

People living in suburban villas often talk about the freedom of living in a house you can “walk around”. The point is that you are not disturbed by noise from your neighbors. But it is not very difficult to build efficient sound insulation between apartments.



The other aspect of “walk around” freedom is that you can have a fence or a hedge creating privacy and protecting against strangers looking into your house and garden. I propose that greenery on the balconies on both sides of the facade could create similar privacy. Curtains and switchable reflective glazing could do the rest particularly at night.



People sitting on these balconies facing the street will spice the street life, and enhance spontaneous contacts and meetings.



Green facades could be very personal with your favorite flowers, plants and geometry. These balconies could be both “gardens” and sculptures adding personality and greenery to each building and thus to the street. They could be inspired from Gaudi’s Casa Mila or from the desert canyons like Antelope canyon. Something very organic and biometric shaped at no extra cost.

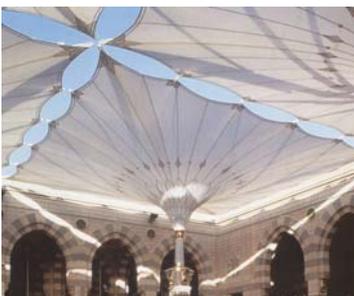
The balconies could be arranged in a stepped geometry offering all balconies a view to the sky. In order to further increase daylight in the apartments all the balcony floors could be made in translucent material, maybe the same material as the pedestrian streets.



The facades could also be covered in plants like Caxiaforum vertical garden in Madrid.

There should be roof gardens and green houses on top of all the buildings where people can grow their vegetables and get together in a common oasis further strengthening the neighborhood relation. As added benefits of the roof gardens is everybody can grown their own food and enjoy the surrounding landscape from their roof garden

The back yards between buildings are also gardens, and there are balconies on the garden side of the buildings as well.



The streets should be curved like in Sienna and Venice Italy. Main streets and squares could be covered by completely retractable glass roofs or membrane parasols in order to enhance the season for street life without spoiling the attraction of real outdoor summer life.

Sustainable Infrastructure



People want to drive all the way to their front door and park there. That is of course convenient, particularly if you shop in a mall a long way from home. The dilemma is that if you drive all the way to your front door you destroy the pedestrian street life in two ways. You stop walking and the cars ruin the “rooms” of the streets and squares.



We can solve that dilemma if we use the entire basement for parking, vacuum garbage handling, district heating and cooling, water, sewage and all kind of installations. You could park right next to the lift for your apartment and all utilities would be accessible for maintenance.



Parking garages are terrible, a dark desert of cars. The garden back yards should go all the way down to this infrastructure deck, in order to let the fresh air, greenery and daylight down in. The parking area could be covered by a pattern of concrete tiles and moss, and the walls could be covered with evergreen lianas like Hedra helix that even clean the air. The famous Japanese gardens could be inspiration.



The pedestrian streets pavement could be translucent so you actually drive beneath the streets and have roundabouts beneath the squares. In the night time the translucent street pavements will light the streets “rooms” in a beautiful way and in the daytime they will daylight the parking area and make the plants grow.



Most cars will eventually be electrical and there should be chargers at every parking place. This could be the first place where city dwellers can recharge their electrical car like the in the suburban villas



Wastewater treatment should be designed for recycling so that the grey waste water is used for the watering and fertilizing the greenery rainwater is processed and purified for domestic use and the dark waste water from toilets are used for biogas production.



Waste from households and institutions and bio waste from plants are carried by vacuum to an Oxy fuel co generation power station producing electricity, hot water for district heating, CO₂ for algae, nitrogen for fertilizing the green city and no pollution at all. This can be a buffer for the fluctuations in the solar power installation. And besides district heating and hot water the utilities could also support district cooling, removing the noisy coolers from the apartments and offices freeing the roofs for roof gardens.



Oasis interiors

Apartments with narrow facades call for a layout with bathrooms, kitchens and stairs in the dark core and bedrooms and living rooms at the facades. Most likely a layout with a bedroom on both sides of the stair-lift-toilet core and a living room extending straight through the building from façade to façade divided by a translucent kitchen in the center would be preferable. More bedrooms can be placed in the interface between the apartments offering the flexibility of attachment to one side or the other. Double high apartments is also an attractive option.

My personal dream apartments would be:

- Accessed by a skylight glazed roof lift (the emergency stairs would be outdoor in connection with the garden side balconies)
- Entering into an open space apartment with a large ceiling height of maybe 4 m
- Facades that are open able towards the green balconies
- With super sound absorbing space capsules with a view to the sky for sleeping
- With a bathroom that can be opened towards a translucent protected part of the garden balcony
- With a BBQ kind of kitchen where you cook and eat around the “fireplace”
- Separated by curved sound absorbing translucent curtains

The ground floor of my dream buildings should be alive with:

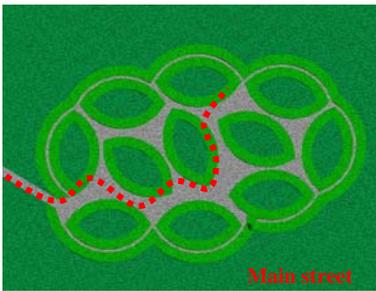
- Shops with windows (not the closed supermarket walls)
- Signs which are supporting the townscape rather than competing with it. In Dubrovnik signs were substituted with banners with the same typographic standard hanging from the walls.
- Restaurants with openable windows creating an opening to outdoor service on the squares
- Offices with exhibitions towards the street telling what they are doing and inspiring pedestrians (instead of the hermetic closed isolated office buildings we are used to)
- Schools and day care centers with playgrounds on the squares and sports in the parks

And all the balconies and roofs should be green.

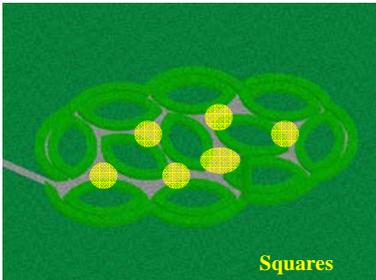
Next generation UNESCO city by Moltke

Could we make a new town from scratch with the qualities of the old UNESCO World Heritage Sites.

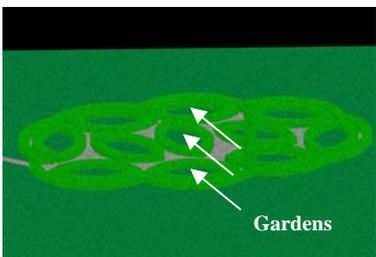
My answer is like Obama's: "Yes we can" if we use the principles of the medieval city.



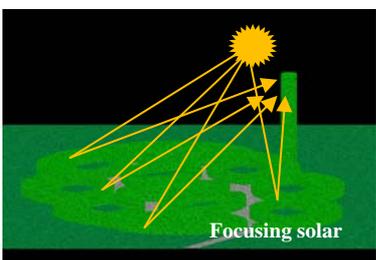
Main street



Squares



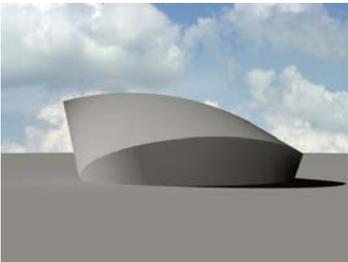
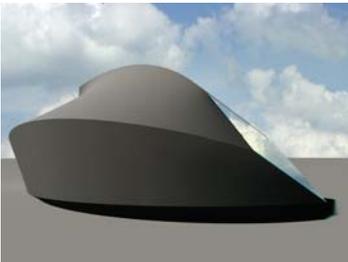
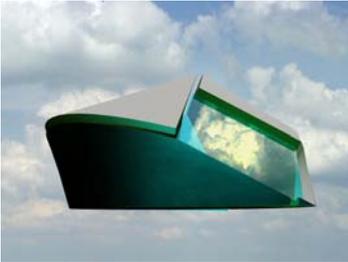
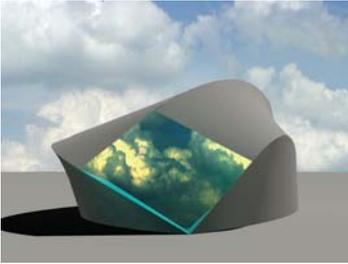
Gardens



Focusing solar

This town is 650 m x 450m
= 30 hectar and include
about 2500 appartments .
100 m2 average plus
50.000 m2 offices, shops,
restaurants, schools,
daycare centers

- *The town is perceived a giant building with doors (gates), corridors (streets), squares (rooms)*
- *Confined and separated from the surrounding sprawl*
- *Entrance through a few gates concentrating flows and creating main street*
- *Pedestrian streets in entire townscape*
- *Winding streets and squares were each square has an attractive focal point*
- *Always at least 2 choices at intersections to enable loops*
- *Leave gates as "windows" to parks, lakes, canals and fountains at the end of the streets so that each square has a view and people have access to gardens and water*
- *Re-integrate residential, work, production and service to create synergy and life in the townscape 24/7*
- *Stratify functionality horizontally instead of on city level*
- *Pave the streets like an outdoor floor rather than a road*
- *Design the town with continuous facades and a harmonic (but not uniform) choice of material, scale and style.*
- *Keep the building height to 3-4 floors, enough to create density and low enough to let sunlight in*
- *Make the facade of each apartment narrow to increase density*
- *Light the outdoor spaces like we would light a room, enhancing the architecture, focusing on places to stay and places of interest and keeping the light distributed and indirect in order to avoid that people in the streets are silhouettes*
- *Furniture in the street "rooms" in order to make people stay*
- *Attract neighborhood people with easy accessible parking.*
- *Concentrate shops to main street and restaurants to squares*
- *Create synergy with offices and schools at street level*
- *Build high quality user centered architecture and design*
- *Roof gardens, stepped lush balconies, back court gardens and large trees on the squares*



SCULPTURAL TECHNOLOGIES

Based on a technological foresight spring 2009

Rendering of Nordic Innovation project by Moltke & Skude



Biometric design tools

Once at a conference in Silicon Valley I saw a master of animation model a dinosaur in Maya software. He started with the skeleton, specified the flexible joints like knees, hips, ankles etc. He then added the muscles, the fat and the skin.

Imagine you designed a building the same way. The skeleton would be all the compression parts of the structures like pillars, beams, arcs. The muscles would be all the tensile parts of the building. The fat would be all the inflated parts. And the skin would be the membranes suspended and shaped over a skeleton, pulled into cavities and inflated into convex surfaces.

Instead of actually designing the building you start flexing your “dinosaur” until it has the shape that fits both the interior functionality and spatial beauty. It will be an artistic innovative iterative kind of “what if process” that will create spaces of both natural beauty and structural minimalism. These shapes will be easy to build with the technologies mentioned below. You almost don’t need the structural analysis or calculations because the shape is already derived from the forces.

When Gaudi shaped Sagrada Familia he used an old trick of turning the design of the church upside down in thin chains and added weights corresponding to the weight of the construction. This way the shape of pillars and vaults were optimal. The dinosaur approach is the digital version of Gaudi’s chain models.

Computers have a great role to play in complex constructions throughout the value chain from design via production and construction to maintenance. Particular in spaces constructed from a lot of customized components like triangulated glass roofs and 3D milled components computers are necessary in all steps of the process.

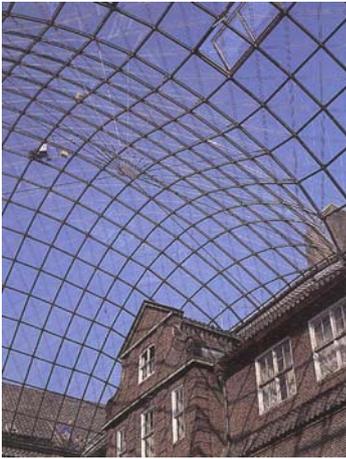
Paper drawing can’t describe biometric geometry. But 3D milled molds and 3D inflatable tensile membranes substitutes the drawing. You don’t need 3D drawings to put up a tent.

Inspiration

- *Design biomimic structures with skeleton (compression), muscles (tension) fat (inflations) and skin (membranes)*
- *Use 3D milled molds and computer cut membranes rather than paper drawing*
- *Keep all information digital throughout the process and value chain.*

Photos:

- 1 **Serpentine pavillon by Hadid**
- 2 **Pavillon Chicago by Hadid**
- 3 **Analog structural calculation by Gaudi’**
- 4 **Sculpture pr Hadid**
- 5 **Puerta America Hotel by Hadid**
- 6 **Bahrain Museum by Hadid**



Curved glazing by Schlaich Bergemann & Patners

German engineers like Schlaich Bergemann & Patners can design double curved glass rooms from almost square windows. It is a kind of triangulation, but the advantage of these almost square windows is that square glass panes better and less glass is wasted. The disadvantage is that each square need a diagonal joint or crossing cables to convert it structurally back into triangles.



Gehry technologies have even developed a design tool enabling the use of standard profiles for glazing (for instance Schüco). The profile allows for 5 degrees bending angle between glass and profile and there is a potential overlap of a few centimeters. The software calculates the geometry with these limitations and enables double curved glazing with square panes in standard profiles. According to Gehry Technologies that saves 50% of the cost compared to triangulation.



These constructions are easy to transport as they have a very minimal volume compared to the area spanned.

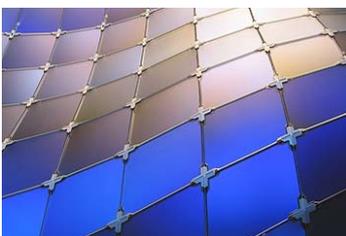
I have been under these soap bubble thin glazings in Hamburg and Berlin and they are amazing, almost illusions. You can't believe that they are strong enough but they are.



They are however difficult to clean and the glazing I have seen are quite dirty and after a while not much clearer than the folio used for EDEN

Inspiration

- *Almost square windows can build double curved glazing*





Switchable mirror glass

Large areas of glass, particularly in roofs tend to overheat buildings. Switchable mirror glass solves that problem and is thus important to the development of free form glazing.

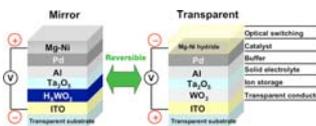
Most electrochromatic glass change absorption (going dark) and that means that solar heat is absorbed in the window. A reflective coating get rid of the excess heat and save air condition.



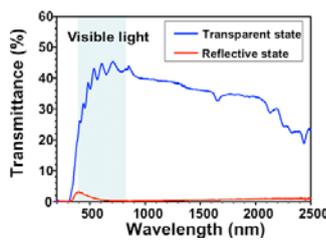
A switchable mirror glass from Energy Control Thin Film Group at AIST in Japan achieves this performance with a electrochromatic solid state coating using electricity to switch. This is a technology very similar to the proven LCD technology in calculators and watches.



The all-solid-state switchable mirror with Mg-Ni alloy film as the switchable mirror layer is initially reflective. When the mirror is subjected to a voltage of about 5 volts, hydrogen ions (H^+) stored in the ion-storage WO_3 layer (H_xWO_3) move to the switchable mirror layer (Mg-Ni alloy in a metallic state), and metallic alloy is hydrogenated to a nonmetallic state that is transparent (Figures 3 and 4). The change takes about 15 seconds to complete.



When reversing the polarity and a voltage of about -5 volts is applied, the hydrogen ions return to the ion-storage layer (WO_3) and the switchable mirror returns to its original reflective (metallic) state. This reverse change takes about 10 seconds to complete. The mirror remains in its changed state even when the power is cut off.



The reflection can further be used in reflective solar devices. In diffuse light the window is open. In direct sunlight it functions as a giant reflector focusing the light on PV. The entire building could be a reflector due to a parabolic shape or due to a Fresnel kind of saw tooth reflector shape

Inspiration:

- *Switchable mirror glass can avoid overheating of glazed spaces*
- *Switchable mirror glass can focus light on PV*



Eden project by Griwshaw

Eden project is a giant green house for a botanical garden I Wales, UK, and it is on my short list of places to visit.

The hexagonals are glazed with ethyltetrafluoroethylene (ETFE), which is a hi-tech transparent foil that:

- Is less than 1% of the weight of equivalent glass.
- Lets through 98% of sunlight (glass lets through about 90%).
- Has non-stick properties (similar to Teflon), which means that bird droppings run off it easily
- Is tough
- Is not degraded by sunlight
- Suffers minimal deformation when it is windy, with its yield/strength ratio remaining the same (glass can crack in windy conditions)
- Is recyclable.

Each polygonal panel is like a club sandwich, with three or four layers of ETFE heat-welded together. After the panels are installed, they are inflated with dry air like big pillows. Their overall thickness is about two meters, which gives better insulation than normal double glazing. This void could be filled with CO₂ increasing the insulation and feeding the plants

Embodied energy of the panels is also very low compared to glass.

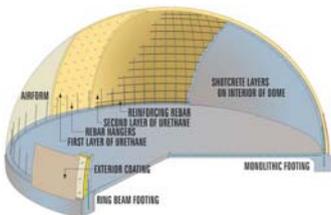
And even though the previous constructions are easy to transport this is exceptionally easy. A truck load of this building envelope could cover thousands of square meters.

The same inflated foil concept is used in the Olympic swimming stadium in Beijing and in the Danish Lalandia.

Imagine one of these large hexagonal was the roof of a house. Well, they are only around 7,5 m diameter, but 2-3 could cover the area of a house, just like that

Inspiration:

- *ETFE is a membrane alternative to glass*



HANS HENRIK ØHLERS Skulptur · Design · Indretning

Monolithic domes

Monolithic domes in USA has developed a technology and proved it in hurricanes and earthquakes in several hundred domes with dimension up to 84 meter diameter.

1. First step is casting the floor in concrete.
2. Next a membrane is attached to the periphery of this foundation
3. The membrane is inflated
4. PUR insulations foam is blow on the inside of the membrane
5. Steel reinforcement is attached
6. Shotcrete is sprayed on foam and reinforcement

The finished construction has a complete tight outer membrane, air and water tight insulation and a load bearing and fire safe interior surface. Nothing missing, and nothing surplus.

The is significant potential for development of this construction concept. There is at least 4 different ways to suspend the membrane:

1. Inflation
2. Tension like a tent
3. Frames like a tunnel tent
4. A combination of the 3 former concepts.

This concept can be used for all kinds of sculptural shapes including Serra's torque ellipsis, hyperbolic parabolic shapes, spheres, cylinders and any combination of these shapes.

The technology could be simplified using fiber reinforced shotcrete. This is a proven technology in for instance tunnels. There are even paint robots for both sprayed insulation and shotcrete. The membrane can be coated, clad with tiles, or made from Teflon.

These constructions are very easy to transport. The membrane can be folded to a minimal volume, the foam expands about a hundred times and the concrete can be mixed on site.

So far only simple spherical shapes has been used, but just as the clothing industry can produce clothes automatically in any shape could the membrane be produced in almost any shape only limited by the possibility to suspend it. This way the entire geometry of the building envelope is transformed from CAD to on site construction through the fabric.

Hans Henrik Øhlers has designed and built this beautiful monolithic dome in Øregårsparken in Copenhagen.

Inspiration

- *All membrane shapes can be insulated, fireproofed and transformed into stiff shells by the Monolithic dome technology*



Tensile structures

I once borrowed this “The cloud” backpack tent, inflated it by the backpacks integrated vacuum cleaner blower and wupti we had a magnificent meeting room. Look closely on it. The artist Monica Forster has succeeded designing a much more beautiful shape than any of the monolithic domes. It is also stronger because the strength I reverse proportional to the radius.



When I entered Maurice Agis’s “Dreamspace” and enjoyed the translucent colors and amazing spaces I was completely lost in space. This psychedelic space is as far as you get without drugs. And it might be as habit forming. The softness of all surfaces, the way light enters the translucency. A transcendent experience for the first 250.000 visitors. Unfortunately 2 persons were killed when the whole structure took off like a hot air balloon in Durham and ended the dream.



Denver airport is the only airport I had ever travelled to just to visit the airport. One of the largest airports in the world, yet covered entirely by one single tent. The daylight filters in and the artificial light glows through the tent at night. A beautiful cathedral like experience.



Suvarnabhumi Airport Bangkok is made partly in tensile construction, partly in glass but it does not have the save beauty

In Rostock harbor I sailed past this much more house scale version with a more continuous and composed shape.



Birdair can now supply the tensile structures as a sandwich of tensile fabric around a flexible translucent super nano insulation core of Tensotherm.

Tensile structure are almost as easy to transport as the thin membrane of the EDEN project.



Concrete canvas is a product like the gypsum gaze you use on a broken arm. The gaze is substituted with a polymer net and the gypsum is substituted with cement based filler. The result is that you can ship a bag to a disaster area, inflate it, spray it with water and your house is finished.

The concrete canvas houses (bottom left) are ugly but the concept is interesting, particularly combined with tensiles or inflatables.

Inspiration

- *The tensile membranes can be composed, combined and include partition walls and columns*
- *Tensile structures can be translucent even when insulated*



Vacuomatics: Freezing shapes

Eindhoven University of Technology is researching in what they have called Vacuumatics. The idea is to create molds in something which is very much like a bag chair filled with EPS beads. If you use an airtight bag and expose it to vacuum, you can use the bag to compress the beads and your mold is ready to cast. If you doubt the principle, test in on a bag of vacuum packet coffee

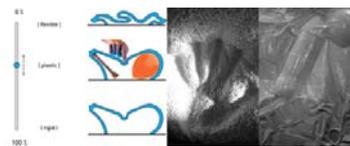


You can thaw it by relaxing the vacuum and when it is thawed you can adjust the shape of the mold. That means that you could have a house, furniture or other structures where you freeze and thaw the shape whenever you feel like having a new shape.



The same “bag chair” concept can alternatively be used as mold for a large number of different casts.

Two molds can be used to cast between or one mold can be used as a core to plaster on both sides with fiber reinforced concrete. (see 3D milling chapter)

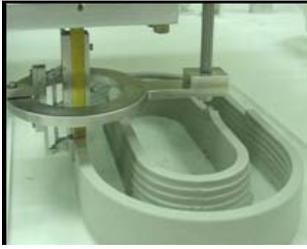


The “bag chair” bag can be filled with different material, for instance straw or saw dust or any other material that can be compressed

Inspiration:

- *Vacuomatics molds can be shaped freestyle and re-used*





Contour Crafting

You have all tried built a jar of clay at school by forming the clay into long cylinders and folding them on top of each other until you have a jar. Then you smooth the surface and are ready to cinder it.

The contour crafting robot does the same thing in one process extruding concrete between to moveable surfaces.



The process is simple and tested in small scale but has never been used for a house.

Transportation from factory to site is no longer an issue as the factory is transported to the construction site instead.



Inspiration:

- *A robot can plaster any surface accurately also without molds*





3D milling

3D milling is the only of all these technologies that can give you any shape and any shape accurately.



It is well known technology to mill a mold in materials like insulation foam, wood or much tougher materials like steel. Dencam in Denmark has a mill capable of transforming 3D geometry straight from the BIM on your computer into object of 53 x 6 x 6 meter. That is quite big.



It is also well known to cast concrete into such a mould.

My invention is to invert the role of the mold from something temporary and disposable surrounding the concrete to something permanent in the middle of the concrete.



The two concrete surfaces are covered with reinforcement net and plastered. They could also be covered with fiber reinforced shotcrete, preferably shot from a paint robot.

The advantage is:

1. One mold instead of two
2. Insulation without thermal bridges

The disadvantage is that the surface is not automatically smooth, but the net helps to smoothen it.



Drawings and curved shapes don't work well together. Another potential great potential of this concept is that all information that used to be in the construction drawing are now milled straight into the EPS. The electrician can put his pipes, wires and contacts into pre milled voids in the EPS. The HVAC people can put their pipes and ducts into pre milled voids in the EPS. And the carpenter can mount the doors and windows into the EPS. The EPS becomes the 3D on site construction drawing. In fact all geometrical information is in the EPS mold.



This concept could be combined with the vacuumatics to shape the EPS mould and with contour crafting for the surface.

Inspiration:

- *You can produce molds in any shape with 3D milling*
- *The mold can be insulations between two plaster shell surfaces*
- *Highly insulated membranes have no thermal bridges*
- *The milled molds substitute drawings and instructions*



Vacuum injection molding

Injection molding is a different way of using 3D milling

Injection molding has two key advantages:

- You get much more fibers= strength in the composite because you both vacuum and pressure the resin into the composite
 - You one need a mold on one side of the component, as a thin membrane is enough on the other side.
1. First a very accurate mold is made from a 3D milling robot.
 2. Next you cover the mold with the finish you need for surface
 3. Next you lay out an almost felt like fiber material to cover the total surface accurately.
 4. Next a layer of flexible but load carrying foam insulation material
 5. Next another layer of the felt fiber
 6. And finally the airtight vacuum membrane

Through the attached tubes you create vacuum beneath the membrane and thus keep the entire sandwich together. At the same time you pressure the resin into the felt fiber matrix. When the matrix is filled and cures you can produce the next component.

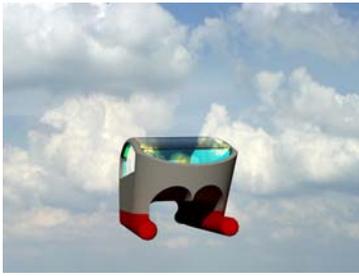
The strange thing is that airplanes (Boeing 787), boats, cars, and busses can legally be made from polymers although they are filled with highly inflammable fuel and run a risk of crashes, while stationary houses without fuel can only be build in fire proof materials plus wood. Why is wood allowed?. If we could build ultra light houses in carbon fiber polymers we could deliver them by helicopter.

It could also be interesting to investigate if self compacting concrete can be used in the same process. The advantage would be a fire resistant and more durable and healthier product.

Inspiration:

- *Vacuum injection molding can save materials, weight and molds*
- *Carbon fiber technology could produce low weight houses for helicopter distribution*





Floating and sailing buildings by Moltke

With a technology that can produce any shape and with foam insulation it is a small step to make the entire house floating. Just add another 50 cm foam insulation in the floor and the house can float.

The big advantage of the floating building is that

- You can produce any size completely finished on a factory
- The site is for free or at least for whatever a place in the harbor cost.
- You are right next to the harbor
- You can move your house if you move

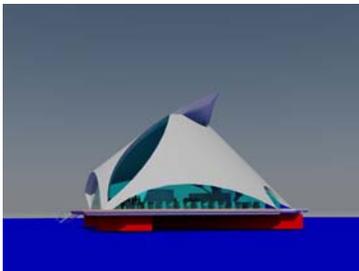


The challenge is to be independent of the utilities processing your own wastewater and waste as well as producing your own wave power, wind power and PV electricity.

Next step is a home powered by sails, PV and wave energy.

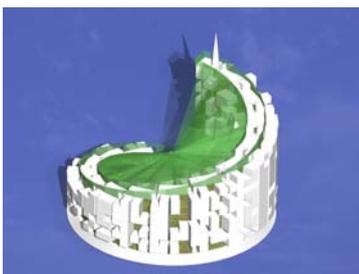
I have designed

- A catamaran houseboat that can propel itself on the power of a PV roof due to low resistance.
- A floating marina being both a building and a harbor
- A sailing event ship to be shared by a number for coastal towns
- And a floating town produced on a ship yard and delivered world wide.



Floating building could also be a smart way of overcoming the transportation problem of mass production of houses, particular in coastal countries like the Nordic countries.

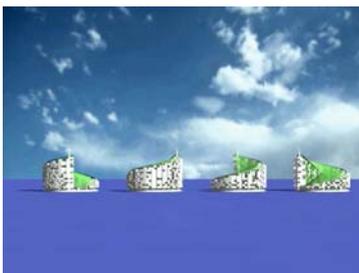
Imagine that the housing factory is situated next to a harbor. The products are sailed as close to the future position as possible and driven to the final position by truck. In many cases you will be able to find a road without obstructions and you will be able to transport quite large completely finished buildings.



Finally floating buildings are safer in areas with risk of flooding like New Orleans

Inspiration

- *The highly insulated membranes are easy to transform into boats*
- *Boats, houseboats and structures distributed by sea or floated into position can be produced in a factory without limitations on dimensions*
- *Full industrialization is possible when the entire building can be transported in one piece*



I HAVE A DREAM

Karate experts tell us, that in order to break the brick, you have to focus your beat on something beyond the brick. In this first phase of the worst financial crisis ever I needed to visualize my dream in order to see that “beyond” and to share that vision.

I have been working a lot with technological foresights and there is no doubt in my mind that artificial intelligence (AI) and robots will change our ways of producing everything within a few decades. There has been a “cry wolf” effect around AI, but now it is finally very close. Prototypes of cars that drive fully automatically around, more than ten thousands robots are fighting the wars for US military, Hondas service robots are close to the performance of the androids in the movie “Blade runner”. In the next decade IBM expects to be ready with a computer reverse engineering the intelligence of humans.

We are also in the beginning of a transformation from oil and coal to more sustainable energy, and we are entering an era with short supply of raw materials and food due to growing population and growing Chinese economy. The environmental issue is overwhelming.

This book addresses all these issues from an architectural point of view, and I am not only naive but also optimistic. We can do it. We can use AI to design and build more sensual sculptural sustainable spaces. Most likely we couldn't do it without AI.

As you can tell from the pictures this is not a religious quest for one design and one technology, but rather a lot of attractive alternatives to the way we do things today. Maybe the construction industry is finally ripe for transformation to knowledge society where things are measured in communication, “difference making a difference”

My vision is:

Affordable sensual sculptural sustainable spaces at any scale

My mission is:

Experimenting with design, AI and technologies to build sensual sculptural sustainable spaces.

Welcome to join



Ivar Moltke@teknologisk.dk
Danish Technological Institute
72202769