

URBAN LIGHT

Multi-functional lighting furniture in new concrete technology for urban spaces: a development project

Author: Anja Margrethe Bache

What is architecture? The masterly, correct, and magnificent play of masses brought together in light - le Corbusier

Abstract

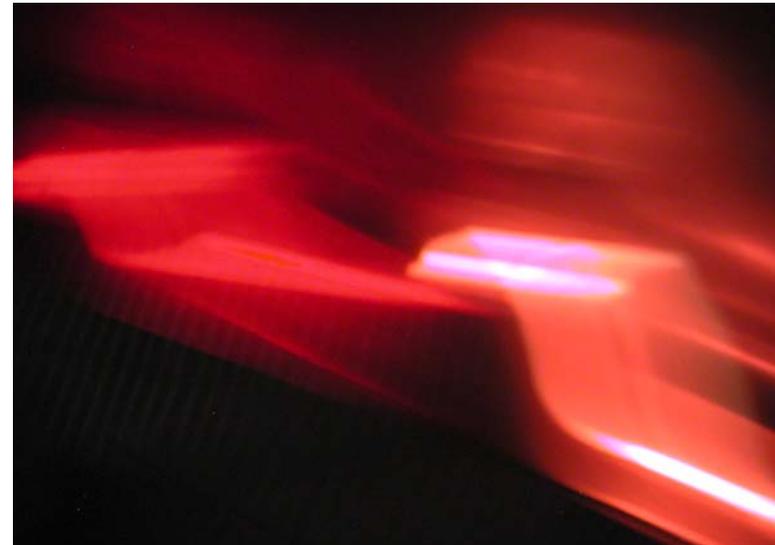
In 2006-2007, furniture designer Claus Hviid Knudsen MDD and sculptor and civil engineer Anja Margrethe Bache PhD carried out a development project entitled Urban Light - multi-functional lighting furniture in new concrete technology for urban spaces. The project was funded by the Danish housing foundation Boligfunden Kuben, and realised at the National Workshops for Arts and Crafts in Copenhagen. It concluded in August 2007 with a number of designs and prototypes in a new concrete technology, CRC (Compact Reinforced Composite), produced by the concrete manufacturers Dalton Betonelementer.

Introduction

Today, public spaces are often packed with scattered items of street furniture, each with their separate functions, including litter bins, bicycle stands, benches, light bollards, signs and perhaps flower containers; objects which are placed "on" the surface, each in their own separate designs, if there is any design at all, and in widely varying materials.

The central concept of our project has been to concentrate these functions in one and the same object: an item of multi-functional sustainable lighting furniture for the urban environment, in a material derived from new concrete technology, and to ensure that the design relates to the base of the urban environment, the surface, by casting it in a flagstone in dimensions derived from the standard paving stone. A number of designs were derived from this concept, of which three were selected and cast by Dalton

Anja Margrethe Bache



URBAN LIGHT: Icon and models



URBAN LIGHT: Examples of scattered and varied street furniture in the urban environment

Betonelementer. These are intended for use in parks, quaysides, squares, lay-bys, church forecourts and pedestrian paths.

The focus of this article is on the manner in which we have worked with light in this project.

I will begin by describing the New Concrete Technology and why it has found application as a material, after which I will give a description of the overall lighting concept of the Urban Light project and a brief outline of the light sources used. The path of light in transmission and reflection is then described, and finally the energy sources, with help from Ib Mogensen, director of the company OUTSIDER, in relation to the use of solar panels as energy sources to optimise sustainability.

New concrete - a designer material

Our starting-point in the URBAN LIGHT project has been knowledge of a new concrete technology, Compact Reinforced Composite, or CRC, including Densit, the potential of which is currently being utilised in other industries, but which could usefully be transferred to the construction industry and contribute to new design solutions there.

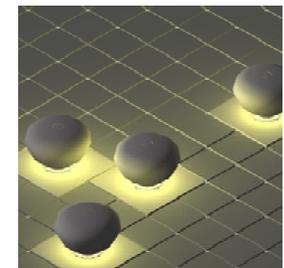
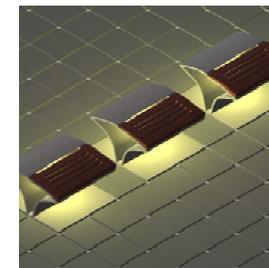
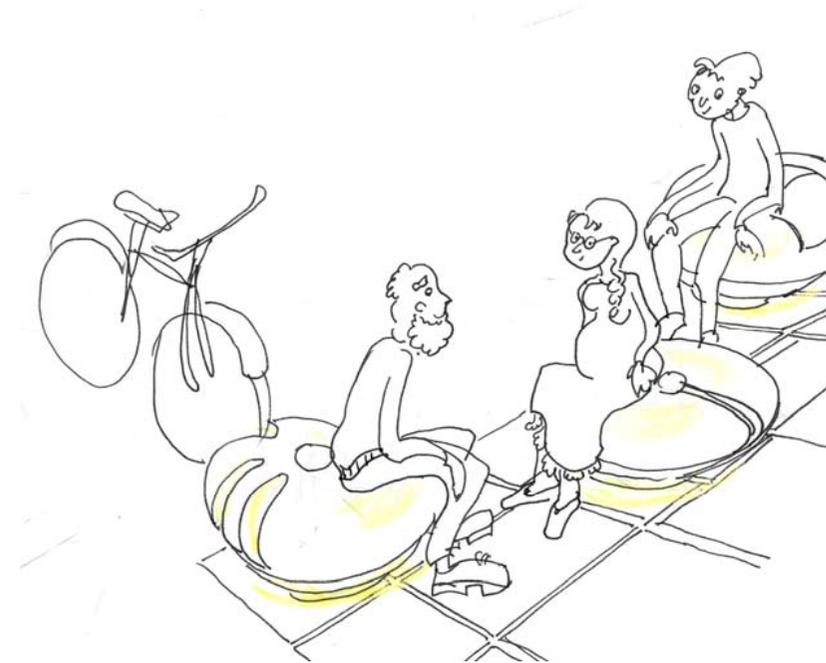
The new concrete is a composite technology which offers an entirely new form language, shifting the expression of concrete from the articulation of massiveness and heaviness to ultra-slim light and open shell constructions, slender profiles and hollow structures with slim material thicknesses. It offers new types of surfaces, including light-reflecting surfaces, and possible new locations for light sources in lighting fixtures made of concrete. It provides an opportunity to embed and protect cables and other equipment, and it is frostproof, stain-resistant and has great resistance to the outdoor climate and physical impacts.

Today, the new concrete finds industrial application in the reinforcement of steel bridges, compression equipment, and in the offshore industry, and while it is used in architecture to create slender staircases and balconies, it has not so far been applied to street furniture design. The existing application areas primarily make use of the concrete's technological and mechanical qualities, while the material's architectural, surface aesthetic and light technical aspects have not yet been explored or applied.

Anja Margrethe Bache



URBAN LIGHT: concrete samples. Note the piece at the top with 0.5 cm thickness.



URBAN LIGHT: Rough sketches of the new multi-functional street furniture in new concrete

Lighting concept

We have developed a general lighting concept for natural light during the day and artificial light at night, on the basis of which we have worked on the design, choice of materials, surface structure, texture, selection of light sources and their location.

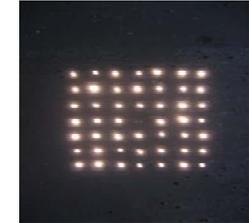
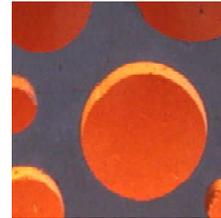
We aim to create lighting fixtures and street furniture in new concrete which will offer psychological security and experiences both by day and night. During the day, the daylight will illuminate the form and functions of the item, the detailing of the surfaces will create information and narrative concerning the location of the functions, and they will provide spheres of experience.

At night, the items will create illuminated areas which will be experienced as secure and useful, and provide orientation in space and in relation to the function of the street furniture. We wish to create a kind of stage, but a stage on which the border between light and darkness is a continual soft transition, with no dazzling. With this lighting, inspired by the lighting artist James Turrell and the painter Mark Rothko, we aim to create a forming of lighting that encourages us to step onto the stage and feel its warmth and security: Urban Light.

The selected light sources

We experimented with such light sources as fluorescent bulbs, LEDs, optical fibres, incandescent lamps and halogen lamps, and we investigated various locations for the light sources, both within, outside and embedded in the shell of the concrete. We examined the colour, dispersion, narrative, dazzle, reflection and transmission of the light, and compared the results of these experiments with considerations of colour reproduction, light intensity, energy consumption, durability and heat radiation. In dialogue with Phillips, we then selected energy-saving bulbs with the energy label A and LEDs as the light sources.

The energy-saving bulb is in principle a bent fluorescent bulb with a screw thread and built-in electronics for operation. The light produced can seem a little flat, and the colour reproduction is slightly poorer than that of incandescent and halogen bulbs. However,



URBAN LIGHT: Concrete samples with the light sources halogen bulbs, diodes and optical fibres. At the bottom are examples of ceramic glazing, galvanised metal plating, gold-plating by sputtering technique, and with a large volume percentage of fibre incorporated.

energy-saving bulbs produce 4-5 times more light per watt supplied than an incandescent bulb, and have a lifetime which is 6-15 times longer. Most types of energy-saving bulb are suitable for both indoor and outdoor use, and they are available in various colours, and in many different sizes and types.

The advantage of LEDs is that they have a very long lifetime and very low energy consumption, and much of the energy used is turned into light rather than heat. The LED bulb also provides excellent colour reproduction, as it has almost the same characteristics as an incandescent bulb, and produces a light that is almost indistinguishable from daylight. www.energitjenesten.dk

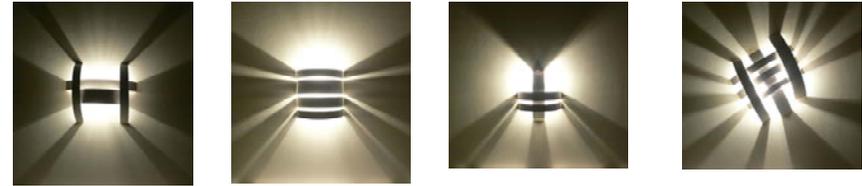
The path of the light

In interaction with these items of street furniture and their surfaces, daylight and artificial light create a play of light and shadow in the urban environment, and reveal the variations in the materials' texture and the architectural features of the urban space. This becomes a dynamic interplay as the sun moves across the sky, while variation and diversity can be created in the artificial light in a similar manner to the use of lighting as an art form in film, painting and photography.

In the Urban Light project we selected three designs: a rounded design which illuminates the hollow space with a very slim shell, a minimum-material filigree item in which the inner side, as a consequence of the hollowing-out, is almost as visible as the outer side; and a profile design with very thin profiles. In these designs the light sources were either located within the hollow space, integrated into or embedded in the concrete shell, or placed outside on the concrete construction as a separate lighting element. The illumination is obtained by means of light transmission and/or reflection.

Light transmission

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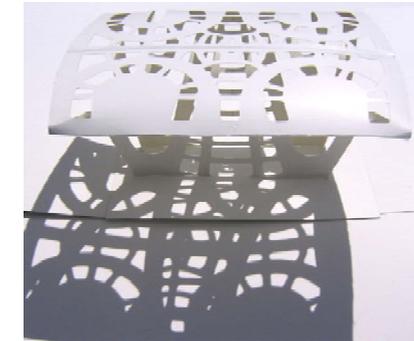
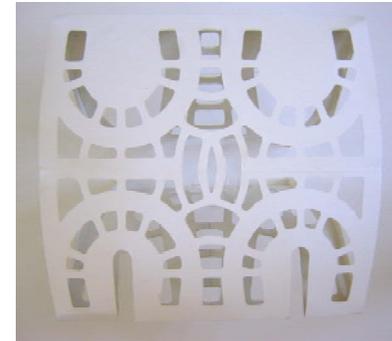
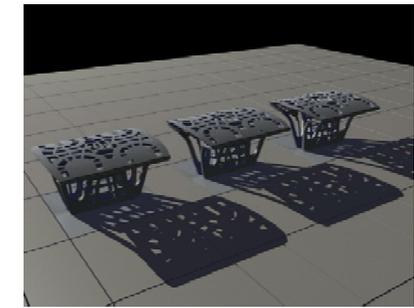
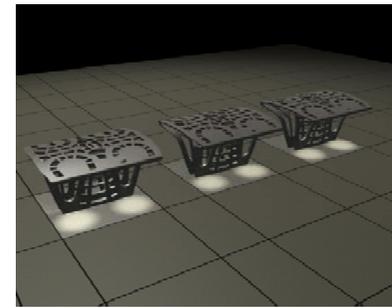


URBAN LIGHT: Light experiments in the development project.



URBAN LIGHT: Sources of inspiration for light forms. James Turrell's light installations are often, as here, created with indirect light, in which the actual light source is hidden and the light is created by reflection. Mark Rothko's paintings blend from one colour to another in gentle transitions reminiscent of James Turrell's lighting.

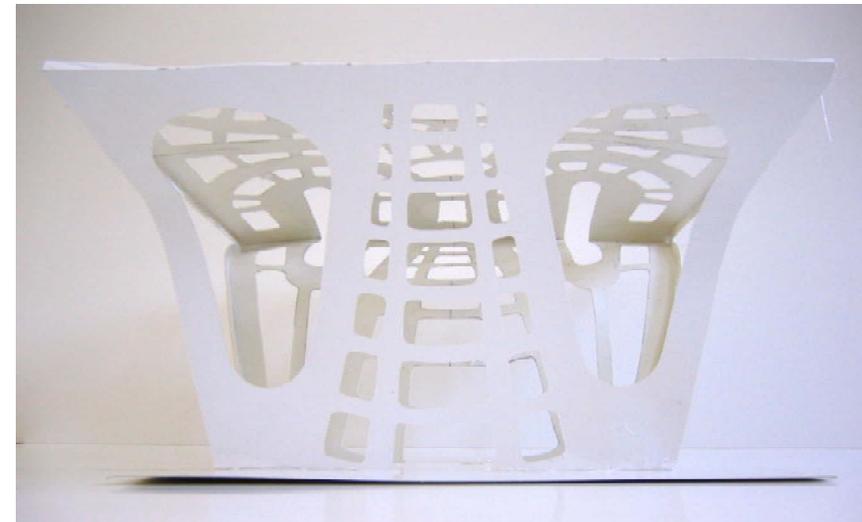
We were very interested in working with Litracon-inspired translucent concrete, but the manufacturing process, which involves placing many fibres in the same direction and casting them, remains to be optimised in relation to industrial use and curved surfaces. It is also a concept which, as yet, is mainly aimed at situations involving forces of up to a maximum of 50 MPa, while in bends it can absorb just 7 MPa. (www.litracon.hu) In our design, on the other hand, we required much greater compression strengths (approximately 200 MPa) and bending strengths (approximately 100-200 MPa). So for the time being, we have chosen to allow the light to be transmitted via the hollows and openings in the concrete surface which are part of the overall design. This can be seen both in the rounded design, in which the light spreads out both through the opening at the bottom, and via a small hole on top which indicates that the sphere is a hollow construction, and at the bicycle stand function. The light here functions as a guide in relation to various functions, such the articulation of design and surface, and as orientation in relation to the urban environment. The same applies to the filigree design, in which the light is located beneath the seating surface and is reflected downwards through openings onto the slab in which the item is embedded.



Light reflection via surface finishing

As mentioned above, we have been inspired by the lighting artist James Turell and by the painter Mark Rothko, who achieves soft continuous transitions between light and darkness and between colours. We aimed to achieve a similar effect by allowing the light to be reflected on concrete surfaces; not just the surface of the actual street furniture, but also on the surface slab in which the item is embedded. We consequently tested various methods by which we could achieve such a light-reflecting concrete

Anja Margrethe Bache



URBAN LIGHT: Filigree model. Lighting furniture for use as a bicycle stand or seating. LED and solar cell-powered.

surface. We have amongst other things cast metallic and reflecting elements in the concrete, and utilised technologies from the car industry, the machine industry and PCB manufacture to achieve concretes with micrometre-thin metallic surfaces. We have also drawn upon the world of ceramics in our search for a smooth, light-reflecting surface.

Characteristic of these techniques is that they make use of the fact that the new concrete is a composite technology, which can consequently be adapted to many industrial processes besides those of the construction industry. In our designs, we point to potential local uses for the new concrete in light-reflecting surfaces in lighting furniture for the urban environment.

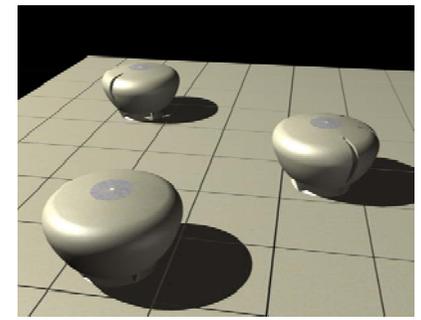
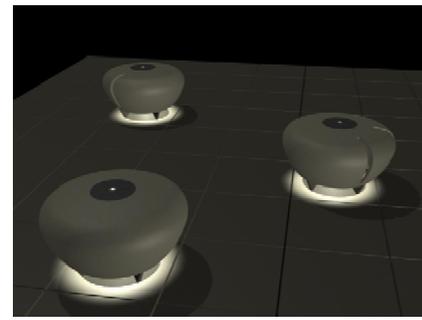
In the rounded design, the interior surface of the hollow space is light-reflecting to allow the greatest possible utilisation of the light. The light, besides being emitted at the small hole on top and at the bicycle stand, radiates outwards from the bottom and is reflected in the item and on the surface slab in the urban environment as a circle of light at foot height with steadily diminishing light intensity. It thus has a guiding effect and creates intermediate pools of light in the dark of the city.

In the filigree design, the light is directed downwards onto the surface slabs in two cones of light and spreads via a slender light-reflecting surface out into the urban space, again at a height that cannot dazzle, but which also illuminates the item's exterior surface and texture.

In the profile design, the external lighting element is located in a "pocket" with a light-reflecting surface. This has the effect of causing the light to fall as a stripe in the vertical part and on the external slabs, indicating the seating function and illuminating the urban space at a height which does not dazzle.

Energy sources and cabling

In our designs, we utilise two types of energy sources: traditional electrical power sources and solar cells. According to Ib Mogensen, former development manager at Louis Poulsen Lighting and now director of a new innovative company, "Outsider", LED light sources can be powered by a mere 200-300 cm² of solar cells, which makes them



URBAN LIGHT: Rounded model. Item of seating/bicycle stand/litter bin lighting furniture. Energy-saving bulbs and solar cells.

suitable for use in outdoor lighting furniture which can be sustainable, and where it is desired to avoid cabling to the furniture from another source of energy.

Solar cells are currently most familiar from the cheap garden lamps of the building market and building-integrated solar panels, but recent years have seen several technological leaps forward in terms of efficiency and appearance which have made it possible to utilise solar cells in a broader perspective. Experiments at Outsider have demonstrated that a solar cell area of 2-300 cm² is sufficient to power the white LED lights used in the designs at a total of 3-5 W in the evening hours.

The Danish Energy Authority sees such great potential in the idea and the concept that it has subsidised the project "Solar cell-powered LED lighting in street furniture" with almost one million Danish kroner in 2007. Besides Outsider, the participants in the project include Risø National Laboratory, Dong Energy and several Danish designers. Ib Mogensen. www.outsider.dk

In our designs, the solar cells, sockets, cables, transformers and batteries are moulded into the concrete or are located in the hollow spaces of the furniture. The advantage of using concrete is that these components can be selected as visible or invisible elements, as long the moulding-in process allows flexibility with regard to replacement.

Conclusion

The development project URBAN LIGHT has lasted for one year. There are still many aspects which have not yet been investigated and implemented in our solutions, but we nonetheless hope that with the three prototypes manufactured by Dalton Betonelementer, we will be able to demonstrate some of the considerable potential for the design of multi-functional lighting furniture in new concrete for urban spaces.

