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MOVEMENTS IN ARCHITECTURE

01 | 2008

The Ultimate Tower – Burj Dubai

The Architecture of Energy Production

The Potential of Intelligent Building
Installations

Living on Water – Prototype of
a Low-Energy Floating House

Hotel Interiors – A Visit to AB.Living
Design in Sweden



ABB



Bettina Filmer, G+S

The combination of economy, ecology and city, of technology, space and art lie, for Professor Dörte Gatermann and Elmar Schossig, in integral planning and digital construction.

To the point: Energy Efficiency

pulse, in discussion with the Cologne Architects Office, Gatermann & Schossig

Which energies will determine architecture and our lives of the future?

I hope that our lives in the future will be supported by the natural resources of our planet, primarily by the sun, but wind and water should also play an increased role.

For which, hitherto unknown applications could these energies be used?

A number of known (or in development) forms of energy are already being applied for the first time: from biogas facilities, solar power stations, hydrogen, for example for use in engines, to the newest photovoltaics. The worldwide research will inevitably generate new applications.

How effective is architecture in comparison to other sectors of industry?

With respect to the knowhow for 'intelligent' buildings, we are, in comparison to the rest of the world, well ahead. The fact that 40% of

global energy use is attributable to buildings shows us what a responsible role architecture plays.

How will living and mobility change with respect to energy?

The energy problem could actually help us to turn back the mobility screw that has been created. Resource-sparing behaviour requires careful management of mobility and in particular individual transport. If we could manage to reduce the distances between the workplace and home and there was more of a mix, our cities would become more vibrant and we would have the ecological advantage for free.

Where do you consider is the greatest accumulated demand in construction and for which technologies do you have the greatest hope?

If we're talking about construction then we have enormous deficits in comparison to other sectors of industry. The difference in the product quality is enormous. Only structured, modular building forms the basis for better quality and, in connection with intelligent software modules and fundamentally new logistics, this difference can be made up.

In your opinion, which role does a building control system play in an energy-efficient system?

A modern building cannot be efficiently operated without software which is co-ordinated for the whole structure. If one thinks that office buildings are on average only occupied up to 25% during the year then it is clear that an intelligent control system for the regulation of all the important building functions is indispensable.

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The high-pressure storage power station Walchensee in Bavaria uses the mass of cascading water from the natural 200 metre waterfalls to produce energy.

The Architecture of Energy Production

Barrages, dams and hydropower plants shape our landscape; they are often visible from far away, construction statements and a sign of their time. However, the newest achievement in the energy sector is the current turbine power generation. It uses the immense power of the oceans in order to produce environmentally-friendly power. This is a quantum leap, not just technologically but also architecturally as the energy production takes place on the ocean floor and is therefore invisible to the human eye.

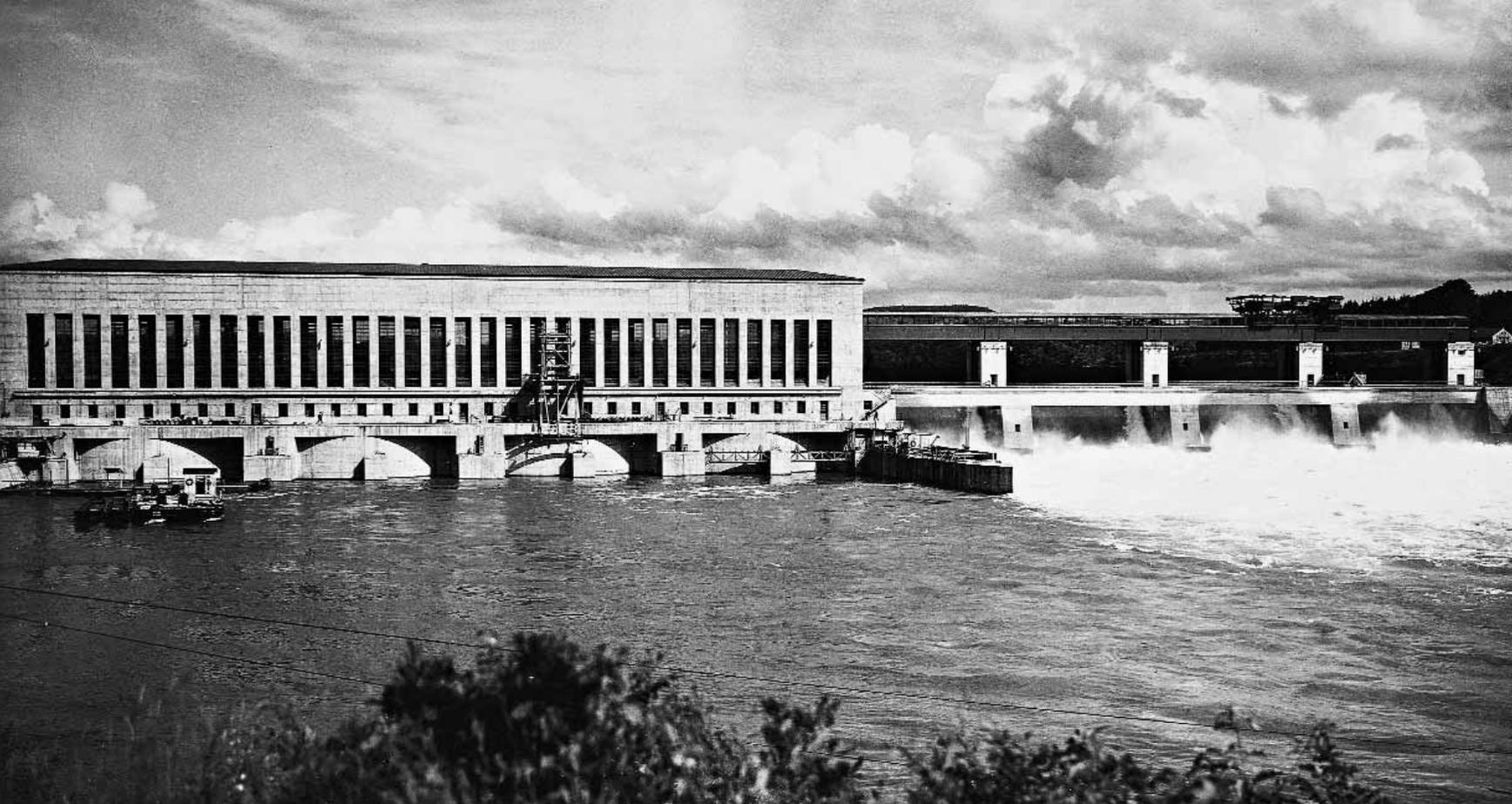
By **Klaus Dieter Weiss**

'Every tenth train uses hydropower' was the title of the *Süddeutsche Zeitung* at the turn of the millennium. A new hydropower station on the Donau in Bad Abbach between Kehlheim and Regensburg uses the 5-meter difference in height between the Rhine-Main-Donau canal and the actual river flow of the Donau. The almost invisible power station which is almost completely built in to an existing dam produces 21 million kilowatts of railway power per hour which is the equivalent of six million litres of diesel fuel. 90 cubic metres of water per hour flow out of the canal in the lower-lying Donau without the water having to be artificially dammed. The use of other regenerative energy sources is difficult for the railway because wind power and solar installations can only intermittently deliver power whilst the trains are in use around the clock. Of course, hydropower stations are also dependent upon the water supply and due to seasonal fluctuations the existing railway's hydropower plants in Bavaria had to be extensively secured by the building of a converter facility in Karlsfeld.

The technically available range of all regenerative energies is many times higher than people's energy consumption. Hydropower is one of mankind's oldest energy

sources and for more than 2000 years the power of dammed or flowing water has been used to drive grain and saw mills or blacksmiths. In fact, worldwide, Hydropower plants deliver approximately a fifth of the entire energy requirements. In Scandinavia and Canada hydropower plays a particularly important role, there are many opportunities there for intensive use. In Germany, hydropower was greatly developed at the end of the nineteenth century and this is one of the reasons why new installations have become more rare, another reason being the demanding environmental regulations. However, in Europe alone 300 million Euros are going to be invested in the construction of ocean energy installations over the next years.

All regenerative energies are created directly or indirectly by energy from the sun. The sun causes the water to evaporate and so it rises to greater heights from which it then flows down where it can transform its potential energy into performance. The twice daily low and high tides depend on the gravitational effect of the sun, the moon and the earth's rotation. Today you can still find remains of middle age flour mills which got their milling water from the tidal range. Another nowadays rare type of con-



Archive ABB Switzerland

The Rhine Power Station, Ryburg-Schwörstadt built in 1931 is the largest of 11 running hydro power plants between Lake Constance and Basel. The generators and electrical equipment were produced by the ABB-predecessor BBC Brown Boveri; five years ago the power station was modernised and furnished with future-orientated technology by ABB.

struction of the water mill was the floating mill which had been developed one century before the common era to divert energy supply shortfalls during the siege of Rome. These mills, which were erected on floating platforms, were independent of changing water levels because they were able to adapt to them very easily. Floating mills were then, in contrast to the conventional water mills, hydropower's first primary load machines which were available around the clock. However with the increased use of the rivers as transportation routes these became a traffic hindrance. Nowadays, the hydropower installations interfere with the complicated ecological balance of lakes, rivers and their surroundings and spectacular large-scale projects have often been obstructed by technical and economical risks.

The largest tidal power station in the world

In 1840, there was an idea to build a dam at the source of the Severn river between Cardiff and Weston. An official study from 1925 provided evidence that at this location it would be possible to produce 800 megawatts of power. In concrete studies carried out between 1974 and 1987, the possible output from this would-be largest tidal power

station in the world was raised by to 8640 megawatts with a maximal tidal range of 15 metres. The planned 16 kilometre long barrier between Brean Down (England) and Lavernock Point (Wales) was to be equipped with nearly 200 turbines. The installation would have covered approximately 12% of the UK energy requirements for that time. After considerable planning and development costs the idea was again picked up in 2006, triggered by the alarming signs of climate change. Tidal power stations use the height-difference (tidal range) of sea water between low and high tides. At high tide, the water flows over the pipe turbines within the dam into the separated bay. If the water levels between the sea and the bay are of an equal height, the openings in the dam wall are closed. At low tide the process repeats itself but in the opposite direction. The tidal power station which has been operational since 1966 in La Rance in the Gulf of St. Malo on the north coast of the Bretagne has been supplying power with little interference and very reasonably for over 40 years. The contentious Three Gorges dam in the Chinese province of Hubei forms a conventional dam which is the largest in the world resulting in a reservoir of double the size of Lake Constance. 26 turbines with a total actual power output of

The Ybbs hydropower plant on the Donau (above), the Hoover Dam on the Colorado River (middle) and a future current turbine power generation on the ocean floor (below) illustrate hydro-power's great potential.

18200 megawatts could cover 14% of Germany's power requirements. The mammoth Three Gorges dam project involved the flooding of 13 cities and 1500 villages – two million people lost their homes.

Invisible Current Turbine Power Generation

The difficulties with tidal power stations are that despite seawater-proof materials there are considerable wear and tear problems to overcome. The maintenance effort caused by the silting up and sludging is also high. Additionally, due to the necessarily enormous barriers, the sensitive biological balance is disturbed. The investment for the building of a dam, the usually essential reservoir and the complicated system of sluices is immense. The efficiency factor of the relatively ineffective low-pressure turbines lies at between 25-65%. The tidal power stations reach their 'zero performance point' four times a day which shifts by about 50 minutes each day so it is inevitable that peak times are affected by these natural failures. Current turbine power generation in the tidal current is, in contrast to wind and sun, predictable and permanent and uses the effects of gravity without having the typical classic disadvantages of tidal power stations. Through the high density of the water in comparison to wind, current turbine power generation only needs (at 2 to 2.5 metres per second) about half the current speed that wind energy installations do. Under water a 20m sized rotor is sufficient for an output of one megawatt – with wind, the diameter of the rotor would have to measure 55m. Current turbine power generation only stops for a moment at the turn of the tide and either changes its direction or the rotor blades are adjusted and the rotation direction is maintained. The world-wide first pilot installation of the British-German 'Seaflo' project was put into operation in June 2003 off the coast of Cornwall. The next step is the development of a double-rotor with an output of one megawatt per installation. The only visible sign of a current turbine power generation is a tower the height of a ship, the so-called monopole. The rotor hub is generally situated about 10 meters under the tide's lowest level and for maintenance or repair work the whole rotor can be brought up. The visible conversion of hydropower with the aid of mills and dams has evolved to become an underwater solution which is almost completely integrated into the topography.

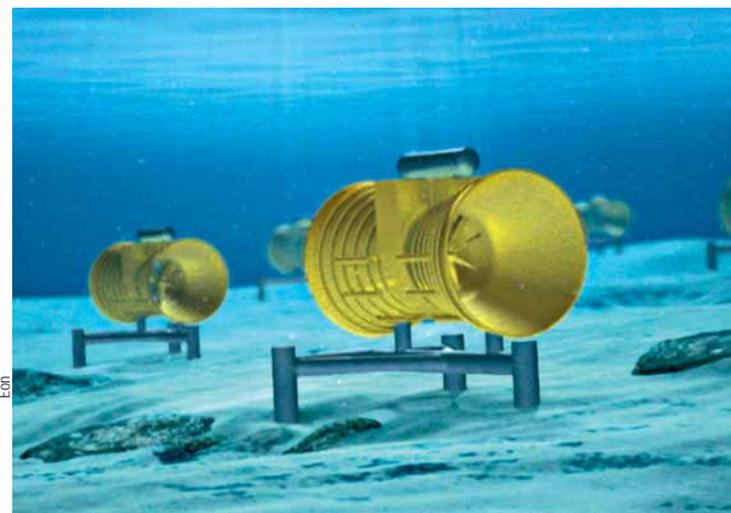
Klaus Dieter Weiss is an architecture critic and photographer who writes and photographs regularly for the specialised architectural press at home and abroad. The author lives and works in Minden.



Verbund



Kathy Steen / iStockphoto



Eon



The explosion of energy requirements in cities – energy saving potential in every single household can help to counteract this.

The Buildings of the Future – recognise the energy-saving potential

Never has electricity, gas and oil been more expensive than today – never has the careful management of energy been more worthwhile. Resource-sparing, efficient construction must exhaust all the possibilities of increasing energy efficiency. For the most part unused potential is to be found in the area of building automation. *pulse* identifies the opportunities of building management.

By **Prof. Dr.-Ing. Martin Becker**

Architecture and building automation seem, on first sight, to be two completely separate areas in which, however, big energy saving potential is possible. Against the background of the increasing demand for resource-sparing construction, it is necessary for the investor or developer to find a suitable compromise. Modern, energetic building planning is about finding a compromise between costs, energy efficiency as well as the comfort and convenience aspects for the user. For this not only the energy requirement values determined during the planning are important but also, during the planning phase, it is important to consider how to monitor and minimise the energy costs which will accumulate during the entire lifetime of the building. The running energy costs, such as energy or servicing expenses, contribute up to 80% of the entire lifecycle costs whereas the initially executed planning and construction costs only contribute 20%. From these numbers it can be seen that a contemporary and adapted building automation in addition to energy and building management play a decisive role in the

economy and energy efficiency of the building. It is not rare for the values determined for energy consumption during planning to be exceeded by two or three times. Alongside the difficult-to-determine user influence the other reasons are non-optimally regulated installations as well as operating parameters which are not adapted to the utilisation. Clarifying these incorrect settings is also one of the responsibilities of building automation. The energy consumption of a building is not of a fixed size but heavily dependent upon user behaviour and an optimal installation and building operation. Contemporary automation techniques are necessary tools for dynamic energy and building management whereby all the necessary data is collected and evaluated. This data guarantees the necessary clarity about all the energy flows by means of appropriate energy data clusters in the building whilst also giving information about the positive as well as the negative influences of the users' behaviour. From this, it is then possible to introduce prompt and target-oriented economic optimisation measures.

Building automation for an energy efficient building operation

Energy-saving potential consists in part of the optimisation of individual systems such as heating, ventilation, climate or lighting. Examples of this are adapted control parameters and variable desired values, an adapted operation of the installations by partial load or physical presence and occupancy-dependent automation strategies for heating, ventilation, cooling and lighting of the room. There is additionally a high optimising potential in the area of comprehensive system automation in the sense of harmonised interplay of the entire installation technology – these could be strategies for the installations' combined heat and power or for the integration of regenerative and distributed energy systems (e.g. photovoltaic, combined heat and power unit, heat pump) in a comprehensive energy provision system. Examples of this are comprehensive automation concepts for geothermal use with heat pumps for the cooling or heating cycle in connection with thermal component part activation and allowing for the actual demand set, weather data or weather forecasts.

Cross-Trade Approach

Modern building automation solutions are characterised by a holistic cross-trade approach. Open bus systems and communication standards such as the European installation bus (EIB/KNX) are usual nowadays and belong to the standard infrastructure of the building. These systems are increasingly being integrated into the normally-available computer network for primary management tasks based on the Ethernet TCP/IP network. Building automation, office and telecommunication networks grow ever more together as a single, integrated communication system and, with this, important installation values for diagnosis or energy consumption can be transferred from one place to another, all over the world. The visualisation of installations and their actual process data in dynamic installation images is an excellent basis on which to monitor the operation in order to evaluate it in terms of energy. Additionally, such tasks as maintenance management or material and personnel planning can be realised and integrated into the primary business process and facility management.

The removal of barriers in the system

If one critically observes the situation today, one has to declare that we are, in many applications, still miles away from an effective use of building automation and management with the already available technological possi-

bilities. A number of the causes are named in the following points: with architects and developers there is often little knowledge and a lack of understanding for the importance and possibilities of contemporary room and building automation and management. The manufacturers have not (as yet) managed to 'translate' the themes of building automation and communication technologies for architects and developers. In many cases cross-trade building automation is delayed and hindered by the classical planning process in individual trades ('my trade'). Hardly ever is a clear life cycle approach incorporated which can be economically justified despite the possible higher investments costs for the building automation due to the reduction in the later lower operation costs. Building automation is not seen enough as a continuous optimisation tool in the ongoing building operation as trained personnel are often not available. Due to this, energy saving opportunities are not, or hardly ever, utilised.

Optimisation during the planning phase

An improvement in the present situation for all the participants (developer/investor, architect, planner, operator, user) would doubtless be desirable - it must however, be implemented during the buildings' planning phase and definitely demands the willingness to rethink the classical planning steps according to the motto "our heads are round so that our thinking can change direction". The building automation and information architecture should therefore be designed as early as possible and individually adapted to the type of building and its intended use. The later the design is created, the more expensive and therefore more uneconomical the building automation solutions will be. Subsequent but thoroughly useful and necessary investments for an optimised building operation (e.g. the installation of additional energy counters, additional sensors for the monitoring of the requirement/user-defined regulation strategies or a primary building control system) are by this time generally no longer economical. However, if this takes place in a consistent way (in a harmonised building automation concept) and is already allowed for in the early building planning and is put into action step by step in the later planning phases, then in relation to the entire building costs, there is comparatively little extra investment needed. In fact, practical examples show that with an integration plan this could be realised without extra costs - we are talking here about the architectural design of the planned automation and information system being implemented parallel to the architectural design. It is rec-

The cockpit of an aeroplane – an example of optimised control technology. In building automation this standard is still being aspired to – cross-trade solutions guarantee a holistic building management.



Carlos Santa Maria / iStockphoto

ommended to involve either an integration planner or a technical design planner who will also allow for the life cycle costs of the building.

Integrated building systems / Mechatronic Façade Systems – A View

A strong trend in building technology at the moment is the development of plug-in, integrated technological systems with co-ordinated part components and integrated measuring, control and regulator technology. An example of this are the plug-in heat pumps with integrated hydraulic assembly and measuring, control and regulator technology. This development will in the future be extended to building shell and façade technology. The first façades of this kind are available on the market which contain distributed ventilation appliances, sun-protection systems, lighting systems and even energy production by means of photovoltaic modules, whereby the individual systems (by means of built-in measuring, control and regulator technology - façade automation)

are optimally co-ordinated with each other. The façade control in turn is connected via a standardised bus system into the room and building automation so that the operation is co-ordinated in respect of usage and energy efficiency. The window or the façade transforms itself from a passive to an active building technological element. In this connection one can speak of a mechatronic façade system which links the mechanical, electromagnetic/ electronic and information technology components to a new, high-quality complete system. There are exciting developments in this area to come which will make new integrated building concepts possible.

Professor Dr.-Ing. Martin Becker teaches at the Faculty of Architecture and Building Climate at the College in Biberach where he conducts research in the fields of room and façade automation, cross-trade building automation as well as in the fields of energy and building management.

Vertical City

The eyes of the world are on Dubai – and all the more so now the world's tallest skyscraper is being built there. The Burj Dubai is just a year away from completion. The building is like a "city within a city" in its own right, not just in terms of the number of people who will use it, but also in matters of resource consumption and the technology of its fittings and equipment.

By **Jakob Schoof**

The Cinderella of the Persian Gulf is about to transform itself into a dream princess. For months the Burj Dubai concrete structure had been reaching into the desert sky like an ash-grey finger. Now fitting the façade panels has been under way since autumn 2007, which gives an idea of the image this giantess will eventually present in her reflecting garb of steel and glass. But the tower makes a disconcerting impression even amidst all the Gulf's hectic building activity, like a Gulliver fallen from another world to find himself among dwarfs. Set a good way west of the city centre and inland from the expressway, the half-finished structure is almost twice as high as all the buildings in its immediate vicinity. And that's quite something in Dubai, a city that now boasts about 150 skyscrapers over 100 metres high.

Some things will change about the Burj Dubai's isolated situation in future years: a new urban quarter, "Downtown Burj Dubai", is planned for the area round the tower. It will cost about 20 billion euros, and offer a mixture



Taylor Bramley / ArabianEye / Agentur Focus





Even now, in other words without its 200 metre high steel tip, the Burj Dubai clearly towers well above the Emirate skyline. The artificial island archipelago called "The World" can be seen as a shell construction in the foreground.

of high quality homes, offices and lavish shopping and leisure facilities. But one unique feature of the tower is to remain, according to the client EMAAR Properties and their architects Skidmore, Owings and Merrill (SOM). The Burj Dubai is intended to answer once and for all the question of who is the tallest in the world: the Taipei 101 with the highest usable storey level (439 metres), or the Sears Tower with the highest antenna tip (527 metres)? Or what about the CN Tower in Toronto, which does not count as a skyscraper, but with its antenna tip at 553 metres is so far the world's tallest freestanding structure. Burj Dubai will put them all in the shade: the ultimate height of the tower is still as closely guarded as a state secret, but there are increasingly signs that a "stop will be made" at about 820 metres. This would meet all four of the Council on Tall Buildings and Urban Habitat (CTBUH) in Chicago's criteria for the tallest building in the world: it would have the highest occupied floor, the highest roof area, the tallest building structure and the highest antenna tip. It will be visible to the naked eye from a distance of almost 100 kilometres.

Desert flower with buttress roots

According to the architect, the idea for the Burj Dubai's ground plan shape came from a desert flower with six leaves. The ground plan has six axes, but only in the base area, where the Burj Dubai has three lenticular entrance

pavilions in front of it. By far the largest part of the tower has Y-shaped ground plans, with the wings becoming successively shorter as the height increases. This shape has practical advantages: high stability with low use of materials (jungle trees use the same structural principle for their buttress roots), and an ideal ratio of façade area to room depth. All the apartments and offices enjoy open panoramic views, without being able – or having – to look into the neighbour's living room.

But the flower is not the only image from Arab culture that suggests itself as an analogy for the Burj Dubai: there is a second one, the ziggurat, the "Tower of Babel", tapering as it rises, with an access ramp spiralling round it. The Burj Dubai has a total of 25 recesses arranged in corresponding spirals, constantly "thinning" the tower the higher it gets. Additionally, the vertical distance between the recesses becomes successively greater towards the top, and thus the tower silhouette becomes increasingly steep. Here again the shape has practical advantages: horizontal wind forces can find almost no real purchase area, they are always "passed on" to the next higher recess.

The Burj Dubai will combine three main uses over 440,000 square metres of gross floor area, of which 312,000 m² will be above ground level: a "five star plus" Armani hotel (up to the 39th floor), luxury apartments (levels 43-108) and office floors (levels 112-154). And as well as this: an underground car park for 2500 cars, the high-

This is how the Nakheel Dubai development group will present itself in the year 2020. By then two further palm islands will have joined "Palm Jumeirah" and "The World", along with the "Dubai Waterfront, in the shape of a half moon.





Ronnie Stewart

est viewing platform in the world (on level 124, 440 metres above street level), several levels for communications technology in the tip of the tower and 4 service zones each rising through three storeys. These latter start above levels 38, 72, 108 and 140 and contain equipment for ventilation, air conditioning, electric junction boxes and pump units, and also the spaces needed above and below the lifts.

Record growth with record concrete

Even though it is not finished yet, the Burj Dubai has its own fan homepage: images and news about building progress are posted almost daily on www.burjdubaisky-scraper.com. And the progress is remarkable: during the shell construction period 2,000 to 3,000 workers were constantly in action on a three-shift system. This meant that the building acquired a new storey every three to four days.

The shell of the Burj Dubai is in two parts: a reinforced concrete structure 601 metres high and a steel tip whose precise height is still secret at the time of writing. A total of 230,000 cubic metres went into the construction, which would produce a cube with sides 62 metres long. The reinforcing steel for the tower, placed end to end, would span one quarter of the globe. Class C80 high-strength concrete was used.

This ready-mixed material contains special chemicals, workability agents in particular, and has three times the compressive strength of normal strength concrete. Two high performance pumps forced the concrete to its point of use at the tip of the tower. It could take up to 20 minutes to reach this position, and had to be cooled by adding ice, so that it could still be worked at external temperatures around 50 degrees.

Usually a few very thick load-bearing walls are built for skyscrapers and the rest of the vertical loads are transferred by point supports. A different approach was taken for the Burj Dubai tower: the tower was built as a honeycomb structure with a large number of frame-like reinforcing walls and wall thicknesses of only 30 to 40, in exceptional cases 60 centimetres. This also affected the shuttering technology: as a rule, the ratio of wall to ceiling shuttering is 1:2 or 1:3. The converse was the case when constructing the Burj Dubai.

Glass cladding with solar shading factor

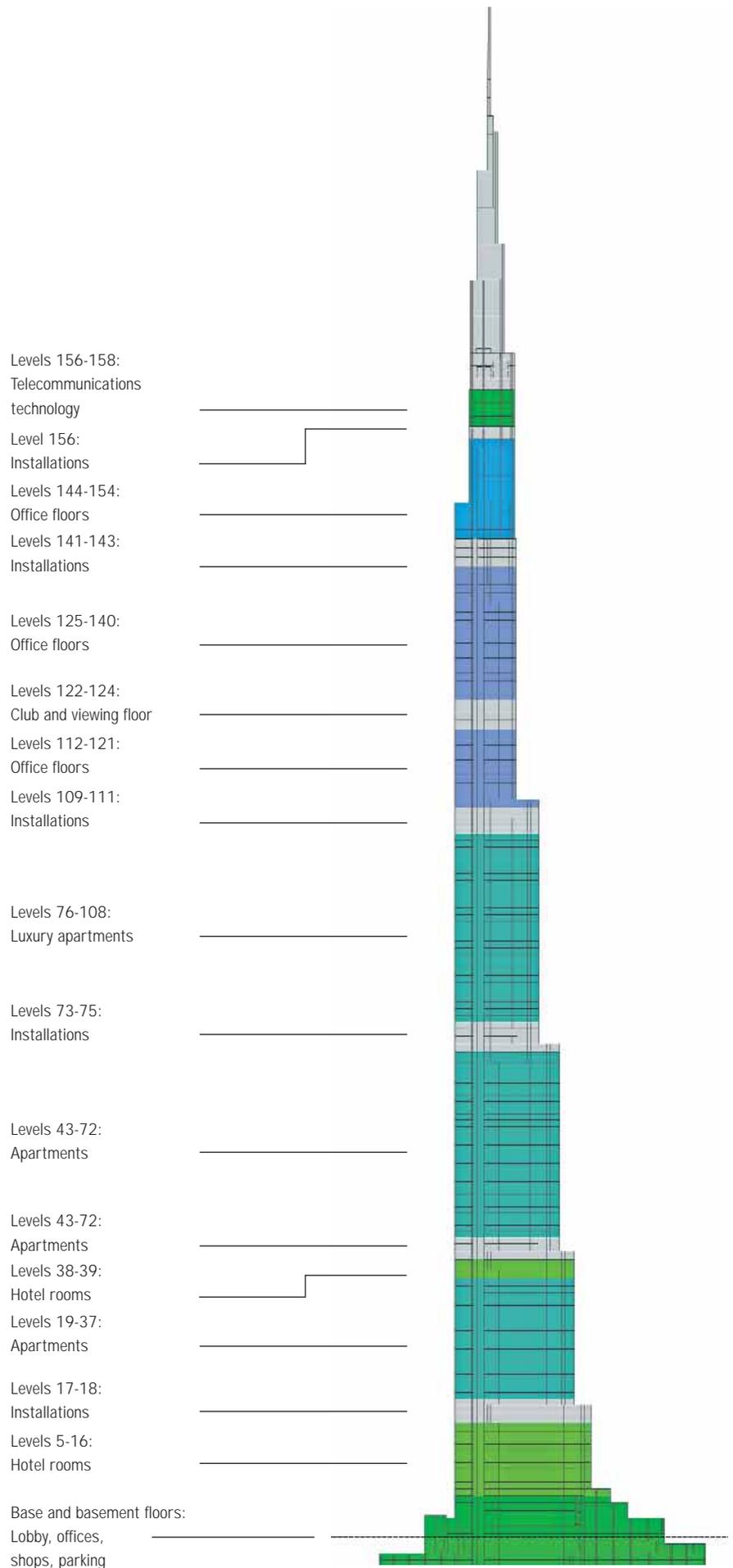
An ingenious mind once calculated that the curtain façade of the Burj Dubai will be as large as 17 football pitches. A façade area of this type can be built only if the potentials for prefabrication and standardization are exploited to the full. 21 different façade panels in sizes of

1.3 x 3.2 metres to 2.25 x 8 metres were used to build the Burj Dubai. The aluminium façade posts are clad with stainless steel masking panels on the outside. These protrude from the façade surface like pilaster strips, articulating them vertically. Double insulating glazing with a 16 mm gap between the panes was used for the façades. The outer pane of glass was coated with silver on the inside, while the inner pane had an outer Low-E coating. This glass combination allows 20% of visible light, but only 16% of heat radiation inside the building. The following figures show the enormous range of weather effects the façade has to withstand: external temperatures fluctuate between +2°C and +54°C, and the surface temperature of the façade rises to 82°C. In addition to this, the wind pressure increases with the height, and the Gulf coast is subject to constantly circulating wind-borne sand, which attacks the façades like scouring powder. The façade surfaces are cleaned with the aid of three external lifts that are parked towards the top of the tower in externally mounted "garages". Each of them is suspended on a 45 metre hinged arm that can itself move horizontally on tracks. Using this method, cleaning all the tower façades once takes three to four months.

First-rate installations

The lift planners adapted a technique familiar from railway systems for vertical access to the Burj Dubai: express lifts take residents and employees to distribution levels, so-called "sky lobbies", placed above the service zones, without stopping. From there, "local" lifts take users to their residential or office floor. The advantages: the express lifts can operate at very high speeds (up to 700 metres per minute) and with a high capacity (2 x 21 people on two cabin levels). In contrast with this, the shafts for the local lifts can be stacked one above the other to save space, as each of them serves only one section of the building.

In all over 50 lifts will be moving up and down in the building. This also includes two service and maintenance lifts for the office floors. One of these travels from the ground floor to the 138th floor, making it the highest lift in the world, with a shaft height of over 500 metres. In planning terms, these lifts represented a particular challenge because of the "reverse chimney effect": in moderate latitudes the air in tall atriums or air-spaces tends to warm up and rise. In the sub-tropical climate of Dubai the opposite is the case: the interior of the building is cooler than the outside air, which causes real katabatic winds in the staircases and lift-shafts. This problem was solved by providing all the express and service lifts with doors that shut tightly.



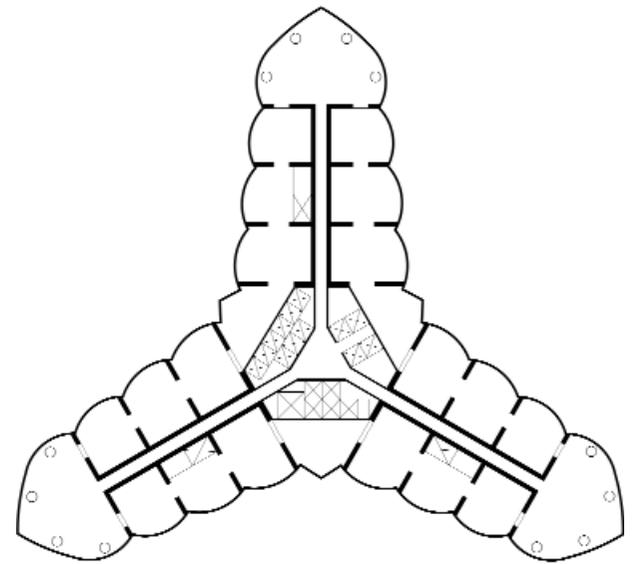
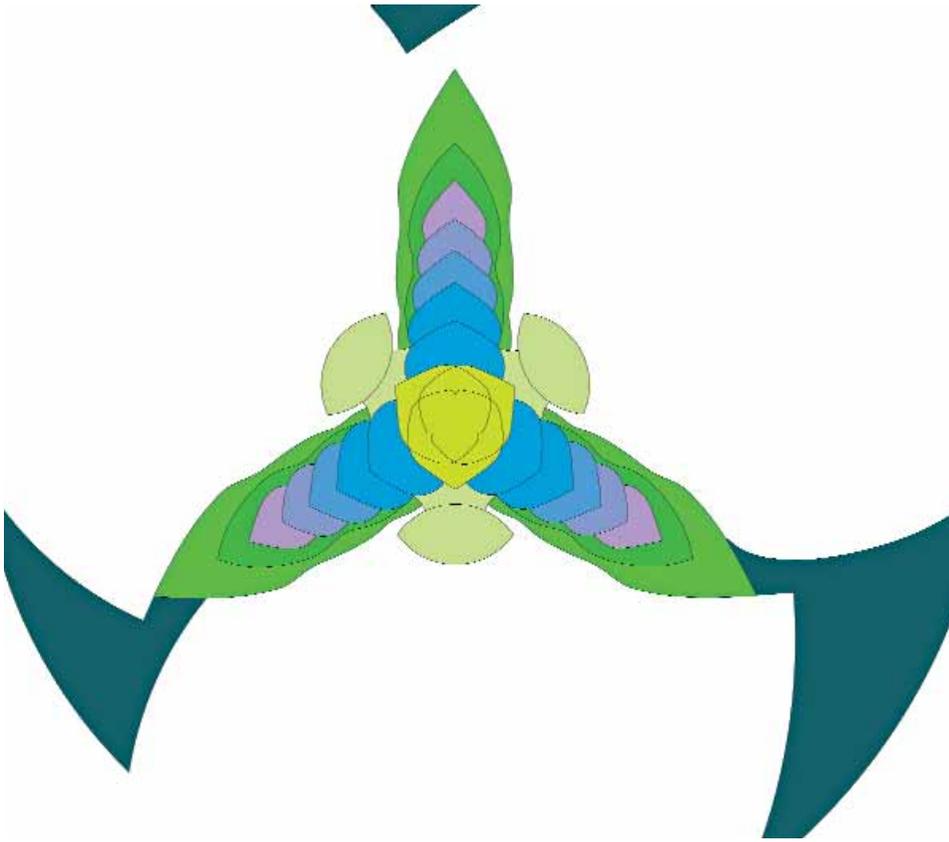


Haider Yousuf / Fotolia.com

Floral forms shape Dubai's urban development, even on the largest possible scale: the Palm Jumeirah, here shortly before completion, consists of about 200 million cubic metres of sand and stones that have been scattered into place. The trunk alone is about five metres long.



Hymenocallis, a type of lily, is native to tropical Central America. Its flower structure is said to have provided the idea for the shape of the Burj Dubai's ground plan.



Top view of roof (top left) and floor plan (top right)

The consumption figures for a building the size of the Burj Dubai are impressive: the thermal energy that has to be extracted from the building at peak times each day would be enough to melt 10,000 tons of ice. The cooling water for the complex comes from two nearby cooling plants, each of which could service the Burj Dubai alone in case of emergency. The base of the building houses heat exchangers and pumping stations to provide the different user zones with cooling water: two each for the residential and hotel floors, one for the office floors and a further plant for cooling drinking water, whose temperature can rise to 39 degrees centigrade in the summer. Fresh air is drawn into the tower in the service zones, then cooled by the exhaust air in a heat exchanger and later blown into the individual floors mechanically. Adjustable ABB drive units ensure that the ventilation plants, exhaust ventilators, pumps, smoke removal ventilators and fresh air blowers are working correctly matched to each other and to the external climate. The Burj Dubai is fully equipped with sprinklers, for which a separate fire-fighting water system able to store 870 cubic metres is provided. It is intended to be enough to prevent fire from spreading in the lower part of the tower for 90 minutes and for 30 minutes in the upper section.

The skyscraper's electricity supply was set up to meet a peak load of 36 MW. For purposes of comparison: the world's largest solar power station, under construction near Leipzig at the time of writing, has a peak output of 40 MW with a module area of 400,000 m². To meet this high demand, the Burj Dubai is one of the first buildings in the Persian Gulf to have a 11 kV supply. The power is not converted to a 230 volt operating voltage until it reaches the building's own transformer. 50 gas-insulated ABB switching units control the flow of current so precisely that sections of the building's full system can be isolated for maintenance purposes or to diagnose faults. This equipment is particularly suitable for use in high-rise buildings because it takes up so little space. As well as this, five 11 kV emergency generators ensure that power can be supplied in emergencies for safety systems, selected lifts, pressure ventilation for the staircases, smoke-removal ventilators, pumps and emergency lighting.

A monument to the age of oil

What will happen to the Burj Dubai when it is completed, what will the world think about it in 50 or 100 years? History teaches us that monuments always gain a hold on the collective memory if they were well ahead of their



Site plan (left). In future years the Burj Dubai will acquire its own city centre. The sizes involved are impressive. The high-rise buildings that have been constructed in the area so far scarcely rise higher than the base of the tallest building in the world (right).

EMAAR Properties

times in terms of size (like the Egyptian pyramids or the Empire State Building) or have won their place in people's hearts because of their formal elegance (like the Gothic cathedrals or the Chrysler Building in New York). The Burj Dubai could some day be one of the buildings in the world that falls into both categories. But perhaps it will be seen as a late monument to the oil age and its unchecked growth. It must be obvious that this building is subject to other rules than "normal" development properties. Its value as an economic and political symbol is the key factor, not its profitability. And this should stand the test of time if anything can: according to the senior site engineer Greg Sang, the stated useful life of the Burj Dubai is over a hundred years.

Project participants

Architects and structural engineering and services planning

Skidmore, Owings & Merrill LLP, Chicago, USA
www.som.com

Client

EMAAR Properties PJSC, Dubai, VAE
www.emaar.com

Project management

Turner Construction International
www.turnerconstruction.com

Contractors

Samsung/BeSix/Arabtec



Living on Water

On the Kieler Förder one can find the prototype of the first floating low-energy house. A team of architects, ship-builders and engineers have succeeded in developing a new house using modern technology and a resource-saving construction which fulfills the highest expectations of comfort. All this was achieved on a minimal plot size with a free view over the water.

By **Cornelia Krause**

To live by the water was always seen as the privilege of particularly prosperous citizens, and those living on the water tend to be seen as being on the edge of society. The hidden places at the water's edge which are used for living and/ or working today are seldom officially permitted and then usually only provisionally and in the form of used barges which are a thorn in the authority's side. When freed of this negative image, however, an excellent idea remains and that is that with innovative thinking and newest technology the banks of rivers, lakes or deserted harbour basins can become absolutely socially acceptable and usable for urban building.

As is so often the case, the new is created from altered economical conditions. The globalised market has forced the Kieler Friedrich boatyard to concentrate elsewhere than on its core business (ship-building) in order to ensure the company's long-term survival.

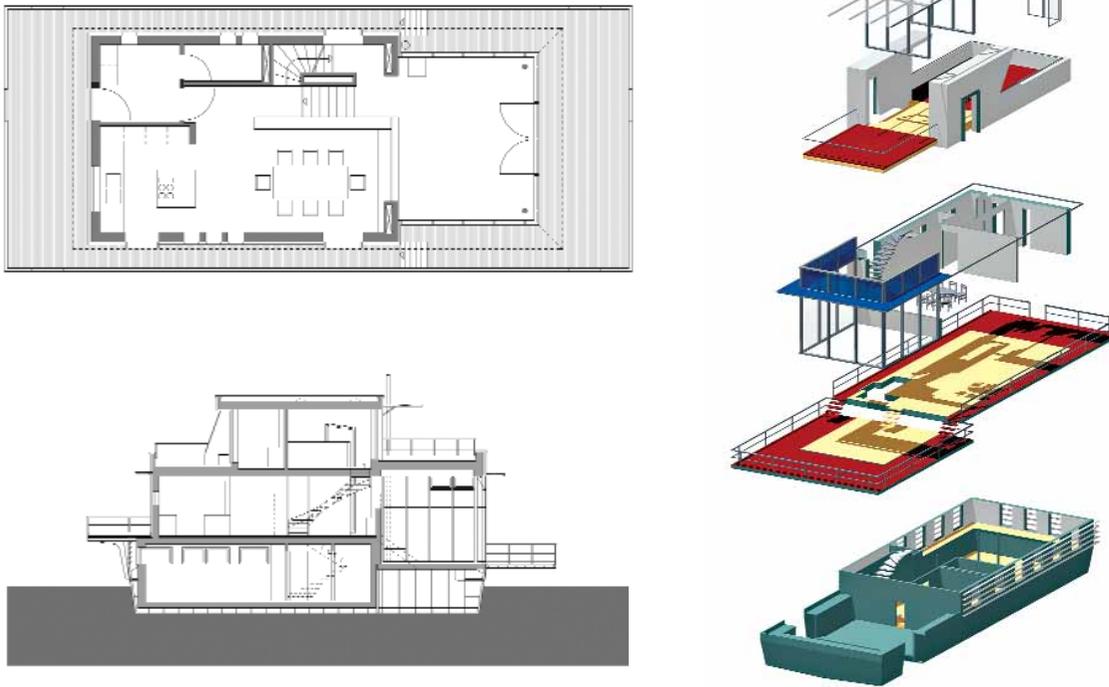
The idea of floating houses is a niche which can very quickly spread and become successful. Where else can one find affordable waterside plots of land in such little space? However, this type of settlement requires careful



Oliver Heissner



The living area flooded with light: winter garden with a view over the Kieler Förde.



Ground plan and section of the prototype 'Living on Water 1'

treatment of nature, as does the sensible allocation of mooring positions as well as the application of regenerative energies for provision and disposal including the selection of building and construction materials. The 'doers' from Living on Water saw their task as not only an extension of city life from land to water but also considered the combination of ship and house to be a special challenge which also has to be made viable for today's living conditions.

The amalgamation of two independent building elements causes changes in the constructive, technical and design aspects which of necessity lead to a new form of appearance. This fruitful co-operation between the boatyard operators and representatives from the Muthesius College of Art as well as architects and city planners has led to a design which not only aesthetically but also technologically masters the difficult split between ship and house. The future (and also courageous) developers have a 140m² living area with outdoor terraces available to them split over 3 levels which, in this case, should logically be named decks. The main deck is reserved for living with a

kitchen and winter garden which extends over both floors. The sun deck serves not only for relaxation but can also be used as a jetty for one's own yacht. On the top deck there is space for a bedroom and bathroom.

Technical construction

The energy generation occurs by means of a photovoltaic installation on the roof, a heat exchanger under the float and a wood pellet stove in the winter garden. The control element ensures that the heat regulation is adjusted to demand so that even the regenerative energies are used economically - in addition an ingenious building system supports the living comfort. Comparable to the computer technology in a modern ship, light, heating, cooling, temperature time and control displays are regulated centrally from the 'bridge' - in this case, the kitchen. An LCD screen shows the entire deck structure of the floating house, from lower to sundeck in a main menu. Additionally all the functions are controllable by means of a remote control or a local control element. The multifunctional display and control instrument takes over the responsibility of the control centre which signals the response (both by





Oliver Heissner

The galley and dining areas merge into one another – whether cooking or eating, the free view over the water is always there to be enjoyed.



From the control panel (which is situated between the entrance and the kitchen) all the functions for the floating house can be activated such as the switching and dimming of lights and heating regulation. Additionally, all the measuring values and/or alarm messages can be read.

sight and sound) from security installations such as movement sensors or window contacts around the house.

The load-bearing structure

The base of the floating house is a ship-like but not 'road-worthy' steel float made of eight millimetre thick welded steel plates in which the three-floored house-like construction is placed. Although it is anchored firmly at a mooring the steel float is treated like a ship which has to be protected against wave impact and the pressure from ice. For this reason, the side walls of the hull incline outwards. In case of damage a watertight bulkhead ensures floatability. The first level is almost swallowed up by the durable anti-corrosion protected steel float and, similar to a conventional lower floor, a large part of this is used for the house technology. The visible part of the house surrounds large-sized, load-bearing wooden sandwich elements with room-high, glazed panes.



Christian Birr

The formation phase of the floating house – with the help of a crane, the lower floor is sunk into the steel float (above). The supplied sandwich elements are assembled in the boatyard hall (below).

A 20cm thick core of Styrofoam provides the necessary thermal insulation. On the inside the well-insulated walls are clad with straw matting and loam rendering as well as being equipped with panel heating. Well aluminium and coloured fibre cement form the outer façade finish.

The co-operation of maritime, architectural and building technicians has achieved new dimensions in aesthetic, ecological and technical areas. The modular-based interplay of float and flexible construction opens up a multitude of application possibilities which range from living and holiday homes to offices, event venues or even restaurants. The linked structures guarantee high efficiency and cost effectiveness too.

Project participants

Client

Living on Water GmbH & Co. KG, Kiel, D

Architects

Fischer, Fromm und Partner GbR, Berlin, D

Shipbuilders

Ingo Clausen, Maasholm, D

Services Planning

HATI GmbH, Berlin, D

Integrated Products: EIB/KNX-System, Control panel as well as EIB controls from ABB/Busch-Jaeger's 'carat' switch series

Interior Design

Dagmar Nordberg, Bisse, D

The Aesthetics of Wind Power

No other type of renewable energy has experienced a similar rate of growth as wind power and architects have long been engaged with its integration into our buildings and cities. The good old wind turbine is mutating in its design to a symbol of progress – or it is, depending upon the purpose and context of the building, occasionally coyly hidden.

Gerber Architects: Energy Tower, Manama, Bahrain

Not everywhere in the world can the primary energies sun, wind and water be used so well together as on the Arabian Peninsula. Inspired by the effectiveness of the traditional wind towers of the region, the architects succeeded in planning the first zero primary energy high-rise building. The 322 m tall waisted tower with its winding glass façade will be used as a hotel, residential and office building. The basic concept of a wind tower has been used for its ventilation in that the energy of the wind is captured by the building and conducted as a coolant through the interior, the double façade playing an important role in this. Using different pressures which are constantly created by wind and thermals, the used air is extracted by natural forces. The ecological cooling is created by a shield layered with photovoltaic cells which rotates with the sun and not only protects from heating-up but also creates additional energy. The Energy Tower is not only very economical but also creates the energy that it needs for itself solely from renewable sources.

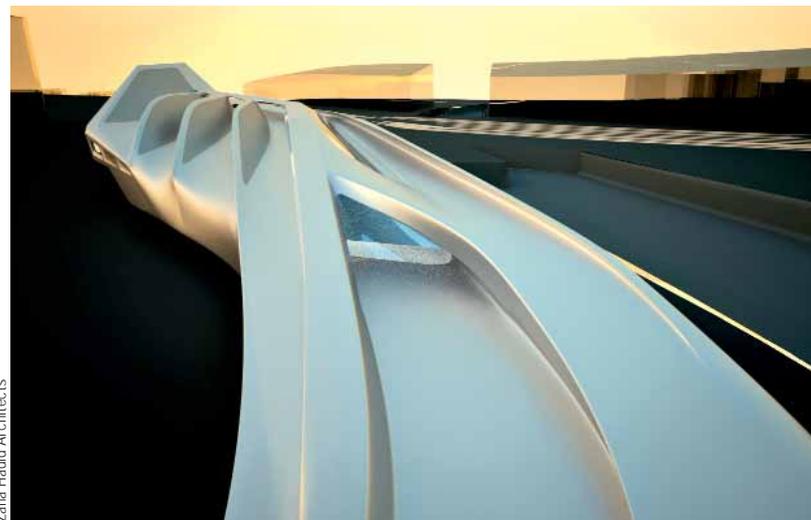
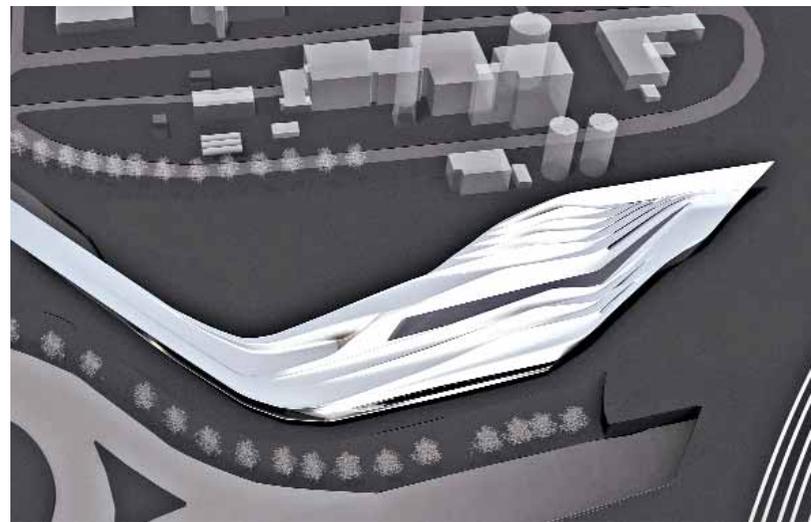


Gerber Architects



Zaha Hadid Architects: Research Institute, RWTH Aachen

At the northern end of the university campus in Aachen, Zaha Hadid Architects are planning this new, low-energy building. The plot of land which is strongly shaped by the direction of a main road seems to be ideal for the Iraqi architect who is well-known for her spacious, architectural gestures. The sculptural design allows the almost invisible integration of technical parameters. The highly pronounced aerodynamic grooves which run along the roofscapes (cladded with fibre-reinforced concrete), modulate the incoming light and the wind which flows over the building. Seven low-noise wind turbines which are built into the wind channels and are framed by wind-spoilers, benefit the building's energy production abilities. In this way, resources are effectively made useful for the interior. The structure and shape of the building are in direct relation to the visible and invisible currents in the area and surroundings. The system is topographically split into an upper and lower level, meaning that the practical and experimentally-equipped areas consisting of four laboratory units and an exhibition hall are optically separated from the academic section. In the design process it was decided early on to lead the users of the building via a footpath to the main entrance in the south-west and this path, which had already existed as a scenic trail, was deliberately staged as an extremely long access route.



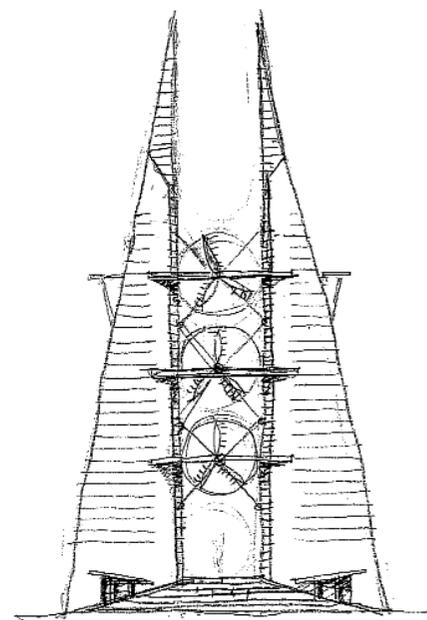
Zaha Hadid Architects



visualisation muharradi-studios, Atkins (r)

**Atkins Architects: World Trade Center,
Manama, Bahrain**

The two 240 m towers, reminiscent of sails, of the new World Trade Center will decisively shape the skyline of the city of Manama. The three connecting bridges upon each of which a wind turbine is installed are powered by the strong coastal winds of the Persian Gulf. The energy generated in this way covers 15% of the entire energy consumption of the towers (which are primarily designated as offices). As there were no comparison values for this integration of wind power into a building, it was necessary to conduct technically sophisticated tests and simulations to assess the vibration behaviour and to verify the dimensions of the components. As a result, it is now possible to affix wind turbines with a diameter of 29 metres to a building. However, the planners were not just interested in the superlative, they also provided, by means of complex landscaping, for sufficient natural shading in the plinth base of the towers. The intensive greening not only hinders the disturbing glare from the glass facades, but also serves as a means of CO₂ reduction.





Marks Barfield Architects

Michael Jantzen: Solar Wind Pavilion, Fullerton

The American architect, Michael Jantzen, designed a sun and wind pavilion as a meeting place for California State University. The pavilion's frosted glass dome is shaded by external concentric discs with solar cells on their south side. An approx. 45 metre tall mast with a vertical wind turbine will provide power for the pavilion and the surrounding university buildings. The energy is stored partly in a battery and partly in a hydrogen tank which are both situated in the plinth base of the building. Rain water which is also stored in a tank under the pavilion is used as the source for the hydrogen.

Marks Barfield Architects: Windturbine 'Beacon', London

Ken Livingstone, the Mayor of London, wants to cover 50% of the London energy requirements long-term from renewable sources. This is planned as part of his 'Green Light to Green Power' programme. The 'Beacon' wind turbines developed by Marks Barfield Architects XCO2 and Price & Myers could be of help here. The 40 metre tall, y-shaped masts can be positioned along the Thames, on roundabouts or along main roads and with 6,650 of these – one per 24 hectares – Ken Livingstone could achieve his energy targets. Too many? According to the designer, this number is relative when one considers that London alone has over 19,000 bus-stops.



Michael Jantzen



The Five-Star Designers

When authentic luxury is required, the hotel operators of the world often call in the specialists from Sweden. Since its foundation in 1982, AB.Living Design has successfully completed projects at more than 90 hotels and resorts for clients such as Kempinski, Radisson SAS and Sheraton. *pulse* met up with Tarek Hegazy, President of AB.Living Design.

By **Jakob Schoof**

Tarek Hegazy knows the international hotel business inside out. Before joining AB.Living Design at the end of the 1990s, the Egyptian-born designer worked in the USA, Egypt, France, Hungary and Dubai where he contributed to the splendour of buildings such as the Burj Al Arab and the Emirates Towers of Dubai. Today, he and his team of sixteen employees offer a turn-key planning service for upmarket hotels which in effect means that his company, based in Stockholm and with a new opened office in Geneva, manages everything from the initial design sketch through to the detailed planning and construction supervision.

Mr Hegazy, you offer your clients a complete service from a single source. Which tasks are performed directly by your company and which are undertaken by external service providers?

We produce the design and the detailed planning for our projects in-house. External service providers take over tasks such as visualisation, project management and construction supervision. In most cases we have worked together with these companies for a long time and can thus rely on them as if they were our own employees.

Does that mean that you have strategic partners throughout Europe to whom you assign, for instance, the construction supervision?

No. We usually send colleagues from Sweden to the site. We have great faith in the Swedish work ethic and quality culture and our clients perceive us as a "Swedish" company although, in reality, we are in fact very internationally structured: We employ interior designers from Great Britain, Ireland, Switzerland and Canada as well as from France which enables us to more easily adapt our work to the practices of different countries and their cultures.

What does "Swedish quality" mean within the domain of interior design?

We exercise extreme care in our approach towards details and I believe this is embedded in Swedish culture. Consider, for example, brands like Volvo or Ikea, here too quality is always defined by cleverly-planned and quality-implemented details.

In which parts of the world do you work - and on which projects?

For a number of years now, our sole focus has been on the hospitality and gastronomy business. Only very occasionally do we take on an order for private residences or offices and even when we do, we adopt the principle that it is we

Tarek Hegazy (left) and his international team from AB.Living Design. They design hotel interiors for the luxury segment.





In Autumn 2007 the refurbished Grand Hotel Kempinski in Geneva was reopened. The hotel bar with its ornamental stainless steel counters and pillars clad with mosaic show more than a hint of extravagance.

AB Living Design

who choose the client and not vice-versa. So far we have only designed for locations in Europe and Russia but are running at full capacity. We were already active in Russia 15 years ago as one of the first western planning offices to operate there, a step that enabled us to become well acquainted with Russian culture.

How greatly do the requirements for Russian hotels differ from those in central Europe?

Each country has its own hotel culture and definition of luxury. In Scandinavia, for instance, minimalism is regarded as luxury. In Russia, however, luxury is portrayed through complex details, an abundance of gold as well as wood carving features. Furthermore, terms such as "contemporary" or "classical" have a completely different meaning there than in France or Scandinavia.

You have worked for prestigious hotel operators such as Kempinski, Sheraton and Radisson SAS. How do they differ in terms of style and requirements?

The differences are huge, perhaps the biggest of which exist between four-star and five-star hotels; a five-star hotel has very specific perceptions with respect to style

and comfort and is not prepared to make compromises of any kind. I very much like working with Kempinski, for example, as this company seeks to give each of its hotels an individual identity. In practical terms this means daring to create something new for each design. Other five-star operators opt rather for a universal corporate design. In each of their establishments they offer the hotel guest the same visual experience. I think such an approach results in many lost opportunities, the hotel neither fits its location nor does it possess a separate identity. This type of hotel works fine as a "globalised" product in the three or four-star category, but not in the luxury segment. In my view, this sensitivity towards the location and the individual has something to do with human emotions – they too cannot be standardised or "globalised" since they always remain individual.

The technical features of hotels and hotel rooms is changing. How does that affect your work?

During the past three years installation technology in particular has changed considerably. Smaller details such as electrical plug sockets, which were previously not really



AB Living Design



The Kempinski Hotel Taschenbergpalais in Dresden (top and right) was opened in 1998. When furnishing this Baroque building by Matthäus Daniel Pöppelmann, AB.Living Design combined classic elegance with modern functionality. In contrast to this, Scandinavian minimalism is presented in the interior of the Hotel Clario in Stockholm (middle left).

items to which hotel guests or designers paid particular attention, are suddenly becoming important. Thanks to EIB and other progressive installation systems, the use of a building's technical equipment and specification can be designed to be more convenient and efficient. On the other hand, there is the issue of the rather high costs which means that hotel operators' acceptance of such systems is not yet as high as it is, for instance, within the office sector. However I am sure that this will change in the near future.

To what extent does your work rely on proficient manufacturing partners?

To a very great extent. If the manufacturers do not work absolutely reliably, projects will end in failure. It is therefore important to be extremely selective when choosing one's cooperation partners. This mutual trust aspect is to be found in our co-operation with ABB/Busch-Jaeger – we know what we can expect and if we recommend the company to one of our clients, they also know what they are getting.

The proliferation of the large hotel chains seems to be unstoppable. In view of these developments, do smaller, family-run hotels still have a future?

They certainly do, but not in large cities, their fortunes there have irrevocably changed. However in the countryside or in smaller towns they will survive due in part to the fact that they have a location advantage in such places - the large chains usually have difficulty adapting to small-town locations. The size of hotels and the culture with which they operate are quite simply different. In historical towns and in areas of great natural beauty the future therefore still belongs to the "family hotel".

If you had the opportunity to spend a night in a hotel of your choice, which one would you choose?

That's a difficult question. Barcelona is one of my favourite cities and is a place where I would like to stay again. The Hyatt in Singapore is certainly one of my favourite hotels and I really rate the Adlon on account of its service. A night at the "Emirates Towers" in Dubai would also appeal very much to me perhaps due in part to the fact that I was involved in its construction. However it all depends to a large extent on the season and my personal mood.

Read more about hotels in the next issue of *pulse*.

The 'House-Technology-Future' Workshop

What potential there is to be found in modern house technology was researched by more than 40 architects, interior designers and specialised planners together with ABB/Busch-Jaeger during a series of workshops entitled 'House-Technology-Future'. *pulse* presents one project in each issue.

Design **Hans-Joachim Paap** of Gerkan, Marg + Partner and **Dr. Christian Mayer** Engineering Consultants for Building Climate

Honestly – before the big climate discussion really became public, wasn't everyone wasteful with energy? The awareness to save has since increased and yet many people still do not understand how to treat energy responsibly whether it be the infamous tilt position of the window, leaving the light or the heating on in rooms which they don't or hardly ever use. The result is that unnecessary energy is being used without the user really profiting from it.

Hans-Joachim Paap und Dr. Christian Mayer can see a great deal of potential for saving in above all the façade area but also in the critical transitions between the exterior and interior.

At present the status quo is characterised by an independent control and regulation of individual components. The designers suggest a cross-trade energy management which would make it possible to directly read the actual energy consumption locally and not somewhere down in the cellar. Only when the user can so clearly see how much energy is being used (like a taxi meter, for example) will he/she be prepared to save. Regular feedback with the possibility of making comparisons would act as an additional incentive.



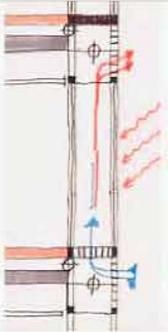
The important light-transmissive façade, so necessary for people's well-being, energetically represents the weak point yet also represents the greatest optimisation potential.



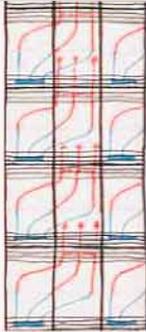
As well as the facades, the entrance and exit areas present opportunities for optimised energy management. Prefabricated door elements could include, apart from the closing function, further integrated components such as lighting and heating.



Mankind, through its behaviour, often acts energetically insensitively. Often the understanding of the consequences of his behaviour is missing. The energy display as a visible element of energy management should help to increase awareness.



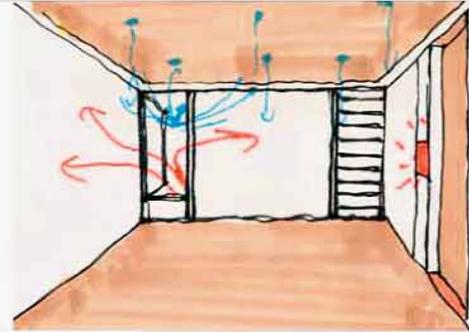
Double facade



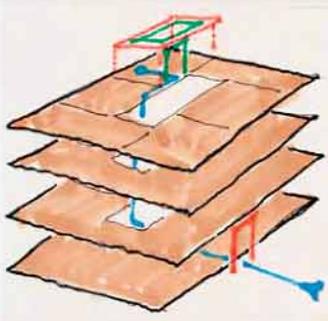
Winter Principle



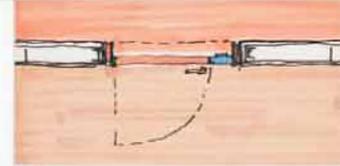
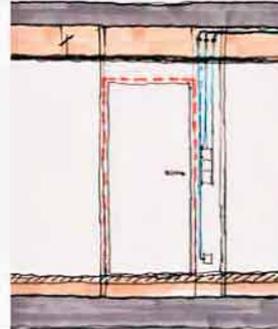
Summer Principle



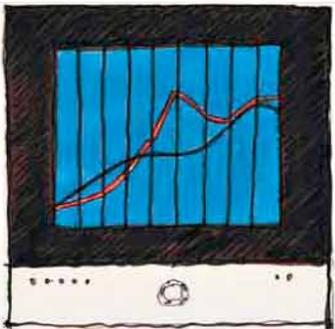
Energy loss



Control by means of differentiated sensors in the access areas



Prefabricated door element with control sensors



Analogue representation



Digital representation



Energy Awareness through Energy Efficiency

Plastic

Materials are the spirit of architecture, they give character to buildings and atmosphere to rooms, but what do architects think about 'classic materials' today? *pulse* asked for their opinions.

Answers by **Prof. Dorothea Voitländer**

What fascinates you about plastic?

Plastics allow for unbelievable design freedom, they are freely mouldable, can be of any desired colour, are resistant to chemicals and weather and also extremely impact resistant. We use glass-fibre reinforced plastic and apply it in the form of hand-laminated, translucent façade panels. Printed special paper is laid into the fluid plastic so that the motive appears like a tattoo which embeds deeply into the reinforced plastic skin. We have registered a patent for this process.

It is hard to imagine architecture without some use of plastic which is, at the same time, not a particularly 'well-regarded' building material. Will this change in the near future?

Plastic has today primarily been given a serving function, it is not optically relevant and this is comparative to the material ferroconcrete which, a hundred years ago, was only gradually discovered for its aesthetic aspect. The majority still describe plastic in a rather derogatory way although in specialised circles this material is enjoying a revival after having fallen into disrepute at the end of the 70s.

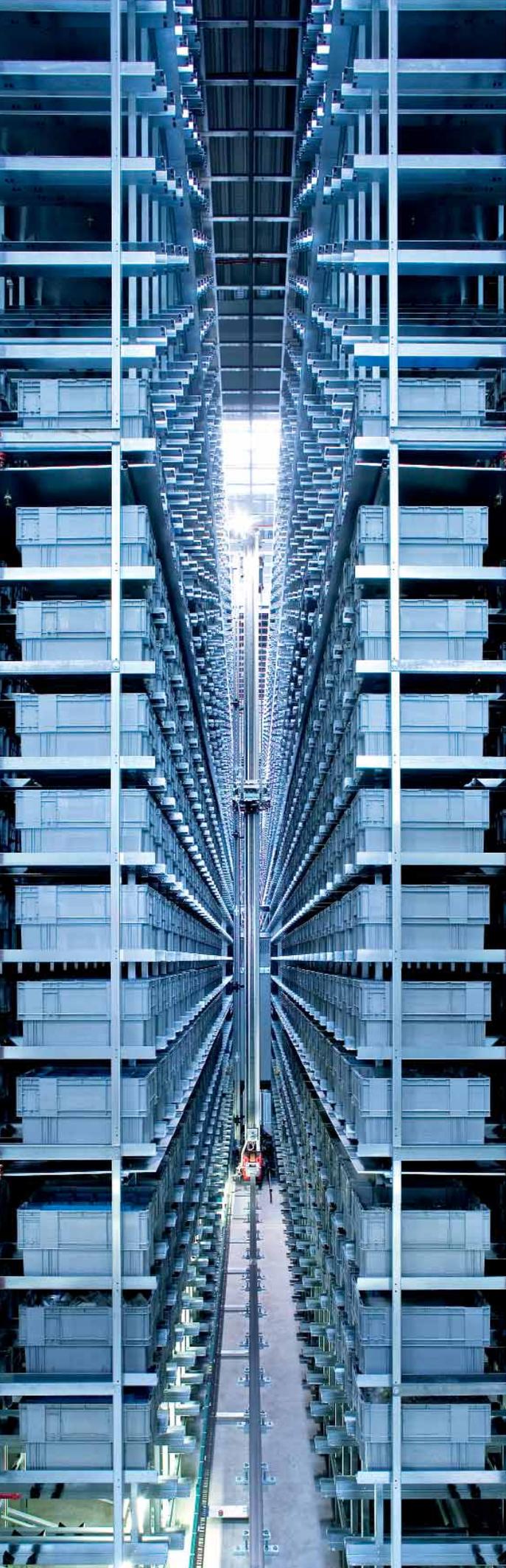
What would your ideal plastic be like which doesn't yet exist?

It should, as well as maintaining its translucency and moulding abilities, either be able to be classified in the fire protection class B1 or a machine would need to be invented which would make the very complex mould construction for plastic components gratuitous and laminate it directly...



Fibre-glass reinforced plastic as façade cladding: Studio house by Deffner Voitländer in Dachau.

Dieter Leisner / arturimages (L), raumprobe



Dynamically positioned

ABB/Busch-Jaeger has invested in the future with its new **logistics centre** in Lüdenscheid. With the new building which was inaugurated mid-June 2007, the entire ABB/Busch-Jaeger logistics were able to be concentrated and modernised. The structural emphasis of the project which cost 18 million Euros is the computer-controlled high-level rack warehouse coupled with a new automated box storage system. Even today, ABB/Busch-Jaeger processes 80% of its orders electronically and with the support of the new centralised logistics, the company will be able to offer an even better service in the future and will be able to react much quicker, more flexibly and more precisely to changes in the market. Quick turn-around times and procedures and a smooth flow of wares provide high product availability and therefore more security of supply. The continuous computing concept offers additional advantages by means of the provision of improved documentation and the application of new delivery units. ABB/Busch-Jaeger has highlighted how significant logistics are for the company by this building project which commenced in 2005.



Show the colours

Beginning with the fact that the most common wall colour is white, it is not surprising that white dominated the switch programme. The colour in colour is due to the fact that house technology should not be noticeable, but this can now change with ABB/Busch-Jaeger's '**axcent**' programme. Four rich colours will mean that light switches no longer need to live a life in the shadows. The colours can be used for various areas, and beyond the decorative effect they are also functional. For example, at the front door, the 'axcent' in green can denote the environment switch which, upon leaving one's home, switches all the appliances on to standby. 'axcent' can also be helpful in public buildings such as hospitals and government offices because it can be smoothly integrated into existing coloured orientating systems. The two-part frame consists of a white bracket and the coloured cover plate which holds the switch, in this way 'axcent' can have a flat design. The smaller shadow gap (due to the smaller bracket) makes the switch appear as though it is flying over the wall.



Extremely comfortable

How often have you been in the situation where you wanted to enter a dark room without both your hands being free. Now the **ABB/Busch comfort switch** means that the room will be lit as if by magic. It looks like a perfectly normal light switch (switch the light on manually as usual) but there is much more to it than that. Three comfort levels which go beyond the normal operation can be integrated. The 'medium comfort' is characterised by its semi-automatic operation, this means that the light will go on automatically but needs to be turned off by hand. With the 'time comfort' the light is turned on manually but is time-controlled and switches off accordingly. The greatest comfort is offered by the fully automatic version which means that no light switch needs to be pressed at all. The ABB/Busch comfort switch is easy to install via a German VDE box and is combinable with almost all the ABB/Busch-Jaeger programmes. Due to the 4 in 1 solution of the **ABB/Busch comfort switch** there are many possible applications which go beyond the living area, for example, for sporadically-used areas in offices or public buildings such as schools and hospitals.



How much power does the Burj Dubai use at peak times and how many 40 watt lights bulbs could be lit with this?

Energy and electricity are terms which are hard to classify; which move in dimensions and numbers; which are beyond our imagination. *pulse* is testing your estimating ability and is presenting a new prize question in each issue. As a prize, the winner will receive a book.



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+49 (0)1805-66 99 09
Email: pulse@de.abb.com

Yes, please. I would like to receive 'pulse' regularly, postage free.

Reply

Burj Dubai's peak time consumption is enough to light 40 watt light bulbs.

Name

Office

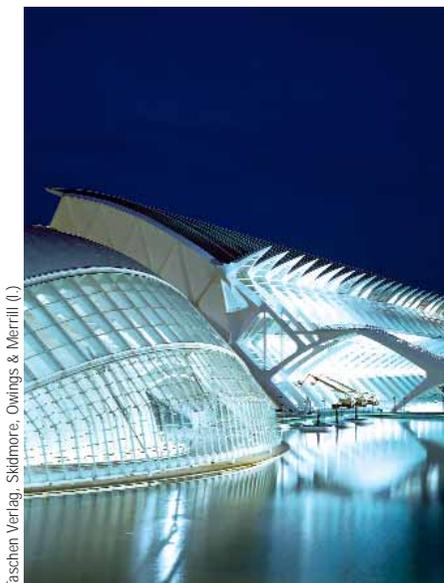
Street

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Taschen Verlag, Skidmore, Owings & Merrill (L)

To win:

The lucky winner picked from all the correct entries will receive a copy of **'Renzo Piano'** and **'Santiago Calatrava. Complete Works'** published by Taschen Verlag. Each of the 530 pages (dimensions 30.8cm x 39 cm) document the monographs collected by Philip Jodidio on the works of both architects in hitherto unknown detail.

Preview, pulse 02-2008:

Worldwide Hotels

From the Spa-Resort in Alpental to a Seven-Star Luxury Hotel in Dubai: What is it that drives the hotel sector and its architects.

More about this in pulse 02-2008.



Dan Talson - fordlia.com

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