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AN APPROACH TO A MORE SUSTAINABLE ARCHITECTURE

Stefan Behnisch†

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Ladies and gentlemen, first thank—you very much for giving me the opportunity to speak here. As you might notice, English is not my mother language, so forgive me if it is sometimes a little bit descriptive and not defining. However, I'll do my very best.

Let me talk briefly about the idea of sustainability in architecture. Recently, the term “sustainability” has been used very often, often discussed and also misused. For the sake of this afternoon’s lecture, I would assume that we can all more or less agree that sustainability makes environmental sense. But I have prepared some examples, three examples to be precise, regarding whether sustainability also makes sense for clients and architects, which I think is the general idea of this discussion.

When we discuss sustainability in architecture, we tend to simply find matters by just discussing energy. We all have a tendency to focus on quantitative matters, because it is easy to count and measure. We usually do not focus on qualitative matters, because they are not easy to count and measure. However, sustainability has more to do with quality than purely with quantity.

Sustainability in architecture in Europe, for example, is measured purely through energy—kilowatt hours per square meter per year. I know you have different measures here, but we will keep it to that.

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Now, if we define the sustainability of a building purely by that, it would be very easy to create a very sustainable building. Just do it in a way that nobody will use it and you save a lot of energy. So sustainability has to have something to do with quality, with the usability of the building.

In roughly 2000, the LEED system in the United States became popular. It was founded before, as sustainability is not a very new idea. However, then it became popular. I think the big benefit of the LEED system is for the broad idea of creating a branding for sustainability. It's not only about keeping score. I know everybody likes to keep score. There are silver, gold, platinum—the black one is missing—plaques for buildings. However, that is merely a side effect. The main effect is that they tried branding. We live in societies where branding is very, very important, and so sustainability became an issue people widely discussed. It is not any more this sort of vague issue, which had always in the past had a little bit of this alternative touch to it. It became really a marketable issue, a brand.

Now, the benefit of the LEED system is, even though it has its weaknesses probably, like all rather new systems have, it has great benefits, because compared to other systems we have, it looks into sustainability in a very broad context. It does not narrow it down purely to an energy discussion. It has at least attempted to have some quality aspects included.

Now, what are the architects and planners role of influence and responsibility? It is the urban, the public realm, and the culture. Architecture is after all the most prominent cultural asset mankind creates. Whenever you travel to another city, you look at architecture. Think New York, think Rome, think Istanbul, and even think Phoenix, Arizona—the lack of architecture is there very prominent. I hope nobody is from Phoenix.

Sustainability in architecture is very much about context. It is very political. Think about your Capitol building, your White House building, the Coliseum in Rome. All these buildings were and are very political elements in the respective societies.

Material—how do we treat materials, the reuse of buildings and materials? Also, how do we treat nature architecturally, the natural environment? We then go in the buildings and we talk about air, climate, daylight, and artificial light—these three elements are very closely connected to energy, but only these three elements of it. All of the other elements are not related to energy really.

I cannot dwell on all of what is shown in this slide, so I will focus on the issue of the last three elements—the energy elements—and show you examples. However, when we look at it, the most important elements are actually the urban and the public realm. They

are very important—how is the building connected in the city, public transport and so on? Is it worth it to be built? Does it enhance the situation?

I will first show you a building we have done in the United States. It is our only LEED building so far. It is a LEED platinum building—the Genzyme Center, Genzyme Headquarters in Cambridge, Massachusetts.¹ This is a drawing from the competition. Our competition drawings are often rather vague, because we believe in developing architecture together with our clients. This is the site plan. The developer is called Lyme Properties. It was an international competition, which asked all architects to come up with ideas for a flexible, but a sustainable building—at that time, sustainability being still a very vaguely defined term. They did so for each of their eight sites' competitions.

That is the Genzyme Center. When we designed the building, it was also about energy, but it was mostly about communication, about workplace qualities—as I said before, the usability of the building. It was also about density. A dense building is more sustainable than a not dense building.

Here we had the problem of the deep floor plate, the typical American block structure. It was a given by a master plan. Generally, if you want to have optimum daylight—we should keep in mind that eight percent of the electrical energy produced on this planet is pure lighting, only lighting. So to have daylight—the goal is that we have about eighty percent of the yearly working time with natural daylight on each work space. Usually you would say a floor plate should not be deeper than forty-five feet. However, the typical American block is something very different from that. So we punched a hole in the middle to get more daylight in the building. In order to do so, we introduced heliostats on the roof, which you will see there. You will see there mirrors on the roof that constantly follow the sun and reflect the natural daylight in the depth of the building.

Light is not visible. Light is only visible when it hits a surface; so, we had to create surfaces to make the light visible. People can experience the daylight and to reflect it in the depth of the building. So we introduced these chandeliers—we call them chandeliers—they are big mobiles of prisms that constantly turn because the atrium is also the air return in the building.

1. Photographs of the Genzyme Center are available at, <http://www.genzyme.com/genzctr/tour/genzyme.html>.

After all, we have natural daylight thirteen floors down. It works with the heliostats. The difference in quality with the heliostats is that artificial light is fixed, is static, but daylight is changing constantly. The cloud, the tree, the birds in front of the window, everything changes. So the sensation of change is a quality of the daylight. Once you capture it with mirrors, it is static. So how could we create the sensation of change in the building to have the feeling of daylight? The chandelier and the louvered wall—you see to the left of the building—a louvered wall with louvers that seemingly randomly constantly change position with mirrors, created this sensation of change in the room. So suddenly you have sun in this corner or in that corner. It is like a cloud chasing over the building. This had less to do with saving electricity; it had more to do with creating an atmosphere of daylight in there.

In addition, throughout the building we have fifteen different window gardens, which are the informal meeting spaces and the communicative areas. Furthermore, if we look at the atrium, you see stairs in the background. These stairs are actually always connecting floors very closely. They are not the escape routes; they are additional stairs.

We architects have a tendency to pancake buildings, to think floor by floor by floor, but once you start programming a building you will notice it makes more sense to program vertically with stairs in between. You create neighborhoods. With big floor plates you can create neighborhoods.

The interior—to the top left you see the cubicle. I never liked cubicles, I have to admit. That was my first building in the United States and it was, for me, a very strange culture. Whenever I came in cubicles they had these little shrines there with the boat and whatever. I always say, let's get rid of these. Did not work. So we were able to redesign them so that at least we got daylight in there and visibility to the façade, to the outside. That is the building from the outside.

Now, was it worth it? First, the energy feature. We have a power plant in the vicinity, and we convinced the client to negotiate with the power plant to have them loop their cooling circle, which normally would go right in the river, once through our building before it goes in the river. We extract the heat from the cooling circle—and with this heat—with absorption chillers, as we cool the building and heat the building. So it is energy that normally would be right away dumped into the river; we just extract it and loop it through the building. So even though the performance of the wall is not too great—it's okay but not too great—the building is close to CO₂ neutral for the very simple reason that we use waste energy, that is there anyway, and normally would be dumped right in the river.

I spoke afterwards several times with the CEO of Genzyme, Henri Termeer. We have worked very closely together in developing the building. He did simple math during the design process when we had all these value engineering sessions, which means making things cheaper. He said at one point that if we improve the performance of the people by ten percent, the added costs are returned in less than four years. If we improve by eight percent, the whole building is paid for in twelve years. I asked him later on, and he said, well, the improvements of the performance is hard to calculate, because when you move in a new building there should be an improvement; otherwise you did something seriously wrong. However, performance is more than ten percent up. Sick time is more than seven percent down and recruiting became far easier for him. The most important thing, in his opinion, however, is that the people who work for him have the feeling they share the same ideals the company has. And on top of that—and I thought this was kind of funny—his building was so well published that he claimed he could have paid for it out of his PR budget.

So is it worth it? Yes, it was worth it for him, and a big part was the issue of sustainability.

Now, I am coming to a German building—the Norddeutsche Landesbank Hannover.² It is an 800,000 square foot building, a high-rise building in Hannover, where we succeeded in covering seventy percent of the heating and cooling and energy out of the ground. Now, this is not even geothermal. What happened was they built, in the 1970s, a subway next to the building and locked off the groundwater movement. So the groundwater cannot move anymore under the building. We used this reservoir as a seasonal storage; that means we heat it up in summer for cooling the building and extract the heat again in winter for heating the building. We counterbalance it. This is enough through where the exchanges through the foundation piles, 170 foundation piles, and natural ventilation and slab cooling; meaning in the concrete we have cubes and run it through the slab. So we balance the temperature.

The natural ventilation is supported—what you see is the red vertical elements; these are the chimneys—with stack effect ventilate the building. We also have double façades to keep the noise out so we can still have window ventilation and bring the clean air from the center courtyard in the double façade. Now, we have a different

2. Photographs of the Norddeutsche Landesbank Hannover are available at, http://www.behnisch.com/site_files/pdf/44.pdf.

climate in Hannover than you have here. The humidity is lower, so we do not need any artificial ventilation there. Here we would need a supporting ventilation to dehumidify the air. Other than that, these systems work everywhere. Here, you see the chimneys, the red dots, the connecting stairways—as I said before, between the floors—natural ventilation, and the entry hall. This building has a very shallow floor plate normally. In average it's about fifteen meters, forty-five feet.

The sun shading devices are like Genzyme in a way that they not only shut out the sun, but they also enhance the daylight to go in the depth of the building. With our daylight enhancement, we have a rule of thumb. We say 1.5 times the height of the window, top part of the window, you have natural daylight in the depth of the building. If you have the sun shading devices, you can double that. So if you have a room, let's say—I don't know—ten feet, you have fifteen feet without that and thirty feet with daylight enhancement system, natural daylight in the depth of the room. Now, a lot of people asked us if it works with so much glass. Often people think glass is a problem. But the natural daylight is actually more important in a building like that, an office building like that than the isolation value, because you have such high internal heat loads in these buildings, they are not really heating driven. They are cooling driven, and for cooling you need sun shading devices. Because in Hannover the air is never that hot; it's just the sun. So we need good sun shading devices. But in the future I probably would close more. One keeps learning.

This is a very innovative, very different building, which I would like to show you. This is the oldest stock exchange in the world, Handelskammer Hamburg.³ It started to be an insurance exchange of the Hanse that was a trading union a long time ago. They asked us to put in this historic hall a structure, a business club, an exhibition space, some work spaces, and a restaurant. It is a historic hall, and you should not see it. It is about three times the space of the hall. This hall has a footprint of 4,500 square feet, and we did put in 10,000 square feet of new floor space. But you shouldn't see it. It should not be there, but they need it. That was the task, a competition also. Now, we started out with a transparent building, all glass and everything. Once we started designing and everything came into play, you see there is not much left of transparency if you see the structure, especially since we could not change the building

3. Photographs of the Handelskammer Hamburg are available at, <http://www.floornature.com/articoli/articolo.php?id=785&sez=3>.

itself. We had to bring—that is the biggest part you see here on the crane—we had to bring everything in through the doors to build the building in there. So we went to immortality—from transparency to immortality. That is the general idea. You see the old and the new coming together, and the new reflecting the old, but also being clearly new, being clearly very different. That is the structure in there.

Now, why I'm showing this is, it is about new materials. This building is fully lit in LED lighting. At that time it did not exist really in this scale. LED was still a thing for the keychain. We developed with a company the LED lighting for it. The whole building takes 1.7 kilowatt hours, which is in about a household dryer at home, energy-wise, for all the lighting. But even more interesting is they give a ten-year warranty for the LED lighting; no changing the bulbs, nothing. Considering that fluorescent lights are environmentally damaging, they are poisonous—that is a big step in the right direction. First of all, it's energy savings, but mainly it's material savings. Since then we kept working on it. We have developed this lighting with a company and right now we are designing the lighting for Harvard in a similar way as a purely LED lit building. The advantages are no maintenance and low energy. The main advantage of LED is the long lifespan, you do not want a janitor on your desk or table changing the bulbs. It looks good because it's only eight millimeters thick, no reflectors. Here you see wherever we were in the Walt Hall, we used old elements, and then in the club to the right-hand side—it's a very posh club—we designed chandeliers but out of LEDs, so the same idea but contemporary technique and elements.

This is the concept for the new University of Baltimore School of Law center.⁴ I'll talk about it very briefly, because I think it belongs in this row. It's something different than an office building. Honestly, it is quite a difficult program, with a library, seminar rooms, all these elements, and a moot court. The court has to be in the ground floorway. It structurally is not ideally suited; it should be on top but it has to be on the ground floor. I think it is a great challenge. I wanted to talk briefly about it. The site is also a challenge, but I think actually it's a great site. It's not your typical block. It overlooks the motorway. It communicates with a train

4. A photograph of the concept for the new John and Frances Angeles Law Center for the University of Baltimore School of Law is available at, <http://www.ubalt.edu/template.cfm?page=2571>.

station across the street, and it is in a very prominent position here. Admittedly it is difficult, but it is a great opportunity to do something very special there. Here are the streets and the entry over by the corner. I did not bring them, but we did maybe twenty different design attempts, the first round was triangular. You know, we tried everything. The obvious would have been a triangular, but we thought it was wrong to react to the site so directly. The advantage is that it steps down the site. You have a noise issue with the motorway, but it steps down so you can actually make use of one floor below, and you have the public users in the ground floor. Here we tried to get an understanding of all these different users in the building and functions. Not only are they very different functions, they all have very different floor-to-floor ceiling heights, so it also doesn't really line up, which is great, because, as I said before, architects tend to pancake things. Here we can create a rather interesting space because three floors of the—I don't know—library, four floors of the classroom, and so you can really create something special there. What we again attempted to do—a little bit like Genzyme, but we do not copy ourselves—it will be a very different building because it's a very different task. It is also a complex structure with a wide opening in the middle, because we want light in it; we want communication in it; and we want spaces to meet in it. And so here we created this solid and wide idea and elements again in the building.

Now, this is a competition design and a very rough idea to start with. This has to be refined with the client and the users through discussion, but I am very confident that we'll succeed together to do something very special here. Here you see a section through the building and you see already the program does not line up horizontally. This is great because you get different perspectives in the building. Structurally I can hear already the builders complain. So that is the last picture. First of all, I think it's quite interesting that you here look and examine, look at other angles of sustainability and sustainable design. We as architects usually look at it technically or architecturally. Legally we do not really care too much. We should, but that's a bit much for us. But I think it is—really, to be successful, it has to be seen from all different angles.

Does it make sense? As I said before, I think we can agree that environmentally it makes sense, but does it make sense for the clients? Does it make sense financially? Financially we can answer that. In most of the buildings we have done so far, it made sense. The payback time, if you look only at the energy, might be in the realm of 12 to 15 years in some projects. We are just remodeling our own office, which is in all the industrial building, to geothermal

energy. When I did the calculation, it's in the magnitude of 20 years with today's energy prices. But even then—even then—it makes sense for us. We have done houses right now for living where in a normal building in Germany of that size, the yearly utility cost for energy would be in the magnitude of 300 euros per month, and they go down to 15 to 20 euros. So there is a fast payback time, because the upfront investment in a new residential building, small, midsize—let's say, 2,000 square foot residential building—is in the magnitude of \$50,000 compared to a traditional heating-cooling system. So that makes very fast sense. These big office buildings—Genzyme, the added costs—if we would purely look at the energy, the payback time would have been in the realm of 15 years. For a company that owns the building and runs the building, it makes sense—for a developer, usually not. Even then I think there is some reconsidering, right.

Now, I spoke to a developer from New York who changed already, his expectations from flipping the building in the first—I don't know—year or two, to really holding these buildings and looking at a 15- to 20-year period. So once we are there—that is where this credit crunch and this crisis actually could help sustainability, because this fast flipping and this fast dealing with buildings and looking at building not as a valuable asset, just as a marketable product which has to be turned within two years—that has changed. So we are looking at least now at a mid-term consideration and not only short-term. Thank you very much for your time.