ARCHITECTONIC DESIGN FOR TECHNOLOGICAL DEVICES

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Abstract: In our current research project we are integrating graphic design and industrial design in an architectural design approach for an implementation in the urban space. It is an interdisciplinary cooperation project from nine chairs of mechanical engineering, one of physics and the external research institute, Fraunhofer Institute for Ceramic Technologies and Systems (IKTS), in Leipzig. The aim is not to let the energy converter appear as a technical device, as this may meet with rejection from those parts of the population who are sceptical towards technical devices in general. Instead, the device should appear in the form of diverse enrichments of private, semi-public and public space, both indoors and outdoors. The enrichment should determine the primary apparition of the energy converter and draw attention to the benefit in space. For this purpose, methods and artistic practices of industrial design and graphic design are used. Industrial design creates objects that can be produced industrially in large series and, in combination with architecture, allow user-oriented scenarios. Through their design, the architectural interventions appear as information boards, public transport stops, lights, bookshelves, benches, climbing towers, moss walls or hanging gardens, while their technical function as energy converters remains in the background as a secondary feature. The development is accompanied by a graphic design that anticipates the corporate design. It is not so much the product variants as the different architectural spaces that emerge as a vision. The virtual photographs, which anticipate the later architectural spaces as a vision, show a complete integration of science and applied art, as creating novel architectural spaces.
Keywords: architecture, visualisation, design, engineering, simulation, virtual photography

LAYERS OF VISUAL MEDIATION

Visual mediation can take place on different levels. It can be limited to illustrating given facts, but it can also contribute to influencing the given facts themselves. Thus, architectural representation classically functions in the design process not only between the architect and client, but also as a reflexive process of the creative person himself.[1] The concretisation of a vision into a visually perceptible form always produces a variation on the original conception and thus enables a virtually endless iterative process of change, if not optimisation. This works equally well between several participants, so that visual communication is also a factor in development teams not to be underestimated.

In contrast to classical architecture, we specialise in communicating spatial but not construction-related concepts, primarily from the fields of archaeology.[2] historical building research and art history.[3] This reference to the humanities allows us to experimentally use the methods of sculptural abstraction and illustrative projection borrowed from the classical discipline of architecture. The usual way of visually communicating abstract contents is the diagram, which in most cases turns out to be two-dimensional. Increasingly, raw data that is available in three dimensions, such as point clouds from three-dimensional surface scans, is also being presented in equally three-dimensional diagrams, but the focus is generally on the objective information content. This means that the objective visual information, for example a 3D scan, is merely supplemented with further information. A model enriched with metadata in this way, then, serves as a three-dimensional database, for example.

The use of abstract three-dimensional representations for buildings and objects is unusual in the humanities,[4] whereas this is not the case in the classical architectural design phase. Here, abstract objects are deliberately created in order to suggest forms that will only be developed later as volumes or cubes.

It is the experience of working with scientists from the non-architectural field that has encouraged us to tread the path from idea to image in a new way in the field of mechanical engineering as well, and to apply the methods of abstraction and concretisation in order to achieve innovative solutions.

GRAPHIC DESIGN AND INDUSTRIAL DESIGN

The basic approach was to use the abstract idea of a technological innovation as the basis for the design of a novel kind of energy converter that consists of an

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1 D. Lengyel, P. Schaerer (2020): “Visualisation”, in: Ludger Hovestadt, Urs Hirschberg, Oliver Fritz (ed.): *Atlas of Digital Architecture: Terminology, Concepts, Methods, Tools, Examples, Phenomena*. Basel, 2000, p. 284–323

2 D. Lengyel, C. Toulouse (2016): “Die digitale Visualisierung von Architektur”, in: Deutscher Verband für Archäologie (ed.): *Blickpunkt Archäologie*, 2/2016 (München, Stuttgart, Darmstadt), 2016, p. 91–98.

3 D. Lengyel, C. Toulouse (2019): “Gestaltete Abstraktion als Vermittlung glaubwürdiger Authentizität”, in: Staatliche Museen zu Berlin (ed.): *Eva Berlin 2019. Elektronische Medien & Kunst, Kultur und Historie: 25. Berliner Veranstaltung der internationalen EVA-Serie: Electronic Media and Visual Arts*: Konferenzband, 6–8. November 2019, Kunstgewerbemuseum am Kulturforum Potsdamer Platz, Berlin. Berlin, p. 146–148.

4 D. Lengyel, C. Toulouse (2017): “Interaktive Virtual Reality zum begreifenden Verstehen eines architektonischen Konzepts”, in: Staatliche Museen zu Berlin (ed.): *Eva Berlin 2017. Elektronische Medien & Kunst, Kultur und Historie: 24. Berliner Veranstaltung der internationalen EVA-Serie : Electronic Media and Visual Arts*: Konferenzband, 8–10. November 2017, Kunstgewerbemuseum am Kulturforum Potsdamer Platz, Berlin. Berlin, p. 104–113.

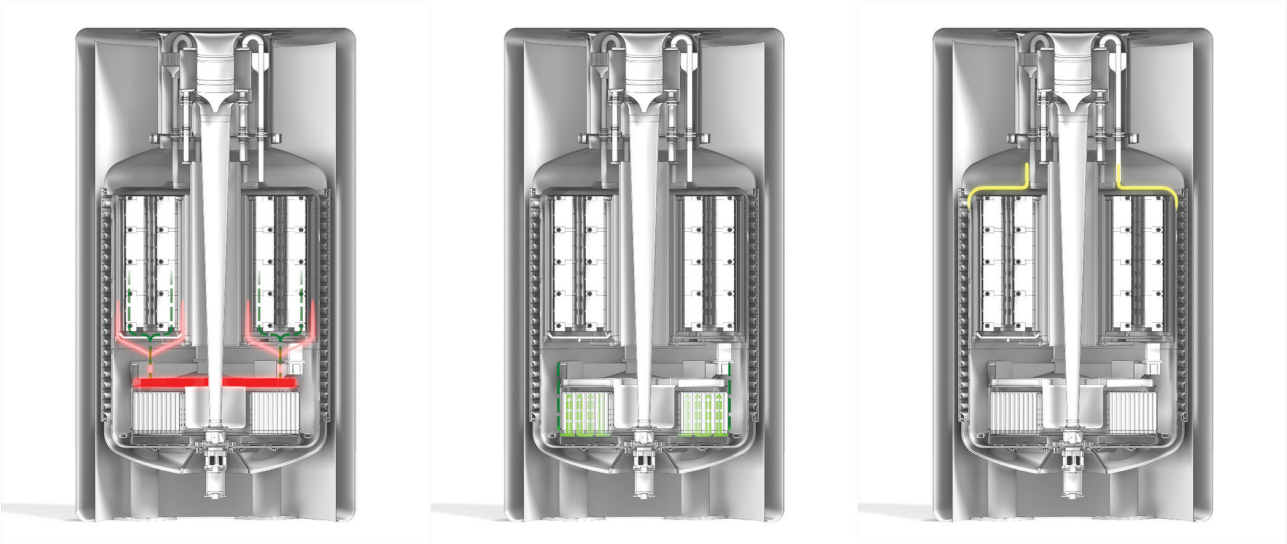

Fig. 1

integrated solid oxyd fuel cell with a gas turbine fuel cell, called T-Cell.[5] It was not the concrete design of a concrete machine, as is usually the case in industrial design, but the communication of the technological idea that was to shape the appearance. In order to increase the acceptance of this approach within the interdisciplinary group of developers, the creative architectural contribution also extends to the internal communication, which consists, for example, in the illustration of the technical processes (Fig. 1). Such functional representations are common in many technical document presentations, but not in the early development phase within the development team. In the end, these functional representations are obviously also used in external communication, but the original purpose was the communication between the different technical specialists.

This means that the design concept does not only relate to product design, which is limited to the later appearance of the machine, but also to graphic design, which develops from internal communication and is also used for external communication. These include internal and external events that serve to present the university's research activities, days of science, such as those organised by the state capital of Potsdam, acquisition brochures for industry that are intended to invite participation and involvement and, last but not least, an art exhibition in Switzerland.

The architectural design is the design bracket; the architectural competence is the connection of different disciplines, here, however, of the different building crafts, but precisely of the different design disciplines with the claim to create a consistent whole and to develop product and graphic design synchronously.

INTERDISCIPLINARY COOPERATION BETWEEN MECHANICAL ENGINEERING AND ARCHITECTURE

The new structure of the interdisciplinary cooperation consists of the classic development team of different chairs of mechanical engineering, a chair from physics, an external research institute of the group of Fraunhofer institutes, the

5 Project *T-Cell* at Brandenburg University of Technology, BTU: https://www.b-tu.de/t-cell/

IKTS in Leipzig,[6] and our own chair of architecture and visualisation. The project is funded by the Federal Ministry of Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie, BMWi).[7] The tasks of the technological and physical scientists are to develop the technological components of the complex integrative system. The tasks of the architectural contribution were to accompany it from the point of view of visual appearance, but not as a purely creative revision or adaptation, and certainly not as l'art pour l'art, but above all for the acceptance of the machine among the public.

Mutual influence plays a central role here, because when weighing up divergent but equally valid options, the design component certainly plays a role, even if technology is always at the centre of such a highly developed technological concept. Ultimately, however, it is a matter of design with a view to the acceptance of the machine to strive for a proportion of height to width that creates an overall impression of a slim rather than a wide one. On this point, the design pays attention to fundamental decisions regarding the overall layout in the sense of a corrective.

We have had this experience in other projects in the industry, too, which in those cases where, from a scientific or technical point of view, alternatives of equal value are at stake, it is quite acceptable if not primarily technical aspects of the design come into play as the decisive moment. In the best case, the design underlines the background of the technology, even if it is merely the rhythmisation of repetitive components that subtly underlines the rationality or even the associated efficiency or economic quality of the product.

Interdisciplinary cooperation that transcends entire subject areas, i.e. not different special fields of mechanical engineering, physics or design, but just in the broadest sense art and science, actually takes place between the fields, and in a bidirectional way, so that there is a gain for both sides. On the technical side, the product is enriched by qualities that would not have arisen from purely technical optimisation, but would nevertheless generate added value in the external presentation and thus in user acceptance . On the design side, the comprehension of the technological interrelationships generates a higher level of complexity, the derivation of which into design effects yields insights for further projects.

DECENTRALISED AND HIGHLY EFFICIENT ENERGY CONVERTER

The technical core aspect of the machine to be developed is, in addition to the energy conversion, above all, the very high efficiency, which is achieved, among other things, by the fact that the gas fuel, in every possible mixture from fossil natural gas to green, emission-free hydrogen, is not only converted into electricity, but the heat generated in the process is passed on as thermal energy, whereby an overall efficiency of 97 percent can be achieved in an optimal composition.

Since transmission losses due to long distances to be bridged only occur in the case of electricity and heat transmission, but not in the case of material transmission such as gas, an essential part of the concept is the decentralised installation of the energy converter directly at the user's location, which can be not only industrial companies but also public institutions and, of course, residential units. The 270 kW

6 Fraunhofer Institute for Ceramic Technologies and Systems IKTS (Fraunhofer-Institut für Keramische Technologien und Systeme IKTS): https://www.ikts.fraunhofer.de/en.html

7 Federal Ministry of Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie, BMWi): https://www.bmwi.de/Navigation/EN/Home/home.html

output targeted here can generate electricity and heat for about fifty residential units, making a fuel cell a suitable choice as the central energy converter for an urban building block, for example.

Decentralisation and high efficiency are thus mutually dependent if the highly efficient energy conversion, which is technically achieved in any case, is not to be undone by unsuitable installation. The new approach is disruptive because it turns the entire infrastructure upside down. There would be no need for central power plants, no transformer stations and no power lines, but only punctual energy converters that access the gas grid that is available everywhere.

ELECTRICITY AND HEAT

This aspect of decentralisation is by no means unusual. Access to the existing gas network is the normal case for the heat supply of residential units, already practised today. Although there are also centralised heat supplies in the form of the so-called district heating, as a rule, the heat supply is first provided decentrally at the consumer's location from energy sources in other forms, such as heating oil or natural gas, and occasionally also electricity, mainly because of the transmission losses. Combined heat and power plants are already close to the new fuel cell in their application, but they have a much lower efficiency and are not interconnected.

The approach of this new energy converter is therefore based on the experience of decentralised heat supply, and also supplies the consumers with electricity in exactly the same way. In addition to the transmission losses that would then also be eliminated in this area, a large part of the infrastructure for transporting electricity over long distances could also be eliminated and, in the long term, only the gas grid would be designed for transport over long distances, while the individual fuel cells would continue to communicate with each other as a network and also interact to balance the loads, but ultimately, movements of heat and electricity would only take place on a small scale between the individual cells.

ENERGY SUPPLY OF THE FUTURE

With a realisation of about sixty thousand units, it would be possible to immediately replace all of Germany's nuclear and coal-fired power plants in one single operation. Of course, it is not possible to implement it in this way. However, due to the flexible use and the possibility of the fuel cell to operate both in isolation and in smaller and larger networks, a successive nationwide expansion is possible and capable of replacing the infrastructure of the large-scale power plants in the same way in the long term and successively, and also under non-technical aspects such as political or economic considerations, guarantees regarding operating times, balancing of compensation payments versus remaining operating time and so on.

It is precisely the flexible deployment scenarios that make it possible to effect an equally flexible transition, taking into account all conceivable external influences. This means that the transition is not subject to a rigid timetable. On the contrary, the concept remains open to future developments and can be adapted at any time or supplemented by more advanced technical generations. Since there will always be unforeseen events in the future – just to mention the complete reversal of German policy on nuclear power, which initially brought about an expansion, but then an almost abrupt halt after the accident in Fukushima – it makes sense from

our point of view to establish a technology that can be integrated today, and in any share of the energy mix, with, nevertheless, immediately noticeable effects on both efficiency and CO2 emissions, or that can also function in the long term as a CO2-neutral technical solution to the energy turnaround.

This would provide the future of energy supply with a cornerstone on which it could be built in whole or in part, depending on which technologies emerge in the meantime. By using regeneratively produced hydrogen as fuel, the fuel cell is thus in play even as part of the completely emission-free energy supply.

SCEPTICISM ABOUT TECHNOLOGY

However, all of this refers to the purely technical parameters, although they are significant for the energy turnaround. A completely different aspect in making the energy turnaround work is consumer acceptance. Here, the public increasingly plays a major role, organising itself decentrally and in grassroots movements when transformations, also of a technical nature, are indicated, whose consequences are not entirely foreseeable. It is not said that a new type of centralised energy conversion would find greater acceptance than a new type of decentralised energy conversion. The big difference, however, is that decentralised conversion approaches the consumer more closely, the consumer's radius of movement overlaps with the network of fuel cells, so the consumer encounters it more or less inevitably. It does not require a pronounced aversion to technology; the experience gained with wind turbines suffices to foresee that there can be a wide variety of reservations about any change, especially in the sensitive area of energy, technology, the environment, but also carbon reduction in particular.

It therefore seems to us to be a particularly important factor in the launch of the fuel cell that scepticism about the technology does not occur, or at least not on a large scale. Irrational suspicions and conspiracy theories can never be completely prevented, but it is important to counteract the appearance of a potential danger as early as possible and to add other aspects of the fuel cell in addition to the attractive technical component and the explicit answering of all possible questions regarding risks, in order to provide as little surface for attack on technological scepticism as possible.

CONSUMER ACCEPTANCE

Consumer acceptance is an increasingly significant factor in the establishment of new technologies, and even after it has been technically verified that they are safe to operate, be it due to malfunction, radiation, noise or even vulnerability to terrorist attacks, there remains a sense of unease that would counter the need for the new, then everyday object. Of course, scepticism about technology may in itself be justified. Often, technical solutions are the cause of accidents of varying degrees of severity, so that security requirements are constantly increasing. At the same time, these requirements can be met by suitable concepts to minimise the risk. As with all risks, the aim is to bring the remaining risk to a statistical level below the general accident risk and at the same time minimise the danger that arises in the event of an accident. However, this hazard-risk assessment based on statistics is sometimes difficult to comprehend, which means that there is a large psychological component to its acceptance among the general public. This makes it all the more important

to disclose the technical concept and to specify the individual risks, including the corresponding prophylactic measures.

This is where the core of the design concept comes into play: the energy conversion does not even appear as its primary function, but as a secondary function that is covered up by a completely different primary function, just as the cogwheel mechanism of a bicycle is not hidden, but is clearly perceived as subordinate to the comfort of fast and health-promoting movement and travel. It is the horizon of expectation that causes a shift in perception. A visually and socially concise primary function that embodies a technical necessity, namely the indispensable supply of electricity and heat, is something completely different from a mere machine generating electricity and heat that suddenly attracts attention as a new object in an urban or also rural context.

APPEARANCE AS ENRICHMENT

The design concept takes up a familiar figure of public space, namely the Litfaß column. The fact that this first became established in Berlin, which is close to Cottbus, is of course pure coincidence. The Litfaß column is an object that has not lost its legitimacy to digital display boards even in the digital age. Although digital displays dominate due to their greater versatility, their flat display is a step backwards in terms of its spatial presence, which will certainly not last long. It is surely only a question of time when digital displays, just as mobile phone displays – which can now be produced foldable, will regain the temporarily abandoned but nevertheless established advantages of displaying on a cylindrical surface.

The decisive aspect of the Litfaß column for us, however, is that it is a familiar image to have an object in public space whose function is limited to something as comparatively trivial as the display of advertising. If it also conceals a technological innovation that makes the energy turnaround possible, so to hope, then all the better.

With this volumetric specification in mind, we have developed a variety of appearances that go beyond the mere information panel, also because, for example, in an inner courtyard of an apartment block, each of whose fifty residential units can be supplied with heat and electricity by a single fuel cell, it would be disturbing and generate too little revenue to display advertising. Here, for example, greenery or a climbing wall would be more appropriate. And even in this spatial context, a centrally placed object is by no means unusual, such as a more elaborate fountain or monument pedestal. All these objects communicate certain values in their own way, as was recently underlined in the Cancel Culture. Although fountains supply the neighbourhood with water, the useful part of this water supply is now obsolete, the benefit as humidification of the air is low, and even the function as a representation of feudal splendour is no longer valid. What remains is a mixture of romantic nostalgia and, of course, the enduring assurance of an established culture, the expression of which both fountains and monuments can effect.

This subtle meaning as a sign of cultural status, perhaps even progress, could at best be attributed to our new objects of public space. They would become the manifestation of a new generation of energy supply. The enrichment would thus not be merely limited to the visually striking outer appearance, but would equally represent the technological turn that lies behind it, hidden but not concealed. There would be, as it were, particularly desirable moss walls, climbing walls, hanging

gardens, benches, etc., which in fact at the same time stand for environmentally friendly progress.

PRIVATE AND PUBLIC, INSIDE AND OUTSIDE

In addition, the use of fuel cells is possible in both the public and private sectors. The private sector does not only mean the individual residential unit, but also a residential quarter with one cell each for about fifty residential units, as well as a correspondingly large residential complex up to high-rise buildings. Private in the sense of non-public is also the area of industry, trade and commerce. The networked structure also permits a balancing of load beyond the boundaries of private and public use. It is only a question of the information technology implementation of the physical capacities as well as the economic accounting.

Due to this versatile application, the fuel cell can appear in a wide variety of spatial contexts, from the foyer of an office building or a sports and swimming complex, to staggered arrangements in industrial applications, to a village square with a surrounding single-family house structure. It is also irrelevant whether the installation is realised indoors or outdoors, as all emissions from the fuel cell can be discharged, and are already harmless to health as so-called breathable exhaust air. Appearances as a bookshelf or noteboard are intended to illustrate these possibilities of installation indoors.

It is part of the basic concept of the fuel cell that its use is independent of its location in order to maximise its acceptance. Any restriction would have consequences even for initially unobjectionable application scenarios. Only a machine that could also be installed indoors will be readily acceptable in the courtyard of an apartment block, both in terms of material flows and other emissions such as noise, radiation and vibration.

PROTECTION AGAINST COLLISION

Especially in public areas, but also in outdoor areas in general, security against attacks plays a major role, and the fuel cell as a machine is particularly exposed to terrorist attacks. Here, particular attention is paid to developing mechanisms that make a physical attack fail, firstly by deactivating the system as quickly as possible and secondly by immediately interrupting the material flows.

The cooperation with another research field of the chair, architectural crime prevention, will deal in particular with the protection of the fuel cell against vehicle approaches. In this context, the chair is in a process of development in several stages together with the German Institute for Standardisation (*Deutsches Institut für Normung e. V.*),[8] which is financed by the Federal Ministry of the Interior, Building and Community (*Bundesministerium des Innern, für Bau und Heimat, BMI*).[9] The first guideline DIN SPEC 91414-1 defined the development of approval guidelines for mobile vehicle barriers for the protection of public spaces against crossing acts, the second guideline DIN SPEC 91414-2 already reads the requirements for the planning of access protection for the use of tested vehicle safety barriers, so that

8 German Institute for Standardisation (Deutsches Institut für Normung e. V.): https://www.din.de/en

9 Federal Ministry of the Interior, Building and Community (Bundesministerium des Innern, für Bau und Heimat, BMI): https://www.bmi.bund.de/EN/home/home_node.html

its results can be directly incorporated into the installation, i.e. the placement of the fuel cell in the public space.

At the same time, the guidelines are being transferred into an international ISO standard, so that there will also be an international application. The goal is to align the fuel cell with these new standards, initially national and later international, again in order to achieve the highest possible acceptance among the users.

METHODS FROM DIFFERENT DISCIPLINES

Due to the high level of integration of the most diverse technical and physical processes, competences from a multitude of disciplines are brought together. Optimising each component individually, as the disciplines are already capable of functioning individually, would not be sufficient for the new fuel cell. The relational interdependence of all process components, in which the input values of one sub--process result from the output values of the preceding process, at the same time as the sub-processes do not merely operate in series, but rather interlock around each other, requires an overall concept whose parts constantly relate to each other and which must constantly be re-aligned. In addition, the methods from design have to draw conclusions from each new insight, to weigh up whether it has an influence on the appearance, what influence it has on the communication of the product and whether the resulting consequences can or should have an effect on the technical arrangement in reverse.

In the end, it is an iterative process that continues in a multidimensional cycle with a sequence that is not always foreseeable, with components that are better and better coordinated with each other and a constantly growing efficiency with a simultaneously reduced overall size.

In this context, architectural civil engineering, again emphasising technology, is also called upon when it comes to highlighting the actual energy conversion as

Fig. 2

an object, while the control electronics, but also the buffer batteries, which are to compensate for outliers in the load, are housed as literal infrastructure, namely in a floor space located right underneath the fuel cell. The separation thus not only follows the significance of the components, but also allows only one floor space to be used for the control when combining several cells, thus avoiding redundancy.

The different design variants serve above all to enable the different user ideas about a desirable enrichment of the space. In this way, they do not in any way establish a closed series, but rather – and this is an essential trait of the architectural design approach, to be able to take up and respond to the most diverse wishes of the clients – represent a deliberately open series that can be expanded virtually indefinitely. The main reason why the series is so heterogeneous is to suggest, and to a certain extent to substantiate, that versatility itself is the core of the concept, instead of the individual form.

THE VARIOUS DESIGN TYPES

The diverse design variants developed so far cover an arbitrary subset of possible appearances with the aim of demonstrating as wide a range as possible in the early stages of this project.

The starting point is the actual technical fuel cell, which also, from the point of view of simple production, consists of a simple vertical circular cylinder, colloquially an upright column stump. From a technical point of view, this basic form is provided with a casing, which has already resulted in the following objects, which we deliberately do not refer to in external communication as the casing of a machine, but as an object with a technical inner life.

Signet carrier (Fig. 2): The fuel cell is simply used as a static information carrier by means of an imprint. Despite this minimal effort, the fuel cell stands, for example, as a sign carrier in the access road to a building complex or a housing estate.

Fig. 3

Fig. 4

Display (Fig. 3): The fuel cell is supplemented by a display technology that changes the contours of the cell very little and allows the display of all kinds of information on the entire surface or only on a part of it. Conceivable applications include the Litfaß column already mentioned, but also display information boards such as timetables at bus stops, tourist information, city maps, weather stations, etc.

Bench (Fig. 4): A radial structure of profiles is arranged around the fuel cell, which allows comfortable seating like on a usual park bench. The strip-shaped structure

Fig. 5

Fig. 6

proposed here allows individual components to be elevated as armrests (Fig. 5), but would also allow for different seat depths and heights.

Climbing wall (Fig. 6): A likewise independent structure supports both the working surface and the grip points of the climbing wall, so that stable and hazard-free operation is possible in principle. Although use in public spaces will have to be regulated in order to prevent accidents, use in private areas of sports facilities, leisure centres, as well as sports facilities of companies and industry would be quite

Fig. 7

Fig. 8

conceivable. Safety devices for climbing are necessary regardless of the form of the climbing wall, and are therefore not subject to the design concept of the fuel cell.

Notice board (Fig. 7): This rather symbolic equipment could easily be used as a notice board, despite its inaccessible higher area in the lower and middle sections, either by actually attaching information carriers to holders or by fixing information on paper, for example, to stationary planar boards via magnets. The benefit of the arrangement as a large space-occupying cylinder as opposed to a usual wall would be the suggestive analogy to the Litfaß column.

Shelving (Fig. 8): Especially in the context of use in libraries, which use high shelves anyway and which require the use of auxiliary tools such as ladders, this variant is able to integrate itself completely. Here, the actual fuel cell disappears completely behind a primary use as shelving, regardless of whether it is books, files or something completely different.

Moss wall (Fig. 9): Almost as space-saving as the pure fuel cell, the moss wall is equally emblematic of the trend to equip buildings or parts of buildings with moss walls in order to express the striving for a positive intervention in the climate. Even if the effective benefit, i.e. the actually measurable influence on the air of the surroundings, may be low, the statement of making a contribution to the air quality itself is in the foreground here. But even apart from the biological effectiveness, the moss wall is a visual enrichment, as it provides a plant-based counterbalance to the built structure, especially in an urban context. Greenery is a psychological factor that cannot be underestimated in terms of well-being and quality of stay, both outdoors and indoors.

Hanging garden (Fig. 10): the extensive widening of the moss wall is a staggering of planting beds that can in principle be planted with any vegetation, although the

Fig. 9

unavoidable shading must be taken into account. Since the cylindrical overall shape of the formwork means that plants that have the capacity to grow in the shade are used anyway, the formal approach here is to exaggerate this circumstance, i.e. to create an even more shady overall shape with a tendency towards a sunshade. Here, too, the positive psychological aspect of greenery takes effect, albeit combined with the enclosure in the form of a planting bed.

Sculpture (Fig. 11): The appearance as a pure sculpture is entirely psychologically effective. The version presented here is intended as a placeholder for the idea of a sculptural solution that can, for example, be related to the respective corporate

Fig. 10

Fig. 11

identity of a company or can actually represent artistic interventions that can in turn contribute to the identity of the site, similar to an individual monument.

A NEW TYPE IN URBAN SPACE

What all design variants have in common, is that they represent a new kind of presence in space. Similar to the Litfaß column, this new type does not stand for the triumph of print advertising, but for a sustainable energy turnaround, energy efficiency and CO2 reduction. But all this, and that is what makes this new type of object, only at second glance. It is the versatility, but above all the enrichment of the space with a non-technical primary function, that characterises this new type, an integration of technology in the best sense, not a highlighting, but an interweaving with primary needs of the quality of stay, visually, practically or ecologically.

EXHIBITION AT THE KORNHAUSFORUM IN BERN

The art exhibition in Switzerland mentioned at the beginning, which took place from November 11, 2021 to January 23, 2022 under the title “Shared Spaces in Change” in the Kornhausforum[10] in Bern, addressed this aspect of technology-based spatial design and selected our project as one of 33 projects from an applicant pool of almost three hundred submissions. The reason for the selection was precisely this bridging of innovative technology to cityscape-defining spatial design, the incorporation of the latest research from the field of mechanical engineering into the architecture of the city.

The Kornhausforum in Bern, which is specialised in architecture, design and photography, sees this approach as a desirable extension of its range of topics. The contribution thus neither meets the expectations of the call for entries, nor is it

10 Kornhausforum, Bern, Switzerland: https://www.kornhausforum.ch/

among their equals. The fuel cell as a new type of urban object would be a unique piece that has yet to be widely accepted.

RECEPTION FROM THE PUBLIC

The image that appears in public will certainly be one of the deciding factors as to whether a use in public space will be imaginable, irrespective of the technical implementation. The reception in an art exhibition, though, can be an important first step. In any case, in addition to the presentation at the Potsdam Science Day on 8 May, and the presentation at a German trade fair for the wind industry, it represents a significant step towards public awareness.

EFFECTIVENESS OF THE DIGITAL IMAGE

The public image that the fuel cell is supposed to generate is a virtual one. To date, neither a technical prototype nor a full-scale model exists that could make the external appearance tangible as a sculptural object. Visual communication runs entirely through the digital image. However, this does not mean a disadvantage if one compares the communication of planned architecture via photorealistic imagery with the communication of realised architecture via photographies. Neither can any differences be detected due to the technical progress of computer-aided renderings when executed appropriately, nor is the appearance of artificiality that has so far been typical of digital images reserved for virtual space. Reviews of new buildings with reference to an appearance that corresponds to a computer rendering are becoming increasingly common.

PRIORITY PROGRAMME ABOUT THE DIGITAL IMAGE

In the Priority Programme "The Digital Image",[11] funded by the German Research Foundation (DFG), in which our chair is participating with a research project on the influence of the digital image on architecture, precisely this relationship is being researched. It is also about the extent to which the digital image already functions today as a complete substitute for actual, personal spatial visual experience. Not many Europeans will have seen the iconic image of the Sydney Opera House directly (!) with their own eyes, yet it is firmly anchored in the visual memory of supposedly all architects and even beyond.

Given this awareness, the method of visually communicating the fuel cell consists of augmenting a wide variety of everyday situations with a suitable design variant by means of a photomontage, in order to project the image of the fuel cell as a vision not only of the future, but already a vision of the present into the imagination of future users.

CONCLUSION: THE FUSION OF SCIENCE AND ART

Ultimately, then, this is a genuine fusion of design and technology, or, to treat it on a more abstract level, of art and science. It is not the technical concept alone, but the concept of placing the energy transition in public space that allows the interaction of art and science to produce a completely novel result, namely an object without

11 Priority Programme "*The digital image*": https://www.dfg.de/gefoerderte_projekte/programme_und_projekte/listen/projektdetails/index.jsp?id=402352280

a definite appearance, a hybrid object whose technical content becomes visible in a continuous manner from unambiguous to completely hidden, and whose practical use in public space ranges from a bench to a sculpture.

Art and science do not meet here by aestheticising technical processes or by putting artistic results to use, but complement each other to form a new overall idea, an appearance of indeterminate form with an abstract value, which is that of energy turnaround towards an emission-free future.

To conclude, we would like to illustrate how effective this method is with an anecdote. A friendly chair from the field of urban planning asked us if the locations from our mediation concept could be put together as an itinerary for an excursion for students. The hint that they were real places but only virtual set-ups, photo montages in the sense of a visual simulation, was indeed a surprise.

ILLUSTRATIONS

1: Technical illlustration of material flows of the T-Cell, Lengyel Toulouse BTU Cottbus
Технички приказ протока материје у Т-ћелијама, Ленгел, Тулуз, БТУ Котбус
2: Signet carrier at Potsdamer Platz, Berlin, Lengyel Toulouse BTU Cottbus
Носач логотипа на тргу Потсдамер, Берлин, Ленгел, Тулуз, БТУ Котбус
3: Information display at Washingtonplatz, Berlin, Lengyel Toulouse BTU Cottbus
Информативни пулт на Вашингтонплацу, Берлин, Ленгел, Тулуз, БТУ Котбус
4: Public bench in a French château garden, Lengyel Toulouse BTU Cottbus
Јавна клупа у башти француског дворца, Ленгел, Тулуз, БТУ Котбус
5: Public bench with armrests at Berlin Central Railway Station, Lengyel Toulouse BTU Cottbus
Јавна клупа са наслонима за руке на Главној железничкој станици у Берлину, Ленгел, Тулуз, БТУ Котбус
6: Climbing wall at Gleisdreieck parc, Berlin, Lengyel Toulouse BTU Cottbus
Зид за пењање у парку Глајсдрик, Берлин, Ленгел, Тулуз, БТУ Котбус
7: Notice board at Kunsthaus Bregenz, Austria, Lengyel Toulouse BTU Cottbus
Огласна табла у Музеју уметности у Брегенцу, Аустрија, Ленгел, Тулуз, БТУ Котбус
8: Book shelf at Berliner Galerie, Lengyel Toulouse BTU Cottbus
Полица за књиге у галерији Берлинер, Ленгел, Тулуз, БТУ Котбус
9: Moss wall at Potsdamer Platz, Berlin, Lengyel Toulouse BTU Cottbus
Зид од маховине на тргу Потсдамер, Берлин, Ленгел, Тулуз, БТУ Котбус
10: Hanging garden in Biosphäre Potsdam, Lengyel Toulouse BTU Cottbus
Висећи врт у ботаничкој башти у Потсдаму, Ленгел, Тулуз, БТУ Котбус
11: Sculpture at Wohnanlage Pallasseum, Berlin, Lengyel Toulouse BTU Cottbus
Скулптура у стамбеном блоку Паласеум, Берлин, Ленгел, Тулуз, БТУ Котбус

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АРХИТЕКТОНСКО ПРОЈЕКТОВАЊЕ ТЕХНОЛОШКИХ УРЕЂАЈА

Резиме: У свом текућем истраживачком пројекту интегришемо графички и индустријски дизајн у архитектонски приступ дизајну за имплементацију у урбаном простору. Реч је о пројекту интердисциплинарне сарадње девет катедри за машинство, једне за физику и Фраунхофер Института ИКТС, као спољног партнера. Циљ је да претварач енергије не изгледа као технички уређај, пошто би то могло изазвати негативну реакцију оних делова популације који су скептични према техничким уређајима уопште. Уместо тога, уређај би требало да добије облике који би унапредили на различите начине приватне, полујавне и јавне просторе, како унутрашње, тако и спољашње. Ово унапређење би требало да надгради примарни облик претварача енергије и скрене пажњу на његов допринос простору. У ту сврху користе се методе и уметничке праксе индустријског и графичког дизајна. Индустријски дизајн бави се осмишљавањем производа који се могу индустријски производити у великим серијама и, у комбинацији са архитектуром, омогућава сценарије оријентисане на корисника. Кроз дизајн, архитектонске интервенције се појављују као информативне табле, стајалишта јавног превоза, светла, полице за књиге, клупе, куле за пењање, зидови од маховине или висеће баште, док техничка функција претварача енергије остаје у другом плану као секундарна карактеристика. У развој се укључује и графички дизајн као део корпоративног дизајна. Варијанте самог производа нису толико у првом плану, колико су то различита решења архитектонских простора. Виртуелне фотографије, које визуализују будућа архитектонска решења, показују потпуну интеграцију науке и примењене уметности у стварању нових архитектонских простора. Остаје да се испита реакција шире јавности.
Кључне речи: архитектура, визуализација, дизајн, инжењеринг, симулација, виртуелна фотографија