Fraunhofer IAO, Center for Virtual Engineering, Stuttgart

Photo: Christian Richters, Berlin

Architects/designers: *UNStudio van Berkel & Bos, Amsterdam (Netherlands), Ermel Horinek Weber ASPLAN Architekten BDA, Kaiserslautern*
Client: *Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.*
Curtain wall package: *Anders Metallbau GmbH, Fritzlar*

anders
metallbau

Mission

Fraunhofer IAO (Fraunhofer Institute for Work Management and Organization) commissioned Dutch star architect Ben van Berkel to design a new building that translates research findings into the perfect architectural environment for the work practices of tomorrow.

The Fraunhofer IAO: a client with a clearly defined vision

The future evolution of office and knowledge work and the promotion of creativity through optimized work environments have long been the focus of study at the Fraunhofer IAO (Fraunhofer Institute for Work Management and Organization) in Stuttgart. Armed with pioneering ideas, the Institute's research and consultancy teams have carved a glowing reputation as workspace innovators. The IAO's "Office21" project, for instance, examines the organizational, technological and spatial aspects of workplace design and their perfect orchestration.

It was hardly surprising, then, that the trailblazers in this field should question their own – conspicuously conventional – work environment. After all, the strict segregation of research into laboratory- and office-based activities has long been superseded. For Fraunhofer IAO Deputy Head, Dr. Wilhelm Bauer, a new building was the only solution. And Bauer already had clear ideas regarding the design of the new "house of knowledge", the Center for Virtual Engineering (ZVE).

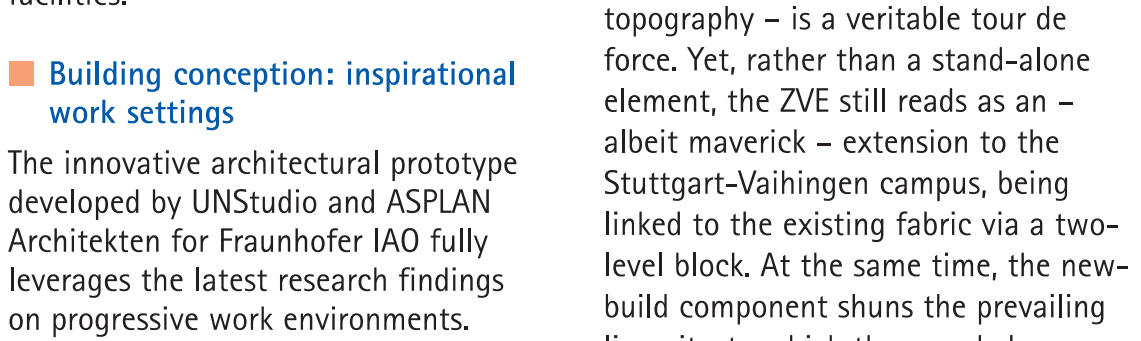

Photo: Christian Richters © Fraunhofer IAO, UNStudio, ASPLAN

Revolutionary work environment: the Center for Virtual Engineering at Stuttgart-Vaihingen

Photo: Blacklight © Fraunhofer IAO

Architect Ben van Berkel, UNStudio

The architects: in preference for tricky tasks

For the majority of architects, forward-thinking clients with clear notions about workplace design and the desire to see these implemented are not necessarily the easiest of partners. Yet Ben van Berkel, Director of UNStudio, now one of the world's most highly esteemed architectural practices, is a virtuoso in handling tricky briefs and crafting progressive architecture. His scheme for the Mercedes-Benz Museum, in which he fused radical spatial principles to create a completely new typology, emphatically underlines his credentials as an innovator. On the ZVE project, Ben van Berkel also highlighted his strengths as a team player through the successful collaboration with ASPLAN Architekten, a design practice with 30 years' experience in building university and laboratory facilities.

Building conception: inspirational work settings

The innovative architectural prototype developed by UNStudio and ASPLAN Architekten for Fraunhofer IAO fully leverages the latest research findings on progressive work environments. These results have unequivocally singled out communication as the key to forward-looking work practices and regimes. And communication is single-mindedly cultivated by the building's architecture. An inspection of the interior immediately reveals how this works: here, the traditional cellular office arrangement has been replaced by sequences of seamlessly merging workspaces. This concept required maximum spatial freedom and the elimination of intrusive columns and window lintels. The architects' solution – a rounded triangular plan shape that sets itself apart from the artificial site topography – is a veritable tour de force. Yet, rather than a stand-alone element, the ZVE still reads as an – albeit maverick – extension to the Stuttgart-Vaihingen campus, being linked to the existing fabric via a two-level block. At the same time, the new-build component shuns the prevailing linearity, to which the rounded corners of the triangle offer a strong counterpoint. Moreover, the eye-catching "sawtooth" ribbon windows add a further masterful touch to the building envelope.

A unique formal language and daring spatial concepts are the hallmark of UNStudio

Photo: Christian Richters © Fraunhofer IAO, UNStudio, ASPLAN

Building Design

Devised as a ground-breaking prototype, the ZVE shows how an intelligent architectural concept can encourage novel work practices. The building design is decidedly bold, if not avant-garde.

Design process: own building as research "guinea pig"

No institute in Germany knows more about virtual engineering than Fraunhofer IAO. Small wonder, then, that this technology – otherwise used, for example, to streamline car bodies – should be adopted for the entire building design process.

Embracing this innovative modus operandi, the architects from UNStudio and ASPLAN joined forces with Fraunhofer IAO's own experts in developing and realizing the ZVE project. Three-dimensional digital models were produced for discussion and decision support at each design stage. Indeed, the insights brought by this process also allowed Fraunhofer IAO to enrich its own virtual engineering know-how. Ultimately, as an aid to optimizing the scheme, the client, users and designers were treated to a 3-D, scale 1:1, real-time mock-up of the new building.

Progressive design concept: wide spans with few intermediate columns

The brief called for maximum spatial freedom in conjunction with a minimum envelope area and a minimum of materials. As a key means of lowering

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Breaking with convention: the ZVE is much more than just another research building

the building's weight, the architects specified biaxial hollow "BubbleDecks" for the structural floors. These slabs incorporate so-called "air bubbles", i.e. air-filled plastic spheres, which reduce the volume of concrete and steel, and thus the structural mass. This served the dual purpose of achieving wider spans and minimizing the number of intermediate columns.

Clear-cut requirements were also placed on the interior work environment, the aim being to simplify communication while maintaining full flexibility of use. The architects responded by arranging the office and laboratory spaces on four levels around an open atrium. Variations in ceiling height on the individual levels open up reciprocal views across and between storeys. At the same time, the workspaces become increasingly secluded towards the periphery: the greater the distance from the core, the more peaceful the environment (e.g. with glass-screened cellular offices or enclosed meeting rooms) and the more conducive to concentrated work.

Not conceived as a stand-alone: the ZVE is linked to the existing campus by an elegant, double-level, curvilinear block

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Fabrication & Installation

Finalization of the architectural design is the signal for Anders Metallbau to start work. The responsibility for detailing, fabricating and installing the relevant building components then passes to us and it is up to our designers to find curtain wall, window or glass roof solutions that meet all requirements to the letter.

The challenge: mastering a complex design task

In March 2010, the Fraunhofer-Gesellschaft – Europe's largest application-oriented research organization, headquartered in Munich – contracted us to construct the facade of the new-build ZVE at Stuttgart-Vaihingen. The extremely complex nature of the design brief was clear to the entire project team from the very outset. To do justice to the architectural composition – specifically, the building's geometry – while meeting the technical requirements, close interdisciplinary collaboration between all specialist designers was of paramount importance.

Working in tandem with Schüco International, we developed a special assembly for the "sawtooth" curtain walling on the basis of detailed consultations that commenced immediately after contract award. It soon became apparent that a custom-designed solution, incorporating a host of new sections and rejigged technical components, would be needed.

We also invested considerable effort in developing a system for the efficient management of the design, fabrication and installation processes. A complicating factor here was the need to allow for the 38 no. of different colour shades for windows and cladding units

Photo: Christian Richters © Fraunhofer IAO, UNStudio, ASPLAN

Revolving door installation

Photo: Christian Richters © Fraunhofer IAO, UNStudio, ASPLAN

Top: The brilliant white-grey of the coated aluminium cassettes and sharp edges of the zigzagging windows set the ZVE apart from its surroundings;
Bottom: Close-up of sawtooth windows

were required to achieve the specified colour sequence along the facade. The preliminary architectural drafts were used to prepare samples of these 38 no. of shades, all of which were special colours not amenable to definition under the standard coding systems. All samples were duly submitted to the architect for inspection and approval.

The design of the curtain wall and window assemblies was completely based on the architect's "master 3-D model", which exhaustively specified the entire facade configuration. The complex geometry also necessitated the use of a 3-D system for the detail design.

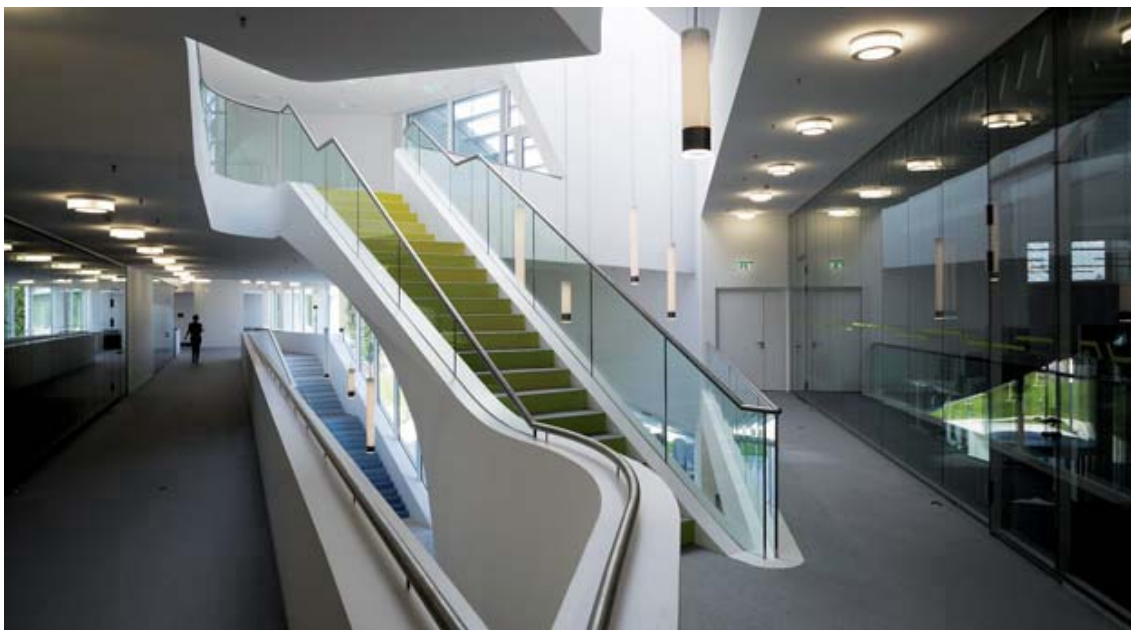
Technical realization: low fabrication and installation tolerances

The need to observe exceptionally tight fabrication tolerances was a logical consequence of the intricate building geometry and multifarious interdependencies between the individual components. This was particularly crucial for the sawtooth window units, which we produced using a computer-assisted fabrication system.

Given their individual deviations in geometry and colour, each of the 284 no. of sawtooth windows was treated as a unique component. However, this was not the only challenge during fabrication: production of the partly

Fabrication & Installation

Manufacturing commences at our workshops in Fritzlar and Borken as soon as our engineers have completed the development work for the production. The fact that the contract then remains in our hands from fabrication through to installation guarantees impeccable quality and planning surety for our clients.



Sculptural stairway with steel balustrade

Glass roof over atrium

Photos: Christian Richters © Fraunhofer IAO, UNStudio ASPLAN

three-dimensional support frame members and the associated metal cladding units was every bit as testing. These were manufactured to the strictest of tolerances at our Borken plant. In all, we produced several thousand different cladding panels and connecting components.

Fabrication of the expansive stick-system curtain walls enclosing the foyer area at the entrance, and the biaxial curved sections in particular, proved an equally tall order. The curved glass sheets incorporated in the facade were up to 4.5 m high.

Logistics and installation: the devil is in the detail

Prior to fitting the sawtooth units, our expert installers set out reference points in three dimensions, subject to minimal tolerances. This ensured a perfect fit between the individual components as well as full compliance with the strict requirements governing external appearance.

A logistical concept was prepared to ensure efficient delivery and installation of the fabricated parts. This allowed for the sequence in which the individual components would be needed on site as well as their sizes. A further part of the logistical operation was to ensure that the 284 no. of different window units and several thousand custom-made metal cladding panels reached the correct point of installation at the appropriate time. The spatial constraints on site caused additional headaches for the logistics planners. Our site management team, which was on the spot throughout the installation process, co-ordinated the individual works in close consultation with the client's site supervisor.

Overall, the project gave our installers various opportunities to demonstrate their skills and ingenuity. Their tasks included the installation and commissioning of ...

- over 140 no. of electric window drives
- approx. 230 no. of motorized sun-shading devices, customized produces
- hundreds of electrically operated glare control systems

These works, like all others, were fully co-ordinated with the finishing trades on site.

Our team has continued to assist the client during the period since building completion and acceptance. We regard this as a natural part of our services in meeting the demands of an exceptional project of this kind.

Photo: Christian Richters © Fraunhofer IAO, UNStudio, ASPLAN

Stick-system curtain wall

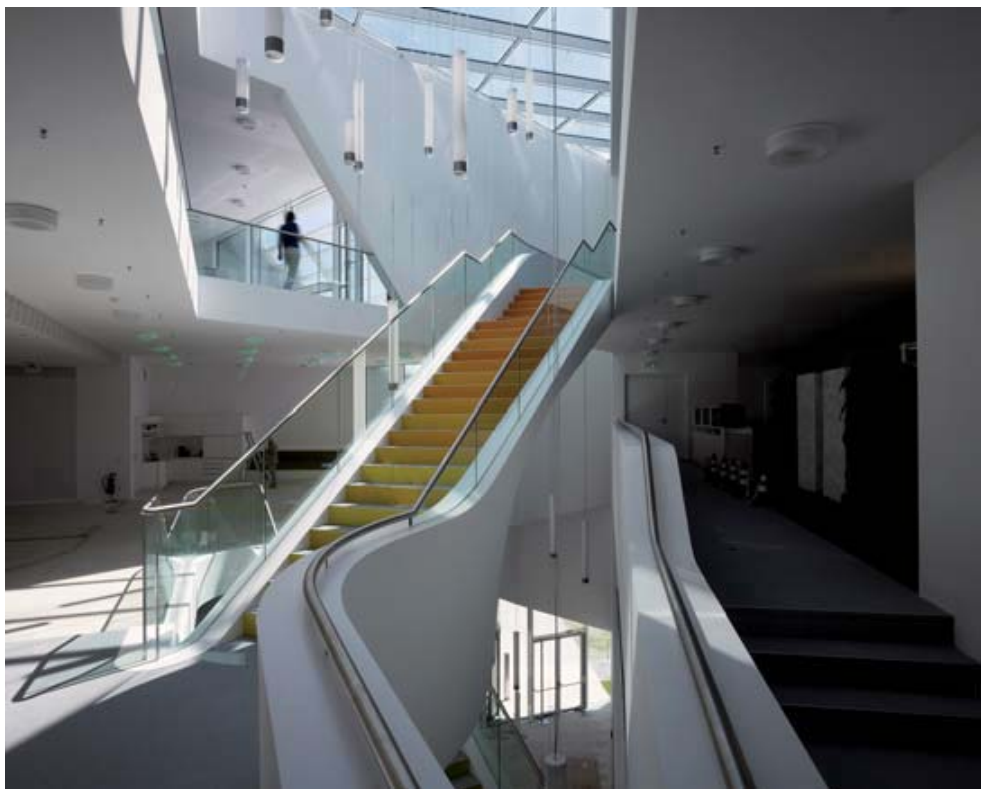
Interiors

Can a suitable work environment boost not only efficiency, but also creativity? With the ZVE, architect Ben van Berkel has delivered a powerfully affirmative answer to this question. The building houses a spacious "working landscape" in which all employees can determine the form and structure of their workplace.

Living lab: the ZVE conducts physical and virtual research into tomorrow's work environment

As the experts at Fraunhofer IAO realized long ago, genuine innovation is rarely achieved by enlightened individuals working in isolation. It is much rather the product of interdisciplinary teamwork fostered by a work environment conducive to interaction. Ben van Berkel's architectural creation exactly fits the bill. At the heart of the ZVE, he inserted an atrium, diagonally criss-crossed by sculptural stairways, that stimulates encounter and communication. Whichever of the four levels the building occupants are on, the ever-shifting visual links up, down and across the atrium void will inevitably encourage informal exchanges.

Yet, Ben van Berkel does not entirely dispense with a structured layout. The two lower levels, with fully equipped "test offices", tend to be the domain of the technology developers while the two upper storeys host temporary collaborations, i.e. projects in which various knowledge workers team up on an ad-hoc basis. The laboratories, on the other hand, are spread throughout the building. The Immersive Engineering Lab, for instance, provides users with access to three-dimensional virtual worlds.



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Facts and figures: the essentials in brief

Employer/architect/project team:

Client:	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V., Stuttgart
User:	Fraunhofer IAO (Institute for Work Management and Organization), Stuttgart
Architects/designers:	UNStudio van Berkel & Bos, Amsterdam (Netherlands) Ermel Hornik Weber ASPLAN Architekten BDA, Kaiserslautern
Curtain wall package:	Anders Metallbau GmbH, Fritzlar
Facade component suppliers:	
Sections and hardware:	Schüco International KG, Bielefeld
CTB high-performance solar shading:	Schüco International KG, Bielefeld
Internal glare control:	Multifilm product
Glazing:	Glas Trösch GmbH, Nördlingen
Revolving door installation:	Gierkes + Brode Tür- und Torautomatik GmbH, Dachwig
Curtain wall structural engineering:	Stahlklar GbR, Kassel

Project data:

Cubic content:	27,221 cum
Gross floor area:	5,782 sqm
Main usable area:	3,220 sqm
Inauguration:	20 June 2012

Completed works:

Sawtooth windows:	1,100 sqm (284 units)
Stick-system curtain wall:	350 sqm
Aluminium glass roof:	65 sqm
Louvred curtain wall:	140 sqm
Metal curtain wall, coping:	2,700 sqm
CTB solar shading:	600 sqm
Internal glare control systems:	650 sqm
Revolving door:	1 no.

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