3F STUDIO
3D PRINTED ARCHITECTURE

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3D printing innovation: New facade designed by Munich-based start-up 3F Studio for the Deutsches Museum is the first of its kind worldwide.

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(Munich, 18 April 2019) As part of the largest renovation in its history, the Deutsches Museum in Munich is set to demonstrate architectural innovation thanks to plans to envelope the temporary main entrance on the bank of the Isar river with a translucent 3D-printed facade. This pioneering application has been developed by Munich-based start-up 3F Studio.

- A 3D-printed, translucent facade is destined to serve as the temporary main entrance to the Deutsches Museum.
- Made from PETg plastic, the multifunctional facade has several lifecycles and can be 100% reused for facades.
- 3F Studio, a start-up founded in 2018, is behind the development and planning of the world's first 3D-printed recyclable facade.
- The project is supported by BigRep and planned to be produced with its 3D-printing technology.
- The entrance building to be constructed behind the 3D-printed facade is being designed by Architekten Schmidt-Schicketanz und Partner GmbH and David Wolfertstetter Architektur.

The envelope designed by 3F Studio for the Deutsches Museum's temporary main entrance is the world's first 3D-printed facade to be made from fully recyclable plastic (PETg). 3F Studio's founders, Moritz Mungenast, Oliver Tessin and Luc Morroni, have already worked together on the research project Fluid Morphology at the Department of Architecture and its Associate Professorship of Architectural Design and Building Envelope at the Technical University of Munich (TUM). Here, they conducted research on facade systems, attracting the attention of the Deutsches Museum. The next logical step was for the team to establish a company and develop the system into a multifunctional facade application, which has numerous beneficial properties due to the use of innovative production technology. "3D printing enables us to integrate a whole host of features directly into the facade panels. It also allows us to minimise planning and production errors and establish a closed material cycle," says Moritz Mungenast.

This flagship project at the Deutsches Museum, the largest science and technology museum in the world, is the ideal basis for demonstrating the strengths of the innovative facade application to a wide audience. Far from being simply a design feature, the wave-like surface of the facade is highly functional. "Architects have always utilised the latest technology and adapted form-finding processes from nature. For these new, translucent facade panels, additive manufacturing and computational design are used to generate soft, wave-like ripples, creating a bespoke geometry for adaptive shading and acoustics for the museum's visitors," explains Oliver Tessin.

In summer the facade provides protection from the heat, while in winter it lets in as much natural light as possible to the building. Other essential functions such as thermal insulation and natural ventilation can be integrated without the need for expensive systems technology thanks to vertical closed air ducts which lend the facade stability and insulate the building. A single facade panel measures around 1 x 1 metre and the unique appearance of its translucent, reflective material will make the museum building truly eye-catching. Visitors may, however, also be left fascinated by the facade design when viewing it up close. The macrostructure of the waves has further micro-folds on its surface, which improves the acoustic properties of the envelope by diffusely scattering sound reflections. All this is provided by just one building component which is manufactured as one piece and can be fully tailored to individual requirements. "Form and function are *fused* together in one unit," summarises Oliver Tessin, before adding, "The resulting quality can, above all, be seen in the correlation between the formation and materialisation, in other words form and function."

At 750 m², the surface area of the facade poses a particular challenge and can only be overcome using specially developed digital tools. The project marks the first time that the Fused Deposition Modelling (FDM) 3D-printing technology is being used industrially on a scale as large as this one. "By integrating the production

parameters during the planning process, the functions and design details can be developed in conjunction with the form-finding process, thereby reducing production time and the consumption of materials," comments Luc Morroni.

The first prototype of a facade panel of this kind measures 280 cm x 160 cm with a thickness of 6 cm and has been installed on the solar station on the roof of the Technical University of Munich since spring 2018, where its suitability is being tested using precise sensor readings. The data collected shows that the concept works and is evaluated in order to optimise the facade system.

3F Studio is initially planning to use this facade cladding in cultural buildings such as museums, libraries and concert halls as well as for interior design purposes, e.g. in exhibition centres, foyers and conference rooms. For future projects, the company is also working on extending its range of materials to include polycarbonate and more sustainable bioplastic.

About 3F Studio
Founded by Moritz Mungenast, Oliver Tessin and Luc Morroni in 2018, 3F Studio stands for fused form and function. The German-based studio specialises in 3D-printed performative architecture and future-oriented design.

3F Studio is a spin-off from the research project *Fluid Morphology* at the Technical University of Munich's Department of Architecture, and offers its expertise in computational design and additive manufacturing (3D printing) for the development of function-integrated facade applications and novel concepts for interior and furniture design. This encompasses the use of new, recyclable materials to create sustainable solutions for overcoming the future challenges faced by the building industry.

3F Studio believes in the performative and aesthetic qualities of innovative technologies such as additive manufacturing to develop novel applications with a distinctive design vocabulary.

Project informations

- Location: Museumsinsel 1, Cornelius Bridge, west side of the Centre for New Technologies
- Client: Deutsches Museum, Munich, Germany
- Design and planning of the 3D-printed facade: 3F Studio GbR
- Design and planning of the entrance building: Architekten Schmidt-Schicketanz und Partner GmbH (SSP) and David Wolfertstetter Architektur (DWA)
- Material: fully recyclable plastic (PETg)
- Number of visitors: 1.5 million visitors a year
- Lifespan: maximum 15 years (4.5 years envisaged)
- Facade dimensions: approx. 45 metres long by 15 metres high
- Panel weight: 10 to 15 kilograms
- Construction of the entrance building: combination of a steel structure and solid structure
- Unanimous approval of the Munich Urban Design Committee on 22 January 2018.
- Visualisations: nuur.nu
- The project's current stage of development is being supported by BigRep, Extrudr and Dow Corning.

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