Beautiful as Nefertiti

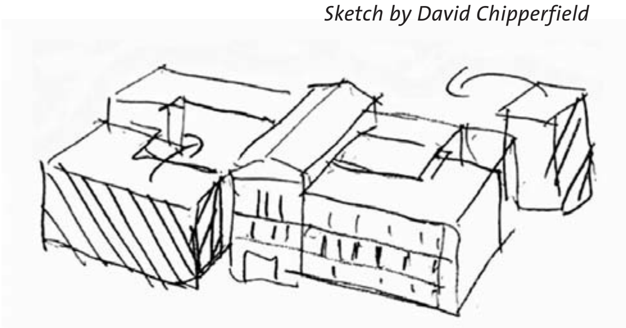
Architectural concrete precast elements for the New Museum in Berlin

She will captivate museum visitors in Berlin once again from Autumn 2009: Nefertiti, the beautiful wife of the Egyptian pharaoh Akhenaton is returning to the Museum Island. It will then be possible to see her in the rebuilt New Museum. Under the guiding theme 'cautious further building', no 1:1 reconstruction of the historic building has been carried out, nor has there been any intervention of modernity in the listed building fabric. The specified structure and cubature of the Stüler building was implemented in the clear language of forms of David Chipperfield whilst preserving the original fabric, and was developed for contemporary and future-orientated use of the museum by the Egyptian Museum and the Museum of Prehistory and Early History. An impressive rebuilding with ambitious extensions in high quality marble concrete.

Façade with rebuilt north-west wing

Five museums make up the Museum Island in Berlin: the Bode Museum, the Old National Gallery, the Pergamon Museum, the Old Museum and the New Museum. Together they represent a unique ensemble, which has been adopted into the UNESCO World Heritage List. A master plan was decided upon in 1999 for the renovation of the buildings and the contemporary development of the entire museum quarter, and was also part of the application for the title 'World Cultural Heritage Site'. It recognises the ensemble of five historic buildings as a unit in terms of content, but respects their architectural autonomy. The implementation of the idea of the masterplan has been taken over by the Museum Island planning group, which is made up of the architectural consultancies commissioned with the renovation of the

Sketch by David Chipperfield



Photos: Dreßler Bau

Main staircase with new stairs made of high quality architectural concrete

individual buildings under the leadership of David Chipperfield Architects. Over 6000 years of human history are presented in a temple city of art and culture on an island in the Spree with an area of almost 1 square kilometre.

New Museum

The New Museum was built between 1841 and 1859 in accordance with plans by the architect Friedrich-August Stüler. During the Second World War, the main staircase was badly damaged in November 1943 and the north-west wing and the south-east projection were completely destroyed in February 1945.

First securing and protective measures were taken in the 1980s, but it wasn't until the reunification of Germany that the New Museum was given a genuinely new perspective. The exciting task was to redesign well-preserved rooms, derelict parts of the building and completely missing areas. The rebuilding strategy was: the history of the building should not be disclaimed and the whole thing should be put in order

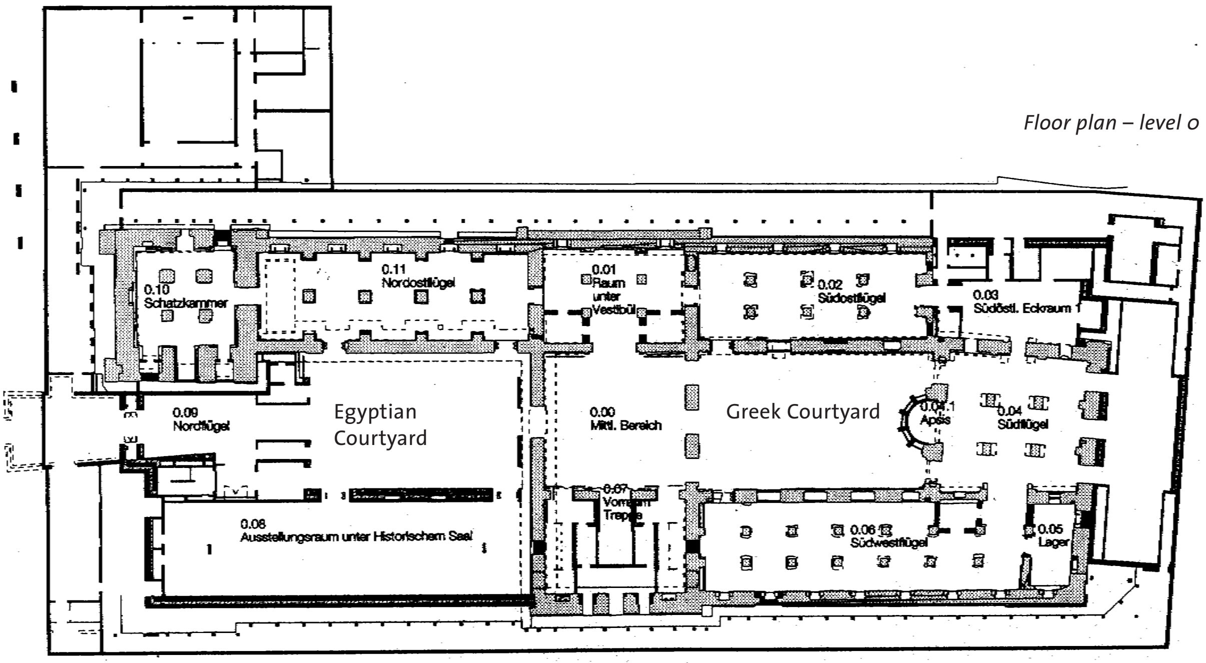
Main staircase before and after the destruction in the Second World War

Ground hand rail in the main staircase

whilst at the same time emphasising the history. The intense discussions on the type and scope of the rebuilding of the New Museum lasted over ten years before the English architect David Chipperfield was then commissioned with the project.
Measures were to be taken in accordance with the premise of the preservation of historic buildings: 'Conservation instead of restoration, retention instead of rebuilding'. New elements were integrated where building fabric no longer existed. Architectural concrete with ground and sand-blasted surfaces was chiefly used here as a building material for ceilings, walls and floor coverings.

Hence, the stairs of the main staircase and the interiors of the rooms in the two building wings were constructed with modern precast elements made of architectural concrete. The architectural challenge lay on the one hand in redesigning the missing parts of the New Museum building in terms of form and material, and on the other in satisfying the demands of a modern museum building with regard to building service engineering, fire prevention and infrastructure. The completely destroyed north-west wing with the Egyptian Courtyard and the south-east projection were re-erected. The exterior walls were rebuilt with old bricks.

Floor plan – level o



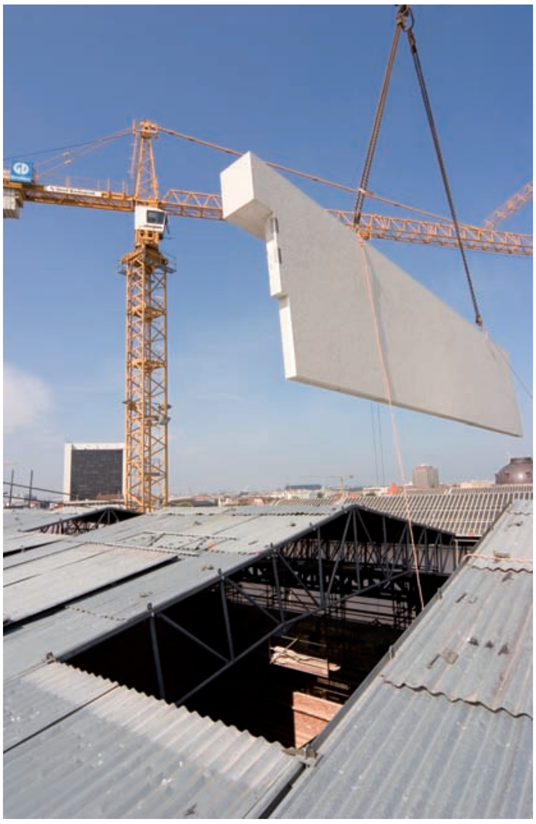
Treatment of the flight of stairs with a diamond drilling miller

Detailed view of the ground hand rail

High quality precast elements

Absolutely sharp edges, the highest possible uniformity of the surface in terms of colour, roughness and structure, the exact fit of the new concrete elements both to one another and to the old structures, with an accuracy of the order of millimetres – these were the clear demands placed on the architectural concrete precast elements. The order for their manufacture was placed with the Dressler Bau GmbH precast works in Aschaffenburg in spring 2005. It was only possible to satisfy the extremely high demands on the manufacture thanks to special preliminary work on the part of the architects: precise measurements of the existing structures and unitisation down to the finest detail. The partnership-like cooperation between the architects, the technical office and the concrete laboratory at the precast factory in implementing the specifications for the structural element thicknesses, fastenings, detail connections and concrete technology were the basic preconditions for the success of this ambitious project. With an enormous amount of effort on both the planning and production sides, the limits of what is possible were reached here. To emphasise one particular point here: a size of 5 mm was contractually specified for both the horizontal and vertical joints; the permissible tolerances of the joints were agreed at +/- 1 mm. Of course, such a specification cannot be realised with the usual measures in precast construction. Specially calibrated tape measures and folding rulers were therefore necessary for both the manufacture and assembly.

The manufacturers Dressler Bau additionally set up a quality assurance system in order to ensure compliance with the specifications for the manufacture of the precast elements, especially for the appearance and the tolerances. To this end, appropriate instrumentation was developed for each individual precast element in order to ensure the high quality standards, from the construction of the formwork and the concreting process through to the storage and transport. By means of a 'precast element pass' for each element, it was possible to fulfil the builder's demands that verification



Lifting a precast element through the open temporary protective roof

View of the precast platform in the Egyptian Courtyard from below

of compliance with the tolerances be provided before delivery and assembly. This high expenditure for the quality verification ensured that only parts that fit were transported to the building site. Standstill times during assembly were avoided as a result.
Closed transport vehicles were used for the most part in order to avoid the elements becoming dirty during transport from the precast factory to Berlin. Great care was also called for in securing the individual high value concrete elements for transport. Assembly was mainly performed by tower cranes, whereby the variable protective roof in the area of the existing building had to be opened for each individual lifting operation. In the basement, the precast elements were brought to the place of installation by means of elaborate transfer inside the building. Extensive measures were taken to protect the concrete surfaces, which were actually the final surfaces even in the raw building state, such as rear-ventilated wooden formwork or galvanised connecting reinforcements.
A total of 8,200 precast elements were assembled, the last of them in August 2008. The heaviest precast element weighs 21 tonnes. Most of the precast elements are unica in terms of their geometry.

Concrete aggregates: (1) white cement, (2) marble 2/8, (3) marble 8/16, (4) marble 16/35, (5) quartz sand 0/1, (6) sand 0/2

Marble concrete

A high quality building substance was developed with marble from open-cast mines in the Ore Mountains. Many attempts were necessary in order to create a rigid concrete with this special aggregate which, with its high rigidity, guarantees the required evenness of the concrete surface. Only the limits of pourability and flowability forced the addition of appropriate quantities of water and liquefier. The following ingredients are to be found in the concrete composition: marble aggregate, white cement, sand, water and liquefier. Each cubic metre of concrete contains 1,300 kg of marble aggregate with a grain diameter from 2 to 35 mm.
In total, 1,950 m³ of marble concrete were manufactured, 5,300 m² of concrete surface were ground and 11,250 m² sand-blasted. Particularly worthy of a mention are the columns of up to 15 m in length with a square cross-section and an edge length of 50 cm, which were blasted on all four sides, and the handrails of the stairs, which were ground to a round form using a diamond form miller.

In addition there were numerous joists, ceiling slabs, door reveals, columns, floor coverings, steps and wall panels with individual element sizes of up to 8 x 3 m, which were also ground and sand-blasted.

Interior view of the apse in the Greek Courtyard

Main staircase

The main staircase of the New Museum stood without a protective roof until 1986. In accordance with David Chipperfield's design for the rebuilding, these 22 metre high masonry walls remain 60 years after the end of the war as they are, marked by war and the division of Germany, and assume only the function of the main staircase. The original dimensions of the room are retained. From the formerly richly decorated walls, only the masonry will remain visible. The new stairs integrated in this room are made up entirely of marble concrete precast elements, with both ground and sand-blasted surfaces. Alongside special individual

Laying the floor slabs in the Greek Courtyard with its distinctive apse

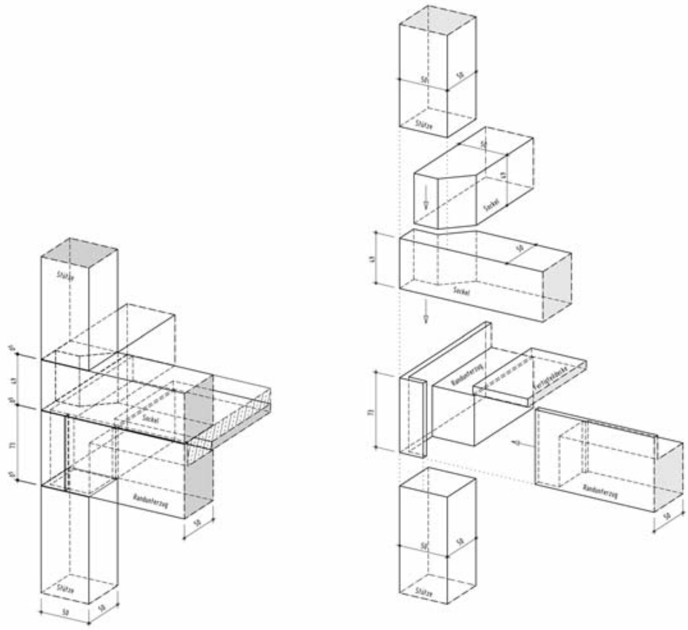
rooms and the Greek Courtyard, it is mainly the Egyptian Courtyard and the main staircase that represent the highlight of the capabilities of architectural concrete.

Inner courtyards

Of the two inner courtyards, the Greek Courtyard was very well preserved, apart from the destroyed apse. In the lower wall area, a new sand-blasted wall of marble concrete was placed in front all round. The apse was built up again in the upper area using old bricks. The so-called Egyptian Courtyard in particular has been given a new interiority through the use of architectural concrete elements. Contrary to the condition before the destruction, new exhibition rooms were added on three floors, supported by a system of columns and covered by a glass roof. The design envisaged four-sided, sand-blasted, 15 metre high 50/50 columns for this support system. At the same time, the intersections of the precast element construction had to be formed in such a way that the observer does not perceive the individual elements and assumes a continuous, monolithic node. All visible concrete surfaces are sandblasted here also.

For their manufacturing, the columns were concreted in a recumbent position with a cross-section of 55/50. Following the initial curing process, five centimetres were removed from the pouring side in order to achieve the final cross-section of 50 x 50 cm. The high rigidity of the concrete was decisive for this. Thanks to this unusual method it was possible to give all sides of the columns a similar appearance by means of four-sided sand-blasting.

Precast columns with grating on the glass roof level of the Egyptian Courtyard



Corner intersection of the precast construction in the Egyptian Courtyard

Rolling ceilings

Due to the destruction in the Second World War, there were no ceilings in the wing areas. Hence, the building service engineering systems required for a modern museum and the associated routing of cables and pipes could be freely designed. Since the intention was to provide an intermediate space for the building service engineering systems in addition to a sand-blasted suspended ceiling and to construct the supporting cast-in-situ ceiling above that, the 'rolling ceiling' was invented as a solution. To this end, the supporting joists were mounted first, sand-blasted, in the lower visible area. The self-supporting suspended ceiling elements, made of marble concrete, were subsequently

Rolling ceiling in the assembled condition without upper ceiling and with still open intermediate spaces

Intermediate space between the suspended ceiling and the supporting storey ceiling

placed at distances on the console of the joists. These ceiling slabs are provided with rollers at the support points and can thus be slid easily. Finally, precast slabs were placed on the joists and the supporting ceiling concrete was poured. In order to install the building service engineering systems, the suspended ceiling elements were simply pushed together and separated again after installation was complete. The lighting units are situated between the ceiling slabs. The remaining intermediate space is either filled with two centimetre thick sand-blasted concrete slabs or serves as an empty space for the installation of lighting units and other built-in technical equipment.

Rolling mechanism for the suspended ceiling

Finished rolling ceiling with built-in lighting units and 'carrot columns'

Symbiosis of decay and revival – impressions of the rebuilding of the New Museum

Prospects

Nefertiti can look forward to moving back into a modern New Museum in autumn 2009. With courage for the new and a great deal of esteem for the old, everyone involved in the project has succeeded in creating a symbiosis of old and new. Alongside the unique exhibits, the visitors will experience an outstanding museum building.

Dipl.-Ing. Tobias Mann

David Chipperfield Architects
London/Berlin
www.davidchipperfield.com

Dreßler Bau GmbH
Aschaffenburg, Germany
www.dressler-bau.de