



baumit.com

Baumit BauMinator[®]

Weight-reduced Ceiling Systems

Baumit. Ideas with a future.

Building the Future in an Easier Way

with the Baunit BauMinator[®]

The CEMBUREAU targets of - 40 % CO₂ by 2030 have already been achieved with Baunit BauMinator[®] technology.

The urgent requirement to radically reduce the emissions caused by the construction industry calls for a rapid rethink in a wide range of areas, such as the immediate use of lower-emission construction methods. Tried and tested lightweight construction methods are part of the solution.

With digital planning methods and produc-

tion processes, such as the 3D concrete printing system Baunit BauMinator[®], we now have practical options for using significantly thinner concrete cross-sections in an economical way and significantly optimising material consumption.

In addition, 3D printing offers architects, designers, precast manufacturers, as well as mould makers and development centers completely new possibilities for design, shapes, construction parts and component development.



Scan to see the Baunit BauMinator film.

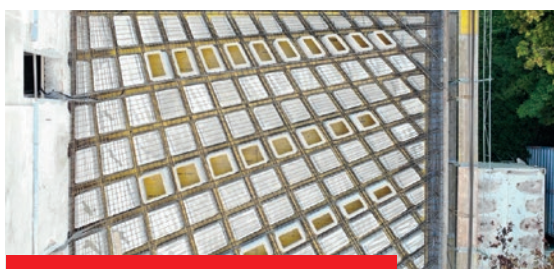


One System – Many Advantages



Resource-saving Construction

Pg. 4–5



Construct Complex Structures Simply

Pg. 6–9



Lightweight Ceiling and Roof Design

Pg. 10–11



Planning and Design

Pg. 12–13



Improved Handling at the Construction Site

Pg. 14–15



Technical Data and Tests

Pg. 16–18

Resource- saving Construction





Coebro Ceiling, ITE Institute for Structural Design, Prof. Stefan Peters

35 % reduced net weight

For the first time, the construction method of a material-reduced flat slab was tested at the University of Technology in Graz by using 3D-printed recess bodies. The results confirm the usability and safe use in the construction industry. Compared to a conventional flat slab, the component was up to 35% lighter.

In the future, construction methods which enable the resource-optimised use of materials in the construction industry will become increasingly important. As the most widely used building material in the world, concrete thereby plays a key role. Additive manufacturing offers a promising perspective for significantly saving material. 3D printing with concrete represents a significant innovation boost in the construction sector and has become a symbol of the digitalisation of the construction industry. The construction process, which can be automated to a large extent, can dispense with costly mould construction and enables the targeted and economical processing of concrete. The economical implementation of non-standard geometries promotes the development of new building components, away from solid concrete cross-sections towards force-flow-optimised load-bearing elements.

“Less concrete with same performance”

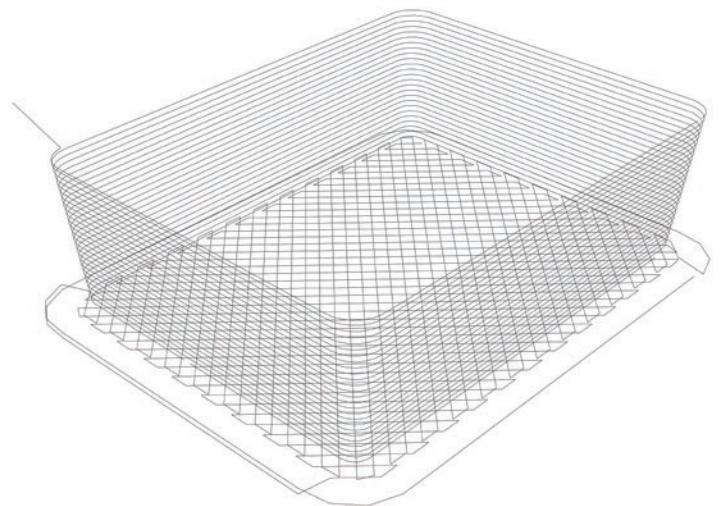
Among other things, Baumit’s 3D printing technology is used in order to produce lightweight slabs with reduced mass by using printed recess formers and additional in-situ concrete. The lightweight construction method developed at the Institute of Structural Design at the University of Technology in Graz – together with Baumit – has been tested through in-depth research and has already been implemented in many practical projects.

Construct Complex Structures Simply

Recess formers as recovered formwork

The structural installation elements are thin-walled, mineral formwork which are produced by using additive manufacturing and help to reduce the amount of required concrete for ceiling structures. The 3D-printed recess formers are positioned on the slab formwork and the concrete on the underside of the slab which is not involved in the load transfer is reduced. The semi-finished parts are installed as permanent formwork, are not reinforced, do not fulfil any static functions and are part of the concrete cover. On average, the elements weigh between 20 kg and 60 kg and their external dimensions are based on the pallet dimensions of 120 cm x 80 cm. This ensures proper handling on the construction site and cost-effective transportation of the elements. Due to the fast production times of 7 minutes on average per formwork

body, even large numbers of square meters can be produced with the existing 3D printing systems from Baunit.





Lunz am See | TU Graz, Atelier Kupelwieser Gusel Bau

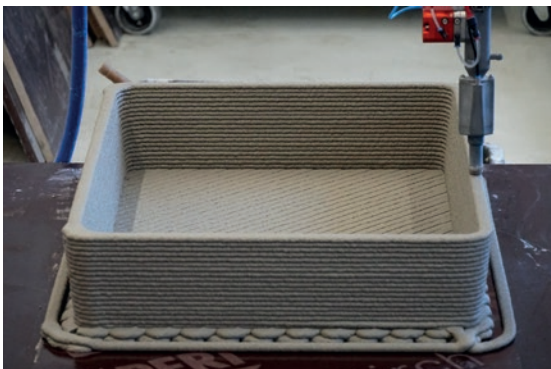
Standardised or individual

The recess formers are produced digitally/serially and can be manufactured in a variety of shapes. The focus is on maximum weight reduction, individual design or a combination of both. The effort which is required for optimisation is minimised by an automated design tool.

Types

You can choose from various basic types of recess formers. The Box type is ideal for two-axis, tensioned cassette ceilings. The Canoe type is often used for uniaxially tensioned ribbed ceilings.

“Box” type



“Canoe” type



Patented pressure nozzle



Procedure



Design:

Design your building as usual with your contractor or architect.



Optimisation:

Our partners optimise your project in terms of sustainability and design.



Production:

Production of the recess formers by our partners using the patented Baunit BauMinator® system.



Construction site:

Installation of the lightweight ceiling by our partners or your construction company.

Quality

The production of semi-finished parts is subject to strict quality criteria. Machine production guarantees consistent quality.

Individuality

There are virtually no limits to your design possibilities. Enjoy the freedom to implement variable geometries cost-effectively with 3D printing. The new technology turns your ceiling look into a unique architectural design object.

Construction

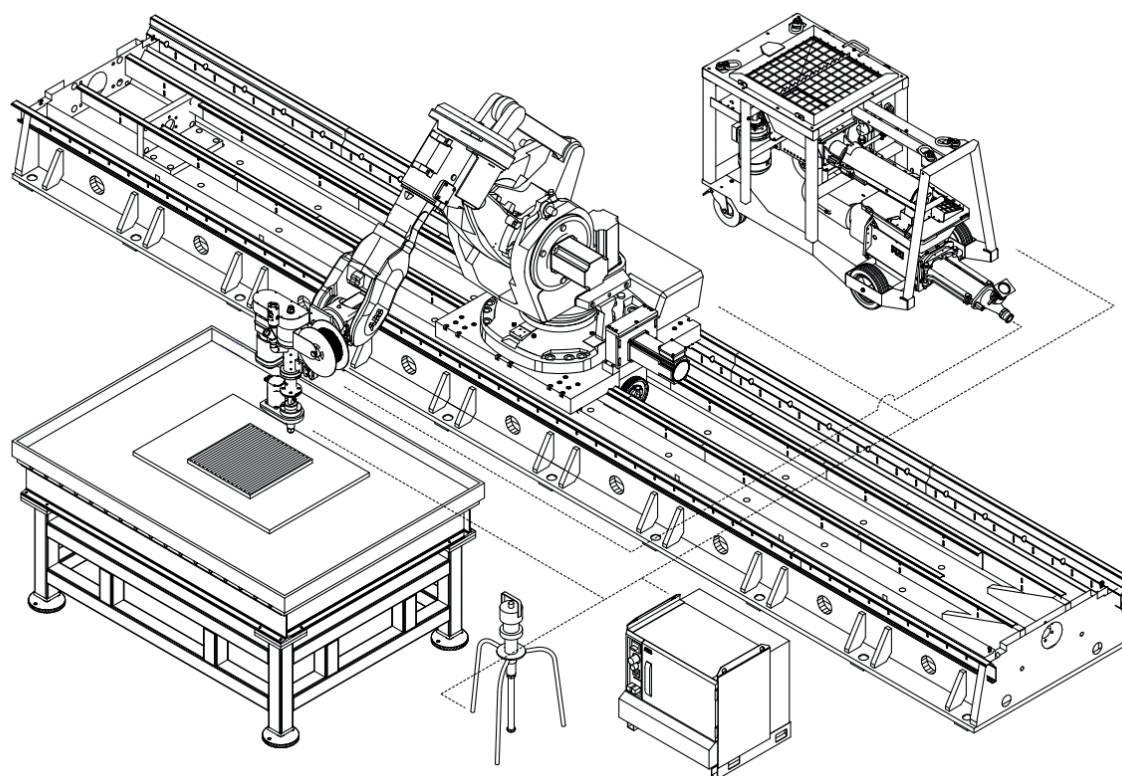
Very large recessed bodies can be realised by lining up segments.

Production processes

You define the spans of your ceiling and then you can choose between predefined grid dimensions or use the service of planning an individual ceiling soffit or one which is maximum weight reduced. The resulting formwork geometries are produced in series by Baunit partners using the 3D concrete printing process and delivered to the construction site.



Diagram of a 3D printing production plant



ARCHITEKTUR
PREIS
BETON
2023

Underground parking garage entrance in Nördlingen, 168 sqm, Eigner Bau, Architecture Award Concrete 2023

Lightweight Ceiling and Roof Design



Ceilings

3D printing technology enables cost-efficient form-work construction, which makes it possible to realise economical ribbed and coffered ceilings. The ceiling systems stand for an economical and intelligent use of concrete and can also be used as a design element.

Individual components

Digital fabrication and additive manufacturing stand for individuality and design freedom. By means of our ceiling and roof system, a wide range of geometries can be mapped and thus the most diverse conditions on the construction site can be accommodated.

Roof

Our lightweight roofs include all the advantages of the ceiling systems. In addition, individually positioned skylights can be installed and, if required, the gradient of the drainage can also be planned as sloping concrete.

Areas of application

- Multi-storey ceilings
- Transfer ceilings
- Roof constructions
- Acoustic ceilings



Bauhof Bludenz 717 sqm, Partner Concrete3D, Builder Werit, Architect Marcus Ender

Layout	Span widths	Element sizes	Screen types								
- Point support - Single-axis line support - Biaxial line support Point support Single-axis line support Biaxial line support	From 5m to 14m Higher span widths are also possible by request. Ceiling thickness From 25cm to 60cm(*1) The production method allows infinitely variable heights. *1 Larger construction heights are also possible on request. Span widths <table border="1"> <tr> <td>A 25cm/<6m</td> <td>-20% CO2e(*2)</td> </tr> <tr> <td>B 30cm/6m-8m</td> <td>-25% CO2e(*2)</td> </tr> <tr> <td>C 35cm/8m-10m</td> <td>-28% CO2e(*2)</td> </tr> <tr> <td>D 40cm/10m-14m</td> <td>-30% CO2e(*2)</td> </tr> </table> *2 Parameter-dependent, compared to the version with full cross-section	A 25cm/<6m	-20% CO2e(*2)	B 30cm/6m-8m	-25% CO2e(*2)	C 35cm/8m-10m	-28% CO2e(*2)	D 40cm/10m-14m	-30% CO2e(*2)	Variety of shapes - Free design of the recess bodies - Optimised, force flow-adapted geometry - Joining to large-format elements possible "Unlimited variety of shapes" Standard sizes Types: L (Large) 130-90cm Q (Square) 90-90cm M (Medium) 90-70cm	Freedom of design The system allows a wide range of design options for the ceiling and is only restricted by system limits and static feasibility. Orthogonal grid Edge compensation High flexibility thanks to easy adaptation to local conditions.
A 25cm/<6m	-20% CO2e(*2)										
B 30cm/6m-8m	-25% CO2e(*2)										
C 35cm/8m-10m	-28% CO2e(*2)										
D 40cm/10m-14m	-30% CO2e(*2)										
Static system - Point support - Single-axis line support - Biaxial line support biaxial uniaxial											

Planning and Design



Pavilion Baunit 100 sqm | Incremental 3D | Fessl Bau

Process flow from inquiry to submission

Decide on a weight-reduced ceiling system in your planning and design process and let us be part of your individual and innovative implementation. Benefit from our 3D printing expertise. Our partners are at your side from the design and planning to the production and construction site support.

Design and planning

Digitalisation offers very powerful digital planning tools which allow the planning of individual and optimised beam-robotic structures with manageable effort. In direct combination with the possibilities of digital production methods, the production of 3D-printed formwork systems is possible and their use in large projects is economical. 3D concrete printing technology in particular makes it possible to realise complex structures, elaborate architecture and shapes at manageable costs, both financially and in terms of execution.

Planning principles

Input

- Span width
- Layout
- Ceiling thickness
- Load capacity

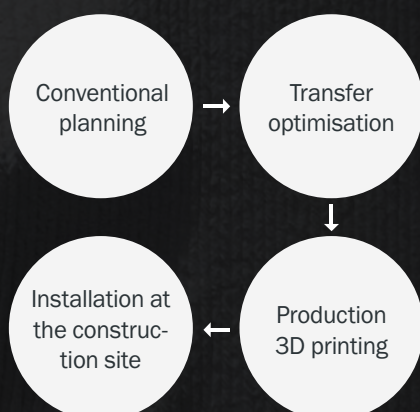
Optional

- Individual recess formers

Output

- Selection of recess former and ceiling thickness (pre-dimensioning)
- Concrete savings
- Reinforcement savings
- CO2 savings

Planning process



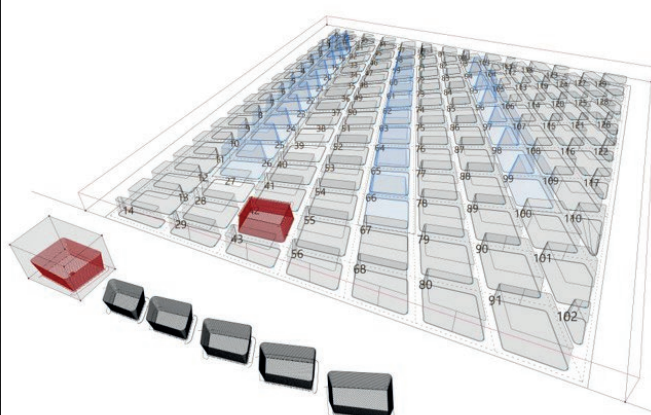
Baumit Partner

Services

- General technical advice
- Feasibility study
- Development of prototypes
- Advice on transportation and installation
- Design and planning
- Baumit family with many locations

3D printing locations

You have the option of having your 3D-printed formwork produced at several locations. Our partners are located in Vorarlberg, Burgenland, Salzburg and Bavaria. You also have the option of printing on site with our mobile 3D printing system.



Improved Handling at the Construction Site

Delivery

The recess formers are delivered to the construction site “just in time” and are positioned directly on the slab formwork. This minimises the use of storage space on the construction site and does not disrupt the construction process.

Formwork

Any conventional slab formwork can be used. It is also possible to increase the height of the formwork.

Positioning

Simple marking and an installation plan make it easy to lift the recess formers onto the slab formwork. Pre-measured adjustment disks facilitate the positioning on the formwork and prevent the concrete elements from shifting during installation and concreting.

Soffit

We will be pleased to advise you on our various sealing options, including slab formwork, and find the right solution for your application. Choose the design quality (sealed) or the commercial version (not sealed).

Reinforcement

Prefabricated reinforcement systems reduce the construction times and guarantee an economical system for ribbed and coffered ceilings. Prefabricated reinforcement cages speed up the installation work.

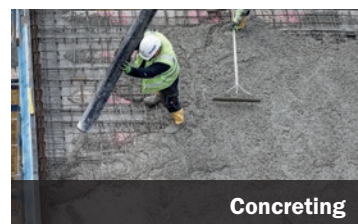
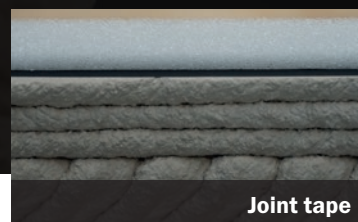
Concreting

Concreting is carried out conventionally with in-situ concrete. The reduced use of materials saves transportation costs. For further CO2 savings, we recommend the use of eco-concrete as filling material.

“We focus on precision and quality.”

“The fastest cassette ceiling thanks to prefabricated rein- forcement cages”

Underground parking garage entrance in Nördlingen, 168 sqm, Eigner Bau,
Architecture Award Concrete 2023



Technical Data and Tests

Test carrier Nördlingen | Eigner Bau



Savings potential

The use of 3D-printed half-shells can reduce the amount of used concrete in components, such as ceilings and roofs in areas subject to low loads. The system ceiling developed at the University of Technology in Graz enables a reduction of 30 % to 40 % in the amount of concrete and reinforcement used in a single-grade construction with individually 3D-printed concrete recess elements



Verifications

In two large-scale tests, both types of lightweight construction, the ribbed ceiling and the coffered ceiling, were tested by an independent institute in terms of their load-bearing capacity and suitability for use. The test specimens were ceiling cut-outs that were reconstructed on a scale of 1:1 in order to represent reality as closely as possible. In compliance with the design rules according to Eurocode 2, the construction fulfills all normative requirements.



Fire tests

The tests were carried out in accordance with EN 1363-1 and EN 1364-2 over a test period of 120 minutes with regard to the criteria of load-bearing capacity, room closure and thermal insulation.

FIRE TEST 1 (not under load)

EI - 120

“Positive room closure, positive thermal insulation 120 min”

FIRE TEST 2 (under load)

REI-90

RE-120

“The load-bearing capacity is ensured up to 120 min”

Carbonation

A major advantage of the construction method is that the formwork remains in the component and can be used in order to cover the reinforcement. The carbonation resistance of the component was tested based on the accelerated method in accordance with ÖN EN 12390 12 and the carbonation speeds of the composite construction method were evaluated.

“The recess formers serve as concrete cover but do not perform any structural function.”

“No stripping and disposal of plastic formwork”



Bond strength test

The tests showed that the adhesive tensile strength is greater than the concrete tensile strength in the area close to the formwork. The bond between the 3D primitive body and the grouted concrete is so good that the component can be assumed to be virtually monolithic.

Adhesive tensile strength > Concrete tensile strength

Tensile stress at 1.8 N/sqmm

Sound tests

“No significant differences to a solid reinforced concrete ceiling”

“Up to 40 % less weight with the same load-bearing capacity – efficiency instead of superfluous tons”



Material data for print concrete

The Baunit PrintCret230 printing material is supplied in white and grey and has a compressive strength > 35 MPa and a flexural tensile strength of approx. 9 MPa depending on the direction of printing. (according to mortar standard EN 196-1)



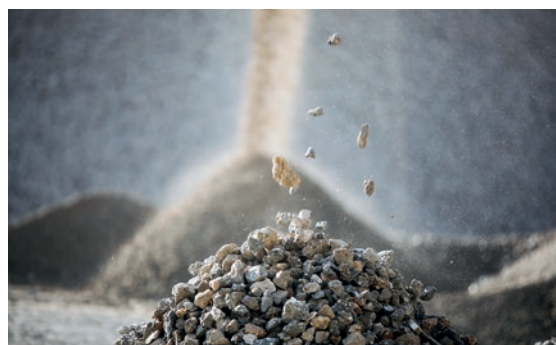
Grouting concrete

The right choice of grouting concrete also offers further savings potential. We recommend the use of clinker-reduced concretes. This can save up to an additional 15 % of CO₂ equivalents.



Reinforcement

Prefabricated reinforcement cages facilitate the installation of the reinforcement and are only supplemented on site with mesh and edge beam reinforcement.



Recycling

As only steel and concrete flow into the structure, it can be easily dismantled and separated by type after use.

“Installation performance is comparable to a conventional flat ceiling”

“The load-bearing shell construction is easy to dismantle and recycle”

Your point of contact

Baumit GmbH

DI Eduard Artner

+43 676 400 1665

A-2754 Wopfing

e.artner@baumit.com

www.baumit.at/bauminator

Institute for Structural Design

+43 316/873 - 6211

A-8010 Graz

tragwerksentwurf@tugraz.at

www.tugraz.at/institute/ite/home

Baumit Partner

Execution:

CONCRETE 3D GmbH

+43 5552 62300 229

A-6714 Nüziders

office@concrete3d.at

www.concrete3d.at

EIGNER Bauunternehmung GmbH

+49 9081 8096-0

D-86720 Nördlingen

info@eigner-bau.com

www.eigner-bau.com

Incremental3d GmbH

+43 660 151 7143

A-7223 Siegraben

info@incremental3d.eu

www.incremental3d.eu

uniQum GmbH

+43 676 38 48 005

A-4882 Oberwang

info@uniquum.com

www.uniquum.com

Civil Engineering Office:

ENGELSMANN PETERS GMBH

+43 316 22 87 85-10

A-8010 Graz

graz@engelsmannpeters.at

www.engelsmannpeters.de

Baumit **BauMinator**®



“The 3D concrete printing system combines creativity and functionality. We open up completely new and affordable design options for architects and designers.”

Eduard Artner, Head of Baumit BauMinator®

Contact Baumit BauMinator®

DI Eduard Artner

Phone No.: +43 676 400 1665

e.artner@baumit.com