

## Zukunft Bau

### STRUKTUR / GLIEDERUNG KURZBERICHT

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#### Titel

Langfassung Titel: „Bauen mit Weitblick – System building set for industrialized social housing“

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#### Anlass/ Ausgangslage

kurze Beschreibung des Problems und des Lösungsansatzes

max. 450 Zeichen (mit Leerzeichen)

In many places additional residential buildings for an affordable prices are urgently needed. Straightaway politics and the housing industry need to create socially acceptable housing. At the same time, planning and building still continue to follow archaic patterns. While preserving architectural diversity, industrialization of housing construction is required. Possible ways for the industrialization of social housing and their implementation are investigate in this project.

#### Gegenstand des Forschungsvorhabens

Beschreibung der Arbeitsschritte und des Lösungswegs

max. 4.300 Zeichen (mit Leerzeichen)

The objective for this project is the development of a methodology and provision of a ‚system building set‘ to enable industrialized social housing in a high sustainable building quality. At the beginning based on the funding criteria for social housing and the building regulations in each Federal State a catalogue of all relevant performance requirements has been defined. The requirement catalogue provides all information necessary for further developments. All functions and product structures, which are needed for a ‚system building set‘, were developed based on the categorized requirements.

A ‚system building set‘ is a modular construction system for a specific system with a certain amount of building blocks (building assemblies), which are chosen to fit a specific application and can be combined with each other, taking into account the compatibility of combination. The building assemblies provide standardized geometrical and material properties. They are harmonized and may be combined out of (less complex) building blocks. When configured the shape of the building assemblies is fixed. Therefore the original attempt of the project to create one unique ‚system building set‘ could not be realized. A ‚system building set‘ can only be realized in a specific building system, e.g. prefabricated reinforced concrete. The static, building physics or fire safety design of different building systems is differing (still) too far to handle a complete parametrization.

During the project building blocks were developed using a building assembly systematic. They are arranged to „building assemblies - building“ (BG-G) containing groups of flats or complete “building assemblies – floor-types” (BG-T). The digital definition of a building assembly includes all elements of the building construction (shafts, partition walls, slabs, roofs, etc.) and all building services. In addition it includes all relevant data to produce the building assemblies, i.e. it provides a complete production planning for the building producer. A building assembly is a complete planned unit and therefore an ideal application of Building Information Modelling (BIM). All data are created only once for repeating applications (in opposite to today’s ‚one-design‘). A partly parametrization, e.g. size of windows, type of facade or span of slabs, is possible. Of course a prefabrication as far as possible is wise, but not absolutely necessary. A ‚system building set‘ in real is represented by a differing mix of prefabrication, precutting and local finalization.

The ‚system building sets‘ developed in this project use a reinforced concrete module construction and a hybrid prefabricated panel construction out of timber frame elements for walls and roofs and prestressed reinforced concrete hollow-core slabs, each system with specific optimized prefabrication. Using these ‚system building sets‘ it is possible to create all required mix of apartments in middle-floor -, arcade-, center- and multi-apartment- buildings. The architectural freedom is given by a partial parametrization and by additional building assemblies as for balconies, arcades (BG-A) or access-units (BG-E). In a number of optimization cycles the processes were analyzed to demonstrate the saving potential by optimization of planning and production, especially due to effects of repetitions. Additional savings will occur based on high numbers of building products. A limitation of these effects is actual given by the current market situation (shortage of building products, production capacities and workmanship). The initial targeted gross cost limitation to 1.200 €/m<sup>2</sup> rentable area based on cost type 300, 400 and 700 (according to DIN 276) could not yet verified. But it seems realistic to be able to limit the costs to less than 1.600 €/m<sup>2</sup> by the described steps of industrialization. Due to additional future optimizations an additional cost reduction is feasible.

In addition further aspects of cost reduction were examined: A special ‚building system set‘ for bathrooms with replaceable installation building blocks, taking into account the special needs of handicapped people, was developed. Also the sufficiency of a air-change rate of 0,2 /h to ensure moisture safety has been proofed as well as the possibility to use direct electrical heating, taking into account highly insulated buildings and the developing change of the primary energy-mix in Germany. Also a number of Life Cycle Cost and Life Cycle Assessment calculations based on reference buildings proofed the suitability of the concepts. In addition it was demonstrated, which digital tools are available and applicable for ‚system building sets‘.

## Fazit

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Beschreibung der geplanten Ziele und der erreichten Ergebnisse

max. 700 Zeichen (mit Leerzeichen)

For specific constructions, it was possible to develop 'system building sets' based on the developed building assembly systematic. The involved companies have developed company-specific 'system building sets'. Based on the results, it is now also possible to develop construction-specific, company-independent 'system building sets' that can be used by configurators by independent planners and advertised openly. Ideal would be an open source 'system building set', which allows the complementary development and addition of further building blocks - thus a real industrialization would be achieved. The project demonstrates additionally the urgent need to harmonize the different financial stimulation rules for social housing projects and the building regulations in the Federal States of Germany, which should have a greater flexibility, to support industrial building.

## Eckdaten

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Kurztitel: Bauen mit Weitblick

Forscher / Projektleitung:

Projektleitung

Technische Universität München (TUM), Lehrstuhl für Holzbau und Baukonstruktion - Univ. Prof. Dr.-Ing. Stefan Winter, Markus Lechner M.Sc., Claudia Köhler M.Sc.

Projektbeteiligte:

Lehrstuhl für Gebäudetechnologie und klimagerechtes Bauen (TUM), Professur für Entwerfen und Holzbau (TUM), Lehrstuhl für Industrial Design (TUM)

Fraunhofer Institut für Bauphysik IBP

Dr. rer. pol. Joachim Brech, Architektur und Sozialwissenschaft

Kommunale Wohnungsgesellschaft mbH Erfurt (KoWo)

Max Bögl Modul AG

Regnauer Fertigbau GmbH & Co. KG

Gesamtkosten: 697.382,81 € €

Anteil Bundeszuschuss: 421.877,51 €

Projektlaufzeit: 24 Monate + 5 Monate kostenneutraler Verlängerung (01.12.2015 – 01.05.2018)

## BILDER/ ABBILDUNGEN:

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5 - 7 Druckbare Bilddaten als **eigene Datei** (\*.tif, \*.bmp, ...) mit der Auflösung von mind. 300 dpi in der Abbildungsgröße (z.B. Breite 10 - 20cm). Bilder frei von Rechten Dritter.

Bildnachweis jeweils:

Bild 1: Dateiname.xxx

Bildunterschrift

Bildnachweis aller Bilder: TUM



180112\_Bild1\_Perspektive 1.jpg

Bildunterschrift: *Visualization of the building system hybrid prefabricated timber panel construction*



180112\_Bild2\_SOMA Würfel.jpg

Bildunterschrift: *Configuration of buildings from building assemblies 3D Tetris*

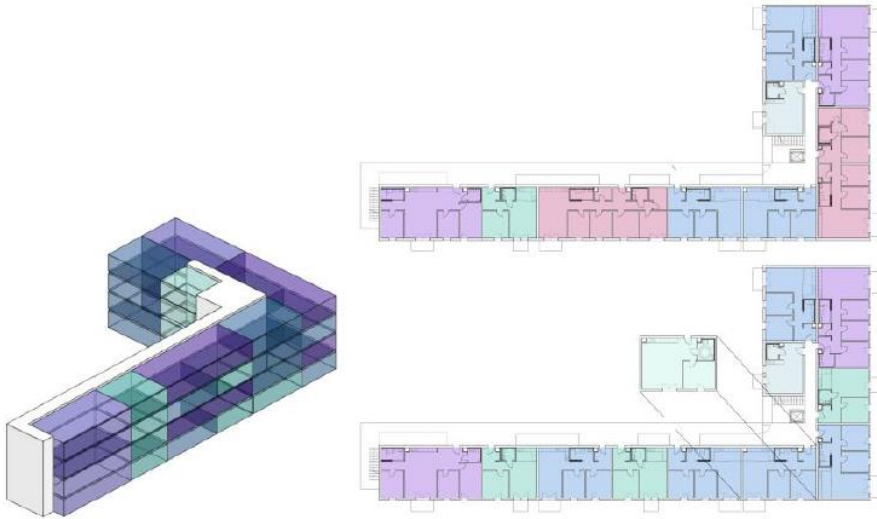
Quelle: ©SOMA – Würfel, Bild: Winter

siehe auch [www.mathematische-basteleien.de](http://www.mathematische-basteleien.de)



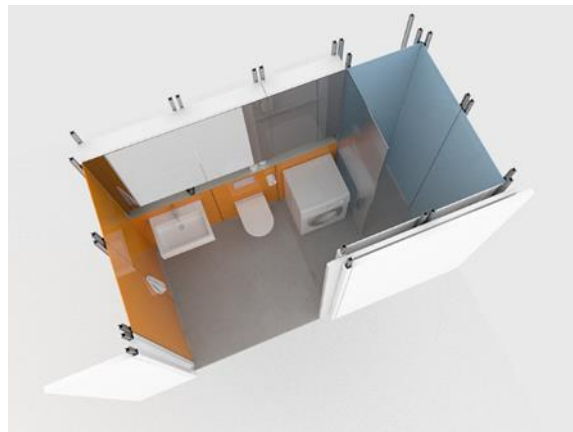
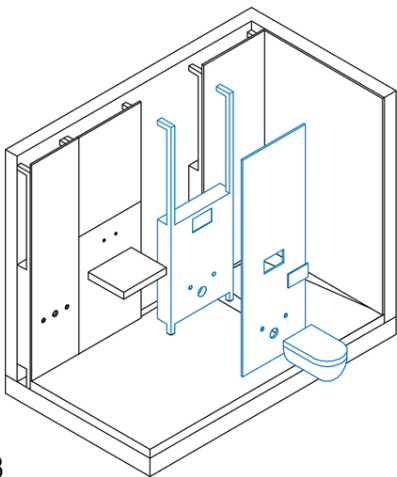
180112\_Bild3\_Nicht-Sortenreine Baugruppen.jpg

Bildunterschrift: *Not unmixed building assemblies - building (NSo BG-G)*



180112\_Bild4\_Laubengang Spänner Kombination.png

Bildunterschrift: *Laubengang-Spänner-combination; three-dimensional representation; rechts: 1.+ 3.level, 2.+ 4. level*

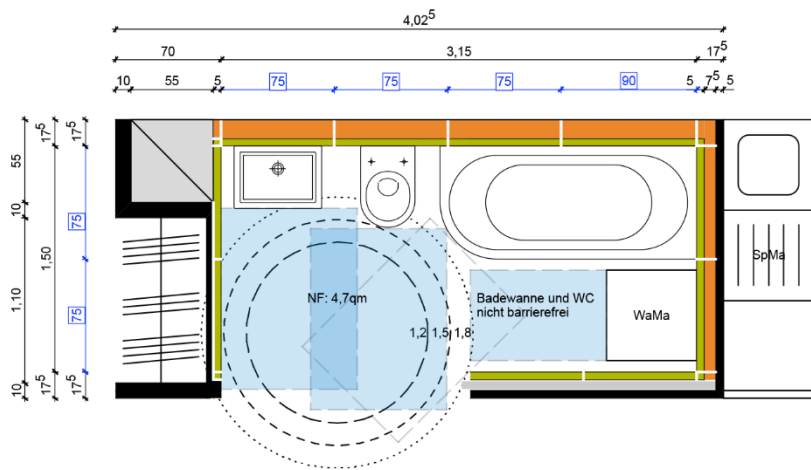


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180112\_Bild5.1\_Systembad Prinzipskizze 1.tif

180112\_Bild5.2\_Systembad Prinzipskizze 2.png

Bildunterschrift: *Summary of sanitary object, wall surface and UP technique to functional units*



**Standard DIN 18040-2 "barrierefrei"**

Anforderung	Soll	Ist	Begründung Abweichung
Bewegungsflächen			
vor WC	120 x 120	✓	
WC seitlich (alb)	20   20	25   16	nicht barrierefrei
vor Waschtisch	120 x 120	✓	
vor Badewanne	120 x 120	75 x 100	nicht barrierefrei
im Duschbereich	120 x 120	-	
Durchgänge / Türen	b >= 90	75	nicht barrierefrei

**Standard "ready"**

Anforderung	Soll	Ist	Begründung Abweichung
Bewegungsflächen			
vor WT, WC, DU, BA	90 x 120	X	BA nicht barrierefrei
vor WaMa	60 x 90	✓	
WC seitlich	90 x 90	X	WC nicht barrierefrei
Dreh- / Wendefläche	d >= 120	✓	
Durchgänge / Türen	b >= 90	75	
Raumgröße			
Nutzfläche	min. 3,6qm	✓	
min. Wandlänge	min. 1,7m	1,5m	Flurbereich mitnutzbar
Ausstattung			
Waschtisch	Tiefe >= 40	✓	
WC	Tiefe >= 65	60	WC austauschbar
Dusche	>= 90 x 90	-	

180112\_Bild6\_Konzeptüberprüfung Systembad.tif

Bildunterschrift: *Concept check for barrier-free use according to DIN 18040-2 and ready-study*