

# [Modern concrete technology](https://assignbuster.com/modern-concrete-technology/)

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Chassis (see page 38), Thus, further advancements in this field can be expected in the future. Sell-compacting concrete or sophisticated procedures in surface design have already found use in numerous buildings. Also, the opportunities in applying insulating concrete have been explored extensively in recent years. The question on how things will continue to progress warrants a look at recent research results. This leads to Identifying three approaches: new reinforcement materials that enable creating very delicate construction components alternatives to rigid framework:

Increasing demands for free-form surfaces, such as the Orca Pavilion In London, require new framework techniques variations In the concrete matrix, e. G. Ultra-high density concrete as used in the vineyard house built by the TU Quartermasters (see page 24), controlled pore distribution , or use of new aggregate materials. A number of promising approaches that show how the parties involved have expanded the limits of what is possible are introduced in the following.

They all emphasize the high significance of construction research for the architectural discipline and indicate that there still are ample opportunities for progress in building with concrete. Freely shapeable framework made of wax Within the European Nylon's research project Tailored, freely shapeable framework made of wax was created at the Chair of Architecture and Digital Fabrication at the HTH Zurich. It permits repeated melting and re-use. As result, a completely zero- waste framework method is proposed for free-form concrete construction elements poured onsite.

For the creation of prototypes, an adjustable framed mould was developed into which melted wax is poured. The hardened wax elements are set into a standardized framework structure and concrete is poured into the cavity. After removing the framework, the wax can be melted again for the next application. Extensive research on wax characteristics, including shrinkage, deformation behavior, and pressure resistance, as well as corresponding adaptation served to reline the manufacturing process.

Fusing framework Joints permits creation of large size seamless concrete surfaces . This new method Is compatible with conventional work on site and related tools. At the same time, It permits Integration of state-of-the RTF technology for the creation of wax elements, Including computer and robot controlled adjustable moulds. In addition, researchers developed the appropriate successfully created full-scale prototypes indicates that this system comprises a remarkable addition to the existing repertoire of production techniques for free-form concrete construction.

Building with textile concrete Textile concrete, a composite material comprised of very fine grain concrete (maximum grain size 1 mm) and textile reinforcement , permits manufacturing extremely light and delicate construction components. The highly flex flexible enforcement supports the creation of free forms. The new opportunities this material offers have been subject to research for a number of years at the Chair of Building Construction and Design at the ROTH Aachen's within the framework of a special research area.

Aside from researching design and construction principles that correspond to material characteristics, the exemplary development of construction components made of textile concrete is emphasized. Unusual applications were demonstrated in the form of curved lattice structures or in the sector of mobile construction and furniture building. The newest prototype is an exhibition pavilion, comprised of an already completed structure featuring four square screens made of textile concrete each 7 m wide and within 60 mm strong cantilevered surfaces.

Within this pure form devoid of any additional elements, the performance and future potential of this technology can be recognized very well. Textile framework for concrete constructions Innovative types of concrete framework made of textile are part of a research focus of the Centre for Architectural Structures and Technology (CAST) of the University of Ma-Manitoba, Founding Director Mark West describes the particularities and advantages f the system: " Ever since concrete was invented by the Romans, rigid moulds are used to form it.

Exchanging a rigid mould with a flexible membrane alters our understanding of concrete and concrete architecture in a fundamental way. The prismatic and rectangular forms that we typically associate with concrete have nothing to do with the material as such". Different than rigid materials, a flexible membrane can only bear tensile stress. Thus, textile framework follows the spatial curves of tensile resistance in a natural way. Tension is the absolutely most efficient way of resisting stress and a principle found everywhere in nature.

Therefore, fabric moulds are hundreds of times more efficient than conventional rigid framework in terms of material usage. The use 01 flexible membrane framework for concrete construction offers two opportunities at the same time: for one, efficient and sustainable use of materials; in addition, a completely new formal language with geometries that resemble biological or other natural structures. Mark West emphasizes the flowingly elegant and sensual character of concrete created with textile framework, leading to a new definition of the sensation and effect of concrete architecture.

Construction methods and details for manufacturing these textile moulds can be complex or extremely simple . The results range from high degree of perfection to undefined, free forming in relation to particular selected materials and type of connections. For architects, engineers, and construction firms, this constitutes hanging fruit", as Mark West calls them. Due to their innovative character, the greatest obstacle to a broad implementation of textile formed construction is finding firms that are willing to offer this procedure, despite the fact that the means of construction involved are actually very simple.

Concrete and its flexible mould act together as a system that produces dynamically formed constructions. In this regard, a type of architecture is supported that features a particular narrative or dramatic appearance. Load curves resulting from gravity become visible in its forms. It is often difficult to distinguish between architectural form, ornament, and structure in these constructions. A designer can change forms resulting from fabric framework by altering the boundary conditions of the textile, by introducing intermediate fixation points, or altering the type or the pre-stretching of he textile.

Further sculptural or structuring effects can be created by targeted buckling or folding of the textile sheet prior to pouring concrete. Preferred materials for textile framework include woven polyethylene (PEE) or polypropylene (UP) sextillion typically used in landscape architecture or road construction. They are available in large rolls up to 5 m wide, which enables creating large, seamless forms. These textiles don't stick to the concrete and are tear-proof. The strong and resilient sheets can be treated with typical tools and connectors, and " tied" connections are possible.

Mark West also emphasizes that these kinds of textile are globally available and relatively inexpensive. They permit repeated re-use, require no release agents such as framework oil, and when no longer needed as framework, they can also serve their original purpose as extolling. This makes a completely zero-waste framework method a reality. The material costs of textile framework comprise no more than one tenth of the costs for plywood. PEE and UP textile are either available as water-proof, coated, or uncoated partly permeable material.

In its permeable form, textile framework permits leasing air bubbles and excess mixing water through the framework membrane, which leads to flawless surfaces comprised of higher-density concrete with higher load bearing capacity. All examples displayed here were created with framework comprised of simple, flat, UN-tailored textile sheets. The multitude of forms and applications that can be achieved by using simple sheets is remarkable. They have been used for walls, beams, and columns, as well as ceilings, panels, and thin shell structures - as prefabricated components or poured on site.

This construction technique has been tested in full-scale prototypes and commercial applications. Digital tools to calculate the geometry of textile framework are currently under development. Gradient concrete - construction material optimized internally By targeted, gradual adaptation of poorhouses within concrete construction components, material characteristics such as density, firmness, and thermal conductivity can be precisely optimized to meet actual load-bearing requirements, and excess material can be avoided.

The technology behind gradient was developed and is extensively researched at the Institute for Lightweight Structures and Conceptual Design (ILEC) at the University of Stuttgart. In principle, the arrangement of different degrees of multiple kinds of concrete can be used for the gradation of concrete. When air entrainment agents, prefabricated loam, or hollow micro structures are introduced in a targeted way, this kind of control of air entrainment leads to variations in density. In addition, controlled De-mixing of concrete by e. G. Enter-fixation is possible, as well as spray techniques that enable gradation by incorporating two basic mixes within a spray nozzle or within the aerosol. Advantages include resource conservation through reduction of mass of construction components, e. G. Lining slabs that - when gradation relates to load-bearing - can lead to savings of up to 60 percent in weight . Also, highly recyclable, multi-functional construction components can be created, such as wall constructions with targeted distribution of load-bearing and thermal insulation characteristics.

As result, a uniform construction component with dense exposed concrete surface can contain a core with thermal insulation properties. If aerosol concrete is used within core area, a construction component with passive house capacity can be created with a wall thickness of 37 CM and a IS- value of 0. 1 W/make. Thus, the approach introduces a perspective that transcends homogeneous thermal insulation concrete components with wall thicknesses that are no longer economically feasible.

An interview with Werner Sober, Director of the ILEC, offers his insight on the opportunities presented by such an internal optimization of concrete construction components: With gradient concrete, you receive a double advantage. The material can be adapted both to structural requirements as well as thermal insulation necessities. What prompted these developments? Werner Sober: The idea of gradation of concrete is actually not that far-fetched. Being able to influence load-bearing characteristics and building physics characteristics at the same time is very appealing.

However, gradient concrete can't be created with unskilled laborers on site. For this purpose, we require new machine. Something we are already working on. How realistic is the use of aerosol concrete in this context? Werner Sober: While comprising a possibility to create highly thermally insulating constructions, we are still pretty much at the beginning with aerosols. We need two to three more years of fundamental research in order to seriously say whether it makes sense or not. Perhaps these fillers need to be replaced by others in order to reach projected goals.

How are topic selected for research? Hemmer Sober: A researcher has to know if a particular inquiry contains hidden chance. This 'sensing" of an opportunity, recognizing a problem, and the following hard work on finding a solution that is heretofore unknown are substantial. Even if a lot of people say that it will fail, you need to have the courage to fail. How long does it typically take until research results at the ILEC become part of construction practice? Werner Sober: Approximately 10 to 15 years. You need to be attention. Construction as a practice is, to a certain degree, conservative.

But this is actually acceptable, since we aren't supposed to burden our client's budgets by for 20 years now. The idea was to optimize the performance and minimize the weight of a construction component, yet not by altering its exterior silhouette, but instead, by employing the same procedure to optimize its interior. This resulted in formulating three fields of inquiry. The first question is: how can 1 develop a prognosis on required distribution of poorhouses? The second question deals with how to determine structural integrity. The third question relates to manufacturing.

For some questions, an answer is found already after two to three years. In the field of manufacturing, this took more than 15 years. At what point can research results be presented to the public? Werner Sober: Our institute follows the principle of open access. Whoever asks a question receives an honest answer on our current know-how. However, when it comes to publications, exhibitions, and such, we typically tend to be rather reserved. We only published the idea of gradient concrete when my assistants and I were sure that we had sufficient intro over all partial areas in order to be certain that the principle essentially worked.

But that is simply part of being respectable. Do you sense an interest in gradient concrete within the construction industry? Werner Sober: Yes. Naturally, there are smart people at the top echelons of companies who say, if gradient concrete permits saving 20, 30 or 50 percent of weight, and thus, also the energy required to create cement and related emissions, it becomes an obligation to be involved. Does that mean that research can become an incentive for acting responsibly? Or seed differently, would a failure to seek innovations be irresponsible?

Werner Sober: That would truly be irresponsible. Experimental house made of wood concrete In order to explore the possibilities offered by 'wood concrete', a mix of cement and wood chips or shavings, a research group at the Chair of Design and Housing at the Bauhaus University Whimper developed a prototype test building that offers room for 50 new workplaces. The greenhouse is part of a campus expansion that is also intended to demonstrate new future-oriented ways of conceptualization, construction, and material selection in architecture.