NEST – Exploring the Future of Buildings

Research – Economy – Society

EMPA
Materials Science & Technology

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exploring the future of buildings

Shaping the Future of Buildings

The built environment is a key element of our civilization. The quality of living and working space influences our wellbeing and capabilities. Infrastructural buildings for transport, energy, supply and disposal offer us mobility, communication and prosperity.

At the same time, we face major challenges: The consumption of resources involved in constructing and running buildings needs to be reduced drastically, especially in the fields of energy, materials and land use. Additional pressure to adapt is resulting in both a growing and aging population – at first glance, a perfect environment for innovative companies with new, groundbreaking ideas.

In actual fact, however, there is hardly any other branch of industry where it is so difficult to implement new concepts and ideas on the market. High investment costs, which have to be amortized over long periods of time, lead to a greater reluctance to take risks, which is heightened even further by the high density of rules and regulations.

Before a new material or system can be launched successfully on the market, it needs to demonstrate its practicality, which requires demonstration projects to be conducted under realistic conditions and supported scientifically – and this is precisely where NEST comes in.

NEST accelerates the innovation process in the building and energy sector. Research, industry and the public sector work closely together.

Your NEST team.

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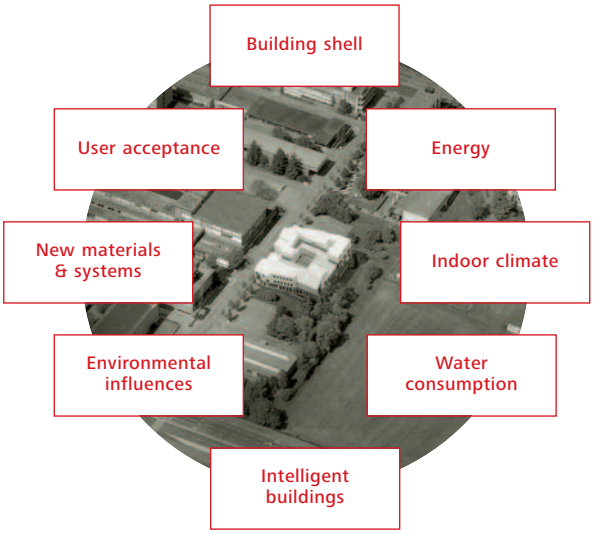
NEST:
Helping New Building and Energy Technologies Find Their Way onto the Market Sooner



NEST is a research and innovation platform for construction and energy solutions of the future. Leading research and industrial partners jointly develop new technologies and systems.

NEST's vision is to bring innovative construction and energy technologies onto the market sooner to help sustainable buildings make a breakthrough. These buildings should enable the residents to feel at home and at the same time:

- Boast a minimal energy requirement
- Produce a minimum amount of greenhouse gases and reduce the ecological footprint
- Be economic with water – and partly recycle it

NEST lays unique foundations and curbs risks in order to tackle these challenges. The goal is to run the building almost exclusively on renewable energies.

NEST will serve as an academic guesthouse and office environment for researchers from all over the world, industrial partners and other guests. Its usage facilitates a practical laboratory that takes the real needs and requirements of its users into account.

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NEST Creates Added Value for Your Company!

NEST's goal is to help innovative companies realize their ideas under optimum conditions and bring new knowledge from research and development to the table. NEST bridges the gap between research and application.

NEST offers the construction industry a platform to road-test new ideas and products, and creates a showcase for national and international target groups.

Acceleration of Go2Market and business development

- Test platform for new technologies and products
- Access to national and international networks of researchers and companies
- Access to startups and ideas
- Showcase for national and international target groups
- Knowledge and information transfer and courses

Branding and marketing

- Support on marketing and communication (increased visibility, own events, appearance in articles, newsletter and on website)
- Support on positioning the brand in the field of innovation and energy/resource efficiency

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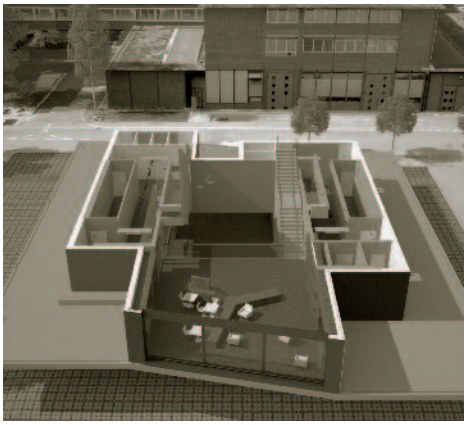
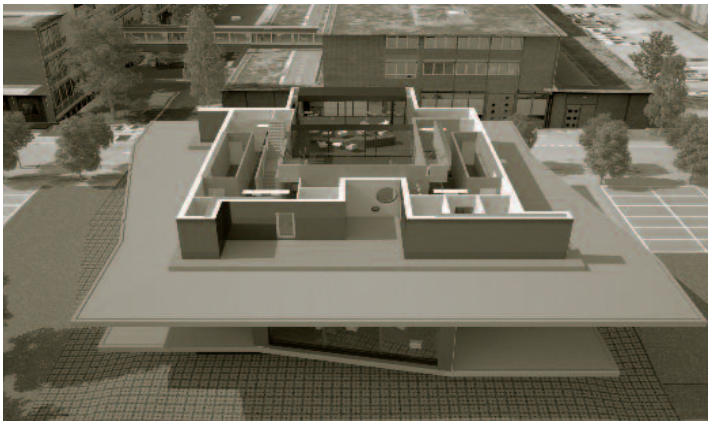
NEST – a Flexible Platform for Future Technologies





NEST is a vertical neighborhood with various residential and office “buildings” being placed on top of each other.

NEST consists of a central structure, the “backbone”, and research and innovation units. The backbone provides the supporting structure and the necessary media (electricity, water etc.) for the units.

The backbone guarantees great flexibility for the installation of new units in the future. It serves as a sort of parking garage for units.

The research and innovation units are designed as apartments or offices and should make it possible to pursue current developments, market needs and issues in a targeted manner and find specific answers.

One special unit is the Energy Hub, which optimizes the energy management between the units, NEST and surrounding the buildings.

Backbone – the Central Infrastructure and a Parking Garage for the Units

The backbone serves as a parking garage for the units and provides several core functions.

- Campus reception with a lobby and conference rooms on the ground floor
- Presentation and exhibition room, where NEST content can be showcased
- Catering area for events with attractive terrace for up to 40 people
- General common area for residents and staff
- Presentation rooms for tours and communal use on every floor
- Basement with comprehensive central building technology (water treatment, central air treatment, Energy Hub)

The backbone enables the realization of a neighborhood of innovative and energy-efficient buildings under one roof. Technologies that are realized more effectively in a network of several buildings are accommodated in the backbone. These include waste water treatment, the Energy Hub and the use of alternative energy systems.

The backbone is currently under construction and scheduled for completion at the end of 2015.

Research and Innovation Units

The experimental residential and work units are arranged thematically in a number of focus areas to set targeted development priorities and launch idea competitions.

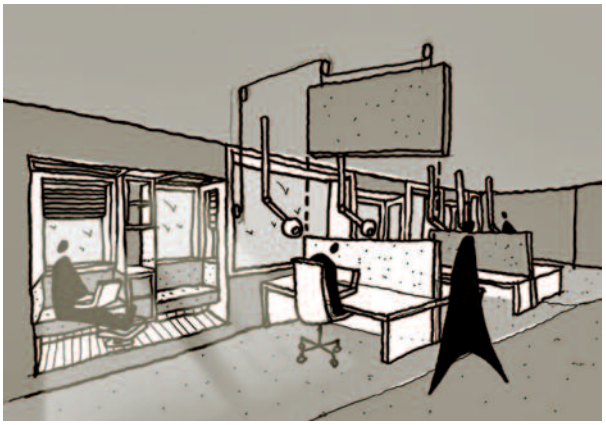
- Office of the future –
  future working environment for creativity and collaboration
- Glass architecture –
  intelligent use of glass as a future building material
- Lightweight constructions –
  flexibility and resource saving
- Modular construction –
  efficiency and flexibility thanks to high degree of prefabrication
- Natural construction –
  sustainable quality of life with natural resources
- "Digital" living –
  intelligent technology for future generations
- Renovations and upgrades –
  sustainable concepts and technologies to renovate the building park
- Fitness/wellness of the future –
  health and recuperation with optimized energy consumption

Calls for each of these topics will be launched, and they will be realized with the most innovative design teams, research team and business partners.

The focus areas are regularly discussed, adapted and broadened with representatives from research and industry.

Unit: Meet2Create

The Office Lab



The main focus of the unit Meet2Create is transformation.

Office buildings are exposed to a permanent pressure to adapt. Working environments are in a constant state of flux and require spatial and technical strategies for their transformation. If efforts to respond to this with the buildings prove unsuccessful, they risk standing vacant and eventually being torn down. The aim is to research office buildings that are able to respond to changes and new requirements as open systems and thus remain of value for as long as possible and have a sustainable impact.

Current issues in the office and open system environment that are being researched at NEST:

- How can an office be designed and realized as an open system?
- How can office buildings respond spatially and technically to changing working environments and new requirements?
- What enables office buildings and concepts to retain their lasting value?
- How can high identification potential among the staff be realized via the work environment?

By answering these questions, the research team is hoping to find key input for the construction of future and renovation of existing office buildings.

Meet2Create is scheduled to be operational in spring 2016.

Unit: Vision Wood

Wood Innovations and Modular Construction

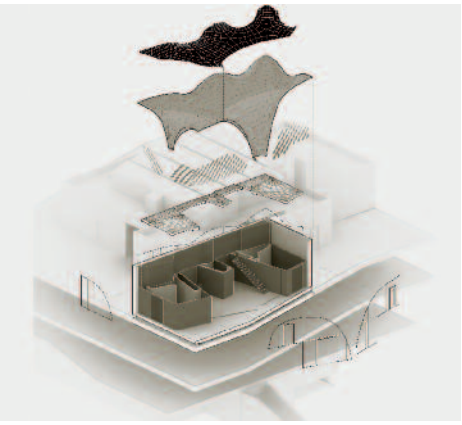
The research unit Vision Wood is home to a large number of wood innovations. Extracted cellulose fibers are used as insulation material or a thickener in sanitary silicone, for instance. Veneers that are completely hydrophobic, flame-retardant or weatherproof and thus open up a whole new field of application within buildings are also produced. In contrast to lab tests, the components here are exposed to real weathering situations, such as on the façade. Users inhabit the unit and use the wood materials in their everyday lives. The materials are thus put to a realistic endurance test and the researchers can determine how the users accept the new material prototypes that they developed in the lab.

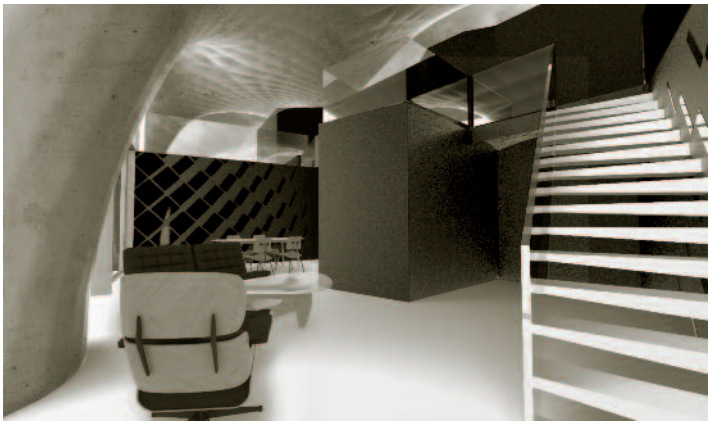
Another innovation topic concerns modular construction: Vision Wood comprises three housing units and a common area. In turn, the housing units consist of several modules, the dimensions of which are geared towards standard containers for freight transport. This creates a lot of leeway for the floorplan design and thus in the desired use. It is thus perfectly conceivable for an existing module to simply be replaced with another room type as and when needed, for instance. The container construction method enables an extremely high degree of prefabrication at the factory, which means that very little needs to be adjusted on the construction site. This keeps the construction period to a minimum. Based on the building-block principle, modules are placed in a frame construction, connected up and supplied with water, power and the internet via a standardized docking station. This enables affordable housing to be created in a very short period of time.

Vision Wood is scheduled to open its doors in spring 2016.

Unit: HiLo

Lightweight and Adaptive Façades





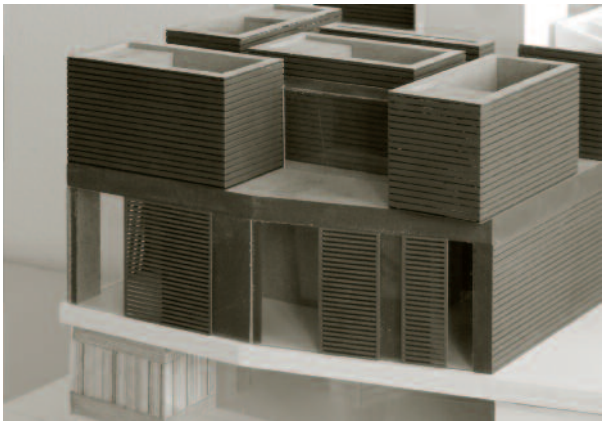
HiLo is to develop and showcase novel solutions for super-light, concrete bearing structures and adaptive façades.

The optimally shaped concrete structures facilitate a considerable reduction in the amount of material required and thus the gray energy used. They consist of extremely thin, curved, concrete roof shells that are 3 to 4 cm thick and produced using taut textile formwork on the one hand, and light, suspended ceilings shaped from thin-walled rib constructions on the other. This reduces the building weight and makes the use of this solution interesting for added stories. The planning and implementation, which inevitably involves new technical risks and unaccustomed building processes, is challenging. Various prototypes are being tested and studied statically.

In the façade area, moveable sunshield panels are being realized, which can be repositioned two-dimensionally towards the sun. This enables the blinds to be controlled as required and at the same time angled as a solar power system. The novel aspect of the façade is also the hydraulic tilting of the sunshield panels using inflatable silicone cushions.

The unit will be ready at the end of 2016.

Unit: Solar Fitness and Wellness
Keeping in Shape with Sustainable Energy Use



Our society is increasingly consuming energy to boost our comfort and quality of life. As the Solar Fitness and Wellness unit demonstrates, fitness and wellness is also feasible without fossil energies. The project involves a 280 m^2 fitness area and a modular wellness center.

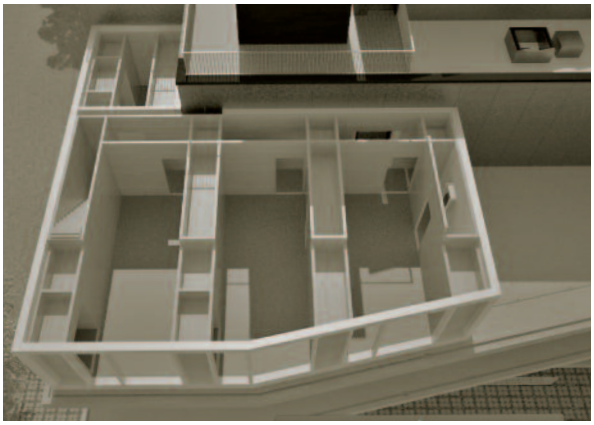
The fitness area is primarily geared towards physical fitness and health. The energy of the work put in does not go to waste, as is usually the case. Instead, it is converted into electricity as efficiently as possible, measured and communicated as a source of motivation. The aim is not to generate energy, which will be comparatively small, but rather raise awareness of the topic of energy, our own output and our consumption.

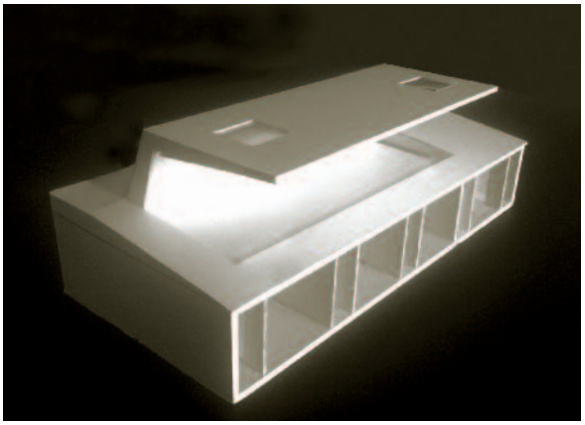
Three largely self-sufficient wellness modules feed off their own solar power. The aim is a neutral energy footprint for the year. The surpluses achieved in the summer are available in the winter months. The modules, which are approximately 20 m^2 in size, contain everything that a compact wellness oasis needs: Changing rooms, showers, sauna or a steam room and, of course, the necessary technology. This also makes these wellness modules interesting for smaller hotels or private individuals who are looking for a sustainable wellness system. High-temperature CO_2 heat pumps and water misting are being pursued as technical innovations instead of vaporization. Combined with optimized insulation and heat recovery, this enables the energy consumed by the sauna and steam room to be slashed by approximately 80 percent.

Solar Fitness and Wellness is scheduled to commence operations in autumn 2016.

Unit: City Lifting

Topping up a Building





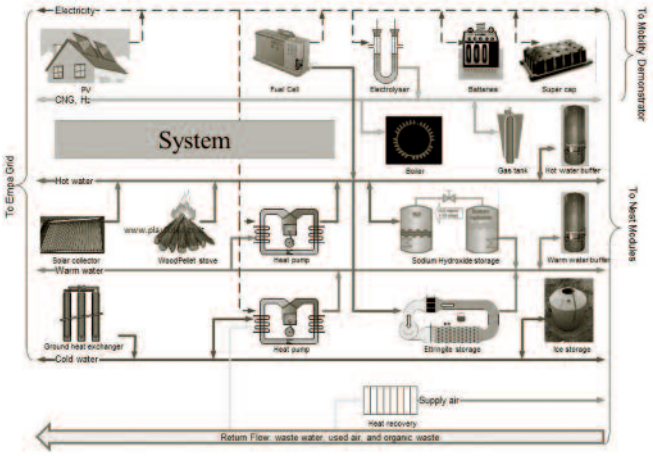
The research unit City Lifting examines the topic of inner-city densification by building new stories onto buildings and searches for solutions using methods borrowed from lightweight construction.

Over 50 percent of the global population already lives in cities – and counting. According to a study conducted by the Swiss Real Estate Institute, 28 percent of the cantonal influx can be absorbed solely by adding one story in a central location in inner-city areas by 2025. For both sustainability and architectural reasons, inner densification by topping up or extending existing buildings is a popular alternative to new replacement buildings.

City Lifting is scheduled to open its doors in 2017.

Energy Hub

Producing, Storing and Converting Energy – Optimizing Consumption



Individual or interconnected buildings are no longer merely energy consumers that are optimized in networks, but nowadays also produce energy. The energy can be harvested in the form of renewable power (solar modules, small wind farms, combined heat and power units etc.) or heat (waste heat with heat recovery, thermal solar power, geothermal energy etc.).

While one building produces an energy surplus, another might well be in need of energy. Any overall surpluses can be fed into the public grid.

The energy consumption and the energy harvest can only be planned to a certain extent; large differences emerge in terms of time and quantity. In the summer, a building harvests surplus solar energy; in the winter, however, the energy consumption often exceeds the supply.

Therefore, different technologies for energy harvest, conversion and storage are implemented both in the building and network. This enables the dynamic interplay between technologies and the associated energy networks to be optimized.

This will help adress research and development questions such as:

- What energy services can be centralized beneficially for low-energy buildings?
- Which technologies can be used for harvesting, conversion and storage in the network?
- What impact does this have on the grids and thus the grid costs?
- How much energy self-sufficiency is feasible and useful?
  What impact does this have on the external (system) services required?
- What control engineering challenges arise from a thermal and electrical perspective?
- What do the results mean for a neighborhood or a city?
- Under what conditions can surplus energy be converted into fuel for vehicles?
- What are the economic benchmarks for such a system?

The Energy Hub will also link to another demonstration platform at Empa: move, the Future Mobility Demonstrator, which is to study the future interplay between mobility and locally generated energy. Moreover, the Empa-Eawag campus with its varied energy networks is also on hand as a real test environment.

Intelligent Control Platform for Energy Topics **SmartHome, SmartBuilding, SmartDistrict**

In modern building technology, but also for energy optimization, increasingly complex control tasks need to be handled. This concerns the thermal and electrical energy supply, but also more and more maintenance-related tasks.

Increasing user comfort and achieving a sustainable level of energy efficiency is another objective. Building users are generally unaware of the control algorithms installed and are surprised by the incomprehensible behavior of the systems. At the same time, specialists are constantly confronted with new control systems, the compatibility of which is seldom guaranteed. Our goal is to change this.

Many technical components for extremely different usage scenarios (such as a detached house, office building, neighborhood network etc.) can be combined freely, which complicates the planning. If a system decision needs to be made, there is a lot of uncertainty among planners or contractors with regard to alternative system designs and their controllability.

NEST will be a platform to test new measurement, control and regulation technology concepts and approve different types of use. An open system should demonstrate how future measurement, control and regulation solutions might develop.

The following issues take priority:

- Division of complex tasks into centralized and decentralized measurement, control and regulation systems
- User acceptance vs. energy optimum
- Integration of future systems
- Incorporation of the measurement, control and regulation system into the communication and information system
- Minimization of energy consumption
- Optimal system design based on the usage scenarios

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UrbanWater and Waste Water Management

An economic use of water is globally just as important as the sustainable use of energy resources. The potential of water management in buildings and neighborhoods should be studied.

Concepts that facilitate the multiple use of water and waste water are being developed and tested under the lead of Eawag. NEST is to help test and refine promising solutions to reduce water consumption and in waste water management.

Priority technologies:

- Modern, environmentally friendly and water-saving toilets
- Waste water treatment
- Local waste water reactors
- Flexible piping for simplified waste water systems

Some of the research and development focus areas:

- The development of innovative waste water treatment and separation methods
- Use of rainwater and recycled gray water
- The extraction of reusable materials from waste water

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«What I find particularly exciting about this joint initiative are the realistic possibilities that NEST offers our industrial partners to test, evaluate and optimize their innovations. NEST is a unique platform for development and technology transfer in the building industry.»

Gian-Luca Bona
Director of Empa

«NEST will enable us to develop energy-efficient, CO_2-neutral buildings with a high degree of comfort and utility. This project ties in perfectly with ETH Zurich's sustainability initiative in the building sector.»

Ralph Eichler
President of ETH Zurich

«In NEST, institutes in the ETH Domain pool their forces to realize the best and most innovative ideas in the fields of building material science, construction technologies and structural system integration. The aim is not to develop one single innovation here; we want to make real progress for sustainable buildings. »

Patrik Aebischer
President of EPF Lausanne

«NEST promises, among other things, to boost our knowledge in the energy sector, which is particularly important for the Canton of Zurich. The entire world we live in is brimming with energy-relevant processes that are all interconnected. With its modular structure, NEST is just the ticket to uncover these links and enable the synergies to be used. If we want to solve our energy problems, a very special kind of energy will also play a pivotal role: the energy that flows through our heads. NEST is the perfect flagship for this and stands for innovation and openness. Such research facilities are urgently needed today.»

Markus Kägi
Government Councillor/Head of the Building Department,
Canton of Zurich

«We need new, innovative technologies if we want to achieve the goals of the government's Energy Strategy 2050. At the same time, we have to adapt our behavior when using energy. NEST enables concrete tests on such pioneering developments. »

Walter Steinmann
Director of the Swiss Federal Office of Energy

«In light of the increasing urbanization, population growth and climate change, new solutions are needed for the water supply and disposal. The economical use of water, its recovery and reuse, and the use of energy and recyclables need to be targeted. At the same time, long-term investments in largely inflexible infrastructures need to be avoided. NEST offers a unique platform to test innovative technologies in reality for the local and global markets. »

Janet Hering
Director of Eawag

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Our Partners – a Strong Team!

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