

Self-programmed...or research connected?

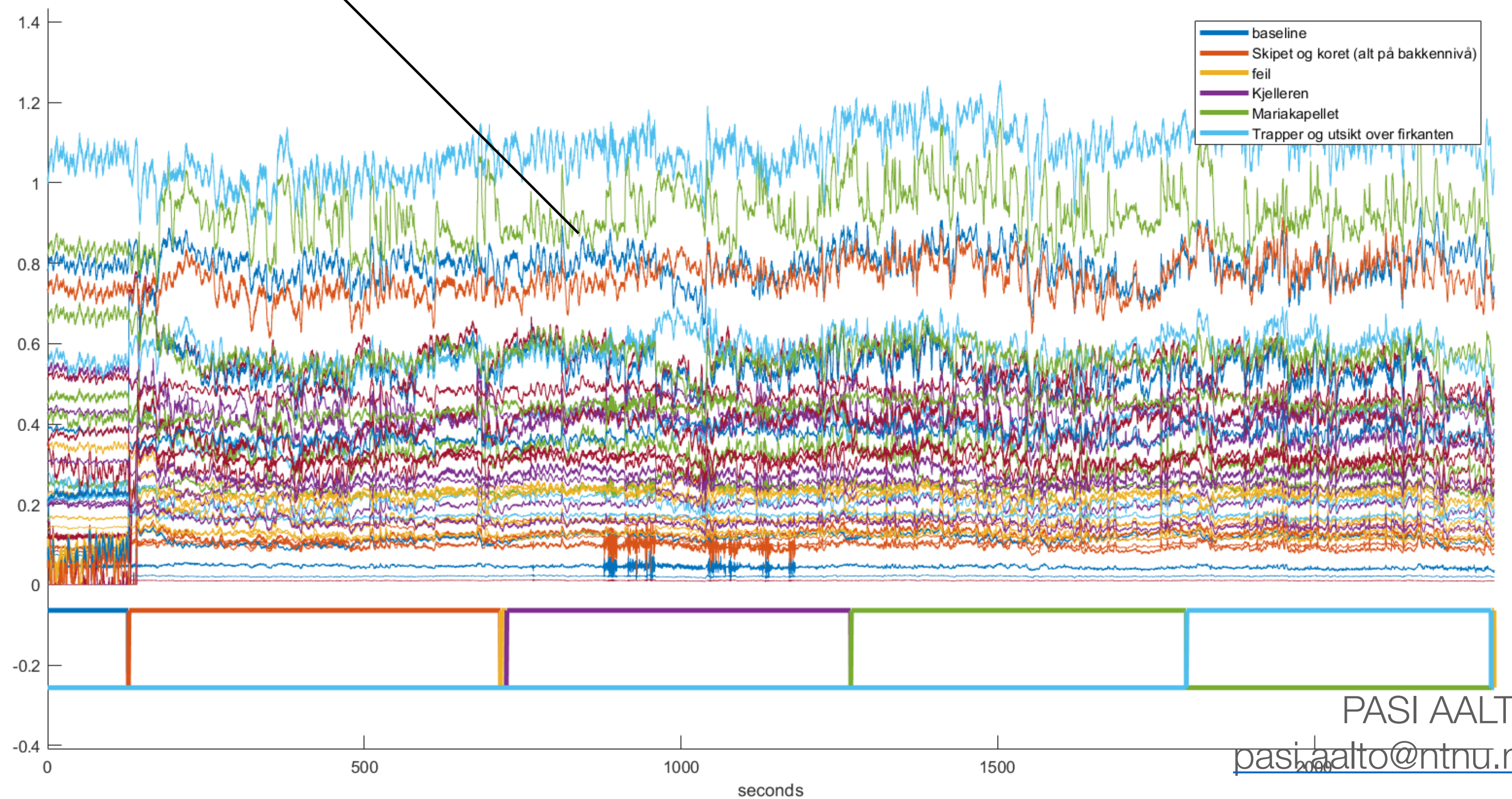
PASI AALTO
Centre Director
+47 98025519
pasi.aalto@ntnu.no

Next Integration: fNIRS + EEG

Measure blood oxygenation in brain
to determine cognitive responses

Equipment in delivery

In situ tests done (Nidaros Cathedral)



Trondheim

210.496 people
77.347 buildings



CIRCULARCITY
Research Infrastructure



Norge

Oslo

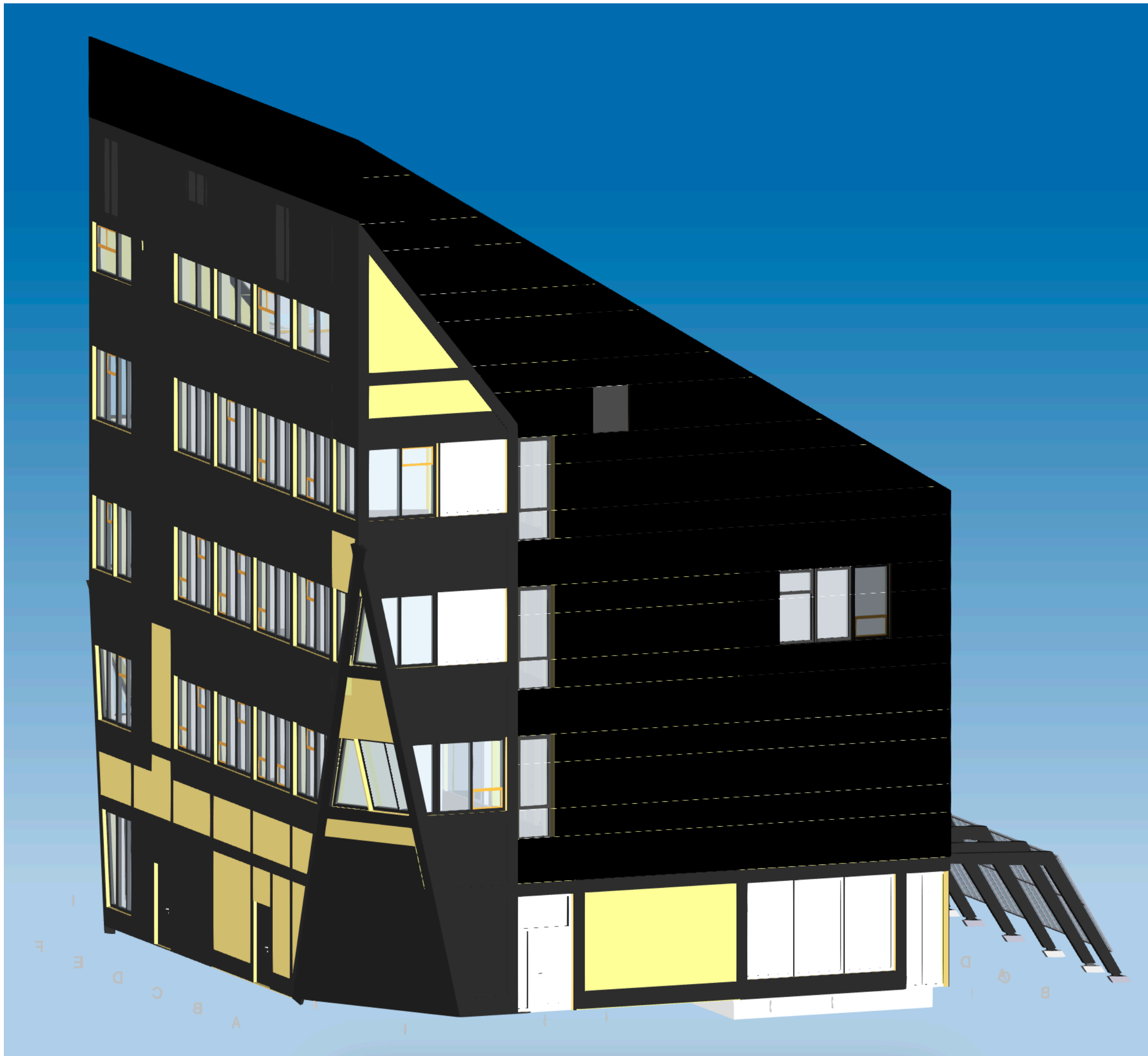
Sverige

Example: How many brick buildings?





NTNU AD Microhouse



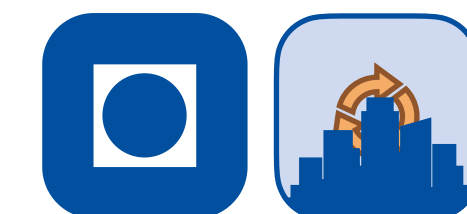
NTNU Building database

89 Buildings

41 Building information models

26 000 PDFs

3 000 DWGs



CIRCULARCITY
Research Infrastructure

Research Infrastructure

Research Infrastructure - ZEB Lab

The ZEB Laboratory, situated within the NTNU Gløshaugen campus in Trondheim, is a dynamic four-story office space spanning 2000 square metres. This facility, jointly owned by NTNU and SINTEF, is a hub for innovative research and development. IAT is one of the three departments at NTNU that manages the ZEB Laboratory. The laboratory accommodates staff from both institutions, functioning as a workspace and an educational venue. Continuous data collection endeavours are underway to assess and enhance building performance meticulously. This research includes detailed experiments on energy systems and indoor environmental quality conducted concurrently with regular operations. The versatility of the infrastructure allows for seamless integration of experimentation with day-to-day activities, fostering a collaborative environment for exploration and optimisation.

Contact: Francesco Goia

Research Infrastructure - ZEB Living Lab

The ZEB Living Lab, a versatile experimental facility designed as a single-family house spanning 100 square meters, serves as a platform for various research endeavours. Situated within the NTNU Gløshaugen campus in Trondheim, this facility is jointly owned by NTNU and SINTEF, with management overseen by IAT. The ZEB Living Lab investigates user-technology interaction within authentic settings, assesses building performance under realistic usage scenarios, and custom systems and strategies for comprehensive monitoring. It offers a unique opportunity to scrutinize both the physical behaviour of the building and its installations, as well as the influence of users on these systems.

Contact: Francesco Goia

Research Infrastructure - ZEB Test Cell

The ZEB Test Cell is a research infrastructure jointly owned by NTNU and SINTEF, and operated by SINTEF. IAT has been heavily involved in developing and using this facility, which is used for testing low-energy, integrated building systems under realistic operational conditions. The ZEB Test Cell is made of two chambers with the size of a regular office room, where one wall faces the outdoor environment, while the boundary conditions of all the other surfaces are controlled. The system can be used to carry out both absolute testing and comparative testing procedures, aiming to analyse and optimise the performance of building envelope systems, integrated energy and environmental installations, and their control systems.

Contact: Arild Gustavsen

Research Infrastructure - NTNU AD Microhouse

The NTNU AD Microhouse is a 100% Circular microhouse co-created, developed and built as part of the H2020 Dialogues project as well as student effort. The microhouse is mobile and allows for 1/3 of the house to be changed via modules. This allows for 2 research variables of location and altered functions such as examining the difference between having access to a social winter garden versus a gaming rig for online games as part of the living space. Participants can use the space from a few hours up to 14 days and it includes all necessities (bed, shower, toilet, kitchen, etc) within 12 square meters. The space is prepared for sensory monitoring that can be included as determined in the experiment design, including the use of the NTNU Mobile Sensory Lab.

Contact: Pasi Aalto

Research Infrastructure - NTNU AD Experiment box

The NTNU AD Experimentbox is a 2 x 1,6m space to rapidly develop and verify experiment designs that focus on how participants perceive and act on sensory stimuli, such as materials, spaces or environments. The experiment box has a fully accessible framework of environmental and biosensors that can be utilized with short notice. The space is ideal to develop and pilot experiments that investigate how people react to different materials both consciously, physiologically, and cognitively.

Contact: Pasi Aalto

Research Infrastructure - NTNU Mobile Sensory Lab

The NTNU Mobile Sensory Lab is a collection of environmental and biosensors that allows us to record the exact location (GPS + UWB), body posture (Mocap, UWB), Environmental surroundings (IEQ), received stimuli (Eye-tracking, sound), Physical response (Heart rate, HRV, GSR) and Cognitive Response (fNIRS, EEG) of a single participant while free-roaming in-situ. This allows us to examine the biophysical and cognitive responses of a person that enters, wanders through, and inhabits a building in experiments. The Lab is a collaboration between 8 departments: IAT (Lead), IAP, MTP, IBM, IPS, INB, KIT and PD.

Contact: Pasi Aalto

Research Infrastructure - Circular City Research Infrastructure

Circular City is a NTNU SUSRES project to develop a research infrastructure that speeds up the systemic research of existing buildings in Trondheim. By organising existing data, registrations and building models, the aim is to build knowledge to transition towards a more circular built environment.

<https://www.ntnu.edu/sustainability/circularcity>

Contact: Pasi Aalto

Research Infrastructure - Climate HubLAB

The Climate HubLAB is a didactic laboratory exploring the pedagogical potential of equipping conventional design studios with machines that are commonly placed in more specialised research laboratories. At the lab, environmental design theory is explained through hands-on activities where digital tools enhance learning potential rather than just mere computational tools. The laboratory is based on three pillars: accessibility, user-friendliness and colocation of machines for model-making and testing. Besides a series of machines for environmental analyses (heliolons and streamline visualisation tools), the laboratory includes equipment for transferring information from the analogue to the digital environment, enabling students to creatively customise innovative design processes for rapid prototyping and testing models.

Contact: Luca Finocchiaro

Research Infrastructure - Traditional Building Crafts Laboratory

The Laboratory is a dedicated quiet workshop space specifically designed to enable teaching and research into artisan crafts. The space is traditionally fitted with carpenters benches and handtools. Located in a listed warehouse from 1826, the spaces are uninsulated and unheated to follow the fluctuations of outdoor temperature and humidity. This helps stabilize the wood materials as well as the tools in the workshop. The laboratory can explore the multitude of Norway's traditional crafts techniques and traditions, which is also reflected in the assortment of carpenters benches and tools available – most of which are faithful replications made in the lab itself, based on historical originals found in Norway.

Contact: Thor Aage Kaminka Heiberg

Research Infrastructure - FORMLab

FormLab was established as an accessible learning workspace for all staff, students and courses. It is an initiative to enable pedagogical methods to be explored and tested. While the lab is physically located at the Faculty of Architecture and Design, its methodology is tested in different locations, workshops and 'real-world' situations. It is important to emphasize that all the methods and exercises in the following examples address challenges in the initial phase of an architectural design process. Hence, they are methods and exercises that aim to trigger and enhance open-ended processes that will challenge the students to explore and embrace risk. In these initial phases, divergent thinking is essential, whereas convergent thinking is required when it is time to wrap up and make decisions.

Contact: FORM group, Bjørn Otto Braaten, Gro Rødne

Research Infrastructure - TEKSTILlab

TEKSTILlab is established with the aim to develop teaching, research and artistic work based on the rich Nordic tradition of textile arts and crafts as well as emerging digital technologies. In a time of increasing need to understand complex relational contexts in the face of societal, environmental and climate-related challenges, the interest in textile materials and technologies is linked to the expectation that this will become a core area in future sustainable design. This relates not least to the need for increased material knowledge in the built environment, if the sustainability goals are to be met, and textile materials with their particular properties open significant new perspectives in this regard. Through development of our physical facilities and competencies in this area, we seek to contribute through design innovation to the international construction, research and learning environments currently exploring this potential.

Contact: FORM group, Nina Holtan, Edith Lundebrekke, Nina Haarsaker, Tordis Berstrand

Research Infrastructure - Lucas Workshop

The Lucas Workshop is a dedicated space for model-making and larger scale constructions (including small 1:1 buildings and prototypes). The lab is primarily equipped for manual woodworking and digital fabrication in wood and organic materials, although there is a possibility for light metalworking. The facility has a comprehensive set of machines and equipment that allows exploring traditional woodworking, fine woodworking, cabinetry, architectural model-making and full scale prototypes in both education and research. The digital fabrication equipment includes laser cutters, full sheet CNC router and 8-axis robotic milling with a 4 meter build envelope. The shop staff of professional cabinet-makers provide a safe and secure environment for students to explore the way things are made and put together. All new incoming students are given an orientation into lab use, access and guidance whenever needed. The lab contributes to research projects, exhibitions and artistic work by staff.

Contact: Pete Roze/ Jörg Schauer

EU Research Projects

Research Project - syn.ikia

syn.ikia innovation project aims to enable the development of sustainable plus energy neighbourhoods in different climates, contexts, cultures, and markets. Over the course of the project (2020-2024), four real-life plus-energy demo neighbourhood projects tailored to different climatic zones are developed, analysed, optimised and monitored, demonstrating the functionality of the plus-energy neighbourhood concept to the rest of Europe.

Contact: Niki Gaitani

Research Project - ARV

ARV is a H2020 EU-funded project (2022-2026) aiming at creating climate positive circular communities in Europe and increasing the building renovation rate in the continent. ARV is the Norwegian word for heritage. Special attention is given to social housing and public buildings. These projects are located in Czech Republic, Denmark, Italy, The Netherlands, Norway, and Spain. Together, they will demonstrate more than 50 innovations in more than 150,000 m² of buildings.

Contact: Inger Andresen

Research Project - iClimaBuilt

iClimaBuilt is a European H2020 research and innovation project (2021-2025) focusing on supporting SME to develop and optimise advanced building envelope systems. The goal of the project to realize and demonstrate an open access ecosystem for developing, upscaling and testing innovations in building envelope materials and technical systems, aiming at reaching a Zero Energy Buildings (ZEB) balance. iClimaBuilt also provides support and help for small high-tech firms to scale up and cope with the continuous rising increases inof technological complexity, assisting in the transformation of research results into innovations.

Contact: Francesco Goia

Research Project - MASS-IPV

MASS-IPV is a European HEU research and innovation project (2023-2027) that aims to demonstrate that suitable tools, technologies, and methods, combined with a collaboration framework among key stakeholders, can overcome the barriers preventing the mass-deployment of Integrated PhotoVoltaics (IPV) systems. The project will deliver new multifunctional and cost-effective IPV systems for building and infrastructures.

Contact: Francesco Goia

Research Project - Making PEDs

Making PEDs is a DUT European Partnership that stands for "Decision-Making digital twins for climate neutral PEDs". The use of simulation tools in the urban context and connected to 2D or 3D web-based visualization applications are valuable tools for decision-makers and citizen's engagement. The aim of the Making PEDs project is not only to research and plan Climate Neutral PEDs but also to facilitate the transition into practice providing Digital Twins to support decision-making and participatory urban transformation processes.

Contact: Niki Gaitani

Research Project - EU-PoTaRCh

EU-PoTaRCh -establishes a network for the past, present and future of use of major non-timber forest raw materials and products in Europe. Whilst it will focus on forest by-products mainly Potash Tar Resin Charcoal (PoTaRCh)–as representatives of traditional forest exploitation heritage, it will touch upon other forest by-products (tannins, pitches). The scholarly vision is to enlighten the relevance of these products in history, especially their role in industrialization. The goal is to identify and assess production changes and their social and environmental impacts on sustainable development, and based on their heritage, to draw lessons for the future. The Action will support stakeholders who know these products and are interested in them, as they use them in the production, education, and promotion of heritage. Due to the participation of stakeholders with significantly different activity profiles (museums, state forests, associations, etc.), hence high diversity of needs will have to be answered by this Action.

Contact: Roald Renmælmo

Norwegian Research Projects

Research Project - Commonground

Commonground is a Norwegian Research Council funded project (2023-2027) to better understand the Norwegian second home phenomenon and address the current shortcomings in ecosystem damage, architectural approaches, conflicts and area use.

Contact: Pasi Aalto

Research Project - SUPER

SUPER develops better understanding of how to teach wicked problems in a university setting. The project is a collaboration between NTNU and Nord University, funded by HK-DIR. The project is developing new pedagogic tools and approaches specifically designed to tackle wicked problems in engineering, design and architecture education.

Contact: Pasi Aalto

Research Project - ChiNoZEN

ChiNoZEN is a research project (2021-2025) fostering international cooperation between Norway and China to address technological challenges in the transition to a reliable and affordable sustainable built environment. The project is co-funded by the Norwegian Research Council and by the Chinese Ministry of Science and Technology. The project develops and demonstrates new knowledge, solutions, and innovative technologies for low-carbon buildings and neighbourhoods: It investigates combined cooling, heating and power generation system, heat pump technologies, photovoltaic and thermal technologies with energy storage, and advanced control infrastructures for building clusters that maximises the exploitation of renewable energy sources.

Contract: Arild Gustavsen / Francesco Goia

Research Project - Nordic Tar Network

Nordic Tar Network is a collaboration between researchers and craftsmen in Norway, Sweden, Finland, Denmark, Åland and Estonia. Traditional produced Pine Tar are important for the maintenance of the Norwegian stave churches and different kinds of wooden roofs on historical buildings in all our countries. Several different research projects are going on within the network and both webinars and physical workshops are held yearly. How to increase the traditional production of Pine Tar according to the increasing demand for maintenance of the historical buildings due to the climate change, and how different coating procedures can make the Tar coating last longer, are some of the questions we work on. In Norway Fortidsminneforeningen, Riksantikvaren, Norsk Folkemuseum and NTNU are a part of the network.

Contact: Roald Renmælmo