Construction of Nanolab Phase 4 is Underway

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DTU Campus Service | Technical University of Denmark

A Thoughtful Densification

Ørsteds Plads has been transformed into a construction site, and the building of Nanolab Phase 4 is now underway. The project exemplifies how DTU Campus Service is working to accommodate increasing activity and development on campus – while supporting DTU's cultural heritage and rethinking the university's physical framework.

Three-meter-high plywood panels now enclose Ørsteds Plads. Parking spaces have been relocated, temporary roads have been established, and machines are digging. What may appear to be a harsh intrusion into the surroundings is, in fact, a sensitive architectural intervention rooted in history and an engineering masterpiece that points DTU toward the future.

By 2027, DTU will have built a new semiconductor cleanroom for nanotechnology – a state-of-the-art facility providing researchers, students, and external partners with the space they need. Nanolab has reached full capacity, and the new building will offer all users modern laboratories for nanotechnology research. At Ørsteds Plads, DTU will gain a building designed to fit into its surroundings and contribute to a vibrant and welcoming campus environment.

With 700 m² of cleanroom space, DTU will acquire the latest generation of nanofabrication equipment, giving partners, research projects, and new initiatives access to the unique and essential facilities needed in Northern Europe.

Construction and Campus Planning. Katja Engel Zepernick (left) and Troels Lysgaard-Hansen (right) are project managers at DTU's Campus Service.

More Than Just a New Building

When DTU builds, the ambitions are high. Beyond providing new facilities, the campus must also evolve positively.

The upcoming building at Ørsteds Plads and its surrounding environment are intended to be a dynamic learning space where students, staff, and visitors can move safely, sense the history, and experience the visions and values of the university and Nanolab.

This is how DTU's strategic campus plan describes the direction for expanding DTU Lyngby Campus as new needs and demands for research facilities and study/work environments arise.

What's Happening at Ørsteds Plads

Behind the construction site fence, preparatory work is underway:

- An outdated underground transformer station that previously supplied power to Building 346 has been removed. A temporary transformer has been installed in a container on-site.
- A new, larger nitrogen tank yard has been established south of Akademivej, with underground piping leading to Nanolab.
- Large excavators are removing surface materials – mainly cobblestones, tiles, and asphalt– which will later be reused.
- Contractors are removing existing tunnels beneath the future building.
- Piles are being drilled, anchors secured, and excavation for the basement is ongoing.

According to Troels Lysgaard-Hansen and Katja Engel Zepernick, project managers for the building and landscape respectively at DTU's Campus Service, attractive outdoor spaces are being incorporated, especially in the areas south of the new building.

"When we expand on campus, we must take care of our cultural heritage, the landscape, and the connections that are part of DTU Lyngby Campus's identity. We must remain a green campus inviting people to settle and stay. We also need to plan for more bicycles and fewer cars," says project manager Katja Engel Zepernick from DTU's Campus Service, referring to DTU's strategic campus plan.

The building now rising at Ørsteds Plads is a vivid example of how strategy is implemented in practice: DTU gains an excellent facility for users needing access to a cutting-edge nanotechnology environment.

The building's design and location enhance DTU's physical campus with new gathering spots, green areas, and outdoor spaces that bring life between the buildings. New oak trees and other native species will be planted around the building. A new bike path will improve cyclist safety on Akademivej, and the sidewalk on the north side of the building will be widened. Pedestrian flow has also been carefully considered in the design.

"When we expand the campus, we must take good care of our cultural heritage, the landscape, and the connections that are part of the identity of DTU Lyngby Campus.

We must continue to be a green campus and encourage people to settle down and stay awhile."

– Katja Engel Zepernick, DTU's Campus Service

From 1960s Ideals to the Campus of the Future

When the original DTU was conceived, designed, and built from the 1960s onward, the idea was to view the campus as a clearing in the forest.

The campus was created with a central axis: a main avenue with parking and buildings arranged in a strict grid. Both the forest and the axis remain defining features, as do the squares and plazas. Many of the original campus concepts still align with today's needs, though some aspects require renewal due to changing realities.

DTU is undergoing a transformation, expecting more activity, users, and visitors. The expansion of Nanolab Phase 4 reflects this development.

A green Campus. The design and location of Nanolab Phase 4 contribute to making DTU's physical campus more attractive, with new gathering spots, green areas, and outdoor spaces that bring life between the buildings. Photo: Kontraframe

Yellow Bricks and Harmony with the Surroundings

When Nanolab Phase 4 is completed in 2027, it will be a modern building architecturally referencing the original Koppel buildings.

In recent years, new buildings at DTU have often stood out with distinct designs. Troels Lysgaard-Hansen explains that with the new Nanolab building, there was a desire to return to DTU's original material palette:

"We are very conscious of DTU's cultural heritage when expanding. We're in a phase of rapid development, and we want new buildings and landscapes—like Nanolab Phase 4—to relate to the existing campus. We aim to stay true to the original DTU and build a bridge to the new. That includes using yellow brick facades and designing arriving areas and intermediate spaces surrounding the buildings in the spirit of the original campus. In line with DTU's sustainability goals, we've decided to use recycled bricks."

Smart Use of the Plot

The ambition is to expand as sustainably as possible and to use space wisely. One approach is to build primarily on so-called brownfield sites—areas already in use—such as Ørsteds Plads.

"We must always think carefully when expanding and building new facilities. We need to thoroughly evaluate the arguments for new projects and ensure we're using just the right area—so we don't build too much. Our planet can't sustain that," says Katja Engel Zepernick.

> "We want to stay true to the original DTU and build a bridge to the new.
>
> That means, among other things, that we're working with a yellow brick façade and designing arrival areas and intermediate spaces surrounding the buildings similar to those on the original campus.
>
> In line with DTU's sustainability ambitions, we've decided to use recycled bricks."
>
> — Troels Lysgaard-Hansen, DTU's Campus Service

Regarding the new building at Ørsteds Plads, Troels Lysgaard-Hansen emphasizes that careful consideration has been given. The new cleanroom and supporting area are necessary for both DTU Nanolab and DTU as a research institution.

The laboratory is designed as compactly and flexibly as possible, directly connected to the existing building. Together, this ensures optimal use of space and shared functions between the two buildings.

Yellow brick facade. Nanolab Phase 4 seen from Akademivej. Photo: DTU

Preparatory Work Below Ground

Leading up to summer 2025, passersby will be able to observe the excavation work for the foundation and basement of Nanolab Phase 4.

Ørsteds Plads was prepared for construction in spring 2025. A massive 90-ton drilling machine will then arrive to begin boring, marking the next phase of the excavation.

DTU uses a method involving drilled holes and cast piles to establish the construction pit. This technique minimizes vibrations, protecting nearby buildings, the main tunnel, and the surrounding environment. As work progresses, the method is continuously adjusted to remain as gentle as possible.

High Attention to Vibrations

It's not just the visible buildings and plazas above ground that the construction team considers. The tunnels beneath DTU are a crucial element that must be protected during the expansion.

The over 50-year-old tunnel is a vital conduit for DTU Lyngby Campus's central utilities and is sensitive to excavation and heavy traffic. Preparatory work for Nanolab Phase 4 required the removal of two existing branch tunnels and the establishment of a new tunnel connection north of the new building.

The excavation for the basement beneath the new building is being carried out very close to the existing main tunnel. That requires precision, says Jens Junget, Project Manager at Artelia, who is responsible for the structural design of the building:

"The excavation for the basement under Nanolab Phase 4 is taking place very close to the old tunnel – in some areas, we're only half a meter away from it when operating the large machines. So, we have to be precise and careful."

To monitor vibrations from construction and heavy machinery, engineers have installed six vibration sensors on buildings around Ørsteds Plads. In March, when large excavators were active, no vibrations were recorded that negatively affected nearby buildings.

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DTU's Tunnel System: A Well-Designed Lifeline

- Beneath DTU lies an approximately 11 km long tunnel system.
- These tunnels are part of the original Lyngby Campus and serve as a lifeline, supplying buildings and labs.
- The system delivers district heating, cooling, electricity, and process gases.
- Established from the very beginning, the tunnels have been modified and expanded as the university has grown.
- The tunnels are a hidden advantage, often allowing maintenance and upgrades without disturbing the life on Campus above the surface.
- In addition to a new tunnel for Nanolab, DTU is currently expanding the network in the Second Quadrant to connect future buildings to existing infrastructure.

The tunnel system beneath DTU is over 50 years old and serves as a vital supply line for Lyngby Campus. Part of the site preparation at Ørsteds Plads involves removing a section of the old tunnel and constructing a new one. Photo: DTU

Challenges and Technical Solutions on the Construction Site

Vibration control will remain a key focus even after Nanolab Phase 4 is completed. The cleanroom – the most sensitive part of the new lab – requires effective isolation from environmental vibrations.

Extensive geotechnical surveys have been conducted to determine the best structural solutions in design. To ensure a vibration-free lab, the cleanroom's structural slab – called a waffle slab–will be isolated from its surroundings. This 110 cm high waffle structure will rest on columns, which stand on foundations separated from the rest of the building. This setup ensures the cleanroom is anchored directly into the ground, preventing vibrations from the surroundings reaching sensitive equipment.

"The large secant pile wall enclosing the basement isolates the building from its surroundings. These piles are drilled about six meters below the bottom basement level, helping prevent vibrations from reaching the most sensitive areas," says Jens Junget.

The cleanroom is thus isolated from the building, which is itself isolated from the surroundings – a layered solution ensuring a vibration-free structure, even with the nearby light rail.

A Secure Shield Against External Disturbances

The light rail, which will run less than 100 meters from the cleanroom, along with regular truck and bus traffic, are potential sources of external vibration noise. Additionally, the building's own systems and users – such as foot fall and technical machinery – can generate vibrations.

"The highly sensitive machines in the new cleanroom, and the vibrations caused by traffic in and around the building, mean that the building must meet extremely high standards for vibration resistance," says Jens Junget.

To assess the impact of the upcoming light rail, DTU and Rambøll have used a "seismic shaker" to simulate vibrations in the area around Ørsteds Plads. This device mimics the vibrations caused by passing light rail trains.

Through a combination of advanced construction methods and thorough preliminary studies, the Nanolab Phase 4 team has ensured that even near traffic disturbance, DTU Nanolab can operate highly sensitive equipment.

Extremely Strict Vibration Standards

The cleanroom is designed to meet the so-called VC-E standard (Vibration Curve E) – a very strict standard that defines the maximum allowable movement in buildings and structures. Using a Finite Element Model (FEM model), the building's response to vibrations is simulated based on the digital design construction model.

The VC-E standard is difficult to achieve and requires thorough preliminary studies and highly detailed design solutions. Meeting the VC-E standard results in an extremely stable structure with minimal movement.

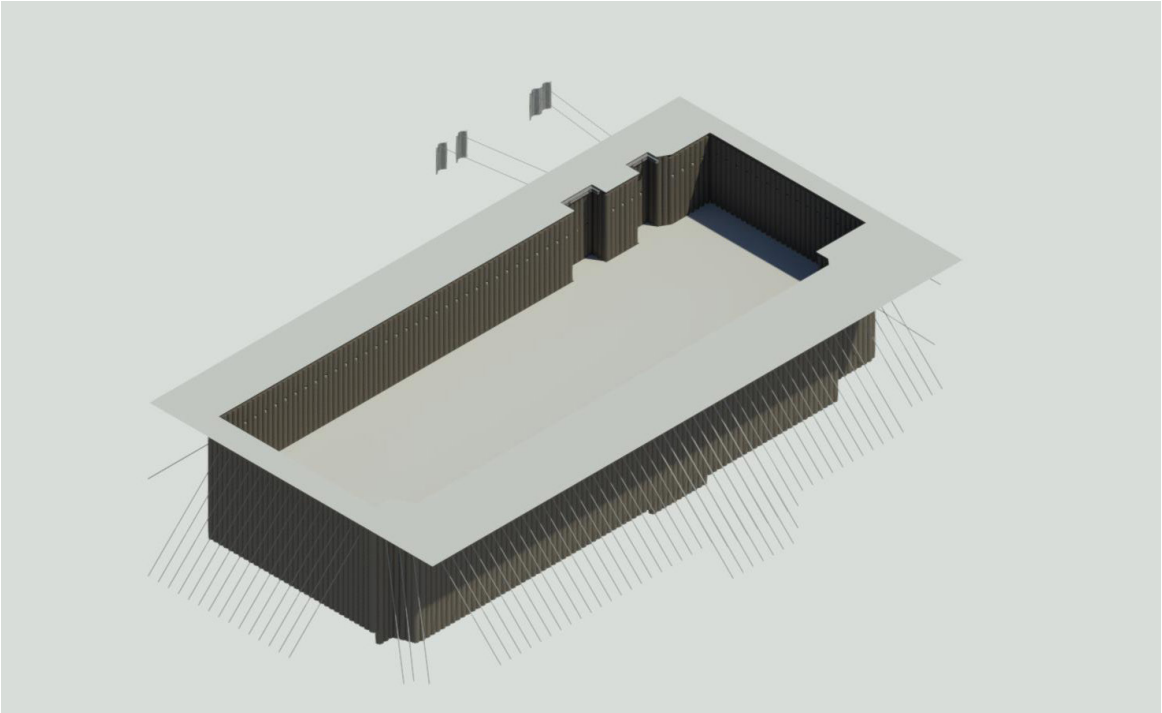
To assess the impact of the upcoming light rail on DTU Nanolab, DTU and Rambøll used a "shaker" to conduct seismic measurements around Ørsteds Plads. The shaker simulates the vibrations caused by passing light rail trains. It was kindly loaned to Rambøll by Cowi. Photo: DTU

DTU Nanolab Remains Operational During Construction

While surveys, design, excavation, and construction are ongoing at Ørsteds Plads, DTU's Campus Service is working to maintain operations at DTU Nanolab and ensure access to the area. The establishment of a new nitrogen tank on Akademivej ensures that the large volumes of nitrogen required for DTU Nanolab's operations can still be delivered despite the excavation. Temporary access roads have been created to allow movement to and from buildings in and around the site, including the Wicked Rabbit canteen in Building 342.

280 Piles and 130 Anchors

- 280 secant piles will be drilled along the perimeter of the construction site where the cleanroom will be built.
- Each of the 280 piles is approximately 15 meters long.
- Starting mid-June, the piles will be secured with over 130 anchors to stabilize the structure.
- The drilling machine bores every other pile first, then the remaining ones are drilled and reinforced, creating an overlap that strengt hens the structure.
- Once the piles are in place, an 8-meter-deep excavation will be carried out.
- The excavation is expected to be completed after the summer break in 2025.



After the summer of 2025, the construction pit will be ready with piles and anchors.

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