THE SCIENCE COLLECTIVE

a circular re-design of the Applied Physics building at the TU Delft

The Applied Physics building in the '60s

The TU Delft (strategic framework 2018-2024) aims to have a CO_2 neutral and circular campus that departs from the linear economy to closed material cycles by 2030, meaning that the campus becomes climate neutral. Currently, the TU Delft is accountable for 47.957 tCO_2-eq emissions, uses 166.038 MWh of energy for electricity and heat , and is for approximately 5-15% circular. There is a need to improve in order to meet the goals set by the TU Delft.
On campus the Applied Physics buildings consumes the most energy, equivalent to 12.873,2 MWh or 425 kWh/m² in 2018 for electricity and heat combined.
The technical state of the building is mediocre and is in need of a thorough renovation to meet the current standard.
The goal of the graduation project is to develop a re-design and renovation strategy for the Applied Physics building, by re-using as many of the existing materials and closing the energy flows on a local level.

Architecture – reuse existing
The building is designed by the architecture firm Roosenburg, Verhave and Luyt and built in 1963. It has an area of 43.100 m², making it one of the largest buildings on campus. The building is located in the centre of the campus next to the Aula and the Library. It is embedded in the urban fabric of the TU Delft with a 175-meter-long rhythmic façade facing toward the Mekelpark. The concrete façade has a sense of monumentality however, it has quite a closed look and is not overly inviting to visit.

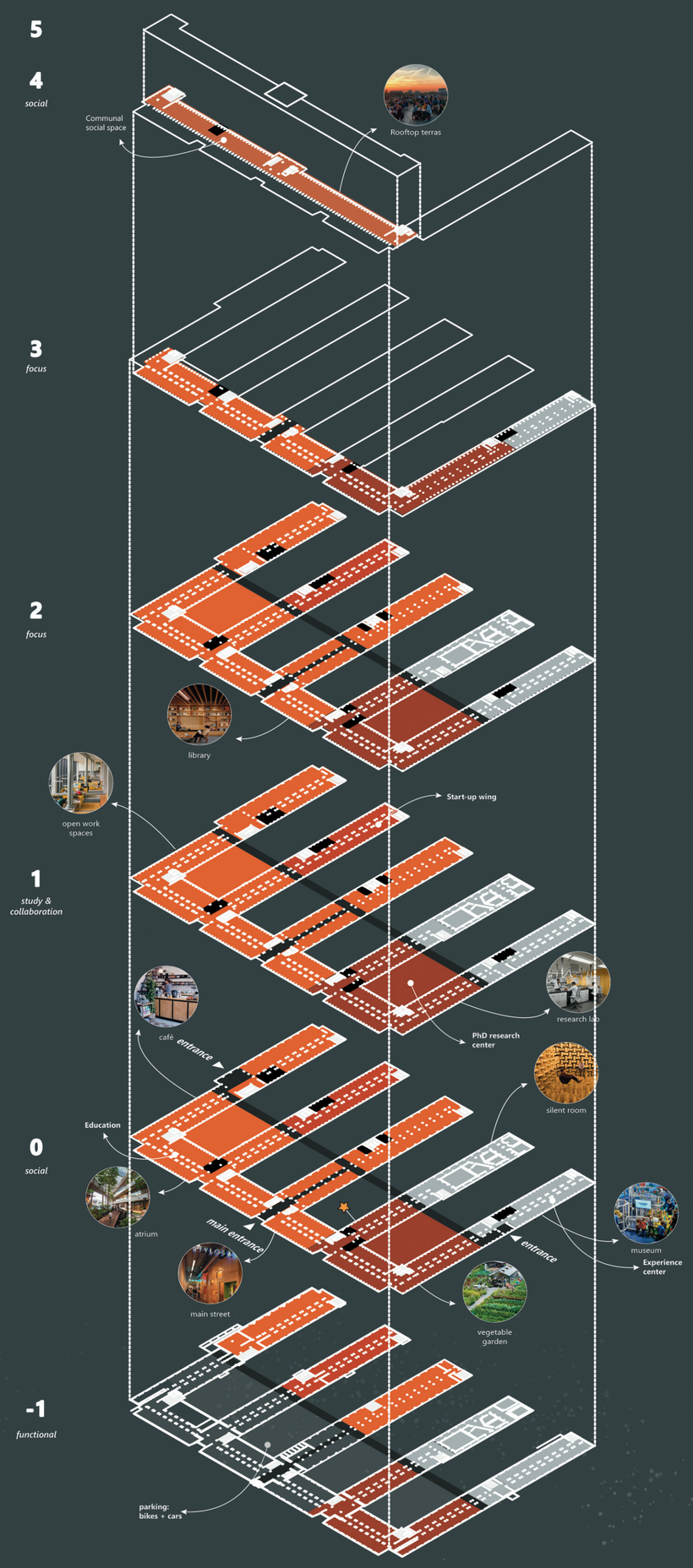
The new architecture starts from the existing building and the desire to reuse as many of the existing materials as possible to reduce the CO_2 impact of the renovation. An inventory of the materials present in the structure and façade has been made. 93% of the materials analysed are in the concrete structure and therefore this will be completely reused.
The remaining 7% of the materials are located in the façade and they will be carefully harvested. Prefab biobased façade panels, based on the existing structural grid, will be attached to the existing structure. On site the harvested materials will be re-used to clad the newly insulated façade.

Energy flow
To move away from an energy system that runs on fossil fuels, there is a need to introduce so called cyclifiers to create a closed loop system. Firstly, the energy consumption needs to be reduced by introducing a well-insulated façade and a smart building system that regulates the temperature and ventilation. The remaining energy needs to be produced sustainably.
A biogas plant is introduced that turns waste into three valuable products, namely biogas, fertiliser and clean water. The biogas plant runs on waste from the sewer system as well as on algae, which are integrated in the roof of the atrium that is added to the building. The algae serve a triple purpose because they provide sun shading in summer, absorbed CO_2 and are a renewable energy source.
PV panels are added to the roof and facades of the building to produce even more renewable energy. The heat for the whole campus is supplied by a geothermal source connected to the already existing heat grid and a heat and cold storage is added to the building.

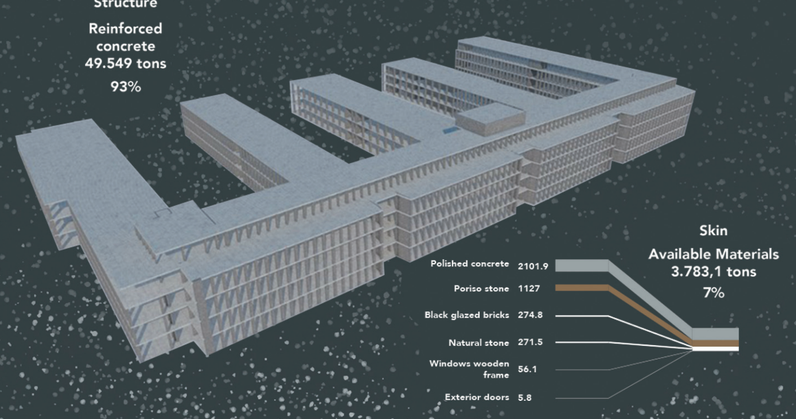
Nienke Scheenaart, January 2021

96%
of the existing materials are re-used

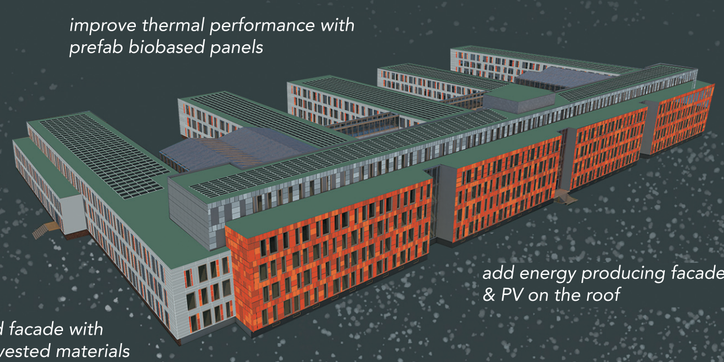
100%
of the energy comes from a renewable source



Proposed program with key functions



Reuse existing structure & harvesting facade materials



Circular re-designed building with energy producing & reused materials facade