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DOI (link to publication from Publisher):
10.54337/aau511019002

Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Johra, H. (2023). *General Study Case Description of TMV 23: A Multi-Storey Office Building and Living Lab in Denmark*. Department of the Built Environment, Aalborg University. DCE Technical Reports No. 306
https://doi.org/10.54337/aau511019002

DEPARTMENT OF THE BUILT ENVIRONMENT
AALBORG UNIVERSITY

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ISSN 1901-726X
Technical Report No. 306

Aalborg University
Department of the Built Environment
Division of Sustainability, Energy & Indoor Environment

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by

Hicham Johra

January 2023

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Published 2023 by
Aalborg University
Department of the Built Environment
Thomas Manns Vej 23
DK-9220 Aalborg Ø, Denmark

Printed in Aalborg at Aalborg University

ISSN 1901-726X
Technical Report No. 306

1. Foreword

The aim of this technical report is to give a general description of *TMV 23*, a multi-storey office building used for teaching and research purposes at the university campus of Aalborg University, Aalborg, Denmark [1].

2. Building description

TMV 23 is a multi-storey office building used for teaching and research purposes at the university campus of Aalborg University, Aalborg, Denmark [1]. This building comprises offices, meeting rooms, classrooms, workshops and laboratories. This building is also used as a *Living Lab*: multiple experimental setups and investigations are run directly in the working environment of the staff and students sitting at the *TMV 23* building.

TMV 23 is located at Thomas Manns Vej 23, 9220 Aalborg Øst, Denmark. The building belongs to a university campus situated on the SouthEast edge of the urban area of the city of Aalborg in the north of Denmark (see *Figure 1*).

Figure 1: *Location of TMV 23 building in the Aalborg urban area.*

Aalborg urban area is a low-density city (population density in the municipality area: 178 habitants/km^2) surrounded by open flatland agricultural fields. Aalborg is situated in the north of Denmark, in the north of the Jutland peninsula. Aalborg city center is roughly 30 km away from the Kattegat (the sea between the Baltic Sea and the North Sea) in the east and 30 km away from the North Sea in the west. This region is very windy, with dominant winds coming from the west.

The *TMV 23* building is located at the western edge of the Aalborg University campus (see *Figure 2*).

Figure 2: *Location of the TMV 23 building on the Aalborg University campus.*

The building is surrounded by low-rise (2-3 floors) office buildings to the north, medium-rise office buildings to the east (5 floors) and flatland open fields to the south and west (see *Figure 3*).

Figure 3: *Aerial view of the TMV 23 building in its surrounding environment on the Aalborg University main campus.*

The *TMV 23* building was built in 2016 and designed according to the Danish building regulation BR class 2015 which specifies minimum levels of energy and indoor environment performances to be met. The main characteristics of the building are as follows:

- Around 9000 m^2 of floor surface area distributed over 5 storeys above the ground level (groundfloor to 4^{th} floor) and 1 basement.
- 1/3 of the floor surface area is dedicated to laboratory facilities (including workshops).
- 2/3 of the floor surface area is dedicated to offices (including teaching facilities).
- The dimensions of the building are 110.50 m in length (East to West direction including a semi-open courtyard on the West side of the building), 31.35 m in width (widest North to South direction), 20.70 m in height (to the main roof platform of the building) and with a maximum height of 26.20 m.
- The building is occupied by around 150 staff employees and 600 students.
- The design's primary energy use of the building is 56.3 kWh/m^2.year (excluding auxiliary energy use for laboratories):
    - Heating energy use: 21 kWh/m^2.year.
    - Energy use for domestic hot water production: 7.2 kWh/m^2.year.
    - Cooling energy use: 0.8 kWh/m^2.year.
    - Lighting energy use: 5.2 kWh/m^2.year.
    - Ventilation energy use: 7.9 kWh/m^2.year.
- Building structure: Pre-fabricated concrete elements.
- Roof: Flat with asphalt cover.
- Exterior wall material: Pre-fabricated concrete elements.
- Energy supply:
    - District heating network.
    - Electricity.
    - Photovoltaic panels (6 kW peak) installed on the building.
- Heating, ventilation and air conditioning (HVAC) systems:
    - 14 ventilation systems:
        - 6 air handling units with heat recovery.
        - 3 air handling units with heat recovery and free cooling.
        - 5 ventilation systems without any heat recovery or free cooling (extraction or similar).
    - Radiators and radiative panels.
    - 3 cooling units.
- Building monitoring and management system:
    - Schneider BMS (Schneider EcoStruxure™).
    - Passive infrared sensor for occupancy detection.
    - Indoor temperature monitoring.
    - Indoor humidity monitoring (a few sensors only).
    - Indoor CO2 concentration monitoring.
    - Light level monitoring.
    - Ventilation distribution system monitoring (variable air volume valve opening).

The AAU-TMV building is used for several purposes:

- Offices and meeting rooms for research staff.
- Classrooms, group rooms and socialization areas for students.
- Laboratories.
- Workshops for students and teaching/research staff.
- A coffee room/dining hall for students and teaching/research staff.
- Living Lab.

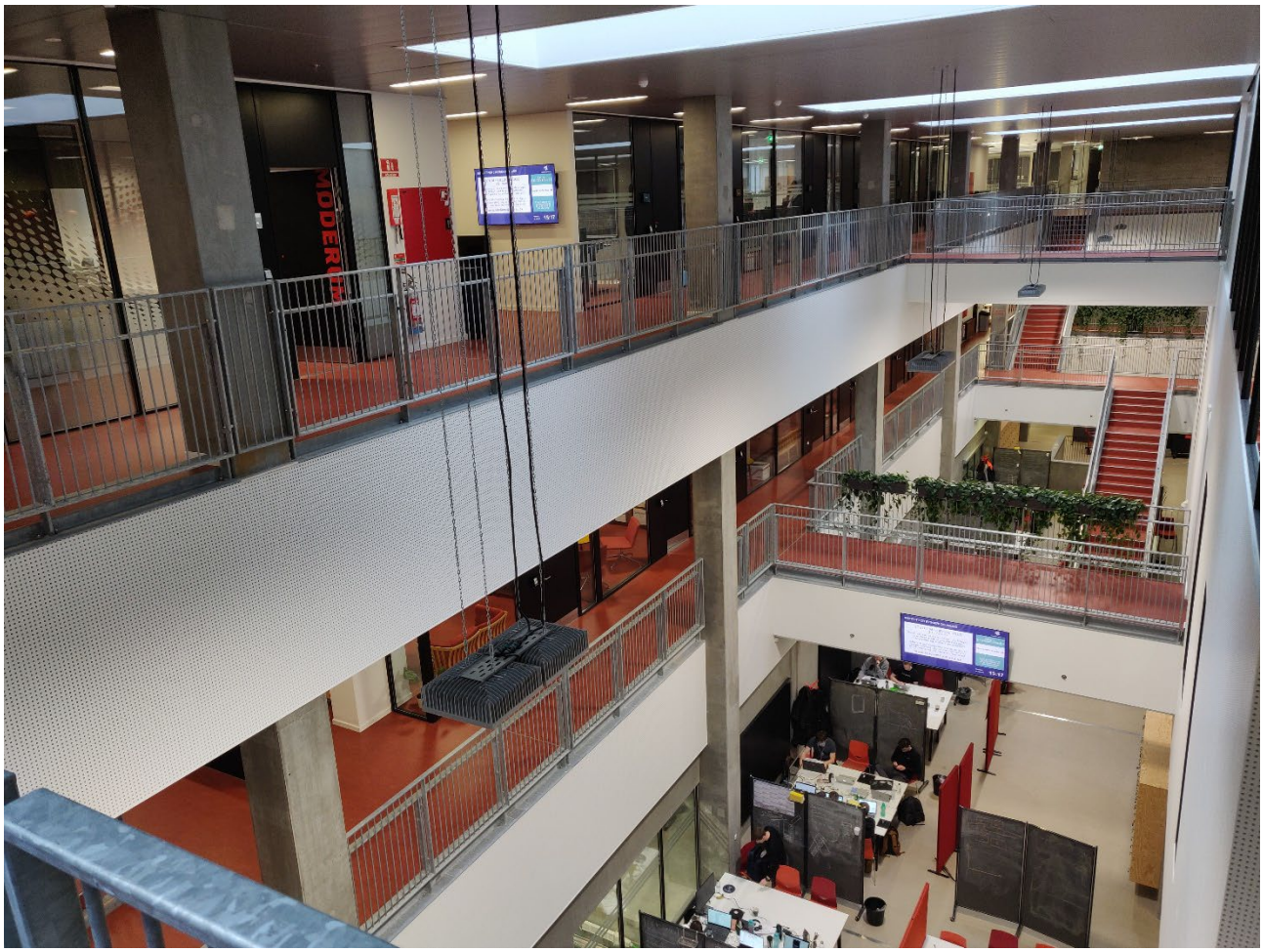

Figure 4: *View of the indoor space inside the TMV 23 building.*

Figure 5: *View of the South facade of the TMV 23 building (credit to Aalborg University).*

Figure 6: *View of the South facade of the TMV 23 building (credit to Ronge Fotografi).*

Figure 7: *View of the South facade of the TMV 23 building (credit to Ronge Fotografi).*

Figure 8: *View of the North facade of the TMV 23 building.*

Figure 9: *Aerial view of the TMV 23 building in its surrounding environment on the Aalborg University main campus. The South façade, the West façade and the roof of the building are visible. In 2022, a new building was built on the East side of the TMV 23 building (the upper right corner of the TMV 23 building in the picture) but was not visible yet in that aerial view (credit to Aalborg University).*

Figure 10: *Aerial view of the TMV 23 building in its surrounding environment on the Aalborg University main campus. The South façade, the West façade and the roof of the building are visible. In 2022, a new building was built on the East side of the TMV 23 building (the upper right corner of the TMV 23 building in the picture) but was not visible yet in that aerial view (credit to Aalborg University).*

Figure 11: *Aerial view of the TMV 23 building in its surrounding environment on the Aalborg University main campus. The South façade, the East façade and the roof of the building are visible. In 2022, a new building was built on the East side of the TMV 23 building (the right side of the TMV 23 building in the picture) but was not visible yet in that aerial view (credit to Aalborg University).*

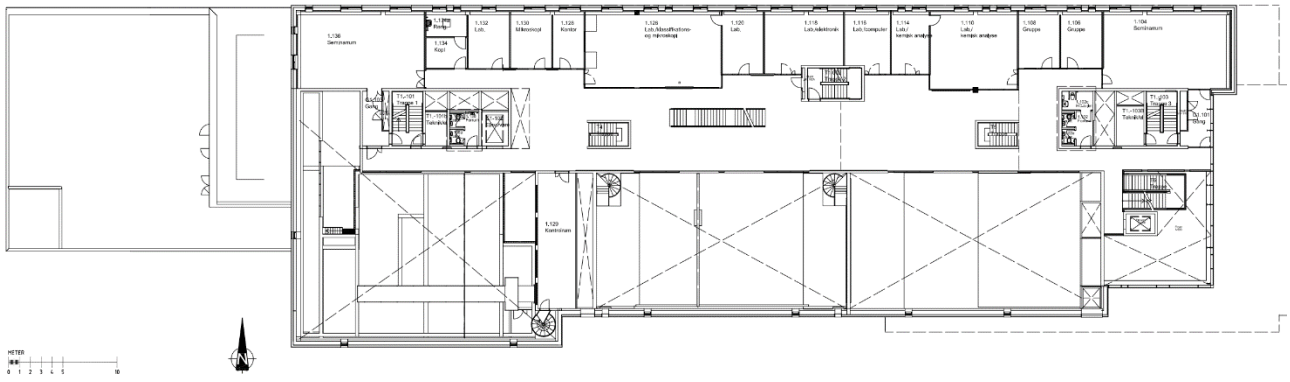

Figure 12: *Floor plan of the AAU-TMV building, 1st floor. The ground floor and the 1st floor of the building are dedicated to laboratories, workshops and a large central open space for students.*

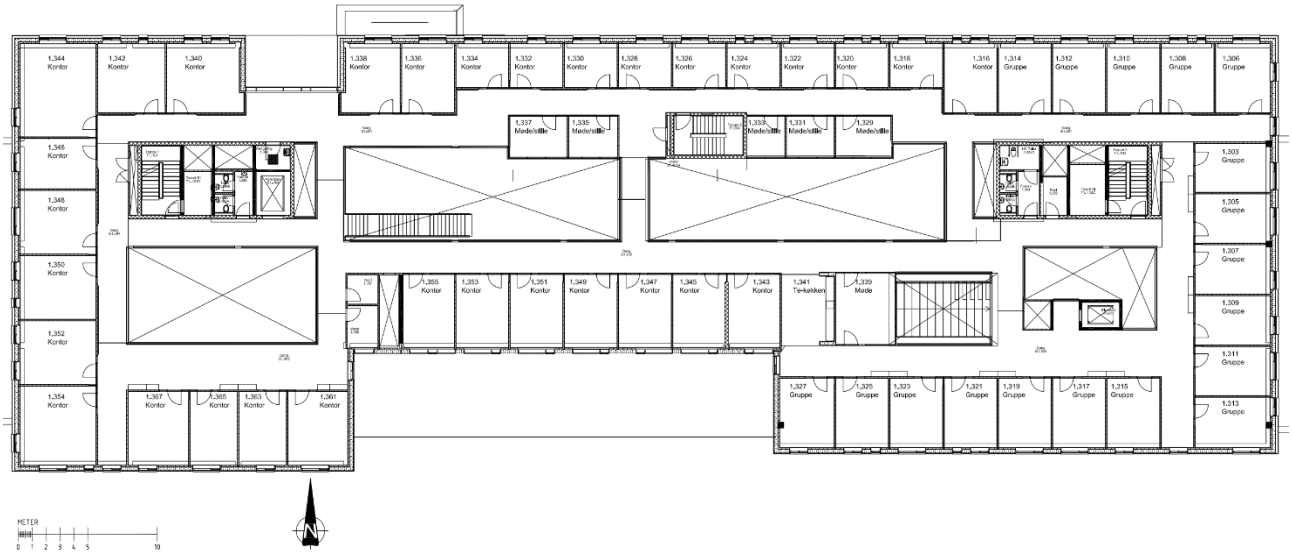

Figure 13: *Floor plan of the AAU-TMV building, 3rd floor. The 2nd and 3rd floors of the building are dedicated to office rooms for the staff employees and the students, together with classrooms and coffee rooms.*

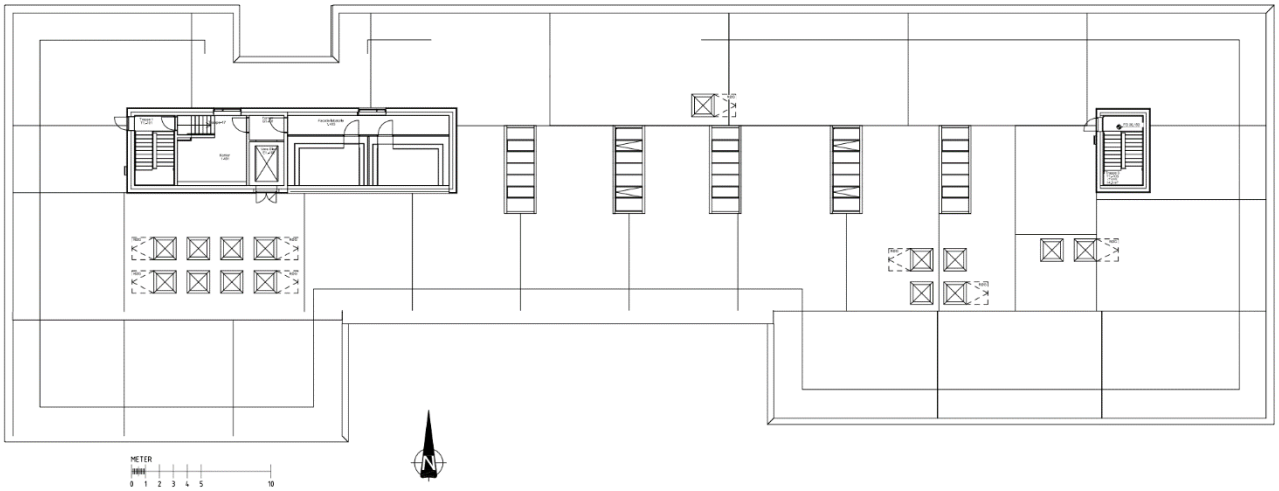

Figure 14: *Floor plan of the AAU-TMV building, rooftop (4th floor). Most of the roof of the building is inaccessible and covered with dark asphalt roll roofing. Skylight windows and cooling units are placed on the roof. A staircase block is located on the East side of the roof. A laboratory facility is located on the West side of the roof (5th floor). A weather station is located in the centre of the roof. A weather radar is located on the rooftop of the 5th floor laboratory: this is the highest point of the building.*

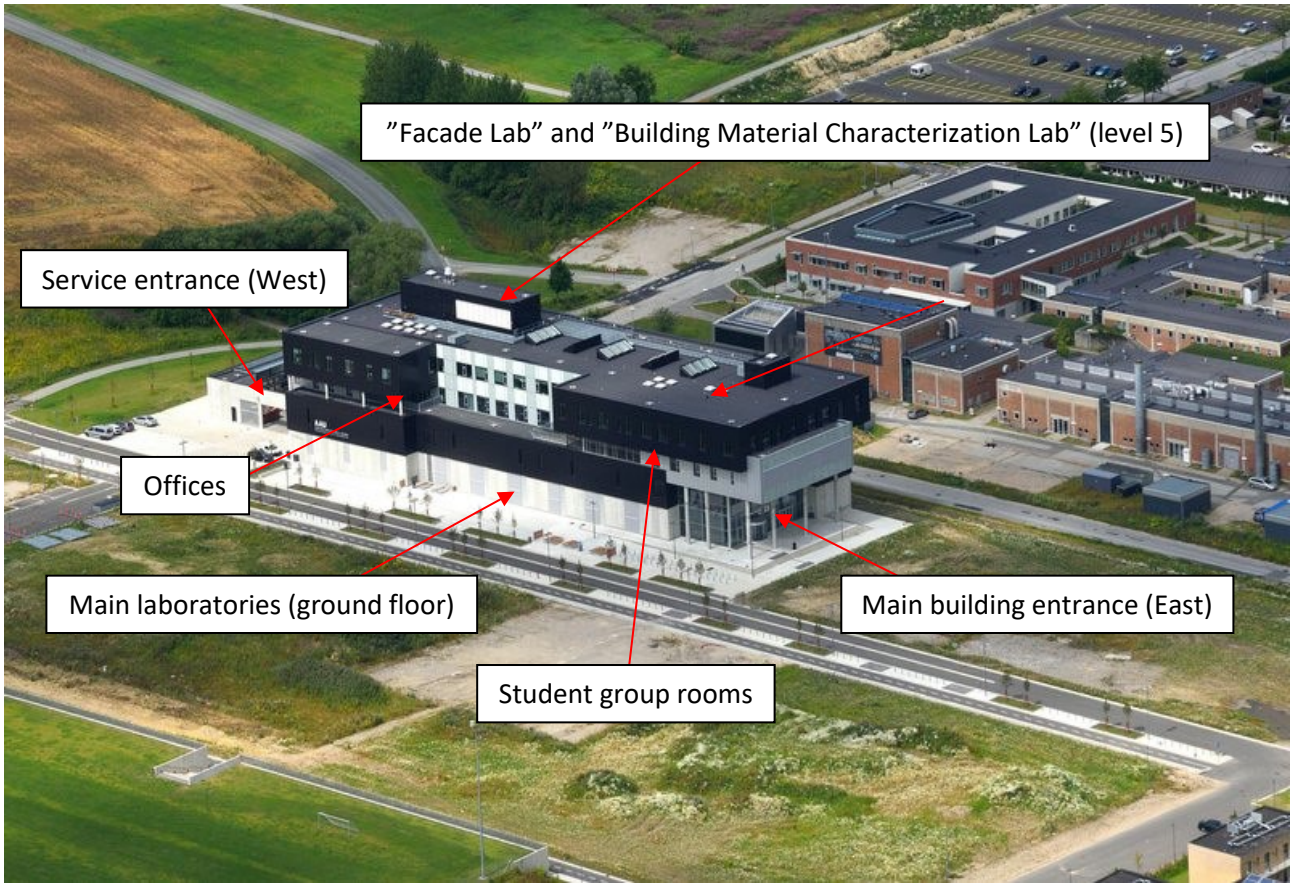

Figure 15: *Aerial view of the TMV 23 building in its surrounding environment on the Aalborg University main campus. The South façade, the East façade and the roof of the building are visible.*

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[1] Aalborg University, Department of the Built Environment, Thomas Manns Vej 23, 9220 Aalborg Øst, Denmark: https://www.en.build.aau.dk/

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ISSN 1901-726X
Technical Report No. 306