Constructional Prerequisites for a Building for Electron Microscopes in Berlin's Inner City

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The Technische Universität Berlin (TUB) runs a modern electron microscope (EM) lab, with state of the art high resolution and analytical electron microscopes for natural and material sciences. The building hosts the Berlin Holography Special TEM used by the work group of Prof. Lehmann and three further EMs (cold-field emission HR-SEM, two beam FIB/SEM and CTEM) operated by the TUB's Center for Electron Microscopy (ZELMI). The building, situated in the inner city of Berlin, is exposed to many external disturbances from car, subway, and boat traffic, urban supply cables and experimental laboratories of TUB. In contrast, there are high requirements for the stability inside the building, e.g. temperature stability +/-0,1° / 30 min, flour vibration <10 nm @ 5 Hz and AC-fields < 80 nT @ 50Hz in vertical direction.

First of all the authors checked the suitability of any available building of TUB, but after all it was clear that only a specially designed building will fulfil the requirements at reasonable costs. In a further two-year evaluation process, several consulting engineers fixed the optimum design of spatial layout and technical parameters.

The building has a house-in-house construction with four laboratories and a common microscopy utility room in the inner part (Fig.1). The outer part is used for the building-technology center, the preparation facilities and offices. The whole building is strongly-build with thicker walls and roofs than would be necessary from pure static requirements. In addition, a one meter thick foundation plate, reinforced bend-resistance corners and braces increase the stiffness of the inner part, whose resonances frequency is simulated to be well above 25 Hz (Fig. 2). To reduce the bounce amplitude of the building, it is founded on 122 unreinforced concrete piles with ten-meter length (Fig. 3). The resonance frequency of the piles is again designed to be well above 25 Hz since the air friction damping of most microscopes is inefficient for small frequencies but works quite well above 10 Hz.

The four inner laboratories (Fig. 4) are designed to be identical to reduce engineering cost for development and sizing of the technical equipment. The steady heat load is removed by cooling ceilings and the temperature stability is guaranteed by an active convection cooling. Non-parallel room walls, porous sound absorber walls and a carpet damp the propagation of unavoidable noise while the noise emitting power supplies and pumps are installed in the adjacent utility room. At the same time, this installation reduces the emission of magnetic field close to the microscopes. For the same reason all supply cables leave the laboratories in radial direction towards the building-technology center.

In conclusion, the TUB's building for electron microscopes required an enormous engineering effort but offers the great chance to work with high-end electron microscopes without external and internal disturbances.

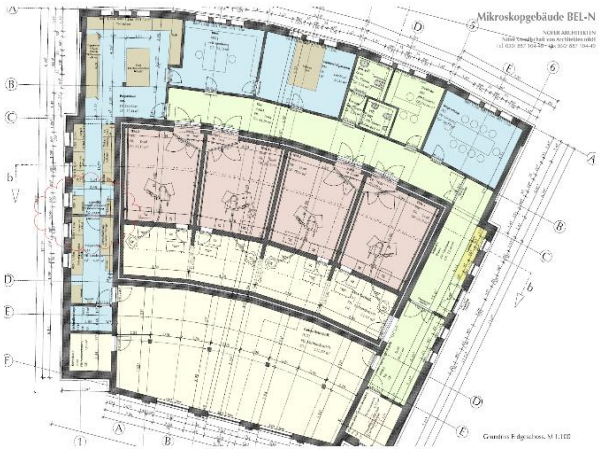

Fig. 1: Layout of EM-building (courtesy of Noefer Architekten)

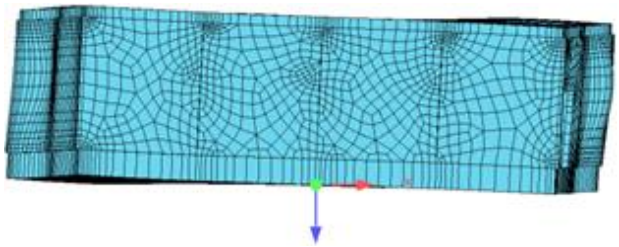

Fig. 2: Finite element calculation of the resonance of the building (courtesy of Noefer Architekten)

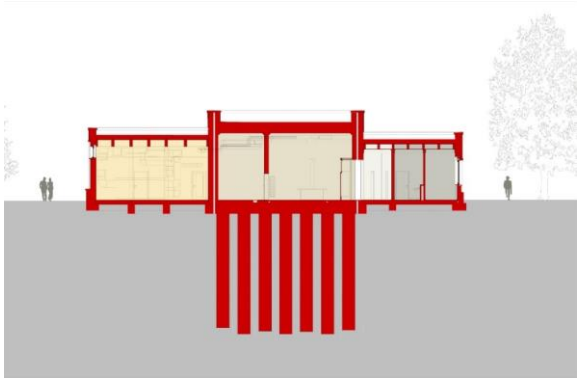

Fig. 3: Grounding of the building on 122 piles (courtesy of Noefer Architekten)

Fig. 4: One of four laboratories in the inner part