MICROSCOPY
ELECTRON IMAGING

Optical microscopes can observe features down to approximately 400nm (the wavelength of violet light). To observe smaller structures, such as computer chips or nanomaterials, where a 10nm feature size is common, a beam of electrons is used. When imaging features of this size, exceptionally stringent vibration isolation is required. Footsteps and machinery shake the building structure; voices in an adjacent room vibrate the air and can shake the microscope unacceptably. Magnetic fields from computers can make the image unusable. Even the body heat of a person can bend the microscope column out of alignment.

The purpose of the instrument room is to isolate the microscope from all of these sources of vibration, electromagnetic noise, and heat.

AIR

Fresh, clean air (20) is supplied to the plenum (21) under the raised floor. The air is distributed throughout the whole instrument room through perforated floor tiles (22). It is heated by the instrument and rises to the ceiling, where it is exhausted (23).

In most cases, temperature control, not fresh air ventilation, governs the air volume needed, so most of the air can be re-conditioned locally (24) and recirculated. This reduces the size of ductwork to the central HVAC plant.

Airflow can also be reduced by using radiant panels to stabilize temperature in the room, so the air is needed for ventilation only.

SERVICES

All services are supplied to the equipment chase behind the instrument room. This space contains all support equipment (40) which can be located remotely (ideally, any equipment which produces noise, vibration, or heat).

There is a duct (41) for vacuum pump (42) exhaust, with a branch (43) at each room. A transparent trap (44) shows whether any vacuum pump is throwing oil into the exhaust stream.

All services entering the instrument room proper (45) are fed through a cable sealing system, under the raised floor, to the center of the room where they connect to the instrument (46).

ISOLATION

To create an extremely quiet, vibration-free environment, the instrument room is constructed as a floating quiet box, which is sealed against, and isolated from, the noisy building structure on all sides.

The quiet floor slab (60) is separated by an isolation joint (61) from the noisy building floor slab (62). The quiet walls (63) of the instrument room sit on the quiet floor slab, and the instrument room is capped by a quiet ceiling (64) which sits on the quiet walls without touching any noisy structure.

Outside the instrument room, the outer layer of the double walls (65) sits on the noisy building slab. These walls serve to stop airborne noise exciting the quiet box of the instrument room. Each wall is constructed of layers of gypsum board (66) and metal studs (67), lined with acoustic batt insulation (68). An exposed face of insulation (69) absorbs sound inside the cavity (70). The walls are painted (71) even where they are not exposed, to seal against high-frequency noise.

Inside the instrument room, a layer of electromagnetic shielding (72, welded plate or copper mesh, depending on the type and magnitude of shielding required) is continuous on ceiling, walls, and floor. Above the raised floor, the walls and ceiling are lined with acoustically absorptive panels (73) to absorb noise from the equipment.

All services which enter the room must be isolated both acoustically and electromagnetically. Services at the equipment chase pass through a cable sealing system (74) which is grounded to the shielding. All ductwork has a flexible, non-conductive section (75) to avoid transmitting vibration or electrical charge, and an acoustic attenuator (76) to prevent HVAC equipment noise from being transmitted into the room.

The vibration isolating base (77) in the center of the room is a large mass of concrete or steel mounted on springs or pneumatic isolators, the center of mass and resonant frequency of which is tailored to each instrument.

Back-to-back doors (78) are used for greater acoustic isolation at the noisy equipment chase, while a single set of double doors (79) provide convenience and width for equipment move-in at the quiet control room side. (Back-to-back doors are at a greater risk of slamming, which would be heard in neighboring rooms.)

ELECTRICAL

Each instrument room has a dedicated electrical supply (80) and ground, fed through a power conditioner (81) and then into a dedicated electrical panel (82). This prevents power surges from one room affecting another.

Power is distributed in the equipment chase (83), where it feeds support equipment (84). Signal and power cables are fed through the service trench (85) and cable sealing system into the underfloor plenum of the instrument room itself.

Control and data cables connect the instrument to the control room (86) in the same way. Here, computers (87) will not interfere with the instrument.

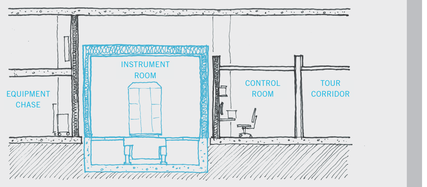
SEPARATED SPACES

The most perfect isolation will be wasted if there are sources of noise, vibration, heat, or electromagnetic interference inside the instrument room. The electron imaging suite creates a series of separate spaces:

The equipment chase (01) contains the most noisy, vibration-intensive support machinery, such as vacuum pumps or power supplies. It also contains the utility distribution which serves the imaging suite.

The instrument room (02) is an isolated, quiet box which contains only the instrument itself (03). It is arranged so that it has no rigid connection to the building's structural columns (04).

Human operators and their computers occupy the control room (05), while visitors stay even farther away in the tour corridor (06) and observe what the microscope is seeing on a computer screen (07).



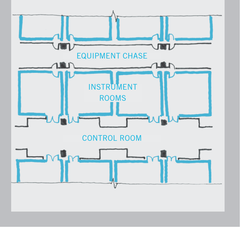
SHARING SPACES

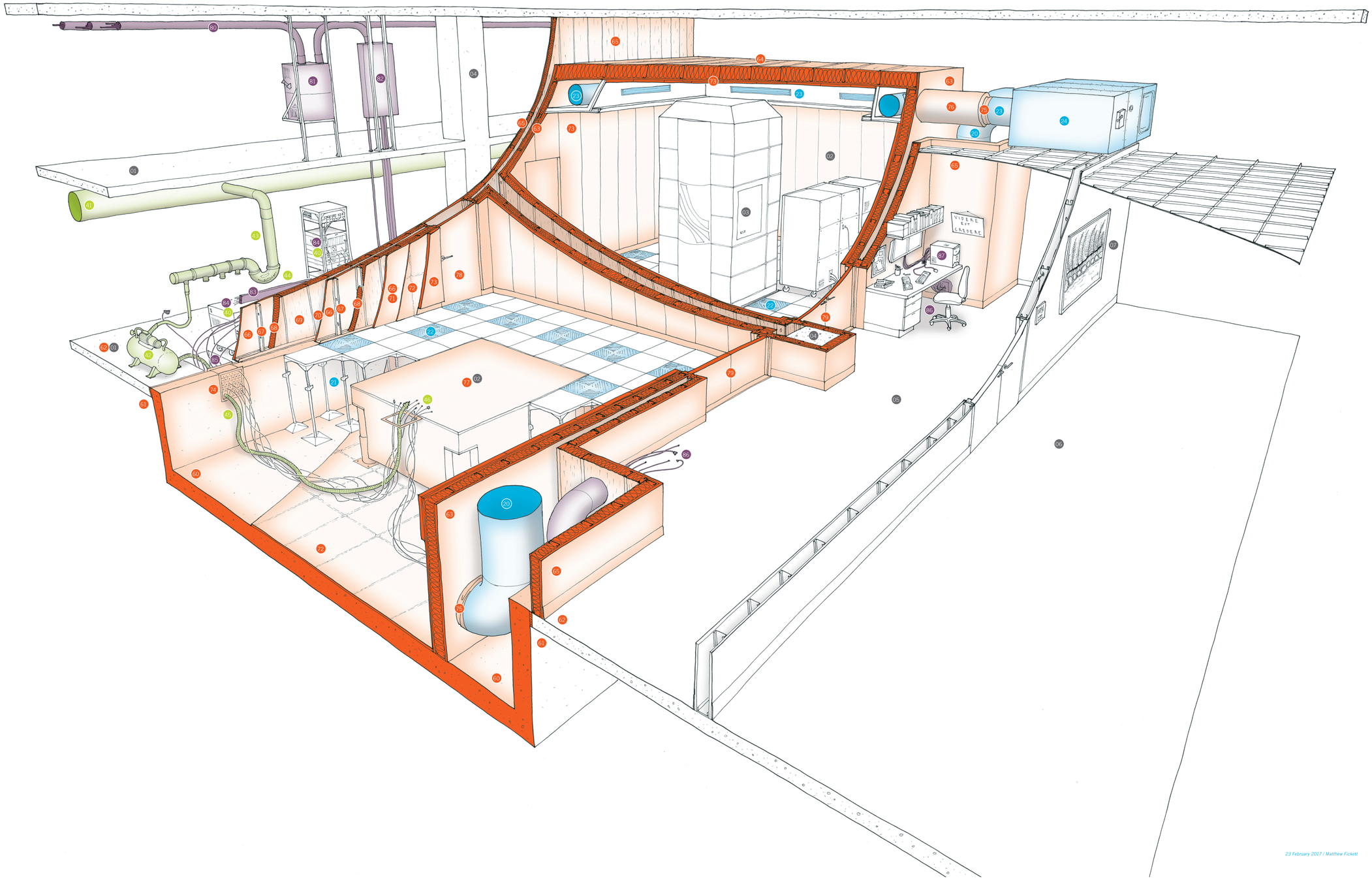
While it is critical to separate the instrument rooms (02) from all sources of noise and vibration (including other instrument rooms), it is possible to share the other rooms.

The control rooms (05) for several instruments can be combined, and so can the equipment chases (01).

When the building structure (04) is laid out with this in mind, an efficient grid of imaging suites can be arranged.

The tour corridor can be as nearby or far away as is desired, and can display images from several rooms at once.





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