



Engineering - Cleanroom Design: Structural Considerations When Implementing Ceilings

Cleanroom-Technology

Cleanroom Design: Structural Considerations When Implementing Ceilings

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Current GMP regulations and other applicable specifications clearly define how a cleanroom must be designed. In practice, client needs must also be considered when selecting the most appropriate solution during on-site implementation. Ronny Töpfer, Project Engineer at Glatt Ingenieurtechnik (Weimar, Germany) explains how to successfully install cleanroom ceilings.

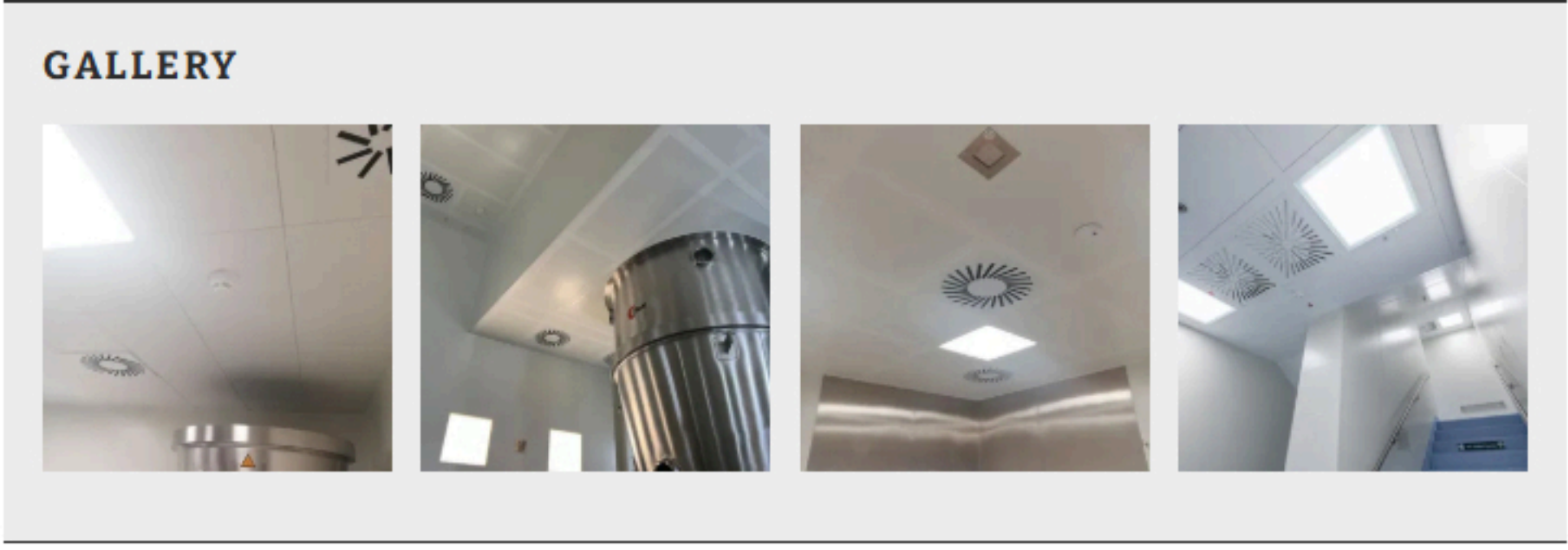


Clamping cassette ceilings are suspended metal ceilings that cannot be walked on. Lights and air outlets can be integrated into the system and lay almost flush with the surface
(Source: Jens Distelberg)

What applies to the design of doors, glazing and walls in cleanrooms also plays a major role when it comes to ceilings: all planning issues must be carefully assessed and clarified with the customer before either a conversion or new construction project begins. As part of the process, issues relating to false ceiling installations, such as the lighting and air outlets, should be agreed at an early stage. It's crucial that every aspect is closely integrated into the planning process. Glatt Ingenieurtechnik, for example, relies on its own in-house specialists for elements such as HVAC, EIBC, black and clean media, etc. This means that everything can be co-ordinated with maximum efficiency. If external service providers are involved, they should be integrated as closely as possible into the project structure.

Ceiling Systems And Their Areas of Application

With cleanroom ceiling systems, there are three main categories: supporting grid, clamping cassette and panelled versions. They are generally used in cleanrooms of Class ISO 8 and similar. For lower-rated cleanroom areas, the use of a drywall scheme and compatible coatings is acceptable. As with the wall systems, tightness of fit must be ensured by minimising the number of joints.



The design of panelled ceilings is much like the wall panel system. Depending on the supplier, self-supporting walk-on ceilings (with a span of up to 6 m) are available that minimise the number of joints. And, thanks to integrated profiles, large-format elements can easily be attached to the ceiling structure or, if required, steel substructures. Lights and outlets are attached before final installation. In contrast to other systems, retrofitting is only possible to a limited extent and is more labour intensive.

The question of whether the ceilings should be accessible or non-accessible is an important aspect. With panelled and supporting grid ceilings, accessibility is possible on request. This means that there is no need for additional gangways or other construction. However, the load-bearing capacity is limited for all systems. It is predominantly used for maintenance purposes and not to accommodate pipe supports or other loads in the suspended ceiling area.

System-dependent Design Options

Supporting grid ceilings comprise a manufacturer-specific flexible grid system with extruded profiles. The widths of the bars vary according to the supplier, whereby fixtures from a width of 80 mm (such as pressure sensors) can easily be integrated. The ceiling panels are available in standard sizes – such as 625 x 625 mm – so that cleanroom lights and air outlets can also be installed without additional joints. However, the market also offers a range of other sizes or special dimensions. Clamping cassette ceilings are suspended metal ceilings that cannot be walked on. As with the other options, lights and air outlets can also be integrated into the system and sit almost flush with the surface.

The tightness of the ceiling plays a key role. As with cleanroom walls, the joints in the ceiling can be sealed with a compatible silicone. This is not the case for clamping cassette ceilings, however, as these should only be installed in lower-rated cleanroom areas. In addition to siliconizing the ceilings, dry seals can also be used. The intervals at which the cleanroom ceilings need to be opened, for example, must be agreed with the client in advance. A silicone seal must be replaced every time, whereas a dry seal is laid above the joints and does not need to be replaced when the ceiling is opened. One disadvantage of the dry seal is the higher leakage rate owing to a small design-related gap.

Close Co-ordination in The Concept Phase

Open communication between the customer and the architect should take place during the cleanroom design phase. Of course, compared with a new build, there are architectural conditions to consider when remodelling. The spatial requirements and dimensions are usually determined by the customer and their project requirements. The planner can rarely intervene in this instance as these parameters and equipment specifications are dictated by the process.

Influential variables that may be specified by the architecture might include container dimensions or the installation of lifting columns. In some cases, it is possible to work with so-called ceiling domes to reduce the actual cleanroom volume: the larger the volume, the higher the air management requirements ... and running costs. A very important part of the preliminary planning of a new building is the structural height of the individual floors. It's often only during construction and the installation of fixtures – such as pipes, ventilation ducts and sprinkler lines – that it's discovered that a great deal of engineering effort will be required to accommodate a very tight plenum.

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This is precisely why an exact estimate of the installation density and sizes, such as ventilation ducts or lights, must be made in advance. Convenient maintenance options are also essential and should be considered and planned for accordingly in terms of space – especially when it comes to safety relevant components such as sprinkler lines. Their integration should not be underestimated. Depending on the project, they are unavoidable and often required for insurance purposes; fire protection systems cannot be installed arbitrarily and are subject to strict regulations. Plus, if the plenum and cleanroom must be fitted with sprinklers, the amount of space and installation work required in all areas increases significantly.

Correctly Integrated: Fixtures in The Cleanroom Ceiling

Cleanroom ceilings may require the installation of a wide variety of systems and appliances ... and all of them must be professionally integrated to fulfil the respective cleanroom class requirements. The most common include the following:

- light fittings
- air inlets and outlets
- filter fan units
- temperature, pressure or humidity sensors
- emergency exit signs
- smoke detectors
- sprinkler heads
- WLAN antennas and much more.

The specifications for any cleanroom, which should be designed to be smooth and flush, also warrant significant attention to detail. This is less of a problem with luminaires and ventilation outlets, though, as most cleanroom manufacturers offer these as flush-mounted components for their ceiling systems. It is also possible to adapt ceiling systems so that luminaires and diffusers from other suppliers can be retrofitted. If possible, sensors should be installed in the grid profiles for maximum flexibility. Alternatively, the fixtures can be integrated into the ceiling panels, but this of course limits the available placement options. Not all sensors can be flush-mounted, but the market offers a wide range of cleanroom-compatible versions and other suitable components. Sprinkler heads, for example, can be supplied with nozzles that automatically extend in the event of a fire.

Cleanroom luminaires can be inspected either from below or above. With the accessible-from-below versions, defective modules can easily be replaced without impacting the status of the cleanroom. This is a major advantage. This variant is also ideal if access from above is difficult or impossible owing to a lack of space in the plenum. The basic consideration for every cleanroom project also applies to lighting: the client should be involved from the outset to approve the best option for the construction project. Ideally, all planning services should be co-ordinated and come from a single source.

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