

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

In cleanroom design and construction, accuracy and efficiency are crucial to ensure a safe and controlled environment that meets regulatory requirements.

Faced with these challenges, BIM has established itself as a transforming work methodology in the sector, facilitating the optimisation of processes and ensuring an integral control that is key to the success of these projects and is shaping up to be a revulsive in the sector.

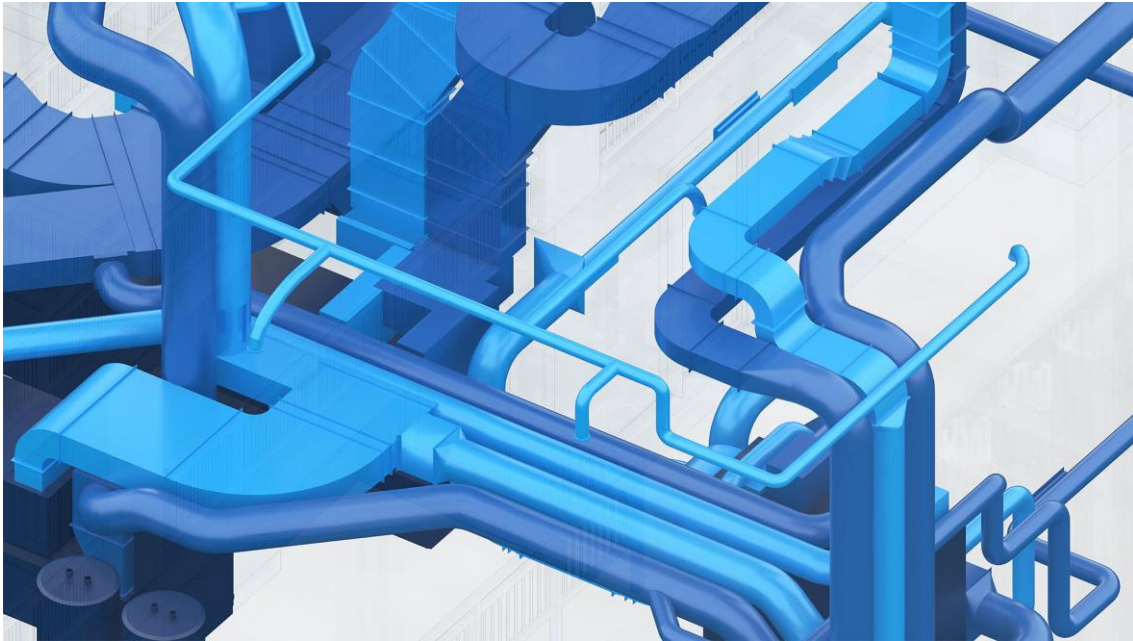
BIM tools not only provide us with a design platform, but also allow us to build a "*Digital Twin*" of the project that covers each phase, from the initial offer, through the detailed design to the monitoring of the construction and maintenance of the installation during its useful life. This "*Digital Twin*" is a virtual replica in which we can simulate and coordinate the different disciplines prior to construction, reducing risks, costs and complying with the highest quality standards, GEP (Good Engineering Practices) and regulatory standards. In this article, we will see how Revit, together with Stabicad, Dynamo and other BIM software improve accuracy, reliability and agility in our cleanroom projects.

1. **Bidding Phase/Basic Design.**

In every new project, our journey begins with the pre-design and/or basic design phase. This is a crucial part of our tendering process, as it is important that our BIM team can generate quick designs and test different MEP scenarios during the tendering process.

Our usual design software, Revit, becomes our base, but it doesn't stop there. By relying on Stabicad, we can quickly create initial MEP designs, allowing our designers to quickly sketch and visualise the basic layout of their systems. For this purpose, there are two tools within this software that we would like to highlight for their usefulness, such as "Solve Node", as well as calculation and dimensioning.

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.



[Fig. 1 Ductwork Design. "General picture of ductwork of a project."]

Calculations and dimensioning: installation tenders.

Our team of designers and engineers follow the BIM philosophy, collaborating to achieve the best results.

- Revit provides a solid foundation,
- Stabicad streamlines 3D modelling and calculation,
- Dynamo automates complex processes.

These software programmes support us in decision making, calculations and dimensioning of installations.

Stabicad allows, in the initial design phase, to model the elements necessary to determine the sizes of return columns and main ducts, so that a rough estimate of materials and systems can be made. It allows the placement of a single element that can represent a branch, a space, a level or even an entire building. In this way, you can quickly find out the space requirements for e.g. the duct system and coordinate with the cleanroom architecture and other systems in terms of space reservation. Moreover, when changes occur at a later stage, it can be adapted quickly without having to change many detailed elements.

It is essential to be able to visualise everything in a single environment and 3D model, which allows us to clearly understand the use of space and to be able to prepare a variety of graphic presentations with which our clients can have a better idea of the designed project.

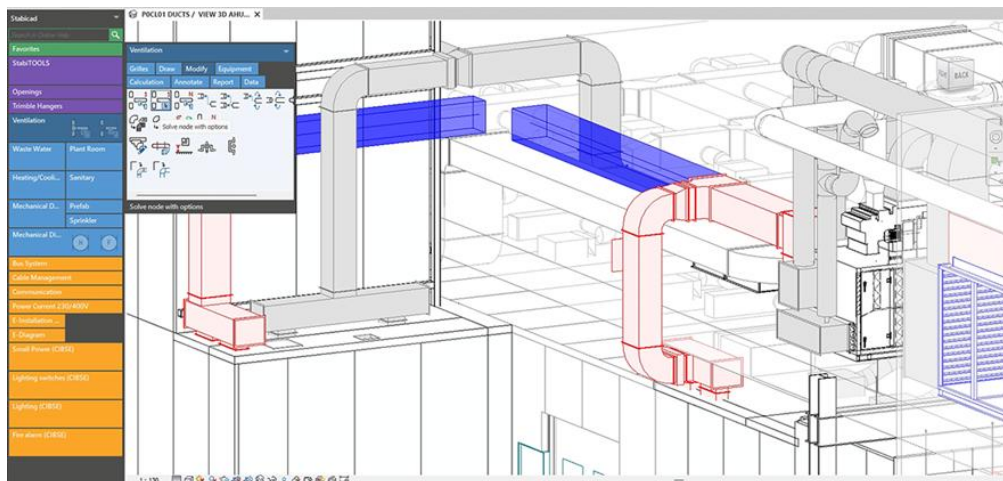
It also means that we can develop an initial MEP design that lays the groundwork for proper project

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

execution, identifies potential future challenges, plans the coordination process and generates a preliminary estimate of the proposed system in terms of size, performance and cost. "Solve Node"

The "Solve Node" and "Solve Node with options" features of the Trimble Stabicad software are very valuable for our projects. Used in the early stages of the project, as well as throughout the design process, node resolution tools facilitate and automate the process of detailing complex interfaces and connections for MEP systems.

The "Solve Node" command streamlines, connects and optimises duct and piping systems. In projects, it automatically connects ducts to air terminals, ducts to other ducts and ducts to equipment, significantly reducing manual construction time for seamless duct routing.



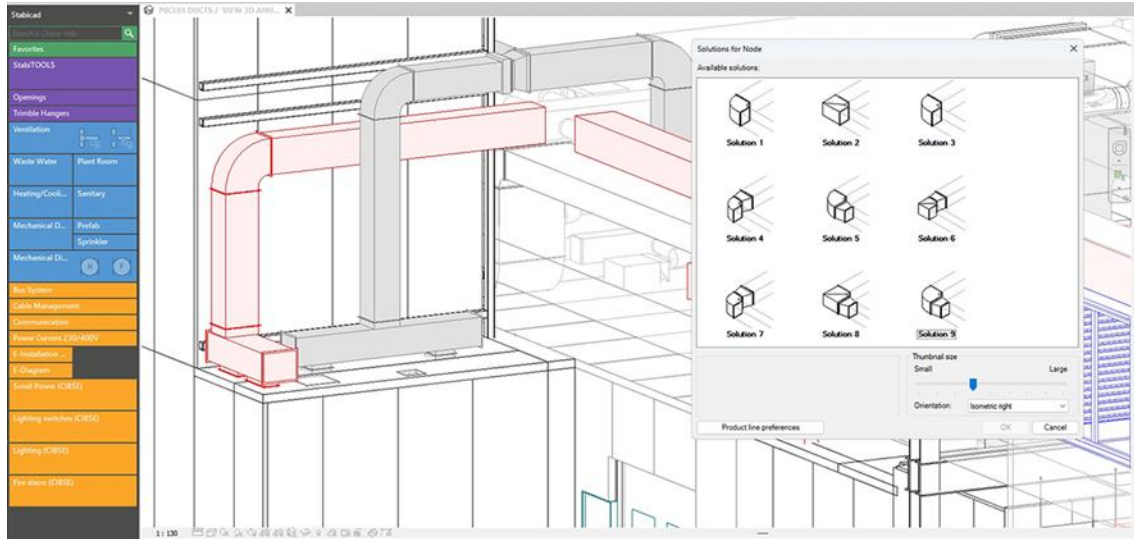
[Fig. 2 "Solve Node" Feature. "Example of the use of the feature for the solution of a duct junction."]

The "Solve Node" feature

- will rotate the air terminals if necessary and adjust the connection ducts according to the design parameters;
- it will position the flexible and rigid ducts with the appropriate lengths;
- it will automatically add elements such as VCDs (Volume Control Dampers) and coupling connectors.

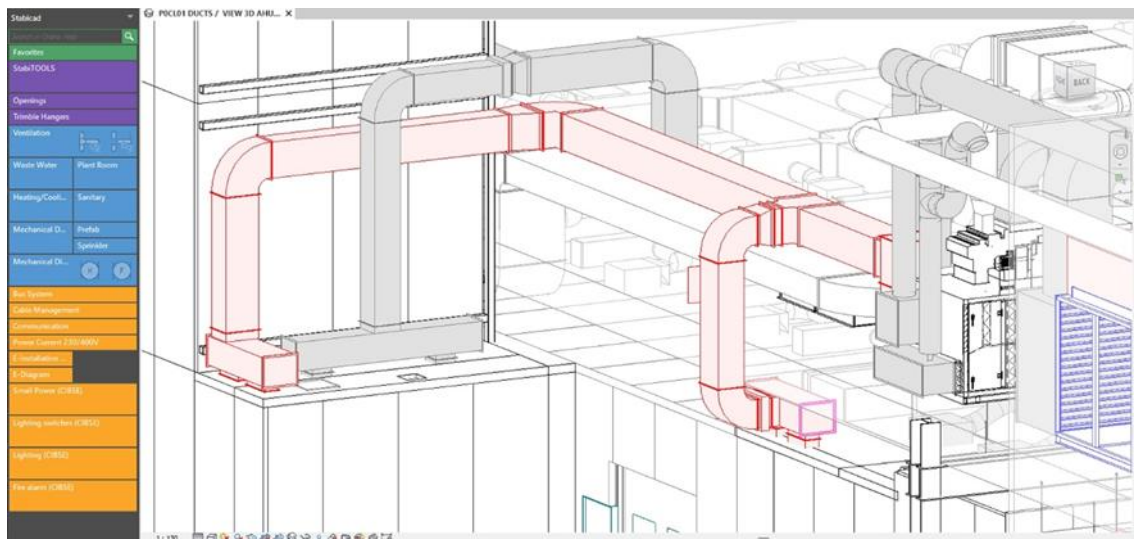
By ensuring that all connections are precise and comply with manufacturers' specifications, it standardises the work of our design and engineering team. Its ease of use reduces errors and rework, making the design process more efficient. Although the automatic command "Solve Node" command is excellent for general use, Stabicad's "Solve Node with options" command offers even more flexibility and control, providing more precise solutions that can be tailored to specific project requirements.

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.



[Fig. 3 "Solve Node" Options. *The "Solve Node" feature offers different possibilities to choose the most suitable one for the design.*]

The "Solve Node with options" feature is especially useful for handling complex design constraints in Revit, automatically suggesting various connection options for duct and pipe systems. It allows the best option to be selected according to the angles and types of fittings required, making it easier to overcome design challenges, while maintaining a balance between control, automation and customisation. This command can be applied to specific nodes or sections, allowing complex projects to be managed efficiently by focusing only on areas that require special attention without affecting the entire system.



THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

[Fig. 4 "Solve Node" Solution. *"Stabicad automatically generates the necessary parts according to the chosen option."*]

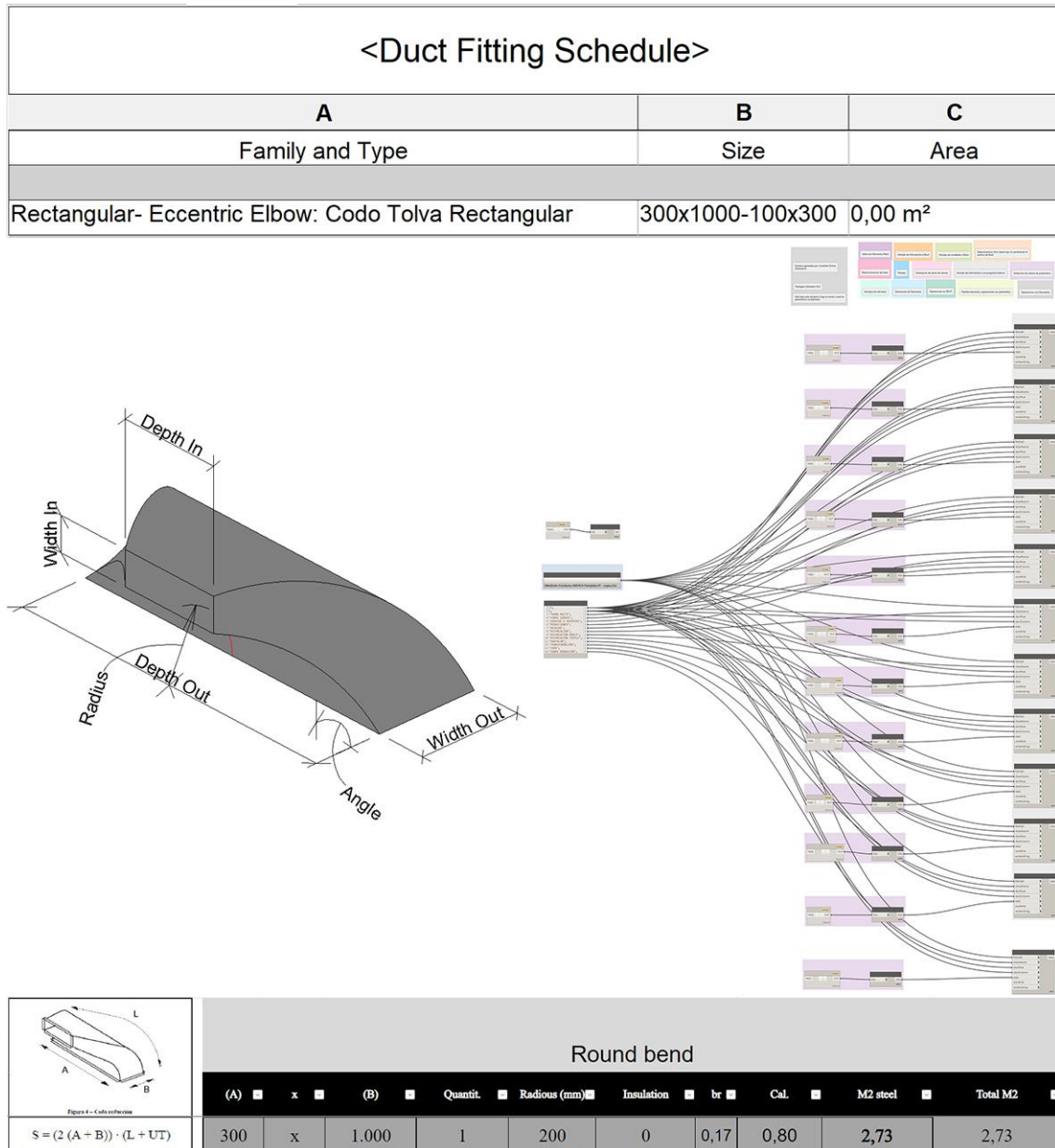
Procedure for the extraction and transformation of data used in tenders.

Dynamo allows you to automate processes through visual scheduling and thus automatically optimise tasks. As an example, we show one of the processes we have developed and automated for the extraction of data from HVAC duct systems modelled in Revit. This process is implemented through a Dynamo routine, which is integrated with a dynamic Excel spreadsheet, facilitating the integration and conversion of the extracted data into accurate measurements, in compliance with the regulations in force in the country.

The standards applied ensure that the measurements accurately reflect the project, taking into account, among other things, material wastage that Revit is not able to foresee. This method is consistent with the practices of the usual material supplier, ensuring a more accurate and appropriate offer phase for the actual conditions of supply and use.

The following image shows how the process works with a parametric part. In this case Revit does not manage to calculate the total area, however, with our routine we manage to export the data to our spreadsheet.

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.



[Fig. 5 Dynamo routine. "Example of the developed data extraction routine."]

2. Detailed Design Phase.

Once our offer is accepted by the client, our journey continues with a new phase of development. We reuse, as far as possible, the approved basic project and optimise it to generate a detailed design of the entire installation. In this phase, we consider all the possible agents involved, from suppliers, coordination with other disciplines involved in the design, maintenance, special solutions to take into account in the assembly, ensuring that every aspect of the design meets the established standards of quality and efficiency.

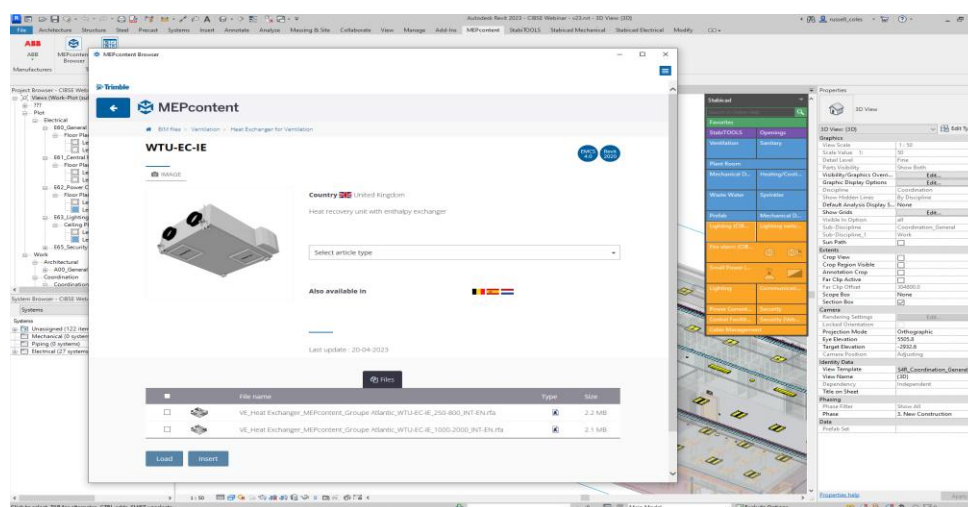
THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

Our engineering team dives into the details, fine-tuning and perfecting each component in the system to realise a customised design, meeting the specific needs of each production process within the cleanroom while adhering to applicable regulations.

At this stage, accuracy, efficiency and modelling tools are essential for the engineering team. Stabicad is valuable for its accurate and reliable calculations, automated system dimensioning and documentation capabilities. This helps ensure that the detailed MEP design is accurate, efficient and well-coordinated, meeting the required quality standards.

Two of the key features of Stabicad software that stand out at this stage are the "Calculations" and "Dimensioning" of the MEP system within Revit, both of which ensure that MEP systems are correctly dimensioned and perform optimally, meeting industry standards and project requirements.

Thanks to the flexibility of the software, we can easily adapt the design and dimensions of the ducts, as well as visualise the impact of critical decisions, all while automatically checking the scheme with the relevant industrial calculations. At this stage, content is another key aspect: Stabicad offers a vast library of dimensionally accurate content, including items and technical data based on manufacturers' catalogues. Connector positions, overall size and service space information are in accordance with the manufacturer's information. In this way, you can be sure that the model can be built in reality. Combined with the "Solve Node" functionality described above, you can quickly insert the right content for your project and connect the system using accessories and equipment that are actually buildable.

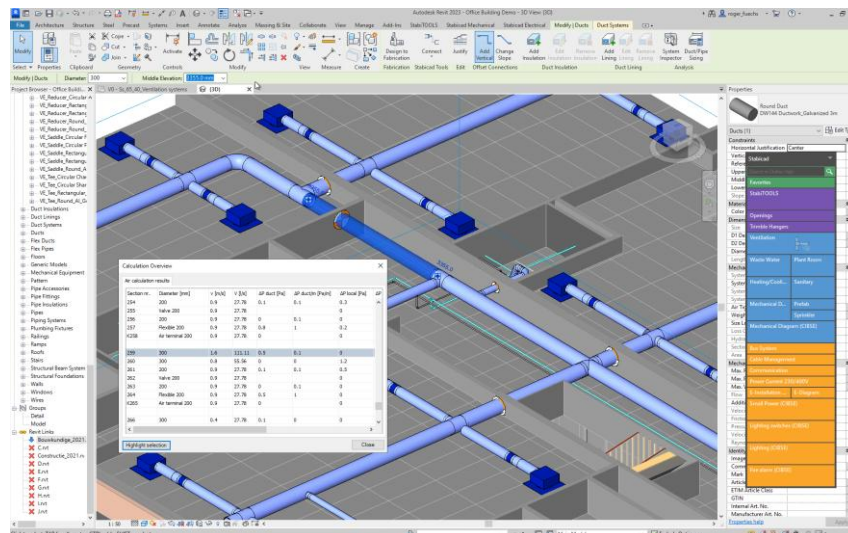


THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

[Fig. 6 MEP Content. "Stabicad platform with already generated families of suppliers ready for optimised calculations."]

Calculations are crucial to correctly determine the capacity and size of the ventilation and filtration (HVAC) system elements.

For duct and pipe systems, Stabicad can automatically calculate flow rates, velocity and pressure drops. This helps us to select the right sizes of installations to ensure efficient system performance and avoid excessive energy consumption. It even allows us to establish the specific design characteristics such as: dimensioning, shape, length, width and maximum diameter; the maximum and minimum velocity, as well as the maximum pressure drop per metre. The calculation will then automatically find the smallest available size that meets all the criteria and apply it directly to the 3D model.



[Fig. 7 Duct Calculation. "Example of a duct calculation result with Stabicad."]

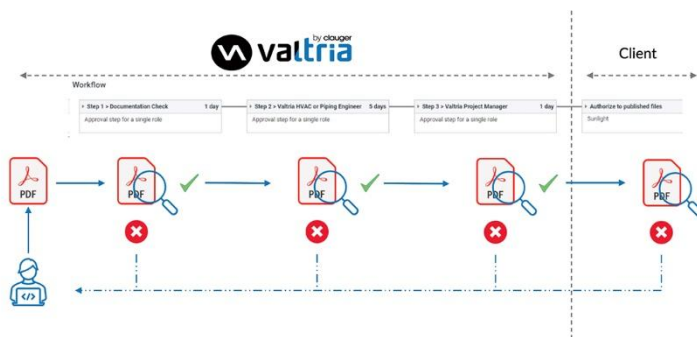
The software supports multiple standards from different European countries, which is ideal when working on international projects. In the case of the British Standards, the calculations are even CIBSE certified, which is an additional guarantee of accuracy and reliability.

However, one of the main advantages of the programme for us is the ability to automatically update calculations and sizes as changes are made to the design. This dynamic capability gives us the assurance that the design will remain accurate and up to date, even when modifications are made.

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

For the team's designers, Stabicad means flexibility, control and the ability to create detailed and accurate MEP designs ready for the construction site. Using 3D software allows us to see everything in a single model, explore complex interfaces between MEP elements and understand the impact of our design decisions. It also improves collaboration and communication with clients by showing them our proposed MEP design in 3D, something that was more difficult with previous 2D drawings.

Another useful tool during this phase is Dalux. This software allows us to involve all stakeholders in the project from the very beginning. Both internally, project managers, site managers and designers, and externally; client, suppliers and other disciplines involved in it.



[Fig. 8 Company-Customer Communication Diagram. "Diagram of how internal-external communication is developed with Dalux."]

This platform allows to have all the technical information, the BIM model and the graphic documentation located in a single location and also to combine the communication channels (e-mails, meetings, etc.), both internal and external. All this facilitates the workflow, as the client only has to focus his efforts on checking and accepting the project, verifying that it meets his needs.

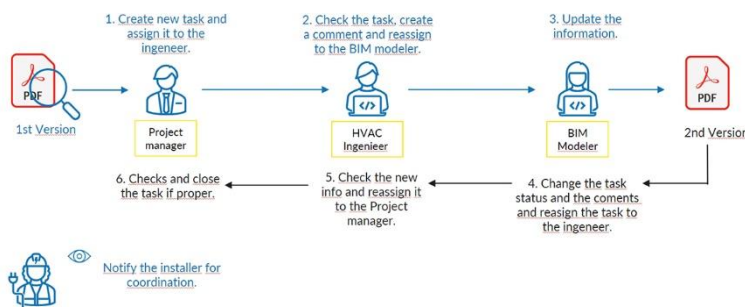
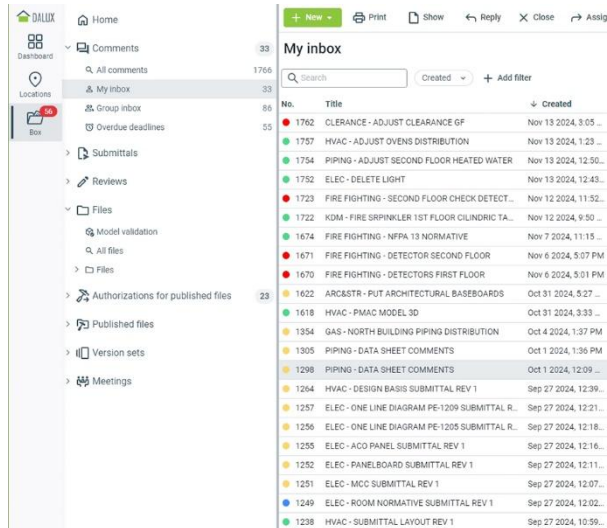


Fig. 9 Internal Approval Phases Diagram. "Example of internal communication channel up to version approval."

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

Within the internal communication, Dalux allows the Valtria team to prioritise tasks, delegate and speed up the review of these more easily, by means of colour codes it is possible to quickly identify the status of the task.



[Fig. 10 Tasks. "Image of the tasks in a project showing the colours associated with the status of the tasks."]

- The advantages of using a variety of complementary BIM tools, such as Revit, Stabicad, Dalux, Dynamo etc., during the design phase, generates a synergy that enhances their feedback. This integration helps us to optimise the efficiency and quality of our projects.

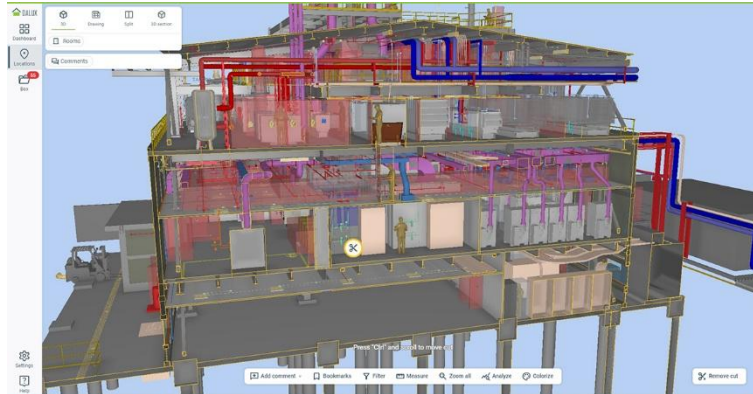
Construction Phase

The end of our journey usually comes with the construction phase, where we continue to take advantage of the synergy between our usual BIM tools, such as Revit, Stabicad and Dalux. During this stage, the continuous updating of our "Digital Twin" becomes an essential task. Each adjustment and modification brings us one step closer to our final goal, ensuring that all details are under control.

With Dalux, site workers can view project documentation from their field location, as well as digitise control, quality and commissioning procedures directly in the mobile application.

Having information accessible to all workers promotes fluid communication between the different teams working on the sites and in the offices.

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.



[Fig. 11 Dalux Interface of a Project. "Project Navigation Screen in Dalux."]

Dalux contains the digital model and the project information, and makes available to the workers the tools that are specific to their role, as part of a real-time, BIM-based collaborative work that works even without an Internet connection.



[Fig. 12 Example view. "Combining 3D model and 2D information in Dalux."]

With the collaboration of our entire team (Site Manager, Project Manager, Design Team, etc.), we ensure smooth project progress, reflecting our commitment to accuracy and quality. We end with the satisfaction of transforming a vision into reality.

4. Operational Phase

Finally, during the lifetime of the installation, we recommend our customers to keep the "Digital Twin" up to date and use it as a reference for cleanroom control and maintenance. To this end, it is already implementing these solutions when required by the customer, using the same software mentioned in the construction phase, including Dalux.

This particular software facilitates the management and monitoring of maintenance tasks, allowing efficient and accurate supervision of all activities, for example, we can include QR codes on the equipment that provide quick and easy information by simply scanning it.

THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

Furthermore, in addition to all the information that has been added to the model during the previous phases, all the control systems of our cleanrooms are registered on this platform and our maintenance operators receive a notification on their mobile phones, which allows them to optimise their functions, identify elements and organise spare parts or materials more easily. This approach ensures that the cleanroom is kept in optimal operational condition, meeting established quality and efficiency standards.



THE NEW BIM ASSISTANTS IN CLEANROOM DESIGN.

[Fig. 13 Maintenance Operator. *"Through Dalux, we have access to the data stored in the model necessary for the proper maintenance and operation of the project."*]

Conclusions

The implementation of BIM tools in every phase of the life cycle of a cleanroom project not only facilitates design and construction, but also optimises communication and coordination between teams, meeting the standards and expectations of clients. This approach allows the *"Digital Twin"* of each project to evolve with the project itself, providing an invaluable resource for future maintenance and management of the space. Thanks to the integration of Revit, Stabicad, Dynamo and other applications, we achieve an efficient workflow, adapted to regulations and with an adjustment capacity that improves the overall performance and the final quality of the project.

Acronyms, Initials and References

BIM: Building Information Modelling

MEP: Mechanical, Electrical, and Plumbing

VCD: Volume Control Damper

HVAC: Heating, Ventilation, and Air Conditioning

ISO 19650: international standard for the integrated management of information throughout the life cycle of a built asset.

Stabicad: Stabicad for Revit is a powerful BIM solution for mechanical and electrical design. <https://mep.trimble.com/en/products/stabicad>

Dynamo: Dynamo is a visual programming tool used to automate tasks and processes within BIM software, such as Revit. <https://dynamobim.org/>

Dalux: Dalux is a project management software programme. <https://www.dalux.com/>