Axis Design Architects is a Birmingham based architect and urban designer firm with a reputation across the West Midlands as a leader in the field of social housing design and construction. We work on projects of all scales; from urban design and master planning, estate and neighbourhood regeneration through to bespoke individual house design. Our services include low energy sustainable design in both new build and retrofit sectors, public consultation and environmental design consultancy. Sustainable design strategies unite all our projects and we offer advice on all aspects of environmentally conscious building design.

The drive to reduce the nation’s housing energy performance and deliver the carbon emission reductions required by 2050 mean that architects must design and build more accurately using techniques that ensure the finished product reliably behaves as expected.

This project – affordable PassivHaus - involved a multi-discipline collaboration between consultants, manufacturers and suppliers to create a Passivhaus compliant pair of houses for the affordable housing sector.

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From the outset the project proposals were modelled extensively in Building Information Modelling software to create a single unified building model to produce drawings and data that could be used throughout the process. The final drawings were created by using an online BIM server allowing consultants to coordinate the building services in unison on a live model.

The design of a PassivHaus standard dwelling requires careful consideration of form, size and orientation from the outset. Although the architect is able ultimately to collaborate with an environmental design specialist to test the building’s performance using the PassivHaus Planning Package spreadsheet, the use of a BIM tool meant that the earliest design decisions could be tested quickly with each iteration of the proposal.

**Energy experiments**

Once the basic footprint of the building had been decided the external shell was created in GRAPHISOFT® ArchiCAD® and a simple arrangement of windows and doors were placed in the model. By using the data provided in ArchiCAD’s window schedule tool we were able to quickly confirm and then adjust the glazing areas for a number of variations based on recommended ranges as a percentage of the floor area. The fully integrated nature of GRAPHISOFT EcoDesigner™ then allowed us to model the solar gain changes against cooling demand losses for each variation. Although the specification for the house was incomplete, the figures could be used to make relative comparisons even at this very early stage. Extracting the data as a spreadsheet allowed us to visualise the relationship between net gains and losses over the course of a year as the glazing area increased, confirming the total glazing target we should be mindful of as we completed the detailed design.

**Design development**

Progressing with the internal layout for each house type was rapid because of the application of composite wall constructions, library parts and zone measurement tools. These enabled us to ensure we had correctly applied the necessary space standards demanded by the affordable housing sector. Working at a scale of 1:100 initially kept the drawing process efficient whilst testing the primary layout constraints. The time invested in this stage was not wasted as the scale sensitive performance of junctions, hatch patterns and objects meant that the same information could be used in the later stages for construction information without the need for a redraw.

**Construction considerations**

With the superstructure complete it was now possible to apply wall construction build-ups quickly using the composite element build-up to apply each material layer to plans and sections simultaneously. Smart cavity closer and reveal settings were adjusted to quickly redraw the finishes detailing around openings and the complex profile tool allowed the completion of slab and wall edge details that accurately reflected the insulation strategy around the building. With each construction build-up in place it was then possible to extract a full energy performance report from EcoDesigner and produce detailed material schedules for use by the Quantity Surveyor in their cost assessment.

**Services strategy**

The final stage of the design process required the integration of the mechanical services into the building. Rather then apply this information in 2D only using the standard symbol notation, the hot water system and mechanical ventilation install was fully modelled to test for clashes with the structure or complications with the siting of products. This work was also completed in unison between two team members working on the same model remotely using ArchiCAD’s Teamwork Server function from two different locations. This allowed the MEP Modeling software used by one consultant to be co-ordinated dynamically into the architectural model with the results being discussed instantly by us and the consultant using the in-built messaging system. Careful control of the layer protocol and rendering options allowed us to share the outcome with the whole team with clear 3D imagery showing the finished installation in place.

**PassivHaus package**

The final outcome was a fully detailed model containing all the data needed to support each consultant's needs. The finished product has allowed us to share our research in a clear, accurate graphical format with confidence in not only the appearance of the building but also the performance - a crucial requirement for the future of housing design. For up to date information on the Affordable PassivHaus project refer to http://affordablepassivhaus.info/