Hereford archive Chooses Passive Preservation
Safeguarding historic documents and other artefacts requires stable building conditions. Until now this was usually achieved with the expensive and energy-hogging use of heating and cooling equipment, but a new approach by Herefordshire Council used the passive house approach to conserve energy, money — and the county’s precious historical archives.

Words: Kate de Selincourt

With its ancient black-and-white cottages, and medieval churches and barns, Herefordshire is a county packed with history — and to match that, extensive archives on paper, wood and cloth. Its collection includes medieval maps and manuscripts, paintings, sculptures, even Anglo-Saxon construction timbers, plus “an awful lot of newspapers”.

A few years ago, Herefordshire Council realised it had a problem. Its archive accommodation was not up to the standards needed to preserve the contents safely. It would have to build a new repository that met the standard required, or the entire collection would go out of the county and be archived elsewhere.

But an archive building does not come cheap. Arts Council England recently suggested the build cost of a public archive is around £3,600 per square metre. Nonetheless, Herefordshire set about procuring a building that would meet the required climate control standards, within the tightest budget possible.

Passive house design specialists Architype were approached to submit a design for the building, which would include a repository for the collection plus offices, labs and exhibition areas. The firm teamed up with passive house specialists Nick Grant and Alan Clarke and — along with Kier Construction and E3 engineers later in the process — they investigated what could be achieved.

The materials in an archive require stable conditions – not too warm, not too cold, not too dry and in particular, not too damp. Temperatures should be between 14C and 19C, and relative humidity close to 50%.

There are not many days of the year when these are the outdoor conditions, so modern archives tend to feature heating for the winter and cooling in summer, and both de- and re-humidification equipment, all controlled by a building management system.

However, there can be problems with this arrangement. As lead architect Mark Barry recalls: “We looked at some critically acclaimed archives, and we found out that not only had they been expensive to build, they also used a huge amount of energy and so were really expensive to run — some had bills in the order of £80,000 to £100,000 a year.

“Speaking to the facilities managers we found many had problems, such as plant running high too often. Sometimes repositories were even having to be emptied because they got too warm.”

Nick Grant believes that problems like this are inherent in complex building services set-ups. “The more complexity you have, the more chance there is of unforeseen effects and gremlins. Weird stuff happens; even when a building appeared to be working perfectly when it was commissioned, the conditions change, and something unforeseen kicks in,” he says.

In the light of these problems, combined with the very constrained budget, Architype and their colleagues went back to first principles to rethink everything from scratch. By good fortune, at around the same time the British Standards Institution (BSI) published its new guidance on archive storage facilities. Although the basic temperature and humidity requirements were unaltered, there was a new acknowledgement of the need to save energy, and a fresh insight that it was not necessarily a fixed optimum point that was important, but protection from sudden changes in conditions.

(below) the contents of the archives should provide ample buffering to ensure there are not unwanted swings in humidity, but by adding the conditioning the air in the archive can be directly controlled as well
And this is exactly what you see in a passive building: the airtight fabric and high levels of thermal insulation keep the inside isolated from the vagaries of outside conditions — just what is required in a repository.

Some initial calculations were done by Nick Grant, who modelled conditions in a notional repository: a reasonably large three-storey, highly insulated, highly airtight box. "Looking at weather data and assuming a small amount of heating to keep temperature above 14C, we found that on average, the conditions would even out to those that were required: the slightly more humid air in summer would be balanced by drier air in winter," he says.

Nick also drew inspiration from another building physics expert. "Tim Padfield’s analysis suggests that because of the large buffering capacity of the building and even more so, the archive itself, and the storage boxes, the stored material would stay safely within the parameters required," he says.

These initial calculations convinced the team that the passive house approach would be the right one for Herefordshire’s new archives, and a
proposal began to take shape. Although archival records, like human occupants, enjoy the steady temperatures that passive house design can offer, there are important differences.

In a passive house occupied by people, there is a high ventilation rate – to remove the high quantities of moisture and pollutants generated by people doing people things. Hence the use of MVHR units that can pre-filter the air, recover the heat, and replace polluted air with filtered fresh air at a comfortable temperature. By contrast, an archive produces virtually no pollution, and is only visited occasionally to store and retrieve documents. So very little ventilation is needed, which means the influence of external conditions can be minimised too.

The team was confident that with their experience of designing to the passive house standard, they could build an extremely airtight building, and use the minimal fresh air requirement to slightly pressurise it with filtered air. This would virtually eliminate uncontrolled infiltration —

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and hence minimise the need to remove any heat, cold or moisture that outside air would bring in.

This approach is strongly endorsed in the new BSI guidance. As Architrype’s Mark Barry explains, this advice grew out of the experience of the archives inspectorate, which monitors a lot of archive buildings and observed that more thermally massive and airtight buildings (often the older ones) are a lot more stable, and give a much longer safety margin if plant malfunctions. The guidance underlines the importance of airtightness, and as M&E lead Andy Jarvis of E3 explains: “Airtightness was a critical part of the strategy, and we achieved an airtightness of 0.35 asch at 50 Pascals over the whole building.”

Close teamwork between the design team and contractor Kier, to deliver such a tight building, was a pleasure, Nick Grant recalls: “This was a real two-way process that moved everyone’s knowledge forward. Project manager Jeremy Mann rose to the challenge and achieved an outstanding result, often rolling up his sleeves to do some of the more fiddly details himself.”

Alongside the complexity, another problem found in many archive buildings is heat leaking into the archive rooms from adjacent spaces occupied by staff and public visitors.

As Architrype’s Mark Barry observes: “You can get separate bits of conditioning plant in adjacent parts of the building basically fighting each other: if archives and office spaces are not thermally completely separated, you get the cooling system fighting to cool one part of the building, with the heating next door fighting to warm it up the other side of the wall, and this spirals until both plants are going flat out. No wonder the bills get so high.”

This situation can be exacerbated because it is common for archive buildings to devote an entire floor at street level to offices and public spaces. Isolating one storey of a building thermally from another – especially if there is a heavy structure higher up – is extremely difficult, because of the need for a strong structure to pass right up through the building. But in Hereford, the team proposed to tackle this very simply – by placing the two parts of the building side-by-side, with a fully insulated cavity between, allowing them to operate independently.

The temperature in a passive house does change noticeably in response to the sun: and this tends to be welcomed in winter, though sometimes solar gain is limited by shading in summer. However an archive is really a lot better off kept cool, and this spirals until both plants are going flat out. No wonder the bills get so high.”

“It also nods towards the ability for conditions to move alongside seasonal changes, allowing the conditions to float within a band. It’s a more flexible approach, and was a key element in allowing the client and the team to think how spaces would work seasonally, rather than seeking rigid all year round control.”

However as this building is — we believe — the first public archive to be designed and built to these new standards, the team also undertook extensive modelling: “We analysed the design under a huge range of parameters,” Andy Jarvis recalls, putting it though its virtual paces across all kinds of conditions. “The building is meant to last a very long time, so we modelled its behaviour against London climate data as well as Hereford’s, to simulate its behaviour in a changing climate.”

Although everyone was keen to understand the figures, the passive house approach also chimed with the archivists’ own experience. “It was great to have the archivists as part of the team; they gave valuable inputs from their experiences with other buildings,” Andy Jarvis says. “They appreciated the benefits of a more passive approach, having had experience with more complicated systems.”

As a result of the modelling E3 added the capacity to cool and dehumidify the minimal amount of supply air, so that internal conditions would stay on target during a hot humid summer.

“...we believe that the contents of the archives will provide ample buffering to ensure there are not unwanted swings in humidity, but by adding the conditioning we can directly control the air in the archive as well, to give additional reassurance to the client,” says Nick Grant.

The small amount of heat required in winter (around 1kW to each floor) is provided via air which is recirculated through small air handling units, keeping plumbing out of the archive storage rooms. Recirculation was used because the fresh air ventilation rate required is too...
small to deliver sufficient heat, and minimal ventilation is key to the stability of the interior. At the front of the building, thermally separate from the archive, are the new offices, exhibition spaces and conservation labs. Built by Irish timber frame manufacturer Cygnum – whose work on Architype’s passive house projects includes the Oak Meadow & Wilkinson schools, and the forthcoming UEA Enterprise Centre – this part of the building is clad in lime render, and there is also generous glazing to make the most of the views outside, with shading above each run of glass to minimise summer overheating. Manually openable louvred lights with insect mesh allow for natural ventilation in hot weather, while a gas boiler also heats this space via radiators.

The repository itself is basically a big concrete box, but Architype wanted the occupied part of the building to look softer and more attractive. “We found that a vertical cedar shingle cladding was pretty much the cheapest of the options we looked at. It’s a beautiful material, and will be slowly weathering down to silver,” Mark Barry says. The whole team is now enthusiastic about putting their experience in designing the archive into practice elsewhere, and perhaps making an even simpler building next time: “Our experience with passive house is each time we revisit a basic design type, things have got simpler and better,” Nick Grant says. “We were able to do this with the schools, so hopefully if we get the chance to design another archive, it will be even simpler.”

Andy Jarvis now wants to take this approach to archive design forward: “The new guidance and passive house have come together and led to a new way of doing this, it’s definitely the way to do it in the future.” Herefordshire has effectively led the way, he believes. “I think this is great for the client because they were in a difficult position, struggling financially, but they stuck with it, and now they have something they can show off.”

**Selected Project Details**

**Client:** Herefordshire Council  
**Architect:** Architype  
**M&E engineer:** E3 Consulting Engineers  
**Contractor:** Kier Group  
**Civil & structural engineering:** Eastwood & Partners  
**Energy consultant:** Elemental Solutions  
**Energy consultant:** Alan Clarke  
**Project manager:** EC Harris  
**M&E contractor:** Axion Building Services  
**Airtightness tester:** HRS Services  
**Timber frame:** Cygnum  
**Cellulose insulation:** Warmcel  
**Cellulose insulation installer:** PVC Insulation  
**Floor insulation:** Jabfloor  
**Airtightness products:** ProClima & Siga  
**Windows, doors & curtain walling:** Pacegrade  
**Roof windows:** DHS Ltd  
**Cladding supplier:** M Camilleri & Sons  
**Screeds:** Avo randomly  
**Sheathing boards:** Warren Insulation Ltd  
**Plasterboard:** Gyproc  
**Ventilation:** GEA Heat Exchangers Ltd  
**Condensing boilers:** Vaillant

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