SCOTTISH EPISCOPAL CHURCH

Guidance on the Appropriateness of Insulation of Church Buildings

Introduction

Energy efficiency improvement is the first of the core objectives in the SEC Net Zero Action Plan. The question as to how to improve thermal insulation efficiency in church buildings and churches themselves, is extremely difficult. Due to the variations and diversity of them in age, design and fabric, it is impossible to find one particular solution. One size does **not** fit all.

Churches built hundreds of years ago vary so much as compared with those built in the 20th century with modern materials and design. So rather than attempting to provide detailed advice on insulation, three case studies are given covering a church hall, a 19th century church and a relatively modern church to illustrate the range of factors to be considered in addition to the choice of insulation.

When considering insulation, it is important to take into account the particular circumstances around the building. These include:

1. Usage – Time-frame – hourly/ day/ night/ 7days/ seasons
2. Type of usage – what activities
3. Occupancy – number of people/ age of people
4. Availability of utilities – electricity, gas, water, heat pumps, land, aspect of sun orientation etc
5. Building fabric – thermal efficiency

All too often people jump to the conclusion that energy efficiency is about technology, gadgets, mechanical devices, boilers, batteries, low energy light bulbs and solar panels - all good stuff but the big gains to be grasped first are often to be found in maintenance and repair: damp building fabric conducts heat faster than dry fabric. The biggest source of heat loss in buildings is often air infiltration and draughts and so consideration of the relationship between good ventilation to keep things dry and insulating parts of the building is important. Useful information can be found in the Net Zero Cards.

The case studies presented later illustrate that many aspects have to be considered together to arrive at a solution that is right for that particular building at that time.

Innovation in insulation

Getting insulation wrong can cause more problems than it solves. All activity in a building generates moisture and water vapour. Managing how this is handled and avoiding it condensing on cold surfaces, perhaps deep in the fabric of the building, is important as it can cause much worse problems than it solves.

The options for upgrading traditionally constructed buildings are often limited. Stone walls lined with timber "strapping" and lath and plaster have long been thought of as impossible to upgrade without ripping out finishes. Quite apart from the aesthetics of swapping historic finishes for modern ones, when we are trying to achieve Net Zero by reducing our reliance on fossil fuels it is important to utilise as far as possible materials that already contain embodied carbon.

A relatively new but well tested option that is receiving attention is the injection of vapour permeable foam between strapping/lath and plaster and stone walls. This has become a contentious subject because of fears raised caused by the (inappropriate) use of closed cell insulating foam and poorly trained and regulated installers. Correctly used, however, this approach can deliver beneficial results. Historic Environment Scotland has published a short guide that gives a range of types of material that can be used.

Implementation.

A first step should be to arrange for a **third**-party organisation to carry out an energy audit/assessment. The Net Zero Action Plan and associated Net Zero Toolkit identifies that, at present, Business Energy Scotland offer a free energy assessment audit for which most charges will qualify.

Following the audit/assessment It is best to seek professional independent advice before implementing any changes as adding insulation or changing insulation and so changing the heating/cooling can alter a buildings fabric and air space performance. A competent quinquennial surveyor should be able to point the Vestry in the direction of appropriate professional help on retrofit options. The quinquennial architect or surveyor should, perhaps, be the default source of guidance on the "Fabric First" approach for maintenance and repair and on how to select a design team to explore and implement upgrading works, if no-one else is appointed.

Funding the work needed to undertake the relevant work is often seen as a significant barrier. The Net Zero Action Plan identifies sources of government funding and makes proposals for funding to be made available from diocesan and provincial funds. Advice should be available from the Diocesan Buildings Committee, Diocesan Environment/Net Zero Group and the proposed provincial Net Zero team.

Provincial Buildings Committee
November 2023

Case Studies

Three case studies are presented illustrative of issues that can be encountered. Two have been anonymised but are based on actual buildings - one being a typical 19th century church, the other a modern building.

1. Church Hall - St Peter's, Lutton Place, Edinburgh

Windows

At St Peter's Church Hall, Lutton Place Edinburgh the steel windows dating from 1937 were in a poor state. The sashes were gummed up with paint and silicon sealant, but they were draughty and their rough single glazing created a gloomy, depressing interior. Being part of an A Listed complex the options were to replace them with new high performing steel windows at eye-watering expense or accept a lower but nevertheless improved standard of insulation by refurbishing them and reglazing with slim double glazing.

In the course of the work it was necessary to remove the old glass before working on the frames. To keep the building secure ply shutters were erected. The refurbishment of the steel windows with heatguns and much scraping and wire brushing followed by painting, brought the windows back to perfect working order and the double glazing finished the job leaving the windows looking "as new".

The temporary shutters triggered a new thought - why not fit permanent shutters so as to improve their thermal performance better and to enable the Hall to be blacked out for showing films and perhaps, sometimes, to reduce noise disturbance to the neighbours? The shutters, in combination with the double glazing, have probably brought the windows up to the thermal performance of new steel windows (which incorporate thermal breaks), at a fraction of the cost.

Upgrading walls and ceilings

The walls of the 1937 St Peter's Church Hall are of brick cavity construction, harled externally and were lined with a very thin softboard lining. Various options were considered for upgrading them. Cavity foam insulation (such as polystyrene beads) were a possibility but on one side of the hall the ground is well above floor level and filling the cavity would have potentially drawn damp into the building. This would, at best, result in a hybrid system. After much thought it was decided to insulate the walls by relining them with woodfibre insulation which, although not the highest performing insulating material on the market, has impeccable "green" credentials in terms of its manufacture and is also very good at handling the vapour load in a building - in effect it "breathes". This material is applied direct to the walls after levelling them off with a coating of lime plaster.

The ceiling/roof presented other problems. The rather utilitarian and very grimy "drill hall"-style steel roof trusses were festooned with various ages of ugly lighting. It would add to the general decline of their appearance to embed the top member of the trusses in insulation. A dramatic scheme had been proposed to encase the trusses and to form decorative cut outs. This would conceal the lighting as well as the trusses. After a lot of careful thought this scheme was dropped in favour of a much lower cost option - insulating the underside of the roof with more woodfibre insulation between the timber purlins and finishing the lining in its original position. This left the trusses whole. A lighting consultant was employed to devise a lighting scheme that would neatly complement the trusses and the decision was made to have lighting the colour of which could be changed.

Once again, a balance has been struck between thermal performance, appearance, and cost.

Heating

The existing heating system in St Peter's Church Hall consisted of very tatty looking tubular electric heaters protected by roughly constructed slatted timber benches. It was a widely held view that these 1937 veterans were well past it. However, when tested by an electrician they proved to be perfectly good. They just looked awful.

Consideration was given to various heating options: connecting the Hall to the gas fired boilers in the Church and running a new wet pipe heating system seemed an obvious choice until it was realised that it would be cheaper and more efficient to provide the Hall with its own gas boiler. But what would the best form of heating be? Radiators would mean the end of the much-loved bench seating. Under floor heating would mean renewing the timber floor about which there were conflicting opinions. Would it be right to use gas? Would a heat pump be more in accordance with the, then as yet unstated, Net Zero objective.?

Given the intermittent heating requirement in the Hall and the Net Zero aspiration and the fact that the timber floor would need to be replaced at a considerable embodied carbon "cost", what was wrong with the 1937 tubular electric heaters? Once they were thoroughly rubbed down and repainted and protected by smart new seating the decision to retain the heaters feels right. The 1937 tubular heaters look like new! However, this is something that can be revisited in time to come. In the meantime, the lightly sanded and varnished Hall floor is also playing its part in the (economically) revitalised Hall. A further refinement has now been added to this: a smart controller that enables the heating to be turned on and off remotely using a mobile phone app which suits the way in which St Peter's manages their buildings.

2. 19th century Church with later addition of a Hall

This building consists of a typical 19th century church with a choir vestry, rector's Vestry, toilets, kitchen, and a church hall which was a later addition. All are connected. The rectory is a new house on a modern estate and meets current standards of heating and insulation.

Church and Ancillary Buildings

Floor – Mixture of flagstone and tongue and groove pitch pine flooring with a carpet covering in places. Solum ventilated.

Walls – Solid dressed and random sandstone, stone rubble infill and painted solid plaster on the hard for the internal finish.

Roofs – dark stained timber exposed slatted timber and wooden structure in the church and elsewhere it is fibreboard/plasterboard painted ceilings with void above structure with sarking and 40-degree slope or thereabouts on interconnecting roofs finished with slate, felt and sarking boards. Asphalt finished flat roof above the toilets.

Windows – single glazed certain leaded on metal frames. Grille protection on the outside.

Doors – existing solid timber doors painted and/or stained.

Heating –Church heating is by electric radiant bar fires at 3m above floor and spaced along wall. Electric tubular heaters at floor level along every second row of pews, warm air electric curtain heating above entrance/exit door which acts as a "greeting heat".

Church Hall

Built in the early 1960s, it was built with modern and competitively priced materials. Developed on what appears to be a tight budget in today's standards.

Floor – Sprung timber tongue and groove flooring on timber joists of dwarf brick walls with vented solum.

Walls – Prefinished precast concrete wall panels from floor to wall head built off poor quality calcium silicate brick external wall from floor to ground which was prone to spall. Inner wall finish fibreboard painted on grounds.

Roof – timber prefabricated fink trusses with shallow pitch. Minimum fibre insulation in void with fibreboard ceiling finish taped and painted. Originally timber shingles on sarking finish.

Windows – Timber single glazed opening hoppers.

Doors – solid timber painted/ stained.

Heating – Gas fire boiler with radiators in hall, toilets, kitchen. Electric water heaters local to appliances.

Ventilation – mechanical extract through window in kitchen. Opening hoppers elsewhere.

Examples to improve insulation.

a. **Church and ancillary buildings/ facilities**

- Door seals and draft weatherbars fitted to all doors.
- Insulate u/floor in solum timber flooring where available.
- Secondary polycarbonate glazing internally/ alternative shutters/ curtains.
- Roof area paddle fans to ensure any rising warm air is redirected downwards.
- Replace more efficient infra radiant heaters.

b. **Church Hall**

- Insulation to be fitted under timber floor where access is possible.

- New inner leaf of structural stud wall to be packed with fibreglass batt insulation.
- Double glazed PVC windows replace failing original timber single glazed units.
- Additional insulation quilt to be to the roof void at ceiling level.

3. 1960's Church and Ancillary Buildings

The Church development consists of Church, Lady Chapel, Hall, Office. Choir Vestry, Rector's Vestry, Large Narthex, Toilets, Tea Kitchen. There is no longer a rectory.

Church, Chapel, Church Hall and Ancillary Buildings

Floors – Reinforced concrete slab throughout except the church hall with a suspended tongue and groove timber hardwood floor. Terrazzo finish in church and chapel part carpet covered with linoleum cover elsewhere.

External Walls – Cavity construction in poor calcium silicate brickwork spalling with some walls rendered/ dry dash finish. Internal leaf exposed facing brick in church/ chapel. Plaster on brickwork/ block elsewhere.

Ceiling /roof – Church /chapel external roof finish was copper with standing seams, Failed and replaced with alternative metal roof over the two vast mono pitched segments on main roof main roof. Internal finish is tongue and groove stained /varnished pine slatted underside with exposed structure in solid posts and beams. Rafters are formed in a compressed glulam structure. Elsewhere everything is a flat structure with felt roofs covered in liquid asphalt. Structure is made up using Stramit (straw board) and with the roof leaking in many places over the years, the structural integrity is questionable. Internal finish is plasterboard.

Windows – Extensive full height single storey timber single glazed windows along the wall of the narthex and similarly 1.5 storey height on majority of one wall of hall. Same storey height on the two gable ends of the church. Elsewhere clerestory single glazing. All the above on failing timber framing.

Doors – External doors solid timber including fire escapes.

Heating – All electric site and no gas available. Church, chapel and narthex have radiant/ convected panel heaters. In the church and chapel additional high level infra-red high level radiant panels are fitted. In all other areas radiant convected wall panels fitted. High level warm air curtain over fire exit door fitted.

Ventilation – Mechanical extract ventilation only in internal toilets and tea preparation area.

Examples to improve insulation.

a. Church and Lady Chapel

- Inject proprietary cavity wall insulation.

- All windows and frames including screens to be replaced with double glazed metal/ pvc/ timber.
- Insulated carpeting cover.

b. Ancillary Buildings (Rector’s vestry, Choir vestry, Office, Narthex, Toilets, Tea preparation)

- The existing flat roof construction with the failing Stramit Board (fibreboard) requires re construction giving the opportunity to upgrade insulation to today’s standards.
- Injected cavity wall insulation as in church
- Replace all clerestory timber windows with double glazed units including frames including extensive screening in the narthex.
- Seals on all external door frames and threshold weather bars.

c. Church Hall

- Fit high level suspended ceiling allowing full insulation above new lighting.
- Injected cavity wall insulation once external brick on gable wall is repaired.
- Suspended timber floor with insulated underside.
- Replace existing clerestory single glazed windows with double glazed and frames.
- Replace existing 1.5 full height single glazed screen wall with double glazed framed units.
- Existing fire exit door weather frame and threshold seals.
- Replace ventilation system.