

Benefits to revising the building regulations construction essay



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The world evolves in front of our eyes each and every day. As such our needs as humans are constantly changing and with it new methods and technologies must be developed to continuously meet these standards that we have become accustomed to.

Revisions to the building regulations aim to tighten the building standards and increase the comfort for the inhabitants of new buildings. With the global concern over rising CO2 emissions the explosion of the world's population, it is important to protect what countryside and rural areas we have left. In doing so, tackling the existing stock of buildings and brownfield sites is the only option available to builders in order to meet housing quotas and projected CO2 emission reductions.

This, as important as it may be, comes with several red flags and limitations. Brownfield sites require a number of tests and decontamination measures in order to prepare them for construction. Once the site has been given the green light, providing the building regulations are adhered to, the development will satisfy any building control inspector assigned to the site.

In addition to brownfield sites it is important include the refurbishment of existing buildings when considering the rejuvenation of an area. This more often than not can prove a difficult and complicated task. This is due to a number of issues relating to the age, location and type of building. For example, tenement buildings, Victorian townhouses and Georgian terraced houses, due to their age are more likely to have been built with low building standards and consequently will not meet the thermal requirements of

modern housing. This in turn has a negative effect on the energy rating of these particular type dwellings resulting in exorbitant annual running costs.

This essay aims to address the sustainable building methods that can be adopted in order to refurbish and increase the thermal performance of the run down Camperdown House West Gate-Lodge at Camperdown Country Park in Dundee, Scotland. This is a typical case study, the methods outlined in this essay are relevant to any proposed refurbishments or renovations.

2. 0 Camperdown House West Gate-Lodge, Camperdown Country Park, Dundee, Scotland

2. 1 Building Location and History

As the name suggests, the West Gate-lodge is located at the West gate entrance to Camperdown Country Park in Dundee. Camperdown Country Park is a 400 acre estate surrounding Camperdown House, a neo-classical house built in 1828 for Robert Dundas Haldane-Duncan, the 1st earl of Camperdown and the son of Admiral Duncan. The estate is named after the battle of Camperdown where Admiral Duncan triumphed over the Dutch fleet in 1797.

In recent years the running of the park has been taken over by the Dundee City Council who have opened it to the public. It is now home to over 300 animals in Dundee's largest wildlife park and adventure centre. There is also a championship 18 hole golf course situated within the grounds. This course has been described in the national press as being " one of the Magnificent 7 courses in Carnoustie Country".

Figure 2. 1. 1 Camperdown Country Park Entrance Figure 2. 1. 2 Manor House

The West Gate-Lodge itself is a possible remodelling of an earlier 18th century cottage. The building is rectangular on plan with a small porch off the south elevation. There are two off centre windows on each of the long elevations and a door in each of the gables. The roof is slate with decorative overhanging barge boarding. Protruding through the roof at the rear of the building is a tall square chimney stack built into the boundary wall.

The external walls are constructed with random rubble. This is the traditional art of building with stone. It uses stones that are not squared, but are of irregular sizes and bedded on mortar or other suitable bedding material. An inspection of the gate lodge discovered sketching and designs on a stone contained in the external wall.

Further examination discovered that this was part of an old Pictish Stone. Pictish Stones are monumental Stalae (Stone Slab) found in Scotland. They usually signify a burial or tribal / lineage territories. As such any remedial work done on the West Gate-Lodge will have to be undertaken with the utmost care and precision in order to preserve this piece of history.

Image to the left showing approach to West Gate Lodge

Below Left - Side Elevation of West Gate Lodge

Below -Pictish Stone (Not the one found at West Gate Lodge)

2. 2 Refurbishing the Building

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At present the building is dilapidated. An external inspection in February 2003 found that the building was vacant and boarded up. Taking this into consideration, the inspectors decided that the building should be categorized as " At Risk".

A number of remedial works would have to be undertaken in order to restore this gate-lodge to its original state (meeting modern up to date regulations). Given that it is a traditional building with substantial historical content it is not permitted to knock the building and rebuild. As such modern refurbishment methods have to be adopted internally to improve the buildings thermal properties all the while preserving the exterior of the building.

The element that this report will focus on is the roof. While all exterior wall, window and door components will need to be updated, I feel that the roof is the most important. It is a buildings first line of defence to the elements and due to the fact that heat rises, a suitably insulated roof can prevent the majority of heat loss in a building.

" A roof with no insulation loses 25% of a buildings heat".

Energy Heritage - A Guide to Improving Energy Efficiency in Traditional and Historic Homes

Figure 2. 2. 1 - Existing Condition of roof at West Gate Lodge, Camperdown Park.

2. 3 The Roof

As part of the external inspection in February 2003 it was noted that the roof was in very bad condition. The majority of the slates were missing, particularly around the chimney stack and the guttering and downpipes were absent. In addition it was noted that the building had been the subject of vandalism.

Another external inspection in February 2010 found that the condition of the building had deteriorated further. The roof had seen the most wear and tear, being battered by the elements over the years since the first inspection had taken its toll. The east pitch of the building had been partially affected, the timber eaves were rotting and the porch above the door on the south elevation was in appalling condition.

The roof was originally constructed in timber and covered with sarking board and finished in natural slate. The sarking board is a sheathing placed beneath the roofing slates to provide thermal mass and prevent the penetration of water. In this case the sarking boards appear to have been eroded when the slates fell away. Any slates still in position on the roof are in poor condition, they are discoloured, worn and at the very end of their life cycle.

A visual inspection has revealed that there are no waterproof or thermal components remaining. The building has been deemed unsafe due to the current state of the roof. This would indicate that a new roof should be at the top of the agenda when assessing any remedial measures for the building.

In order to ensure the traditional integrity of the building remains intact it is paramount that all new finishes match the existing as much as possible.
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Furthermore in keeping with the UK government carbon reduction initiative and the stigma that surrounds a country estate, all work should be carried out sustainably with locally sourced materials and contractors. This not only promotes the building and Camperdown Country Estate but it also has a beneficial effect on the local economy.

2. 4 Upgrading the Existing Roof

After safety the principal idea behind replacing the roof is to seal the building and prevent heat loss. The roof, at present is fundamentally non-existent therefore sealing the building envelope will automatically be an improvement. However, this is not solely the task. Any repairs or replacements must meet all up to date building standards. The aim of this report is to utilise a modern method of construction and show its thermal improvements and advantages over dated construction methods.

With so little of the existing roof at the gate-lodge left undamaged it is difficult to establish an accurate U-Value from when it was fully operational. For the purpose of this report it is assumed that the gate lodge was built using the common construction procedures of the early 1900's. (Please refer to Table below original roof U-Value calculations)

Table 2. 4. 1 - Resistance through the section between the rafters.

Layer

Material

Thickness

(mm)

Thermal Conductivity (W/m. K)

Thermal Resistance (m². K/W)

1

External Surface Resistance

–

–

0.100

2

Natural Slate

7

2.0

0.014

3

Sarking Board

18

0.023

0. 000414

4

Internal Surface Resistance

—

—

0. 100

Total Thermal Resistance – 0. 214414

R1 = 0. 214414

As this construction does not relate to the whole roof it is important to take a U-Value reading of the section through the timber rafters and combine the two readings. This construction relates to approximately 88% of the complete roof. Therefore, a fractional area reading of 88% (F1) of the above reading should be combined with 12% (F2) of the reading obtained from the section through the rafters (Please refer to Table 2. 4. 2) to determine an accurate existing U-Value for the original roof.

Table 2. 4. 2 – Resistance through the section through the rafters.

Layer

Material

Thickness

(mm)

Thermal Conductivity (W/m. K)

Thermal Resistance (m². K/W)

1

External Surface Resistance

—

—

0. 100

2

Natural Slate

7

2. 0

0. 014

3

Sarking Board

18

0. 023

0. 000414

4

Timber Rafters

175

0. 12

0. 021

5

Internal Surface Resistance

—

—

0. 100

Total Thermal Resistance – 0. 235414

$R_2 = 0. 235414$

The formula used to determine the existing U-Value of the existing roof s as follows

$$U = 1 / (F1/R1) + (F2/R2) =$$

$$U = 1 / (0. 88/R1) + (0. 12/R2) = 1 / (0. 88/0. 214414) + 1 / (0. 12/0. 235414)$$

$$1 / 4. 104 + 0. 509 = 0. 2167 \text{ W /m}^2\text{K}$$

Natural Slate Roof Covering

Sarking Board

Timber Rafters

EXTERNAL

AIR

INTERNAL

AIR

Figure 2. 4. 3 Existing Roof Build Up – See Tables Above for U-Value

2. 5 Roofing Materials and Construction

One solution is a new cut roof. A cut roof is a roof that is made up of rafters and joists. Cut roofs are assembled on site by cutting suitable lengths of timber and positing them on the roof. The joists give stability to the overall roof by preventing the rafters pushing outward and providing a ceiling for the floor below. This particular style of roof will mimic the original construction method.

The timber for this should be sourced locally where possible. The rafters should be fixed to a ridge board and birds-mouthed over a 100 x 75mm wall plate fixed to the existing rubble wall. The building span (approx. 5m) indicates that kiln dried ceiling joists 220mm x 50mm at 400mm centres will be required to carry the proposed dead load. Ridge collars, purlins and hangers should also be included where a structural engineer deems necessary.

The roof covering consists of felt or membrane laid on the bare rafters and folded over the fascia board. Timber battens hold the felt in place. A standard roll of felt is 1m in width and the size of the proposed roofing slates will dictate the width between the timber battens. Felt should be laid out one row at a time from the eaves to the ridge. Each row of felt should overlap the previous row to prevent water penetration. The roof should be finished with natural slate to replicate the original as much as possible.

Unless a roof space has been designed or converted to contain a room, it should not be hot. Insulating a roof is for the sole purpose of preventing heat escaping, consequently keeping it within the living spaces of a dwelling. Amendments to Part L of the building regulations state that home owners should upgrade existing buildings loft insulation to a minimum of 200mm. In order to exceed the minimum requirements for thermal insulation, a thickness exceeding 200mm should be installed in the new roof of the gate lodge. This can be achieved by inserting insulation between and over the ceiling joists. The proposed joists for the new roof are 200mm in height, the space between them should be filled with 200mm insulation along with further 100mm insulation over the joists.

For the purpose of this report, specifications and details of “ Knauf Insulation” were used for the basis of the proposed U-Value calculations.

Insulation should be stopped short of the edge / eaves leaving an air gap to prevent condensation. Air can enter and exit the loft space through vents in the soffit board. If condensation forms, the moisture will soak into the timber causing unnecessary damage and subsequent remedial work down the line.

Internally the ceiling should be built up using 12.5mm plasterboard and skimmed. It is also important to take care when insulating around wires and light fixtures, bad workmanship in these areas can cause overheating and fire.

Trusses are an alternative to a cut roof for this type of job. Trusses are fabricated in factories and delivered to site complete and ready to be installed. They are quick and precise but due to the fact that they are factory assembled and transported to site on large trucks they do not possess the same sustainable properties as a site assembled cut roof. Regardless of which roof construction is chosen the insulating method and roof coverings will remain the same.

Table 2. 5. 1 – Resistance through the section through the ceiling joists.

Layer

Material

Thickness

(mm)

Thermal Conductivity (W/m. K)

Thermal Resistance (m². K/W)

1

External Surface Resistance

—

—

0. 040

2

Insulation Over Joists

100

0. 04

0. 014

3

Insulation Between Joists

200

0. 04

0. 000414

4

Plasterboard

12. 5

0. 17

0. 021

5

Internal Surface Resistance

—

—

0.100

Total Thermal Resistance – 0.235414

$R_2 = 0.235414$

2.5 Sustainable Building

The first rule and slogan of sustainable building is “Reduce, Reuse and Recycle”. That theory can be adopted here when replacing the roof with one more thermally efficient.

Firstly the existing roof must be stripped down. In order to do this in as green a manner as possible, the materials should be separated and categorised in groups of recyclables, reusable's and materials for safe disposal. All hazardous material should be identified and dealt with safely at this stage.

The rotting timber can be set aside for recycling. Timber is a very popular recycled material due to its green expression. The timber is scanned with a metal detector to ensure there are no nails before it is re-milled. The most common use of recycled timber is in timber flooring, beams and decking.

The existing natural slates are in poor condition. This is not the end of the world. Reusing existing slates is a common procedure. The slates should be checked for de-lamination, cracks and spalls. Any worn slates free of

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imperfections can be simply turned over and reused. If it is not practical to use these on the main roof, the acceptable recycled slates can be used in the repair of the porch above the door on the south elevation.

Other uses of natural slate include internal slate flooring. This is a decorative and sustainable alternative to tiles bought at your local hardware. Tiles that are too damaged and unusable can be transported to a local quarry where they can be broken down and used as aggregate.

As mentioned previously the timber should be sourced locally where possible. Natural insulations such as mineral wool or thermafleece use renewable and recyclable materials in their construction. These forms of insulation are low embodied and very often readily available locally to the proposed site.

2. 5 Additional Work Required

Admittedly upgrading the thermal properties of the roof alone will not restore the building as a whole to a habitable lodge. Further remedial work and treatment to the inside of the external walls will be required to complete the buildings thermal efficiency.

Firstly the installation and sealing of double or triple glazed windows will fit into the voids the original windows once occupied. Due to the historic nature of the building, the use of UPVC windows is not acceptable. Timber sliding sash windows should be used in an attempt to replicate the originals.

Once the windows have been installed, the inside of the walls should then be treated to improve their ability to resist the loss of heat. This can be done in a number of ways.

One such method is “ Directly Applied Internal Insulation”. This is where insulation sandwiched between a vapour control layer and a slab of plasterboard is fixed directly to the inner leaf of the external wall using continuous plaster ribbons. The vapour control layer prevents any condensation moisture by preventing warm internal air meeting the cold rubble wall.

Another popular method is “ Internal Insulation with Studwork”. This method involves the construction of new timber studs that are fixed back to the existing wall. These studs range in thickness but are usually XXXmm. Similar to stud partitions in new dwellings, the studs are constructed in timber. Rigid insulation is fitted between the vertical stud member and a sheet of plasterboard backed with a vapour control membrane seals the stud. The finished stud is the plastered and the skirting is applied as in a new dwelling. Unlike “ Directly Applied Internal Insulation”, this method is very space consuming. The width of the studs around the room directly reduces the floor area. This means that it may not be suitable for smaller buildings where floor area is minimal.

In both cases it is important that no gaps are left between the insulation in the walls and the proposed new insulation in the roof.

3. 0 Conclusion

Refurbishing existing buildings is a great way to regenerate a community. Existing buildings hold the key to the historical context of an area. Without the preservation of these buildings the study of vernacular architecture would not be important and traditional buildings would be lost through time.

Traditional buildings were often built at a time where building standards were not as important as they are today. This combined with the fact that the building regulations are tightening all the time mean that the majority of traditionally built homes are below standard. This can often mean that prospective home buyers will pass over the opportunity to purchase a piece of history in favour of a new comfort built dwelling.

This essay attempts to outline some of the methods and procedures involved in upgrading a buildings thermal performance in an attempt to reach the building regulations minimum requirements. When these practices are adopted in a sustainable manor, the financial as well as the environmental savings can be seen by the homeowner.

In short, a well insulated home will have significantly lower annual running costs than most traditional buildings. These buildings are often grand and decorative externally but leave a lot to be desired internally. This essay has shown that with careful and educated insulation solutions, traditionally constructed buildings can match and in some cases exceed the minimum building requirements set out for new buildings, providing a pleasant and homely living atmosphere for the occupants.

In order to achieve the government targets for lower CO2 emissions it is vital that we adopt methods and practices of this nature and implement them into everyday building techniques.