ART504

Case Studies & Regional Work:

New Futures

Part 2

Repair Strategy

Of

WHITCHURCH HOSPITAL

formerly

Cardiff City Asylum

CONTENTS

Aim of the Repair Strategy

This repair strategy focuses primarily on roofs and is approached in two parts; firstly, reactive repairs, these works are to halt ongoing decay, deterioration and include repairs to damaged roofs etc where moisture ingress is currently being experienced. As part of these works, site security is to be included, as much of the current damage present to much of the site is a direct result of vandalism in various forms (Adams, 2020).

Secondly a programme of repairs that incorporates the end use, these will include improvements to fabric and services as required.

As with all repairs reactive and programmed, the fabric of the building, history and significance should be kept at the forefront of all works and interventions (BSI , 2013). The strategy should aim to be sympathetic and work with the building and its construction materials and structure. Works should aim to work for both the historic building, its historic value and importance as well as being fully functional for the intended end use (CADW, 2011). All repairs are to be evaluated with these perspectives in mind. The aim is to produce a sustainable use for the building that retains its architectural and cultural significance through use and ongoing maintenance.

Building Context / History

Brief overview:

Built 1902 to 1908; officially opening 15 April 1908; originally known as 'Cardiff Lunatic Asylum' and later as 'Cardiff City Mental Hospital'. Architects Messrs Oatley and Skinner of Bristol. Building amongst most modern of its period, having provision for latest treatment methods, incorporating a large recreation hall, bakery, kitchen, boiler house and own fire station.

Taken over by military 1914 - 1919 as 'Welsh Metropolitan War Hospital' (refurbished following war), and again during Second World War as 'Whitchurch Emergency Hospital'. The hospital was taken over by Ministry of Health in July 1948. The hospital continued to be well-used throughout the 1960s and '70s, even though many were now questioning the viability of large, outmoded institutions such as this. A phased closure of the hospital began in 2015 with the last patients leaving the site in April 2016. Non patient services remained onsite till early 2017 when the doors were locked for the final time. (Thomas, n.d.)

Current Condition

With Reference to ART504 Case Studies & Regional Work: New Futures Part 1, Condition Appraisal of WHITCHURCH HOSPITAL formerly Cardiff City Asylum, dated 13/01/2020.

“The front elevation and entrance are constructed of bathstone, decoration briefly consists of bathstone pillars and capitals, cornices, open pediment etc, the remaining front façade uses ashlar bathstone with red brick side elevations. The remaining structure behind the front façade is built of red brick and buff bandings. A water tower and chimney are constructed with red brick, the water tower having Portland stone cornices and dentils etc. Roofs are generally pitched, and slate covered except for the water tower being domed and copper covered. Several additional roofs are covered in corrugated steel sheets and temporary covers. The layout follows a broad arrow plan/ echelon plan, which allows main administration through the centre and wards and corridors spreading out from this.” (Authors Own, 2020)

Proposed End Use

The proposed end use is as a community/business hub. The scale of the building makes using it for a single purpose only, complicated and wasteful as the various spaces around the site are of a selection of small, medium and large scale rooms together with several large open areas (halls and stores etc) including irregular shapes room with difficult access to several areas . In addition to this, plant rooms and service areas are of considerable size and not a good use of space considering todays modern services. The building could be planned to solely accommodate businesses of varying sizes however, this not only would remove the building from public access but also the potential of the site, is that it could feasibly accommodate multiple uses. This would create a group of facilities for the community whilst providing valuable business spaces for SME's with the benefit of raising much needed revenue.

Potential uses

- History Interpretation Centre combined small scale museum, documenting the buildings history and the wider community's historical past. This will retain the photographs, documents, exhibits and archives including the Whitchurch Historical society works. Ongoing live archives would be incorporated into the centre and include ongoing change.
- Dedicated services built around youth engagement, career advice and living assistance.
- Senior drop-in centre, with services ranging from a meeting place, activities, living assistance and advice.
- Incorporated into the area for all, a range of facilities from education and training, assistance with finances and living requirements.
- A community health unit to take the strain off local services or offer a more personalised service or particular requirements.
- A business hub for small and medium businesses, this ranging from head offices through to small start up businesses. Perhaps combined with partnerships for example Business Wales, with provision for assistance for start-up businesses (Bussiness Wales , 2020). Businesses will be zoned into areas dependant on their requirements and impact on the surroundings i.e. architectural practices, offices, etc where the requirement for relative peace and quiet are required will be respectfully distanced from craft based and media-based businesses.
- A creche, particularly for users of the business hub and working families.
- As the range of uses will bring a variety of people together, services will be required, café's, restaurants, coffee shops, small newsagents, grocery and a Post office in particular as these are being vastly reduced across the country (Politics.co.uk, 2020). "*The Post Office also provides a vital infrastructure for small businesses with over half visiting a branch each week"* (Politics.co.uk, 2020).
- Sports areas and even swimming facilities, both used by public and resident business users. Busy professionals lacking the free time to allocate time for this outside the working day may find this possible during the working day.
- Small community shops, locally grown, even a city farm, gardens if not on a permanent basis perhaps on weekly, very much like the once weekly markets.
- To create sustainable services i.e. electric, heating, communication etc, a range of sustainable sources are to be utilised to create a centre for alternative technology with emphasis on sustainable and renewable. Perhaps incorporating many of the existing provisions within the building… Boiler room and distribution, water tower and ventilation towers. Solar and thermal, ground source heat to contribute to the main source. Combining the best of Victorian innovation with today's technology.

Approaches to Repair, Renewal and or Alteration

This approach has been taken with the guidance of CADW, Historic England, Historic Scotland and SPAB.

> "*repairs should be the minimum necessary to stabilise and conserve the building both for its long-term survival and to meet the needs of continuing use".* (CADW, 2017)

1. Prior to carrying out any repairs firstly an understanding of the buildings structure should be sought, this should include the overall design, each building component and the characteristics of those component parts. These works should also include any and all changes throughout the life of the building, noting how these works have been carried out and how they have impacted on the overall structure of the building. This will help guide future decisions regarding materials and future changes.

2. Structural problems should be recorded and monitored through the course of works if part of planned repairs. Structural problems that impact upon the performance of the building, fabric or safety should be prioritized and made stable, and repaired prior to any adaptions or further repairs are carried out.

3. An understanding of the current condition of the building will enable an overview of priorities, risks and works phases. This will ensure that historic building fabric is not compromised during the various stages of repair and adaptions.

4. Understanding the overall buildings performance and each building element will determine the characteristics of each material and better inform the repair methods and techniques of future works. This is particularly important as traditional building materials and finishes behave in a completely different way to today's modern building materials and techniques. Where traditional construction aims to work with elements allowing for small amounts of movement, wetting and drying, vapour permeability and air circulation, in contrast modern buildings are rigid, impervious to moisture and airtight. The merging of these differing approaches often leads to disastrous consequences.

   (CADW, 2011) (Historic England, 2020) (Historic Environment Scotland, n.d.) (SPAB, 2017)

Devising a repair strategy

____

This overview approach to the repair strategy should be read in conjunction with Appendix A (Devising a repair strategy).

Collate a comprehensive diagnosis of all deterioration and the attributing causes;

> This will include the buildings history to enable context and highlight periods of change and or neglect.
> Materials, and construction, expected lifespan etc.
> Maintenance pre and post closure.
> Vandalism.

Determine the objectives of repair and any constraints that require consideration;

> Listing, significance, adaptions, access, maintenance.

Prioritise repairs;

> Reactive - due to sudden damage, neglected failures and vandalism etc.
>
> Planned – Repairs that will be required as part of ongoing maintenance or where reactive repairs have to be made part of a long-term strategy.

Determine the conservation objectives;

> Legislation, Roof-scape, Material performance, Regulations (compromise).
>
> Building – Construction and materials historic value.
>
> Materials – Traditional materials and properties to ensure compatibility.
>
> Adaption process – Working with the building first and foremost.

Resources;

> Financial – to ensure the works are appropriate and not compromised.
>
> Materials – Proven Materials.
>
> Skills – In traditional roofing techniques including lead work.

Explore the various options and implications available prior to committing to a plan;

> Implications in regard cost including future maintenance costs – Reversibility.
>
> Incorporating services or adapting to improve performance – Inherent defects or thermal improvements.

Impact upon the building and its significance;

> All works aim to not damage or compromise the existing.

Prioritize works in order to create repetition or unnecessary cost or loss of significance;

> Thermally improve whilst roof repairs are being carried out.

Area of Focus

____

Roofs

Repair

Note: Whilst externally, roofs are generally pitched except for several flat roofs and the domed water tower, the construction of the various roofs differs significantly. The majority are of timber cut roof construction, several being wrought iron and steel framed construction incorporating decorative detail supported off of corbels.

Several roofs being flat, the construction of these are undetermined however these are later additions and assumptions here have been made, these are believed to be generally timber framed with timber over boarding and bituminous felt weather protection.

Incorporated into several areas are several reinforced concrete fire-proof ceilings, these again would require a full investigation whilst access is available particularly from above.

Throughout various locations, roof lanterns and ventilation cupolas are installed.

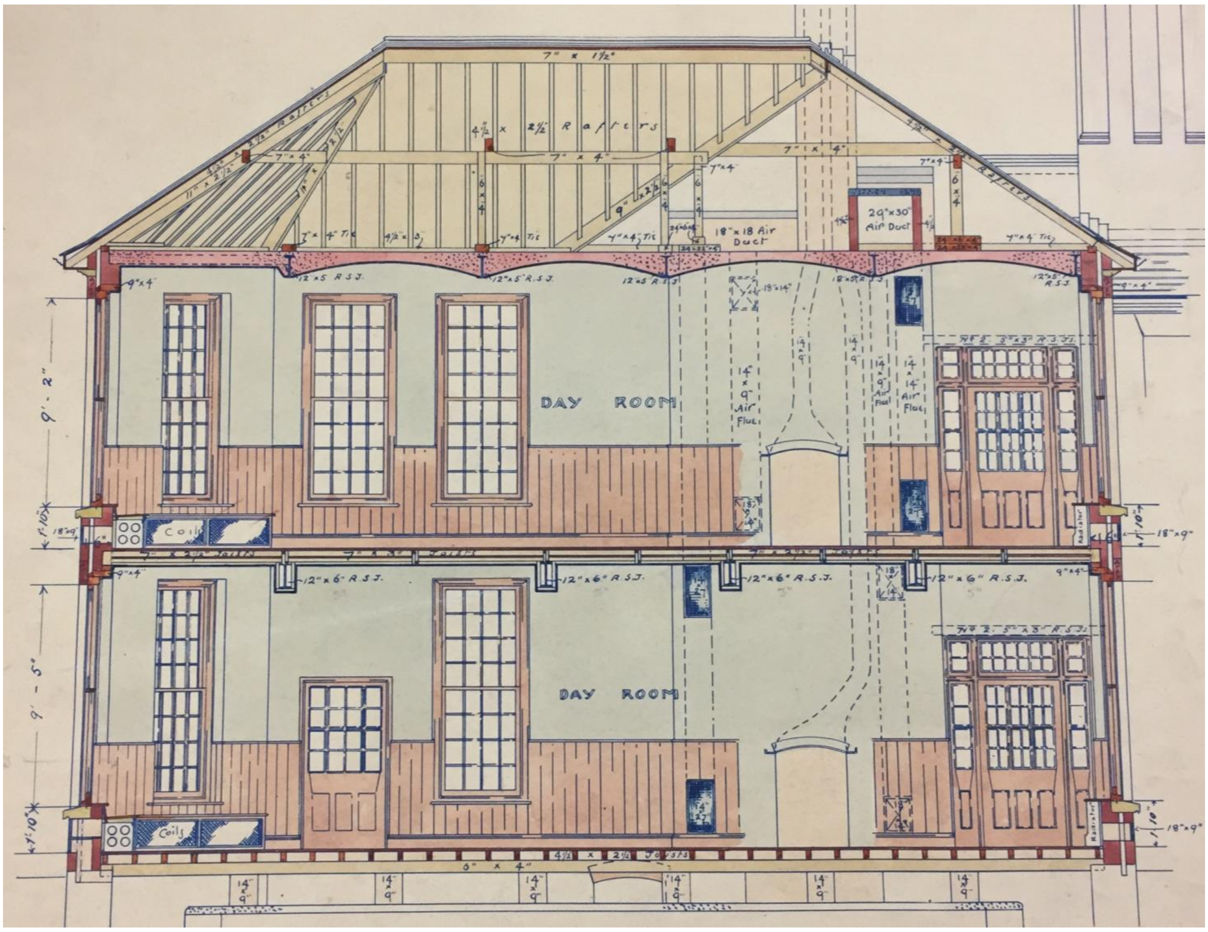


Image 1, (Britton, 2019) showing the timber framed constructed roof with the use of purlins ad rafters, note the arched ceilings to the ceiling of the first floor, these being concrete fire-proof construction, Architects drawings referring to Dennett Concrete', being a patented fire-proof construction concrete, referred to as the Dennett's System or Dennett's Fire-proof Construction. (Rabun, 2000)

Many of the roof coverings throughout the complex layout of the buildings are in need of varying degrees of repair; from slipped, loose and damaged slates to more significant areas of decay and large scale repairs, through to areas of substantial vandalism (generally lead theft as a consequence slate damage). Additionally, due to restricted access further repairs will be undetectable until a full examination is carried out.

Due to the age of the buildings and construction, potential slate fixing fatigue can be expected to be found throughout the remainder of the roofs elevations to some degree and may be found to have limited life expectancy left. This creates the dilemma of do you repair all now or only the known failed areas, the risk being once all immediate repairs have been carried out, subsequent repairs may be necessary or become apparent with a year or two. This not only impacts on costs but also the risk to the historic building materials and significance. The more an area or areas are exposed, the risk of further damage or loss to the historic building fabric is increased.

Should inspections reveal decay to timber sarking boards and structural members below i.e. rafters, purlins and in several areas steel frame construction then a more extensive program of works will be required. On inspection on the 24th of October 2019 no evidence of further decay was present besides isolated areas of ceiling collapse due to roof slate damage noted within the photographs below, however until a fully detail inspection is carried out additional areas of decay should be anticipated.

Image 2, showing area of ceiling decay attributed to roof defects (Branford, 2019)

Image 3, close up of image 2

Image 4, showing the general condition internally (Branford, 2019)

Two Staged Approach to Repairs

A two staged repair approach is required at Whitchurch Hospital, the first dealing with the immediate halt of further decay and the second being repairs through a programmed schedule of works.

Immediate works

Initially damaged and exposed areas should be covered/wrapped with heavy gauge tarpaulin or covered with corugated tin roofing sheets or similar to provide protection from further decay and moisture ingress and provide a period of time to compile a programme of works. These works ae to include site security to prevent further vandalism (Adams, 2020).

A Brief Programmed of works

All pitched slate roofs regardless of frame structure:

Carefully assess all elevations to determine the extent of repairs required and any additional available access available, i.e. from below via roof spaces and damaged areas of ceiling.

To areas of slate coverings that are failing but not completely failed, photograph and number each slate removed from the area, this will guide reinstallation and provide a reference when refitting/replacing, some slates differing in dimensions to fit the area/s.

Slates that have split, broken, become friable thus reducing the life expectancy and slates that have been reused multiple times due to previous repairs etc should be documented and removed. Natural roofing slate having an expected life span of 100 years plus (Owen, 2013) dependant on quality, however in many cases this estimation is cautious as many slate roofs throughout wales etc exceed this (Branford, 2020).

All slate removal and areas of damage should be carefully stripped so as not to damage or dislodge the slates around the perimeter of the intended repair.

Slate fixings i.e. nails are approaching 112 to 118 years old, oxidisation will be the main cause of fatigue, these tend to be concentrated at the point at which the head of the nail is formed, due to the iron being thinner here also at the seams where the nail shank is formed oxidisation can expand the iron causing it to become brittle (English Heritage, 2013).

All previous fixings should be removed fully, where fixings do not provide sufficient area to effectively remove, these should be cut flush with battens.

Where battens have decayed or has sufficiently weakened whether due to the onset of decay or damage whilst removing slates, remove to the nearest rafter. Carefully cut midway between the rafter to retain a fixing point for the retained batten and provide a fixing point for the replacement.

Due to the age of the existing construction and the possible impact on historic materials both external and internal (ceilings) pre-drill with an appropriately sized drill bit all battens prior to fixing back to rafter. Fixings to be as original i.e. square cut forged nails or machine cut [1](whichever has

[1] "The first machined nails were flat and headless. From 1811 these were produced from rolled sections of plate iron, cut into strips of the same width as the length of the nail. The strip was then placed under a powerful guillotine which cut off a single nail on an angle. Then the sheet was turned over and the next was cut. As a result, these nails taper to a point on two sides only, producing a square point (see illustration), and are easily distinguished from earlier cut nails."

(Taylor, 1999) (English Heritage, 2013)

been determined during the investigations. Modern nail gun fixings have a ribbed shank which will be difficult to remove at a later date should the need arise, likewise screw fixings would offer the least impact and vastly reduce potential damage to adjacent materials however aside from the fact these are not of a like for like material, screw heads can round with poor instalation and intime the heads decay, making removal destructive to the materials it passes through, additionally screws have a tendency to shear under tension. Ferrous iron and steel fixings have a flexibility whilst being rigid enough to be driven into the timber. They hold by way of friction however with sufficient force applied these can be removed with minimal damage to materials to which they are applied.

Do not over hammer fixings as this could vibrate loose ceiling coverings and damaged adjacent slates.

Slates should be responsibly sourced, with preference towards welsh slate and in particular where possible the original quarry. Whilst there is a wealth of reclaimed slate available, these tend to have multiple fixings holes which compromise the life expectancy. It is advised that it is better to replace with new slate where required, matching the quality (the previous proving to have longevity) and aesthetic appearance. Closely matching the original source, colour and quality will as much as possible, age in a similar manner to the original.

All lead works, flashings soakers etc should be carefully examined during works, lead that is deemed to retain limited life expectancy or show poor previous repairs that cannot be appropriately repaired to provide a suitable stable weather protection should be removed. Note all details, lead not sufficiently sized originally or installed with inherent defects should be highlighted, discussion here will have to carried out to determine “like for like” or repair to provide longevity.

Areas that have been previously wrapped in plastic sheeting; it is expected that a larger extent of decay will be present to the roof structure timbers. As above the same approach will be taken, however it anticipated that a significant area of structural timbers will require repair and replacement. This can be carried out in localised areas to minimise the extent of damage to surrounding areas. Timbers should be responsibly sourced, sized and have matching characteristics to of that is replacing. Fixings should be similar in properties as the original, performance and longevity.

Adaption / Improving roof conditions through thermal upgrades to ceilings

The types of roof construction being focussed on here are primarily cut timber roofs and steel trussed all with some form of ceilings below.

On inspection no evidence of insulation was identified within the any of roofs (Visual inspection only, no access provided to the roof voids). In an attempt to improve the thermal efficiency throughout the building, the roofs are the most significant, in most areas these areas are accessible and do not require the fabric of the building to be altered or adapted to gain access. The aim here is to carry out the minimal fabric alteration to the building but provide thermal improvements as much as the building fabric allows. Being listed it is not necessary to meet the requirement set out within Building Regulations, which would most definitely lead to the loss of historic fabric, the aim is to work with what we have and compromise whilst improving where appropriate.

Several roofs throughout due the construction techniques applied restrict the options available for thermal upgrading. Listed below are the various roof constructions and an summary of possible upgrades…..

Several roof structures have no void areas that can be utilised to provide a thermal improvement. To achieve any thermal benefit in these areas either the slate roof covering would have to be raised, this requiring the entire roof of a chosen area to be completely removed to allow for the addition of counter battening etc to allow space to install insulation. This would dramatically alter the appearance externally of the roof and facades, with the roofs being raised anywhere from 100mm to 300mm anticipated. This option would also require the external walls to be either raised or a substantial soffit and facia to be installed as well as extending and alteration of the rainwater goods. Internally the architectural details of the underside of the roof, pitch pine sarking boards, detailed structural timbers, and steel trusses and all additional decorative details including corbels attributed to these areas would be lost or at least significantly altered, impacting greatly on the architecture of the building, either by covering up to allow thermal improvement which then would require boarding of some kind either bland flat surfaces or a false pastiche in an attempt to replicate the original. None of these options are justified, the loss/damage to the historic fabric would be deemed too significant. In many of these areas it is suggested that we must accept these are inefficient spaces in terms of thermal improvements. Within these areas it is suggested that a suitable use be chosen that does not require a high comfort level.

Image 5, section through steel trussed roof construction. (Bristol University, 2019)

Image 6, Roof structure of store (Branford, 2019)

Image 7, Changing rooms- roof structure (Branford, 2019)

Image 8, Shower room - roof structure (Branford, 2019)

Image 9, Suspended Ceilings Showing condensation staining. (Branford, 2019)

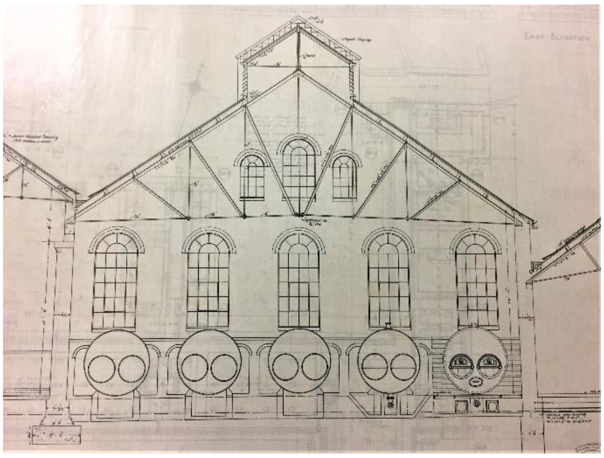


Image 10, Section drawing – highlighting roof structure. (Skinner, 2019)

Types of Roof Construction & Internal Roof Areas

Trussed roof structures with ceiling below as seen in the images below

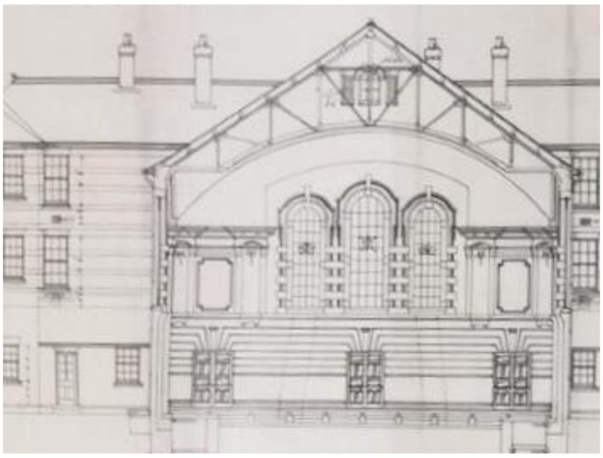
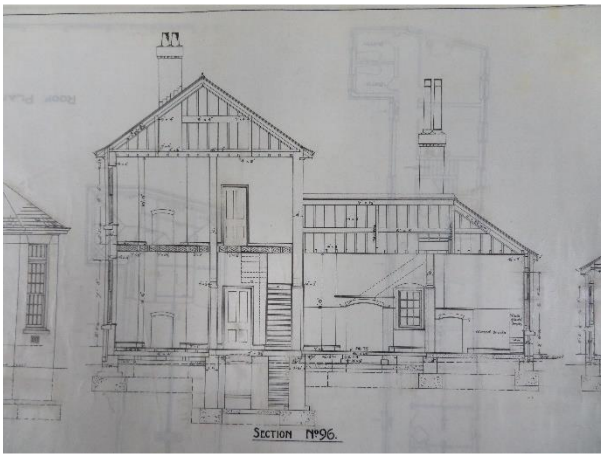


Image 11, Vaulted fire-proof concrete ceiling (Branford, 2019)

Image 12, Section drawing, roof & ceiling construction (Skinner, 2019)

Cut timber roof construction as seen throughout several areas of Whitchurch Hospital



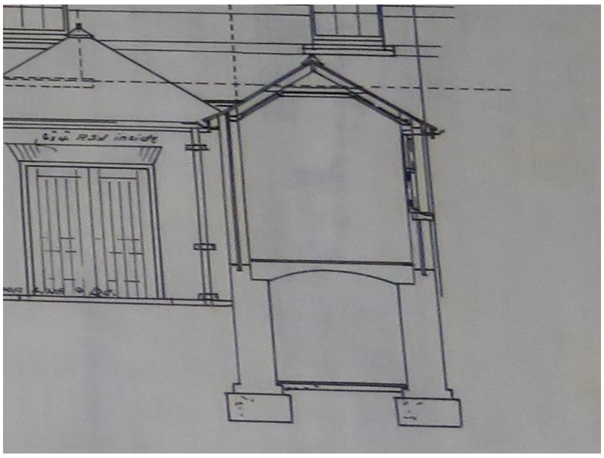


Image 13 & 14, Section drawings showing cut roof construction (Skinner, 2019)

Flat roofs are minimal throughout the layout, being much later additions

Image 15, Example of the flat roofs including evidence of vandalism. (Branford, 2019)

<u>Vaulted fire-proof ceilings appear to be unique to Whitchurch Hospital at the time of Construction</u>

Image 16, Vaulted fire-proof concrete ceilings (Branford, 2019)

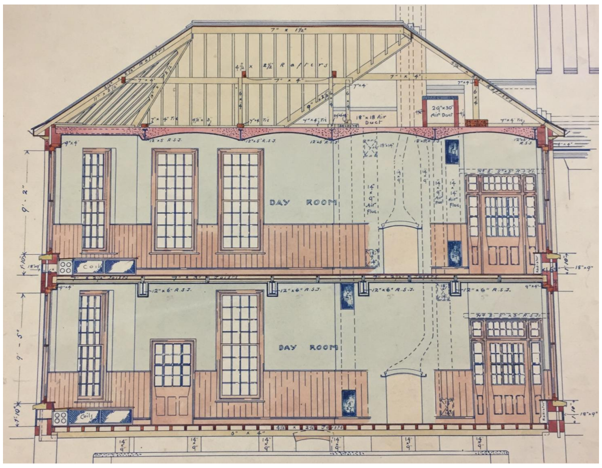


Image 17, Section drawing showing the adjacent image 16 (Skinner, 2019)

Image 18, Decoration decay attributed to poor ventilation and condensation (Branford, 2019)

Potential Areas to install Thermal Improvements

Existing Aerial layout

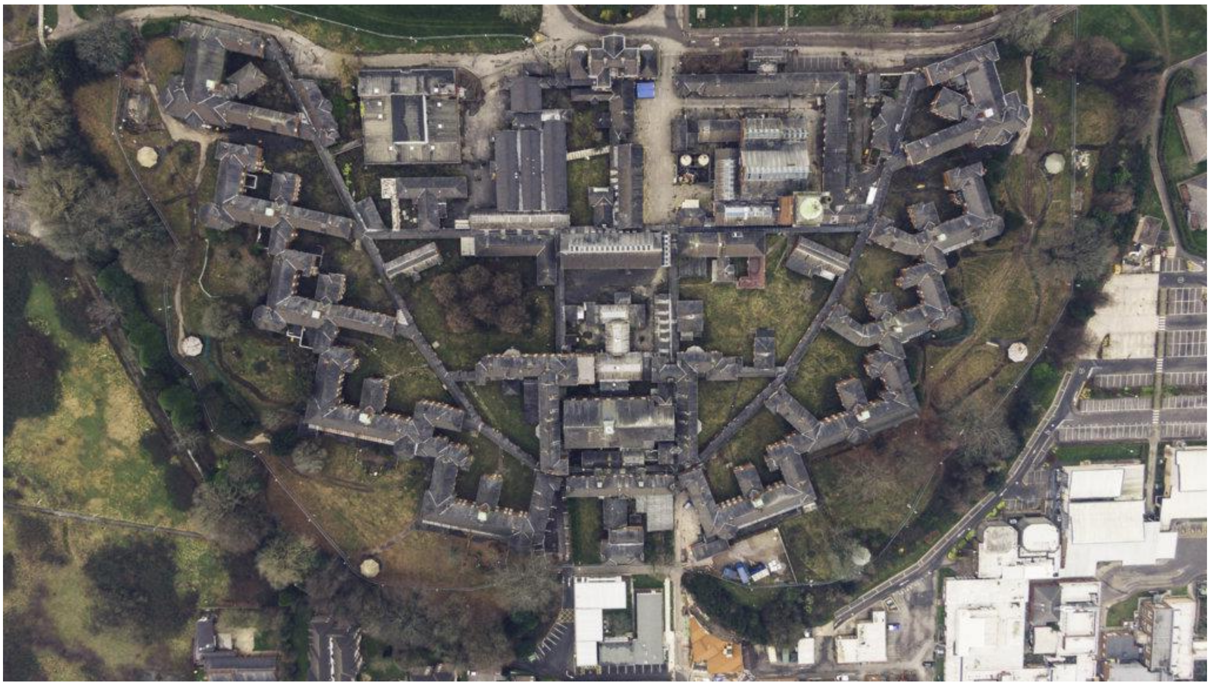


Image 19, Aerial view of Whitchurch Hospital layout. (Snooky, 2019)

Potential thermal improvement overlay

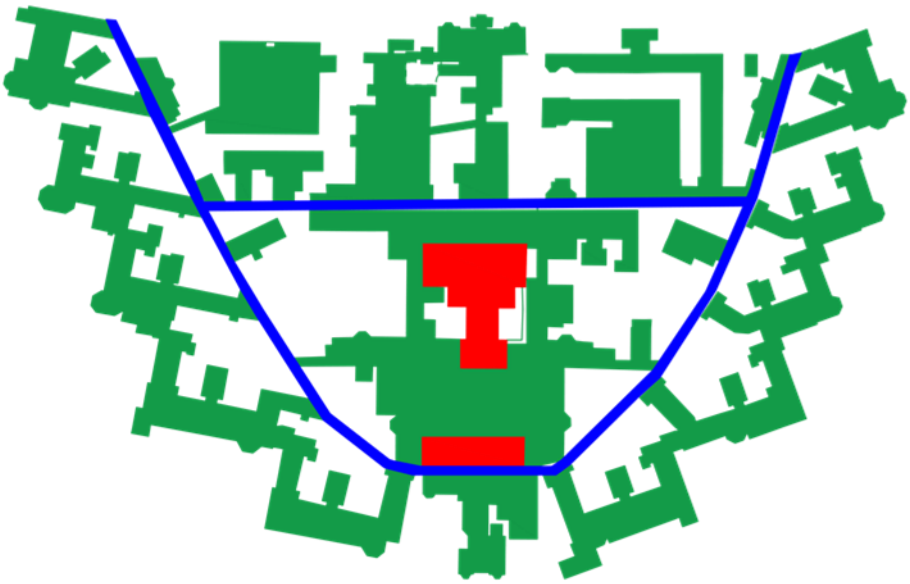


Image 20, Building layout separated into thermal improvement zones (Branford, 2020)

Area of overlay	Overall % Area
(green)	85.22%
(blue)	9.038%
(red)	5.139%

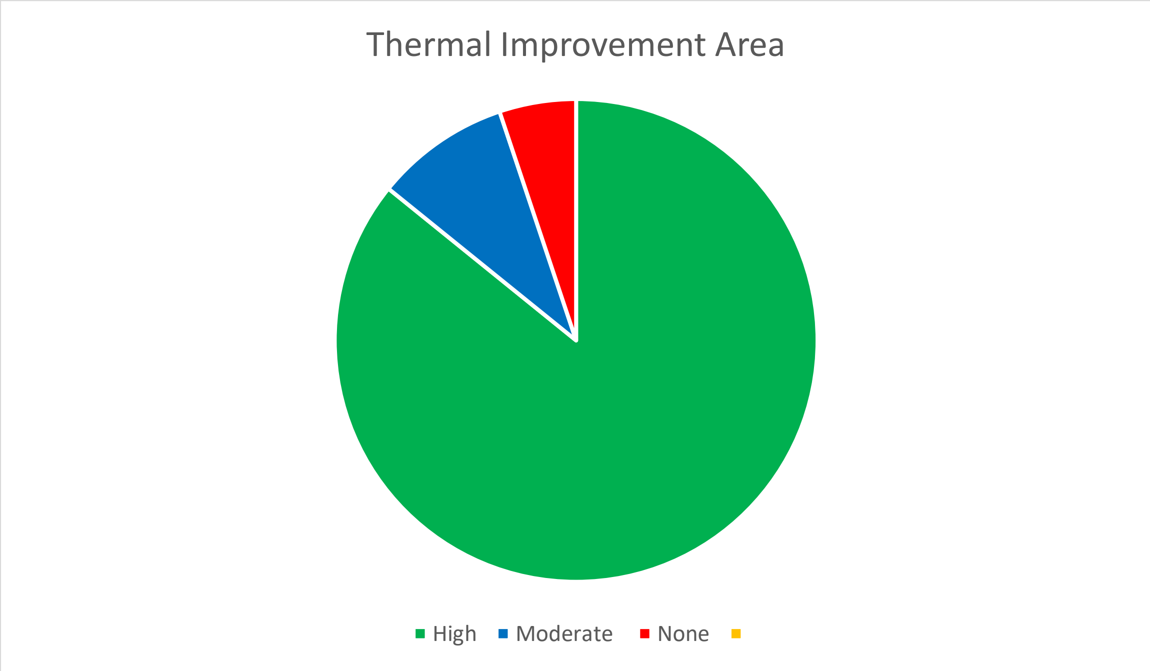


Image 21, Showing thermal improvement potential areas (Branford, 2020)

Cut Roofs

Before & After section drawings of connecting corridors incorporating thermal insulation.

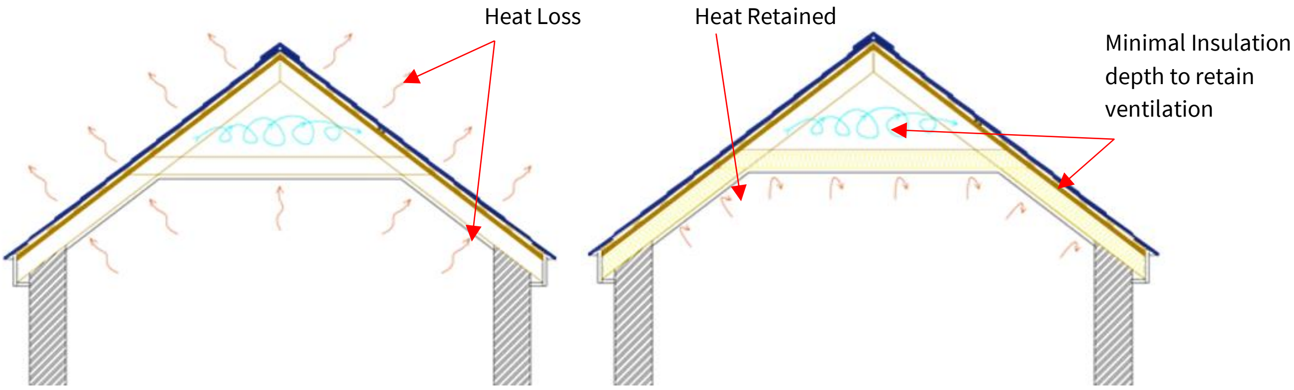


Image 22 & 23, showing existing thermal performance and potential results from thermal upgrades. (Branford, 2020)

To determine the potential expected U-value of the ceilings / cut roofs to generally the connecting corridors, a basic assessment of the current U-Value was determined then accepting that the thermal upgrade here would be minimal given the access and area available to insert insulation whilst retaining ventilation.

To provide an approximation of the current U-Value some assumptions have been made as follows:

- Ceiling plaster depth 20mm with 10mm allowed for area between lath and creating anchor
- Timber lath 6mm
- Rafters and collar tie 110mm x 60mm

As ventilation is essential to provide a healthy roof void by allowing any moisture vapour to be driven off, the roof construction has been omitted from all the calculations, choosing to concentrate on the ceiling element only.

The U-Value for the existing ceiling in good repair is calculated at 5.069544 W/m²K (refer to appendix B).

Installing an 80mm depth Thermafleece type board to the ceiling between the rafters and between the collar ties the U-Value is calculated at 0.3927013 W/m²K (refer to appendix B)

Using this data as a benchmark, the minimal thermal improvement would be a 92.2537155216%. This would significantly improve the thermal comfort within these areas and contribute to potential energy saving during the winter periods and reduce the solar gain during the summer periods, thus making for a more comfortable area to commute through.

Trussed roofs with ceilings below incorporating thermal insulation.

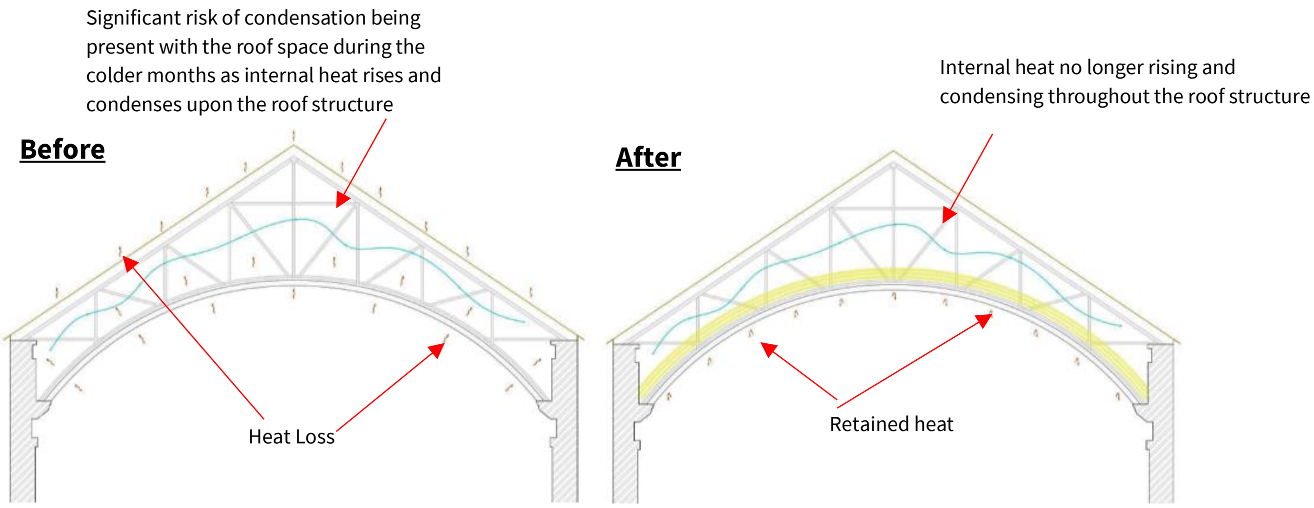


Image 24 & 25, showing existing thermal performance and potential results from thermal upgrades. (Branford, 2020)

To determine the potential expected U-value of the fire-proof concrete (Steel reinforcement not determined) ceilings throughout the various parts of the buildings, a basic assessment of the current U-Value was determined then applying an example of an thermal upgrade the calculation was carried out again.

To provide an approximation of the current U-Value some assumptions have been made as follows:

- Depth of concrete 100mm minimum (particular makeup of concrete as yet unknown, upon findings this may alter the values calculated).
- Steel frame to which it is expected the concrete is attached in some way, omitted from calculations.

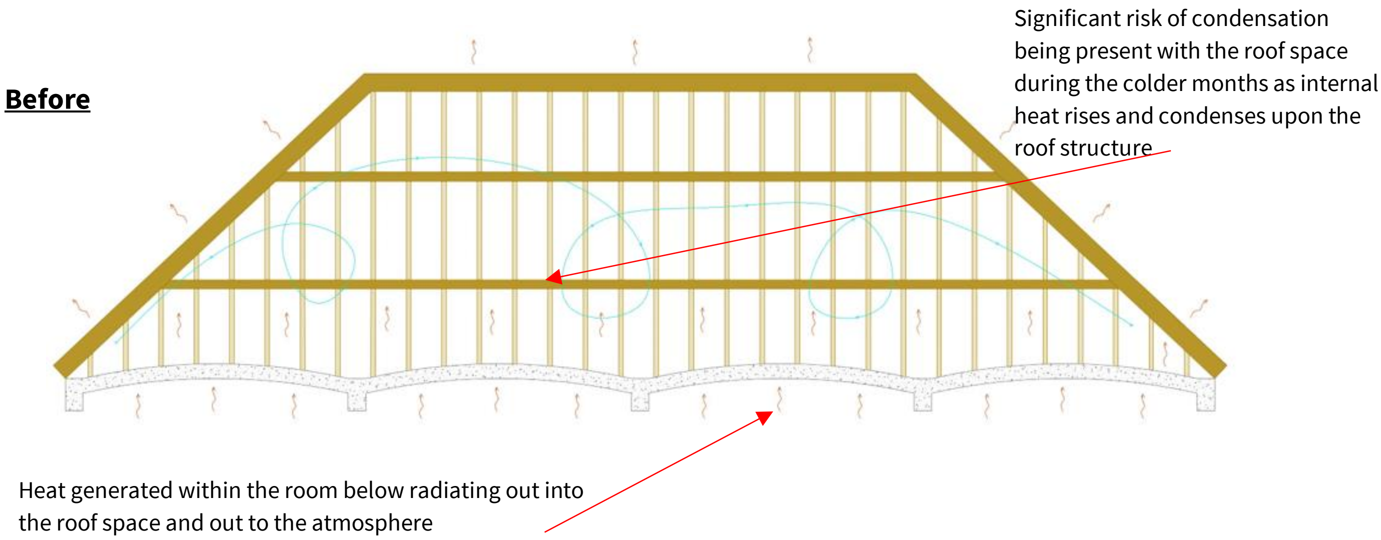
As ventilation is essential to provide a healthy roof void by allowing any moisture vapour to be driven off the roof construction has been omitted from all the calculations, choosing to concentrate on the ceiling element only.

The U-Value for the existing ceiling in good repair is calculated at 5.4502387 W/m²K (refer to appendix B)

Installing a 300mm depth Thermafleece flexible wool slab directly on top of the fire-proof concrete the U-Value is calculated at 0.1142176 W/m²K (refer to appendix B).

Using this data as a benchmark, the minimal thermal improvement would be a 97.9043560055%. This would significantly improve the thermal comfort within these areas and contribute to potential energy saving during the winter periods and reduce the solar gain during the summer periods, thus making for a more comfortable area to inhabit and utilise.

In short 97.9% of the energy currently passing through the existing ceiling would be retained within the room. This would require less heating within the thermally upgraded rooms and reduce the risk of condensation being experienced within the roof space caused by heat rising and condensing on the roof structure. Thermally improvements here can provide the room with much wider future uses.



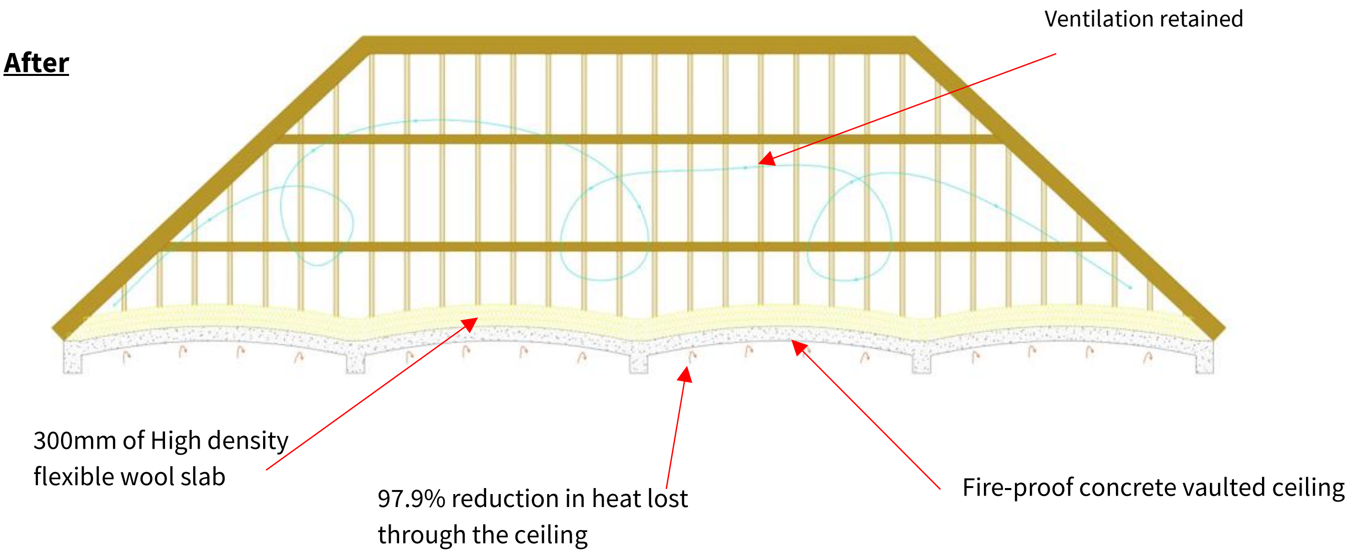


Image 26 & 27, showing existing thermal performance and potential results from thermal upgrades. (Branford, 2020)

All thermal improvements would require the thermal value of the remaining elements (walls and floors) to be calculated to enable the correct type and depth of insulation to be included as drastically improving one area can have a negative effect of another , i.e. where moisture vapour may have evaporated effectively through the original ceiling and out through the roof the improvements may change this to the wall being the point at which the humid air condenses (dew point).

All of the roof voids have the capability of running services such as electricity supplies and communications, fibre etc. These services can be installed and clipped onto galvanised track, enabling the wiring to remain clear, tidy and restrained whilst being held away from the ceiling etc providing increased safety and longevity for services.

Flat Roods & ceilings

Flat ceilings are assumed to have an element of insulation currently installed, as it is assumed these have been periodically repaired and insulation has been incorporated during these repairs. A thermal upgrade is achievable within these areas however the area of flat roofs throughout is minimal and have not been included here.

Bibliography

Adams, S., 2020. *Risks and Opportunities: Current Risks, planning framework and funding opportunities.,* Cardiff: Susie Adams.

Authors Own, 2020. *ART504 Case Studies & Regional Work: New Futures Part 1, Condition Appraisal of Whitchurch Hospital formerly Cardiff City Asylum.* Cardiff: Paul Branford.

Branford, P., 2019. *Changing rooms - Roof structure.* Cardiff: [Photgraph].

Branford, P., 2019. *Corridor - General decay.* Cardiff: [Photograph].

Branford, P., 2019. *Decoration decay attributed to poor ventilation and condensation.* Cardiff: [Photograph].

Branford, P., 2019. *Flat roofs including evidence of vandalism.* Cardiff: [Photograph].

Branford, P., 2019. *Roof defect - Corridor Ceiling.* Cardiff: [Photograph].

Branford, P., 2019. *Roof structure, store.* Cardiff: [Photograph].

Branford, P., 2019. *Section Drawing - highlighting roof structure.* Cardiff: [Photgraph].

Branford, P., 2019. *Shower room - roof structure.* Cardiff: [Photograph].

Branford, P., 2019. *Suspended ceiling showing condensation staining.* Cardiff: [Photograph].

Branford, P., 2019. *Vaulted fire-proof concrete ceiling.* Cardiff: [Photgrapgh].

Branford, P., 2019. *Vaulted fire-proof concrete ceilings.* Cardiff: [Photograph].

Branford, P., 2020. *Data collated into chart.* Carmarthen: s.n.

Branford, P., 2020. *Existing and Potential Thermal Upgrades.* Carmarthen: s.n.

Branford, P., 2020. *Thermal Improvement overlay.* Carmarthen: s.n.

Bristol University, 2019. *Section elevation.* Bristol: s.n.

Britton, L., 2019. Bristol: s.n.

BS 12524:2000, 2000. *BS EN 12524 Building materials and products - Hygrothermal properties-Tabulated design values.* s.l.:British Standards Institute.

BSI , 2013. *BS 7913:2013 Guide to the Conservation of Historic Buildings,* s.l.: BSI Standrads Limited 2013.

Bussiness Wales , 2020. *businesswales.gov.wales.* [Online]
Available at: https://businesswales.gov.wales/starting-up/
[Accessed 03 March 2020].

CADW, 2011. *Conservation Principles.* Cardiff: CADW Welsh Assembly Government.

CADW, 2017. Repair. In: *Managing Change to Listed Buildings in Wales .* Cardiff: CADW, p. 9.

English Heritage, 2013. Practical Building Conservation. In: E. Heritage, ed. *Roofing.* Farnham: Ashgate Publishing Limited, pp. 607-613.

Hannigan, B., 2016. *#After Whitchurch,* Cardiff: Ben Jannigan.

Historic England, 2020. *Principles of Repair for Historic Buildings ,* s.l.: Historic England.

Historic Environment Scotland, n.d. *Repair of traditional buildings: Advice on repairing traditional buildings, including finding the cause of an issue, using skilled tradespeople and using suitable materials. ND,* s.l.: Historic Environment Scotland.

Natalia Gnoińska, Elen Hughes, 2020. *ART504: Case Studies and Regional Work: Whitchurch Hospital (B) Significance: Site History, both tangible and Intangible,* Cardiff: Natalia Gnoińska and Elen Hughes.

Owen, J., 2013. *www.welshslate.com.* [Online]
Available at: http://www.welshslate.com/reaping-the-rewards-2/
[Accessed 03rd March 2020].

Politics.co.uk, 2020. *https://www.politics.co.uk/reference/post-office-closures.* [Online]
Available at: https://www.politics.co.uk/reference/post-office-closures
[Accessed 03 March 2020].

Rabun, S. J., 2000. Structural analysis of historic buildings:. In: *restoration, preservation, and adaptive reuse applications for architects and engineers.* New York: John Wiley & Sons Inc, p. 357.

Skinner, O. &., 2019. *Section drawing showing roof and ceiling construction.* Cardiff: s.n.

Snooky, 2019. *https://www.28dayslater.co.uk.* [Online]
Available at: https://www.28dayslater.co.uk/threads/whitchurch-hospital-cardiff-jan-2019.116089/
[Accessed 15th May 2020].

SPAB, 2017. *THE SPAB APPROACH: to the conservation & care of old buildings ,* s.l.: SPAB.

Taylor, J., 1999. *www.buildingconservation.com.* [Online]
Available at: https://www.buildingconservation.com/articles/nails/nails.htm
[Accessed 03 May 2020].

Thomas, H. M., n.d. *Whitchurch Hospital 1908-1983,* s.l.: Jacoe Print.

Appendix A

Devising a repair strategy

____

For the purposes of this repair strategy the focus has been specifically in relation to the roofs of Whitchurch Hospital, further reading can be found within appendix A.

Arrive at a comprehensive, soundly based diagnosis of deterioration and its causes

1. The buildings structure dates from 1902 to 1908 (Thomas, n.d.)making the building elements circa 112 to 118 years old. All building elements have a natural life span, this varies dependant on;

    - The skill and application of materials during construction.
    - Weather exposure.
    - Inherent construction design floors.
    - Maintenance and repairs.

2. General wear and tear of building materials particularly during multiple use changes and adaptions.
    - 1908 – 1915 Cardiff City Mental Hospital.
    - 1915 – 1920 Welsh Metropolitan War Hospital (WWI).
    - 1920 – 1939 Returned to its original function as a mental hospital.
    - 1939 – 1945 Whitchurch Emergency Hospital (WWII).
    - 1945 – 2016 Whitchurch Hospital (1948 the hospital absorbed by the Ministry of Health – Beginning of the National Health Service.
      (Natalia Gnoińska, Elen Hughes, 2020)

3. Lack of maintenance post closure in 2016. (Hannigan, 2016) (Adams, 2020)

4. Lack of security in the immediate years following its closure leading to Vandalism, theft and destruction. (Adams, 2020)

5. Weather exposure and moisture ingress, primarily due to the results of Vandalism, theft and destruction but also due to no ongoing maintenance.

    - Lead damage and theft.
    - Slate roofs damaged.
    - Roof structures compromised.
    - Glassing and timber framework to windows destroyed.
    - Rainwater goods blocking, overflowing, freezing and general damage leading to ever increasing moisture ingress to roofs and external walls.

6. Lack of ventilation and heating since the building has been closed leading to condensation and in turn the decay of various building materials, preliminary paints, plasters, timbers and flooring.

7. Water supplies – unmaintained and or left with water supply connected and or non-drained, leading to freezing pipes and bursting.

8. Heating systems corroding and leaking, damage leading to leaks etc – all causing internal historic building fabric decay.

9. Wildlife inhabitation, due to the result of Vandalism and entry points being created.

Define the objectives of treatment or repair and any constraints

1. Understanding the intended purpose for the building should be observed when establishing a way forward for the repair of the building.

2. Listed Building Consent (LBC) will be required for elements where significant damage has occurred and the majority of elements are damaged or missing. Additionally, where improvements are intended LBC will be required, justification for these improvements / adaptions will have to be carefully considered as part of the LBC application.

3. The significance of the building in relation to the historical past of the building including the wider historical context of the community will have to be established and considered throughout repairs and adaptions.

4. All repairs to be carried out using traditional materials where possible and justification required where not.

5. New additions or adaptions should be sympathetic to the existing buildings and not detract in anyway.

6. Work with the existing layout as much as feasible, minimising significant alterations or adaptions.

7. The future maintenance of the building and historical building elements should not be compromised or made to extensive whilst carrying out repairs and adaptations.

8. The limited access of the site will require all planning and intended repairs and adaptions to be thoroughly assessed logistically so as not to compromise the significance of the building.

9. Sprawling site and range of buildings require heating and other services, maximising efficiency and use should be an important consideration when installing, adapting the installations.

Determine how urgent the need for work is

The first thing to do is to secure the site to prevent any further decay. This is essential prior to carrying out any repairs reactive, maintenance or planned

1. Reactive repairs;

Due to vandalism and or general building decay through wear and tear are required critically to prevent the building slipping into further state of decay and more historic fabric being lost.

These would include roofs and windows where water ingress is or could become present, Works here however short term is anticipated, unforeseen changes to programmes and elements beyond control (Covid-19) short term can turn into years. Using a tin sheeting or hardwearing weather proof fabric that has the capacity to withstand several years of ravaging weather would provide weather protection, tin sheet and similar having the benefit of being re-usable and or recyclable once finished with making temporary repairs as sustainable as possible.

2. Planned long term repairs and adaption based repairs;

Bring the building back into use is essential to halt further decay and bring the building into good repair. A building being used will be heated and ventilated and therefore building maintenance will be carried out. This essentially helps the building pay for its upkeep. The longer a building remains unoccupied the less likely that maintenance will be carried out, the building will generally be unheated and unventilated due to the cost and lack of revenue.

Long term repairs will be thoroughly considered before being applied; however, these currently include roof repairs i.e. slate coverings, timber roof structures, rainwater goods to manage water. Windows, doors will be repaired and where missing reconstructed using adjacent examples as reference. Walls generally around the site are in good repairs, however as part of a maintenance program, periodic repointing etc will required.

Establish the likely extent of the works needed to meet the conservation objectives, including mitigating the causes of deterioration

The listing designation, this provides details on the significant elements of which the building is valued.

Conservation area, this will determine any restrictions or areas that require prior consideration before implementing programmed works.

NPPF and LPPF will help determine the framework of legislation and development policies that may impact the project.

Suitable and sustainable uses are proposed for the building, taking into account the practicality of physically adapting the building to achieve those uses.

Understand how the building works and how it was intended to work

Understand why building elements and defects have failed/occurred and how to prevent this happening in the future

Understand the building periods and differing construction

Surveys and design studies should be undertaken to ensure the building is capable of being adapted for the proposed use and that repair implication are not worse than anticipated. Some of the key issues to consider are:

- Weather tightness of envelope and roof
- Degradation of stone, brick, plaster, joinery and additional internal finishes
- Load bearing capacity of floors and structure
- Structural defects including corrosion of metal work
- Capacity of rainwater goods and existing drainage together with waste drainage management and current conditions (much of these being 112 to 118 years old)
- Fire resistance and ability to upgrade
- Insulation and potential feasible upgrades
- Capacities of incoming utilities and the condition of existing wiring, internal pipework etc including routes for additional services
- Sound insulation characteristics
- Presence of asbestos, lead pipework or other health hazards
- Presence of beetle or other infestation
- Presence of dry/wet rot
- Threat from groundwater levels, sea/river flood risk etc
- Potential to meet Disabled Access Regulations.

Roofs – Without immediate repair or at minimum some form of weather protection further historical building materials will be lost and or damaged, as seen in several areas plaster, internal timbers and wooden floors are already suffering significant damage

Damaged roofs whether slate deterioration or through areas being damaged through lead theft etc will firstly be a loss to the weather protection materials however these are expected to have a limited life span and these areas are now at the point where a thorough inspection is required to establish the current life expectancy remaining. With the loss or damage to these areas internal structural decay of timbers and plasters will occur. These will be a total loss of historic fabric

Broken glazing and damaged window frames will allow access for vandals and wildlife both of which leading to further harm to historic fabric in damage and decay

Moisture related damp whether it be via water ingress or condensation will degrade internal building fabric, addressing the contributing issues will allow more historic fabric to be retained, minimise the need for intervention and in areas of great significance enable historic building fabric to be retained and as a consequence the significance of each element of building fabric will be retained

Assess the available resources (knowledge, skills, materials, finance)

Knowledge

- Craft skills
- Professionals
- Labour

Materials

- Appropriate performing materials for the existing construction and modern alternatives that complement the building and building elements. Sustainably sourced, sustainable and high performance.

Finance and Funding

- Local Grants
- HLF (Heritage Lottery Fund)
- Community Sourced, Fundraising
- Private Investment avenues

Identify options that meet the objectives for treatment or repair

1. Materials that appropriate, tried and tested for and on the historic building.
2. Sympathetic materials that can improve sustainability and thermal performance of the building.
3. Reversibility.

Assess the 'buildability', effectiveness, cost and maintenance implications of options

Buildability – Identify the areas in need of repair, Identify the necessary areas of building performance required both thermally and services including end use.

The main areas requiring repair are roofs and windows externally, these have the most significant impact upon the fabric of the building as these manage water and prevent weather ingress.

Utilising Opportunities.

Roofs require repair of varying scales, also the remainder of the roof coverings will be aged and is likely to require further areas of repair etc in the coming years. Additionally, the roof space throughout is currently uninsulated and an unutilised area.

Where available the roof space, has large capacity, runs almost continuously around the site with much being connected. These areas can accommodate both thermal upgrades and services, electrical and communications and where absolutely necessary plumbing/heating and ventilation.

Several areas of roof coverings will be required to be removed during roof repairs, some more extensive than others although it is anticipated that these works will be considerable and involve to varying degrees all roof elevations. These works present the opportunity to thermally upgrade the ceilings and roof areas with little requirement to provide access internally through ceilings etc thus preventing/limiting the impact on historic internal finishes.

Where required and where feasible services such as electrical, ventilation and communications can be installed and rolled out throughout the complex of buildings again reducing the requirement to remove or provide additional means of ducting and installing services throughout walls etc.

Several ceilings throughout are significantly damaged this also allows access into these concealed areas where services can be installed.

Many thermal upgrades are going to be difficult to implement throughout the building, these would include insulating walls internally which would either require over boarding in some way incorporating insulation or removing historic plasters which are in relatively good condition. Floors would have to be lifted to include thermal upgrades, again removing historic building material which in the most part is in good repair.

It would be difficult to justify the upgrading the walls and floors however the roof areas above ceilings is feasible, cost effective, negates and minimises damage to internal fabric, can become part of the roof works again reducing costs. Thermal upgrades here would be positive to the building, low to little historical impact, completely reversable and works with the building thermally and feasible both in the context of feasible upgrades and low impact high return.

Assess the impact of these options on the heritage values of the elements affected and thus on the significance of the building as whole

The roof repairs are necessary to prevent further decay and to bring the building back into a state of good repair. In repairing the roofs, the building has the potential to become habitable once again. Further repairs such as windows, walls, floors, ceilings and services can be made allowing the building to become occupied. Therefore, the building can generate funds, has a use, is used and is maintained as there is a vested interest by all inhabitants. This ensures the building, its significance and history is retained and taken forward for the future. Additionally, the building and new uses etc can become a blueprint for many other disused buildings, the scale can be adapted to suite a wide variety of historic buildings.

Select options that minimise harm to significance, while being effective and affordable

Repairing the roof with natural slates, timbers etc ensure the repairs are compatible with the remaining structure. The life expectancy is known due to the historic fabric and the characteristics of each element is less likely to jar against the existing, this reducing the impact of the repairs aesthetically.

Determine priorities for implementation

Temporary repairs (roof sheeting) to prevent further decay and provide time for a plan of works and future use to be drawn together.

Site security to prevent further acts of vandalism and theft and loss of historic fabric

Plan of end use for the building, this determines the programme of works and priorities

Appendix B

EXISTING CEILING - CORRIDORS

a. (Plaster)

$$R_{SI} + \frac{0.030}{0.8} + R_{SE}$$

$$0.10 + 0.0375 + 0.04 = 0.1775$$

$$\frac{1}{0.1775} = 5.6338028 \text{ W/m}^2\text{K} \times 13.284\% = 0.7483943$$

b. (Plaster, Lathe)

$$R_{SI} + \frac{0.020}{0.8} + \frac{0.006}{1.8} + R_{SE}$$

$$0.10 + 0.025 + 0.003 + 0.04 = 0.168$$

$$\frac{1}{0.168} = 5.9523809 \text{ W/m}^2\text{K} \times 68.716\% = 4.090238$$

c. (Plaster, Joist)

$$R_{SI} + \frac{0.025}{0.8} + \frac{0.110}{1.8} + R_{SE}$$

$$0.10 + 0.03125 + 0.611 + 0.04 = 0.78285$$

$$\frac{1}{0.78225} = 1.2783636 \text{ W/m}^2\text{K} \times 2.88\% = 0.0368188$$

d. (Plaster, Lath, Joist)

$$R_{SI} + \frac{0.020}{0.8} + \frac{0.006}{1.8} + \frac{0.110}{1.8} + R_{SE}$$

$$0.10 + 0.025 + 0.003 + 0.611 + 0.04 = 0.779$$

$$\frac{1}{0.779} = 1.283697 \text{ W/m}^2\text{K} \times 15.12\% = 0.1940949$$

a. + b. + c. + d.

$$0.7483943 + 4.090238 + 0.0368188 + 0.1940949 = 5.069544 \text{ W/m}^2\text{K}$$

IMPROVED CEILING - CORRIDORS

a. R-VALUE + THERMAFLEECE

$\frac{0.080}{0.035} = 2.2857142$

0.1775 + 2.8857142 = 2.4632142

$\frac{1}{2.4632142}$ = 0.4059736 X 13.284% = 0.0539295 W/m²K

b. R+ $\frac{0.080}{0.035} = 2.2857142$

0.168 + 2.2857142 = 2.4537142

$\frac{1}{2.4537142}$ = 0.4075454 X 68.716% = 0.2800488 W/m²K

c. R+ $\frac{0.080}{0.035} = 2.2857142$

0.78225 + 2.2857142 = 3.0679642

$\frac{1}{3.0679642}$ = 0.325949 X 2.88% = 0.0093873 W/m²K

d. R+ $\frac{0.080}{0.035} = 2.2857142$

0.779 + 2.2857142 = 3.0647142

$\frac{1}{3.0647142}$ = 0.3262946 X 15.12% = 0.0493357 W/m²K

0.0539295 + 0.2800488 + 0.0093873 + 0.0493357 =
0.3927013 W/m²K

EXISTING CONCRETE FIRE-PROOF CEILINGS

$$0.10 + \underset{\text{CONCRETE}}{\frac{0.100}{2.3}} + 0.04 = 0.1834782$$

0.0434782

$$\frac{1}{0.1834782} = 5.4502387 \ W/m^2K$$

WITH THERMAL IMPROVEMENTS

$$0.10 + \underset{\text{CONCRETE}}{0.0434782} + \underset{\text{THERMAFLEECE}}{\frac{0.300}{0.035}} + 0.04 = 8.6977632$$

8.5714285

$$\frac{1}{8.6977632} = 0.114972 \ W/m^2K$$