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ENABLING A FUTURE FOR CULTURAL HERITAGE BUILDINGS

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ABSTRACT

Modernisation and re-use of cultural heritage buildings has been a constant theme over a long period of time; for some buildings this begins shortly after original construction and is a continuing process. Adaptation, alteration and extension may all be part of this, as captured by TS Eliot – "In succession Houses rise and fall, crumble, are extended, Are removed, destroyed, restored" [1].
More recent examples include in London the adaptation of the King Charles Palace at Greenwich (itself a world heritage site) for Trinity College of Music and St Pancras Chambers, now returned to luxury hotel use. Warehouses are converted to apartments and art galleries and private dwellings to hotels. At one extreme, façade retention keeps at least a part of what is deemed to be of significance.
The challenges such changes offer are considerable, aesthetically, technically and in terms of heritage significance. These include determining an acceptable approach when adding or extending, reconciling design life requirements between new construction and fabric which may be several hundred years old, the application of regulatory requirements to new and old, avoiding unintended changes to existing load-paths. A delicate balance between an element of pragmatism in accommodating change without excessive compromise is required.
The need to meet these challenges is imperative. In England alone it is thought that there are approximately 17000 listed buildings 'at risk'. Appropriate re-use of such buildings, with or without an actual **change** of use, is needed to provide them with a viable economic future, a 'future for the past'.

Keywords: *Re-use, Adaptation, Significance, Design life*

1. INTRODUCTION

In looking at the basic premise of 'enabling a future for cultural heritage buildings' there may be an implicit assumption, and indeed expectation, that this *should* be achieved. Before pursuing this assumption there are a number of key issues to explore. These include the obvious need to decide what constitutes cultural heritage in this context, a framework for deciding what can sensibly be preserved in some form for the future and the technical challenges that need to be met.
While the examples within the paper are generally drawn from Great Britain, it is apparent that the issues apply to a much wider geographical spread and the concerns are relevant to the international heritage community.

1.1. Cultural heritage

The definition of *cultural heritage* has been variously addressed by others. The World Bank, for example, defines physical cultural resources, also known inter alia as cultural heritage, as "movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance." http://go.worldbank.org/IHM9G1FOO0. [2]
In this paper the focus is on buildings rather than other assets such as sites and landscapes.
In England such buildings are accorded special status and are designated as 'listed'. English Heritage on its website (www.english-heritage.og.uk\) describes the importance of such buildings as follows:

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Listing helps us acknowledge and understand our shared history. It marks and celebrates a building's special architectural and historic interest, and also brings it under the consideration of the planning system so that some thought will be taken about its future.

In England there are just over 370,000 listed building entries; of these 2.5% are deemed to be of 'exceptional interest, sometimes considered to be internationally important, and a further 5.5% are acknowledged as 'particularly important buildings of more than special interest'. Thus in England alone (not Great Britain, as Scotland and Wales have their own heritage bodies and separate protection status) there are approximately 30,000 buildings deemed to be at least of particular importance but also a further 340,000 classed as being of national interest and special importance. In addition there are further buildings which may be recognised as being of local importance and regarded as significant within a community.

The older a building is, the greater the likelihood that it will be listed. Again, in England, about 15% of all listed buildings date from before 1600. The spread of age and significance of heritage buildings will vary by country and probably also by region, but it is probably fair to suggest that the problem of allocating appropriate funds for the preservation of cultural heritage is widespread. Looking at this issue in the first half of 2012, it is easy to understand why such funds may be particularly squeezed and why there is an even greater imperative to identify solutions which 'enable a future' in an economic sense while simultaneously maintaining the essence of what makes the building important and constitutes its cultural heritage.

There may be a perception that the latter requirement precludes alterations and additions and requires the building to be maintained in its present form and possibly in its present use. If a viable future is to be enabled, 'unlocking the potential of the building' to use a phrase seen on the scaffold around a building in one of the great London estates, then protection of cultural heritage whether by statute or otherwise has to be seen as a challenge rather than a constraint. While any change needs to be very carefully assessed in terms of aesthetics, changes to fabric and technical requirements it is also important to recognise that all buildings undergo change throughout their life. The details of 'listing' constitute what is deemed to be significant at a particular date, but for an older building in particular will include changes and additions that have taken place from the time of the original construction up to that date.

Where change to heritage construction is contemplated, its significance should be explored at the outset, including the following activities:

- Carry out an audit of the fabric in order to identify original material;
- Identify modifications, with dates where possible;
- Identify later additions, with dates where possible; and
- Assess the cultural significance of the building.

This establishes a reasonable starting point for determining where changes may be most acceptable – and where intrusive works should be minimised as far as possible.

Examples of buildings where change has been made vary by size, age and heritage significance. They vary from country churches several hundred years old to royal palaces, domestic buildings, industrial facilities and railway stations.

This paper includes some more detailed case studies of buildings where both alteration and change of use have taken place over time, with description of the particular technical issues encountered. It is also recognised that there are many examples of cultural heritage where no change of use is contemplated but alterations and additions may be desirable for a variety of reasons, for example to attract more visitors, to retain present level of use, to expand educational facilities etc. For all buildings there is a need for regular, appropriate maintenance, which itself has financial implications and a requirement, which is itself an issue, for availability of the requisite skills [3]. While in general best practice has advocated use of matching materials for repairs and maintenance, there is also a role for the development of new technologies and sustainable solutions.

In many ancient monuments, part of the 'standard' information for visitors is a plan coloured to indicate the date of construction of different parts. Commonly in churches, for example, phases of construction over a period of several hundred years will have taken place. The Church of St Nicholas in Sevenoaks, Kent, to give but one example amongst many, is Grade II* listed. Part of the fabric dates from the 13C when the original church was constructed, with additions recorded to the 15C (and a pulpit from 1636). In the late 20C, in common with a number of other churches of a range of size and significance, there was a desire to expand the accommodation at the church to offer a wider range of activities on the site, and an undercroft was constructed. This was the option selected, after detailed

consideration, from a number considered, and necessarily required geotechnical, structural and archaeological investigations, together with monitoring during the works. Despite the extensive work required to the existing foundations the construction was achieved without incident and the new facilities have enhanced the community use of the historic church (and have presumably been recognised with some additional colouring on its historic plan).
A rather different church project is the conversion of a church in Maastricht dating from 1294 to a bookshop after previous use as a warehouse and a bicycle pound.Here the nave has been left untouched and an independent multi-storey structure has been constructed within it to house the books. Climbing stairs to the top of the book store allows a close view of the vaulting and ceiling paintings which date back as far as 1337 [4]. http://www.selexyz.nl/winkel/38/selexyz-dominicanen/
The changes to a building may be internal and/or by addition(s). New construction may be an extension to the original footprint or a separate building within the curtilage. In each case the interface will be of importance, as will each of the separate components. An extreme example here is perhaps the famous Pyramid within the Louvre, which was itself originally constructed as a royal palace with the earliest sections dating back to the late 16C. The Pyramid was criticised as being extravagant and certainly aroused strong views at the time of its construction, but is now recognised as an integral part of this internationally famous gallery and is itself an important structure in its own right.
A controversial solution for preserving cultural heritage, seen by some as that of last resort, may be the retention of the facade alone. This may adopted where the significance of the building lies primarily in the facade, perhaps in its contribution to a streetscape rather than in its entirety in its own right, or where it is the only element of the building that can be preserved without extreme alteration and intervention to the interior such that the heritage value is compromised. The reasons are explored further in guidance on retention of masonry facades published by CIRIA [5].

1.2. Setting priorities

The numbers above suggest clearly that priorities are needed in determining where efforts are best directed to enable a future for cultural heritage. In examining this further there is a distinction to be drawn between cultural heritage in public ownership and that in private hands, notwithstanding obligations that may be imposed on private owners.
The majority of designated buildings are in private hands, but there is a need for public funding to support the owners in the major tasks of maintaining their properties to prevent the loss of significant fabric and making adaptations where necessary. In addition of course there is a further call for funds for the upkeep and repair of the great national monuments. The need to provide safe access, including access for the disabled, can be a particular challenge for such buildings, and this is only one aspect of stewardship.
The English Heritage Corporate Plan for 2011-2015 [6] notes that heritage at risk is increasing in some areas, and also identifies the need to 'find new partnerships with public and private funders..... to help reduce the amount of heritage at risk in a measurable way'. This is identified as one of the key areas where they need to be successful over the lifetime of the plan.
In addition to public funds, a future for cultural heritage may be enabled by philanthropic donation and by developers with sufficient vision, perhaps as part of the partnership referred to above. Harry Handelsman of Manhattan Loft Corporation, for example, is noted in a recent article [7] as "having a talent for breathing new life into old buildings". It is the Manhattan Loft Corporation which has transformed the former Midland Grand Hotel at St Pancras Station in London into the St Pancras Renaissance Hotel in a project lasting over a decade, described in this paper in further detail. In the same article he is quoted as saying "Many people thought I was mad. But when I walked into the building I knew it had to be rescued. Gilbert Scott's architecture is outstanding....." If this is 'madness' then it is of a sort that the heritage community needs to be grateful for and foster wherever possible!

2. THE TECHNICAL CHALLENGE

2.1. Performance requirements

The technical challenges of enabling a future for a heritage building are also significant. There is a need to understand the details of the original construction, changes that may have been carried out in the past and the materials used. Often records are poor, incomplete or in many cases non-existent. At present, while there is plenty of guidance on surveys, appraisal and the use of materials in historic buildings, and there is access to historic design codes, there is no single reference that sets out a 'code of practice' for adaptation – perhaps because so much needs to be decided on a case by case basis.

Cracking and signs of movement may appear alarming (see Figure 1) but further investigation may confirm that these are historic and that movement has ceased.

Fig. 1 Historic distortion in timber framed house, ©Peter Ross

For an engineer the process of appraisal is a critical activity at the outset where adaptive reuse is contemplated. There is a need to develop an understanding of the structural performance, and to assess the impact of what is proposed.

The key aspects of performance to be examined include:

- Stability;
- Robustness;
- Existing loadpaths;
- Imposed load capacity (and compatibility with the proposed use(s));
- Durability;
- Fire resistance; and
- Serviceability.

Where alterations/additions/change of use are proposed, the impact of statutory requirements (in the UK the Building Regulations) on, for example, fire resistance and robustness must be taken into account. Even where specific requirements are not applicable, the engineer may make a pragmatic assessment of the robustness of the structure and recommend additional measures in some instances – perhaps in limited areas only of an existing building.

There is a need to consider loading, means of escape and access. Each of these may have an impact on what can be achieved, in particular if intrusive works on heritage fabric are to be minimised.

In the UK where there is a change of use then the current regulations will be deemed to apply, although this is not the case where the original use is retained. This can raise some interesting issues where use has changed several times in the lifetime of a building.

The code requirements for imposed loading can be unduly onerous. It may mean that there is a need to look at, for example, not just the intended use of the building overall but the use of specific areas and agree imposed loads on almost a room-by-room basis. There is at least one example – and likely to be others – of a fine Grade 1 listed building in London where loading restrictions mean a limit on the numbers allowed at functions within one of the main rooms.

Working on existing buildings in general carries a number of unknowns in terms of scope and cost, and the work involved in adapting a heritage building for re-use is a specialised case of such work – the different items in very simplistic terms being the requirement for craft skills, materials that may be less commonly used or available, and the time taken for agreement with heritage authorities.

The process of appraisal has been well described in a number of what are probably accepted as standard references, with BRE Digest 366 (Structural appraisal of existing buildings for change of use) [8] providing specific guidance when change of use is intended. These provide the basis for underwriting the current condition of a structure and its ability to withstand the intended future use, focusing on the key aspects of performance identified above.

2.2. Design Life

While information exists on technical aspects of appraisal and change of use, these do not provide explicit guidance as to the anticipated future life of the structure, or its resilience in relation to, for example, the change in environmental loads due to climate change. There is an implicit assumption that provided an adequate appraisal has been carried out and the structure is inspected and maintained consistent with its environment and use, then there is generally a long life expectancy. The importance of regular inspection and maintenance is emphasised.

For older buildings the idea of design life is less likely to have been an explicit consideration, although in many cases the local materials used were inherently durable, the standard of workmanship was often (but by no means always) high, and with appropriate care these have lasted well. The areas where this is not the case are well documented – timbers built into solid walls, iron and early steel where moisture has been held against the structure, use of poor quality bricks where hidden from view, failure to keep water away from susceptible materials, even fabric prematurely damaged by inappropriate intervention in the more recent past.[9]

One approach is to invoke the 'hundred year' rule, whereby it is held that if a building is not showing signs of distress and the following all apply:

- There is an identifiable stability system;
- It has stood for a hundred years; and
- The imposed loads do not change,

then provided it is well maintained it should continue to perform satisfactorily. It might be argued, however, that this would not stand good for all time in all cases, as there is a natural process of material change, some of which cannot be seen, and the impact of, for example, cyclical movement may equally be both deleterious and undetected. This suggests, as has been pointed out by others, that there remains ample scope for studying further the behaviour of historic structures and developing a more defined system of assessing future performance. It also has to be emphasised that for materials where brittle failure occurs, with cast iron being a prime example, the 'rule' is not safe and it must not be applied blindly. Past performance may not always be a satisfactory guide [10].

The concept of an explicit design life is something which has entered the vocabulary of the structural engineer relatively recently, probably within the past thirty or forty years or so.

For an existing structure undergoing refurbishment it is possible to define the design life according to modern standards for elements of new construction. For the retained structure however, which might typically be expected to be the majority (other than for works such as façade retention), the residual life can only be determined using an appropriate process of appraisal, incorporating investigations as are deemed to be necessary and accepting a [limited] degree of residual risk. The strategy for such justification needs to be established for different elements of the structure, depending on the material/use/condition and the anticipated environment in which it will be used and maintained.

3. CASE STUDIES

3.1. Trinity College of Music, Greenwich

Trinity College of Music is a good example of a complete change of use – and not the first in the life of the building. It illustrates well the various stages of investigation and appraisal that were identified earlier.

King Charles Court is part of the Maritime Greenwich World Heritage Site and is Grade 1 listed. After extensive structural refurbishment it reopened as Trinity College of Music in October 2001.

It was originally built as a Royal Palace for Charles II but never occupied and instead used as a Royal Hospital for naval seaman until 1869. For the next 125 years it was part of the Royal Naval College. During this period changes took place, including extensive alterations to the floors, addition of new wings and substantial rebuilding of the Western Range (originally completed by Wren in 1698), as shown in Figure 3 below.

The main ranges were originally the hospital ward blocks. The circulation routes between the pavilions and the main ranges were not ideal for the new single use proposed, and required careful consideration in relation to retention of original or otherwise significant fabric.

Repairs, strengthening and alteration works were undertaken to extensive areas of these floors during the mid and late 20th Century; these were principally to the second floor of the Eastern Range where large areas of the existing construction were replaced with reinforced concrete construction. Elsewhere, and particularly in the first floor of the Eastern Range, steel beams were introduced at that time to supplement or replace original primary timber beams.

As part of the proposed conversion works at the very end of 20th Century a number of investigations were required to determine structural details. As a Grade 1 listed building any intrusive investigations required heritage consent, and throughout the course of the project there were continuing discussions with English Heritage.

Fig. 2 King Charles Court, Greenwich

The investigations were carried out in two phases. An initial exercise consisted of simple operations such as lifting floor boards to check timber floor joists in a few locations. The second phase built on that, with intrusive investigations such as trial pits and masonry coring. Based on these investigations an extensive 'library' of details was developed, showing repairs, strengthening, formation of openings etc, both typical and location-specific.

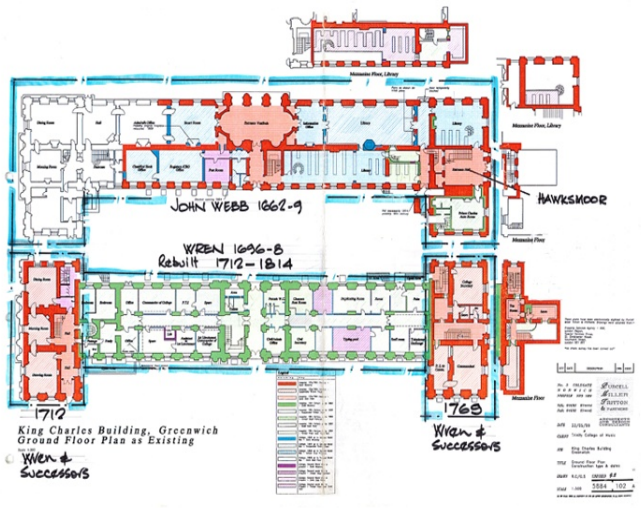

Fig. 3 Development of King Charles Court at Greenwich

As an educational facility and music school it required both a library and practice rooms. For the former floors were strengthened and for the latter independent acoustically isolated structures were installed on the existing floors. In both cases the principle was to add to existing structure rather than alter or replace, and the details developed permitted removal of the additions at some time in the future if required. In general however an important element in developing the design of the new facility was the attempt to match new uses to previous in terms of likely imposed load so as to minimise any changes to the structure.

3.2. St Pancras Renaissance Hotel

This is a further example of a Grade 1 listed building which has had several changes of use in the 150 years since its original construction as the Midland Grand Hotel, designed by Sir George Gilbert Scott. The hotel formed the frontage to the new long-span arch structure at St Pancras Station, which was under construction at the time.

This red brick structure, comprising generally six storeys and two levels of basement with a tall clock tower on the east side, housed what was in its day a high quality hotel with more than 400 rooms, a spectacular sweeping cantilever stone staircase and an early example of a hydraulic lift. By the mid-1930s it was deemed to be too dated to operate successfully as a hotel and too expensive to modernise. It was taken into use as railway offices, known as St Pancras Chambers, but was once more vacated when it was judged to no longer meet fire regulations. The years when it then stood empty led to severe deterioration externally and damage to fabric internally.

Of various plans put forward for its future it was the proposal by Manhattan Lofts to restore it to its original function as a high class hotel which was adopted.

Much of the building has fireproof floors, incorporating a proprietary system developed by Moreland. This comprises timber floorboards on bearers, laid on coarse lime concrete on corrugated sheeting which in turn is supported on wrought iron bow trusses. The plaster ceilings are supported by timber joists attached to the underside of the trusses.

Parts of the Moreland floors were found to have deteriorated significantly due to long-term water ingress and required replacement. Investigations were carried out to determine the extent of damage to the floors and the areas where repairs were needed. The form of the floors also required the arch thrusts to be catered for in areas where adjacent bays are removed, for example to install new lifts. The details for temporary works had to be developed to accommodate this scenario – just one aspect of the structural details that were needed for this project.

The appraisal of the structure required an understanding of the various materials and their use, their present condition and the loadpaths within the building. Testing of the concrete from the Moreland floors (cored samples), the wrought iron (tokens) and masonry from the walls was carried out. The concrete gave a spread of results, which is not surprising given the nature of the material, consisting of crushed, varied aggregate in a weak matrix of essentially lime with some indications of Portland cement; the wrought iron tests gave ultimate strengths in a range around 400N/mm2, allowing a safe working stress to be derived with appropriate factors of safety according to standard references, while the masonry tests gave reasonably consistent results from which design strengths were adopted for walls of less than two bricks thickness and those of greater thickness. In addition, detailed investigation of the timber has been carried out, in particular the roof trusses [9].

It has also been necessary to address the requirements of current building regulations, with those relating to fire, services and staircases and balustrades having some of the greatest impact. For the latter, the issues were those of balustrade height and ‘open-ness’; the latter was a particular issue for the ‘back of house’ staircases. The requirements were addressed by raising the balustrades and adding mesh in-fill panels.

3.3. Sun Yat Sen Museum, Hong Kong

The Sun Yat Sen Museum in Hong Kong occupies a building constructed as Kom Tong Hall between 1914-1917 and refurbished in 2004. It was originally built for a private owner and then acquired by the Mormon Church, so over the hundred or so years since construction it has already had both a change of use and some alterations, although kept substantially intact. Like St Pancras Chambers it had been threatened with demolition, in this case despite its listed status.

It has three storeys with a semi-basement and is built of structural steel with brick and stone masonry, which was very much state-of- the-art in Hong Kong the early 20C .The building was given Grade II historic building status in 1990 in recognition of its ‘historical and architectural significance’. A detailed description of the building and the refurbishment works was given in a paper presented at the Conservation of Heritage Buildings Conference in Hong Kong on 16 May 2007 and subsequently in an edited version of the paper which was published in The Structural Engineer in October 2007 [11].

A thorough structural survey including materials testing was carried out; as noted earlier this is a general requirement for such work but essential in the absence, as in this case, of archive drawings or other information on the structure. Tests were carried out on the concrete slabs, including test samples from the cold worked wires used as reinforcement in a somewhat novel system described further in the paper referenced here. In addition, a full-scale static loading test was carried out to verify the ability of the slabs to carry the additional imposed load required for museum use.

Repairs and remedial works were carried out to address corrosion of the steelwork and some localised deterioration of concrete. Part of the timber staircase had been weakened by termite attack, which was remedied by replacement of a section of timber.
In this case the issue of Building Regulations as applied to staircases and balustrades was addressed rather differently from the solutions at St Pancras Renaissance Hotel. A new staircase in structural steelwork was inserted in an area of lower heritage value, and a lift for disabled access was similarly sited, although this posed a number of technical challenges. For the grand timber staircase, in order to allow its use as an escape stair without modification to the balustrade, the number of museum visitors was limited and "management measures" were introduced to "discourage visitors straying too close to the edge" [11].
The three heritage buildings described here form a tiny proportion of instances where cultural heritage has been preserved and given a viable economic future through a process of defining a change of use and the alterations and repairs necessary to enable this. There are clearly some common factors, but in each case there has been a particular assessment of the key cultural significance and how this can best be preserved with minimum intervention to heritage fabric.

4. CONCLUSION

It is unlikely that in many cases a future will be enabled for cultural heritage buildings without acceptance of some change, be that alteration or addition to the fabric, change of use and incorporation of attendant requirements, or some combination of these. There is a need to introduce some rigour into determining what is acceptable in terms of change in order to avoid damaging, diluting or losing essential elements of cultural heritage. It is also important to recognise that such change may be only the latest in the history of the building and that without it, crumbling and eventual destruction, to use Eliot's description, may be inevitable.

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