IDENTIFYING HERITAGE VALUE IN URM BUILDINGS

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Tribute: Dr Garry Tonks died suddenly at home on 21 April 2009. Garry taught architecture at the University of Auckland for 18 years, is a past president of the New Zealand Timber Design Society, and most of all was a friend and mentor.

ABSTRACT

A large number of the heritage buildings[1] in New Zealand are constructed from unreinforced masonry (URM). These buildings were not designed to resist seismic loads and now pose the highest earthquake risk of any building type due to the inherent weakness of the material and several key structural deficiencies.[2] Many of these buildings will require seismic retrofit in order to meet the requirements of The Building Act 2004. URM buildings are a salient part of the culture and landscape of New Zealand, and it is vital that their important aspects are identified prior to any strengthening work.[3] This identification process will inform the selection and design of an appropriate seismic retrofit intervention and ensure that a solution which is sympathetic to the heritage and aesthetics of the building is achieved. The primary aim of this article is to reconcile the engineering goal of seismic strengthening of at-risk heritage buildings with the architectural goal of ensuring that their historic and aesthetic qualities are retained. This article is intended to assist structural engineers in recognising the important heritage aspects of URM buildings, but it is emphasised that this is not a substitute for the engagement of a professional heritage consultant.[4]

1.0 INTRODUCTION

New Zealand's URM historic buildings form a rapidly diminishing aspect of the nation's collective heritage, which is a physical link to the past and provides valuable evidence of cultural progression. There is a real danger that if insufficient consideration is given to the historic and architectural qualities of these buildings, seismic retrofit interventions may cause visual damage or remove important historic material. Indeed, this has already occurred many times in recent history.[5] In the authors' view, some of these retrofits, while possibly resulting in safer buildings, have had an overall detrimental effect.

The historic value of the surviving URM building stock is slowly becoming recognised[6] and some buildings have been protected from alteration by heritage legislation and organisations. The Historic Places Trust (HPT) is required by the Historic Places Act 1993 to maintain a register of recognised heritage buildings, and acts in the interests of their conservation when any significant alteration is proposed.[7]

Figure 1. Streets in Auckland where the character of the streetscape is largely provided by URM buildings

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However the HPT has limited resources, so only the most historically and architecturally significant buildings tend to be protected. Many other URM buildings also have significant historic value and contribute greatly to the character of towns and cities, but are offered no protection from demolition or significant alteration. It has been advocated in the past that demolition of these buildings is the preferred solution to their structural inadequacies, regardless of any positive attributes that they may have.

The aim of this article is to assist in the protection and retention of historic URM buildings which otherwise are prone to destruction in an earthquake, and to safeguard human life in the process. Unfortunately as all historic buildings are different, there cannot be a standard response in all cases. This article has been conceived as an aid to Engineers to understand important architectural ideas; and serves as a conceptual rather than a practical guide to retrofit technique. It is also an attempt at marrying the seemingly disparate goals of an efficient engineering solution with an appropriate architectural solution and a sensitive heritage solution.

2.0 HISTORICAL APPROACHES

Advances in seismic engineering in New Zealand between about 1960 and 2000 have tended to focus primarily on maximising life preservation and minimising costs.[8] This has led to a mindset where the building is often considered to be a liability, where interventions have therefore been undertaken without consideration of the architectural impacts of the improvement measures, or preservation of the building fabric after the event of an earthquake.[9] Rather than working with the materials which are present, designers have found it easier to add a modern structure around the original building, often with inadequate consideration of composite action or stiffness compatibility.[10] A scarcity of any real guidance on the analysis and treatment of historic URM buildings may well have contributed to this evolution.

A number of seismic retrofits were documented during the 1980s which tended to largely prescribe coating the inside of the walls with sprayed concrete to form shear walls, and upgrading diaphragms, which, while effective in increasing strength, permanently covered much historical evidence on the inside of the building and changed internal surfaces and room volumes. Some of the less sympathetic retrofits advocated removal of 'inconvenient' historic fabric as a matter of course, altered interiors so as to make them unrecognisable, and were almost completely irreversible. Some retrofits also resulted in changes to the technical performance of a building, in some cases rendering them uninhabitable. This has created numerous problems, as the value of some of these buildings has now been recognised and steps are being taken to restore them to some semblance of their former aesthetic and function, but the retrofit alterations hinder every step of this process. The Napier School of Music (Figure 2) is an example of this; a retrofit removed most of its exterior decorative character defining elements, which transformed a remarkable building into an unremarkable one. Work has been done to attempt to return the building closer to its original form, but the historic material is irrecoverable.[11] Similarly, the conversion of the Cranmer Square Normal School in Christchurch (Figure 3) into luxury apartments involved almost total loss of interior character and of the relationships between interior spaces, as the interior surfaces were covered or replaced, and much of the historic material was removed.

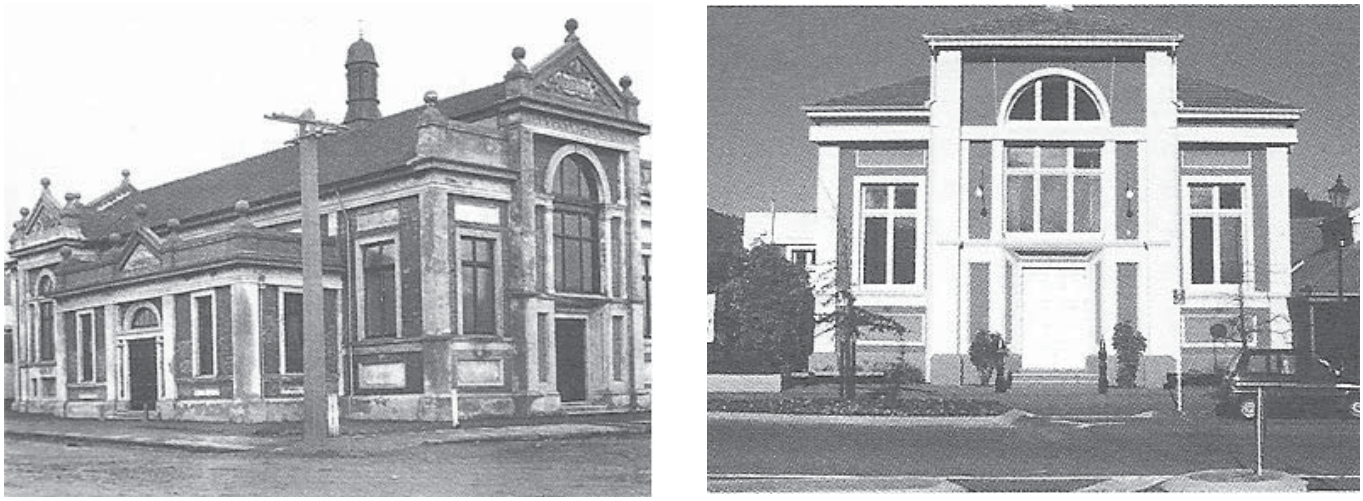

Figure 2. Napier School of Music before and after retrofit (reproduced from Robinson and Bowman)

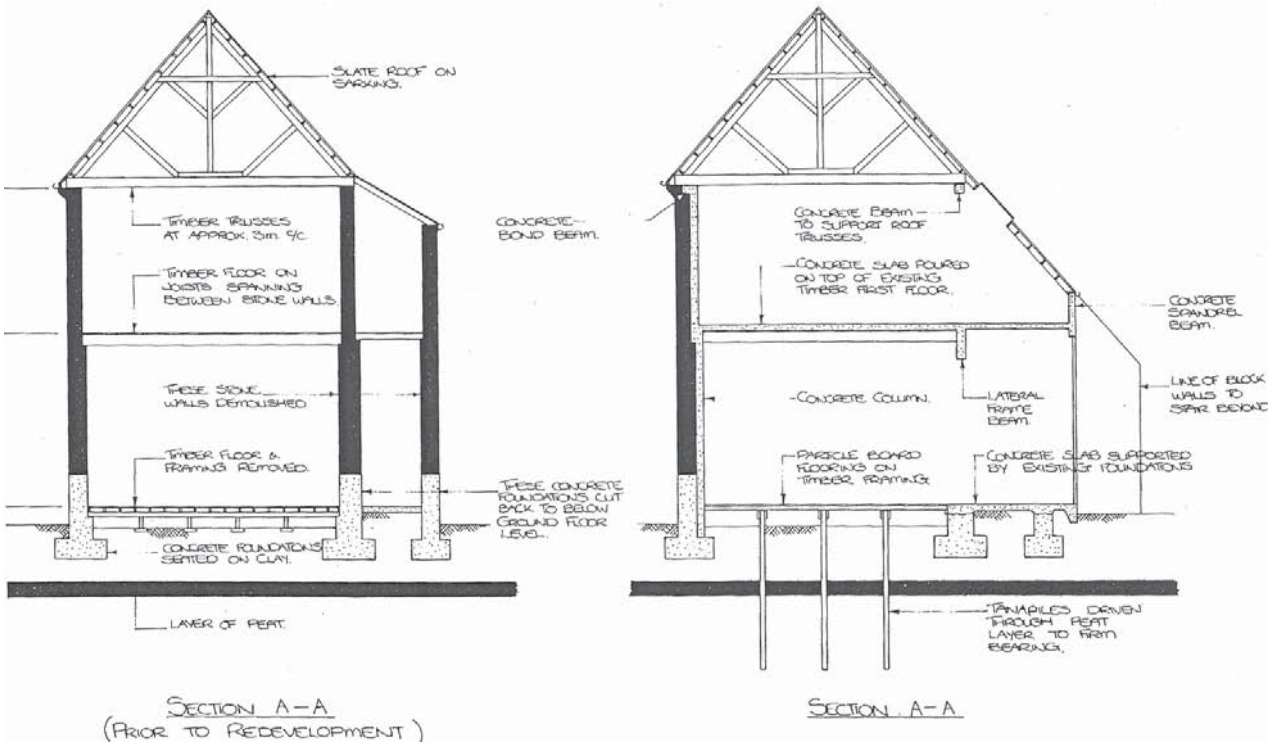

Figure 3. Before and after cross sections through Cranmer Square Normal School, Christchurch (reproduced from Wilby, 1983). Strengthening and changing use of the building has completely changed the interior layouts and surfaces and removed a large amount of the historic material.

3.0 HERITAGE AND CONSERVATION

In New Zealand, acts which seek to prolong the useful life of a building while respecting its history and originality are known collectively as conservation, and seismic retrofitting falls, or by virtue of its conservation goals should fall, under this category. A successful act of conservation will ensure that a heritage building is treated with care in order to preserve its historic fabric and aesthetics to the greatest extent possible. New Zealand has its own particular history of development of heritage principles, and its own set of unique problems in conservation. This history and the present day environment resulting from these particular issues have been amalgamated with broader international principles and adapted specifically for use with New Zealand buildings in a document produced by the International Council on Monuments and Sites (ICOMOS) *New Zealand Charter for the Conservation of Places of Cultural Heritage Value*.[12] This Charter forms the current foundation of heritage conservation in New Zealand.

Seismic improvement of unreinforced masonry (URM) buildings is likely to require invasive work and additional structure which could fundamentally change the character of a building. Before engaging in any such work, it is important to understand the underlying principles of good conservation practice in order to ensure that buildings and sites are sensitively treated and their future integrity can be assured. It is also important to understand that there is more to a building than simply its physical material. This intangible component is comprised of concepts such as its history and social use, and spiritual significance of the place, which are essentially what the building means to an observer or group at a point in time. When combined with the physical elements, these are collectively known as its heritage value.[13]

3.1 Heritage

Heritage as a concept is the collection of things which relates people to who they are, where they have come from, and why they are the way they are. The cultural aspects of heritage relate to human activity, namely; historical, archaeological, architectural, aesthetic, scientific, spiritual, social, traditional, or some other special cultural significance.[14] These aspects represent the ideals of people and help to define who they think they are, so heritage can be said to be a collection of items which represent individual and group histories.[15] This knowledge is important in order to gain an appreciation of sense of place and culture, and enables people to better understand the greater physical and cultural environments in which they live. Heritage can also be a useful way of defining identity, as well as serving as a cultural record. It also implies a gift for future generations and for the benefit of communities, in terms of both physical and cultural inheritance. It can be said to be a mark left by a bygone era which one can identify with, respect, and which can help people to understand their history.

The influence of cultural heritage is great; it links people to the past, and gives them a sense of place and progression. However, its influence is also subtle and intangible, and has

often not been given the recognition which it deserves. There have been a great many theories on the treatment and protection of cultural heritage, particularly buildings and artworks, throughout history. Some of these have been considerate and respectful, and others destructive and oblivious.[16] Debates on the importance of cultural heritage and its deserved treatment continue to this day.

3.2 Conservation

Everything which is made has a relationship to the past, as something has always come before which has informed it or set a precedent. As time passes, buildings of a certain type or character become increasingly rare, and as such their social value for heritage or scientific purposes increases. The ICOMOS New Zealand Charter explains that the purpose of conservation is to '…care for places of cultural heritage value, their structures, materials and cultural meaning.'[17] In general, such places:

i. have lasting values and can be appreciated in their own right;

ii. teach us about the past and the culture of those who came before us;

iii. provide the context for community identity whereby people relate to the land and to those who have gone before;

iv. provide variety and contrast in the modern world and a measure against which we can compare the achievements of today; and

v. provide visible evidence of the continuity between past, present and future.[18]

Conservation encompasses all acts which prolong the life of cultural and natural heritage with a view to ensuring that it is able to be appreciated by future generations, and maintained in a state in which it can continue to communicate heritage value. For a building, conservation ought to preserve (and potentially enhance) the historic narrative, allow it to have a continuing useful life, and retain its value for its owner and the community into the future.[19] Thus it becomes important to evaluate the building or site in order to discover just what its heritage value is, and consider taking action to conserve it if required. There are several main factors which contribute to overall heritage value, all of which relate in some way or another to the relative rarity or uniqueness. Bowron and Harris (1994) defined these values below:

Social: The notion of a spiritual, traditional, political, national, or any other cultural sentiment expressed by a group.

Aesthetic: Considers the formal qualities of the fabric and setting; the form, scale, materials, space etc. It addresses the design and cultural aspects of the place.

Scientific: Is concerned with the importance of the place as evidence and with the physical survival of that evidence in the fabric. Scientific value is the potential to provide information about past human activity. This may encompass technology, archaeology, philosophy, custom, taste and usage as well as technique or material.

Historic: Is the ability to demonstrate an association with persons, ideas, or events. It includes the history of all the above concepts.[20]

These values apply to parts of sites and buildings as well as to the whole, so a particularly beautiful historic staircase will have strong heritage value, which will add to the site as a whole; even if the building which contains it is of comparatively low value.

The NZ Charter outlines conservation principles which meet the unique cultural requirements of New Zealand and suit its particular stock of historic sites.[21] To date this is the best and most comprehensive document relating to conservation principles in New Zealand and should be considered as the basis for all conservation work while it remains so. It is important to note however, that the NZ Charter is a series of guidelines rather than mandates; almost all heritage projects will require some degree of compromise in order to arrive at a practical and practicable solution.

All conservation projects should have their cultural heritage value identified and defined in order to establish which aspects are most important. On larger scale projects, this is usually contained within a Conservation Plan, which is a document authored by a conservation professional which serves to also suggest strategies for protecting these important elements, and for managing potential problems. There are a number of general principles which guide the approach to conservation, outlining the responsibilities of the conservator when planning conservation work; in essence describing the desirable traits of an act of conservation. The outcome of a conservation project should be consistent with the cultural content of the place. Thus, relevant influence and cultural factors shall be considered in the planning stage and the scope and scale of the result should not be greatly removed from the scope and scale of the original structure. Conservation should:

- Make use of all relevant conservation values, knowledge, disciplines, arts and crafts;

- Show the greatest respect for, and involve the least possible loss of, material of cultural heritage value;

- Involve the least degree of intervention consistent with long term care and the principles of this charter;
- Take into account the needs, abilities, and resources of the particular communities; and
- Be fully documented and recorded.[22]

In addition to these principles, the conservator ought to respect a building's alterations and additions as they are part of the ongoing history of the building, and should only be removed where they significantly inhibit its heritage value or meaning. This also extends to evidence of age; it is desirable for an old building to look old, and as such the marks of age should be considered as integral with the fabric of the building. Sometimes alterations will detract from the heritage value of a place, but this cannot be said categorically and investigation should always be done. Similarly, the contents and setting of a building will often take on heritage value of their own and as such need to be considered as integral with the building for purposes of conservation.[23] Risks from natural processes or events need to be assessed, and plans formulated for their mitigation.[24] These might range from ground subsidence to fungal attack to earthquake, all of which can have damaging effects on historic buildings. This latter aspect is particularly pertinent to this article, which aims to minimise the adverse effects of earthquake strengthening work upon heritage buildings.

All new work on an historic site should be distinguished as being new work. This ensures that future generations examining the building will have no difficulty determining which parts of a building are original and which are later additions or changes. The materials and style of alterations ought to be significantly different in order to best express their separation in time. This work also should be reversible[25] to allow for imperfect solutions. The ideal solution will almost never be arrived at either due to lack of technology or funding. If at some time in the future this solution is possible, it ought not to be prejudiced by a previous solution.

The reality of conservation is that experts are only consulted some of the time; public bodies and some developers will commission conservation plans, but many projects go ahead without the benefit of these. While New Zealand possesses a series of principles in the New Zealand Charter that are well founded in established international theory, the sympathetic treatment of heritage is still not guaranteed by legislation or by popular opinion. Many property owners and developers are either ignorant of these principles or choose to ignore them, and until they are universally adopted there will continue to be demolition and destruction of valuable cultural heritage. Current legislation is inadequate to fully protect heritage buildings or ensure that all changes are undertaken in the spirit of the Charter.

4.0 ARCHITECTURAL CHARACTER

Every building is unique and possesses many attributes that help to define it as being distinct from all others, which are collectively known as its character. Architectural character is the physical presence which gives a building this distinguished quality. It is defined by the building's overall shape (architectural form), its materials and methods of construction, the size and arrangement of openings and projections, the interior spaces and relationships between these, and the setting and surroundings of the building.[26] In an old building, preservation of architectural character is particularly important, as its character differentiates it from modern buildings.

There are also many facets to physical understanding, beginning with the overall definition of the building style, material and type. It may typify a period of construction, which usually relates to an architectural style, or exemplify construction in a certain material, or represent a particular type of building.[27] Style and archetype will not necessarily affect the specific treatment of a building, but will provide background information as to its degree of importance and aesthetic qualities. Once these characteristics have been established, further distinction can be imparted by examining the architectural form, site, construction technique, material use and craftsmanship, evidence of age, furnishings, and decorations.

It is recognised that in many cases, time and resources will not allow for an extensive investigation of architectural and historic significance.[28] The technique outlined below considers only the physical and tangible attributes of a building; the parts that can be seen and appraised, and constitutes a basic level of analysis, but it is simple and is able to be performed relatively quickly.[29] In some cases, where a building is architecturally unremarkable and is of little historical interest, this will be an adequate investigation; however it is emphasised that all old buildings will possess some degree of historical significance, and unless research is done, the extent of this significance may not be properly identified. Recognition of character is an imprecise practice, and as such there will always be some debate as to what constitutes an important element.

4.1 Overall Visual Aspects

The first step when analysing architectural character is to view the building from a distance, and walk around it if possible to view it from each side to ascertain its dominant features. Some sides will be more important than others, but this is not to say that rear walls have no value; merely that they contribute less to the overall character than a decorative street façade. The purpose of this exercise is to identify the elements that make up the architectural form, which is essentially the combination of shape, size, colour, texture, and organisation,

Figure 4. Primary form of a URM building in Auckland. At this stage the basic shape and the broad gestures that make up the building are noted. In this case the building has a reasonably simple form and displays a typical 3 part vertical hierarchy

that makes the building identifiable as this particular building. The overall visual picture is established by considering the main features of the exterior of the building without concentrating too much on details; most of these will be immediately and easily recognisable. The primary form is defined by the outline of the walls and roof, as well as any projections such as balconies, porches, or chimneys, or where buildings are touching, by the edge of the change in material or style. The purpose of this exercise is to consider the geometric form of the building as if it were composed of simple blocks (fig. 4).

Next the elevations should be checked for elements that define their makeup; openings are important in this regard. The locations of the primary openings should be noted, along with the location and nature of the main entrance, the pattern and rhythm of windows, and whether these are regular or random, deep or surface set, or have any other distinctive features. URM buildings often have a series of piers with windows between which can form a defining pattern (fig. 5). Projections and recesses should also be noted, particularly further balconies and porches, arcades, and any dominant decorative features. The depth and articulation of the facades, in particular of elements such as piers, cornices, and windows, and the ways in which these elements are layered and relate to each other is an important contributor to the primary form. In essence, it is important that the facades are considered in three dimensions.

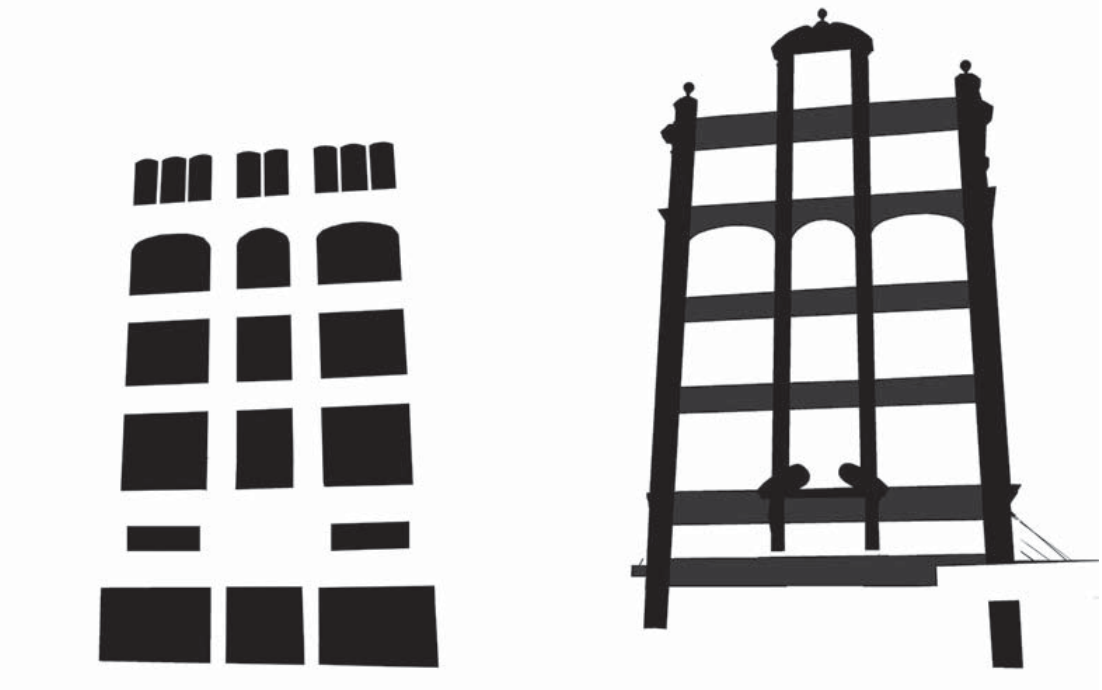

Figure 5. A study of the building's openings in two dimensions. This has been done firstly as the physical openings in the URM, and secondly as the forms surrounding the openings. Interfering with these patterns will change the way the building reads; something as simple as changing the colour of the window frames will bring these forward and make the openings smaller and less distinct

The roof can form a particularly important element, although this is less common in URM buildings. A visible roof with gables, dormers, chimneys, or an interesting surface material or pattern will be a strong feature for defining character (fig. 6). More commonly with URM buildings, the parapets will obscure a plain roof behind. The shape of the parapets should be noted, and their interesting features examined (fig. 7). Attention should be paid to materials and colours, particularly in the case of URM, as even subtle deviations from the original materials can stand out starkly on an otherwise uniform surface. Similarly, any ornamentation on the surface or surface features should be conserved wherever possible.

The setting of the building influences how the building is read, and therefore affects its character. A building in a garden setting is somewhat integral to that garden, and likewise a building within a row of similar buildings is integral to that row. Drastically altering the setting in which the building has come to be known will affect the character of that building (fig. 8).

Figure 6. Shed 13 on the Wellington waterfront, that features a distinctive roof that is integral with its character

Figure 7. A parapet that is integral with the design of the rest of the facade and which contributes historic information.

Figure 8. The Auckland ferry Building is integral with its waterfront setting and altering this relationship would remove historic meaning

Identifying the important primary elements that make up the exterior of the building will provide guidance regarding suitable retrofit techniques. A building with an exposed character brick exterior will generally be unsuitable for strengthening techniques involving exterior diaphragms or shear walls. The size and spacing of primary vertical and horizontal elements will inform the layout of potential moment frame or bracing frame solutions. Historically, façades have been considered the most important aspect of a building. Unfortunately, this belief has given rise to some particularly destructive treatments of buildings where the façade is preserved and integrated into a new modern building directly behind. While marginally better than complete demolition, this practice destroys all but a caricature of the original building and should be avoided. While the façades are important, the rest of the building is equally so; it is the interior that provides character for the occupants, and the arrangement and volumes of spaces that governs the experience that the building provides.

5.0 CLOSE UP CHARACTER

Once an inspection from afar has been completed, an inspection should be made at arm's length (where possible) in order to appreciate how the building has been constructed, and the particular characteristics that help to define its surface and details. The finer details of the colour of the materials should be noted; in the case of URM, the colour of the brick and mortar will hint as to its composition and origin, and the bond type will form a surface pattern. The shape of the bricks and striking of mortar may also be distinctive and character defining (fig. 9).

Weathering, alterations and demolition, and changes of size or demolition of adjoining buildings will all leave distinctive marks that indicate age. Attention should be given to the craftsmanship and craft details that have been employed. In some cases materials may have been employed in interesting ways that give the building an individual character, or some other small detail may make a significant impact to the way the overall building is read and understood.

This process will likely have less impact on the types of seismic retrofit techniques that may be used than when assessing the overall aspects, but will provide information on the construction of the building. Some façades that look undistinguished from afar may contribute more to character or have more significance than previously thought.

Figure 9. Details of openings. Things to take note of here are the bond pattern and technique used for laying bricks, colouring, striking of mortar, changes in surface, recesses and depressions, and proportions of windows and other components

6.0 INTERIOR SPACES

Defining the distinctive character of internal spaces can be far more challenging than for the building exterior. This exercise can also be done on two scales, as for the exterior assessment, except that enclosed spaces are three dimensional volumes as well as a series of surfaces. Sometimes the spaces themselves or the relationships between several spaces are important to the character and nature of the building; inspections of interior spaces should be carried out progressively by appraising each space in its entirety before moving to the next.

The first step is to identify primary spaces. These are essentially the spaces that are important to the function or feel of the building. In many buildings this will be the first space you enter from the street; a lobby or circulation space is often designed with special treatment as it provides the first impression of the building. Such spaces should be analysed and their proportions, shape, ceiling height, and massing of elements recorded, as well as any large features such as stairways or columns that help define them. There will often be a series of interrelated spaces that also help to define the character and function of the interior of the building. Such spaces might include an atrium that connects to one or more circulation spaces, or prominent stairways that in turn connect to a mezzanine. All of these spaces are individually defined in their own right, but the visual relationship between them is important to the extent that to significantly alter one of these spaces would affect the others (fig. 10). Sequentially important spaces will often involve a primary circulation route, although this is not always the case. Another way in which spaces can be related is through their relationship with the function or type of the building. For example in a church there is often a long, tall nave that is flanked by two shorter aisles that are separated from the nave only by a row of columns. These columns are a sufficient barrier to signify the boundary between two distinct but related spaces. If the spaces between the columns were filled in, or extra columns added, this would not only fundamentally alter the spatial feel of the building, but also affect the ability of the building to be read as a church.

Once spaces have been considered, interior surfaces and features need to be appraised. This process is similar to that undertaken on the exterior. Important interior features are original or historic elements that add to the feel of the space; these might include fireplaces and their mantelpieces, decorative ceilings, mouldings, or panelling, lighting fixtures, elevator doors, and open stairways. Many buildings will possess all of these features in some form; to determine their importance, consider whether the space would have the same historic qualities if they were removed.

Many heritage buildings, industrial buildings and warehouses in particular, are likely to feature open plans with extensive exposed structure. In these cases, the exposed structure forms an integral part of the industrial nature of the building and therefore contributes to defining of its character. Exposed brick load bearing walls, cast iron or steel columns, timber or steel roof trusses, posts and beams, and stone foundation walls were all designed to be seen and expressed as part of the nature of the building and it is important to the architectural character that they remain so.

Figure 10. Arcades in Auckland with complex spatial relationships where blocking lines of sight between spaces or impeding established pedestrian routes will have significant negative effects.

7.0 OTHER CONSIDERATIONS

The character of the place as it exists is formed by the visible material in the present; however each historic building will have a long history, often involving renovations and alterations, wear and tear, disaster damage, or removal of some features. For these reasons, it is important to attempt to gain a historical knowledge of the building as well as knowledge of its present state. This knowledge will help to further understand the character of the building, and help inform the design of retrofit solutions. The developmental sequence of the place can be important; there are a series of events in the development of any building that will affect its current state. In the late 1970s and early 1980s, a number of New Zealand buildings had character-defining towers and parapets removed in response to fears about their seismic safety, rather than being strengthened by retrofit.[30] These elements could possibly be reinstated if they still exist, or allusions made to their existence in subsequent treatments.

The functions of the building or parts of the building can influence treatment, even when these have little physical manifestation within the building itself. An example of this is the series of buildings that are now known as Victoria Park Market in Auckland City. This complex began life as a waste incinerator and refuse collection depot, but fell into disuse and was converted into a marketplace in the 1980s.[31] Even though the buildings retain much of their industrial character and possess little to distinguish them as markets, they are now known collectively as Victoria Park Market, and it is impossible to separate this new use from the original industrial use of the buildings in their history. Any proposed development or retrofit would need to consider the full history of the buildings, paying heed to both their marketplace and industrial uses.

8.0 RETROFIT TECHNIQUE

Once a building has been identified as a seismic risk, a more thorough investigation is required. It makes sense at this stage to establish a detailed picture of its intrinsic seismic resistance, and assess whether simple measures that address basic inadequacies could be undertaken to give significant increases in strength. This will ensure that the existing fabric is retained and utilised as much as possible and will minimise the extent of required additional measures. It is generally considered that a progressive approach to strengthening is appropriate, calculating the resistance of progressively more extensive configurations to establish the most effective and sympathetic approach.[32]

A basic reading of the architectural character of the building will often assist in deciding on an appropriate approach, and an appreciation of which parts of the building are visually important will inform which strengthening techniques will allow a sensitive solution. By considering the elements that form a building, a practical appreciation can be gained of its character, and understanding will be gained of exactly what is important about it architecturally. This will give cues as to the type of strengthening systems that might be appropriate.

Most solutions will result in some visual impact to the building; invisible strengthening solutions are generally the safest option for visual impact, but these are often precluded by some other consideration. Of visible solutions, the best option will work with the existing material if not to blend in, then to complement the architectural character. In situations where strengthening work cannot be hidden, an appreciation of the architectural character will assist the designer in deciding on ways to incorporate visible strengthening that does not detract from the building.

There is a perception that façades, the public faces of buildings, are the most important aspects when considering a retrofit, although this is arguable. This means that many improvements are installed within the building's interior. The spaces, surfaces and materials will provide information about where and how these might be undertaken in a sensitive manner. For example, it would generally be poor practice to insert a large steel K-brace in the middle of a primary circulation space or lobby, and a fine decorative wall covering would suggest that an internal concrete shear wall is not an ideal solution. A sound understanding of architectural character will help to furnish the designer with relevant knowledge in order to exercise good judgement in determining how to best deal with the problem of retrofitting.

Once it has been accepted that seismic improvement is required, it is necessary to determine the required extent, and the methods that are appropriate to a particular building. Generally, this analysis is undertaken in stages, beginning with assessing the architectural character of the building, then addressing the basic known inadequacies of URM construction, then determining what types of additional strengthening systems are appropriate. There are myriad approaches and options for the strengthening of URM buildings. The first step that should always be taken is to establish the building's intrinsic resistance and utilise this to the greatest degree possible. In the likely event that this proves to be inadequate, this resistance should be enhanced by sensitively upgrading connections and other basic URM inadequacies using current best practice, or by creating new techniques. Strengthening is a complex art, and balancing visual impact with economy, reversibility, and architectural expression is a delicate act, but one that is possible in most situations, and one that ought to be the aim of all retrofits. With skill and care, a good solution can almost always be reached.

9.0 RETROFIT OBJECTIVES

Assessing the architectural character will establish the important features of the building. Many well-intentioned retrofits with clever engineering solutions have completely ruined the aesthetics of the building they were supposed to be protecting. There are sufficient strengthening techniques currently available for all retrofits to be reversible and sympathetic to architectural and heritage value. Strengthening of heritage buildings is difficult and sometimes it will be a case of selecting the least of several evils. Many approaches and options are available for strengthening URM buildings, and all solutions will result in some impact on the building, so the type of strengthening system used needs to be very carefully considered. The way it looks, how it connects, its impact on heritage material and on spaces, and its harmony with the historic aesthetic are all important considerations. Furthermore, strengthening technology is constantly improving, and it is vital that current best practice is understood. A summary of the basic considerations is included in Table 1 below.

The designer may wish to consider the building as a functional but potentially deficient system that can be modified by various degrees in order to improve its performance. There are several primary objectives to be considered when undertaking this process.[33] These are not rigid rules, but guidelines for achieving a sensitive solution, so there is always some leeway for alternative approaches and creativity. If the spirit of these guidelines is adhered to, generally a good outcome will be reached.[34]

Table 1. Retrofit Checklist

Knowledge of important characteristics of the building	• Allows the key features of the building to be identified. • Helps inform an appropriate solution that does not detract from the character or quality.
New work involves minimal intrusion	• Only adds as much as is necessary and changes as little as possible. • Can be flexible as sometimes more work can result in a better overall solution.
New work is reversible	• Allows for the imperfection of current technology and for future improvements. • Allows for the possible fallibility of the designer.
New work respects the integrity and character of the building	• Strengthening work should not detract from a building, or greatly alter or damage it. • Identifying architectural character assists with this, and informs the appropriateness of a solution.

10.0 CONCLUSION

There is now no question that something must be done about the seismic strength of a large number of URM buildings. They form a large proportion of New Zealand's heritage structures, and have far more importance to society than simply their functions; thus retrofit for seismic strength is not merely a nice idea, but a vital action. This need is further bolstered by recent legislation requiring action on buildings below a certain strength threshold, which includes most URM buildings. Aside from retrofit, there are two alternative options for these buildings: ignore their inadequacies and hope that there are no earthquakes, or demolish them now. Neither of these addresses the problem, and both are likely to result in an unacceptable loss of built heritage.

Retrofitting is potentially invasive and destructive; therefore a method should be adopted to guide the design and implementation of any intervention. Fortunately, a series of authoritative principles have been developed, and are prescribed in the ICOMOS New Zealand Charter for the Conservation of Places of Cultural Heritage Value. These can be summarised into four basic principles: know the important characteristics of the building; respect its character and integrity; only do as much as is necessary; and make new work recognisable and reversible.

The most important attribute that a designer can have is creativity. Conservation principles exist to inform the type of action that will result in a good solution from the perspective of conservation of heritage. Stringent adherence to these principles will not necessarily result in a solution that is good from an architectural or usability perspective. Sound judgment and design skill are required to deploy conservation principles with imagination and artfulness. The best strengthening solution will work with the existing material to complement the architectural character with a minimum of impact. There may never be a perfect solution or a single right answer; however, a solution that significantly works towards achieving the above goals can be considered to be a successful and effective intervention.

11.0 REFERENCES

1. It is noted that all old buildings hold some degree of heritage value, whether or not they are listed as heritage buildings.

2. For further information and general further reading, visit http://retrofitsolutions.org.nz/

3. 'Strengthening' is used in this article as a standard term that covers all work that serves to improve seismic performance.

4. Heritage consultants have at times been perceived to make the process of changing an old building complicated and costly. Ideally, a heritage consultant will inform their client of the important heritage aspects of a building or site, and suggest ways in which the required work can be undertaken in the most sensitive manner possible, resultingin beneficial cross-disciplinary cooperation rather than adversarialism.

5. Examples of previous retrofits are documented in the New Zealand Society of Earthquake Engineering Bulletin. See Christianson, John. "State Opera House – Upgrading." *New Zealand Society for Earthquake Engineering Bulletin* 16, no. 2 (1983): 175-178, Evans, D.S. "Strengthening of State Trinity Centre, Christchurch." *New Zealand Society for Earthquake Engineering Bulletin* 16, no. 2 (1983): 162-164, Leuchars, J.M. "The Use of Sprayed Concrete in the Strengthening of Earthquake Risk Buildings." *New Zealand Society for Earthquake Engineering Bulletin* 22, no. 3 (1989): 167-171, Taylor, J. M. "Cashfields Shopping Centre: Christchurch." NZSEE Bulletin 16, no. 2 (1983): 172-174, and Toomath, William. "Some Aspects of the Strengthening of Earthquake Risk Buildings." *New Zealand Society for Earthquake Engineering Bulletin* 12, no. 4 (1979): 287-288.

6. Gavin McLean, "Where Sheep May Not Safely Graze: A Brief History of New Zealand's Heritage Movement" in Common Ground? Heritage and Public Places in New Zealand, edited by Alexander Trapeznik (Dunedin, NZ: University of Otago Press, 2000), 41.

7. New Zealand Historic Places Act 1993 No.38 Part 3 Section 39.

8. A.G Cattanach, G.W. Alley, and A.W. Thornton, Appropriateness of Seismic Strengthening Interventions in Heritage Buildings: A Framework for Appraisal. Paper 30 presented at New Zealand Society for Earthquake Engineering Conference 11-13 April 2008, Taupo, NZ, 2.

9. Cattanach et al, 2.

10. Cattanach et al, 2.

11. Lou Robinson and Ian Bowman, Guidelines for Earthquake Strengthening. (Wellington, NZ: New Zealand Historic Places Trust, 2000). 5.

12. ICOMOS New Zealand Charter for the Conservation of Places of Cultural Heritage Value (1993): http://www.icomos.org.nz/nzcharters.html (accessed 13 May 2008).

13. Graeme Aplin, Heritage: Identification, Conservation, and Management (Melbourne: Oxford University Press, 2002), 14.

14. ICOMOS New Zealand Charter, article 22.

15. Aplin, 15.

16. An example of the type of strengthening thought typical of the late 1970's can be found in Smith, Ian C. "Our Old Buildings can be Safe in Earthquake (sic)." *New Zealand Society for Earthquake Engineering Bulletin* 12, no. 4 (1979): 289-291 where the removal of towers, chimneys, and even whole storeys is advocated. A better example of strengthening philosophy, in the authors' view, can be seen in Boardman, P.R. "Restoration of Old Auckland Customhouse." *New Zealand Society for Earthquake Engineering Bulletin* 16, no. 1 (1983): 73-79.

17. ICOMOS New Zealand Charter, article 1

18. ICOMOS New Zealand Charter, article 1.

19. Sarah Holman, Guidelines for Developing Heritage Buildings, (Wellington, NZ: New Zealand Historic Places Trust, 2000), 2.

20. Greg Bowron and Jan Harris, Guidelines for Preparing Conservation Plans, Wellington, NZ: New Zealand Historic Places Trust, 1994, 6.

21. ICOMOS New Zealand Charter, preamble.

22. ICOMOS New Zealand Charter, article 4.

23. ICOMOS New Zealand Charter, article 6.

24. ICOMOS New Zealand Charter, article 7.

25. The origins of this principle are explained in Alessandra Melucco Vaccaro, "The Emergence of Modern Conservation Theory" in Historical and Philosophical Issues in the Conservation of Cultural Heritage, edited by Nicholas Stanley Price, M. Kirby Talley Jr., and Alessandra Melucco Vaccaro (USA: Getty Conservation Institute, 1996), 207. It has been adopted into New Zealand current best practice and is also referred to in Lou Robinson and Ian Bowman, Guidelines for Earthquake Strengthening (New Zealand Historic Places Trust: Wellington, NZ, 2000), 4.

26. Lee H. Nelson, Preservation Briefs 17; Architectural Character (Washington D.C.: U.S. Department of the Interior National Parks Service, 1988), 1. Available at http://www.nps.gov/history/HPS/TPS/briefs/brief17.htm.

27. Nelson, *Preservation Briefs* 17, 1.

28. Kelly, Michael. "Building a Case; Assessing Significance" in Common Ground? Heritage and Public Places in New Zealand, edited by Alexander Trapeznik (Dunedin: University of Otago Press, 2000), 125.

29. This technique is borrowed from the United States Department of the Interior Preservation Brief 17 on Architectural Character. The methodology used is largely the same here, although the examples specifically reference New Zealand URM buildings and retrofits. See http://www.nps.gov/history/HPS/TPS/briefs/brief17.htm for further reading.

30. Ian C. Smith, "Our Old Buildings can be Safe in Earthquake(sic)" NZSEE Bulletin 12, no. 4 (1979): 290.

31. Jones, M. & Makintosh, L, "Auckland Municipal Destructor and Depot (former)," New Zealand Historic *Places Trust Register of Historic Places*, no. 7664 (2006): *http://historic.org.nz/Register/ListingDetail.asp?RID=7664&rm=Full&sm=* (accessed October 26, 2008).

32. Lou Robinson and Ian Bowman, Guidelines for Earthquake Strengthening (New Zealand Historic Places Trust: Wellington, NZ, 2000), 5.

33. Robinson and Bowman, 4.

34. Note that these guidelines are a heavily summarised reading of the ICOMOS New Zealand Charter for the Conservation of Places of Cultural Heritage Value.