On this auspicious Friday of Preservation Week, I thought it appropriate to look into the date, which was pointed out to me is something special: 5/15/15.

Zip Code for Griswold, Iowa

#1 hit on Google is a particular model of an oil filter (WIX 51515 spin on oil filter, pack of 1 for $9.04) followed by a brake control harness or Krylon 51515 Ivy Leaf Interior and Exterior Decorator paint and the IRS Form 990 due date.

5/15 is the birthday of Madeline Albright (1937) and the date 17 states implemented gas rationing in 1942, and Ebony & Ivory began a 7 week run at #1 on the pop music charts (1982), and the date of Nolan Ryan's first no-hitter (1973).

Perhaps most relevant, 51515 is a palindrome, as my son pointed out.

In the spirit of the palindrome, I will start with Nepal and return to it at the end again as well, though I can't guarantee that everything in the middle is the same if I went backwards.

Agenda

- Why?
- The Problem
- What is Future-Proofing?
- Future-Proofing the Arctic Building
- Future-Proofing and Life Cycle Analysis
- Future-Proofing and Traditional Building Materials and Methods
- Future-Proofing, Adaptive Cycles & Panarchy
- Implementing the Principles of Future-Proofing
- Conclusion

Figure 1: The Belvedere Castle by Calvert Vaux, 1869. Central Park, New York City, NY. Credit: Brian Rich, 2013

Figure 2: A woman praying at a temple in Nepal amidst the devastation after the 2015 earthquake. Credit: www.columbian.com.

In Nepal, the recent earthquake devastated villages, towns, and cities alike. Thousands of people are dead – and we mourn for them. Thousands of buildings damaged or destroyed. The economic damage to a poor region will take decades to recover from.

The Kathmandu valley lies at a historic crossroads of Asian trade routes, religion and cultures. Its monuments are internationally recognized as of unique quality and importance, mixing Indian and Tibetan styles as well as Hindu and Buddhist iconography. The kingdoms of the Kathmandu valley, fertile and well-defended, were among the most powerful and vibrant in south Asia when at their peak between the 15th and the 18th centuries.

Many of the UNESCO World Heritage Sites are temples and cultural centers for Nepal. Scores of globally significant monuments suffered badly too. In some waya, this is worse for the Nepalis than the family and friends lost because of the central part their faith plays in their lives. One Nepali is quoted as saying “So many things – religious, cultural, historical, social, economic – are interconnected here. This is a city for which the cultural sites are part of its skeleton. If you take them away, the city collapses.”

Lakshmi Shreshtra, a 71 year old Nepali woman, said the destroyed temples in the square had been “companions” since birth. “I played on them when I was a little girl. Young people meet there. Old people go to sit in the sun and talk there. I go every day to prayer there. Everyone comes together to celebrate our festivals there

The temples and carved wood and masonry artifacts are highly sought after on the international art market and therefore soldiers moved many into secure locations to protect them. Where soldiers are not available, unofficial neighborhood watch schemes have sprung up.

Nepal is an extreme example of loss. The examples I will offer today are smaller, simpler and less tragic, but are, nonetheless, representative of the loss of our cultural heritage.

I feel the same way as the shell shocked Nepalis whenever we lose a piece of our culture here in the Pacific Northwest. That a part of the environment or habitat which anchors me is lost. This environment gives security, comfort, and a sense of place. If you don't know where you are, says Wendell Berry, you don't know who you are. Beyond all of the sustainability and economics and resource shortage issues, this is why we must future-proof our built environment and why I believe future-proofing is important.

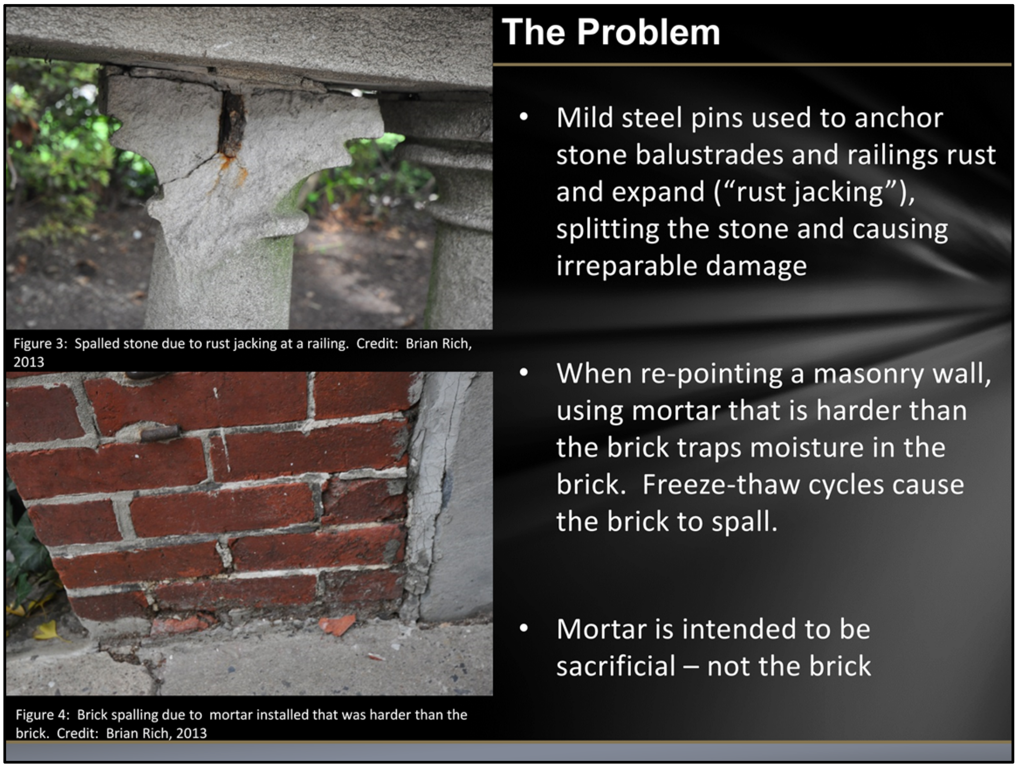


Figure 3: Spalled stone due to rust jacking at a railing. Credit: Brian Rich, 2013

Figure 4: Brick spalling due to mortar installed that was harder than the brick. Credit: Brian Rich, 2013

Too often, I have seen the decisions made by architects and historic preservationists cause further damage to our historic buildings. As I began my Masters degree research, one of my professors and friends, Kathryn Rogers Merlino, suggested I look into the topic of future-proofing.

The Problem

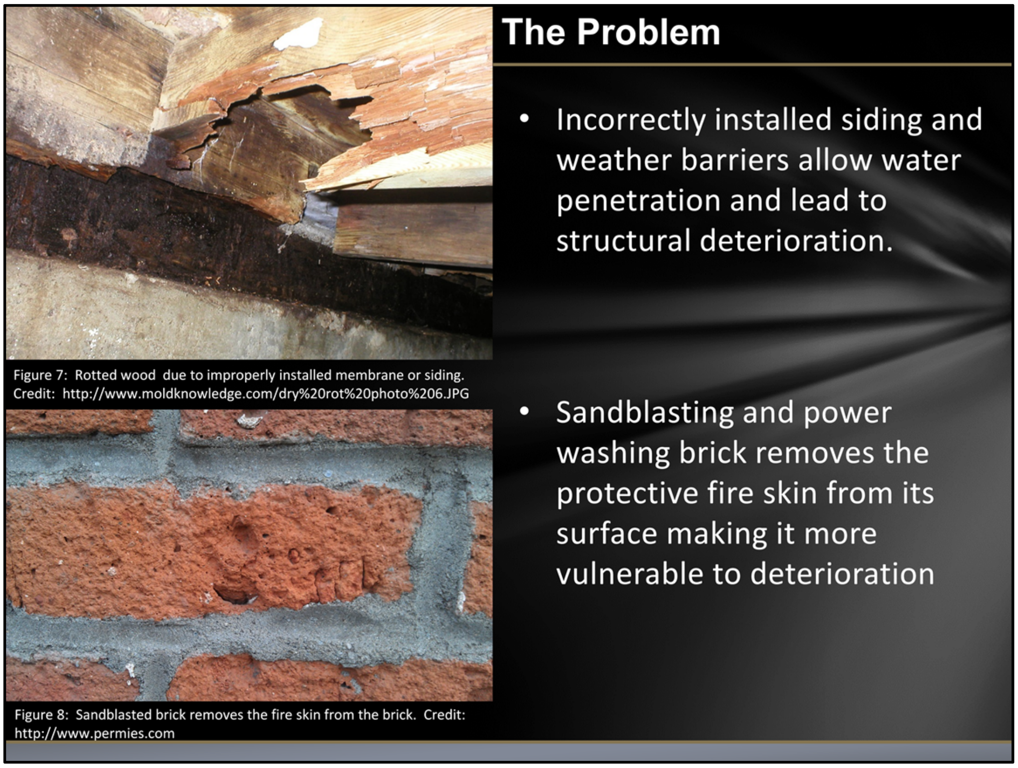
Figure 5: Deteriorating brick, mortar and plaster at the barracks at La Citadelle de Quebec. Credit: Brian Rich, 2014

- Constant exposure to water and extreme freeze thaw cycles for decades is harsh on brick, mortar, and plaster – no matter how hard it is!

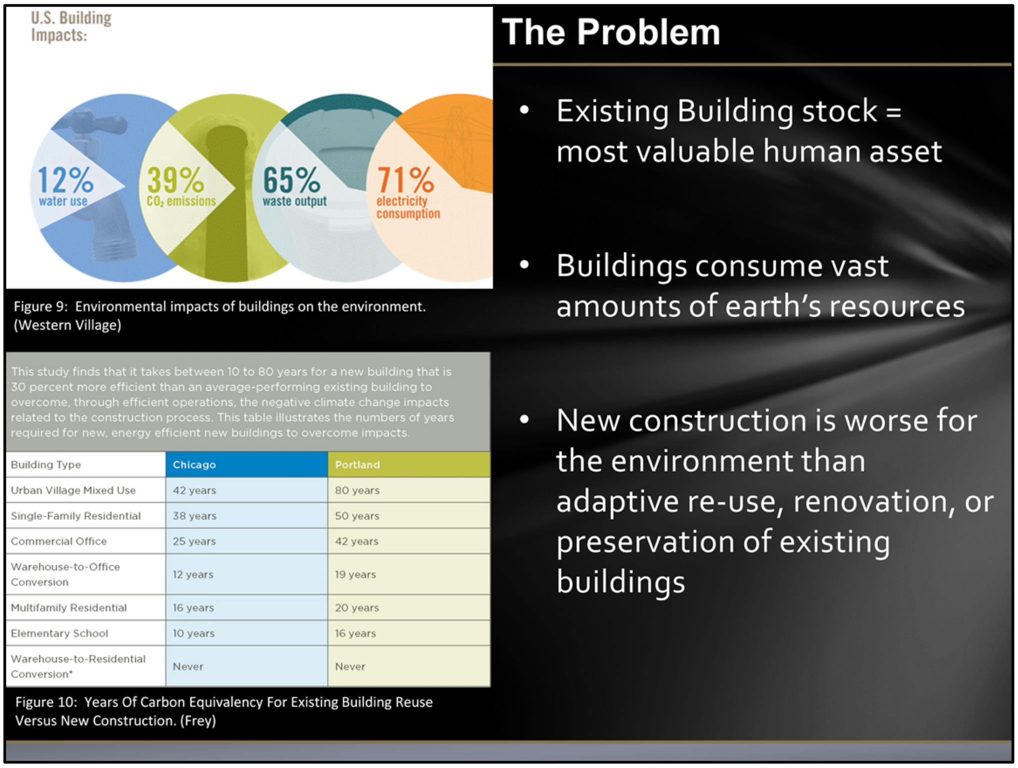
Figure 6: Mold caused by too much water vapor trapped within a building. Credit: http://media.kmvt.com/images/MOLD1.jpg_BIM.jpg

- When designed and built to prevent air infiltration, trapped water vapor can cause Sick Building Syndrome, including severe mold attack

Since that suggestion, I have bent every paper in every class to understanding what future-proofing meant. This presentation represents a summary of my research.



Interventions or designs such as those in the last couple slides are intended to repair and make a building viable and attractive for the long term future. However, they have caused irreversible damage to the building. Major repairs are necessary to mitigate the reduction of the service lives of these buildings. No matter how successful the mitigation, though, historic fabric has been lost and cannot be replaced.



The environmental issues argue for sustainable development through renovation of our existing building stock rather than demolition and new construction.

There are also economic, social, and cultural reasons to support historic preservation as well, but that's another presentation.

Figure 10 makes clear that the loss of existing building stock exacts a heavy toll on our environment. Consider that most new construction is based on a 20 to 30 year service life compared to the average service life of 50 to 100 years in a renovated historic building. You may have to build 2 or 3 new buildings to replace one historic building.

Consider also the vast amount of embodied energy, materials, capital loss, and loss of social and cultural assets when you demolish an historic building. Ill-considered interventions in historic buildings are just as damaging as the wrecking ball, if only a little slower.

Enter the concept of future-proofing.

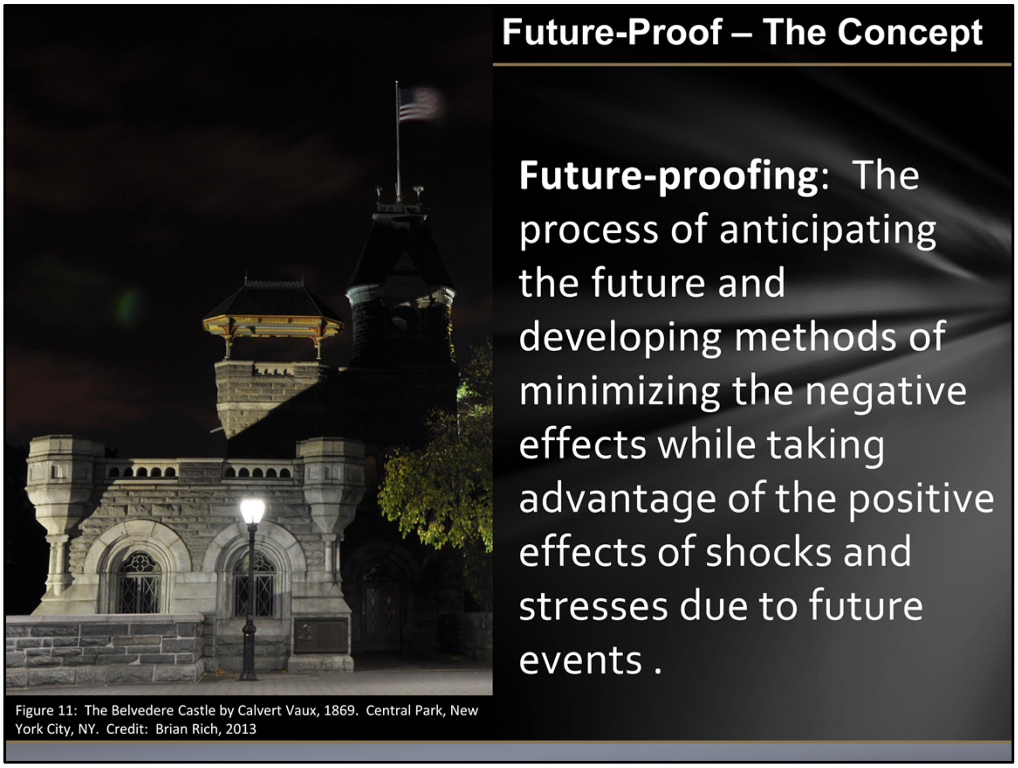


Figure 11: The Belvedere Castle by Calvert Vaux, 1869. Central Park, New York City, NY. Credit: Brian Rich, 2013

So, just what does “future-proof” mean?

It is a concept found in the AEC industry and many other related industries too. These other industries for a body of knowledge about the concept of future-proofing from which we can derive general principles that can be applied to historic buildings.

Let’s see what future-proofing means in these other industries and what we can draw out of them.

Related Industries

Figure 12: SERCOS – a future-proof standard: Broader, deeper, more universal. Credit: http://www.boschrexroth.com

Electronics:

- “flexible distribution systems”
- Telecommunications: system designers focus heavily on the ability of a system to be reused and to be flexible
- Teleradiology: open modular architecture and interoperability

Industrial Design:

- In industrial design, future-proofing designs seek to prevent obsolescence by analyzing the decrease in desirability of products.
- characteristics of future-proof products include: a timeless nature, high durability, aesthetic appearances that capture and hold the interest of buyers

The electronics industry offers flexibility, reusability, and interoperability as principles of future-proof

Industrial Design offers timeless nature, durability, holding (and ideally increasing) interest over time

Related Industries

Figure 13: Climate change will have significant impacts on our planet.
Credit: www.jordanmallen.com

Climate Change:

- ability to withstand impacts from future shortages in energy and resources, increasing world population, and environmental issues
- ability to resist the impact of potential climate change due to global warming
- flexibility and adaptability of structures… …may defer the obsolescence and consequent need for demolition and replacement

Future-proof is a term used fairly commonly in climate change discussions today.

It offers a few more key concepts: withstanding or resisting future impacts, flexibility, adaptability, and deferring obsolescence.

Related Industries

Figure 14: Lewis & Clark High School in Spokane, WA, received a major renovation several years ago. Credit: Brian Rich, 2012.

Sustainable Preservation:

- Jean Caroon states that “there’s no way to make a building that doesn’t have an environmental impact,” but that “you can lessen the environmental impact by taking existing objects and extending their service life”

2005 APT Halifax Symposium:

- understanding the importance of stewardship and planning for the future
- building to last, including material selection and treatment, craft, and traditional building techniques
- durability and service life of materials and assemblies and their implications for lifecycle assessment
- understanding extending buildings’ service lives and systems renewal

Related Industries

Sustainable Preservation:

- May Cassar, for example, suggests interest in sustainable rating systems if durability is incorporated as a metric for evaluating buildings. Cassar also argues that historic buildings must fully engage in the process of "adaptation to climate change," lest they become redundant and succumb to "environmental obsolescence"
- Cassar: "'long life, loose fit' strategy to managing historic buildings"
- The hygrothermal performance of the original building materials at the Hudson Bay Department Store in Victoria, British Columbia, was carefully analyzed to ensure that improvements would not reduce the "building's time-proven durability"

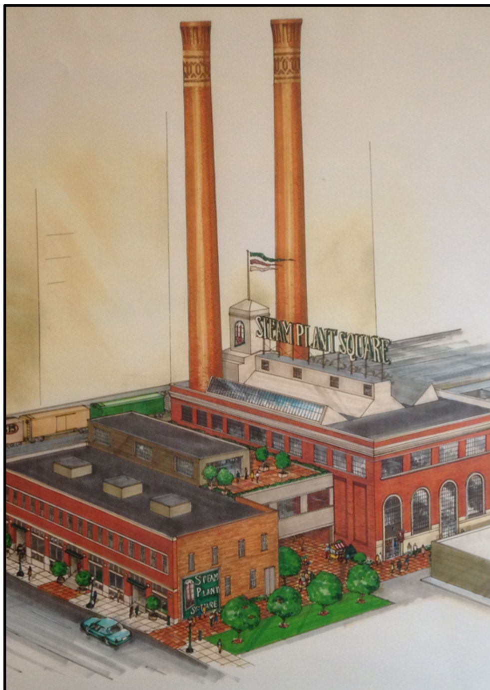


Figure 15: Steam Plant Square in Spokane, WA, is an excellent example of a place that has found a loose fit strategy. Credit: Spokane Steam Plant.

Steam Plant Square in Spokane is an old district steam heat plant in Spokane which has been re-made as a restaurant, office, and retail center for the city. It has found creative ways to work the old features of the steam plant into the retail themes. For instance, you can dine at the bottom of the big stacks or have a party in one of the boilers. Remnants of the steam plant create a coherent aesthetic where there are a lot of nooks and crannies and not every square inch of space is made to generate the highest retail return on investment.

Related Industries

Figure 16: The collapsed I-5 bridge at the Skagit River was "functionally obsolete." Credit: http://en.wikipedia.org/wiki/File:05-23-13_Skagit_Bridge_Collapse.jpg

Real Estate - Obsolescence:

- Physical
- Functional
- Aesthetic
- Sustainable?

Low energy consuming dwellings reduce the likelihood of a prematurely obsolete building design.

Utility Systems:

Forward planning for future development and increased demands on resources

In the valuation of real estate, there are three traditional forms of obsolescence which affect property values: physical, functional, and aesthetic. A potential fourth form has emerged as well: sustainable obsolescence.

The I-5 Skagit River Bridge, which collapsed in 2013, was classified as functionally obsolete, in this case because the bridge does not meet current design standards for lane widths and vertical clearance in new highway bridges. The bridge is not Future-Proof due to obsolescence rather than lack of maintenance.

Thus, real estate offers the idea of obsolescence

Utility Systems also offer the idea of planning ahead – but more about that later.

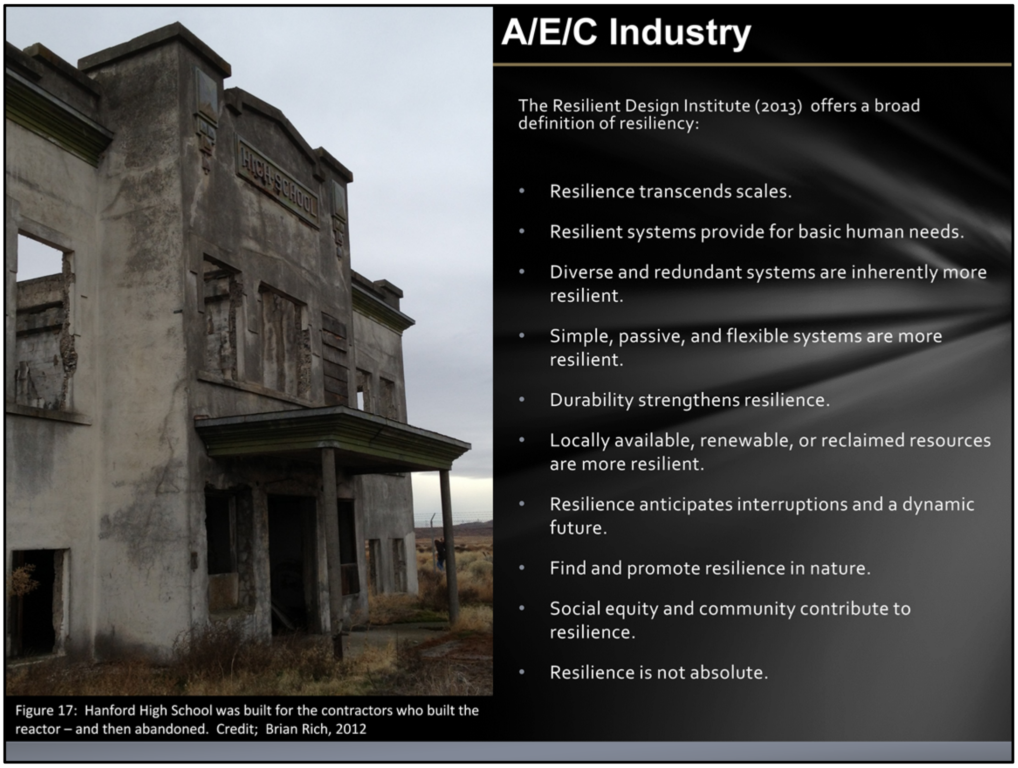


Figure 17: Hanford High School was built for the contractors who built the reactor – and then abandoned. Credit; Brian Rich, 2012

A concept closely related to future-proofing is “resiliency.” Here are a few of the basics of a resilient design.

While not as broad as the concept of future-proofing and not specifically developed for application to the built environment, it does offer valuable suggestions for the principles of future-proofing.

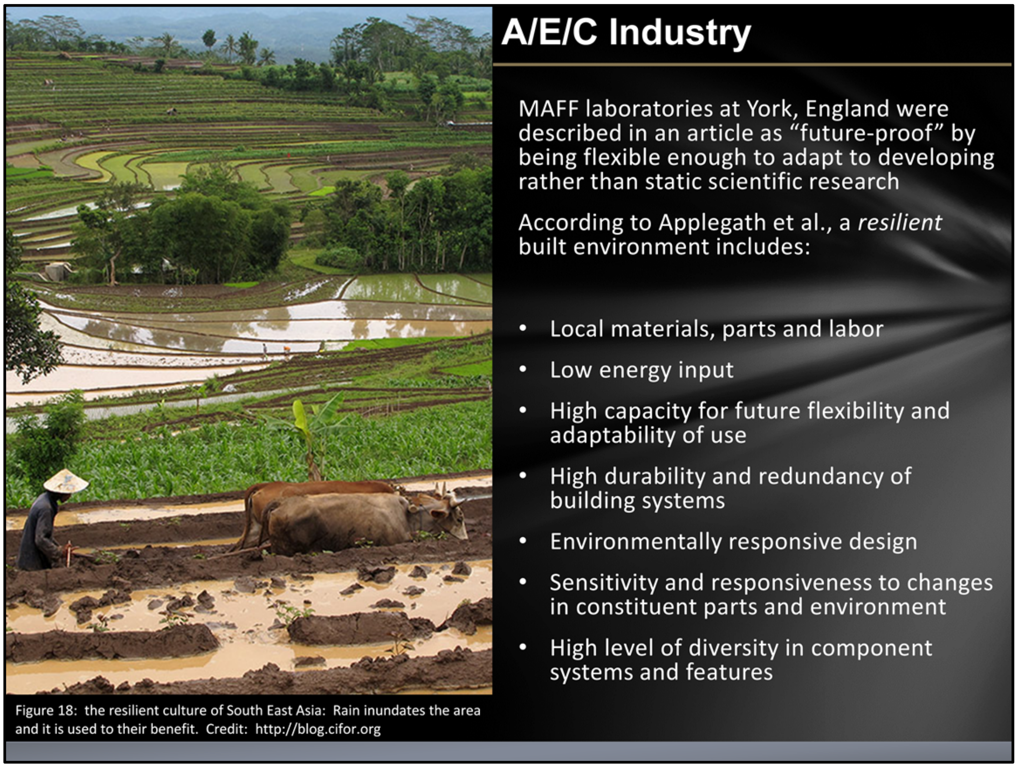


Figure 18: the resilient culture of South East Asia: Rain inundates the area and it is used to their benefit. Credit: http://blog.cifor.org

In the AEC industry, future-proof means flexibility in the design of a facility.

In addition, Appelgath has developed a list of seven characteristics of resilience that are important to consider as well.

A/E/C Industry

Figure 19: Place Royale, where Samuel De Champlain founded his "abitation" in 1608, Quebec. Credit: Brian Rich, 2014

In urban design, resilience:

- Includes an integrated multidisciplinary combination of mitigation and adaptation
- Is less dependent on an exact understanding of the future than on tolerance of uncertainty and broad programs to absorb the stresses
- keeps many options open, emphasize diversity in the environment, and perform long-range planning that accounts for external systemic shocks
- events are viewed as regional stresses rather than local

We see resilience in urban design as well.

Preservation & Conservation

The concepts of future-proofing are present in preservation philosophy:

- Georg Morsch: "first, that historical evidence and vestiges must be decipherable; and, second, that evidence and vestiges must be decipherable by a broad public which requests flexible approaches on certain conservation concepts"
- James Marston Fitch argues that the "reworking of extant structures to adapt them to new uses is as old as civilization itself " and has significant lifecycle benefits as the "characteristic mode of energy conservation"

Figure 20: Saint Coeur de Marie Church in Quebec City, 1919, built by the Eudists is now a used bookstore. Credit: Brian Rich, 2014.

So how does future-proof apply to historic buildings?

To begin with, we can see that many of the concepts of future-proofing are present already in preservation philosophies.

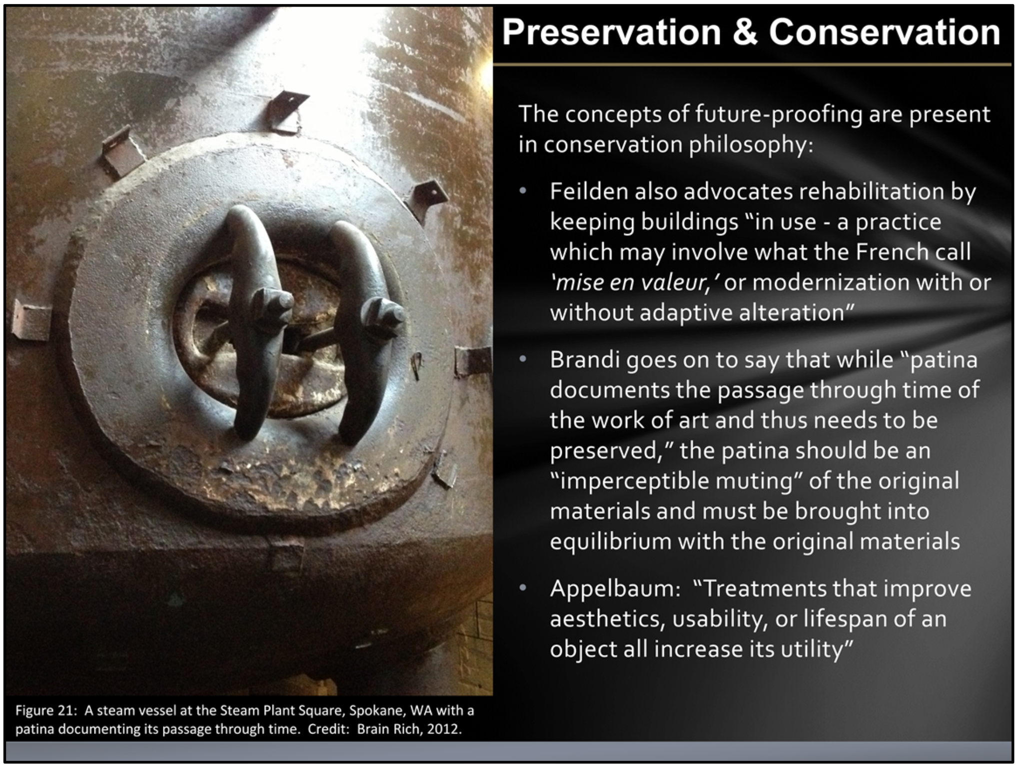


Figure 21: A steam vessel at the Steam Plant Square, Spokane, WA with a patina documenting its passage through time. Credit: Brain Rich, 2012.

Bernard Feilden calls conservation "primarily a process that leads to the prolongation of the life of cultural property for its utilization now and in the future". Feilden advocates evaluation of all practical alternatives in a rehabilitation "to find the 'least bad' solution."

Brandi's intent is that the patina should not overwhelm and disguise the original, nor should patina be completely removed, but rather a balance must be sought between the two. This approach promotes the understanding not only of the original material but also the aging and interventions that it has been subjected to over its history.

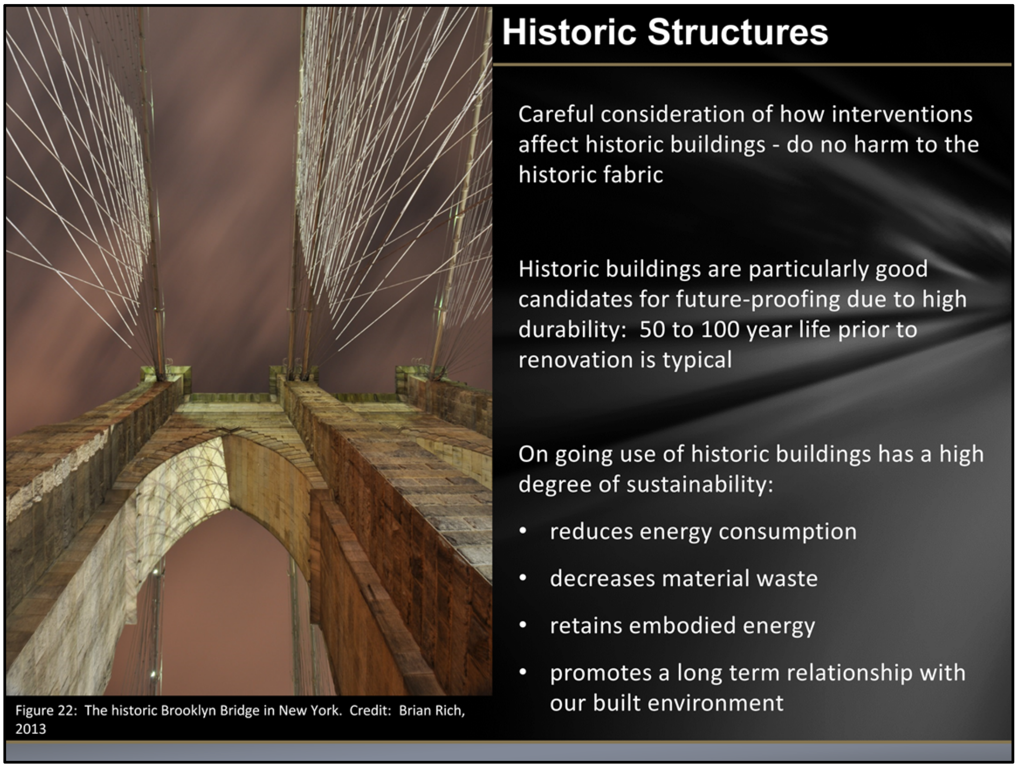


Figure 22: The historic Brooklyn Bridge in New York. Credit: Brian Rich, 2013

The Brooklyn Bridge is an example of the long term service life and built in redundancy that Pamela Jerome discusses in her APT article. The individual structural elements are flexible, and adaptable enough to accommodate significant changes in vehicular traffic since it was built.

The original design by Roebling was intended to carry four lanes of traffic. Today it carries 6 lanes of traffic, pedestrians, and two train tracks.

Based on observed uses of the term “future-proofing” in several industries, we can develop a coherent set of Principles of Future-proofing. So what are these principles?

Figure 23: The sarsen trilithons of Stonehenge (ca. 2500 BC): A Future-Proof structure? Credit: http://hdw.eweb4.com

If you'll forgive me, I'll read the description that goes along with each Principle.

1. Prevent decay.
Promote building materials, methods, maintenance, and inspections that prevent premature deterioration of our built environment. It is natural for all building materials to deteriorate. Maintenance and interventions in historic structures should mitigate the deterioration of the existing building fabric rather than accelerate deterioration.

2. Promote understanding.
Allow for understanding of the built environment and its place in our built heritage. Minimal interventions in existing structures allow future students of history to understand and appreciate the original historic building and *Gesamkunstwerk*, or unity of craft, as well as the patina. Interventions that have kept it viable should remain distinguishable from the original structure.

3. Stimulate flexibility and adaptability through diversity.
Flexibility and adaptability of our built environment and our attitudes toward it are essential to retention of our built environment in a disposable society. The interventions in an existing structure should not just allow flexibility and adaptability, but also stimulate it while minimally impacting the historic building fabric. Adaptability to the environment, uses, occupant needs, and future technologies by keeping a diverse array of options open is critical to the long service life of a historic building.

4. Extend service life.
Extend the service life of our built environment so it may continue to contribute to our economy, culture, and sustainable society. Regular maintenance and appropriate interventions in existing buildings help to make the buildings useable for the long-term future rather than shorten their service life.

5. Fortify!
Fortify our built environment against climate change, extreme weather, and shortages of materials and energy. Interventions should prepare buildings for the impacts of climate change by reducing energy consumption; reducing consumption of materials; and helping them to withstand extreme natural events, such as hurricanes, floods, and tornadoes.

6. Increase durability and redundancy.
Interventions in existing buildings should use equally durable building materials. Don't mix short-term materials with long-term materials. Materials that deteriorate more quickly than the original building fabric require further interventions and decrease the service life of a building. Building designs should either include components with similarly long service lives or be designed for disassembly for replacement of the shorter life components. Redundant systems provide backup in the event that a primary system fails and allow a building to continue to function.

7. Reduce obsolescence.
Don't accept planned obsolescence. The built environment should be able to continue to be used for centuries into the future. Take an active approach to preventing physical, functional, aesthetic, and sustainable obsolescence. Regularly evaluate and review current status in terms of future service capacity. Find the most appropriate uses for the building, even if that means it has to be unused for a short period of time.

8. Consider lifecycle benefits.
Consider the long-term lifecycle benefits of interventions in our built environment. The embodied energy and material resources in existing structures should be incorporated in environmental, economic, social, and cultural costs for any project.

9. Be local and healthy.
Incorporate non-toxic, renewable, local materials, parts, and labor into our built environment. The parts and materials used in designing and implementing building interventions should be available locally and installed by local labor. This means that the materials and manufacturing capabilities will be readily available in the future for efficient repairs.

10. Take advantage of cultural heritage policy documents.
Cultural heritage policy documents provide excellent guidance for the long-term retention of an historic building. From the Secretary's Standards to the World Heritage Convention's charters, documents, and declarations, these documents offer invaluable guidance, including

the concepts of minimal intervention, reversibility, and differentiation, when working with historic buildings as well as other existing buildings. Above all, in striving to meet the above principles, respect the historic building as a work of art, including its past interventions.

These Principles continue to evolve and be refined. Recent research on future-proofing large infrastructure systems has brought me to the conclusion that there may well be two more Principles to be added:

11. Plan Ahead

Plan for optimum maintenance to prevent the need of major interventions. Should interventions be necessary, plan to include the best materials and techniques to prevent future decay, the best phasing of the implementation to minimize waste of resources and maximize efficiency of time funding, and materials.

12. Diversify

Systems are ecologically resilient precisely because they do not depend on only one aspect of a system to dominate and hold fast. Ecological systems allow for multiple stable states, including different uses, capabilities, and economic models. A diverse built environment, as an ecosystem for humans, can support multiple different economic, social, cultural, and functional uses.

So having developed these Principles, I would like to continue by sharing some of my exploratory work into specific aspects of future-proofing.

Figure 24: Aerial photo of the Arctic Building from the Southwest. Credit: City of Seattle Archives, SPU Fleets and Facilities Department "Imagebank" Collection. Item No: 120399

Figure 25: The Third Ave and Cherry Street corner of the Arctic Building. Credit: Brian Rich, 2013

My initial foray into the application of the Principles of Future-Proofing was to try to apply them through a case study to the Arctic Building in Seattle, Washington.

The Arctic Club Building was listed on the Washington and National Registers of Historic Places in November 1978. The building was designated a City of Seattle Landmark on April 4, 1985.

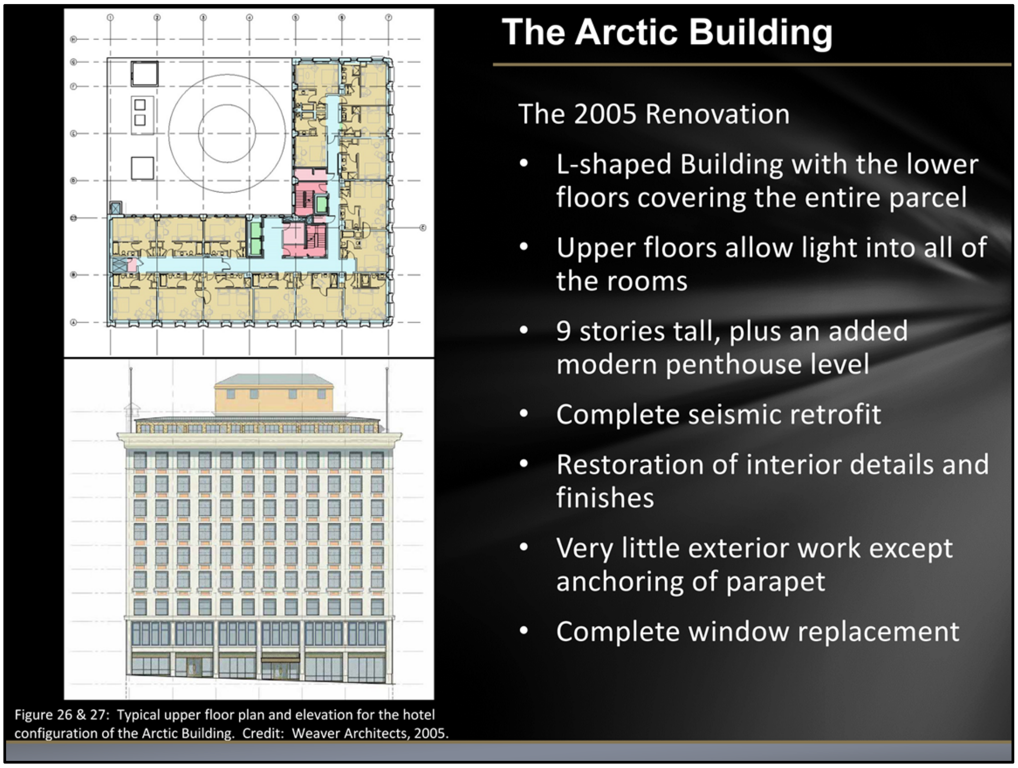


Figure 26 & 27: Typical upper floor plan and elevation for the hotel configuration of the Arctic Building. Credit: Weaver Architects, 2005.

In 2005, the Arctic Building was adaptively reused as a boutique hotel. A thorough interior rehabilitation was undertaken, but the exterior was largely un-touched at this point.

I'll come back to this rehabilitation later.

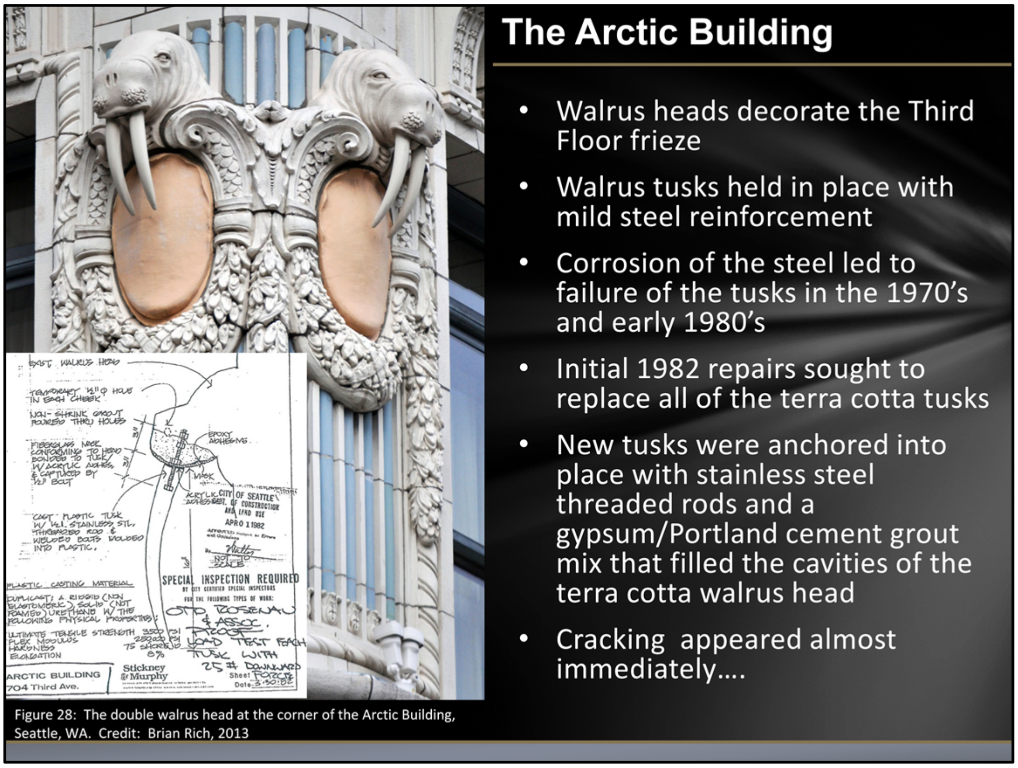


Figure 28: The double walrus head at the corner of the Arctic Building, Seattle, WA. Credit: Brian Rich, 2013

The design of the walrus heads and tusks could be considered problematic from the start.

The use of mild steel in any condition where moisture is present can lead to corrosion and rust jacking.

Figure 28: Repair detail for the walrus tusks at the Arctic Building. Image obtained from the files of the City of Seattle Landmarks. Original Detail by Stickney Murphy Architects.

Repairs in 1982 made the situation worse and further damage began almost immediately.

The Arctic Building

Figure 29: Fractured terra cotta walrus head. Note the degree to which the grout fills the terra cotta void. Credit: Wiss, Janney, Elstner, 1995

- A 1995 investigation found that the gypsum reacted to water penetration forming ettringite.
- Ettringite expanded uniformly and put pressure on the terra cotta.
- Flaws in the 1982 repair also included drilling the grout hole on top of the head rather than on the vertical face of the snout

This photo shows the location of the holes for the grout injection on top of the snout – exposed to the weather more. Note that the cracks all radiate from the grout injection hole. Compared to the architectural detail, there are significant variances in the actual installation.

In the end,

- 15 of the 27 walrus heads were replicated and replaced
- 7 additional heads were anchored together using helical pins
- Terra cotta repairs were crucial to maintaining the building envelope and historic appeal of the building for future investors

Figure 30: Cherry Street Entrance to the Arctic Hotel. Credit: Weaver Architects, 2005

Was the 1982 repair future-proof? No.

- Led to further damage to the building (Principle 1)
- Decreased the Service Life of the building (Principle 4)
- Decreased durability of the building (Principle 6)
- Increased physical and aesthetic obsolescence (Principle 7)

Are the 1996 and 2005 rehabilitations future-proof?

- Yes!
- The rehabilitation, while undoubtedly doing damage through interior demolition, revived the use of the building (Principle 1)
- Sensitive rehabilitation acknowledges the historic fabric of the building (Principle 2)
- Adaptive re-use of the building from a club to offices to a hotel demonstrates adaptability and flexibility as opposed to functional obsolescence (Principle 3)
- The rehabilitation has extended the service life of a building in an area with high demand for density through height
- The structure has been fortified again seismic events and climate change with thermal envelope improvements
- The in-kind terra cotta rehabilitation has returned the natural durability of the terra cotta

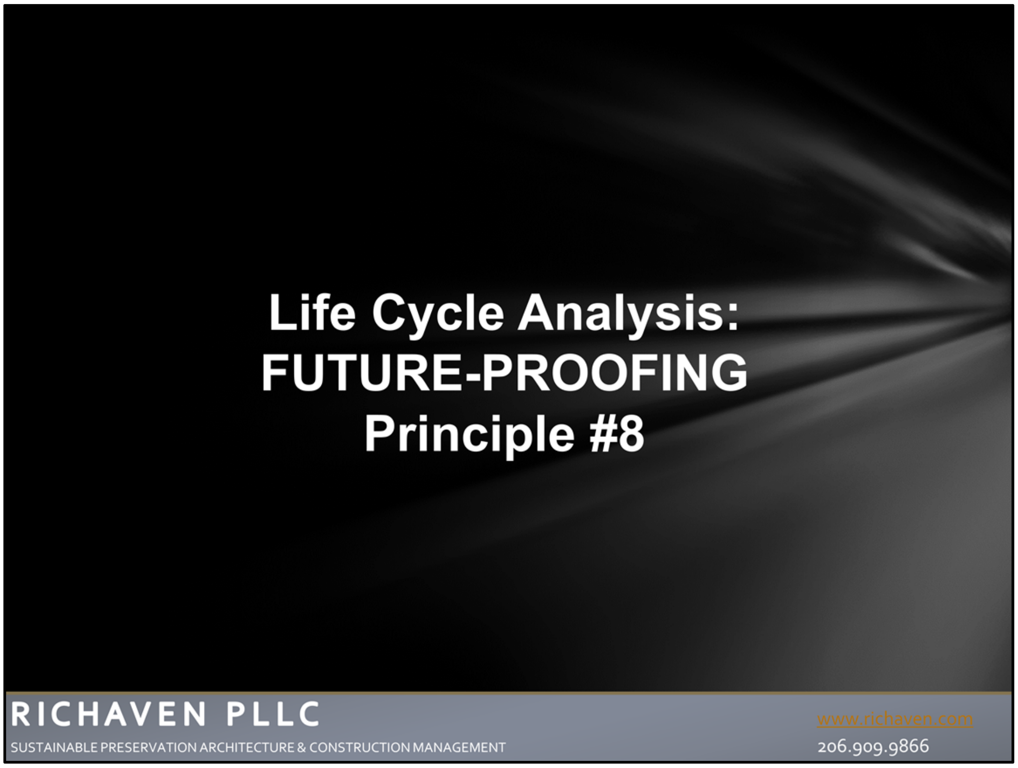
The Arctic Building

Figure 31: The Dome Room at the Arctic Hotel after the 2005 rehabilitation. Credit: Weaver Architects, 2005.

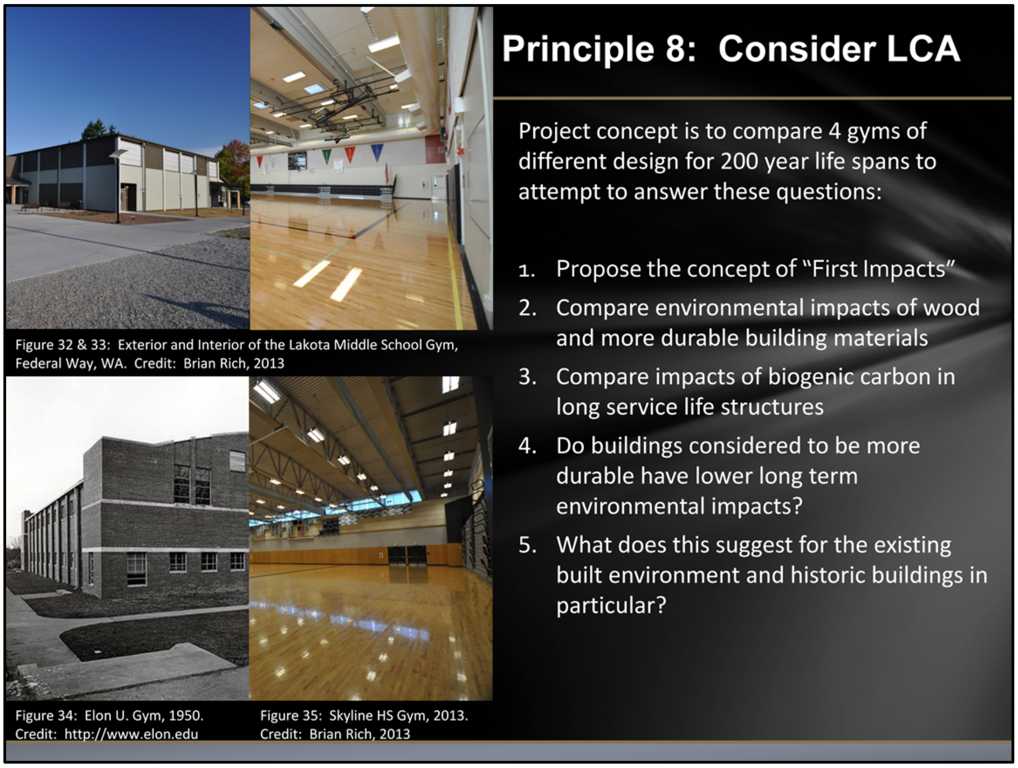
Are the 1996 and 2005 rehabilitations future-proof?

Are the 1996 and 2005 rehabilitations future-proof?

- The rehabilitation has extended the service life of a building in an area with high demand for density through height
- Physical and sustainable obsolescence were addressed in these rehabilitations
- Life cycle benefits were realized through retention of the historic structure (Principle 8)
- Local labor was used for the project (Principle 9)
- The Secretary's Standards for Rehabilitation were followed (Principle 10)



In another piece of research, I explored the possibilities of Life Cycle Analysis as a justification for retaining and adapting historic buildings.

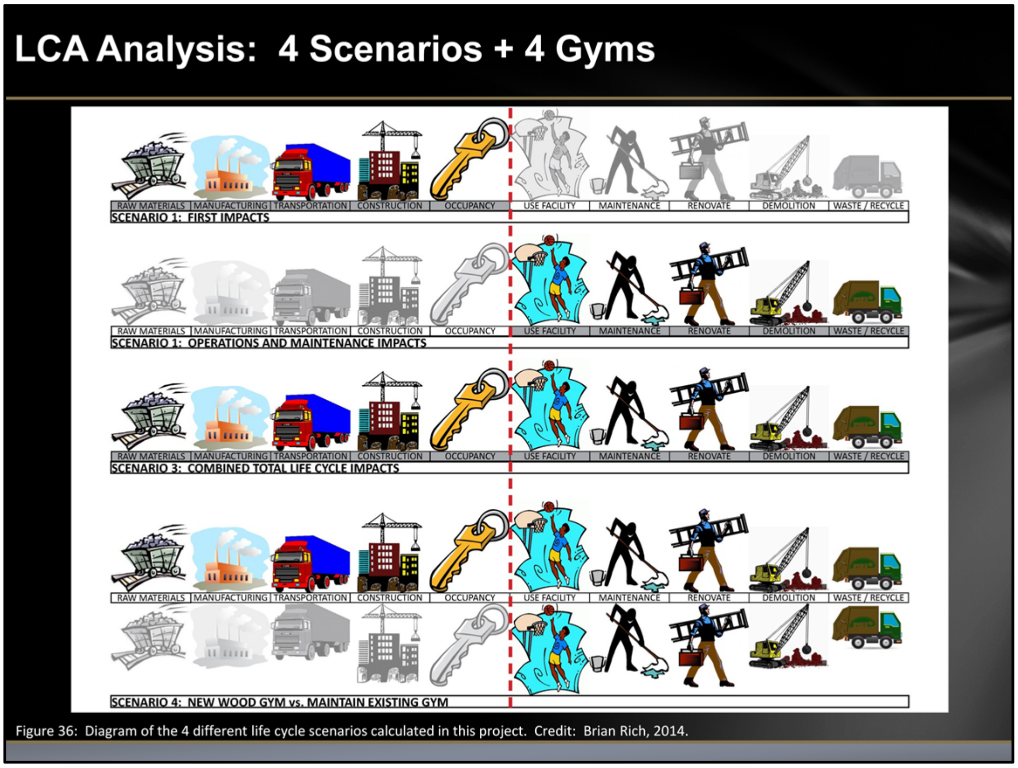


In 2011, the Preservation Green Lab completed a study to support the preservation of old buildings. It was called The Greenest Building: Quantifying the Environmental Value of Building Reuse.

While it showed conclusively, through life cycle assessment, that keeping old buildings was sustainable and environmentally efficient, it only focused on the first 20 years of a building's life. I sought to explore the environmental impacts over a 200 year life span, though the results may be applicable to older buildings as well.

Athena was used to calculate the impacts for the life cycle of each of 4 gym construction types: wood framed (with and without biogenic carbon), light metal framing and siding, structural steel and CMU, and concrete with brick and stone masonry.

By way of explanation, Biogenic Carbon is the carbon absorbed by trees and plants as they grow. This is retained and sequestered until the wood deteriorates – anywhere from 10 to 200 years or more, depending on how well protected it is.



4 different scenarios were envisioned for this project:

- First Impacts of each of the 4 different gym designs
    - I coined the term First Impacts, like First Cost, to describe the impacts from raw material extraction up to occupancy of the building.
- Operations and Maintenance Impacts of the 4 different gym designs
- Combined total life cycle impacts for the 4 different gym designs
- New wood gym vs. maintaining an existing concrete structured gym with brick and stone

- First impacts were calculated using a 1 year life span in Athena.
- Based on my experience, I assigned life cycles for each building type such that simple multiples would add up to 200 years.

And so, to some results….

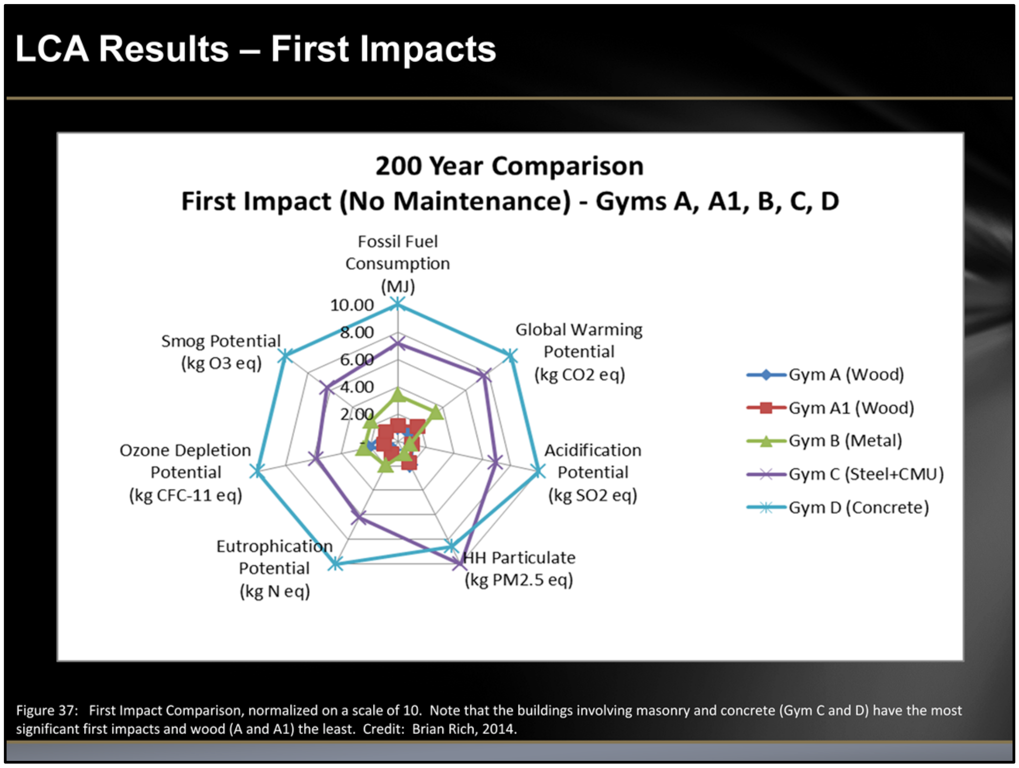


Figure 37: First Impact Comparison, normalized on a scale of 10. Note that the buildings involving masonry and concrete (Gym C and D) have the most significant first impacts and wood (A and A1) the least. Credit: Brian Rich, 2014.

Allow me to explain the diagram a bit first:

Each of the spokes represents one of the 7 measures of environmental impact. The results are normalized to show their relative impacts on a scale from 1 to 10. Last, each of the different colors represents a different gym construction type.

In the first scenario, not surprisingly, the First Impacts for wood framing (Gym A and A1) were significantly less than that of concrete, brick, and stone (Gym D).

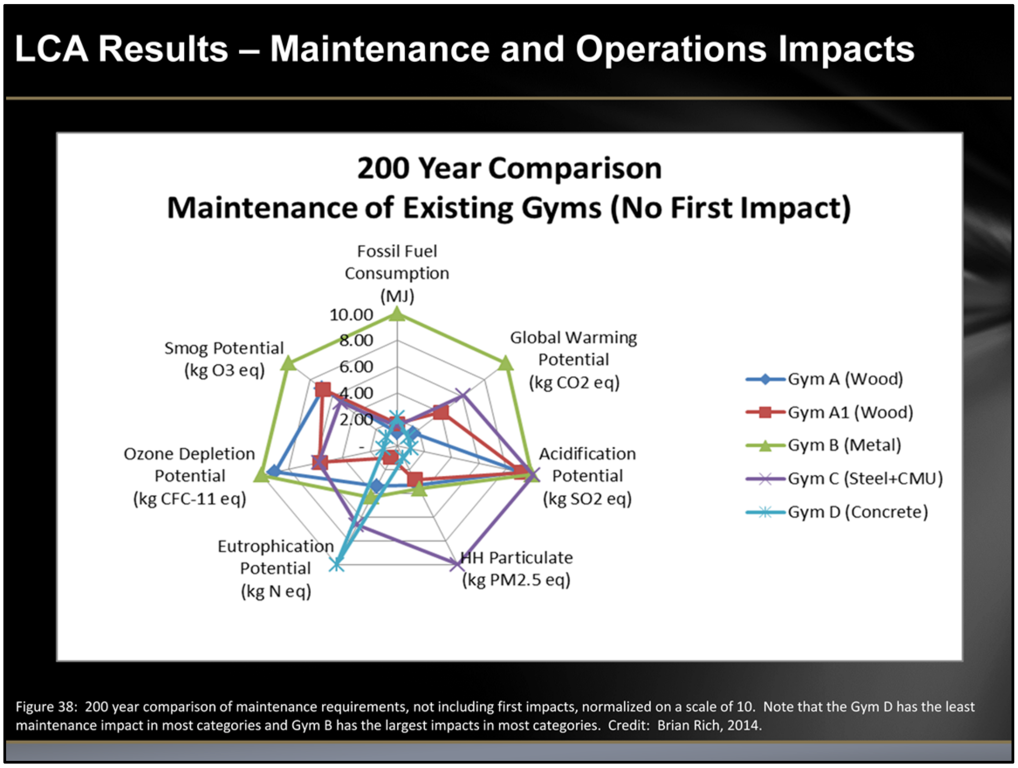


Figure 38: 200 year comparison of maintenance requirements, not including first impacts, normalized on a scale of 10. Note that the Gym D has the least maintenance impact in most categories and Gym B has the largest impacts in most categories. Credit: Brian Rich, 2014.

In the second scenario, comparing Operations and Maintenance impacts, not surprisingly, the results for Gym D (concrete, brick, and stone) were less than Gym A and A1 (wood framed).

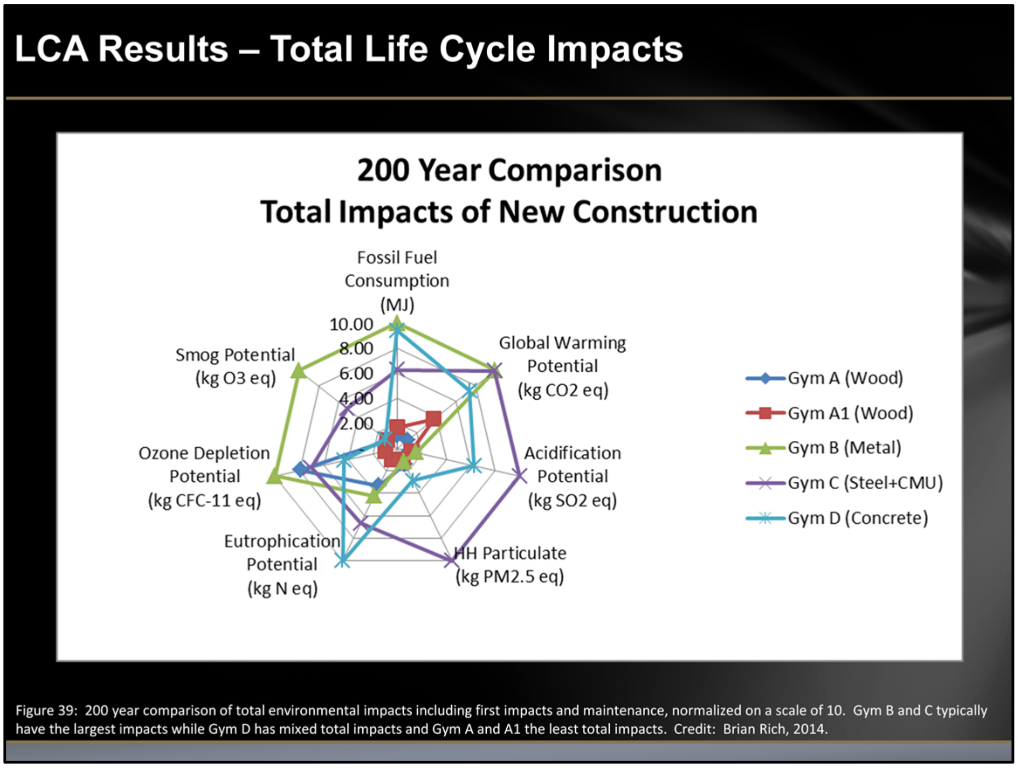


Figure 39: 200 year comparison of total environmental impacts including first impacts and maintenance, normalized on a scale of 10. Gym B and C typically have the largest impacts while Gym D has mixed total impacts and Gym A and A1 the least total impacts. Credit: Brian Rich, 2014.

In the third scenario, total 200 year impacts (including First Impacts as well as Operations and Maintenance impacts) were examined.

As the graphic makes clear, a wood framed structure (Gym A and A1) still had less impacts on the environment than a concrete, brick, and stone gym did.

As a preservationist who loves those old brick and stone buildings, I was beginning to get a bit concerned….

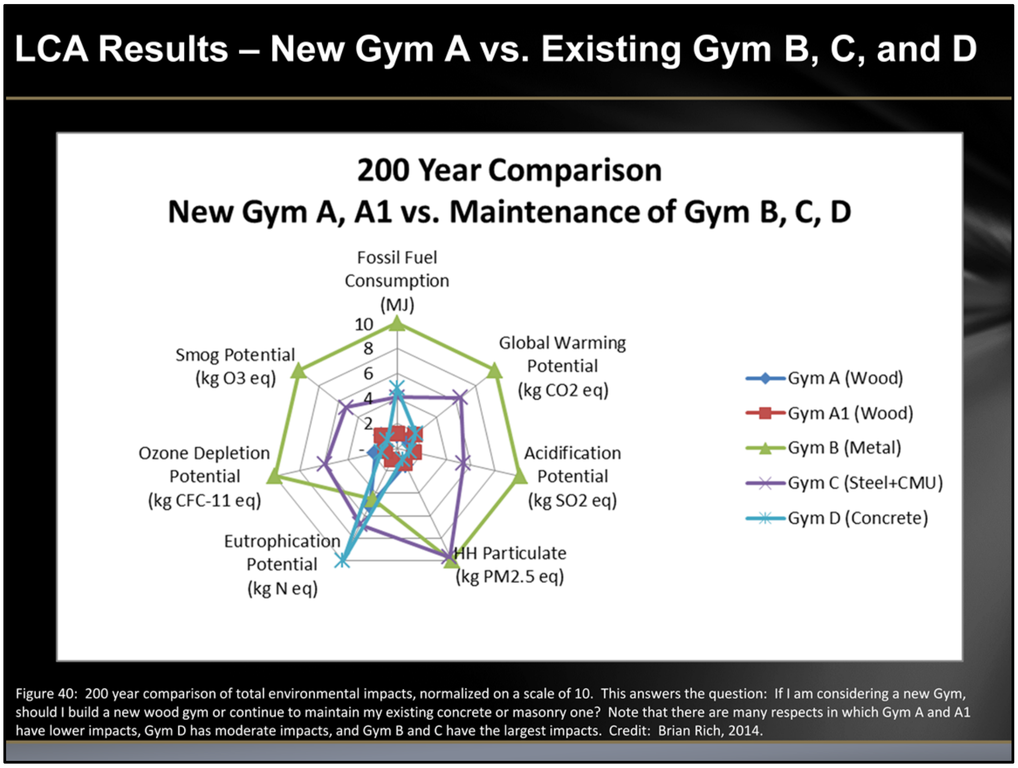
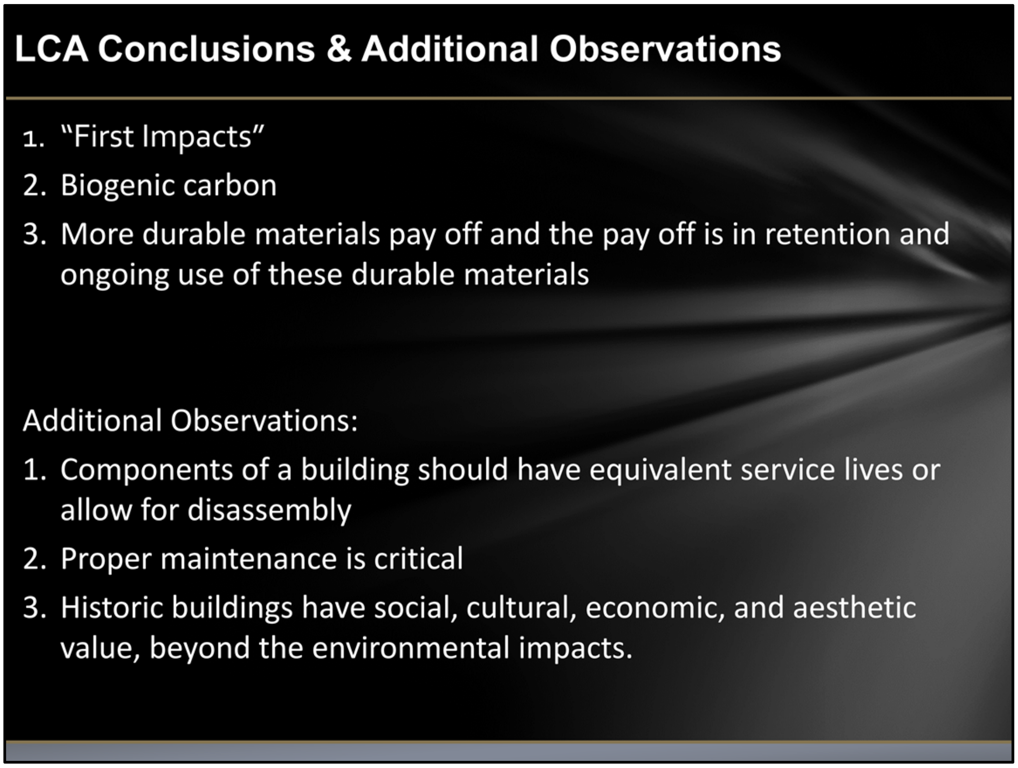


Figure 40: 200 year comparison of total environmental impacts, normalized on a scale of 10. This answers the question: If I am considering a new Gym, should I build a new wood gym or continue to maintain my existing concrete or masonry one? Note that there are many respects in which Gym A and A1 have lower impacts, Gym D has moderate impacts, and Gym B and C have the largest impacts. Credit: Brian Rich, 2014.

Last, Scenario 4 becomes mor einteresting.

This compares the Operations and Maintenance impacts of Gym D (concrete, brick, and stone) with replacement by a new Type A or A1 (wood framed) gym. And Gym D is demonstrated to have similar impacts in 5 of the 7 measures.

What's also clear from this graphic is that Gym types B and C had significantly higher impacts.



1. The concept of "First Impacts" is introduced in this Life Cycle Analysis
2. Wood structures appear to have the lowest short term and long term environmental impacts, regardless of how biogenic carbon is accounted for. What I did not investigate were the implications of shifting to a wholly wood based construction system and the impacts of deforestation.
3. More durable CMU, structural steel, concrete, and brick materials pay off when ongoing maintenance is compared to wood structure replacements.
4. Biogenic carbon only affects Global Warming Potential and is eventually released (and thus non-beneficial) if the service life under consideration is approximately 200 years. Biogenic carbon sequestering is a good short term CO2 reduction strategy – if more trees are planted. However, it is not a long term global warming mitigation measure.

Additional Observations:

1. Durability of all components of a building system should have equivalent service lives or allow for disassembly in order to maintain the shorter service life materials.
2. Proper maintenance of a building is critical to long term service life. Maintenance prevents deterioration of less durable materials and can significantly affect the service life of a building.
3. Historic buildings have value that go beyond the environmental impacts of their materials and construction. Historic buildings have social, cultural, economic, and aesthetic value, beyond the environmental impacts. Historic buildings form the core identity of many places and provide stability and increased personal and community resilience because of the way people identify with their “homes.”
4. Look at the response to the destruction in Nepal.

I also had a chance to look into the use of local materials through the lens of traditional building materials and methods – part of Principle #9.

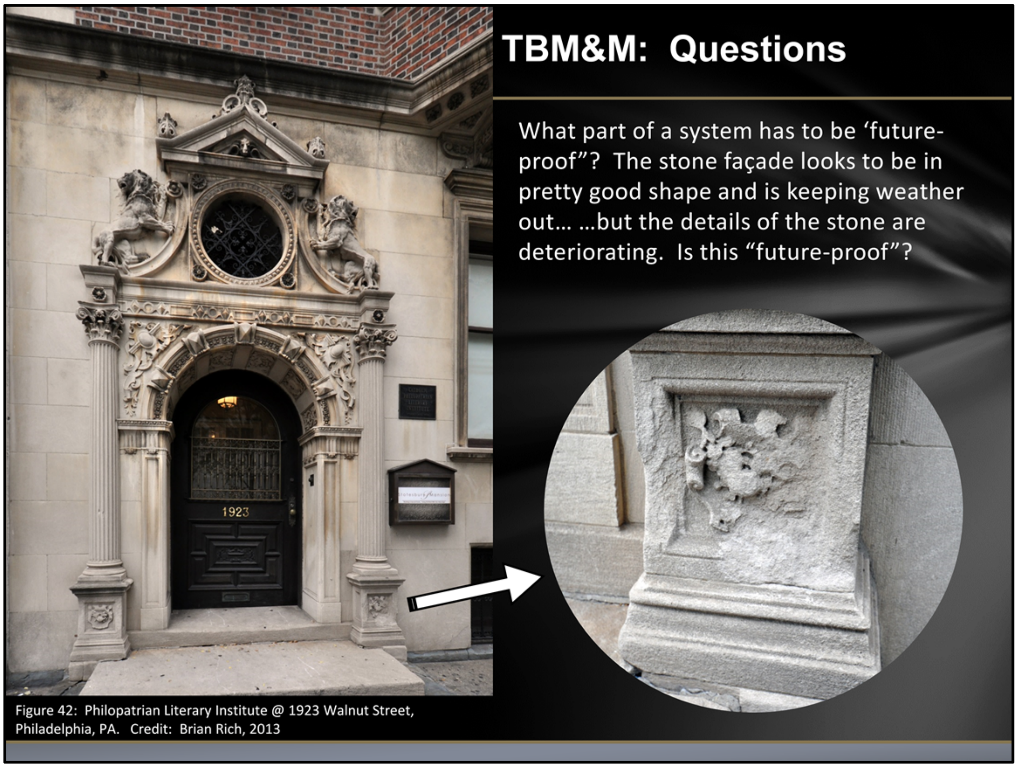
Figure 41: A typical Hmong house-building technique in the tropical climate of Vietnam. Credit: http://en.wikipedia.org/wiki/Rammed_earth

Traditional Building Methods & Materials (TBM&M)

- When is a material or building method considered “traditional”? How long does it have to be used?
- Carved Stone has been used for centuries in Europe and even the US. Is it a “traditional building material”?
- Does a building material have to be “traditional” to be Future-Proof?
- Are materials manufactured in industrialized regions of the world “Future-Proof”?
- What part of the manufacture of a industrialized material has to be local to qualify to be “Future-Proof”?

There are several materials that might be classified as traditional building materials. These include rammed earth, bamboo, mud brick, straw bale, adobe, thatch, reeds, wood, and stone. But there are others which have been used for centuries too such as concrete. Are they not “traditional” by now? Perhaps “traditional” is less important within the discussion of Future-Proofing than locally available and other features.

This began to raise all sorts of questions for me….



This beautiful stone doorway in Philadelphia looks great, until you look closely at its condition. It is deteriorating, probably due to salts and freeze-thaw cycles. It's probably been around for 150 years – maybe more. Isn't that long enough to be called future-proof?

Here's another way to look at it: If deterioration doesn't matter to the nature of future-proof, then would softwood framing that may rot within 10 years considered future-proof?

Figure 43: A man makes construction bricks from mud at one of several refugee settlements in Dadaab, Kenya. October 9, 2013. Credit: REUTERS/Siegfried Modola

Research Findings:
- Service life of TBM&M varies, but can usually be extended easily through maintenance and repairs when used in appropriate climates and designs
- Less technologically dependent materials are often more future-proof
- Future-proof building methods are not necessarily low cost when they are employed in developed regions
- Hybrid building systems take the best of both TBM&M and industrialized materials
- Environmentally responsive building design is critical to making TBM&M work in each region
- Intent of future-proofing is not to prevent use of manufactured materials
- TBM&M in industrialized regions is viable
- Use of TBM&M in industrialized regions is heavily affected by real estate economics (highest and best use)
- TBM&M is not possible in some areas where highest and best use results in extremely dense development (i.e., Manhattan)
- TBM&M may be contrary to sustainable goals of preventing urban sprawl (i.e., Mexico City)
- Building codes are significant factor in the viability of TBM&M as future-proof building systems – codes still being developed and adopted.

Research Findings: Are locally manufactured materials future-proof?
- Recommend that entire manufacturing process be completed locally
- Local expertise in installation and repair of materials is required
- Locally manufactured highly durable materials may be considered future-proof despite

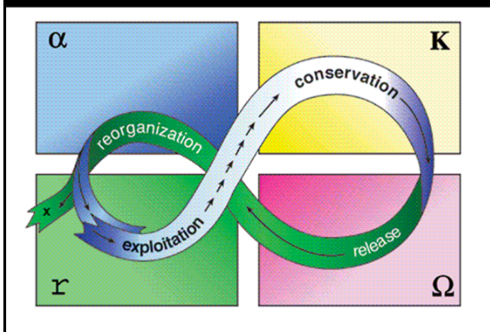
manufacturing process – long term life cycle benefits

- Embodied energy and long term life cycle design may make highly durable manufactured products future-proof – trade off to replacement impacts (straw and rammed earth vs. steel)
- Future-proof materials should ideally be regionally appropriate

Most recently, I looked into the question of how future-proofing applies to huge infrastructure sized projects – and learned about panarchy and adaptive cycles.

Adaptive Cycles & Panarchy

Panarchy is the process by which ecological and social systems grow, adapt, transform, and, ultimately, collapse over extended periods of time.



4 Adaptive Cycle Phases:

- Exploitation (r)
- Conservation (K)
- Release (Ω)
- Reorganization (α)

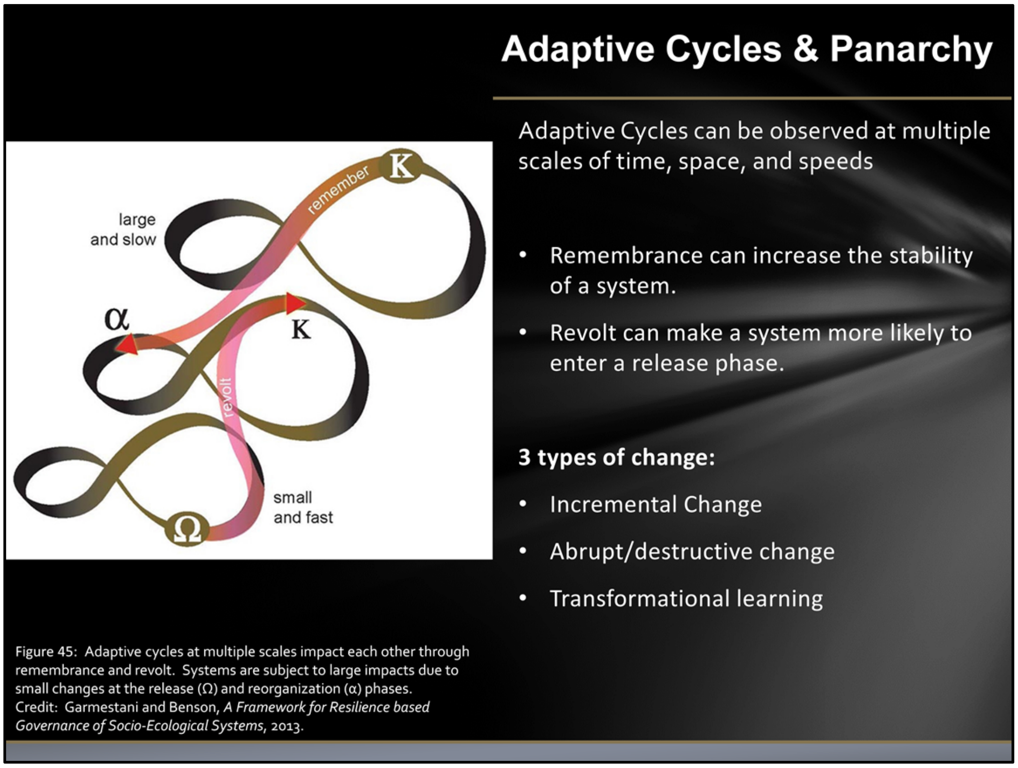
Figure 44: The basic adaptive cycle diagram as developed by Holling and Gunderson, 2002. The 4 phases include: entrepreneurial exploitation (r), organizational consolidation (K), creative destruction (Ω), and re- or destructuring (α). Credit: CS Holling, *From Complex Regions to Complex Worlds*, 2004.

Typically on a single building project of fairly limited duration, the program requirements are determined at the very beginning and the design is created to meet those program requirements. Panarchy and larger adaptive cycles come into play when one considers larger systems such as infrastructure or multi-decade endeavors.

Panarchy is the process by which ecological and social systems grow, adapt, transform, and, ultimately, collapse over extended periods of time. In the context of the built environment, panarchy refers to a framework for conceptualizing adaptive cycles in human and built environment systems.

On a large project, Panarchy and adaptive cycles are important because as the project progresses the circumstances surrounding the project will most likely change.

In the diagram shown here, the r phase, potential and connectedness are low but resilience is high; in K, resilience decreases while the other values increase. Eventually, some internal or external event triggers the Ω phase, in which potential crashes; finally, in α, resilience and potential grow, connectedness falls, unpredictability peaks, and new system entrants can establish themselves



When looking at multiple scales of the adaptive cycle, the impacts of each phase depend on when they interact with other phases.

There are three potential types of change in the adaptive cycle: (1) incremental changes in the r and K phases which are smooth and fairly predictable, (2) abrupt change in the transitions from K through Omega and alpha, and (3) transformational learning, meaning change involving several panarchical levels and interaction between different sets of labile variables.

Indeed it is precisely the potential for destructive change that we seek to moderate with human ingenuity and manufactured or "engineered" resilience.

What is "engineered resilience"? Gunderson and Holling defined two types of resilience. The first is "engineered resilience" or an "equilibrium steady state, where resistance to disturbance and speed of return to the equilibrium are used to measure the property." The second is "ecosystem resilience" and is "measured by the magnitude of the disturbance that can be absorbed before the system changes its structure"

Despite human efforts toward stable environments, apparently stable and artificially stabilized systems will eventually change. The question becomes one of how can we best control the release phase of the adaptive cycle. I argue that a future-proof built environment wants to embrace "'the two opposites: growth and stability on one hand, change and variety on the other'"

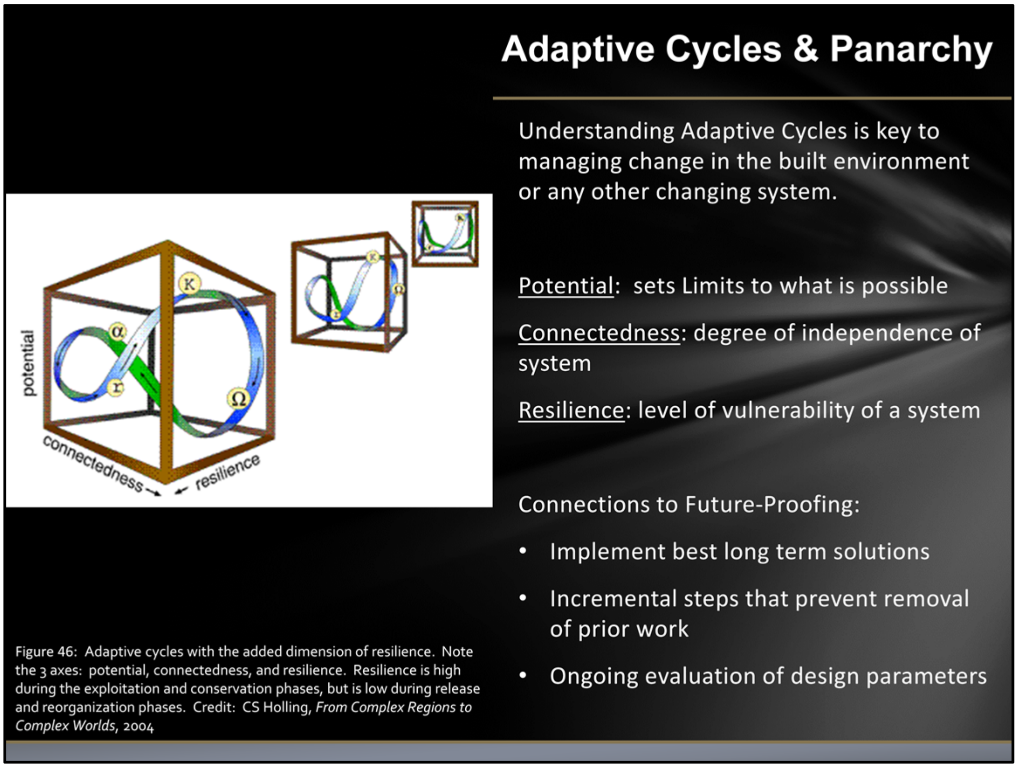


Figure 46: Adaptive cycles with the added dimension of resilience. Note the 3 axes: potential, connectedness, and resilience. Resilience is high during the exploitation and conservation phases, but is low during release and reorganization phases. Credit: CS Holling, *From Complex Regions to Complex Worlds*, 2004

Holling, et al, explained the three dimensions of the adaptive cycle in 2002. *Potential* sets limits to what is possible – it determines the number of options possible options for the future. *Connectedness* determines the degree to which a system can control its own destiny, as distinct from being caught by the whims of external variability. *Resilience* determines how vulnerable a system is to unexpected disturbances and surprises that can exceed or break that control.

So how is this connected to Future-Proofing?

First, it is recommended to implement the best long term solutions that can be devised. This may include increased cost of interventions due to selection of the best known materials and increased time for planning of the interventions to ensure the best approach to the intervention.

Due to the long term life span of an infrastructure system, we should devise interventions that are forward looking to what the system will need in the future. To be sure, this involves trying to predict an unpredictable future. Often, however, infrastructure systems can be developed in alignment with planned development of a building or region.

Second, it is recommended that interventions be implemented in such a way as to not have to remove portions of work that have already been improved in order to implement the next step. Here the key is to sequence the interventions with a long term view toward efficient use of human, time, and material resources.

Third, ongoing evaluation of the design parameters of the system can help guide adjustments to the system being implemented.

Adaptive Cycles & Panarchy

11. Plan Ahead:

Plan for optimum maintenance to prevent the need of major interventions. Should interventions be necessary, plan to include the best materials and techniques to prevent future decay, the best phasing of the implementation to minimize waste of resources and maximize efficiency of time funding, and materials.

12. Diversify

Systems are ecologically resilient precisely because they do not depend on only one aspect of a system to dominate and hold fast. Ecological systems allow for multiple stable states, including different uses, capabilities, and economic models. A diverse built environment, as an ecosystem for humans, can support multiple different economic, social, cultural, and functional uses.

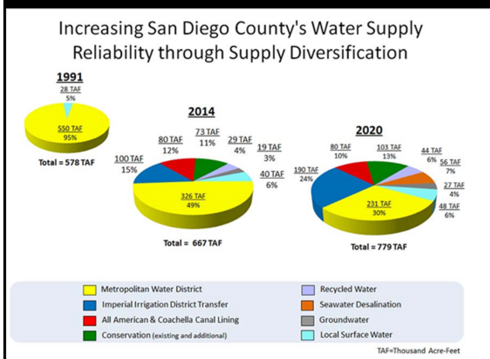


Figure 47: Diversification of the water sources for the San Diego County area shows reduced dependence on metropolitan water district sources and increased use of desalination, recycled water, and conservation. Credit: SDCWA, 2015.

As a result of this look at critical infrastructure systems, I believe 2 additional Principles are applicable for future-proofing as you see here. While planning ahead and diversification may seem pedantic and obvious, the long term implications of each are essential to ensuring a lasting built environment.

I was recently researching the San Diego water supply system as a case study of future-proofing a critical infrastructure system. Here, planning ahead for the water needs of the region is critical to long term stability and ongoing development of the region. Planning ahead takes on a new meaning in this context. San Diego, traditionally dependent on an aqueduct system for over 95% of their potable water, has also been diversifying their water sources in an effort to build ecological resilience and future-proof their system.

So the question becomes: If future-proofing is worth while, then how do we implement it.

As I discovered, it seems easier to implement in the international heritage conservation realm than within the United States.

To better understand how the Principles of Future-Proofing might be incorporated into preservation practice, I analyzed the US system of preservation as promulgated by the Secretary of the Interior and adopted by the vast majority of jurisdictions in the US. I compared this to the system promulgated by the United Nations through UNESCO.

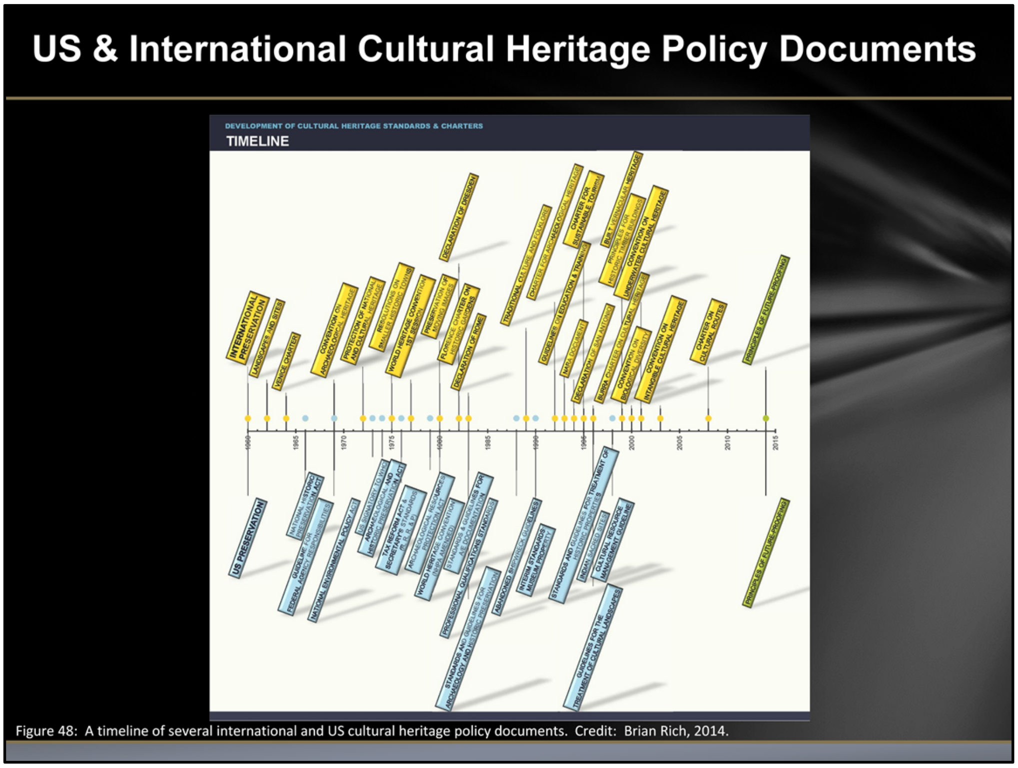


Figure 48: A timeline of several international and US cultural heritage policy documents. Credit: Brian Rich, 2014.

This slide shows a selected group of both US and International cultural heritage policy documents from over 120 documents I reviewed. They are representative of the different types of documents that have been published since 1960. The International documents are on the top in yellow and the US documents are on the bottom in blue. The green highlighted documents at the right end are the Principles of Future-Proofing, which, ideally would be included in both the US and International systems.

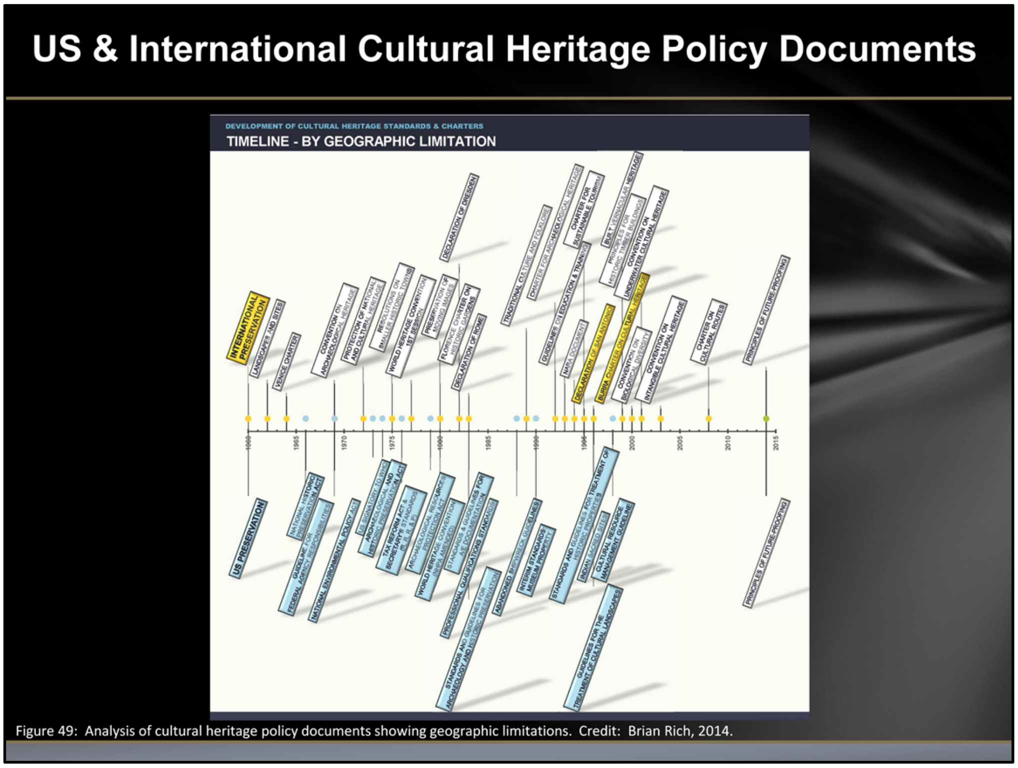


Figure 49: Analysis of cultural heritage policy documents showing geographic limitations. Credit: Brian Rich, 2014.

This slide demonstrates the geographical limitations of the cultural heritage policy documents. The policies in force in the United States are all limited to the US, whereas the vast majority of the international documents are applicable worldwide.

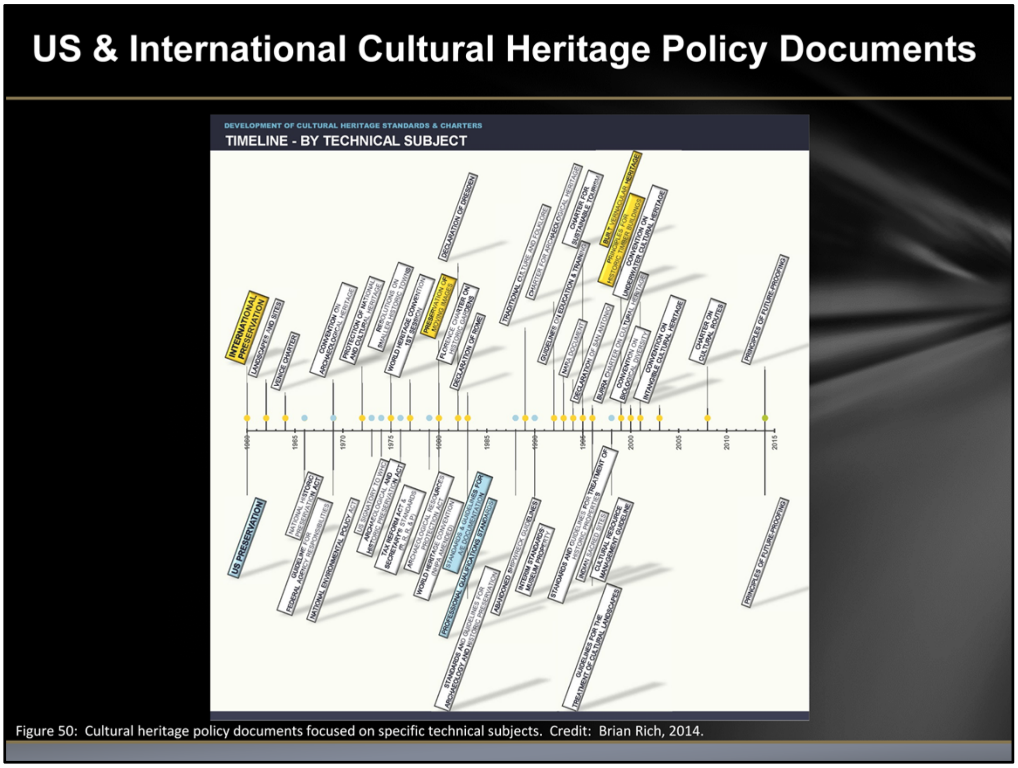


Figure 50: Cultural heritage policy documents focused on specific technical subjects. Credit: Brian Rich, 2014.

This image shows that both the US and International documents have a few documents focused on specific technical topics. There is room for more.

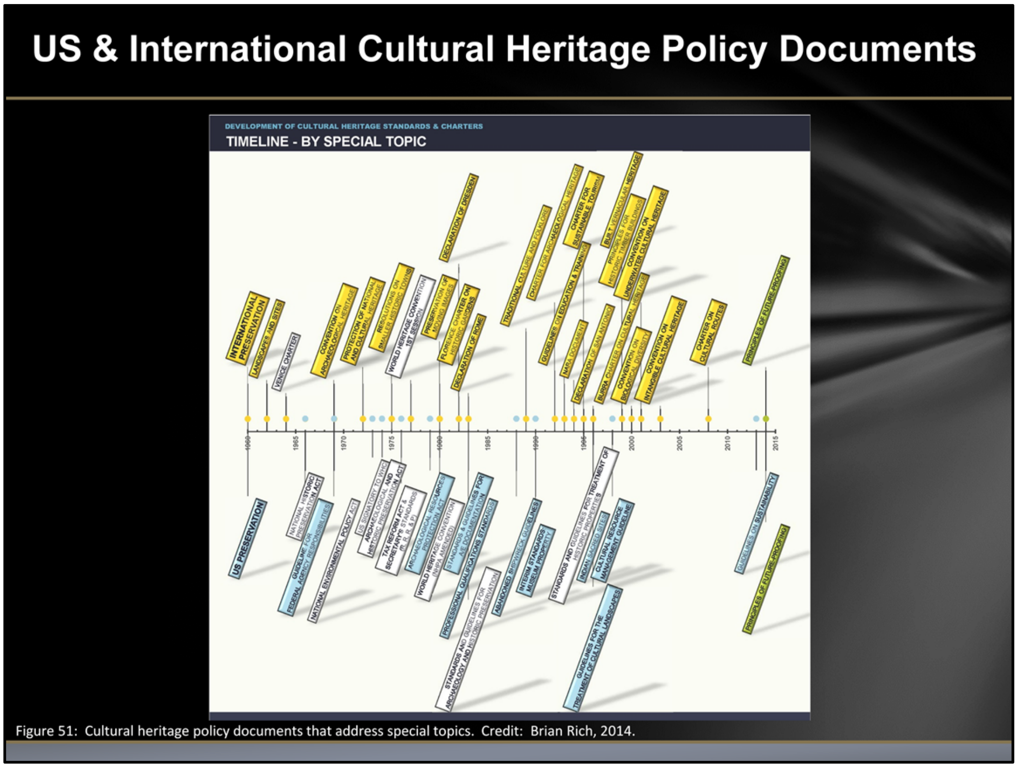


Figure 51: Cultural heritage policy documents that address special topics. Credit: Brian Rich, 2014.

In this analysis, I compared the number of documents that addressed a specific topic – not necessarily technical. Here it becomes clear that there has been significant work at the International level to develop clear understandings of how to address the peculiarities of specific topics. The US, by contrast, has very fewer such documents and seems to rely on the broad application of the Secretary's Standards.

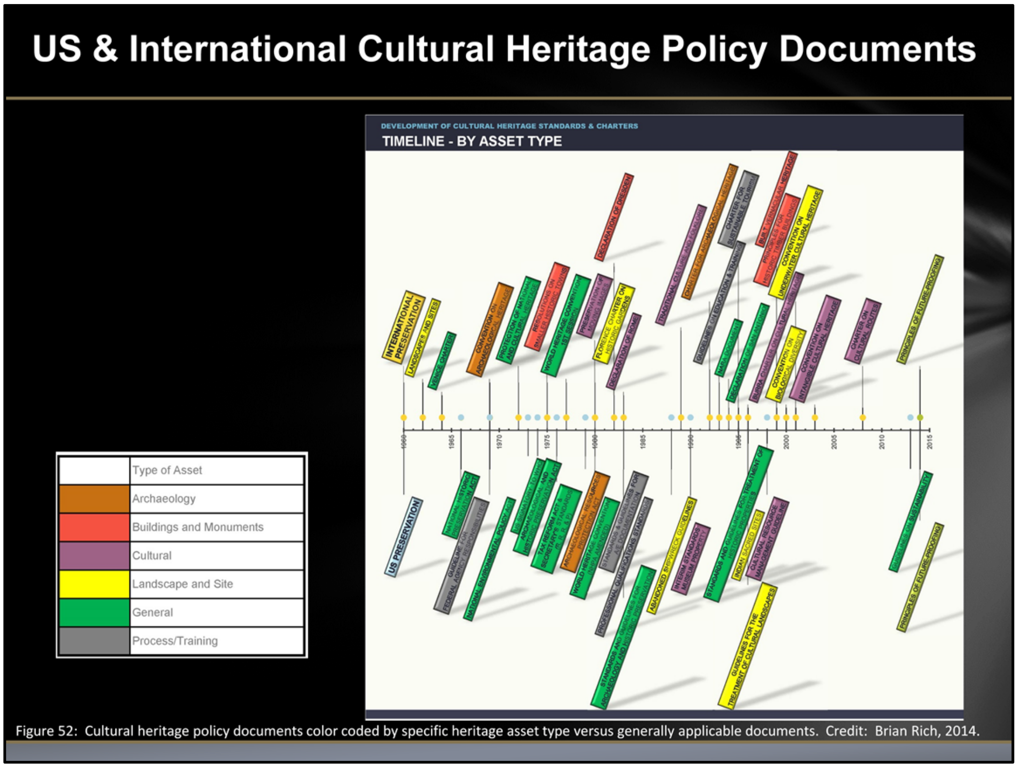


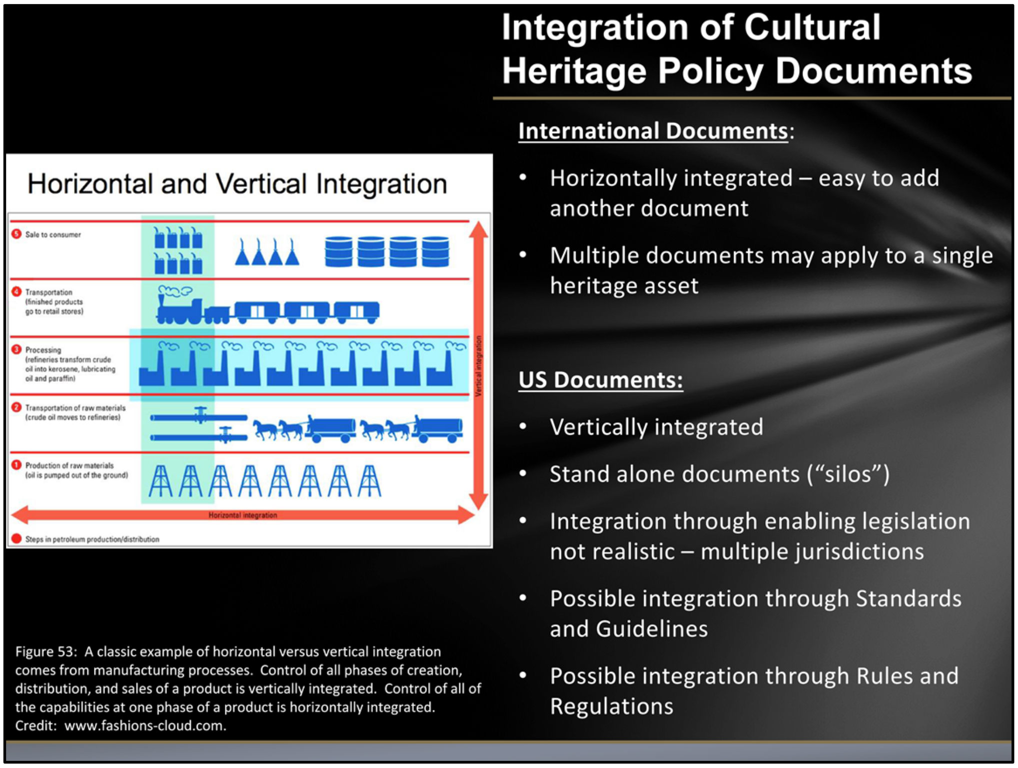
Figure 52: Cultural heritage policy documents color coded by specific heritage asset type versus generally applicable documents. Credit: Brian Rich, 2014.

Perhaps the most informative way to categorize the documents that have been created is to look at general documents versus ones focused on specific types of assets. This is a clue as to how the systems work.

In this case, the US system has several general documents. It's a bit harder to tell, but the US has spent a lot of time revising these general documents. There are fewer Standards that are focused on specific types of heritage assets.

By contrast, the International system has very few general documents and a lot of documents focused on specific types of heritage assets.

So how do these systems of documents work together? We can examine them from the point of view of horizontal and vertical integration.



Understanding the organization of the US and International cultural heritage policy documents is a key element when formulating a way to integrate the Principles of Future-Proofing into these systems.

Similar to the LEED Rating Systems, the US documents are vertically integrated or "silo-ed". This means they can stand alone and do not need other Standards to complete or compliment them. For instance, the 4 Treatments for Historic Properties can each be employed on their own. Indeed, the Rehabilitation Standards are often the only Standard referenced by jurisdictions or Rules and Regulations.

By contrast, the international cultural heritage policy documents are horizontally integrated. This means that the Principles of Future-Proofing have to be integrated in a way different than the integration into the US documents.

For integration of the Principles of Future-Proofing into international cultural heritage policy documents, I propose the development of a parallel charter to be horizontally integrated. Based on the format of many of the charters and documents that have already been developed, the proposal includes a preamble, acknowledgements, definitions, objectives, and finally the Principles of Future-Proofing. I've not included the text here for the sake of brevity.

Of course, in the US, revision of the Standards is a very challenging proposition. Integration of Future-Proofing through legislation is next to impossible in the thousands of independent jurisdictions in the US. Integrating the Principles into the Rules and Regulations that govern the jurisdictions is the more likely path, avoiding the political process, but still facing the challenge of multiple jurisdictions.

Based on this analysis, I came to the rather damning conclusion that the US system of preservation standards is archaic and unable to keep up with the evolving understanding of what is encompassed by cultural heritage. To add to this, though, I realized that the vast majority of jurisdictions haven't even adopted the full range of Standards developed by the Secretary of the Interior to begin with. They have only adopted the Standards for Rehabilitation….

So what are the chances of adopting The Principles of Future-Proofing? Perhaps the best way is to share this research with you and ask that you share it with others.

At this point I would like to return to Nepal for a moment and share the wonderful story of the Kumari

arguably a future-proof cultural institution

And an example of why our cultural heritage is so important to us.

I'll ask you to recall the earlier discussion of how central the temples and religious beliefs are to the lives of the Nepalis. Hardening against an earthquake is simple compared to hardening against climate change, economic downturns, developers' lust for profit, and the disinterest of the community. Well….

Figure 54: A Nepali Kumari in ceremonial dress. Credit: http://blogs.r.ftdata.co.uk/photo-diary/files/2013/09/Nepalese.jpg

With the Kumari, the Nepali living goddess, we see an essential part of Nepal's culture preserved in living form. The Kumari are as much if not more significant a part of their cultural and religious heritage because of the position she holds in their society. They are manifestations of the divine female energy or devi in Hindu religious traditions.

The Kumari is looked upon as not just a protector of her house or village, but of the nation. They are believed to purify the places they are in. Many Nepalis believe that the Kumari protected their homes from damage.

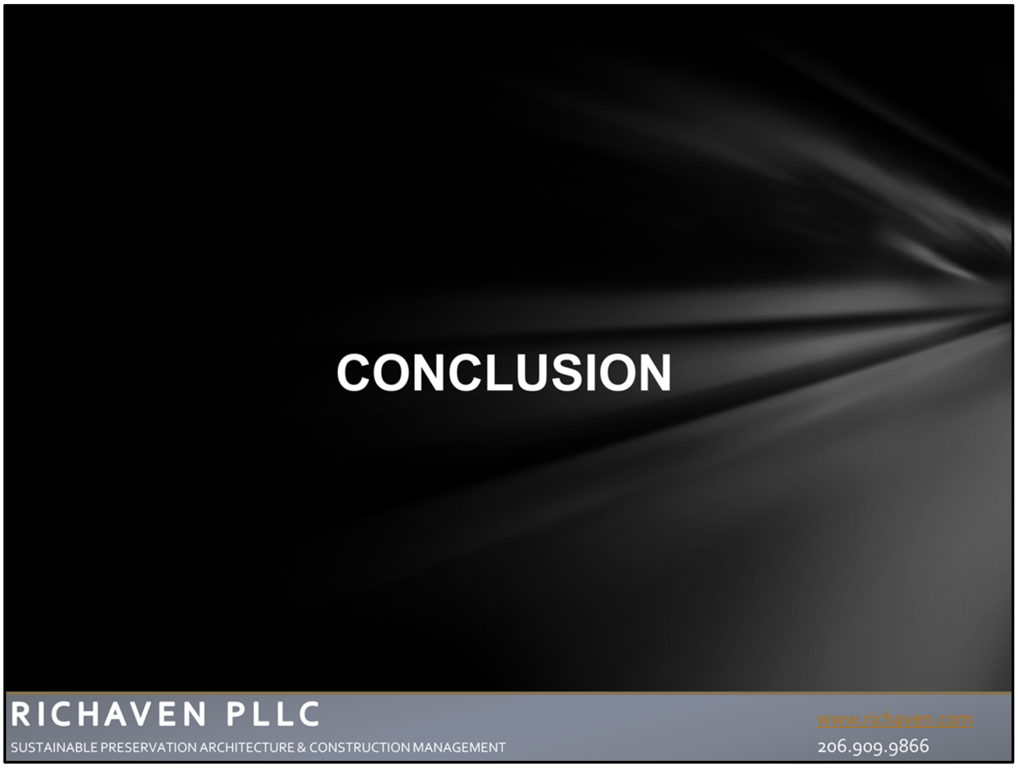
The Kumari is always a young pre-pubescent girl who is selected to be a living goddess until her first menstruation. Kumaris are often local girls who are chosen from within the community of Nepal.

They are selected for specific physical characteristics to maintain a consistent understanding of the appearance of the Kumari. The Kumaris are tested for their strength of will and character, ensuring that they will withstand the rigors of life well and remain the solid core of their community. Not only must a Kumari have a body like a banyan tree and a neck like a conch-shell; she must also calmly endure a test of nerve in which the young candidates are confronted in the dead of night by men in demon masks and a roomful of severed buffalo heads.

Typically the Kumari spends her life restricted to one room, only coming out for celebrationsToday, the Kumari is no longer simply a young girl kept indoors in a secluded room seeing only her family and closest friends. Rather she is a woman of intellect taught by private tutors – even in the poorest village.

Once a Kumari is no longer a goddess, she rejoins the rest of her community. The institution of the Kumari is carried on by a new young girl. One is described as having to learn to walk again – at the age of 15.

The Kumaris is, has been, and will always be a central part of the Nepali culture and religion. All of the Kumaris survived the recent earthquake and are pillars of their communities, lending their strength as the recovery from the earthquake progresses. The Kumari is future-proof.



And briefly to a conclusion….

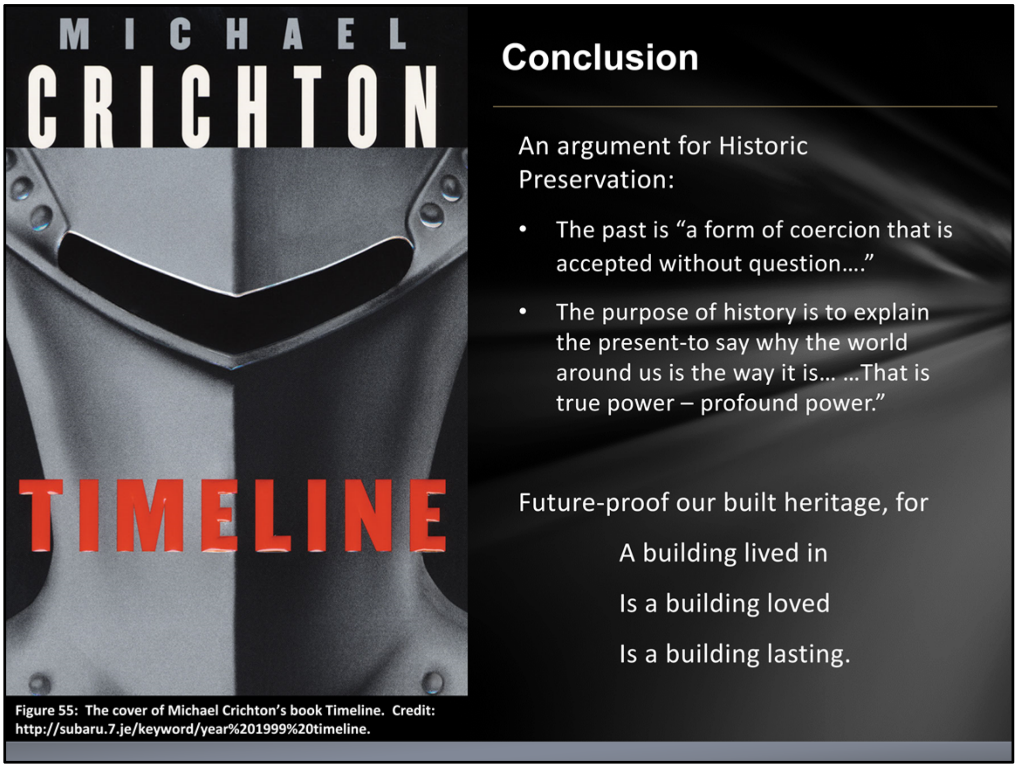


Figure 55: The cover of Michael Crichton's book Timeline. Credit: http://subaru.7.je/keyword/year%201999%20timeline.

I'll conclude with an inspiring view of our past from Michael Crichton's novel Timeline. His character Doniger explains:

"We are all ruled by the past, although no one understands it. No one recognizes the power of the past,"

"A teenager has breakfast, then goes to the store to buy the latest CD of a new band. The kid thinks he lives in a modern moment. But who has defined what a 'band' is? Who defined a 'store'? Who defined a 'teenager'? Or 'breakfast'?

"None of this has been decided in the present. Most of it was decided hundreds of years ago. This kid is sitting on top of a mountain that is the past. *And he never notices it.* He is *ruled* by what he never sees, never thinks about, doesn't know. It is a form of coercion that is accepted without question.

This is real power. Power that can be taken, and used. For just as the present is ruled by the past, so is the future. That is why I say, the future belongs to the past.

Doniger goes on to argue that the artifice of the modern day will compel people to seek out authenticity - where things exist for their own sake. “The past is inarguably authentic.”

“Let us be clear. History is not a dispassionate record of dead events. Nor is it a playground for scholars to indulge their trivial disputes. The purpose of history is to explain the present - to say why the world around us is the way it is. History tells us what is important in our world, and how it came to be. It tells us why the things we value are the things we should value. And it tells us what is to be ignored, or discarded. That is true power - profound power. The power to define a whole society.

The future lies in the past - in whoever controls the past.

I would suggest that this is all the more reason for us to approach our work with enthusiasm tempered by integrity. To apply the Standards and our criteria for designation in as clear and unbiased a manner as possible. To make ourselves and our movement as broadly understood and appealing as the modern trends that so attract our children, not least my 12 year old boy.

The future lies in the past, and we control that past. Let us future-proof our built heritage, for, as the slogan of this preservation week says:

A building lived in
Is a building loved
Is a building lasting.

Thank you.


End
Thanks!
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