Sustainable Building Culture:
Reconstructing Historically-Significant Buildings in Munich, Germany

Mary Sturgeon

Instructor

Werner Lang
Sustainable Building Culture: Reconstructing Historically-Significant Buildings in Munich, Germany

Mary Sturgeon

Sustainable Building Culture

“Building culture describes how society deals with the built environment, and how that environment is planned and used, preserved and further developed. It embraces architecture, urban development, public spaces, and protection of historic buildings. The starting point is raising awareness and preserving assets: the will to achieve a sustainable overall quality, the willingness to apply procedures that enhance quality.” Federal Ministry of Transport, Building, and Urban Development: Germany

Sustainable building practice today is measured by the building Life Cycle Assessment (LCA) criteria. The purpose of LCA is to understand all the effects a building has on the environment. All phases of extracting, processing, and transporting raw materials for construction (embodied energy) are recorded and quantified. The total energy required for building operation, technical investments (such as PV systems), user-engage-ment, and end life (demolition or repurposing of a building) are taken into account. All phases aforementioned constitute the life cycle known as “cradle-to-grave”.

- Initial investment costs
- Construction
- Material choice and its environmental performance
- Operation of the building:
  - Energy
  - Water
  - Other utilities
- Maintenance/Repair/Replace
- Residual value:
  - Re-sale
  - Resource recovery
  - Disposal

The estimated life of a building in Europe is 80-120 years, compared to a 30-year lifespan of a building in the United States.

The majority of Europe’s energy
consumption by buildings is used during their operation over a long-period of time, while the amount of waste generated by the demands of new development every 30 years in the U.S. is unnecessary and detrimental to a sustainable future.

It is important to understand that Europe’s energy and building demands, in general, are regulated by state and the larger European Union entities. There is also a greater public awareness of energy usage and a response to preserving the architectural heritage in many of its cities. Now, more than ever, sustainability is intrinsically linked to economic, social, and cultural valuation. Long-term building investment is imperative to sustainability, and the direction of the European building community can serve as a positive model for building practice in the United States.

“Cradle to Cradle” Model

In looking forward to a sustainable future, it is important to slow overdevelopment and improve qualities of urban areas. Existing buildings that can be restored, renovated, or repurposed offer the perfect opportunities to revitalize cities and preserve that architectural tradition. The life cycle analysis must also be applicable to these buildings.

Because it is difficult to measure the original construction and operational energy usage of buildings pre-1960 there is a need for a modified life cycle assessment specifically directed towards historic buildings. “When historic preservation advocates discuss ‘sustainable’ issues and the retention of existing buildings that have embodied energy, they are looking for a ratio factor that holistically supports this economic metric enhanced by the emotional values of memory. Many wishing only to equate the payback period for new construction amortized over a relatively short period, say 20 years, miss the point entirely that the connection of existing buildings to their communities can bring stability, a sense of pride of place, a scale of livability and interesting craftsmanship of materials and details often missing in new construction”. The quantitative life cycle analysis must then become qualitative. The LCA should recognize, along with construction, operation, and residual energy usage and costs, the positive or negative impact demolishing a historic building may have on the larger community.

Although this assessment would be highly subjective, and statistics would not be immediately available to “quantify”, the often overlooked existing LCA criteria [recycling process] would carry more weight in determining a building’s end result. Perhaps then, factors such as disposal of rubble, re-excaovation of the site, and the continual draining of non-renewable resources and materials for a new building would be taken into consideration. A strong public opinion would also likely deter insensitive development decisions. Historic buildings are inherently sustainable and serve as the ideal “cradle to cradle” model. They have proven their durability over time, are structurally sound, and employ a simple and traditional building

Modified Building Life Cycle Assessment

![Modified Building Life Cycle Assessment](image-url)

1. Resource Extraction
2. Manufacturing & Transportation of Materials
3. On-Site Construction
4. Occupancy & Maintenance
5. Demolition
6. Recycling & Re-Use

Preservation: Restored Renovated Repurposed

Fig. 2: Modified Building Life Cycle
design. “Future-proof buildings have redundancies. Given a robust primary structure, [the] ceiling heights, floor spaces, [and] static load-bearing capacities [guarantee] flexible use. Equipment and technical installations guarantees user-friendliness and with that, efficient exploitation of the materials cycle”.

There are several benefits of restoring and renovating buildings that meet this criteria: existing materials of the building can be re-used and therefore does not add to the waste in a landfill. “The output of building rubble amounted to between 22 and 34 million tonnes a year. Even now, the detritus from demolished buildings forms a considerable part of the steadily increasing volume of hazardous waste”.

Also, many old buildings were built before modern electric, heating, and cooling systems. Without artificial climate control, these buildings were originally designed to respond to local conditions and most likely oriented on the site to maximize the use of prevailing winds for ventilation, openings for day light, and constructed with materials such as stone and brick that acted as thermal masses. Because cities may have developed around these buildings, they are already situated within an existing infrastructure that does not require additional investment and land development.

Strategies for Transforming Historically-Preserved Buildings: “Meeting new requirements, preserving old fabric and incorporating a synthesis of old and new into the built environment”

Since preservationists, architects, and contractors are bound by strict guidelines for restoring and renovating buildings, the integration of new, energy-efficient technologies and upgraded structural components need to be incorporated with smart and sensitive design strategies.

The operation of a building draws the greatest amount of energy. In Germany, a third of primary energy is used by buildings. Reducing this energy loss by insulating lightweight elements in the interior of a building and the roof can be simple, cost-effective, and adaptable. Insulating the exterior is more challenging because it conflicts with the historical preservation intent. In addition, monolithic masonry walls that many of these older structures have are not compatible with today’s multi-layer wall insulation methods that allow an open air space for drying or drainage plane. One German company that specializes in the re-insulation of historic buildings, Deutsche Energie-Agentur GmbH, touts an expandable polystyrene board material called Neopor®. This composite material is lightweight insulator and also doubles as a sound absorber (Figure 3).

Neopor® has been so successful in historic projects for its sensitive application, that it has even been installed as roof insulation in addition to standard gypsum plasterboard.

The material’s properties include “latent-heat accumulators that limit temperature peaks during the summer, ensuring a comfortable climate indoors... Unlike conventional insulating materials, Neopor® has infrared absorbers and reflectors that serve to reduce heat conductivity. As a result, a panel made of this silver-grey foam is 20 percent thinner than conventional EPS panels... Since less raw material is needed, costs can be lowered and resources saved. New, highly compression-resistant and dimensionally stable floor insulation slabs made of Neopor® have proven effective by cutting energy costs in previous renovation projects by about 80 percent”.

Fig. 3: The composite board is made of 8 centimeters of Neopor® laminated with a gypsum plasterboard. This board represents a double function, i.e. as a thermal insulation as well as a sound insulation board, and is sensitive to historic building application

Fig. 4: Historic window protected by storm window
Composite material developments like this collectively work with the existing building structure without causing irreparable damage and will help preserve the building for the next hundred years.

Indoor air quality of historic buildings when renovated can be problematic. A thorough investigation of walls and surface treatments may be required to remove accumulated molds and toxic materials used in the original construction. Although upgrading the building to accommodate a regulated ventilation system may be necessary, the traditional high ceilings of these buildings allow a constant circulation of air and natural daylight to penetrate the interior spaces.

Most renovation projects replace original wood-framed windows with carefully sealed, high-performance windows allowing no thermal break. Historic windows are often a defining characteristic of a building and preservationists maintain that window performance can be increased without removal. Remediation of these windows can be done by installing protective storm windows, applying caulk, weatherstripping, and insulating jambs (Figure 4). Operable historic shutters can be used to minimize interior heat gain. Blinds and curtains are effective and can be cleverly hidden within the window system or compliment the original interior design of the room.

Another relatively simple strategy is replacing light bulbs with energy-efficient bulbs, assuming outlets already exist in the building. In non-residential historic buildings, such as office buildings and museums, occupant activity varies during the day, and ambient lighting systems can be installed to sensor necessary lighting conditions.

These buildings usually have flat or low-sloping roofs perfect for integrating new mechanical systems that cannot be hidden between interior walls. More importantly, because these roofs cannot be seen from the ground, preservation guidelines are less stringent. Architects can use these spaces to design skylights, flooding interior rooms with natural light (Figure 5). These measures can substantially reduce operating energy costs over time if implemented correctly.

When designers and preservationists consider the detailing of the building, natural finishes are often used or carefully crafted to keep the integrity of the building (Figure 6). This material “honesty” also lowers the environmental impact by not coating surfaces petroleum-based paint. The re-use and re-surfacing of existing materials adds an aesthetic quality unique to the building.

Finally, historic buildings already exist within an integrated urban site. They are within a concentrated urban fabric, developed before the advent
People perceive buildings - especially historic ones - as secure, important, and permanent. Historic buildings form the urban fabric unique to a city and to which its citizens can identify. The restoration, renovation, and repurposing of historic buildings actively demonstrates a cyclical process that does not have to end with a building’s demolition. The re-use of site, materials, existing structure, and improved energy performance in historically restored buildings is just as important to integration of sustainable system technologies. Moreover, the restoration of historic buildings that helped characterize cities in the past also has the potential to re-invent cities for the future.

**Rebuilding from Ruins: Munich, Germany**

The city of Munich, Germany is a perfect example of historic preservation and restoration. Germany’s southernmost city was targeted by Allied forces in 71 bombing raids during the course of World War II (1944-1949).

Most of the destruction was a result of strategic fire bombing that essentially burned the buildings, but left foundations and the heavy skeletons of walls [Figure 15]. Because of this, Munich - unlike most German cities - was able to rebuild from what remained. A meticulous building approach was mandated by city officials to preserve the architectural integrity of the ruins and rebuild what could not be salvaged in a conservative manner. By interpreting the building’s original design, many of Munich’s buildings today share a complimentary architectural typology that has helped foster a strong city and regional identity.

“Revalorisation of post-war buildings is a hot topic in Germany... Reusing [the] existing building is also an attempt to devise a way of dealing with a part of our architectural heritage that is not always very popular. Yet dumping it – in other words, demolition – is not the answer”⁶.

**Case Study #1: Alte Pinakothek**

Munich’s prominent art collection resides in the Alte Pinakothek, a Neo-Classic building originally designed by the architect Leo von Klenze in 1836. Klenze’s vision for the museum included an elongated main section with the central cross section that surrounded a traditional, three-aisled basilica plan. The East and West “endpavillons” served as entrance and circulation. On the ground floor of the two-stories, was a 150 meter-long building and several exhibition rooms.

The center of the main building was a hall that served delivery and Visitors arrival. The actual main entrance was the transverse wing of the building facing east. Once visitors entered, they were received by a vestibule reaching out over a relatively narrow staircase to the upper floor. The upper floor plan was a multi-barreled hall and exhibition rooms. Here, visitors had the choice of either a guided path through the halls and interior “cabinets” [smaller rooms] adjacent to the north aisle, or walk through a loggia in the south aisle.

The prominence of the south loggia was Klenze’s central design idea. He designed the south façade with
Fig. 7: Alte Pinakothek, south facade (1938)

Fig. 8: Alte Pinakothek, Allied bombs left a gaping 45 meter hole in the south facade (1945)

Fig. 9: Alte Pinakothek, south facade (2010). Seven slender steel columns of the loggia from the 1952 reconstruction are actually retained in the subsequent masonry walling. The columns are partially embedded, as if they were attached columns or pilasters. In this way, historic preservation is achieved with a remarkable subtlety in appropriation of the ruin and the fragment, incorporating not only the early nineteenth-century remains, but also structural tectonics of a later time. “Why disguise something! People should see that the Pinakothek has its history and that it, too, has not been spared by the war” - Architect, Hans Döllgast
monumental arcaded openings, which was to be unglazed. Formally, the façade design integrated forms resembling models of Roman and Florentine Renaissance architecture. Despite these typologies, Klenze succeeded in designing an independent creation and prototype of the modern art gallery.

In accordance with the internal division, and in spite of the immense length of the building, the traditional emphasis is the middle. More problematic was the design of the roofs. Original drawings show pitched roofs with gables on the main and transverse wing. Skylights were to be inserted as a horizontal glazing for the roof. The costs incurred (by installing a skylight system such as this) could not be executed at that time, considering the weight of snow on the windows during winter. The solution was the construction of box-rising "lantern windows" (Figure 7). Their visible and disproportionate placement led to undesirable accents on the ridge and the abandonment of the proposed gable roof. Klenze seemed not to have been satisfied with the running of the Alte Pinakothek roofs.

The Second World War broke out and the museum was closed and paintings outsourced. In late 1944 and early 1945 the building was largely destroyed by Allied bombing. At war’s end, the middle of the main building was scarred by a 45 meter wide hole (Figure 8). For many years, there was discussion about the future of the ruins, but nothing was done to safeguard them. The area in front of the south elevation was used as a rubbish bin. At this time, architect Hans Döllgast watched from the scenario unfold from the nearby Technical University: "In front of our windows on the Arcisstraße is the rubble heap ever higher and the facade naked".

The situation continued even until 1952, because no decision had been made on reconstruction or demolition and new construction. Uncompromisingly, there were supporters of both plans. Döllgast...
him to consider the simplest infilling of the gap in the south façade. Döllgast’s plan showed the upper floor of the south facade open and supported by ten lightweight circular hollow steel pipes supporting a continuation of the pitched roof and descending towards the ground against a closing of the gap by an exterior wall with large rectangular windows (Figure 9). In the room beyond Döllgast planned the installation of two symmetrical, straight-flight staircases, ascending from the central axis and serving as the new main entrance from a foyer (Figure 11). This circulation well also allows natural ventilation throughout the expanse of the building. This main staircase, previously located in one of the end wings, assumed a more twentieth-century look, in which circulation was the centerpiece of the architecture and privileged above the works of art themselves. The external wall is thus pushed back to the rear of this loggia and staircase.

The first phase of construction began with the restoration of the interior walls and roofs. Döllgast’s reconstruction of the building was conscious not to copy the pre-war state. He eliminated, as he put it, “Eight false box lanterns, which Klenze had trouble concealing” and replaced it with gable roofs with horizontal glazing above the central and the transverse wing. On the upper floors of the transverse wing he made almost all windows bricked up in order to gain additional hanging space for paintings (Figure 14).

In 1952, Döllgast finally received an official planning commission, after the parliament had approved 500,000 Deutschmarks to secure the project. The budgetary restrictions compelled him to consider the simplest infilling of the gap in the south façade. Döllgast’s plan showed the upper floor of the south facade open and supported by ten lightweight circular hollow steel pipes supporting a continuation of the pitched roof and descending towards the ground against a closing of the gap by an exterior wall with large rectangular windows (Figure 9). In the room beyond Döllgast planned the installation of two symmetrical, straight-flight staircases, ascending from the central axis and serving as the new main entrance from a foyer (Figure 11). This circulation well also allows natural ventilation throughout the expanse of the building. This main staircase, previously located in one of the end wings, assumed a more twentieth-century look, in which circulation was the centerpiece of the architecture and privileged above the works of art themselves. The external wall is thus pushed back to the rear of this loggia and staircase.

The first phase of construction began with the restoration of the interior walls and roofs. Döllgast’s reconstruction of the building was conscious not to copy the pre-war state. He eliminated, as he put it, “Eight false box lanterns, which Klenze had trouble concealing” and replaced it with gable roofs with horizontal glazing above the central and the transverse wing. On the upper floors of the transverse wing he made almost all windows bricked up in order to gain additional hanging space for paintings (Figure 14).

In 1955 the restoration of the exterior was largely completed, and the second phase of construction began with the redevelopment of the interior. Döllgast altered Klenze’s first floor gallery arrangement of exhibition spaces which ran along the east-west axis, flanked by a pair of smaller cabinet spaces. The gallery today, allows privileged views from one large exhibition space to the next from both ends of the building. Also, the main foyer paralleled the grand staircase and is partially lit by the large southern windows, lending a contrast between the dramatic, high, open space and the inviting light of the stairs and bright upper exhibition rooms (Figure 10).
The Second World War did not spare the Glyptothek, as it was heavily bombed in an air attack between the 11th and 16th of July, 1944. One direct hit destroyed the entire Roman antiquities room (almost the entire east wing of the building), and 50 incendiary bombs ruined the Egyptian exhibition hall located in the southwest corner of the museum. The roof was also completely destroyed. From 1947 to 1953 temporary rebuilding measures were limited to safeguarding the building. Slowly, The Western Wing was rebuilt in 1954. In 1957, the city, museum directors, and historic preservation-

Case Study #2: Glyptothek

Leo von Klenze was also the lead architect for the Glyptothek, located two blocks from the Alte Pinakothek. This museum, built from 1816 to 1830, was intended to showcase Greek, Roman, and Egyptian sculpture and the architectural typology took the form of a Greek temple (Ionic). The vaulted and domed ceilings of the interior inspired by ancient Roman baths were elaborately decorated in richly-colored frescoes, and the fourteen exhibition rooms were artworks in themselves. Grouped around a large Inner Courtyard, Klenze emphasized the axial vistas and openings of each room with large windows. The original building’s thermal ceiling windows were intended to bring light into the corner rooms but it was not sufficient enough to highlight the sculptures and was an early criticism of the building. Klenze was also involved in the interior design and insisted that the sculptures be arranged near the walls and centered symmetrically in the rooms. This was to harmonize the architecture and the sculpture.

By 1966 fire regulations and weathering damage to the facades required a second exterior renovation in the 1970’s. The hipped roof was rebuilt in 1977, and the renovation patchwork was smoothed out in detail.

Most recently, a restoration of the West Wing roof and skylight was undertaken in 2009. It is this replacement of the skylight with efficient glass that protects the exhibition room paintings, and still allows ample natural light to flood in. The white, curved ceiling of these exhibition rooms reflects and redirects the light throughout the room and smaller interior “cabinet” exhibition spaces (Figure 12). The rooms were also brought up to proper insulating standards and the ventilation system was upgraded.
ists met to decide how the museum was to be reconstructed. "...Various designs for extensions and conversions of the Glyptothek were put forth, in which Greek originals could be shown in a modern environment with better lighting. Among the proposals considered were the installation of a glass construction in the Inner Court; a modern reconstruction of the Roman room with glass wall to the Inner Court; and a separate museum building connected to the Glyptothek. All these solutions would have involved making considerable changes to the Glyptothek’s austere, compact architecture..." The majority didn’t want it restored with the original décor, but rather, "entrestaurierung" – de-restoration. Architect Josef Wiedemann was consulted and hired in 1964 for the re-design and construction. From the very beginning of the design process, Wiedemann stressed that the original spacial configuration of the architecture would be preserved and nothing new would be added. "The rooms take their form from the big wall that joins with the arches and vaulting to form a natural whole... What remains of the portals of the individual ornamentation should be left...The others should be completed with brickwork of the same high-quality as the original brickwork, using flush pointing and covering it with a thin coat of mortar" – Josef Wiedemann. However, when the renovation commenced, the years of damage and deterioration had taken its toll on the interior building materials. The brick walls of the internal rooms were saturated with water, nitrate, and sulphur, and finally damaged beyond repair. Four centimeters (2 ½ inches) of the interior walls were scraped away and restored with handmade bricks and mortar that had a unique colored quality Wiedemann discovered by accident. The bricks were dulled, smoothed, and consisted of a chalky finish. The white-grayish bricks carefully inlaid to create a subdued and minimalist wall and ceiling respect the structural qualities of the building. The original thickness of the exterior walls serves as a thermal mass for the building and the spacially-conscious interior shell allows active air circulation without the need for complicated mechanical systems. The partially-exposed brickwork articulated details, coffers, friezes, and cornices. The dome in one hall leads to an arch and barrel vault in another. The new Glyptothek is an example of material and structural honesty. The highlighting of Greek and Roman construction is successful in the reconstruction. The reconstruction was an opportunity to remedy the natural light infiltration that the
original corner rooms lacked.

Lunette windows were installed above the rectangular floor-to-ceiling windows that were either blown-out by the bombings or in a dilapidated state. This extra semi-circular opening structured the daylight and allowed it to reach further into the rooms. To remain faithful to Klenze’s original design, the domed skylights were restored over the corner rooms, and indirect, ambient lighting was placed upturned on the walls to reflect off the whitewashed ceilings. The Inner Court also needed to be rehabilitated. “It is like an atrium. Unlike before; it is now also possible from any given wing of the Glyptothek to look across the Inner Court into the rooms on the opposite side”10. In order to heighten this effect, Wiedemann raised the level of the Inner Court by 80 centimeters. This subtle platform made it possible for the antiquities to be presented in a new way. When the majority of the reconstruction was complete, Wiedemann oversaw that the minimalist quality - “reinen Raum” (clean/minimal room) and architectural expression showcased the marble sculptures. Gray shell lime used for the floor was also cut into pedestals intended to hold the marble busts that were originally lined up against the wall. Today, the sculptures stand scattered about the exhibition hall, almost creating a dialogue between the viewer and the art. The light that floods into the room bounces off the curvature of the ceiling and strikes the patina of the sculptures illuminating the history of art and architecture. Conceptually, the overall design was taken by museum specialists and architectural critics to be a “Courageous and straightforward integration of old and modern...”11. The museum was reopened on April 28, 1972, and the restoration cost 6.6 million DM (3.3 million Euros). The Glyptothek was the “first example of integrating an old building with modern possibilities[and] one of the strongest concepts of this time period...” The consciousness Wiedemann displayed in the restoration positively influenced public perception with regard to historic preservation. Consequently, in 1973, a state law was changed to implement the preservation and restoration of all historic buildings.

Conclusion

Historic and older buildings follow an architectural tradition of efficient, conservative design that integrates passive energy use and saving strategies. The construction quality and utilization of natural materials do not degrade and poison the environment. They are sustainable merely because they already exist in an established infrastructure. The modified building life cycle assessment discourages demolition of these buildings because of the comparative costs that re-using a building has to excavating, constructing, and operating a brand new building. Additionally, the preservation, reconstruction, and repurposing of these buildings challenges architects, preservationists, and urban planners to not only remedy the damaged structure, but to do so in a smart and sensitive manner that promotes good building applications and design. Most importantly, historic buildings have an intrinsic social and cultural value. Although the measures of sustainability, today, may emphasize the technological enhancement of a structure, buildings that have stood for the past hundred years and are still occupiable, useful, and visual reminders of successful long-term investment.

“Building preservation in a meaningful way does not mean to restore it in exactly the same way”12.

Glossary

Restored: reconstructing an old building to its original state.

Renovated: modifying an existing building. This revitalization means upgrading the building to current technical standards for the purpose of some contemporary use, thereby maintaining or increasing their value. The degree of structural intervention goes beyond straightforward maintenance measures, and becomes repurposed - transforming the existing building’s user-space with new programmatic elements.

Sustainability: A set of principles used to evaluate a building’s environmental impact. Sustainable architecture tries to reduce energy use, and may also promote recycled or local materials in construction.

Adaptability: The attempt to anticipate uses for a building other than the one for which it was built, thereby preventing the need to tear it down.

Life Cycle Assessment: Life cycle assessment (LCA) quantifies energy and material usage and environmental releases at each stage of a product’s life cycle.
Notes

1. Sharon C. Park, FAIA, Chief, Technical Preservation Services, National Park Service


12. “Un Encuentro" Film, Juan Domingo Santos

Figures

[All photos were taken by the author, unless otherwise specified]


7. Photo courtesy of article sent by Melanie Eibl

8. http://www.b donline.co.uk/Pictures/web/l/sf/Alte_Pinakothek_ruine_EB7D1.jpg


17. http://sitem.herts.ac.uk/art-des_research/papers/wpades/vol4/mg04.jpg

Further Reading (Articles)

1. “Sustainable Living: The Role of Whole Life Costs and Values”. Mithraratne, Nalanie; Vale, Brenda; Vale, Robert.


Books


Special Thanks: Gerhard Kremer, Prof. Dipl.-Ing. Victor Lopez-Cotelo [Architecture Design and Conservation, TUM], Melanie Eibl [Dipl. Restauratorin, Univ., Doerner Institut], Matthias Rammig, and Conny Lang for the translations.

Fig. 21: Plaque on a building in Idstein, Germany. “Created with wisdom and restored with respect".