Norman Foster and Water Conservation:
A Comprehensive Analysis of Sustainable Design

by

Anne deBoer
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Introduction: *Sustainability & Sustainable Architecture*

Part I

Within the past several years, the term “sustainable” has become a buzzword among economists, politicians, businessmen, bankers, and people of nearly every occupation. In fact, the word “sustainability” has become so widely used that in 2009 the Center for Policy Studies in England declared the term “vacuous” and “potentially dangerous,” and that “few words have become more heavily used or abused in government and corporate affairs.”¹ “Sustainability” is most often used in the context of “sustainable development,” a relatively recent concept that aims to bridge the divide between environmental preservation and economic progress. Since the 1990s, the term “sustainability” has been increasingly applied to the field of architecture. While the word has become a contemporary sensation, it has been in use for 300 years.

According to German scholar Ulrich Grober, Hans Carl von Carlowitz (1645-1714) coined the term “sustainable” in 1713 in his book on forest management published in Leipzig.² Hans Carl von Carlowitz was the head of the Royal Mining Office in the Kingdom of Saxony and worked to supply timber to the mining district of the kingdom.³ At the turn of the century however, the timber and mining industries were severely threatened by the amount of deforestation for agricultural production

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² Jurgen Schmandt, *George P. Mitchell and the Idea of Sustainability* (College Station, TX, USA: Texas A&M University Press, 2010), 11.
and ore smelting. In response, Carlowitz wrote *Sylvicultura Oeconomica*, in which he predicted a complete loss of timber resources and sought possible solutions. He proposed potential timber alternatives, more efficient uses of timber, and most importantly, the replanting of trees in areas that had become cropland. The book explains how to re-forest and continue the harvest to ensure “that there will be a continual, steady and sustained usage,” or “nachhaltende Nutzung.” The word “sustainable” comes from the Latin word “sustinere,” meaning to endure or to last. The word “sustinere” itself originated in the word “tenere” meaning “to keep.” In the *Sylvicultura Oeconomica*, Carlowitz uses “sustained” to describe the continuous yield of wood necessary to guarantee the economic benefits of the environment for future Saxons. *Sylvicultura Oeconomica* had a significant impact on reforestation efforts in the years after its publication and since then has been credited as the first book dedicated to forest management.

Throughout the nineteenth and twentieth centuries, “sustainability” was most often used to describe the protection of threatened natural resources that were necessary for trade and industry, such as forests, fisheries, and water. The idea of continuous productivity for the benefit of future generations was explicitly noted by German forestry expert Georg Ludwig Hartig in 1804: “There is no continuous forest economy unless the yield of wood is calculated according to the principle of sustainability…The forest manager must use the forest in such a way that the next

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generation can benefit at least as much from the forest as the current generation.” In 1837, Adolphe Parade, Director of the French Forest Academy in Nancy, was the first to translate the German “nachhaltende” to French when describing “production soutenu,” from the French verb “soutenir.” The English term for “sustained yield” was first used in the mid-nineteenth century. The concept of the sustainable yield as it regards to forest management is still in use, and was adopted for the management of U.S. national forests in the \textit{Multiple-Use Sustained-Yield Act of 1960} (Public Law 86-517) stating, “The Secretary of Agriculture is authorized and directed to develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained therefrom.”

A separate use of “sustainability” emerged in the late nineteenth century, which applied the term to the new field of ecology. In this application of the word, sustainability was used to describe the importance of maintaining safe conditions for the survival and well being of all species. This definition was not anthropocentric, but instead emphasized the need for healthy “relationships of the organism to the environment” as described by German biologist Ernst Haeckel in 1866. This adaptation of the term for ecological purposes would inspire environmental movements and political developments in the late twentieth century.

The economic and ecological uses of “sustainability” were brought together for the first time in a directive by the International Union for the Conservation of

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Nature (IUCN) in the late 1960s.\textsuperscript{13} When IUCN was founded in 1948 as the International Union for the Protection of Nature, it was the first and only international environmental organization.\textsuperscript{14} In 1969, they published a mandate declaring the importance of “the perpetuation and enhancement of the living world…and the natural resources on which all living things depend,” focusing on the management of “air, water, soils, minerals and living species including man, so as to achieve the highest sustainable quality of life.”\textsuperscript{15} Sustainability was interpreted as an enduring quality of life for all species that was dependent on the enrichment of the natural world.

The relationship between healthy environment and a sustainable quality of human life evolved into the concept of “sustainable development” at the “United Nations Conference on the Human Environment” in 1972 (commonly referred to as the Stockholm Conference). At preparatory meetings for this convention in 1971, developed and developing nations recognized the challenge of facing global environmental crises without limiting economic development. As noted in the final Declaration of 1972: “To defend and improve the human environment for present and future generations has become an imperative goal for mankind—a goal to be pursued together with…the established and fundamental goals of peace and of worldwide economic and social development.”\textsuperscript{16} As a result of this conference, the United

\textsuperscript{13} Schmandt, “George P. Mitchell,” 13.
Nations Environmental Program was established to promote sustainable development worldwide.¹⁷

Sustainable architecture is an emerging field that applies sustainability to design in order to build with a minimal environmental impact.¹⁸ The Royal Institute of British Architects has claimed that the relationship between the terms “architecture” and “sustainability” began after the publication of the UN Brundtland Commission report, Our Common Future in 1987.¹⁹ In this document, sustainable development is defined as the ability to meet “the needs of the present without compromising the ability of future generations to meet their own needs.”²⁰ Six years later, the American Institute of Architects and the French Union Internationale des Architectes wrote the Declaration of Independence for a Sustainable Future at the World Congress of Architects meeting in Chicago:

Sustainable design integrates consideration of resource and energy efficiency, healthy buildings and materials, ecologically and socially sensitive land-use, and an aesthetic sensitivity that inspires, affirms, and ennobles...sustainable design can significantly reduce adverse human impacts on the natural environment while simultaneously improving quality of life and economic well being…²¹

Through this definition there began an international recognition among architects and clients for the need to incorporate the principles of sustainability into building design.

In the recent past, sustainable architecture has become a field of its own, separate from management practices and economic yield concerns. Today, there are initiatives worldwide to promote sustainable design. The Leadership in Energy and Environmental Design (LEED) program was established in the United States in the late 1990s to provide incentives for private and public companies to invest in sustainable practices. In Germany, such programs are often legal initiatives, requiring buildings to have low energy consumption and to publish evaluations of building performance data. Sustainable architecture adopts the century-old idea of providing for future generations but does so through a new lens: building with minimal negative impact.

Sustainable improvements in the construction and operation of new and renovated buildings can have substantial global implications. Buildings produce one third of global greenhouse gas emissions and consume over forty percent of the world’s total energy.\(^{22}\) Eighty percent of these emissions are from the use of mechanical systems during the building’s lifetime, such as heating and cooling, lighting, and water heating.\(^{23}\) Globally, the building and construction industry uses the most natural resources of any sector as calculated by its share of land use and extraction of material.\(^{24}\) An estimated forty per cent of the raw materials used worldwide are for building purposes.\(^{25}\) Modern technologies, however, are capable of

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\(^{23}\) Ibid.
reducing the energy consumption of buildings by thirty to eighty percent. Twenty years ago, many technologies cost a ten to twelve percent premium with a five-to-seven year payoff in energy savings. Nowadays, due to large-scale production and increased demand for energy-saving technology, many such investments amount to less than two percent with cost savings paying off in two years.

While people understand the need for responsible environmental design, the meaning of “sustainable architecture” remains a contentious issue. In 1997, Sara Cook and Bryn Golton noted: “The designation ‘green’ is extremely wide ranging, encompassing many viewpoints and open to broad interpretation.” Furthermore, they claim, sustainable architecture is an “essentially contestable concept.” This interpretation varies greatly from that of architect Susan Maxman, who noted in 1993: “Sustainable architecture isn’t a prescription. It’s an approach…it shouldn’t really even have a label. It should just be architecture.” According to British architect Sir Norman Foster in an essay from 2003 on “Architecture and Sustainability,” “Sustainable architecture can be simply defined as doing the most with the least means.” In 2006, Foster & Partners completed the first U.S. sustainable skyscraper in New York City for the Hearst Corporation. The Hearst Tower cost an estimated $500 million, an amount that has little correlation with the virtuous claim of “doing the most with the least means.” Foster’s definition, like others, is extremely vague and problematic, and contributes to complicating our understanding of the field.

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26 UN Buildings & Climate Initiative, “Buildings and Climate Change.”
27 Bruce Fowle (Co-Founder of FXFowle, New York), interview by Annie deBoer, March 24, 2012.
One of the lead contributing factors to the global misunderstanding of sustainable architecture is the subject’s critically flawed literature. While the field has only existed for two decades, journalists, scholars, and architects alike have begun to establish certain conventions of its historiography that significantly limit any comprehensive understanding of the purpose of sustainable design. Three main conventions define this discourse and have contributed to inadequate information about, and ineffective evaluation of, sustainable structures. The first convention is the focus on the singular architect rather than the collaborative efforts. Engineers, clients and governments often play an influential role in determining the final design of a building, yet their efforts are rarely mentioned. The second convention is an emphasis on technology over context. Sustainable architecture is commonly understood as a technological revolution, but in reality it is largely a product of social, political, and geographic pressures that can both limit and advance sustainable agendas. Lastly, the literature on sustainable architecture highlights recently constructed buildings and rarely focuses on long-term performance. This significantly limits forward progress in sustainable building, as the achievements and shortcomings of a structure post-occupancy cannot be analyzed for future design improvements.

A new convention for discussing sustainable architecture is thus necessary for the effective development of the field of sustainable design. In this paper, I explore a more holistic approach to the historiography of sustainable architecture through an exploration of the work of Sir Norman Foster. Foster is an internationally recognized architect known for his innovative approach to building sustainably. Foster’s work has been both praised and critiqued since his career began in the 1970s. Some have
referred to him as a “one stroke architect” with a “singular idea,” and others have called his work a “prototype invented for no particular site or program.” Some of these critiques are not a result of Foster’s work, but are a product of the inadequate literature of the field that has led to false conclusions. Such literature can also lead to erroneous praise, as Foster is often given credit for work that is achieved by other, less discussed, members of the team, such as the engineers. Architecture critic Paul Goldberger, for example, called Foster the “Mozart of Modernism,” without any mention of the contributions of his technical collaborators. Through a close analysis of Foster’s work, the shortcomings of the conventional discourse on sustainable architecture will be examined and a clearer evaluation of Foster’s own portfolio will be achieved. In this way, a new standard can evolve to evaluate sustainable design.

The historiography of the broader field of modern architecture has always focused on the singular architect. However, in reality, buildings are the result of a collaborative effort, which can include clients, engineers, project managers, site developers, construction companies, and occasionally government officials. Professor Steven A. Moore noted in 1997, “Conventional architectural history commonly awards the authorship of large, complex projects involving hundreds of workers to a single architect.” While this convention has existed for a long time, it has become increasingly flawed since the increased division of expertise between architect and engineer that has occurred over the past century. The construction of giant

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skyscrapers, the evolution of complex mechanical systems, and most recently, the emergence of efficient and sustainable technologies require engineering backgrounds that often go beyond the realm of an architect’s training. Volker Fischer stated in a monograph dedicated to Foster & Partners’ Commerzbank in Frankfurt, Germany (1991-1997): “Contrary to widely held popular opinion, the architect in charge is by no means the only designer for a building of the size of the new Commerzbank…each project is kept moving by a group of collaborators, who in Foster’s case themselves work largely independently.” Completed in 1997, the Commerzbank design was greatly influenced by both the client company and the local government. In fact, Foster had little control over whom he was to work with, and the team was greatly determined by the unforeseen challenges requiring local expertise. By not discussing the multiple contributors to the project, accounts have overlooked the challenges of such collaboration that often have defining impacts on the final design.

In a similar vein, the literature dedicated to efficient technologies significantly undermines the importance of context in sustainable design. Publications such as *Green Building Trends: Europe* (Island Press, 2009) by Jerry Yudelson have short discussions of multiple buildings highlighting the most impressive technological elements of the design without any mention of the contextual reasoning behind such decisions. Dean Hawkes and Wayne Forster begin their book *Energy Efficient Buildings: Architecture, Engineering, and Environment* (W.W. Norton & Company, 2002) with: “The aim of this book is to examine the nature of the evolving relationship between engineering and architecture in transforming the environmental

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function and performance of buildings.” These publications aim to create a generic formula to be followed by any professional trying to build sustainably. They also lead critics to claim that Foster’s work is prototypical, applicable to any site and function. In 1997, Steven A. Moore attributed this lack of contextual discourse to the limited vocabulary of the broader field of architecture: “Public concern for the environmental sustainability of development has required that architects understand technology in other than instrumental terms. Architecture, however, lacks a vocabulary that enables practitioners to adequately understand the social construction of technological systems.” In 2001, Simon Guy and Graham Farmer wrote an article entitled “Reinterpreting Sustainable Architecture: The Place of Technology” in which they discuss the fundamental issue of such technology-based literature. They note:

Sustainable buildings are assumed to merely represent differently configured technical structures, with particular pathways of technological innovation viewed as objectively preferable to others. Reflecting the ‘technocist supremacy’ that dominates most environmental research programs, this perspective tends to ignore the essentially social questions implicated in the practice of sustainable architecture.

This significant gap in the literature of sustainable architecture provides no concept of the importance of the broader context that is so relevant to every environmental building project. The sustainable solutions of each of Foster’s projects are often the direct result of contextual limitations dependent on location, social and political pressure, as well as commercial and public image. To achieve a proper understanding

of each commission and to be able to describe a method for how to apply the sustainable successes to other projects, it is necessary to understand the full context in which the commissions were developed.

Finally, one of the most troubling conventions of this young historiography is that the majority of the published information is written or compiled directly after the completion of a building. These works are primarily press releases by the firms who worked on the project, newspapers in the geographic area of the development, and monographs written by people who tracked the evolution of the structure from the design phase to the last steps of construction. While such literature is necessary to the overall understanding of a project, its lack of critical distance severely restricts effective evaluation and progress reports. It results in an uneven amount of the available information dedicated to recent successes rather than long-term achievements.

Such a lack of assessment also limits the development of the field as a whole, as success becomes extremely difficult to measure, replicate, and build upon. For nearly every large-scale sustainable building, there are multiple cost simulations, computer renderings of energy savings and 3D modeling. However, all of these concentrate on the pre-construction phase, the “expected” reductions, rather than on the post-construction, performance data. In 2010, there appeared one of the first books dedicated to environmental performance, *The Environmental Performance of Tall Buildings* by Joana Carla Soares Gonçalves and Érica Mitie Umakoshi (Earthscan, 2010). In the forward of this text, the project engineer for the Commerzbank and other large sustainable developments, Klaus Bode, wrote:
There is actually very little operational data available for tall buildings substantiating the claims of some designs to be low energy consuming; it is unfortunate that such data is generally unavailable, as such data should be treated as ‘positive feedback’ benefiting the design of any buildings.\(^{37}\)

Furthermore, this lack of information has led us to “continue to design in what may be described as a virtual vacuum of factual feedback / knowledge.”\(^{38}\) Klaus Bode believes the monitoring does not happen as a result of a lack of funding, and often a lack of understanding the value of such evaluations.\(^{39}\)

This significant gap is also due in large part to an underlying characteristic of most historical studies of architecture, which is the element of ownership and changing tenants. Many subletters and owners of buildings do not want to make their energy use public. At Four Times Square in New York City (completed in 1999) Fox & Fowle designed what has been claimed to be the first environmental skyscraper in the United States. This building is referred to as a breakthrough in sustainable design, and has been given credit for helping determine the U.S. green building certification standard called Leadership in Energy and Environmental Design (LEED).\(^{40}\) While the new structure included a central monitoring system to test indoor air quality, nowhere are the actual energy savings of the structure published. Even if the monitoring has been executed as planned, the information is not publically available.\(^{41}\) According to architect Bruce Fowle of the former Fox & Fowle partnership (now renamed FXFowle), this is due to the plain and simple fact that owners are secretive about their


\(^{38}\) Ibid, xxiv.

\(^{39}\) Ibid.


energy use. This challenge will be revisited, as there are simple solutions to encourage the publication of such data.

The challenges of evaluating sustainable design go beyond the published literature, and only begin to be explored in this paper. However, it is critical that the discourse on sustainable architecture be re-evaluated and explored through a multi-faceted analysis that incorporates the significance of the collaboration, the implications of the context, and to the extent that it is possible, the critical evaluation post-completion. Such a comprehensive analysis will allow for a more appropriate understanding of how and in what areas sustainable architecture has progressed in the past twenty years, and more importantly, the direction in which it and its historiography can most effectively continue to develop.

**The Ideal Sustainable Structure**

Through the three comprehensive case studies of Norman Foster’s work, this paper will explore how to evaluate sustainable design more effectively, and ultimately, how to achieve the ideal sustainable structure. The term “sustainable architecture” as it pertains to this discussion requires a definition. As explored in the following chapters, it is an architecture that minimally impacts its environment while simultaneously promoting the human understanding of, and engagement with, such surroundings. For the purpose of this paper, the terms “green,” “ecological,” “environmental,” and “sustainable” will be interchangeable as they conventionally are in the literature. To fully appreciate the definition and ultimate evaluation of a sustainable structure, one must first define the “ideal” sustainable building.

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42 Bruce Fowle (Co-Founder of FXFowle, New York), March 24, 2012.
The average lifespan of an office building in the United States is sixty-five years, while the entire field of modern sustainable architecture has evolved in the past twenty years. One major difficulty that arises for any sustainable architect is how to design a structure that can remain sustainable overtime, since technology and design innovations are improving so rapidly. The ideal sustainable building does not only last longer than the average of sixty-five years, but its sustainable agenda also endures the test of time over its lifespan. In this field, structures that are a mere decade old can be considered part of the first generation of sustainable design. Therefore, when evaluating “older” buildings it is necessary to do so with the understanding that what was most efficient in the recent past differs greatly from what might be most environmental by today’s standards. Due to the lack of literature on long-term success, such an evaluation is severely limited. For example, the Commerzbank, completed in 1997, is one of the few large structures with available performance data. Yet the reality is that the true success of an environmental building depends not only on its innovation at the time of its completion, but also on how it maintains efficiency through the years.

As explored below, there are design approaches that can maximize the sustainability of a structure overtime. Structures that rely on passive systems are less likely to be outdated than those dependent upon the constantly changing field of efficient technology. Passive design is that which maximizes the benefits of non-mechanical elements that require no energy, such as natural lighting, operable windows to decrease mechanical heating and cooling, and materials with large

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thermal mass to decrease heat loss. The average lifetime of mechanically powered devices can be extremely short. In the United States, the average durability of heat pumps and central air conditioners is a mere eleven years.\textsuperscript{44} Passive systems, such as natural ventilation and lighting significantly reduce the time and money invested on technologies including maintenance, operating costs, and updating. Furthermore, the buildings that are able to continue their sustainability most effectively are those that are designed from the beginning to be adaptable to new environmental technologies and changing internal functions. As discussed in Chapter Two, the Commerzbank remains one of the most environmentally impressive structures due to its passive design systems and its capability for adapting to new technical systems introduced well after its completion, even when its occupancy levels significantly increased.

Lastly, the ideal sustainable structure goes beyond a neutral connection with its context, and instead gives back to the built (and often un-built) environment that surrounds it. For example, Foster’s Reichstag in Berlin, discussed in Chapter One, creates enough energy on site to provide for both its own needs and the needs of the surrounding buildings. Chapter Three discusses Foster’s Hearst Tower, completed in New York City in 2006. The Hearst Tower has its own rainwater catchment system, decreasing the building’s pressure on New York’s sewage by a remarkable twenty-five percent relative to conventional buildings of its size.\textsuperscript{45} The original aim of sustainable design was to minimally impact surroundings through decreased use of resources and limited disruption of the natural environment. Recent innovations


however, allow buildings to go beyond a minimal impact and instead establish a
symbiotic relationship with their immediate architectural and urban environment.

Part II

*Norman Foster & Water Conservation*

Sir Norman Foster has emphasized the incorporation of environmental design
into projects throughout the world since the 1970s. This paper will specifically look
into Foster’s commissions for the Reichstag renovation in Berlin (1992-1999), the
Commerzbank in Frankfurt am Main (1991-1997), and the Hearst Tower in New
York (2000-2006). These three case studies demonstrate the wide range of factors
that determine the challenges and successes of a sustainable project including
collaboration, client demands, geographic location, budget constraints, politics, and
public opinion and reception. The following case studies aim to demonstrate a more
holistic understanding of sustainable architecture and a more comprehensive method
of evaluation.

Norman Foster has become a somewhat mythical figure in the field of
architecture, largely as a result of the biographical literature. He is often introduced
with a discussion on the amount of awards he has received in the last several decades,
including the Royal Gold Medal for Architecture in 1983, the American Institute of
Architects Gold Medal for Architecture in 1994, the 21st Pritzker Architecture Prize
in 1999 and the Praemium Imperiale Award for Architecture in 2002. He was granted
Knighthood by the Queen of England in 1990 and nine years later became a life peer, becoming Lord Foster of Thames Bank.  

Norman Foster’s biographies also often emphasize his “blue-collar beginnings.” Born in 1935, he grew up in Manchester, England in a working class family. He left his high school at age sixteen and worked in the British treasury department and served with the RAF, where he worked with electronics and aviation. He then worked with John Bearshaw and Partners, an architectural firm in Manchester, where he was part of the contracts department. At twenty-one, he decided to study architecture at Manchester University where he paid his tuition through a variety of jobs. According to Foster, “In Britain the idea one could go from blue-collar beginnings to the university was so far out, it was quite unthinkable.” He noted the diversity of jobs he took in order to pay for his tuition including ice-cream salesman and nightclub bouncer, “whatever earned the most money in the least time.”

After graduating, Foster attended Yale University’s graduate School of Architecture through a Henry Fellowship. Here, he studied under Paul Rudolph and worked alongside his future partners Su and Richard Rogers. Upon graduation, he decided to stay in the New Haven area and work in the urban planning field Pedersen and Tilney. Shortly after, he moved west and worked on a project for a new UC Santa Cruz campus with the firm Anshen & Allen and others in San Francisco. In

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49 Rogers in On Foster...Foster On, 271.  
50 Malcolm Quantrill, The Norman Foster Studio: Consistency through Diversity, 19.
1963 he and his future wife Wendy joined Su Brumwell, Richard Rogers and Wendy’s sister Georgie Wolton to create the firm Team 4 in England.\textsuperscript{51} He founded Foster Associates (now Foster & Partners) in 1967.\textsuperscript{52}

Technology has been the driving force behind the fame of Foster & Partners since the firm’s early years. Already in 1971, Foster Associates was known for its technologically advanced yet inexpensive solutions. By the time the firm was established, Foster had already begun to make a name for himself with his portfolio of cheap yet durable projects.\textsuperscript{53} He had built an inflatable office building that was constructed in fifty-five minutes for the employees of Computer Technology. The 740-square-meter structure was made of nylon and other fabrics anchored to beams and stood for a full twelve-months.\textsuperscript{54} By this time he had also constructed a fully air-conditioned headquarters for IBM of 15,000 square meters that was less expensive to build than if it were to be an office of temporary wooden huts.\textsuperscript{55} Today, technology, and in particular environmental technology, remains a vital component of each project whether through interior building operations such as heating and cooling or via engineering feats such as those that permit grand and open spans of space. The buildings that will be discussed here are urban, large-scale governmental and commercial projects that demonstrate his technological achievements and have had significant impact on both his career and the architectural field’s understanding of sustainable design.

\textsuperscript{52} BBC News, “Building the Future.”
\textsuperscript{53} Pawley in \textit{On Foster...Foster On}, 185.
\textsuperscript{55} Pawley in \textit{On Foster...Foster On}, 185.
Cities are the setting for this examination. In 1800, less than three percent of the population lived in cities. In 2008, this number grew to fifty percent, with trends predicting an increase to seventy percent by 2050. In 2008, there were nineteen cities worldwide with over ten million inhabitants, compared to 1975 when there were a mere three. It is predicted that by 2025, there will be twenty-seven such “megacities”, the majority of which will be located in developing countries. It is imperative that a new approach to urban development is understood before these cities and megacities become more socially and environmentally unstable than they are presently.

In particular, this paper will focus on Norman Foster’s use of water technologies and conservation. Water plays a significant role in nearly every aspect of a building, from plumbing and irrigation to other, less visible uses including heating and cooling, and use of water in the manufacturing of the materials (see discussion below on embodied energy). Another aspect of a building’s relationship with water is the handling of stormwater. Stormwater varies greatly depending on geographic location, but whether in a climate of drought or one of great rain, buildings must be designed to handle extreme conditions.

There are many designs that can significantly decrease a building’s use of water and decrease the impact on urban stormwater management systems. Plumbing demands can be greatly reduced by installing low-flow fixtures for appliances such as faucets, toilets, showerheads, and urinals (see section below on low-flow and dry fixtures. Stormwater management on site is another design component with great potential. The U.S. Environmental Protection Agency has found that over ten trillion

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gallons of untreated stormwater goes into surface water resources annually, and that less than one-fifth of U.S. watersheds are calculated to have good water quality. In 2000, the European Union published the Water Framework Directive, which sought to prevent the pollution of water sources and improve the condition of aquatic ecosystems. A list of thirty-three priority pollutants were declared for monitoring purposes, yet in many urban areas stormwater still tests positive for a number of these substances. Rainwater catchment can significantly decrease the amount of water and pollution that enters into city stormwater systems. Cisterns or storage tanks allow rainwater to be reused for potable or non-potable purposes, such as landscaping or plumbing. Rainwater catchment has been in use for nearly 4,000 years and has multiple benefits. It is a water supply that is located on site close to the user(s), decreases runoff substantially, and subsequently decreases soil erosion. Furthermore, it does not require any pumping across great distances, or chlorination or fluoridation treatments from the municipality, thus greatly decreasing municipal energy loads. With the implementation of water saving design practices, it is now easy for commercial buildings to decrease the amount of water they use by over thirty percent.

Water is used in many different types of heating and cooling systems that are both new and old, and can be energy efficient or intensive. Examples of water in

59 Kinkade-Levario, Design for Water, preface, 13
60 Ibid.
heating and cooling systems include centralized air-conditioning, cooling towers, radiant heating, aquifer thermal energy storage, and water boilers. Water-dependent cooling systems are often much more efficient than conventional air-conditioning systems as air has a much lower specific heat capacity than water. Furthermore, air-conditioning systems both cool and ventilate, requiring a substantial amount of air needed just for reducing humidity. Separating ventilation and cooling therefore, saves a large amount of energy.\textsuperscript{62}

On average, nearly twenty-five percent of a commercial building’s energy demands are from heating and cooling needs.\textsuperscript{63} In recent years, architects have begun to have a new appreciation for natural ventilation, which significantly reduces a building’s energy use. This idea is very different from Herman Worsham’s exclamation after the completion of the first building to boast year round air-conditioning in San Antonio, Texas, in 1929. In the first volume of the journal \textit{Heating, Piping and Air Conditioning}, Worsham noted: “The windowless skyscraper, already envisioned by others and made possible by air-conditioning plus artificial illumination, will surely become a reality… Let those who cry for ‘fresh’ air through open windows from the out-of-doors be reminded that it doesn’t exist in the congested city… So air-conditioning has come to make available every day the best in atmospheric comfort that nature offers so spasmodically.”\textsuperscript{64}

The above uses, although fundamental, are dependent on water as a resource that is greatly threatened in our changing world.\textsuperscript{65} The accessibility and management of water is a worldwide issue that is expected to worsen as the climate continues to change. The world’s clean water resources are rapidly dwindling, with an expected 1.8 billion people living in areas of severe water scarcity by 2025.\textsuperscript{66} People living in coastal areas will be increasingly threatened by the drastic changes in rainfall patterns and rising sea levels. Runoff from lack of proper stormwater management is currently one of the major sources of pollution in our rivers and our oceans. These conditions can be significantly improved through appropriate stormwater management, water retention and low-energy, on-site heating and cooling that taps into the thermal capacity of water.

Conclusion

The following examination will explore a new discourse of sustainable architecture through the consideration of Sir Norman Foster’s use of water design. Through an appreciation for collaboration, context, and performance, a new assessment of how to understand and evaluate sustainable design will evolve that will allow the field to develop more effectively. While the concept of sustainable architecture sits on the precipice of losing all meaning, recent technological breakthroughs, lowered premiums, and federal regulations have shown that


sustainable architecture is not just a passing fad. Instead, it is a way of understanding life and the human environment that is necessary to incorporate into the design of every new structure and every renovation.

Terms

There are two main categories of architectural literature that draw distinct audiences. The first is a more mainstream readership and appears generally in columns of magazines and in newspapers, attracting wide audiences through artistic critiques. Senior critics who write in this way include Paul Goldberger of the New Yorker, Blair Kamin of the Chicago Tribune, Nicolai Ouroussoff of the New York Times, and Christopher Hawthorne of the Los Angeles Times. These articles often include overarching statements about a new building’s symbolism and significance, an architect’s achievements, and the budgeting of projects. The other strain of literature is written primarily for practitioners within the field, including books and essays on theory, engineering and technology. While there are certainly exceptions to these definitive categorizations, the truth remains that the knowledge of sustainable architectural vocabulary is largely limited to those who work in the field as both designers and clients. This paper aims to bridge the gaps that exist in the discourse of sustainable architectural literature, and provide a critique of how we, as a society, must fully grasp the principles and goals of sustainable building. The following terms are therefore briefly defined so as to provide a general background in the vocabulary of sustainable design as they are discussed in this paper. The following three

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categories were chosen in particular for their importance in the field of sustainable design and the broader issue of water conservation.

Classifications of Water

After water is used in buildings, it changes from a source that is clean and often potable, to a ‘used’ resource. There are multiple classifications of water that are important to understand for design purposes, as there is great potential for buildings to incorporate specific categories of improved water technology in the overall structure. Unused water is classified as blue, green or atmospheric water. Blue water is freshwater, such as that from aquifers and rivers. Green water refers to the moisture in soil, and atmospheric water classifies rain and fog. Used water can be classified by a number of different terms. Gray water refers to water that has been used for laundry, baths, showers or a bath sink. Black water is the water from toilets and from kitchen sinks. Alternate water is that which has been already used, usually by equipment – such as for cooling purposes in a cooling tower or air-conditioning system. Stormwater is any rainwater that has hit the ground. Lastly, reclaimed water is that which has gone through the wastewater treatment stage but is still considered non-potable and is often used for irrigation or plumbing purposes. These different classifications allow for architects to maximize the reuse of water as well as minimize the amount of wastewater that enters into the sewage system.

Embodied Energy

Building materials, such as steel, aluminum and concrete, require a substantial amount of water and energy to manufacture, transport, and install. The production of these materials also amounts to large emissions of carbon dioxide and other greenhouse gases. Looking at the total lifespan of a material, from its production to use, aluminum has the highest emissions per ton of metal produced. However, if the total amount of production is incorporated into the calculations, then steel has an overall global impact greater than aluminum due to the large amount that is manufactured. Steel requires a three-step process of iron ore removal, coke production from coal, and limestone extraction. The conventional manufacturing of steel produces roughly two tons of carbon dioxide for every ton of steel. It also requires a remarkable amount of water throughout the production, such as for cooling the coke before it is dried. In recent years, the manufacturing of these materials has become more efficient. Before World War II, to produce one ton of steel required between sixty and 100 tons of water, while today, a ton of steel can be created with less than six tons of water. Aluminum, while it is more energy intensive and its composites are less commonly found, requires 1.5 tons of water per ton of material produced.

Low-Flow & Dry Fixtures

72 Ibid, 39.
Low-flow and dry fixtures can significantly decrease a building’s overall water use. Low-flow fixtures aim to maintain pressure while decrease water use. Low-flow toilets are classified as those that use less than 1.6 gallons of water per flush, faucets that use 2.5 gallons or less per minute, and showers that use 2.5 gallons or less per minute. Dry fixtures are those that do not use any water, such as dry urinals that don’t flush. New York City replaced 1.5 million of its total 4 million toilets in public buildings to low-flow fixtures between 1993 and 1995 when the city was undergoing significant water stress. This installation saved 100 million gallons of water daily, as regular toilets use an additional three gallons per flush in comparison to low-flow models.

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Chapter One: The Reichstag
Berlin, Germany 1992-1999

The renovation of the Reichstag Parliament building in Berlin (1992-1999) was a project with unique political and cultural challenges.\(^7\) The design would have to help justify the controversial relocation of the newly reunited German government to the Reichstag building in Berlin. The representatives of the Bundestag greatly influenced the final project, a renewed building that incorporated historical and modern elements in order to satisfy all parties. New ecological technologies, including an innovative aquifer-based energy geothermal system, were a central component of the design and were implemented in order to promote the symbolism of a democratic and forward-looking government. The new Reichstag emits ninety-four percent less carbon dioxide than the previous structure that was significantly renovated in the 1960s. Foster’s Reichstag is the ideal example of a sustainable structure greatly defined by a collaborative design process and geographical, social and political contextual constraints.

A significant amount of literature has been published about Foster’s new Reichstag completed in 1999. Such discourse often touches upon the public opposition of the relocation and the symbolism inevitably intertwined throughout the design process. The literature ranges from monographs, to history books, press releases, and news reports. Foster himself has written multiple pieces on the building including a book entitled *Rebuilding the Reichstag* (Overlook Press, 2000). While these publications have provided a wealth of information regarding the new

Reichstag, each type has its own conventions that highlight different aspects of the design and limit comprehensive analysis. The history books often include short sections on the building as it relates to the broader history of German government. In his book, *The Reichstag: German Parliament between Monarchy and Federalism* (Berlin-Brandenburg, 1999) historian Michael Cullen discusses the parliament’s role in the design process and the challenges of the collaboration, yet passes over the sustainability of the structure. The monographs concentrate on the building as a snapshot in time, giving a brief background before the building was commissioned and ending the discussion directly after it was completed. Finally, the press releases concentrate on recent headlines and breakthroughs that catch the public’s attention, such as Nicolai Ouroussoff’s “Architecture Review; Holding History and Hope Up to the Light; the Glass Dome at the Heart of Berlin’s Rebuilt Reichstag Celebrates a Spirit of Government Openness while the Building’s Preserved Scars Acknowledge a Nation’s Turbulent Past” (LA Times, 1999). It is necessary to combine the elements of each of these three literary categories to have a more accurate understanding of the final Reichstag. Such a comprehensive study can reveal how the new Reichstag design rose to the challenges of satisfying the demands of a divided parliament, responding appropriately to a structure with a tumultuous past, and incorporating a sustainable agenda to promote the image of an innovative German nation.

**Setting: Berlin**

The new Reichstag was to be both a product of the German parliament and a promotion for its global profile. Since unification, Berlin has been a focus for
international contemporary design. Frank Gehry, Peter Eisenman, Rem Koolhaas and Daniel Libeskind are just some of the major names who have been commissioned to build in the city. Libeskind, who designed the new Jewish Museum (completed in 2001), once said of building in Berlin:

In America, the private world of power and money is seen as an inevitable force that dictates city form. And so architecture becomes little more than advertising. In Berlin, as in the rest of Europe, there is a notion that public space and civic space are important and of concern to everyone.\(^78\)

Former U.S. Secretary of the Treasury and current Director of the Jewish Museum in Berlin, W. Michael Blumenthal noted the amount of bureaucracy required for decisions to move forward in Germany that often prolong a project’s completion. He then concluded that this process influences “a more coherent and comprehensive view” of architectural structures that are designed “to relate to history and to have a certain collegiality.”\(^79\) This was the collaborative approach to design that Norman Foster had to incorporate in his renovation of the Reichstag.

Another contextual factor for Berlin and all of Germany has been a concern for sustainable resources of energy. Germany has been concerned with sustainable resources of energy since the 1970s, when it was deeply impacted by the energy crises of 1973-74 and 1979-80. In 1990, the country signed on to the Kyoto Protocol, aiming to decrease their emissions of greenhouse gases twenty-one percent from 1990 levels by 2008-2012. In 1991, the government implemented a federal Electricity Feed Law (StrEG) which required utility companies to have a percent of their power come from renewable resources including wind, solar, biomass and landfill gas, and hydropower. This boosted the renewable energy sector substantially and began the process.

of limiting dependence on non-renewable sources; since 1990, the country’s wind energy generation has increased 2,000 per cent while solar panel installations has increased 15,000 per cent.80 The government’s commitment to renewable energy was further demonstrated when Angela Merkel declared in March of 2012 that Germany would invest $263 billion (200 billion Euros) in renewable energy, equivalent to eight percent of the country’s GDP.81 Germany aims to reduce its energy consumption of buildings eighty per cent by the year 2050.82 The new parliament building then, was to be an avenue to physically and symbolically demonstrate the government’s environmental commitment.

The Original Reichstag

The Reichstag has played an integral role in Berlin’s history and in the shaping of the German parliament’s identity. The term Reichstag, or Imperial Diet, was first used in 962 AD to define a group of territories under the Holy Roman Empire.83 Around 1470 the term came to be used in reference to all of the territories under the jurisdiction of Europe’s largest estates. From 1661 on, this Reichstag was seated in Regensburg.84 In 1848, following the widespread revolts against autocratic governments throughout Western Europe, an elective chamber representing the

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83 Peter Chametzky, “Rebuilding the Nation: Norman Foster’s ‘Reichstag’ Renovation and Daniel Libeskind’s Jewish Museum Berlin,” Centropa 1, no. 3 (2001), 251.

84 Morgans Herman Hansen, A Comparative Study of Thirty City-State Cultures: an Investigation, (Copenhagen: C.A. Reitzels Forlag, 2000), 296.
German states emerged to balance the Council, which was comprised of German princes and Prussian leaders. The assembly was short lived, however, lasting only a year. In 1871, after Bismarck created the North German Confederation and agreed to the need for direct representation for the growing territory, the term Reichstag was applied to the re-established lower chamber of representatives in the constitution of the Second German Empire (1871-1918).\textsuperscript{85} The Reichstag was elected by a direct popular vote of German male citizens twenty-five years and older and each representative had a five-year term.\textsuperscript{86} While the popular vote represented the first democratic element of any modern German government, in reality, the monarch retained the majority of the powers, including the authority to appoint the chancellor as the government’s the chief executive, equivalent to a prime minister.\textsuperscript{87}

In 1872, a competition for the Reichstag parliament building was held, with a surprisingly international set of submissions that included fifteen English architects. A site, however, was not found until 1881 at which time a second competition was held, with the requirement that competitors speak German. The final site, located outside the medieval wall and far from the city center and the Royal Palace, would occupy a plot of six hundred square meters, sufficient space for a building with a debate chamber that would host four hundred representatives.\textsuperscript{88} French architect Paul Wallot won the commission.

\textsuperscript{86} Bryce, The Holy Roman Empire, 488.
\textsuperscript{88} Chametzky, “Rebuilding the Nation,” 251; Wise, Capital Dilemma, 123.
Paul Wallot faced a grand challenge: to design a democratic building for an otherwise imperial government in a country with a limited architectural tradition. One representative had noted: “Berlin is a very ugly city. A few hours suffice to make a tour of inspection of its buildings, almost all modern ones...[The new part] is built in that odious Munich style which will be the eternal disgrace of German architects.”

The debate concerning the appropriate architectural style for German public buildings had been going on for several decades before Wallot won the commission. Several theorists were supported an ancient Greek architectural vocabulary, such as the art historian Johann Joachim Winckelmann. Others, like architect Heinrich Hubsch, believed that the classical style was not fit for the German climate, culture or building material. Wallot could also not take any lead from recent monuments erected under Prussian power, as that would be contrary to any democratic sentiment. The project was further delayed due to the lack of support from the Kaiser, who took ten years to approve any of Wallot’s designs for construction. Willhelm I wanted the building to demonstrate Germany’s unity and newfound power while members of parliament were hoping for an expression of the newly born German democracy.

Despite the lack of a recognized German aesthetic and imperial support, Wallot completed the Reichstag in 1894. It was a building with elements recalling neo-Baroque and Renaissance revival with heavy sandstone facades, a colonnaded and pedimented front entrance, and a four-sided steel and glass cupola (see Image

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89 E. Wetterlé and Frederic Lees, _Behind the Scenes in the Reichstag: Sixteen Years of Parliamentary Life in Germany_ (New York: George H. Doran Co., 1918), 18; Bryce, _The Holy Roman Empire_, 485.
91 Chametzky, “Rebuilding the Nation,” 251.
Each corner had a tower representing the four largest kingdoms of the
German Empire: Prussia, Bavaria, Saxony, and Württemberg. The stone (Silesian
sandstone) and wood of the structure came from all of the Confederation States,
physically representing the new territorial unity.  

The glass dome, more correctly referred to as a polygonal cloister vault, was
not part of Wallot’s initial proposal and was originally designed to be of stone.
However, the structure would not be able to support a stone dome and the glass
cupola with a rectangular base was erected in its place, a change interpreted by many
to represent a democratic state. Wilhelm II (grandson of the commissioning
emperor, Wilhelm I) was not one to appreciate such an interpretation, later referring
to the building as the “imperial monkey house” and the cupola as “the height of bad
taste.” Yet for the public, the dome became a symbol along with two other prominent
domes of the city: the Berlin Cathedral (which had been most recently renovated in
1750) representing the church, and the Hohenzollern Palace (early 18th century)
signifying the court. To further support this interpretation, Wallot’s modern glass
and steel dome was even slightly higher than that of the Royal Palace. This new
dome has been credited for influencing modern glass domes of the time throughout
Europe, including train stations and exhibition halls in cities such as Nuremberg,

Contemporary European Urban Landscape,” in *European Landscapes of Rock-Art*, ed. Christopher
Dresden, and Lucerne, Switzerland.\textsuperscript{99} Heinrich Wefing commented on Wallot’s original cupola in 1999 in a statement easily applicable to Foster’s later dome: “For its time it was a rather advanced roofing solution, delicately concentrating the symbolism and technology to represent the bourgeoisie’s aspirations to share power.”\textsuperscript{100}

The heating and cooling system of Wallot’s Reichstag was another element that was considered very modern for its time, although there is very little information published on it. American engineer David Grove designed the system of Wallot’s Reichstag to maximize the use of Berlin’s fresh air through a ventilation system dependent on up-draughts and flues (see Image 1.02).\textsuperscript{101} The ducts for the ventilation were interspersed among the masonry walls that were up to two meters thick.\textsuperscript{102} Along the west-pediment, there was a large fresh-air intake that would be incorporated into Foster’s design over a century later. In the winter, a slightly less ecological heating system was used based on coal-fired boilers.\textsuperscript{103}

Wallot’s Reichstag was lavishly decorated, with crowns and eagles, coats of arms and emblems throughout.\textsuperscript{104} A twenty-foot tall sculpture called “Germania in the Saddle” and sixteen other figures were installed on the façade and the four towers (see Images 1.03 and 1.04). Inside there were inlaid marble floors, frescoes, statues, bas-reliefs, coats of arms and stained-glass windows.\textsuperscript{105} Some of the building’s

\textsuperscript{99} Wise, \textit{Capital Dilemma}, 125.
\textsuperscript{100} Quoted by Chametzky, “Rebuilding the Nation,” 251.
\textsuperscript{101} Foster, \textit{Rebuilding the Reichstag} (Woodstock, New York: Overlook Press, 2000), 183.
\textsuperscript{103} Foster, \textit{Rebuilding the Reichstag}, 183.
\textsuperscript{104} Barnstone, \textit{The Transparent State}, 181.
\textsuperscript{105} Wetterlé, \textit{Behind the Scenes in the Reichstag}, 22, 23; Wise, \textit{Capital Dilemma}, 124.
amenities included a gymnasium, a library, offices, the center parliamentary chamber (which had quite poor acoustics), a pharmacy, a hairdressing salon, and a restaurant.\textsuperscript{106} The new building was extensively discussed in the leading architectural journal of Berlin, the \textit{Deutsche Bauzeitung}. The articles focused on Wallot’s choice of aesthetic, discussing the facades and the towers, the dome, the use of sculpture, the artwork and the tapestries. There was very little mention of any of the mechanical systems, and in a vein similar to contemporary architectural literature, the collaborators, such as David Grove, were only mentioned in a small section in the last pages.\textsuperscript{107}

In the years leading up to World War I, the powers of the Reichstag assembly grew tremendously, so much so that the building itself became too small and an extra floor for office space was built in 1912. In 1916 the inscription \textit{Dem Deutschen Volke} or, “To the German People” was placed above the western pediment.\textsuperscript{108} On November 9, 1918, Phillip Scheidemann declared the first republic of Germany from the windows of Wallot’s Reichstag.\textsuperscript{109} A new constitution was established, declaring the first true parliamentary democracy Germany had ever seen by changing the assembly to an institutionalized Parliament with actual powers.\textsuperscript{110} Due to protests, however, this new constitution was completed in Weimar rather than Berlin, where

\textsuperscript{106} Wetterlé, \textit{Behind the Scenes in the Reichstag}, 22, 23.
\textsuperscript{107} Anon source, \textit{"die Bauzeitung vereinigt mit baukunst und werkform. The Parliament building of Berlin" Deutsche Bauzeitung} (1894).
\textsuperscript{109} Ibid, 7, 26.
\textsuperscript{110} Schulz, \textit{The Reichstag}, 26.
the new republic relocated. The Weimar Republic legislators returned to the capital only in 1920.\textsuperscript{111}

The republic was short-lived however, and the depression beginning in 1929 resulted in great political and social unrest. On February 27\textsuperscript{th}, 1933, the Reichstag was set ablaze (see Image 1.05). This fire led Hitler, as newly appointed Chancellor, to declare a state of emergency through the Enabling Act, thereby effectively curtailing all parliamentary powers.\textsuperscript{112} Hitler had once said of the building that a single battleship cost nearly double the amount spent on Wallot’s design, an inadequate expenditure for “the first magnificent building of the Reich, intended to stand for eternity, the Reichstag Building.”\textsuperscript{113} Yet Wallot’s design could no longer stand for eternity, as the fire significantly damaged the democratic dome and the central core of the structure both symbolically and literally.

After becoming Chancellor, Hitler used the fire as an excuse for the persecution of communists.\textsuperscript{114} After the declaration of the Enabling Act, the puppet parliament met in the Kroll Opera House, and the Reichstag became an exhibition space for Nazi propaganda with shows such as \textit{The Bolshevik Terror} and \textit{The Eternal Jew}.\textsuperscript{115} During this time, Wallot’s dome was reglazed and the whole structure was made watertight. The building was to become a central component to Hitler and his

\begin{itemize}
\item\textsuperscript{111} Wise, \textit{Capital Dilemma}, 125.
\item\textsuperscript{113} Wise, \textit{Capital Dilemma}, 131-132.
\item\textsuperscript{115} Schulz, \textit{The Reichstag}, 26; Wise, \textit{Capital Dilemma}, 122.
\end{itemize}
architect Albert Speer’s reconstruction of Berlin, a capital otherwise to be known as “Germania”.

World War II brought new significance to the Reichstag. During the war, it housed a maternity ward and medical archives for the military to report deaths and casualties. By the end, as the final weeks culminated in destructive blasts around the city, the Reichstag became a central focus of attack and symbolism for both the Soviets and the Nazis. The building “became one of the best bunkers in the city”, and the subject of a challenge proposed by Stalin: for Soviet troops to waive a victory banner from its roof. According to Frederick Baker, of the nine banners that were given out, whoever made it to the roof first would “become a hero of the Soviet Union.” On May 1, the banner was raised despite the fact that within the building, German soldiers were still fighting from the cellars and the Russian troops had only secured the roof – the battle line running right through the core of Wallot’s Reichstag (see Images 1.06 and 1.07).

In 1949, the city of Bonn was declared the provisional capital of West Germany with the understanding that the seat of government would return to Berlin upon reunification. The Bundestag stated: “The leading organs of the Republic will relocate to the capital Berlin as soon as general, free, fair, secret and direct elections are implemented in Berlin and in the Soviet Occupation Zone.” Yet unification was not for another several decades, and the Reichstag stood in ruins for years. The

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118 Ibid, 18.
119 Ibid, 19.
120 Ibid, 21.
121 Ibid, 22.
122 Quoted by Strom, Building the New Berlin (Lanham, Maryland: Lexington Books, 2001), 159.
remnants of Wallot’s dome were removed in 1954 out of fear that it would collapse. In the 1960s, the West German Bundestag funded a renovation of the building to demonstrate the representatives’ intentions of someday returning. This expression of relocation was not appreciated by the Soviet Union, which was still in control of East Berlin and noted the act as presumptuous. The Bundestag therefore, barely used the renovated space, which instead was used as an exhibition space financed by the government.  

From 1961 to 1972, Paul Baumgarten designed the renovations, which had no similarity or reference to Wallot’s original design. Instead, Baumgarten sought to erase the controversial history of the Reichstag, covering up Wallot’s interiors so much so that it was later believed that none of the original structured had survived. No glass cupola was redesigned for a new roof, and in place of the grand parliamentary room, a spare, modernist-style chamber was built. Baumgarten also relocated the main entrance from the west to the northern side of the building and lowered the height of Wallot’s doorways from over three meters to just above two meters, effectively eliminating throughout the structure any sense of Wallot’s original elaborate and spacious designs.

Since erected in 1894, the Reichstag parliament building has played a pivotal role in the political and social movements of the country. Such contexts have also affected the public’s interpretation of the building, as people’s associations with Wallot’s design changed from a symbol of democracy to one of fascism, a structure.

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123 Wise, Capital Dilemma, 122.
126 Wise, Capital Dilemma, 122.
127 Ibid, 131.
of luxury to one of destruction. The Reichstag is thus an example of a building that has both defined and has been defined by its surrounding environment. Through an appreciation of the building’s history, it is possible to achieve a more holistic understanding of the context in which the new Reichstag developed.

The Expectations for a New Reichstag

Upon reunification in 1991, the relocation of the parliament to Berlin became the subject of national debate. Berlin supporters argued that the city provided recognition of a reunited country, a city that literally bridged the two worlds of East and West Germany together. They thought Bonn was a city of bureaucrats, very separate from the cosmopolitan diversity of a city like Berlin. Those who argued for Bonn to remain the capital noted that the city represented a successful democracy.\textsuperscript{128} The political buildings in Bonn had been built to represent postwar, anti-authoritarian and democratic principles, constructed largely of glass and steel along the Rhine.\textsuperscript{129} They also referred to Bonn’s location not only in the most populated state, North Rhine-Westphalia, but also as geographically closer to the West, to the countries of NATO in Europe that had led to the very possibility of any democratic reunification. A move to Berlin was seen as a move towards Poland, Central and Eastern Europe.\textsuperscript{130} Economics also played a significant role, as officials from Bonn stated that the government seated there had generated roughly 100,000 jobs. Advocates for Berlin noted that the move would provide an economic boom necessary for the depressed

\textsuperscript{129} Ibid, 225.
\textsuperscript{130} Ibid, 224-225.
eastern division of the country.\textsuperscript{131} The decision was ultimately made on June 20\textsuperscript{th}, 1991, when the West German Bundestag voted 338-320 to relocate to Berlin.\textsuperscript{132}

The controversy behind the relocation was evident in the call for architects to enter proposals to the 1991 competition for the new Reichstag. The Jewish Museum competition two years prior had over eight hundred proposals submitted.\textsuperscript{133} For the Reichstag, three hundred people requested a copy of the competition brief, and only eighty actually submitted. This was a clear demonstration of the various pressures that the architects realized would inherently come with this project.

The competition brief required that the proposal have an element of transparency, aesthetically and publically signifying the democratic principles of the Reichstag’s new inhabitants.\textsuperscript{134} The jury chose three winners who were to resubmit for a second round: Santiago Calatrava, Pi deBruijn and Foster.\textsuperscript{135} Calatrava’s design preserved a large part of the original Reichstag, adding a dome that could open up like a flower, along with several other internal and external alterations and additions.\textsuperscript{136} DeBruijn designed a plan to build an entirely new plenary chamber that would stand alongside the old building, allowing the past and present to physically confront each other and coexist.\textsuperscript{137}

Foster’s firm, which had recently consulted on a project dealing with the remains of the Berlin Wall, was familiar with the challenges of building in the

\textsuperscript{131}Strom, \textit{Building the New Berlin}, 160.
\textsuperscript{132}Ladd, \textit{The Ghosts of Berlin}, 224-225.
\textsuperscript{133}Barnstone, \textit{The Transparent State}, 179-180.
\textsuperscript{134}Ibid, 183.
\textsuperscript{135}Ibid, 185.
\textsuperscript{136}Barnstone, \textit{The Transparent State}, 185; Wise, \textit{Capital Dilemma}, 127.
\textsuperscript{137}Barnstone, \textit{The Transparent State}, 185.
Foster’s original proposal for the Reichstag consisted of a large glass canopy over the whole building that would be supported by twenty pillars representing “a new image of an open future” (see Image 1.08). He noted the importance of incorporating democratic ideals into the design and suggested a public piazza that would go along the Reichstag perimeter at the same height as the parliamentary chamber, elevated above the surrounding ground level (see Image 1.09).

In the final run-off competition, the proposals had to be redesigned to address a lower budget, resulting in the need for the new submissions to somehow incorporate the old structure. The amount of square footage that designers were allotted went from 33,000 to between 9,000 and 12,000 square meters, smaller than the 17,000 square metered Reichstag still standing. By this point, many representatives of the Bundestag had made it clear that they did not support Foster’s original, and expensive, canopy idea. Members had related the canopy to an airplane hanger or a gas station. His final proposal therefore, was much more conservative. It did not include the piazza or the canopy and instead placed a flat glass roof atop the original structure. Foster had noted in a statement at the Second Competition Stage of the Reichstag Competition in June of 1993:

We do not recommend raising this roof artificially above the skyline of the present building either as a new dome or a version of our original umbrella…At a philosophical level we question the need, for purely

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138 Ibid, 183.  
139 Foster as quoted by Wise, Capital Dilemma, 127.  
140 Wise, Capital Dilemma, 127.  
141 Barnstone, The Transparent State, 185.  
142 Wise, Capital Dilemma, 127, 128.
symbolic purposes, of going higher than necessary and spending more money for questionable effect.\textsuperscript{143}

Interestingly, these words were far from the actual final design, which incorporated a large glass dome Foster would later refer to as the “lantern” leading the way for the people of Berlin.\textsuperscript{144} The final vote was left to the parliament members and in July of 1993, Norman Foster won the commission.\textsuperscript{145}

\textit{Challenges of Relocating}

While the design process was moving along, the decision for relocation underwent significant delays. Despite the final vote to move the capital to Berlin, there was still major opposition. The Interior Minister of the time, Klaus Westkamp, the man in charge of handling the move, believed it to be: “the idiocy of the century.”\textsuperscript{146} Those who were against the move tried to convince the public that it was an economical nightmare, with estimates equivalent to one hundred billion dollars simply for the new political accommodations. They hoped to hold back any definitive forward progress until the next elections of 1994, when the newly elected Bundestag could hold a re-vote.\textsuperscript{147} However, advocates for Berlin partnered with international companies who had jumped on the opportunity to build headquarters and offices there, such as Sony, now headquartered at Postdamer Platz. The exhibition “Berlin 1998” was formed by developers and businesses to put further pressure on the

\textsuperscript{143} Foster as quoted by Wise, \textit{Capital Dilemma}, 128.
\textsuperscript{144} Foster, \textit{Rebuilding the Reichstag}, 14
\textsuperscript{145} Barnstone, \textit{The Transparent State}, 183.
\textsuperscript{146} Quoted by Strom, \textit{Building the New Berlin}, 161.
\textsuperscript{147} Strom, \textit{Building the New Berlin}, 161.
relocation that was originally supposed to be completed by 1998. In 1994, the decision was finalized. Bonn did not suffer greatly as many offices of the federal government were to remain there indefinitely and an agreement allotted $1.7 billion in aid to the city in the following years.

The ultimate rebuilding of Berlin was an international project of immense significance symbolically and physically. Berlin became a visible experiment of whether a unified Germany was to prevail. Hans Stimmann, the director of city building in Berlin from 1991 to 1996, noted in 1991: “Berlin is the place where we will see whether the Germans succeed in finding the way from the tragedy of division to a new identity.” The chancellor and Berlin’s mayor signed an agreement that planning decisions would be jointly made between the federal government and the city.

This quest for a national identity included the search for an architectural vocabulary that could be collectively acknowledged and supported. Any architect building in the recently reunified Berlin was willingly subjecting him/herself to unusually high levels of opposition, questioning, and criticism, for there was no universal agreement on how the city’s past was to be understood in architecture: both in newly built structures and perhaps more importantly, in renovations. This is an interesting parallel with the challenges Paul Wallot faced when searching for an appropriate architectural tradition for the original Reichstag. In particular, political architecture had its own challenges. Many believed that government structures ought

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148 Ibid, 162.
not come off as too grand or overpowering.\textsuperscript{150} Although even this consensus was not fully supported, as officials of Christian Democratic Union (CDU) argued: “We maintain that the Chancellor’s Office, as an organ of the constitution, should receive an appropriate [architectural] emphasis.”\textsuperscript{151} In 1997 historian Brian Ladd eloquently described the challenge of rebuilding Berlin: “All cities’ buildings display their cultural traditions, but the sandy soil of the German capital conceals the traces of a history so fiercely contested that no site, however vacant, is safe from controversy…A building or monument might be able to display the wounds of Berlin’s past, but it can do little to heal or even hide them.”\textsuperscript{152}

Throughout the city, the question arose as to what was important to preserve and what needed to be destroyed. Many of the officials from Bonn came to Berlin expecting to have offices in new buildings that would stand upon sites of a demolished Third Reich. However, opposition by politicians of Berlin required many of these buildings to stay standing, including buildings of the Third Reich and of the German Democratic Republic. Big building projects in the 1980s in the old city center of East Berlin by the GDR included renovations of ruined historic buildings that were not to be demolished come reunification. The Foreign Ministry was to be housed in the former Reichsbank headquarters, which was renovated with an annex and a front atrium that hides the Nazi-era façade.\textsuperscript{153} Berlin was not a blank slate for modern, post-reunification democratic architecture to overwrite.

\textsuperscript{150} Strom, \textit{Building the New Berlin}, 166.
\textsuperscript{151} Quoted by Strom, \textit{Building the New Berlin}, 170.
\textsuperscript{152} Ladd, \textit{The Ghosts of Berlin}, 234-235.
\textsuperscript{153} Strom, \textit{Building the New Berlin}, 170.
One of the few areas that had been fully cleared for new construction was a large plot of land located north and west of the Reichstag, which was designated for numerous parliament buildings. This large project would be completed in 2001, two years after Foster’s Reichstag. Architect Axel Schultes of Berlin was chosen for his design based on an east-west axis, a literal configuration unifying the once divided urban core and an antithesis to Hitler’s plan of reorienting the city on a north-south axis. The Bundestag, the Bundesrat (the ‘Federal Council’, or Upper House, comprised of members from the state governments whose consent is required for the passing of most laws or amendments) and the chancellery were to have offices here and in the nearby Reichstag beginning at the turn of the new millennium (see Image 1.10).

Foster’s Reichstag

The core challenge for the new Reichstag was to acknowledge a difficult past and at the same time, inspire a brighter future. Foster’s design aimed to achieve a simplistic but meaningful symbolism through sustainable technologies and the incorporation of the building’s scars, including wartime graffiti and World War II bullet holes (see Image 1.11). Many of his solutions however, were controversial and subject to significant debate among the members of parliament. As Michael Wise has noted: “Foster experienced how difficult it was to work with a legislative body as his patron, which meant having several hundred deputies and ministers peering over his

shoulder as he drafted. The Foster design that the Bundestag eventually approved and built was the result of countless compromises with what was in effect a multiheaded client.”

The solution for how to approach the new roof was one such contentious issue. The majority party, the conservative Christian Democratic Union (CDU) wanted a roof influenced by Wallot’s original cupola that would be a visible statement of the renovation from afar. An architectural advisor to Chancellor Kohl and a former building minister, Oscar Schneider was a main supporter of a faithful restoration, noting: “The arsonists of February 27, 1933 should not have the last word.” Contrary to this approach, the liberal Social Democratic Party was in support of a more modern and distinguished approach to the roofing that went beyond Wallot’s outdated dome.

Foster believed that if any dome was to be built, it should be a glass cylinder representative of a democratic “lighthouse” (see Image 1.12). The Social Democratic Party encouraged this proposal, which was still somewhat problematic with the CDU. The CDU members had termed the flat circular top of Foster’s cylinder a “flying saucer”. Minority parties were also unsatisfied: the Free Democrats sought a modern dome while the Green Party did not support any elevated roofing solution. Finally, it was determined that a faithful renovation of Wallot’s dome was too expensive and on April 28, 1994, a debate among representatives resulted in a

156 Wise, Capital Dilemma, 128.
157 Ibid, 128-129.
158 Wise, Capital Dilemma, 122-123.
159 Ibid, 129.
160 Ibid.
compromise calling for a ‘modern dome.’\textsuperscript{161} A modern dome could incorporate contemporary materials while simultaneously recalling Wallot’s historical form. In the end, however, it seemed no one was fully content. As building committee Chairman Kansy stated: “Actually, nobody wants the thing.”\textsuperscript{162}

Foster designed a total of forty different domes before one was unanimously accepted.\textsuperscript{163} The final dome is 1,200 tons, 23.5 meters high and forty meters in diameter. It is comprised of twenty-four steel ribs and seventeen steel rings that form a core structure under a layer of Austrian-made transparent glass panels.\textsuperscript{164} Concrete pillars that go around the circumference of the plenary chamber uphold the steel ribs in supporting the structure.\textsuperscript{165} The dome also has a custom-designed built-in cleaning system for the exterior surface.\textsuperscript{166}

While Foster initially opposed any dome solution, he soon declared it a symbol of Germany’s new and modern direction. The final dome includes a public area above the chamber, similar to the piazza proposed initially, that is open to visitors even during parliament sessions (see Image 1.13). It was originally completely publically accessible but due to security reasons now requires reservations.\textsuperscript{167} The glass dome works with other elements of the overall design such as glass elevators and large windows, to promote the sense of visibility and transparency originally sought by the competition brief.\textsuperscript{168}

\textsuperscript{161} Barnstone, \textit{The Transparent State}, 201-202.
\textsuperscript{162} Wise, \textit{Capital Dilemma}, 129.
\textsuperscript{163} Strom, \textit{Building the New Berlin}, 167.
\textsuperscript{164} Barnstone, \textit{The Transparent State}, 203, 205; Wise, \textit{Capital Dilemma}, 130, 131.
\textsuperscript{165} Wise, \textit{Capital Dilemma}, 131.
\textsuperscript{166} Ibid, 130-131.
\textsuperscript{167} Ibid, 130.
\textsuperscript{168} Ibid, 126.
Foster’s decision to incorporate the scars of the building’s lingering memories rather than demolish the entirety of the Reichstag’s interior, was also somewhat controversial. Foster incorporated wartime graffiti of Soviet soldiers into his designs, kept bullet holes that remained from World War II, and delineated sections of the old and new structure with junctions of incised shadow gaps.\(^{169}\) Remarking on the graffiti, the *New York Times* noted in 1999: “Certainly there is something ‘open,’ if not plain masochistic, about Chancellor Gerhard Schröder going past Russian obscenities to reach his blue-doored parliamentary office. Schröder’s father died in 1944 on his way back from the Russian front.”\(^{170}\) Yet Foster replied that Chancellor Schröder “was an ardent supporter of our approach.”\(^{171}\) Even after the building’s inauguration, the decision was a topic of debate, with conservative members calling the graffiti “morally offensive” and similar to “tribal markings.” As one moves upwards in the new Reichstag, the marks of the old building become less and less concentrated, and physical movement is coupled with an emotional feeling of verticality, towards the natural light that floods in through Foster’s glass cupola, towards what Foster claims as “growth and change”.\(^{172}\)

For Foster, the Heritage Department of Berlin had to approve any design changes that would affect the building’s overall character, a process that did not exist at the time of Baumgarten’s renovations.\(^{173}\) His approach of facing the building’s past was in complete opposition to that of Paul Baumgarten’s 1960 renovations that covered all of the walls in a layer of plaster. Foster repositioned the entrance to the

\(^{169}\) Ibid, 12.
\(^{170}\) Quoted by Wise, *Capital Dilemma*, 11.
\(^{171}\) Ibid.
\(^{173}\) Ibid, 11.
western façade and restored the proportions originally used in Wallot’s doorways (see Image 1.14).\textsuperscript{174} Foster has noted that while “Baumgarten’s approach has to be understood in the context of a period when the built legacy of Germany’s past was regarded with some unease, in retrospect it might now be perceived as an act of civic vandalism more devastating than anything wrought by the Red Army.”\textsuperscript{175} Context thus greatly determined the architects’ approach to the Reichstag’s renovation; what was appropriate for the 1990s renovation would have been unimaginable during Baumgarten’s 1960s restoration, and Foster’s incorporation of wartime scars would not have been remotely possible if they were any closer in time to the war’s end.

Many other aspects of Foster’s design caused division amongst the parliament, which, as is evident, had significant control over the final project. The parliament building in Bonn, which was designed by architect Günter Behnisch and finally completed in 1992 after many delays, became an architectural symbol of democratic nostalgia for many representatives. The color of the members’ seats, the seating arrangement, the naming of the building, and the prominent German symbol of the eagle were several of the matters representatives collaborated on with Foster.\textsuperscript{176} The Bundestag changed the color of the seats to be purple, as they had been in the democratic Bonn.\textsuperscript{177} The seating arrangement of Foster’s design was originally the same as that in Bonn but parliamentarians believed that this circular seating had poor acoustics and sightlines, thereby promoting a final design that was based on a three-
quarter-circle form (see Images 1.15 and 1.16). Furthermore, members were against Foster’s design of the eagle (the bird of Germany), which was to be hung in the main chamber. They believed it looked too similar to the eagle of the Third Reich and preferred the less threatening heavier eagle, dubbed the “fat hen,” that was housed at the Bundestag in Bonn. Foster designed a compromise. Lastly, the Bundestag did not want the building to be called the Reichstag, a name that called to mind a government of anti-democratic principles and powers. They termed it the Plen-ARBereich Reichstagsgebäude, or the plenary area of the Reichstag. However, the conservative CDU did not agree to this change and thus all signs still refer to it as the “Reichstag.”

The renovation of the Reichstag cost 600 million marks (the 1997 equivalent of $350 million), and was the most expensive public building project in the reunited Berlin. This expense was more than twice that of the Bonn parliament building designed by Behnisch. In fact, building an entirely new structure would have cost the German government less money. Parliament’s input and collaboration significantly altered Foster’s final design, which aimed to satisfy all parties while at the same time maintaining a bold aesthetic that veiled the true political divisions behind nearly every design decision.

The Reichstag as a Source of Energy

178 Wise, Capital Dilemma, 131.
179 Strom, Building the New Berlin, 167-168.
180 Strom, Building the New Berlin, 168.
181 Wise, Capital Dilemma, 132.
Foster’s Reichstag is at the heart of Berlin’s urban core, literally pumping energy into itself and the surrounding buildings. Before the renovation, the building used an amount of energy equivalent to what would be required to heat five thousand modern homes each year. To raise the temperature of the building’s interior by one degree in the middle of winter would consume enough energy to heat ten houses annually. After the renovations, the building is so efficient that it now heats the surrounding government quarters. Foster has noted: “In its vision of public architecture that redresses the ecological balance, providing rather than consuming energy, lies one of the Reichstag’s intrinsic expressions of optimism.” The passive design and active mechanic systems result in a 94% reduction of carbon-dioxide emissions relative to the original structure, going from 7,000 tons to 440 tons emitted annually.

While the project involved many concessions and compromises, an ecological agenda was consistently supported. The energy is largely provided by renewable biodiesel fuel composed of vegetable oil that is made from sunflower seeds or rapeseeds. It was Foster who pushed for maximizing the ecological benefits of the cupola, which included natural ventilation and illumination. An enormous mirror or “light sculptor” as the conical center allows the new dome to act as a “lantern” for Berlin and for the Parliament itself, which sits right underneath the light in the heart of the building (Image 1.17). A mobile shield moves around the conical mirror

184 Foster, Rebuilding the Reichstag, 14.
185 Foster, “Architecture and Sustainability,” 10; Foster, Rebuilding the Reichstag, 14.
187 Strom, Building the New Berlin 203.
throughout the day to prevent glare while permitting sunlight. Furthermore, this cone of illumination extracts heat from the warm air exhausted from the chamber below creating a zero-energy passive ventilation system.\footnote{Foster, \textit{Rebuilding the Reichstag}, 10, 14.}

Some of the original air ducts by David Grove are still in place and act as part of the natural ventilating system. The fresh air rises up on the west side to underneath the plenary chamber. There, it rises through “perforated mesh in the floor and is filtered through the loose-weave carpets”. Afterwards, the warmed air rises and gets drawn into an exhaust cone within the “light sculptor,” the whole design acting as a natural flue.\footnote{Foster, \textit{Rebuilding the Reichstag}, 183.} The fans installed to help this process are powered by 100 solar panels on the roof, with a peak output of roughly 40kW.\footnote{Ibid, 183.}

\textit{History of ATES \& the Reichstag ATES System}

Perhaps one of the most important ecological aspects of the renovations is the Aquifer Thermal Energy Storage system, a heating and cooling system dependent on underground water reservoirs. ATES systems store excess heat in aquifers and retain cool temperatures in other cold-water aquifers, acting as extremely low-energy thermal storage units (see Image 1.18). This aquifer provides chilled water for the water-cooling systems of the building. Estimates of ATES systems have found that they can result in a 60-80\% increase in energy savings relative to conventional air-conditioning operations, with an investment recovery time of two to eight years.\footnote{Smith, \textit{Sustainability at the Cutting Edge} (Oxford: Architectural Press, 2003), 30.}
Underground heat storage energy systems that tap into the thermal capacities of water are an environmentally efficient product of twentieth-century engineering. Underground Thermal Energy Storage (UTES) systems are different from Ground-Source Heat Pump (GSHP) systems, first patented in 1912, in that they provide both heating and cooling, tapping into the earth’s potential to store and lower the temperatures of already used heat. Two kinds of Underground Thermal Energy Storage systems have gained popularity in the last half-century. The first is an Aquifer Thermal Energy Storage (ATES) system, which uses underground aquifers of differing depths as the means to store energy. The second is a Borehole Thermal Energy Storage (BTES) system that stores heat not through aquifers but in vertical wells that utilize the heat storage capacity of the rock and do not have any direct fluid connection with the ground. ATES is an open system, meaning the water is stored in underground aquifers or wells. Borehole Thermal Energy Storage systems are closed systems, in that they pump fluid through heat exchangers underground with no use of open underground caverns. Factors to determine whether a borehole system or aquifer system is more suitable include the amount of groundwater, the type of soil and rock, and porosity.

Norman Foster’s renovation of the German Parliament buildings includes a large scale Aquifer Thermal Energy Storage system. The system, although a

192 Oliver Evans first proposed the idea of the heat pump in 1805 but it was not constructed until the 1830s. Lord Kelvin was the first to apply the mechanism to the heating of buildings and did so with the extraction from air outside. The pump was used with underground heat beginning with Heinrich Zoelly in 1912.
breakthrough in its efficiency and scale, was not the first of its kind. In 1975, Martin, Harris and Davidson proposed an aquifer storage system that would work in conjunction with large solar energy systems. In 1978, the Water Resources Research Institute at Auburn University conducted one of the first experiments with aquifer based storage systems. The experiment was unsuccessful due to technological failures resulting from the clogging of the wells, and was therefore reconstructed with new equipment in Mobile, Alabama in 1979 and again in 1981.\textsuperscript{195} One of the conclusions produced from the Auburn study was: "the geochemistry problem…must be studied carefully, and the effect of high temperatures on the mechanical and hydraulic properties of clay confining layers must be determined."\textsuperscript{196} In the same year of the Auburn experiment, in 1978, the Lawrence Berkeley Laboratory in Livermore, California held the first International Aquifer Thermal Energy Storage Workshop.\textsuperscript{197}

In the late 1970s and throughout the 1980s, numerous experimental projects continued to emerge internationally. In 1983, Dr. A. Zaporozec wrote of the potential of tapping into aquifers as either a heat sink and/or an energy source if coupled with a heat pump. He notes in GeoJournal,

Successful – but only slowly gaining recognition – is a special use of ground-water reservoirs utilizing the unique thermal properties of ground-water…Only recent developments of more efficient equipment and concerns about diminishing sources of energy resulted in a significant increase in interest in using ground-water as an alternative source.\textsuperscript{198}

Projects in Canada, France, Holland, China, Japan, Sweden and the United States were producing abundant and fruitful conclusions. German investigation into seasonal

\textsuperscript{197} Sykes, “Numerical Simulation of Thermal Energy”, 569.
\textsuperscript{198} A. Zaporozec, "Human Interactions with Ground-Water," \textit{GeoJournal} 7, no. 5 (1983), 430.
thermal energy storage also began around this time, in the early 1980s. In 1983, a successful experiment of a complete storage cycle, including injection, storage and recovery of heat for the winter and cooling for the summer, took place in southeast Germany in Dresden using a shallow-depth aquifer. In 1988, a 1,000 cubic meter artificial aquifer was installed for ATES at the Stuttgart University campus. According to a presentation at the Third International Conference on Case Histories in Geotechnical Engineering in St. Louis, in Missouri in 1993, the “artificial aquifer was built for ATES due to strict German laws governing injection of groundwater.”

Researchers at the Geothermie Neubrandenburg GmbH geothermal company published findings on the potential of aquifer thermal energy systems in Germany. In 2006, Seibt and Kabus cited a European Commission project that “showed that aquifers suitable for thermal energy storage exist on approx. 70% of the overall territory of Germany. The investigations were limited to a depth of 150 m. This natural potential is enhanced by using even deeper aquifers…” Yet as of 1998, Germany did not have a significant amount of geothermal energy, due in large part to geology and economics. Licensing procedures for building geothermal systems were difficult, although the International Energy Agency worked to investigate possible frameworks to improve this process beginning in 1991. In Germany, it

199 C. Mirza, "Case History of Aquifer Thermal Energy Storage (ATES)" (paper presented at the Third International Conference on Case Histories in Geotechnical Engineering, St. Louis, Missouri 1993), 1277.
201 Joachim Poppei et al, "Recent Examples for the Utilisation of Geothermal Aquifers for Heat or Cold Storage or Improvement of the Reservoir Conditions by Heat Injection (Storage and Combined Production / Storage Projects in Germany)" (paper presented at the Twenty-Third Workshop on Geothermal Reservoir Engineering, Stanford University, California, 1998), 441.
202 Poppei, “Recent Examples for the Utilisation of Geothermal Aquifers,” 441.
remains the case that licensing involves multiple steps: licensing for aquifers less than 100 meters are permitted through the Water Management Act, while depths greater than 100 meters follow the regulations of the Federal Mining Code.\textsuperscript{203}

The implementation of such a system for the Reichstag building was therefore somewhat of a risk. However, two distinct contextual factors unique to this parliament building led to the decision of an ATES system. The first was that the Reichstag is a building with significantly fluctuating levels of use. When conference periods are in session, the building must be able to accommodate heating and cooling loads for hundreds of people. However, on off-days, very few people require such amenities. This particular type of building use led to the consideration of a system that would depend on the base temperature of the building’s thermal mass and could provide “topping up” when needed.\textsuperscript{204} The geology of the site also determined which type of UTES system to use, as a successful ATES system depends largely on the soil and geological foundations of a building. The soil underneath the Reichstag is ideal for such a system as there is a 120-meter thick clay layer of “Rupelian” clay, a tight soil that would prevent breakthrough between the two reservoirs. An exploratory well was drilled in 1996 as part of the preliminary stage of geological investigations.\textsuperscript{205} It was found that “several sandstone horizons with good reservoir properties…were proven,” with productive depths of 286-315 meters below ground.\textsuperscript{206}

The Reichstag system is composed of two aquifers at different depths that provide both heating and cooling needs (see Image 1.19). The lower aquifer is

\begin{footnotesize}
\textsuperscript{204} Foster, \textit{Rebuilding the Reichstag}, 186.
\textsuperscript{205} Poppei, “Recent Examples for the Utilisation of Geothermal Aquifers,” 443, 444.
\textsuperscript{206} Ibid, 443.
\end{footnotesize}
roughly 300 meters underground, and is able to provide heat ranging from twenty to sixty degrees Celcius. The excess heat of the mechanic cogeneration systems – in particular the biodiesel plant - provides the heat for this salt-water aquifer that is then brought up via one deep well. The design calculations estimated that roughly 60% of the stored heat would be recovered and could supplement the installed absorption heat pump system. The upper aquifer, composed of freshwater, is roughly sixty meters underground and keeps water cooled from the winter to provide for the air-conditioning system for the warmer months. The water is circulated at a rate of 300 cubic meters per hour via ten wells that go up to the surface. Ideal temperatures were calculated based on whether it was a “conference period” or “conference-free period” for each season. An extensive monitoring program was installed to keep track of the technical system and its economic benefits. In comparison to conventional heating methods, this system was expected to decrease the heat load peaks by roughly thirty percent.

Conclusion

Since completion, the sustainable performance of the Reichstag has been discussed in several publication categories. Several papers have been presented at conferences on Aquifer Thermal Energy Storage systems, such as the presentation by

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207 Ibid, 442.
211 Poppei, “Recent Examples for the Utilisation of Geothermal Aquifers,” 442, 443, 444.
213 Foster, Rebuilding the Reichstag, 186.
specialists Seibt and Kabus at the EcoStock Thermal Energy Storage Conference in New Jersey. News articles discuss recent energy commitments regarding the building operations. Kate Connolly’s “Reichstag to Run Solely on Renewable Power” from *The Guardian* in 2008, for example, notes the German parliament’s goal to have 100% of the building’s energy come from renewable sources. While such articles keep the sustainable agenda of the Reichstag and the German parliament in the news and promote the country’s international profile as a leader in sustainability, they are severely limited. There are few publications, if any, that are dedicated to the long-term evaluation of the biodiesel fuel, the solar power generation and most importantly, the ATES system. Furthermore, the discourse surrounding the Reichstag’s sustainable practices needs to be more critically evaluated not only in terms of the mechanical performance, but also regarding its success, or failure, in instilling the symbolism of a forward-thinking nation that was originally sought. Articles such as Connolly’s demonstrate at least some measure of success, as the government continues to use such sustainable efforts as a means by which to encourage support and positive awareness.

What is evident about Foster’s Reichstag, however, is that it was the direct product of collaboration and contextual limitations and expectations. Foster’s Reichstag is an example of the new and beneficial societal impacts that sustainable architecture can have on the surrounding environment. Paul Wallot’s 1894 Reichstag was discussed in the architectural literature of its time entirely in terms of its visual appeal, structural ornamentation and symbolic facades. The critics claimed that the

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dome recalled a renaissance palace and that the four corners were overbearing, and they noted with detail the figures on the exterior and the hanging tapestries inside. Yet Foster’s Reichstag is an example of a new symbolism of architecture that goes beyond aesthetic. Foster’s Reichstag was to create a new image of the German parliament through a sustainable agenda that literally brought new (and clean) energy into the city. The new Reichstag goes beyond the realm of conventional architecture, interacting with and providing for its surroundings. Foster’s renovation went well beyond structural components and ecological agendas, and entered the realm of social and political discourse, defining a new national identity through a highly collaborative design process.
Chapter Two: The Commerzbank
Frankfurt am Main, Germany 1991-1997

Upon completion, the Commerzbank (1991-1997) in Frankfurt, Germany was Europe’s tallest building and praised as the world’s first “ecological skyscraper,” a title that will be critically revisited below. It was also the first to create an entire ecosystem within its walls, four-story high gardens comprising a significant portion of the office building’s indoor space. These gardens, coupled with the unique shape of the structure and high-efficiency heating and cooling methods, amount to a building that uses twenty-five to thirty per cent less energy than equivalent structures of its time.215 The Commerzbank is the ideal example of a project that was significantly affected by collaboration and context. It is also one of the few sustainable buildings with available (although limited) performance data, as published in a recent book by Joana Carla Soares Gonçalves called The Environmental Performance of Tall Buildings (Earthscan, 2010).

Although the tower was constructed primarily for the employees of Commerzbank, the project as a whole was a multi-use complex incorporating public space and housing. The final design was the product of many years of planning and debate that began even before Foster was commissioned. Social opposition to banking developments and a recent housing struggle made for a unique environment in which the new headquarters evolved. This public pressure resulted in a significant political involvement in the development of the Commerzbank and Frankfurt’s greater financial district. The Commerzbank itself also played a large role in the planning and

execution of the final design, interviewing and reviewing every consultant brought to the project. The new Commerzbank was to satisfy local regulations and promote the company’s international profile through an environmental and global aesthetic.

In the 1980s, the Commerzbank had over thirty different offices in and around the city of Frankfurt. At this time, the city government was limiting development, particularly of high-rise structures. By the end of the decade however, opposition eased and Commerzbank saw the opportunity to unify its workforces.216 The final tower and surrounding complex are located in Frankfurt’s developing financial district between Kaiserplatz and the Große Gallusstraße, Neue Mainzer Straße and Kirchnerstraße.217 It consists of the two office towers, a multi-level garage with a 300-car and 200-bicycle capacity, twenty-seven apartments, shops, offices, and a bank.218 The project was part of a larger transformation of the city of Frankfurt, which in the 1990s was becoming a finance capital of Europe.

There is a substantial amount of literature dedicated to the construction of the Commerzbank, including multiple monographs that provide a significant proportion of the information presented in this chapter. The two main sources are Colin Davies and Ian Lambot’s Commerzbank Frankfurt: Prototype for an Ecological High-Rise (Birkhäuser, 1997) and Volker Fischer and Horst Gruneis’ Sir Norman Foster and Partners: Commerzbank, Frankfurt am Main (Axel Menges, 1997). While these publications allow for an in-depth understanding of the design process, the authors discuss the project as one that began with Foster and ended with the building’s

217 Volker Fischer and Horst Gruneis, Sir Norman Foster and Partners: Commerzbank, Frankfurt am Main (Stuttgart: Axel Menges, 1997), 7.
218 Ibid, 11.
completion. These two books were both published in 1997, thus preventing the ability for any critical distance. While both touch upon the geographic, political and social context in which the project developed, neither sufficiently explains or emphasizes the unique extent to which these factors affected the project. The following analysis, while largely dependent on information from these publications, is an effort to present the information in a way that more accurately explores the decisions behind the final Commerzbank headquarters.

A Financial Capital

While Berlin and Frankfurt are cities in the same nation responding to similar national goals and pressures, there are many differences that are clearly expressed in the design of the new Commerzbank headquarters. The politics of Frankfurt, the history of the city, and its present status as a financial capital, all significantly impacted the final project. While the new Commerzbank differs greatly from the Reichstag in that a private company commissioned it, politics nevertheless played a significant role in its development. Frankfurt’s unique history and specialized municipal provisions regarding construction greatly determined the final design for the Commerzbank’s new headquarters.

During the 1990s, both the Commerzbank and the city of Frankfurt were flourishing. The Commerzbank was an international company and the third largest bank in Germany (the first two being the Deutsche Bank and the former Dresdner Bank).\(^\text{219}\) Frankfurt was also becoming increasingly globalized, as a unified Germany

established trust in the stability of investments in the country. As of 1999, a third of Frankfurt’s population was foreign-born.\textsuperscript{220} In March of 1997, the German and greater European equivalent of NASDAQ became headquartered in Frankfurt, called the Neuer Markt.\textsuperscript{221} In 1999, only two years after the completion of the Commerzbank, $5 billion were invested to build a finance center in a ninety-hectare lot in downtown Frankfurt. It was designed to include 4,000 apartments and Europe’s new tallest building, the Millennium Tower, to be completed in 2006.\textsuperscript{222} The government had announced that within the decade up to twenty new skyscrapers would be constructed.\textsuperscript{223} \textit{Bloomberg Business Week} published an article in 1999 entitled: “Booming Frankfurt,” classifying the city as the leader in “Europe’s primary source of financing for entrepreneurs.”\textsuperscript{224}

Frankfurt’s title as the banking capital of Germany is due to a multitude of factors, some of which stem from somewhat controversial theories. Between 1816 and 1866 Frankfurt was the capital of the German Federation. In 1848, the democratically elected chamber of representatives (discussed in the previous chapter) was headquartered in this city, located roughly 400 kilometers southwest of Berlin.\textsuperscript{225} Therefore, when the city was denied capital-status in West Germany after World War II, it was a surprise to many. The new aim was to create a center of finance that would

\textsuperscript{222} Ewing, “Booming Frankfurt”
\textsuperscript{224} Ewing, “Booming Frankfurt”
establish Frankfurt once again as an important German metropolis.\textsuperscript{226} The physical fabric of the urban area made it an ideal center for modern banking development. Between March 18\textsuperscript{th} and 22\textsuperscript{nd} in 1944, Allied bombs destroyed most of Frankfurt’s historic neighborhood. This allowed for new development that was further enhanced by Frankfurt’s central location in Europe, its extensive railroad connections and its airport.\textsuperscript{227} The destruction in World War II also made those buildings that remained even more significant, a fact that would be very much prevalent in the debates surrounding the new Commerzbank headquarters.

City planning director Helmut Bosch believes that Frankfurt’s success in finance development stems from its long history of trade via the Jewish banking community. Since the twelfth century, Jews began to play a major role in the economic functioning of the city. In 1550, eight percent of Frankfurt’s population was Jewish. Throughout several centuries, Jews experienced periods of security and periods of persecution. In 1811, the Jewish population of Frankfurt received citizenship. Roughly fifty years later, in 1864, the Jews of the city received political equity. By 1925, sixty-seven percent of the city’s leading bankers were Jews. In 1938, all of this changed. Nazi troops deported 30,000 Jewish citizens of Frankfurt to concentration camps, and only an estimated one hundred survived. Bosch believes that the reclamation of Frankfurt’s status as a banking capital represents the city’s long-standing religious tolerance, and the need for social acceptance in a post-reunification world of global capitalism.\textsuperscript{228}

\textsuperscript{226} Moore, “The Banks of Frankfurt,” 8.
\textsuperscript{227} Ibid.
\textsuperscript{228} Ibid, 9, 10.
While it is clear that banking is an important part of Frankfurt’s identity, the way to approach the physical construction of a finance capital post-World War II remained a contentious issue for several decades. In the 1960s and 1970s, the finance industry was looking to greatly expand their office space around the city as a result of a growing economy. At the same time, there was a budding movement of conservatives with a great fear of American-style development and skyscraper office towers. This fear manifested as anger when many residents primarily from the historic West End were forced to move out of particular districts in order to allow for further development.

In 1969, angered citizens created the Aktionsgemeinschaft Westend initiative. The housing conflict, now referred to as the Häuserkampf, erupted into violence in the streets and continued throughout the 1970s. In the 1980s, the debate entered into the discussions of the city council and played a primary role in the upcoming elections. The conservative Christian Democratic Union (CDU) approached the issue with a plan to develop low-rises around the city’s arterial roads, such as the Mainzer Landstrasse. The reasoning behind the CDU’s plan was to prevent the development of American skyscrapers that were associated with density and environmental destruction. The CDU won the elections in 1985 and quickly implemented laws to limit development, essentially halting any opportunity for high-rise construction.

In 1989, the liberal Social Democratic Party (SDP) and the German Green Party took control of the city government. The SDP approach to development was to

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231 Ibid.
build the new offices in the old banking quarter, thus supporting high-rises and limiting any negative effect on surrounding residential areas. The laws and the social opposition surrounding skyscraper construction became significantly less stringent, and people began to understand that a skyscraper could actually be environmentally beneficial. Volker Hauff became the city’s mayor. Hauff was one of the co-authors of the previously mentioned 1987 Brundtland Report, the influential document that defined sustainable development. The new environmentally progressive government aimed to establish an ecologically and socially responsible government and implemented a statute that required all new banking construction projects to publish a sustainability report. In 1990, the city of Frankfurt became a founding member of the European Climate Alliance and agreed to reduce its carbon dioxide emissions by half in the next two decades. The Social Democratic Party and the German Green Party remained in power until 1995, and significantly influenced the Commerzbank design.

In 1989, the same year that the SDP won the majority, the Commerzbank decided to expand its 1960s, two-block headquarters and concentrate all of their offices on a single site. Despite the recent legislation supporting high-rises, the project was to become another chapter of controversy surrounding bank development. The original briefing recommendations included a new 133-meter-high building alongside the original 109-meter tower and would require the demolition of several historic structures. The city denied the application and the bank entered into

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236 Ibid, 13-14.
negotiations with the city. Frankfurt’s urban planner Helmut Bosch spearheaded the discussions.\textsuperscript{237}

\textit{Commerzbank and Frankfurt’s Building Expectations}

After several months of negotiation, the Commerzbank and the city of Frankfurt published a detailed outline of the requirements for the new development. Former chair of the \textit{Aktionsgemeinschaft Westend}, Nicole Weidemann, said of the final approval in 1991: it was “no reason to rejoice, but [it is] a compromise we can live with.”\textsuperscript{238} The group was not going to uniformly approve of any development project, but supported the collaborative efforts and the ultimate commitment to a mixed-use construction. In February of 1991, Commerzbank distributed a very detailed brief to twelve invited architectural practices after a preliminary round of thirty-five firms had been completed.\textsuperscript{239} Nine of these twelve selected firms came from Germany, two from the United States (including Skidmore, Owings and Merrill), and one from England, with submissions due on June 3rd.\textsuperscript{240}

The compromise was a building that would have to be environmentally responsible, publically accessible, and mixed-use, with space dedicated to the public and to housing.\textsuperscript{241} The final design needed to integrate the new tower into the existing urban fabric, alongside other non-Commerzbank buildings dating from the 1870s and the old Commerzbank offices (see Image 2.01 and 2.02).\textsuperscript{242} This previous office

\textsuperscript{237} Moore, “The Banks of Frankfurt,” 13
\textsuperscript{238} Ibid, 14.
\textsuperscript{239} Davies, \textit{Commerzbank Frankfurt}, 39.
\textsuperscript{240} Ibid, 14, 39.
\textsuperscript{241} Moore, “The Banks of Frankfurt”, 13-14.
\textsuperscript{242} Fischer, \textit{Commerzbank}, 7.
tower was designed by Richard Heil (1970-1973) and was to play a significant role in the final design of the new headquarters.\textsuperscript{243} The competition for the architect was required to include invitations to international firms, symbolizing the globalization efforts of the city.\textsuperscript{244} Energy-saving techniques such as minimizing material used for the external envelope, maximization of natural light and ventilation, and passive solar heat were all outlined in the brief. As a means by which to preserve interior space while providing public areas, the company recommended architects incorporate roof gardens into their submissions. It also proposed distributing common areas throughout the structure to promote interaction among employees.\textsuperscript{245}

The government’s demand that the design follow an environmental agenda was an example of greater German policy towards sustainable development, as described in the previous chapter dedicated to the Reichstag. One of Germany’s biggest issues upon reunification was how to handle development. Many areas previously dedicated to agricultural purposes were being built up, while former industrial sites in urban areas remained deserted.\textsuperscript{246} In fact, Article 164 of the Federal Building Code of 1971 aimed to diversify urban development through the public funding of mixed-use projects.\textsuperscript{247} One of the most well known aspects of the final Commerzbank design was also a direct response to German law. It is federal law in Germany that every work area has access to a window and to a view outside, a direct opposition to American skyscrapers that have deep plans preventing natural light and

\textsuperscript{244} Davies, Commerzbank Frankfurt, 13.
\textsuperscript{245} Ibid, 14.
\textsuperscript{246} Urban Policy in Germany: Towards Sustainable Urban Development (Paris: Organisation for Economic Co-operation and Development (OECD), 1999), 33-34.
\textsuperscript{247} Ibid, 42.
ventilation. German regulation also puts pressure on minimizing energy spent on air
conditioning.\textsuperscript{248} The Commerzbank building therefore, was to be one of the world’s
first naturally lit and ventilated skyscrapers.\textsuperscript{249}

An ecological skyscraper was one of the city council’s demands and it had
been fully supported by the Commerzbank. In fact, Green Party leader Daniel Cohn-
Bendit argued that the “idea to make the building green must have had its origins
within the Commerzbank” since there was much room for a conventional building
within the city’s regulations.\textsuperscript{250} A green skyscraper would promote the company as a
forward-looking establishment while at the same time save money.\textsuperscript{251} The
competition brief stated, “through the creation of an ecologically sound building, we
have the chance to portray ourselves as an innovative Bank which takes its social
responsibility seriously.”\textsuperscript{252} Investing in an efficient building would also significantly
decrease expenses on heating and cooling in the long-term. Furthermore, if an
improved work area created an increase in employee productivity by just one or two
percent, it would have a substantial return on investment for the company as a
whole.\textsuperscript{253} Lastly, a green and innovative tower was much more likely to gain the
support of the unwelcoming public as it would bring international recognition to the
city and would promote environmentally conscientious development. An ecological
skyscraper, however, would not be cheap and the company was quite privileged to be
able to make the initial investment.

\textsuperscript{248} Davies, \textit{Commerzbank Frankfurt}, 13-14, 15.
\textsuperscript{249} Ibid, 14.
\textsuperscript{250} Moore, “The Banks of Frankfurt”, 14.
\textsuperscript{251} Ibid, 14.
\textsuperscript{252} Ibid.
\textsuperscript{253} Davies, \textit{Commerzbank Frankfurt}, 193.
The jury that would declare the winner of the Commerzbank commission comprised architects, experts in construction, engineering, elevator planning, office layout, and construction law. The jury took four weeks to present their final decision. Foster and Partners won the project, while Christoph Ingenhoven Architekten of Düsseldorf, Germany, was chosen as runner up.254 The committee made their final decision based on several factors including: the integration of the structure within the surrounding urban layout as well as the relationship of the building with the streetscape, the quality of open spaces and the ecological aspects of the design.255

Political involvement in private developments such as the Commerzbank headquarters is unheard of in the United States. While it requires more time and energy dedicated to the planning stages, it also ensures private investment in public space. In the discussion of the Hearst Tower below, the difference between German and American development will become more evident. In the Hearst Tower, the only extent of public and political involvement was with regards to the landmarked walls of the tower’s base. The final agreement of the Commerzbank and city officials recalls Daniel Libeskind and Michael Blumenthal’s discussion of the importance placed on public space and the ever-present role of bureaucracy in German urban development, which had become even more prevalent due to the housing conflict and recent concerns regarding development. While the environmental agenda was

254 While Foster won the commission, Christoph Ingenhoven Architekten soon won the commission for the Rheinisch-Westfälisches Elektrizitätswerk office tower. The 127 meter-high tower for RWE was completed in 1997 in Essen, Germany. While Foster and others claim the Commerzbank to be the “first ecological skyscraper,” architect Christoph Ingenhoven says the title should go to the RWE, which incorporated natural ventilation and a double-skin glass exterior, and was completed just months before the new Commerzbank.
Davies, Commerzbank Frankfurt, 39, 193; Peter Cachola Schmal, "Christoph Ingenhoven with Engineers Werner Sobek and Klaus Daniels Devise a Crystalline, Energy-efficient Workplace for Lufthansa Aviation Center in Frankfurt," Architectural Record 195, no. 8 (2007).
255 Fischer, Commerzbank, 7.
certainly promoted by the Commerzbank, there is no doubt that the significant bureaucratic involvement and public opinion resulted in a design that was more committed to sustainability.

_Foster’s Commerzbank_

The Commerzbank was a product of the work of many different individuals, consultants and firms. Spencer de Grey and John Silver were the main architects from Foster & Partners for the project.\(^{256}\) Structural engineers Ove Arup & Partners had helped Foster & Partners created the competition proposal and stayed partners throughout the project as general contractors.\(^{257}\) Arup is based in London and had worked on multiple projects before with Foster, including the Hong Kong and Shanghai Bank (1986) and many more since the Commerzbank’s completion.\(^{258}\) Arup partnered with Krebs und Kiefer to have a local firm part of the engineering team. Hochtief AG, under director Friedrich Racky, was appointed as the other general contractor and the main overseer of construction.\(^{259}\) It was Hochtief that was responsible for ensuring the building was completed within the budget agreed on contractually, taking the financial pressures off the Commerzbank.\(^{260}\) The German associate of engineering consultants Roger Preston & Partners came to the team to help the environmental planning, specifically working on the design of the natural ventilating system.\(^{261}\) Roger & Preston, which was bought by British engineering

\(^{256}\) Fischer, *Commerzbank*, 7.
\(^{257}\) Fischer, *Commerzbank*, 9; Davies, *Commerzbank Frankfurt*, 42.
\(^{258}\) Fischer, *Commerzbank*, 7; Davies, *Commerzbank Frankfurt*, 42.
\(^{259}\) Fischer, *Commerzbank*, 9; Davies, *Commerzbank Frankfurt*, 45.
\(^{260}\) Davies, *Commerzbank Frankfurt*, 45.
\(^{261}\) Ibid, 42.
company Grontmij in 2008, was a British consulting firm known for its sustainable portfolio.\textsuperscript{262} They had worked previously with Foster and Partners on the Century Tower in Tokyo (1987-1991).\textsuperscript{263}

The Commerzbank company itself played a large role throughout the design process. The building needed a project manager, but the company was unsatisfied with all the independent managers they had contacted. Instead, they established Nervus Generalübernehmer GmbH, an in-house managing group created specifically to represent the interests of the bank. This allowed the Commerzbank directors to have an unusual amount of involvement in the design process, as Nervus was to play a principal role from start to finish. Nervus examined every aspect of the design process through specialized teams, evaluations, and written reports.\textsuperscript{264}

At times, Nervus determined that some of the firms brought to the project by Foster & Partners were not suitable to continue. HL Technik, a firm established in Germany for its work on sustainable buildings, had worked with Foster & Partners on the entry proposal as environmental services consultants.\textsuperscript{265} For the final project, however, Nervus replaced HL Technick with three separate and local engineering companies: Pettersson & Ahrens for mechanics, Jappsen und Stangier for elevators, and Schad & Hötzle for the electrical.\textsuperscript{266} Foster’s original geotechnical consultants for the foundation design, GBI Sommer, were also later replaced by Ingenieursozietät


\textsuperscript{264} Davies, Commerzbank Frankfurt, 45.

\textsuperscript{265} Ibid, 15.

\textsuperscript{266} Ibid, 41.
Katzenbach und Quick. This firm had designed many foundations in the Frankfurt area and thus had experience with the local geology, such as Helmut Jahn’s Messeturm completed in 1990.\textsuperscript{267} Nervus was a unique component of the overall design process, and their search for firms and continual analyses often resulted in an altered team. While such alterations of the final team was challenging in itself, the collaborative efforts resulted in a diversity of expertise brought to the project and ensured knowledge of the local contextual complexities.

The design was also constantly evolving, from its foundations to the final design of the core structure. Foster’s initial proposal was a building of 185 meters, slightly taller than the original office tower on site. However, as a result of the municipal authorities requesting a structure that was more slender and less disruptive to surrounding areas, the final design was a sixty-three-story, 300-meter-tall building.\textsuperscript{268} The budget of 600 million Deutschmarks also played a significant role in determining the final design. Building an ecological skyscraper was not a cheap endeavor, particularly in the 1990s when there was no precedent for a “sustainable” skyscraper and there were not yet practices that specialized in sustainable construction. Throughout the process therefore, nearly every aspect of the design was subject to cost simulations. Even though the cost simulations factored in the potential benefit of future savings, many of the proposals were still found to be too costly and were sent back to the drawing board to be reconfigured.


Testing methods and models were often implemented to ensure maximum energy efficiency.\textsuperscript{269} Passive and active ventilation methods, heating, cooling, and natural and artificial lighting were just some aspects of the project that underwent thorough examination. Between 1992 and 1994, Nervus requested 120 technical reports. It was estimated that the final design would consume thirty percent less energy than conventional office towers of similar size. It was also expected that the operating costs would amount to less than half of the original headquarters of only twenty-nine stories.\textsuperscript{270}

The original headquarters created significant challenges for the new building and had a substantial role in determining the shape of the final structure. If the new tower were built based on a conventional rectangular plan, the two headquarters would have little space between them.\textsuperscript{271} Furthermore, achieving natural light and ventilation for all offices in a building based on a deep rectangular plan, would be nearly impossible. The result was an equilateral triangular structure of sixty-meter-long sides (see Image 2.03).\textsuperscript{272} This triangular layout was then planned around a central atrium that allowed for interior offices by permitting light and air throughout the core of the structure. Foster had implemented such an atrium at the Hong Kong Bank (1986) and the Century Tower in Tokyo (1991).\textsuperscript{273} What had not yet been done anywhere in the world, however, was the most famous aspect of the design, the four-

\textsuperscript{269} Davies, \textit{Commerzbank Frankfurt}, 40.  
\textsuperscript{270} Ibid, 40, 41.  
\textsuperscript{271} Ibid, 16.  
\textsuperscript{273} Davies, \textit{Commerzbank Frankfurt}, 16; Foster & Partners, “Century Tower.”
story high gardens that maximized the natural heating and cooling capabilities of the structure (discussed below; see Image 2.04).\textsuperscript{274}

The garden concept satisfied the company’s request for roof gardens and common spaces in a unique way, but it too presented challenges. The original design had the gardens all along the south-facing side of the building and the offices on the other two sides of the triangle. The elevators would be alongside these south-facing gardens. However, calculations found that this system provided little heat gain from the sun and would require heavy structural beams to provide support.\textsuperscript{275} The next proposal moved the transport services to an addition outside the triangular plan, an add-on piece to one of the corners. In the future, the original office tower could be rebuilt in a triangular form and could connect to the tower via this addition. However, this design interfered with the wind pressures, increased the load on the foundations, and created a wind tunnel between the new office building and the old. It also proved incapable of handling the large number of workers and was not economically or ecologically efficient, requiring a greater external envelope area that would lead to greater heat loss.\textsuperscript{276}

The team was asked to seek alternatives, as this garden design was found to be too expensive. The alternatives included placing the gardens at the corners and establishing a more conventional central core. However, both the company and Foster decided this would eliminate the most important element of the design and decrease the project’s overall innovativeness.\textsuperscript{277} The final design aimed to increase the amount

\textsuperscript{274} Davies, \textit{Commerzbank Frankfurt}, 16.
\textsuperscript{275} Ibid, 17-21.
\textsuperscript{276} Ibid.
\textsuperscript{277} Ibid, 21.
of floor area by centralizing and minimizing the space dedicated to mechanical and transport services. The elevators were organized into three divisions, each responsible for a third of the building. This allowed the rest of the space above and between the shafts to be dedicated to other functions such as bathrooms, meeting rooms and plant rooms. Each set of lifts was placed at the corners of the triangular structure (see Image 2.05). In the end, the garden and communal element of the design was still a substantial investment, as only thirty-five per cent of the entire structure was dedicated to work stations.

This solution also altered the original layout of the south-facing garden areas. The new design increased the height of the gardens from three stories to four, and distributed them around all three sides of the triangle. The gardens extend 450 square meters and are each fifteen meters in height. Every twelve-story group has three four-story gardens, each facing a different direction (see Image 2.06). This allowed sunlight to come in equally from all sides throughout the day and balanced the vertical loads along all three sides. It also permitted wind to come in from various directions throughout the day and therefore maximized natural ventilation. At the top of each twelve-story section, there is a horizontal layer of glass across the atrium which permits natural light to enter while at the same time prevents draught and a “chimney effect” in the case of a fire (see Image 2.07). The jury appreciated this design and the fact that it is “planned to be visible from a distance.”

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278 Davies, Commerzbank Frankfurt, 22.
280 Fischer, Commerzbank, 13.
281 Davies, Commerzbank Frankfurt, 17-21
283 As quoted by Fischer, Commerzbank, 9.
which has 120,000 square meters of indoor space, is visible from fifteen to twenty kilometers away, allowing the company’s dedication to an environmental agenda to be seen by a wide audience.\footnote{284}

The final “sky gardens” symbolize a global presence in both the aesthetic and environmental agenda of the structure, which must have been appreciated by both the bank and the city. The plantings are dependent upon the orientation and incorporate an international element through biodiversity (see Images 2.08 and 2.09). Those that face west have North American plants such as robinia, maple trees, and sequoias. The gardens that face south have plants of Mediterranean origin, including olive trees, lavender, pomegranates, cypress, oleander, and cork oaks. Lastly, those that face east are of the Orient, including bamboo, Japanese maple, azaleas, rhododendrons, snowball trees, and magnolias.\footnote{285} Before the plants were placed, they grew for eighteen months in greenhouses around Frankfurt. By the time of installation, some were already up to nine meters tall (see Image 2.10). They were transported to the site and raised through the unfinished facades at the various levels of the gardens.\footnote{286}

All of the windows in the buildings are operable, maximizing the efficiency of the heating and cooling system. The gardens are backed with fourteen-meter-high glass panel windows with ventilating slits, and all of the interior offices have windows that can open into the space and benefit from the atrium’s natural air.\footnote{287} The exterior offices have outer glass panes in an aluminum facade and inner double-glazed windows. Between the two panels is an eighteen-centimeter gap. In colder

\footnote{284}{Fischer, Commerzbank, 7.}
\footnote{285}{Ibid, 13.}
\footnote{286}{Ibid.}
\footnote{287}{Ibid, 17.}
temperatures, the cavity allows for greater thermal insulation while still permitting sunlight to enter. The outer pane has ventilation slots while the inner can be tilted to adjust the amount of natural air introduced into the room, allowing workers to open the windows for natural air on a rainy or windy day without worry, even for the offices on higher floors. Furthermore, between the inner and outer glass is a Venetian blind, which can prevent heat from entering the inner glass pane and thereby decrease cooling loads (see Images 2.11 and 2.12).

While the floor plan of each story averaged 776 square meters, the office areas are only twelve meters deep, allowing significant light and ventilation from the windows – both the four-story windows behind the gardens and the exterior office windows. Workstations can receive over 500 lux daily, greatly decreasing dependence on artificial lighting. Lux is a unit that measures brightness, rather than power or energy. An average bright office space has lighting of 400 lux, which is the equivalent to outdoor lighting during sunset or sunrise on a clear day. Every workstation is within nine meters of an operable window. Furthermore, each floor averages space for sixty people, allowing productive communication and physical interaction.

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290 Davies, *Commerzbank Frankfurt*, 158.
292 It is unknown if this calculation of 500 lux was established prior to construction or post. Considering the substantial amount of modeling that took place in the design process, however, it is likely this number was in fact pre-calculated.
295 Murphy, “Innovation in Building Design”, 37.
The operable windows can be controlled either by the employee or via a computer-monitored central control system, allowing individual control over ventilating needs and lowering energy expended on mechanical heating and cooling.\textsuperscript{296} A mini meteorological device was installed in every garden to help control the microclimate in each three-storey area and determine when the mechanical systems should turn on.\textsuperscript{297} The environmental control system allows for maximum efficiency in heating and cooling even after hours. When no one is in the offices overnight, it is possible to command the system to open all of the windows to let in cool air on a summer’s night and prepare the building for the next day. The computer-controlled system can also release and lock controls and turn off lights and mechanic systems in unused areas.\textsuperscript{298}

When active heating and cooling methods are necessary, there is a hot water and a chilled water system, in addition to a conventional air-conditioning system.\textsuperscript{299} The hot-water convectors comprise an ordinary radiator-based system located below the windows.\textsuperscript{300} The cool water system goes through coils in the ceiling panels.\textsuperscript{301} The chilled water is pumped via an absorption system that is connected to Frankfurt’s steam network.\textsuperscript{302} Absorption refrigerating machines are located in the cooling tower at the top of the structure and connect to pipes from the city’ and turn heat from the city’s heating system into cooled water. As noted in the introduction, absorption cooling uses less energy than conventional cooling methods as it utilizes wasted

\begin{itemize}
  \item \textsuperscript{296} Fischer, \textit{Commerzbank}, 13.
  \item \textsuperscript{297} Gonçalves, \textit{The Environmental Performance of Tall Buildings}, 245.
  \item \textsuperscript{298} Ibid, 17.
  \item \textsuperscript{299} Lechner, \textit{Heating, Cooling, Lighting}, 555.
  \item \textsuperscript{300} Davies, \textit{Commerzbank Frankfurt}, 197.
  \item \textsuperscript{301} Lechner, \textit{Heating, Cooling, Lighting}, 555.
  \item \textsuperscript{302} Fischer, \textit{Commerzbank}, 17.
\end{itemize}
heat.\textsuperscript{303} The chilled water is separate from the air-conditioning system, which is a conventional cooling system used only for the hottest times of the year. This separation allows for cooling even when the air-conditioning is turned off and natural ventilation kicks in, rather than having mechanical air wastefully re-circulated, as is often the case in conventional office towers.\textsuperscript{304} Since the system is mostly not dependent on air, the air ducts can be much smaller than for conventional office buildings.\textsuperscript{305} Chilled ceilings are now a relatively common cooling system in German office buildings, and capitalize on both energy and space.\textsuperscript{306}

Because of the extreme efficiency of the natural air-circulation system, different estimates have concluded that natural ventilation in the completed tower can be used between sixty and eighty percent of the time.\textsuperscript{307} This particular design component significantly reduces the building’s overall energy consumption, and was expected to reduce fuel costs relative to conventional structures by as much as two-thirds.\textsuperscript{308} The natural ventilation also substantially decreases the building’s total water use since the water-based heating and cooling systems are often not needed. Water conservation techniques are also found in the plumbing systems. The washbasins in the toilets are provided with no hot water and the water for flushing the toilets comes from cooling towers, greatly decreasing water needs from municipal sources.\textsuperscript{309}

\textsuperscript{303} Davies, Commerzbank Frankfurt, 200; P.E. Hufford, “Absorption chillers improve cogeneration energy efficiency,” \textit{ASHRAE Journal} 34, no. 3 (1992)
\textsuperscript{304} Fischer, Commerzbank, 17.
\textsuperscript{305} Lechner, Heating, Cooling, Lighting, 556.
\textsuperscript{306} Davies, Commerzbank Frankfurt, 247.
\textsuperscript{307} Murphy, “Innovation in Building Design”, 38; Gonçalves, \textit{The Environmental Performance of Tall Buildings}, 246.
\textsuperscript{308} Davies, Commerzbank Frankfurt, 193.
\textsuperscript{309} Fischer, Commerzbank, 17.
While the primary purpose of the gardens is to decrease energy spent on the HVAC systems, they also relate to the building’s overall structural design. The tower is comparable to a hollow tube and therefore requires perforations on each side to handle the wind loads. The gardens provide large openings and allow outside air to enter, thus enabling the building to more effectively handle wind-bearing loads. The spiraling of the gardens up the structure also allows the two office-space sides on any given level to provide structural rigidity.\(^{310}\) The tower is supported mainly by megacolumns concentrated at the three corners. Large Vierendeel trussed frames allow for greater spans of open space and column-free garden areas as these trusses are based on rectangular frames with only vertical and horizontal members and no diagonals.\(^{311}\) The Vierendeel framing spans thirty-four meters between the megacolumns, resulting in large, unobstructed spaces (see Image 2.13).\(^{312}\)

The structure is made of both steel and reinforced concrete. Structural elements, like the megacolumns, are also cased in concrete.\(^{313}\) Most buildings in Germany are made primarily of concrete and the Commerzbank was the first high-rise structure in the country to use steel as the main material.\(^{314}\) While concrete provides fireproofing and protection against future corrosion, steel allows for quick construction as it can be prefabricated off site.\(^{315}\) The whole tower was completed in thirty-six months (see Image 2.14).\(^{316}\) Steel is also much lighter than concrete, and

\(^{310}\) Davies, *Commerzbank Frankfurt*, 63.
\(^{312}\) Davies, *Commerzbank Frankfurt*, 91.
\(^{313}\) Ibid, 64, 91.
\(^{314}\) Murphy, “Innovation in Building Design”, 37.
\(^{315}\) Davies, *Commerzbank Frankfurt*, 64, 67.
\(^{316}\) Hochtief, “Project – Commerzbank-Turm in Frankfurt am Main”; “Hochtief completes and delivers Europe’s highest building to Commerzbank”
therefore amounts to less pressure on the building’s foundations. The whole tower weighs roughly 132,000 tons, which is close to the weight of the 109-meter tall old headquarters (the rough comparative ratio of weight to floor would then be 2,275 tons per floor of the new tower versus 4,550 tons per old floor).³¹⁷

The foundations for the new building were another aspect of the design that was greatly influenced by the old tower. The old tower foundations are dependent on a reinforced concrete raft that rests forty meters under the structure atop clay soil. This type of foundation was commonly used in the city until the early 1980s. The construction for a new foundation alongside the old could severely disrupt the stability of the former headquarters.³¹⁸ Furthermore, since the majority of the new tower’s weight is concentrated at the three corners, an evenly spread piled raft foundation would not provide enough stability in Frankfurt’s moist clay.³¹⁹

The solution was to use 111 forty-five-meter-deep bored piles that extended to the layer of porous limestone beneath the clay soil.³²⁰ The piles were concentrated at the three corners of the tower to allow maximum support where the weight was greatest. The foundation was completed by the spring of 1995. Thirty of the piles had monitoring instruments attached to them to allow the stresses of the load bearing to be recorded. Darmstadt University’s geotechnology laboratories analyzed the data.³²¹ It was found that after the completion of the tower the piles of the new building have settled only two centimeters, while those of the old have settled a mere 0.6 centimeters. In comparison with other tall buildings in Frankfurt, these numbers are

³¹⁷ Davies, Commerzbank Frankfurt, 68, 69; Emporis, “Neue Mainzer Straße 32-36.”
³¹⁸ Davies, Commerzbank Frankfurt, 68.
³¹⁹ Ibid, 70.
³²⁰ Fischer, Commerzbank, 17 & Davies, Commerzbank Frankfurt, 71.
³²¹ Davies, Commerzbank Frankfurt, 73.
the smallest ever recorded. On average, towers in Frankfurt have measured settlements between ten and thirty centimeters.\footnote{Davies, \textit{Commerzbank Frankfurt}, 73.}

It is clear that many challenges of the Commerzbank design were a result of the parameters defined in the initial brief. The foundations, structure and most importantly, the gardens were all influenced by the site limitations and environmental requirements promoted by the city of Frankfurt and the Commerzbank. An exploration of the design’s evolution as well as an understanding of the original expectations allows a greater analysis of the overall environmental agenda. While the building was a significant breakthrough in environmental construction for its time, it is necessary to critically evaluate the extent of its sustainability in order to learn from both its successes and shortcomings.

\textit{Conclusion}

Foster’s Commerzbank now represents something very different than it did at the time of its completion. The economic recession of the early 2000s and again in 2008 had significant impacts on both the Commerzbank and the skyline of Frankfurt. The Millennium Tower and other skyscrapers planned for the financial downtown were put on hold, and remain unbuilt today. In 2002, an email leaked regarding the low value of the Commerzbank, marking the beginning of the bank’s downward slope towards financial instability.\footnote{Faisal Islam and Will Hutton, "Global Crash Fears as German Bank Sinks," \textit{The Guardian} (2002). http://www.guardian.co.uk/business/2002/oct/06/germany.globalrecession.} The stock market crash and fears of a “double dip” recession in the U.S. resulted in significant losses and mistrust in the global economy. In March of 2003, the Commerzbank announced that it was going to cut an additional
3,100 jobs beyond the 4,300 already eliminated in the previous two years. These cuts would save an estimated 688 million Euros (or $740 million) necessary for the bank struggling with its first annual losses in its history of over 130 years. In 2008, the Commerzbank bought out its long time yet struggling rival, the Dresdner Bank from the insurance company Allianz. The deal was the result of an agreement between the Commerzbank and the government bailout plan, and resulted in the Commerzbank company becoming partially government-owned. The government would allot ten billion Euros to the bank, in addition to the eight billion the company was already approved for. Over the course of just several weeks, the company went from a value of four billion Euros to eighteen billion Euros within just several weeks. The buying of Dresdner was not beneficial to Commerzbank finances. In 2009, the Commerzbank remained economically unstable, with a net loss of 4.54 billion Euros over the course of the year. At the time, the Commerzbank’s biggest competitor, the Deutsche Bank had reported a 2009 profit of five billion euros. The authorities of the Commerzbank contributed the losses to investments in U.S. real estate and central and eastern Europe. In 2011, the bank began to recover and paid back the $20.3 billion bailout from the government. Commerzbank officials said that the payment would come from shares sold out of the original federal package. The government, however, continues to own twenty-five percent of the

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company and has veto power over the Commerzbank’s decisions.\(^{327}\) The Commerzbank headquarters have thus become a part of the bank’s history, built during a time when the Commerzbank company had full power over its decisions. The office represents a period of financial prosperity, when significant investments could be dedicated to promoting a sustainable corporate image.

The Commerzbank has commonly been referred to as the world’s first "ecological skyscraper." Whether or not this title is well earned is a question for debate, but the more significant question is how such a title is and should be defined and awarded. For its time, the Commerzbank was an impressive structure as it applied small building standards such as natural ventilation to a large-scale skyscraper. This is an interesting and telling shift away from Herman Worsham’s 1929 declaration: “The windowless skyscraper, already envisioned by others and made possible by air-conditioning plus artificial illumination, will surely become a reality…. Let those who cry for ‘fresh’ air through open windows from the out-of-doors be reminded that it doesn’t exist in the congested city.”\(^{328}\) It is an example of how the built environment has become so separated from our natural surroundings that once fresh air enters a tall office tower it is international news. Yet the reality is that tall office and residential buildings require an entirely different vocabulary and approach for basic needs that are standard in low structures. A skyscraper therefore requires its


own terms of ecological evaluation. Under this criterion it becomes clear that natural ventilation of a 120,000 square meter skyscraper is a significant success.³²⁹

The other challenge of evaluating an “ecological skyscraper,” is how to distinguish a comprehensive sustainable building from a building with particular sustainable elements (a challenge originally discussed in the introduction of this paper). While several aspects of the design of the Commerzbank are extremely energy efficient, there are many areas for improvement. The gardens for example, reduce energy costs on lighting, heating and cooling but require a substantial amount of water for irrigation purposes. Generally speaking, irrigation does not have to be unsustainable and in many other projects by Foster it is incorporated into the overall ecological agenda. The water for the heating and cooling system is provided by gray water from the cooling towers, but nowhere does the literature mention of how they gardens are irrigated. A rainwater catchment system or application of gray water for such a purpose would provide a much more sustainable solution, as exemplified in several other tall office buildings designed by Foster including the Hearst Tower discussed in Chapter Three.

The sustainable design of the structure was also extremely expensive, and in reality was an investment only affordable for a company of substantial resources. Since the Commerzbank’s completion, premiums for sustainable technologies have greatly decreased. At the time however, the cost of installing a mechanical plant and an operable window system with inserted blinds outbalanced the future savings.³³⁰ Furthermore, the amount of maintenance required to upkeep the gardens, operable

³²⁹ Fischer, *Commerzbank*, 7, 11.
window system and atriums continues to be more demanding than if the structure were based on conventional heating and cooling methods (although in terms of simple operational costs, the building is cheaper to run than conventional equivalents). If the bank had decided to hold off just a few years on its new headquarters, they would most likely not have been able to even consider such an investment. Such expensive solutions limit the potential for clients of lesser means to incorporate sustainable designs.

Furthermore, the natural ventilation and the mechanical heating and cooling systems, could have been more efficiently incorporated. The original design had air units for each floor, which would maximize efficiency and make the system directly dependent on the most local conditions. However, maintenance costs of fifty different units would be substantial and the final design had only several larger units located on two levels throughout the structure. The design also does not utilize effective materials for maximizing thermal storage. The floors were originally supposed to be constructed of precast concrete, which is inaccurately noted in some publications as the final design (note Murphy, “Innovation in Building Design”). Concrete flooring has the ability to store a substantial amount of heat within the material, subsequently lowering heating demands. In the end however, steel-framed floors replaced the concrete as a lighter and cheaper alternative that would be quicker to install.

331 Gonçalves, The Environmental Performance of Tall Buildings, 247.
332 Davies, Commerzbank Frankfurt, 200-201.
333 Mike Votruba, “Commerzbank.” University of Waterloo, 3.
334 Murphy, “Innovation in Building Design”, 37.
335 Davies, Commerzbank Frankfurt, 199.
Finally, while the light weight of the steel allows a smaller foundation, it is a very energy and water-intensive material. This high embodied energy can be somewhat reduced through the use of recycled steel. However, even if Commerzbank had incorporated recycled materials, nowhere is there mention of it in the literature.\textsuperscript{336} This is very different from the Hearst Tower, which began only three years after the completion of the Commerzbank and was constructed of nearly eighty percent recycled steel. Therefore, while certain elements of the Commerzbank are impressively efficient, the tower is a clear example of the need to evaluate sustainable structures on a holistic and comprehensive level. This holistic approach is more difficult in evaluating the Commerzbank in particular, since the standards for today’s “ecological skyscrapers” are much more demanding than those of 1997. Furthermore, the building was completed before the establishment of any standard accreditation systems or awards, making its assessment even more challenging.

For its time, however, it is hard to argue that the Commerzbank was not a significant breakthrough in sustainable tall building construction. The performance data for the final tower was more efficient in some cases than had been anticipated. Estimates before completion concluded that energy consumption would amount to thirteen million kWh annually while actual energy consumption equates to roughly ten million kWh.\textsuperscript{337} This reduction is due in large part to the small amount of energy expended on heating and cooling, as natural ventilation is used for more of the year than had been expected. In 2002, they replaced the nine separate weather stations with one extremely precise sensor that they installed on the roof. This new device, an

\textsuperscript{336} Votruba, “Commerzbank,” 3-4.
\textsuperscript{337} Peter Muschelknautz (Commerzbank Building Manager), interview by Brian Dean, MIT, in 2000.
example of the building adapting to new technologies, provides more accurate wind data and makes the interior climate more efficiently controlled. Finally, the Commerzbank headquarters has demonstrated impressive adaptability to meet the changing demands of the company. The original structure was built to have office space for 2,400 employees. As of 2010 however, that number has increased to 2,820 occupants. To accommodate this increase, the floor plans were rearranged to create more open office space out of the previously cellular offices. Such open areas allowed for an even greater amount of natural ventilation, as work stations could have air coming in from multiple directions.\textsuperscript{338} The Commerzbank was an example of international importance that proved the great potential of applying a sustainable agenda to a skyscraper. While it lacked in several environmental design components, the Commerzbank created precedent for future large office towers to build upon and improve.

\textsuperscript{338} Gonçalves, \textit{The Environmental Performance of Tall Buildings}, 247.
Chapter Three: Hearst Tower  
New York City, United States 2000-2006

The Hearst Tower (2000-2006), located at 959 Eighth Avenue on 57th Street in New York City, is often interpreted as a symbol of New York’s turn-of-the-century movement towards ecological construction. In 2001, the Hearst Tower was the first building in New York to receive the Leadership in Energy and Environmental Design (LEED) Gold certification for new construction. In 2008, the new headquarters was awarded the International Highrise Award, an award created in Frankfurt in 2003 to promote the construction of ecologically responsible skyscrapers. The Hearst Tower made headlines again in 2012 when it was promoted to LEED Platinum rating for existing buildings on March 5th, becoming the first building in New York to receive both LEED Gold and Platinum certifications. As a result of the tower’s innovative role in New York City’s skyscraper design, and its significant environmental accreditations, the majority of the information about the building is comprised of press releases and other forms of media, including a recent television debut as part of the PBS special The Treasures of New York. The most prominently featured aspects of the structure include its efficient and visually dramatic diagrid core, a rainwater catchment system, and its low-energy heating and cooling systems. While these elements are usually discussed simply in terms of the building’s “environmental agenda” and “unique aesthetic,” a closer analysis reveals that the

341 Architectural Record, “Hearst Tower Wins International Highrise Award” Architectural Record, 196, no. 12 (2008), 38.
overall sustainability of the structure is actually the result of two main factors: the Hearst Corporation’s goal to visibly demonstrate a forward-looking and “state-of-the-art” agenda, and physical site limitations, including a landmarked structural base and an adjacent apartment tower. Foster responded to these challenges through a design that was aesthetically bold and visibly sustainable.

The project was an important structure in Foster’s career and is an appropriate concluding study for this thesis. The new tower was first conceived in the late 1990s, when the Hearst Corporation decided to consolidate and expand their office space. The building is complete with a fitness center, a television station, and a lab and test kitchens for *Good Housekeeping*, and was designed to use twenty-four per cent less energy than conventional office towers of similar size. The $500 million, 79,500-square-meter structure was Foster’s first skyscraper in the United States (see Image 3.01). To this day, Foster & Partners have their only North American headquarters located in the Hearst Tower, and remain the sole tenant in Hearst’s forty-six-story, 182-meter high building. The Hearst Tower encompassed many of the challenges of both the Reichstag and the Commerzbank, in that it responded innovatively and respectfully to a historical building while at the same time meeting ecological standards for a large-scale office tower.

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343 Lou Nowikas (Senior Director Hearst Real Estate), March 2012; Christopher Kieran, “Hearst Tower: Foster & Partners and Gensler” *Architectural Record* 195, no. 11 (2007), 114.
**Setting: New York City**

Like the Reichstag and Commerzbank, the Hearst Tower was greatly defined by its geographic context. New York City presents unique legal and social obstacles distinct from those of Berlin and Frankfurt, issues that are necessary to understand when looking at the Hearst project. Foster designed the Hearst Tower during a time of significant change in both New York’s building legislation and its skyline. There was a considerable amount of attention surrounding the new “green movement” in the media at the time, a trend that promised considerable publicity for any project that contributed to the excitement. Furthermore, the enormous influence of the Hearst Corporation in the publishing world ensured that this would be an internationally observed project. The ecological agenda that is so often praised was thus largely the result of social and commercial pressures arising in New York at the turn of the new millennium.

While New York City and the northeast United States are considered areas with abundant water resources, the metropolis faced multiple water crises in the 1990s. Mayor David Dinkins entered office to find the city struggling with increased water and sewer rates, increased water usage, limited capacity for sewage treatment, clean up demands of pollutants in the Long Island Sound, and a potential requirement by the EPA to filter the previously unfiltered water sources coming from upstate. The total cost for construction facilities and infrastructure that would solve the issues would add up to more than $20 billion, with an additional $400 million in

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operating costs each year.\textsuperscript{348} New York had to either drastically increase its spending or significantly decrease its demands.

The city chose to initiate a vast and substantial water conservation program. Leaks were found and sealed and building codes were altered to require metering and the installation of low-flow fixtures.\textsuperscript{349} In the 1980s, New Yorkers were using 1.5 billion gallons of water each day. In 2005, after the implementation of the conservation project, each person used twenty per cent less water than in 1990.\textsuperscript{350} Even when not undergoing a period of drought, it is a challenge for the Department of Environmental Protection to ensure New Yorkers have enough water and treatment rates are affordable. One method has been to request that large commercial users incorporate recycled wastewater for non-potable applications.\textsuperscript{351} While there is no specific mention of these new codes altering or influencing the design of the Hearst project, it is clear that Foster was coming to a city that would support his sustainable water practices and designs.

Also around the time of the project’s inception, several large-scale ecological skyscrapers were undergoing construction, creating commercial pressure on the Hearst Corporation to build sustainably. In 1999, Fox & Fowle Architects (now called FXFowle) completed the Condé Nast building at Times Square, also referred to as 4 Times Square. The Condé Nast building was the first sustainable skyscraper in the United States and is largely credited for influencing the LEED standards. The Condé Nast project did not begin with any sustainable agenda. Around the time of the

\textsuperscript{348} Kevin Bone et al, \textit{Water-Works}, 225.
\textsuperscript{349} Ibid, 14.
\textsuperscript{350} Ibid, 221, 228.
project’s inception, however, the nonprofit think tank Rocky Mountain Institute (RMI) received a federal grant to invest in four projects around the United States to promote better performance in construction. RMI got in touch with Fox & Fowle to ask if they had any projects in mind that might utilize such funds. The architectural firm thought the proposal would be an interesting idea for the Condé Nast building. Several of the jurists for the project had previous experience with environmentally responsible renovations and were open to the idea.

At this time, however, large-scale sustainable design was still a new concept. Architect Bruce Fowle of Fox & Fowle noted, “When they started this building [in 1995] the whole notion of green buildings was almost unknown.” Fox & Fowle tried to find specialists who could help with the engineering and construction of a sustainable high-rise, but Mr. Fowle stated in an interview in 2012, “Nobody knew what we were talking about…mechanical engineers had never done anything like this before,” we were “getting a bunch of wild and crazy responses.” The final project was an experiment in sustainable design, a 247-meter high building estimated to consume forty-five per cent less energy per year than a conventional office block.

The literature on the Condé Nast structure often notes the efficient shading and insulation provided by the exterior, the collection chutes for recyclables, and the building’s incorporation of photovoltaic panels and hydrogen fuel cells. This is a clear example of the shortcomings of sustainable literature. In reality, the

352 Bruce Fowle (Co-Founder of FXFowle, New York), interview by Annie deBoer, March 24, 2012; About RMI," Rocky Mountain Institute, http://www.rmi.org/About%20RMI.
photovoltaic panels supply less than one per cent of the structure’s total energy needs. Furthermore, while the building is called the Condé Nast, the company actually had little to do with the funding of the project and its sustainable agenda. Instead, the new construction was part of the 42nd Street Master Plan promoted by the 42nd Street Development Corporation that aimed to create mixed public and private use areas and renew the district’s commercial image. It was built with support from the Durst Organization and several leading environmental institutes in addition to RMI, including the Commission for the Defense of Natural Resources. Condé Nast agreed to the concept of sustainability but was primarily concerned with the structure being built in a timely fashion. As a result of this, the interior of the building was not very green and the sustainable focus was primarily on the exterior shell and the structure’s core. Nevertheless, 4 Times Square and Condé Nast both received substantial public recognition for this structure. As a competitor of Condé Nast, the Hearst Corporation had to respond boldly to the resulting commercial and social pressure, even if Condé Nast had little to do with the building’s ecological agenda.

Competition for green construction only increased with the establishment of the Leadership in Energy and Environmental Design (LEED) program for “New Construction” in 1999. As noted in the introduction, the United States Green Building Council (USGBC), a non-profit organization founded in 1993, created LEED. The LEED certification program established a publicly visible goal for the Hearst Tower

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355 David Owen, “Green Manhattan.”
356 Bruce Fowle (Co-Founder of FXFowle, New York) March 2012.
358 Bruce Fowle (Co-Founder of FXFowle, New York) March 2012.
to achieve. While Foster had to respond to the environmental building codes and pressures promoted by German law for the Commerzbank and the Reichstag, LEED became the United States standard for rating the ecological efficiency of a building. LEED takes into consideration energy and water consumption, use of material, and air quality within a structure. For the 2005 LEED rating on a scale of sixty-nine points, buildings could receive LEED certification if they scored between twenty-six and thirty-two points. If a building scored between thirty-three and thirty-eight points they were awarded LEED Silver. If a building got between thirty-nine and fifty-one through the LEED system, they receive a LEED Gold certification; fifty-two to sixty-nine points, a LEED Platinum rating. Initial ratings upon a building’s completion can be modified to account for performance post-construction under the LEED for Existing Buildings award.360

The Hearst Corporation and Foster & Partners were aiming to construct New York City’s first LEED Gold certified building. Yet at Seven World Trade Center (2002-2006), Skidmore, Owings & Merrill were also fighting for the title.361 The developers had turned the race into a marketing strategy: “going for the gold.”362 The fifty-two-story, $700 million Seven World Trade Center was the city’s first to receive a gold rating for the LEED program with thirty-five points on the LEED scale. However, they were certified gold only under LEED’s “Core and Shell” rating.363 A “Core and Shell” is distinct from a LEED certification for “New Construction” and

362 Pogrebin, “7 World Trade Center.”
363 Ibid.
assesses only the building’s base components, including the envelope, the HVAC system, and the embodied energy in the structure.\textsuperscript{364} As the president and CEO of Hearst Corporation, Frank A. Bennack, Jr. has noted, “All gold is not equal.”\textsuperscript{365}

Hearst Tower claimed first LEED Gold status in New York, as they received the certification for LEED “New Construction,” which includes exterior and interior approval rating for an occupied office space.\textsuperscript{366}

Since 1999, the construction sector in New York City has undergone a complete transformation. Between 2000 and April of 2006 (the year the Hearst Tower was completed), 3,000 projects throughout the United States registered for LEED certification, with 450 completed buildings already approved. In New York City alone, fifty commercial buildings were undergoing review for certification.\textsuperscript{367} In the past decade, the city has implemented substantial municipal tax credits for ecological buildings and builders are increasingly mandated to build LEED. In 2005, New York City implemented a regulation stating that all nonresidential public buildings costing a minimum of $2 million were to be required to build according to LEED standards.\textsuperscript{368}

LEED requirements are very strict concerning a building’s use of water. The category “Sustainable Sites” aims to decrease a building’s effect on ecosystems and waterways, and promotes stormwater management.\textsuperscript{369} In particular, LEED credits for Sustainable Sites (SS) set standards for rainwater management, encouraging buildings

\textsuperscript{365} Pogrebin, “7 World Trade Center.”
\textsuperscript{366} Hearst Corporation, “Hearst Tower Officially Opens.”
\textsuperscript{367} Pogrebin, “7 World Trade Center.”
\textsuperscript{368} Ibid.
to increase on-site infiltration and reduce or eliminate pollution that enters into stormwater. On-site infiltration directs the rainwater to a source on the property that will store it, such as rain gardens or planter boxes. Possible solutions the USGBC provides include the incorporation of the natural stormwater flows, pervious pavements, and re-use of stormwater. The building is expected to improve the site relative to what was there previously and form a connection to the site in a way that ensures building responsibility.

There is also an entire category dedicated to “water efficiency” where architects may gain points for “water efficient landscaping,” “innovative wastewater technologies,” and “water use reduction.” These categories are meant to increase the efficiency of water use in buildings and therefore decrease dependence on the municipal water supply and reduce the total volume of wastewater. Recommendations for doing so include high-efficiency and dry fixtures (such as waterless urinals) and the reuse of stormwater or graywater for on site needs. The Hearst Tower implements many design elements that achieve such reduction, which will be elaborated on below.

Around the time of the tower’s completion in 2006, New York City was becoming a focus for sustainable initiatives. Mayor Bloomberg published the PlaNYC initiative, a program established to make New York a more sustainable city.

373 Ibid.
As part of PlaNYC, Bloomberg established the Greener, Greater Buildings Plan in 2009. This mandate requires all buildings to have publically available annual energy efficiency benchmarking. It also requires evaluations and upgrades of the city’s largest public and private buildings to increase their energy efficiency. A few blocks south of the Hearst Tower, Renzo Piano was designing the new headquarters for the New York Times and Cook + Fox were constructing the new Bank of America, both of which were green skyscrapers completed in 2007. In March of 2007, *Bloomberg Businessweek* noted: “Given New York’s love affair with tall towers and the unmatched scale of the city’s real estate market, it’s no surprise that Manhattan is emerging as the epicenter of green high-rise construction.” After the Condé Nast building and the establishment of LEED, there was significant pressure on all architects building large-scale office towers in New York to design sustainably. In the design of the Hearst Tower, Norman Foster was therefore responding to a contextual expectation that, if successful, would result in significant visibility for both the Hearst Corporation and his firm.

*The Original Hearst Tower*

The design for the new Hearst Tower was greatly defined by the historically landmarked, six-story International Magazine Building, completed in 1928 (see Image 3.02). William Randolph Hearst initially conceived of the headquarters to be

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an office tower for the employees of the corporation’s twelve magazines.\textsuperscript{377} It was to be built in an up-and-coming cultural center of New York that would largely expand the city’s theater district around Columbus Circle.\textsuperscript{378} The site was just blocks away from Carnegie Hall (881 Seventh Avenue on 57\textsuperscript{th} Street, completed in 1891) and the proposed expansion of the Metropolitan Opera at 57\textsuperscript{th} Street announced in 1923 (the Met at the time was located at 1423 Broadway between 39\textsuperscript{th} and 40\textsuperscript{th} Street in a building completed in 1883).\textsuperscript{379}

Architect and stage designer Joseph Urban designed the International Magazine Building. Urban was born in Vienna and his first independent architectural project was a bridge in his hometown in 1898. In 1900, he won the Grand Prix for a project he designed at the Paris Exposition and in 1904 Urban came to the United States for his design of the Austrian Pavilion at the Louisiana Purchase Exposition in St. Louis. He moved to the United Stated permanently in 1911 and became the artistic director of the Boston Opera. Soon after, he was designing sets for the Metropolitan Opera. Between 1917 and 1933, Urban designed sets for a total of fifty-one productions.\textsuperscript{380} He met William Randolph Hearst through Florenz Ziegfeld, for whom he had designed the sets for “Follies.” In 1926, Urban designed the Ziegfeld Theater, which was financed by Hearst. That same year, he was chosen to be architect for the

\textsuperscript{378} Ibid.
new Hearst offices, and shortly after, was commissioned for the plan for the Metropolitan’s proposed expansions, which were not carried out.\textsuperscript{381}

Two months before construction of this office block began, on May 29\textsuperscript{th}, 1927, Hearst published his own editorial in his newspapers on the architecture of New York. Hearst declared it “the most magnificent architecture in the world—an architecture that is not an imitation of some other period, a modification of some other type, but that is new and distinctly American in character.”\textsuperscript{382} In 1928, Urban’s six-story building of $2 million was completed (the equivalent of $90 million dollars today), with ideas of a future tower rising above his grandiose and stage-influenced Art Deco core. Urban’s structure of 3,700 square meters consisted of low-ceilinged offices built around a central courtyard.\textsuperscript{383} It was constructed of cast limestone and is modestly adorned by dramatic allegorical figures of music, art, commerce, and industry.\textsuperscript{384}

Urban, however, did not have much experience with the engineering and architecture of high-rise structures. Urban consulted the firm of George B. Post & Sons to assist with the design and engineering of a nine-story tower above the six-story base.\textsuperscript{385} After the 1929 economic downturn of the country, the Hearst Corporation could not fund any further construction at the time. Joseph Urban died in


\textsuperscript{382} Ibid, 9, 16.

\textsuperscript{383} Masciale, “Treasures of New York” & Amelar, “Foster and Partners Creates the new Hearst Tower”


\textsuperscript{385} Landmarks Preservation Commission, "Hearst Magazine Building,” 6.
In 1945-1947 the unrealized hopes for a tower evolved into another plan by
George B. Post & Sons. These proposals, however, were never realized.

In 1988, the exterior of Joseph Urban’s six-story structure became landmarked
by the Landmarks Preservation Commission of New York. They stated: “On the basis
of a careful consideration of the history, the architecture and other features of this
building, the Landmarks Preservation Commission finds that the Hearst Magazine
Building has a special character, special historical and aesthetic interest and value as
part of the development, heritage and cultural characteristics of New York City.”

Joseph Urban’s building, therefore, was to become an integral factor in both
determining Foster as the project’s architect and in constructing the final design.

Foster’s design gutted out the entire interior of Urban’s structure and created a
grand lobby, twenty-four meters in height. He claimed that the height of the old
floors would be considered cramped and contrary to the open atmosphere the
company desired. The landmarked art-deco shell remains untouched on its outside,
yet from the exterior it is possible to see Foster’s addition of large steel columns that
extend the height of the lobby through the windows of Urban’s facades. Incorporating
Urban’s base into the overall aesthetic vocabulary of a modern tower was a challenge,
and many believe Foster was not at all successful in his attempt to do so.

Hearst Corporation Building Expectations

386 Aronson, Architect of Dreams, 56.
387 Hearst Corporation, “Hearst Tower History.”
388 Amelar, “Foster and Partners Creates the new Hearst Tower”; Landmarks Preservation
Commission, “Hearst Magazine Building.”
The Hearst Corporation is managed by a board of trustees and owned by the Hearst family. As of 2003, the Hearst Corporation had more than 18,000 employees worldwide.\textsuperscript{390} The corporation owns twelve daily newspapers, fourteen weekly newspapers, eighteen U.S. magazines, television and radio stations, and a cartoon service.\textsuperscript{391} It also has over 300 international editions of its magazines.\textsuperscript{392} President and CEO Frank A. Bennack, Jr. asked Gilbert Maurer, a director of the Hearst Corporation, to spearhead a search committee to find the best architect for the project. Maurer decided to pick a candidate from the pool of Pritzker Prize winners, specifically looking at those who had worked previously with historic buildings. Maurer stated in 2012: “We were interested in those Pritzker winners who had pretty good credentials in reconstructive architecture…Norman Foster absolutely stood out from the crowd.”\textsuperscript{393} As noted by Bennack in 2001, Norman Foster “impressed us greatly with his work on the Reichstag, the British Museum and other important commissions in which he combined visionary original designs with existing historical structures.”\textsuperscript{394} It was therefore decided that Foster and Partners would join the team to promote Hearst’s dedication to respecting the past while simultaneously embracing the future.

Most importantly, the Hearst Corporation wanted their new tower to be “state-of-the-art.”\textsuperscript{395} Large-scale buildings were being constructed all around Columbus.

\textsuperscript{391} Ibid.
\textsuperscript{392} Masciale, “Treasures of New York”
\textsuperscript{393} Ibid.
\textsuperscript{395} Lou Nowikas (Senior Director of Real Estate), March 2012.
Circle, and the area was undergoing a cultural revival similar to when William Randolph Hearst first chose the site. The Trump International Hotel and Tower, formerly an office tower, was fully renovated in 1997 by Costas Kondylis and Philip Johnson.\textsuperscript{396} The AOL Time Warner building, now called the Time Warner Center, designed by Skidmore, Owings and Merrill, was constructed between 2000 and 2004.\textsuperscript{397} In 2002, the Museum of Arts and Design (formerly known as the American Craft Museum) bought Edward Durell Stone’s Art Deco building at 2 Columbus Circle. The Hearst Tower needed to distinguish itself amongst its neighbors.

While the Hearst Corporation wanted their new tower to be state-of-the-art, it was Foster who recommended an environmental agenda by which to achieve such distinction and to gain visibility through the competition of New York’s commercial sustainable design projects.\textsuperscript{398} The goal for LEED certification thus quickly became an integral part of the project, and the Hearst Corporation aimed to construct one of the most ecological high-rises built to date.\textsuperscript{399} Brian Schwagerl, former vice president of real estate and facility management for the Hearst Corporation noted in a \textit{New York Times} article in 2006: “We will have the cleanest air of any other building in the city.”\textsuperscript{400} The final design aims to maximize the visibility of the structure’s ecological agenda and publicly promote the company’s environmental commitment.

The real estate and facility management group, Tishman Speyer, supported the aim for a sustainable building. Tishman Speyer Properties develops properties and

\textsuperscript{397}Emporis, “Time Warner Center”
\textsuperscript{398}Lou Nowikas (Senior Director of Real Estate), March 2012.
\textsuperscript{399}Schroepfer, “Global Design and Building Practice,” 4, 5.
\textsuperscript{400}Pogrebin, “7 World Trade Center.”
manages assets. Founded in 1978, the company is valued at over fifteen billion dollars with properties including the Chrysler Building and Rockefeller Center, as well as buildings in both Frankfurt (at the previously mentioned Messerturm) and Berlin (the Sony Center). The company is the second largest office owner in the U.S., controlling a total of 53.9 million square feet as of 2007. The construction company for the project was Turner Construction, which was founded in New York in 1902. Turner and Tishman Speyer had worked together on numerous projects prior to the Hearst Tower. The structural engineers were the Cantor Seinuk Group and the electrical and mechanical engineers were Flack and Kurtz. These two groups are part of the larger WSP Group (formerly called the Williams Sale Partnership), a company that had worked on the Condé Nast building, the Petronas Towers, and the Time Warner Center at Columbus Circle. The associate architects, Adamson Associates of Toronto, was established in 1934 and were selected to help with the details of the project. They were chosen for their substantial portfolio as assistant architects to large-scale projects, which includes projects such as the Petronas Towers (Kuala Lumpur, 1998), Citigroup European Headquarters (London, 2002), and the International Finance Center (Hong Kong, 1998 and 2003). As Alex Richter, the head architect for the Hearst project from Adamson Associates noted in 2006, “How

401 Schroepfer, “Global Design and Building Practice,” 3.
404 Schroepfer, “Global Design and Building,” 4; Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
405 Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
many people can say they have crawled into the heads of these innovative architects?" The consultants for the Hearst Tower were thus very high profile, and had direct experience with some of the projects that influenced Foster’s design.

The private ownership of the Hearst Corporation means that its stock is not publically traded and the design process did not have to incorporate interests of shareholders or future renters. In fact, one of the main factors influencing the final design was that the new office tower was to be occupied entirely by Hearst employees with the exception of several offices for Foster & Partners. A unique ownership situation like this decreased the financial pressure often created by the need to maximize rental capability and allowed much more flexibility in the overall layout of the structure. The building’s organization, as discussed below, was thus determined in large part by the Hearst Corporation’s vision for a collaborative workspace.

**Foster’s Hearst Tower**

Once Foster was commissioned and the design was in progress, he and the board of the Hearst Corporation faced several obstacles. Foster and Hearst associates had scheduled a meeting for September 11, 2001 to discuss any last changes before the final presentation on September 12th. The events of September 11th, however, prevented either meeting from happening and created doubt as to whether or not the project would go through. In October of 2001, the Hearst board decided to pursue the new tower. Bennack stated in 2012: We thought, “this city needs this boost – we’re

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408 Merkel, “Hearst Tower and IAC Building,” 114.
going to be here.” The next step was to get approval from the Landmarks Preservation Commission. The designs were presented to the commission in the fall of 2001 and were immediately approved by a unanimous decision. Finally, the Hearst Corporation only had the air rights for a structure of forty-stories. To solve this, they made an agreement with the City of New York to fund improvements of the Columbus Circle subway station in exchange for the air rights for six more stories.

The Hearst Corporation wanted the new structure to decrease the feeling of hierarchy within the offices and maximize communal and open spaces. Foster chose to hollow out Urban’s interior base and create a naturally lit central atrium for Hearst employees to gather (see Image 3.03). All of the corner spaces of each floor, usually reserved for corporate heads and executives, were instead designed to be conference areas open for collaboration (see Image 3.04). This layout was described in the following clichéd statement from a 2007 article in the *Architectural Record*: “Shorter workstation walls and casual meeting areas in desirable corner areas also encourage collaboration. Synergy among the leaders of Hearst’s many publications is greater now due to the seamless flow of space in the building.” The hollowed out atrium required support from concrete-filled steel mega-columns that extend up to the tenth floor.

While the board determined the open layouts of each floor, the final design of the tower’s structural organization was largely a product of the site’s limitations. The efficient and unique diagrid structure, for which the building is most renowned, was

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409 Masciale, “Treasures of New York”
410 Ibid.
412 Kieran, “Hearst Tower: Foster & Partners and Gensler”
not part of the original plans or ecological agenda. Instead, the diagrid core was a direct response to restrictions caused by the nearby Sheffield condominium building completed in 1978. The Sheffield obstructs all views and natural lighting along the entire western facade of the tower (see Image 3.05). To minimize the impact on the Hearst offices, Foster and the project engineers decided to move the core structural and transporting elements of the building entirely to its west side (see Image 3.06).

All fifteen passenger elevators and two service lifts were thus coupled into one quarter of the tower.

This design solved the issue along the west side, but meant that the east side of the structure no longer had enough support against wind loads. As president of WSP Cantor Seinuk Structural Engineers, Ahmad Rahimian noted in 2006, “With a central core you enjoy the benefit of symmetry. Here we don’t have that.” The first design proposal for handling the support for the eastern side was to increase the perimeter columns along the east side of the building. However, this created an awkward clutter of columns along one façade. The next idea was to add diagonal bracing in addition to the vertical columns along the east side, but this also resulted in an unbalanced aesthetic. The final solution was a diagrid support structure, a series of triangular forms with vertically angled columns and horizontal beams on all four facades of the tower that begin at the tenth floor (below which the structure is supported by steel-reinforced concrete columns). Each triangle measures sixteen

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414 Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
416 Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
418 Ibid.
meters high and is equivalent to the height of four stories (see Image 3.07). The angled columns are all connected via nodes that act as load transferring points (see Image 3.08). The weight is spread evenly across the structure’s foundation of rock and twenty-one caissons (watertight foundation chambers that are attached to the bedrock) each nine meters deep.

Diagonal bracing, which is a combination of diagonal and vertical columns, was first utilized in the late nineteenth century for its effectiveness at resisting lateral forces. Recently, however, this particular type of framing has evolved toward the elimination of vertical columns into the diagrid design, comprised only of diagonal columns. The Hearst Tower, in fact, was the first building in New York to not use any vertical structural columns. The form is structurally appealing as it can carry gravitational, seismic and wind forces without the need for vertical columns.

Norman Foster had previous experience with the diagrid, beginning with a submission for the new Humana Headquarters in Louisville, Kentucky in the early 1980s, which was not chosen. Foster’s Swiss Re Headquarters (1997-2004) in London, often referred to as the “Gherkin” (because it resembles a pickle), was his first implementation of the diagrid. The “Gherkin” is based on a circular-planned
form that tapers at the apex. There are no other high-rises alongside the Swiss Re, allowing for views along all sides and a great flexibility in the form. Furthermore, the building is not protected on any side from wind and the circular structure greatly decreases the amount of wind loads that the building has to bear. The shape also helps air circulation through the tower to cut energy use. The different expression of the diagrid form in the Hearst Tower and Swiss Re headquarters is a clear example of how environment dictates form.

While the decision to make the silhouette angled instead of conventionally rectangular is often discussed in terms of aesthetics, it too was largely a product of structural restrictions. Every eight floors, the forty-five degree angled columns need to meet the other half of the diamond so as to be fully supported. If the tower had straight corners, the columns at the four corners would be unstable as they would be six meters beyond the middle nodes of the triangular frames and not have support along the outer sides. A cantilever support, vertical corner post or system of cables at the fourteenth, twenty-second, thirtieth, and thirty-eighth floor would have been necessary to ensure stability. Since the Hearst Corporation was not planning on renting out any office space, there was no pressure to maximize the floor surface areas. Foster therefore, decided to eliminate the conventionally squared corners completely. This design also decreased wind pressure on the structure, as the chamfered corners angle the wind in different directions and decrease the loads.

The chamfered corners are usually discussed only in terms of their aesthetic appeal. According to project manager Lou Nowikas, Foster chose to angle the corners

425 Joseph Boschetti, *Details in Design* (Mulgrave, Vic.: Images Publishing Group, 2006), 64.
so as to not have any vertical elements in the overall design, thus rejecting the idea of corner posts.\textsuperscript{427} Although many believed the silhouette to be out of place with the rest of the New York skyline and completely discordant with Urban’s base, supporters of the structure claim that the diagrid was implemented to relate the corner triangles with Urban’s chamfered corners below (see Image 3.09).\textsuperscript{428} The triangular element also responds to the ornamental design below Urban’s theatrical balustrade and the geometric capitals atop the fluted columns (see Image 3.10). Foster uses triangular forms in many of his structures, including the atrium roof at the London Royal Society of Art. It has been noted that his appreciation for the triangular form was influenced by Buckminster Fuller’s use of the shape, in particular his geometric experiments relating to the triangle in the 1950s and 1960s.\textsuperscript{429}

The diagrid design required specialized fabrication and high labor costs. The framework took over a year to complete, and required custom window shades and a custom window-washing device.\textsuperscript{430} All of the window shades are built into the structure. The shades for the upper windows of the downward facing Vs had to be designed to rise from the bottom to the top. The window-washing unit bends and extends to reach all sections of the angled panes.\textsuperscript{431} Furthermore, the steel beams are connected with three different kinds of nodes.\textsuperscript{432} In total, the building consists of 3,000 windows, with each floor having twelve different window configurations.\textsuperscript{433}

\textsuperscript{427} Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
\textsuperscript{428} Merkel, “Hearst Tower and IAC Building,” 113.
\textsuperscript{429} Rustow, “Scenography and Structural Theatrics,” 155, 158.
\textsuperscript{431} Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
\textsuperscript{432} Fortner, “Landmark Reinvented,” 48.
\textsuperscript{433} Masciale, “Treasures of New York,” PBS.
Despite these immense costs and the fact that the diagrid was not part of the original design, the final structure is consistently discussed as a main element of the building’s overall ecological agenda. The cladding of the steel beams deflect the sun to lower cooling needs via a finish that has low reflectivity, called linen finish.\(^{434}\) The glass between the steel framing is low-emission glass that also decreases the amount of heat that enters.\(^{435}\) While steel is a water-intensive material to produce (see Introduction definition of embodied energy), the diagrid structure requires twenty-one per cent less steel than comparative projects of conventional framing. The total saving is 2,000 tons of steel relative to a rectilinear frame.\(^{436}\) Furthermore, eighty-five per cent of the steel that was used was recycled (as compared to the thirty per cent recycled steel used for the structure of Seven World Trade Center).\(^{437}\)

Water plays a prominent role in the environmental design and functioning of the building beyond the efficient steel structural elements. A water-based radiant heating system pumps hot water through the stone floor of the atrium and provides heat up to nearly two meters above. In the summer, cold water fills these embedded tubes and absorbs the sun’s heat projected on the floor.\(^{438}\) The central atrium also has a passive water-based heating and cooling system provided by the central waterfall

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\(^{437}\) Pogrebin, “7 World Trade Center.”

\(^{438}\) Ibid.
called *Icefall* that will be further discussed below. This cascade humidifies the entranceway in the winter and cools it in the summer using captured rainwater.\(^{439}\)

Many of the building’s water needs are met using rainwater, which is collected in a 14,000-gallon tank (see Image 3.11). The basin is expected to cover half of the building’s watering demands.\(^{440}\) It supplies the water for the tower’s irrigation needs, including the five trees around the exterior, the main *Icefall* waterfall at the building’s entrance (described below), and the water used to hose down the building’s sidewalks.\(^{441}\) It also provides water to replace what is lost in the air-conditioning system via evaporation.\(^{442}\) While the water is used for many purposes, in its six years of use the supply has never run out.\(^{443}\)

The system is designed to maximize the amount of collected rainwater and thus minimize the building’s water needs and its impact on the New York sewage system. The location for a rainwater system such as this is challenging as it takes up a lot of space and weighs a significant amount. Ideally, a rainwater tank can be located in the roof of a structure so as to utilize gravity and eliminate the need for any pumping. However, the basin is located in the basement due to its weight (14,000 gallons of water weighs 52,961.5 kilograms), the amount of space it occupies, and most importantly, because all of the building’s exterior surfaces contribute to the basin, not just the tower’s roof.\(^{444}\) The water collected, primarily from the roof, goes

\(^{439}\) Schindler, “Hearst Tower,” 2 http://www.us.schindler.com/hearsttower_casesudy.pdf; Pogrebin, “7 World Trade Center”; Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.


\(^{441}\) Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.

\(^{442}\) Pogrebin, “7 World Trade Center.”

\(^{443}\) Lou Nowikas (Senior Director of Hearst Real Estate); Vincent Iacovelli (Chief Engineer for Hearst Tower, Tishman Speyer) interview by Annie deBoer, March 2012.

\(^{444}\) Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
down through the building via pipes.\textsuperscript{445} It consists of two tanks: a hydro conduit and a 14,000-gallon basin. Each tank has eighteen-inch concrete walls and an inner liner.\textsuperscript{446} The hydro conduit is a passive system that filters out any sediment. The sediment stays at the bottom of the tank while the sediment-free water overflows into the larger basin.\textsuperscript{447} When the 14,000-gallon tank reaches capacity, the overflow goes into the New York sewage system. It was estimated that this rainwater-collecting design would reduce the amount of water that enters the New York sewage system by twenty-five per cent compared with a conventional building of equal size.\textsuperscript{448} This reduction has substantial implications. If applied to other projects, or if required by New York City law, the city sewer system and water purification needs would decrease immensely.

\textit{Icefall}

The focus of water is also demonstrated aesthetically. Upon entering, one faces a twelve-by-twenty-one meter mural entitled \textit{Riverlines}, designed by Richard Long (see Image 3.12). This piece was made with mud collected from the Hudson River.\textsuperscript{449} Directly in front of this enormous canvas is the rainwater-supplied waterfall alongside the lobby escalators called \textit{Icefall} (see Image 3.13). The \textit{Icefall} was initially designed to consist of falls that would correspond to the columns created in \textit{Riverlines}

\textsuperscript{445} Vincent Iacovelli (Chief Engineer for Hearst Tower), March 2012.
\textsuperscript{446} Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
\textsuperscript{447} Lou Nowikas (Senior Director of Hearst Real Estate); Vincent Iacovelli (Chief Engineer for Hearst Tower), March 2012.
\textsuperscript{448} Holusha, “A Tower Designed to Be Environmentally Friendly”
\textsuperscript{449} Schindler, “Hearst Tower,” 1.
and the escalators were originally designed as a grand staircase. However, the
Icefall underwent significant changes throughout the design process.

The final Icefall was the result of an entire year of planning. As previously
noted, it is a design that is both sculptural and functional. The purpose of this
fountain was to create a grand entrance to the large third-story lobby and to provide
greater natural light, which is in part enhanced by a stainless steel wall that rests
behind the structure as both a supportive and reflective element. The Hearst Tower
is not open to the public, and only employees and visitors are allowed to ride up the
escalators surrounded by the smooth flowing water.

The Icefall has been described as the most challenging and time-consuming
element of the entire project. James Carpenter of James Carpenter Design Associates
and Jim Garland of the subcontractors Fluidity Design Consultants of Los Angeles,
were the lead designers for this two-and-a-half story high fountain. Carpenter has
contributed to many large-scale projects throughout New York including Seven
World Trade Center site (2002-2006) and the Time Warner Center (2000-2004) to
create reflective glass along the buildings’ facades. The majority of his work
however, relates primarily to the aesthetics of glass and the reflection and
transmission of light, and he is not a specialist in water design. Carpenter worked
with Foster, Fluidity, and numerous other consultants and contractors to design

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450 Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
453 Emporis, “Time Warner Center” in Emporis Buildings (Emporis GMBH),
http://www.emporis.com/building/timewarnercenternorthtower-newyorkcity-ny-usa; Sam Lubell,
Icefall.

The sculpture’s steel and glass components weigh a total of nearly sixty tons. It has 595 horizontal glass planks (each one weighing between 120 and 130 pounds) as well as 173 glass blocks (each ten pounds), which are held in place by 316 stainless steel clips designed by Allied Bronze, the architectural metals subcontractor. Each glass piece is designed with specific grooves and edged areas to precisely control the direction and speed of the water flows and to prevent any splashing (Image 8).\footnote{Steel Institute of New York, “Hearst Icefall,” 27, 31; Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.} Nearly two tons of water flows down alongside the escalators of this 305-square-meter expanse supported by beams that are integrated into the tower’s steel structure.\footnote{Steel Institute of New York, “Hearst Icefall,” 27, 31.}

The challenges of the waterfall result entirely from its own design. The fountain is extremely fragile. To clean it, trained maintenance workers are repelled from the ceiling above, stepping only along the fountain’s steel support beams as they hand-scrub the entire structure. Even still, many of the glass pieces are cracked (see Image 3.14). The design was further complicated due to the fact that it is not one continuous structure, but instead is separated by the diagonal escalator unit. While this diagonal creates a continual aesthetic dialogue between the entranceway and the diagrid structure, it also posed a challenge to the designers to keep the water at the same flow speed throughout. To achieve an even course and compensate for the changing surface areas between top and bottom, designers placed gutters on either side of the escalator. On the south side, shaped as a V, a gutter collects extra water as it flows from a broader surface area to a more narrow section. On the north side of the
fountain, shaped as an upside down V, another gutter spews out more water to keep the lower stairs equally covered. All of the water ends up in pools at the bottom of the structure that are roughly 1.5 meters deep. While the lighting and aesthetic purposes of the *Icefall* are successfully expressed, it is again a possibility that the design as a whole cost more energy and money than would a conventional heating and cooling system for an area that size.

**Conclusion**

The Hearst Tower incorporates significant water-saving practices throughout the entire structure. The rainwater catchment system provides the building with a substantial percent of its watering needs. The radiant and passive heating and cooling systems and the steel-saving diagrid core, while somewhat controversial in their relative effectiveness, in the end provide the Hearst Corporation an office building with a highly noticeable ecological agenda (see Image 3.15). In total, an estimated twenty-five million gallons of water are saved annually due to the building’s design and water conservation practices. While the collaborative process with the board of the Hearst Corporation influenced the design, the final tower was largely determined by uncontrollable limitations and outside incentives.

The Hearst Tower was the beginning of many real estate deals made by the Hearst Corporation in the area. In 2007, the company bought 10,125 square meters of office space at the abutting Sheffield apartment building. This purchase was made in addition to the $29 million worth of real estate the Hearst Corporation had already

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457 Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
458 Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
bought around their new headquarters that same year. When asked why they were making so many purchases, Hearst spokeswoman Amy Davidson said it was “for future growth” and that at Foster’s new tower “there is no significant unused office space.”

In March of 2012, the Hearst Tower was awarded the LEED Platinum rating. This same month, the 12,000th commercial building was certified under the LEED program in the U.S. (the total amount of LEED certified buildings as of March, 2012 was 137,000). As a result of the Hearst Tower’s new status, there has been a recent wave of publicity surrounding the company and the tower. Such publicity resulted in the decision to release a significant amount of performance data. However, the information must be received somewhat critically, as the Hearst Corporation itself released it. Since opening in 2006, the building has used less and less energy each year. According to recent press releases, the Hearst Tower has become one of the top ten per cent most efficient commercial buildings in the United States. The Hearst Corporation notes that Hearst has reduced its total energy consumption by forty per cent, although the company does not explain relative to what standard. The Hearst Tower became the first commercial structure in New York to compost 100% of its wet food waste. They have decreased the amount of waste sent to landfills by over eighty per cent. Yet while the rainwater tank was expected to cover half of the


461 Lou Nowikas (Senior Director of Hearst Real Estate), March 2012.
building’s water needs, in practice it has reduced water use by thirty per cent annually.\textsuperscript{462} The Hearst Tower has been both internationally praised and severely critiqued. Architect critic Paul Goldberger called it a “gorgeous, gemlike tower” in 2005.\textsuperscript{463} In 2007, the efforts for a more collaborative atmosphere were expressed by Cosmopolitan publisher Donna Kalajian Lagani in an article in the Architectural Record in which she noted: “There is much more camaraderie companywide. I used to say I work at Cosmopolitan. Now I say I work at Hearst first.”\textsuperscript{464} Yet the tower has also been referred to as a “‘jack-in-the-box’ without the Jack,” “placeless and awkward,” and a “prototype invented for no particular site or program.”\textsuperscript{465} In an interview in 2012, Bruce Fowle claimed it an “eye sore,” and asked “why the landmark’s commission ever approved that.”\textsuperscript{466} While the silhouette is certainly different from any other, an analysis of the design’s evolution demonstrates that the distinct diagrid was formulated as a direct result of the site’s limitations and the building’s overall ecological agenda. Foster’s Hearst Tower is a product of commercial and physical limitations, and extensive collaboration. Understanding the building in this holistic context reveals that the structure is anything but a “prototype invented for no particular site,” and demonstrates the significant flaws in today’s

\textsuperscript{464} Kieran, “Hearst Tower: Foster & Partners and Gensler”
\textsuperscript{466} Bruce Fowle (Co-Founder of FXFowle, New York), March 2012.
conventional literature. Such a contextual assessment allows for a deeper appreciation of the structure and a more accurate evaluation of its success and its shortcomings.
Conclusion: Moving Forward

A New Historiography of Sustainability

Norman Foster has been praised worldwide for his leadership in sustainable architecture. A close analysis of his structures, however, demonstrates the great discrepancy between his image as the “Mozart of modernism” and the reality of immense collaboration. Mozart both composed and performed his own pieces. Foster, and the other architects of his practice, work with numerous firms, clients, and technical, political and social demands, that significantly alter any original compositions. Such inconsistency between the realities and public conception of his working methods is a direct result of the incomplete literature and lack of critical analysis of the field of sustainable design. The Reichstag, the Commerzbank, and the Hearst Tower are three examples of sustainable buildings that were greatly defined by collaboration and context. Furthermore, the significance of these structures has changed since the time of their completion, demonstrating the need for literature dedicated to performance evaluation several years post-construction. It is necessary to completely redefine the conventions of the historiography of sustainable architecture in order to evaluate properly the success and failures of structures and develop the field most effectively.

The Reichstag was designed to respond to social and political pressures that were the result of the building’s controversial history and the country’s reunification. The involvement of the parliament throughout the design process greatly influenced the ultimate solution. A contextual understanding of the history of the structure from Paul Wallot’s original construction to the end of World War II and into post-war
Berlin is necessary for an accurate appreciation of Foster’s final design. The Aquifer Thermal Energy Storage system was an energy efficient solution for heating and cooling the building that was determined by the fluctuating occupancy of the building and the geological characteristics of the site. While there are a great many publications dedicated to the Reichstag renovation, few of these highlight the collaborative and contextual complexities that arose during the seven-year project.

Frankfurt’s title as the Finance Capital of Europe coupled with the political and social response to high-rise development and the economic success of the Commerzbank significantly influenced the new headquarters completed in 1997. The Commerzbank case study clearly presents the challenges of all three historiographic issues: team, context and performance. Commerzbank employees were very influential in the design process and had substantial control over the firms and people who were brought to the team. In the end, Foster had little input as to who he was to work with, creating an interesting dynamic in the subsequent design efforts.

The city of Frankfurt was largely destroyed in World War II and in the late twentieth century it became a center for modern development and banking, resulting in a housing crisis and public outrage. Political parties became involved and had significant impact on determining the requirements for large-scale projects such as the Commerzbank. In addition to the political pressure, authorities at the Commerzbank wanted to promote their company as environmentally conscientious and forward-looking. This would promote a more positive relationship with the people of Frankfurt and create a “green” commercial profile. The bank had a large amount of resources with which to invest, and in the end constructed a tower that has
had continual success. The Commerzbank building was able to accommodate a
growing work force and incorporate new technological advancements, without
significantly increasing overall energy consumption.

Finally, the Hearst Tower in New York City demonstrates the importance of
location and exemplifies the distinct challenges and contextual factors that emerge
when building in a different country. The final Hearst Tower was a highly
collaborative effort, with the engineering complexities greatly determining the final
design. The central Icefall was the biggest challenge of the building and one of the
better well-known elements of the new tower. Close analysis, however, shows that
Foster ultimately had little to do with its design. The most famous aspect of the
structure was the diagrid form. Conventional texts highlight the diagrid for its unique
silhouette, efficient use of steel, and aesthetic connection with the landmarked base,
yet rarely is there any mention of the site limitations and engineering reasoning
behind such a design. Finally, elements of the Hearst Tower’s performance were
made public by its recent 2012 upgrade to LEED Platinum status, an example of an
incentive to publicize performance data. Such recognition of the structure has created
substantial commercial visibility, including a recent special on PBS dedicated to
buildings around New York called the “Treasures of New York.”

Recent literature has also begun to recognize the need for a more critical
analysis of sustainable design but continues to be severely limited by lack of
performance data and the ongoing misconception of the importance of collaboration.
In 2007, Ike van der Putte of the International Federation of Consulting Engineers
presented a paper at the “Conference on Sustainable Building South East Asia” in
Malaysia titled, “Project Sustainability Management – Beyond the Greening of Building.” In this paper he notes:

What is needed is a framework that encourages multi-discipline participation in design and integrates single building projects with infrastructure and communities… Without some way of recognizing the benefits of cross-business-unit co-operation, each unit tends to seek improvement of its own financial performance even at the expense of others. Given the urgency and serious consequences of our current non-sustainable operations, it is clear that actions should be taken to remove these barriers and enhance the engineers’ ability to innovate.\textsuperscript{467}

This call to action demonstrates the significant divide between engineers and architects within the design and construction sector. Such a division could be greatly decreased if the field of sustainable architecture put more emphasis on the importance of collaboration and focused less on the architect as ultimate composer. In 2010, Joana Carla Soares Gonçalves published \textit{The Environmental Performance of Tall Buildings} in which architect John Worthington notes: “Tall buildings, if they are to contribute to the sustainable city, will require an approach that is holistic and integrative. It begins with the context of the city and its values, and then the building within its surrounding neighborhood.”\textsuperscript{468}

Through collaboration, the design process can most effectively integrate contextual elements and further develop the potential of sustainable architecture.


\textsuperscript{468} John Worthington in \textit{The Environmental Performance of Tall Buildings} (London: Earthscan, 2010) xxii.
The Ideal Sustainable Structure

Through such comprehensive analyses, the achievements and flaws of sustainable structures become much easier to understand and to evaluate. The above case studies allow us to compile a formula for the ideal sustainable design that is unlike previous recommendations often ignorant of context and dependent on technological solutions. The Reichstag project exemplifies how a structure can positively interact with its surroundings by providing renewable energy to neighboring buildings. While this design was made possible by modern technologies, it was the result of a political aim to symbolize a modern democratic government. Both context and technology thus played a significant role in the execution of a design that represented the ideal symbiosis between structure and city.

The new Commerzbank headquarters demonstrates the need for a building to be both adaptable and continuously monitored. Furthermore, the Commerzbank demonstrates that passive systems are often superior to technology-dependent design of active systems as they require much less maintenance and do not need to be constantly updated. Some of the technological systems that the structure does utilize have been altered and renewed since the building’s completion over fifteen years ago. This allowed the Commerzbank to alter the office layout and accommodate the structure’s growing occupancy. These factors demonstrate the structure’s adaptability. Perhaps even more importantly, such performance data and efficiency updates demonstrate a long-term commitment by the client that goes beyond initial publicity and promotion of a commercial profile. The ideals to be learned from the
Commerzbank therefore include passive-based systems, adaptability and finally, a client that ensures long-term examination and enhancement.

The Hearst Tower design exhibits the benefits of approaching structural challenges with sustainable solutions and certifies the value of public standardization programs, such as LEED, that promote and publicize sustainable efforts. While the diagrid core was not part of the original design, it was a way to structurally and aesthetically demonstrate an environmental investment by the Hearst Corporation. The benefits of the 14,000-gallon rainwater catchment tank are significant, decreasing the amount of water entering New York City’s sewage system by twenty-five percent compared to conventional buildings. While the LEED rating system itself has several flaws, related in large part to the lack of emphasis on performance standards, the Hearst Tower demonstrates an important aspect of LEED that encourages building occupants/owners to work towards upgrading their status. The new “Platinum” title has created an entire new buzz of press releases and commercial publicity that can provide such companies with significant incentive to maintain their efficiency.

New regulations, economic benefits and systems of assessment are emerging worldwide to encourage such sustainable design. Life-cycle assessments (LCAs) analyze the environmental impact of a project from the raw material extractions in its initial stages, to the building’s deconstruction and final disposal of material.\textsuperscript{469} The concept of LCAs has existed for several decades, but has only recently become realistically applicable. In a book on conservation and energy use in buildings from

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1984, Littler and Thomas note the use of lifecycle assessments simply in terms of premium investments:

An approach to cost-calculations, which is gaining in favour, is lifestyle costing in which assumptions about the future, such as those for fuel costs, are made explicit. When energy-conservation measures are assessed on this basis they are often much more attractive than on the simple payback method…Nevertheless, there is no clear consensus as to what is to be done and in what order.470

Architects have begun to reach a clearer consensus on how to factor in such predictions. Cost-saving calculations often play a determining role in a final design.

In Germany and the United States there are classifications for buildings that produce either as much energy as they consume or a surplus of energy, such as the system at the Reichstag. In Germany these structures can be referred to as a “Plus Energie Haus” and in the United States it is the “Zero Energy House”, or “Zero Energy Building.”471 There are also “Net-Zero Energy Buildings” which explain the relationship between the building and the grid, implying that the building is selling as much energy as it is taking from the grid.472 These classifications can also be used to describe buildings that contribute more to the grid than they use individually, when the grid acts as an energy sink. One main criticism of these terms is the energy-demanding materials needed for such energy-saving performance. Professor Xavier García Casals noted in 2006:

In order to reach these low (or even negative) operational energy demand levels, these buildings often must incorporate a big amount of materials like aluminium, stainless steel or glass, and additional HVAC equipment, significantly increasing their EE [embodied energy] in such a way that the life cycle energy impact of these buildings is not as favorable as their certification pretends. In fact...these buildings could have a worse energy impact than other buildings that are not distinguished with this kind of certification.\(^{473}\)

However, Foster has stated that while “the refinement of aluminium requires such an enormous energy input that it has been dubbed an ‘unsustainable’ material...high-quality aluminium can last for decades without maintenance. Lower grade materials, which may appear to be more sustainable, might need to be repaired or replaced in the same period, leading to a greater consumption of energy.”\(^{474}\) The solution to this debate has been sought out through a classification of “Life Cycle Zero Energy Buildings” which aims to incorporate life cycle analysis into the building’s energy assessment.\(^{475}\) This last method seems most effective in that it can incorporate the materiality of the building in addition to the energy costs of the functioning structure. Perhaps the main challenge related to defining the zero-energy movement is that these terms are constantly being critiqued and subsequently altered, as the goal is to create the most holistic and meaningful definition possible.

Regulations and policies regarding energy consumption and performance monitoring are also beginning to emerge worldwide. On January 4, 2006, the Directive on the Energy Performance of Buildings was implemented in Europe four years after its original publication.\(^{476}\) This document requires all members of the European Union to establish a framework for performance calculations, achieve

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\(^{473}\) Casals, “Analysis of Building Energy Regulation” 384.

\(^{474}\) Foster, “Architecture and Sustainability” 6.

\(^{475}\) Torcellini, “Zero Energy Buildings” 5; Hernandez, “From net energy to zero energy buildings” 817.


While such policies are a step in the right direction, there is still much work to be done. The challenges of sustainable design can be met with creative solutions that incorporate contextual demands and performance standards. Building owners should be required to publish their energy consumption to provide data for future developments.

\textit{Moving Forward}

Sustainable design pushes the boundaries of the conventional understanding of architecture. In the past, architects concealed their buildings’ inner mechanics using plastered walls, hanging tapestries, ornamentation, and creative structural form. Critics and architects discussed buildings in terms of their aesthetic accomplishments and shortcomings, such as the neo-Renaissance columns of Wallot’s 1894 Reichstag and the theatrical elements of Joseph Urban’s International Magazine Building. In the last three decades, however, architecture has reached new meaning with the development of sustainable design. Sustainable architecture goes beyond the realm of...
aesthetics and instead responds to and promotes the aspirations of companies, communities and governments through visible technologies and efficient designs.

The literature of sustainable building must therefore adapt to the evolving and expanding responsibilities of the field. Louis Sullivan’s commonly quoted phrase, “form follows function” is no longer sufficient when discussing architecture, as it prevents any consideration of context that extends beyond a structure’s walls. The discourse of sustainable design must incorporate the contextual and collaborative factors that consistently define today’s architecture. The literature must also emphasize the importance of a building’s long-term performance to ensure that every individual project contributes to the field’s continual development. These new conventions reveal the potential for sustainable architecture to play an integral role in addressing the social and political issues of our future.
Chapter One: Reichstag

1.01
Paul Wallot’s 1894 Reichstag. The steel and glass cupola appears at the top right.

1.02
Original drawings by David Grove from the 1890s on the plans for the Reichstags’s services. The chamber was naturally ventilated.
1.03
Sculptures decorating Wallot’s facades. Each corner of the building, shown at the top right, represented one of the four major kingdoms of Germany.

1.04
Eagle on the south-facing pediment of Wallot’s structure.
1.05
Paul Wallot’s Reichstag in flames on February 27, 1933.

1.06
Soviets raising the symbolic flag of victory in World War II on the roof of the Reichstag.
1.07
Soviets writing graffiti on the remains of the Reichstag after the war’s end.

1.08
Foster’s initial proposal with a large canopy roof. This proposal was not built as it was unpopular amongst parliament members.
1.09
Drawing for Foster’s proposed elevated public piazza. This plan was not built but manifested in a similar public space in the final glass dome.

1.10.
Location of the Buildings around the Parliament area.
1.11
Graffiti incorporated into the new Reichstag.

1.12
The first proposal for a “lighthouse” dome. This particular dome was not built, but was similar to the final design.
1.13
Foster’s glass dome with public walkways along the interior and exterior.

1.14
The plan on the left is Foster’s mezzanine level. The plan on the top right is the mezzanine layout by Wallot, and the bottom is that of Baumgarten.
Norman Foster’s Plenary Chamber
After construction 1999.

Paul Wallot’s Plenary Chamber,
Parliament meeting in 1922.

Conical center that reflects light and supports a natural ventilating system.
1.18
Aquifer Thermal Energy Storage system at the Reichstag.

1.19
Drawing of the two aquifers part of the Reichstag’s geothermal system.
Chapter Two: Commerzbank

2.01
The new and the old Commerzbank office buildings. Foster’s tower dwarfs the darker twenty-nine story headquarters designed by Richard Heil in 1973. Both stand behind historic structures dating back to the 1870s.

2.02
The Commerzbank headquarters in its surrounding historical yet modernizing setting.
2.03
A model of the steel frame, demonstrating the structure’s triangular form.

2.04
Digital rendering of the proposed gardens.
Floor plans for floors 11, 12—14, 15 and 16-18. These plans show the escape staircase (1), service lift (2), lift lobby (3), lavatories (4), service rooms (5) combi-offices (6), team offices (7) and gardens (8). Note the transporting services are located at the structure’s corners.
Darker glass frames are the areas of the four-story high gardens.

The central glass atrium looking up from below. This glass protects the structure from indoor winds and the possible spread of fire.
East-facing gardens at level seven. The gardens that face east are planted with bamboo, Japanese maple, azaleas, rhododendrons, snowball-trees, and magnolias.

Trees and shrubs being transported to the site.
2.10
Plans of the west-facing garden at floor twenty-seven. West-facing gardens have North American plants.

2.11
The window cladding with double-panes. These windows are operable and provide a significant amount of natural ventilation to offices throughout the year.
2.12
A detailed explanation of the different sections of the office cladding, as drawn Colin Davies and Ian Lambot’s monograph on the structure.

2.13
The large spans of permitted by the Vierendeel trusses.
2.14
A model of the structure’s steel frame. Steel is rarely used in Germany but was chosen for the Commerzbank to be able to prefabricate offsite and accelerate the construction process.
Chapter Three: Hearst Tower

3.01
The Hearst Tower on 57th and Eighth Avenue, completed in 2006.

3.02
The original International Magazine Building by architect and stage designer Joseph Urban, completed in 1928.
3.03
A sectional drawing of the new tower’s lobby and open atrium.

3.04
An open office at one of the building’s corners.
3.05
The Hearst Tower stands directly next to the Sheffield, a condominium building completed in 1978.

3.06
Floor plans demonstrating the open corners offices and the services located towards the west.
3.07
The vertically angled columns of the diagrid structure.

3.08.
The construction of the tower and the steel node that holds the angled columns together.
3.09
Urban’s chamfered corners next to those of Foster’s diagrid.

3.10
Foster’s diagrid forms juxtaposed to the geometry of Urban’s balustrades.
3.11
The rainwater collecting system, complete with a hydro conduit and stormwater collector.

3.12
Richard Long’s *Riverlines* made with mud from the Hudson River.
3.13
The *Icefall* water cascade at the Hearst Tower’s front entrance on Eighth Avenue.

3.14
The custom-designed glass of the *Icefall* is already cracking in many areas.

3.15
The Hearst Tower stands out across New York’s skyline. Photograph taken from Sheep’s Meadow in Central Park from the northeast of the structure.
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Images


