AMERICA'S TWIN TOWERS

History, Legacy, and the Case for Renewal

1st Edition

WORLD TECH CENTER

BRINGING STEM TOGETHER

OFFICIAL CONTEXTUAL REPORT

FIRST EDITION

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Executive Summary

The World Technology Center is a proposed vertical campus for science and technology and public inspiration, in Chicago. It would serve as the United States' national instrument for STEM discovery, education, and technological prosperity. Its architectural significance are Twin Towers that carry forward the iconic silhouette of the legacy, which were considered to be one of America's most emblematic skyscrapers in the second-half of the 20th Century. This summary sets out, for the reader with limited time, what the project is, why it is proposed for the city, what it is expected to achieve, and how it is intended to progress from concept to reality. The full report that follows develops each of these subjects in depth.

The Vision

At the heart of the campus stand two skyscrapers. Clad in blue glass, they reach 110 stories each, rising 1,510 feet (460 meters) to their roofs, and with a spire reaching 1,969 feet (600.15 meters) in deliberate tribute to the Apollo 11 lunar landing of 1969. The towers reimagine Minoru Yamasaki's original World Trade Center silhouette for a new century and a new purpose: the North Tower is dedicated to technology and the South Tower to science, expressing the partnership of understanding, teamwork and application on which all human progress depends. Around them, across a site of approximately 35 acres, are six major buildings and auxiliary structures and amenities — laboratories, engineering workshops, a public library of STEM, lecture halls and exhibition spaces, an observation deck, a hotel, and generous public plazas and gardens. It is planned to house some 600 to 800 tenant organizations. Though faithful in form to their predecessors, the towers are entirely new buildings: an ultra-high-performance concrete core, high-strength steel framing, and fire protection and egress provision designed to meet and exceed the most demanding modern codes.

Purpose and Mission

The World Technology Center is not a conventional real-estate development project, nor a rebuilding of the World Trade Center in Manhattan. It is a mixed-use civic and scientific undertaking conceived for the mutual benefit of the public and private sectors alike — a place where universities, established companies, start-ups, national laboratories, and government authorities could work side by side; where dedicated workshop space brings regulators and researchers into daily contact; and where success is measured in scientific capability, education, employment, and inspiration rather than rentable square footage. Its mission answers four national needs documented in this report: the decline in long-horizon civic ambition, the fragmentation of the American STEM ecosystem, the over-concentration of innovation in a handful of coastal regions, and the estrangement of the public from the science that shapes its future.

A Legacy Carried Forward

No aspect of the project has been weighed more carefully than the ethics of restoring a form so bound up with national sorrow. The proposal honors both convictions that emerged after September 11, 2001: the longing of many — including many bereaved families — to see the towers rise again, and the equally sincere conviction that the ground where they stood must remain a place of rest. By raising the silhouette anew in a different city rather than in Manhattan, the project keeps faith with both: the hallowed footprints at Ground Zero remain undisturbed as the memorial they have rightly become, while the towers' spirit is given a new and constructive life as a spiritual successor devoted to discovery. The initiative from its roots have gathered roughly ten thousand signatures of support, including from some family members of September 11 victims, and it carries forward Yamasaki's founding conviction that such a structure should stand as a living symbol of peace, cooperation, and human dignity.

Why Chicago

The modern skyscraper was invented in Chicago and thus it is the natural home for its most ambitious revival. The city offers a central North American location and one of the continent's great transportation hubs; a deep engineering and steel manufacturing heritage; world-class universities and the national laboratories of Argonne and Fermilab; a rapidly emerging quantum-technology corridor; the Midwest's leading workforce-development infrastructure; a major convention economy; and available land with strong regeneration momentum in the districts surrounding the city center. The proposed site — approximately 35 acres bounded by West Polk, West Harrison, and West Taylor Streets on the Near West Side — places the campus at the center of this convergence. The city resolves the question that stalled every effort to rebuild in New York: on new ground, remembrance and renewal no longer compete for the same sacred earth.

Economic and Educational Impact

At full development the campus is projected to support tens of thousands of permanent, high-value jobs — on the order of 75,000 by the project's working estimate — in addition to construction employment across the build period and the substantial multiplier by which each innovation-sector job generates further local employment. It would expand the region's tax base, strengthen its tourism and convention economies through its observation deck, exhibitions, and conference facilities, and accelerate the regeneration already under way in the surrounding districts. Its most distinctive contribution, however, is educational: an integrated apprenticeship model in which students and early-career professionals undertake paid, hands-on roles within the live research and development projects of resident organizations while pursuing high-quality academic study on the same site — one of the most ambitious vocational-academic pipelines in the country, built on Illinois's nationally recognized workforce-development infrastructure and designed to open scientific careers to communities the existing innovation geography leaves behind.

Implementation Strategy

The project deliberately inverts the conventional development sequence. Rather than securing capital first and designing behind closed doors, it follows the discipline of aerospace engineering and the findings of modern megaproject research — “think slow, act fast” — by completing thorough conceptual design and transparent public outreach before financial commitment is sought. Implementation proceeds through seven phases: public awareness and conceptual development, which is the current stage; stakeholder networking; formation of a professional architectural and engineering consortium; independent feasibility studies and environmental review; tenant and institutional partnerships, secured before capital so that demonstrated demand attracts investment; diversified funding through public-private partnership, federal and state incentives, tax-increment financing, and institutional and philanthropic capital, with construction phased so that early components are completed and generating value while later ones proceed; and a long-term construction roadmap that embraces the patience a generational undertaking requires.

Partnership Opportunities

The initiative is currently in its second phase, and it invites engagement. These include (but not limited to) universities and research institutions; industrial technology, aerospace, artificial-intelligence, and energy companies; national laboratories; government agencies; schools and community colleges; philanthropic foundations; and civic organizations all have natural roles within the campus' ecosystem. Expressions of interest, preliminary letters of intent, advisory participation, and academic collaboration at this stage cost little and shape much — and each early commitment strengthens the foundation on which the project's later phases will stand.

National Significance

The World Technology Center belongs to the tradition of prodigious generational undertakings. From the great cathedrals and railway tunnels to the Apollo program and the International Space Station project (and amongst many other examples), they were conceived by people who understood that their fullest benefits would accrue to those who came after them. It is conceived as a demonstration that the United States can still plan across decades, build boldly, and renew its most treasured symbols rather than surrender them; as a venue for open international scientific cooperation in an era that needs it; and as an invitation to a new generation to take up the work of discovery. Its premise is simple and its ambition is large: that destruction need not have the last word, and that the future is something to be built toward with confidence.

Contents

Acknowledgements

The team convey our mutual appreciation to the supporters and volunteers whose advice, guidance, and encouragement – whether substantial or in passing – have strengthened this initiative from its early stage to the present. Their collective expertise across engineering, architecture, law, and academia has enriched this work immensely.

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At the time of publication, Mr. Gardner was unable to complete a formal contribution statement due to existing professional commitments. The author remains grateful for his assistance and looks forward to the opportunity to include any future contributions in subsequent editions of this report.

Foreword

I believe stories are the medium through which humanity is transmitted across time. The story of the Twin Towers' journey of healing can finally be completed with the World Technology Center—a beautiful gift for humanity.

— Haru Morioka, supporting designer

An engineering and artistic mindset coupled with teamwork equals a pair of magnificent towers that stand tall and proud. Resting on American soil, they stood as a global symbol of peace and economic leadership and collaboration. Their rebirth – to take on the reins of scientific and technological development and education – would bring about a measure of national healing and closure from the past, and a sense of hope and tangible optimism for the future.

America yearns for bold dreams – to be free, to be strong, and never to yield to intimidation. A strong nation has leadership, courage, wisdom, and the independence to think clearly and reason with evidence; it takes calculated risks for high reward and turns uncertainty into opportunity. Such a nation must tackle the fundamental problems of its society – and it must do so through teamwork in spiritual, functional, and tangible form.

— Raphael J. Chryslar, founder and project lead

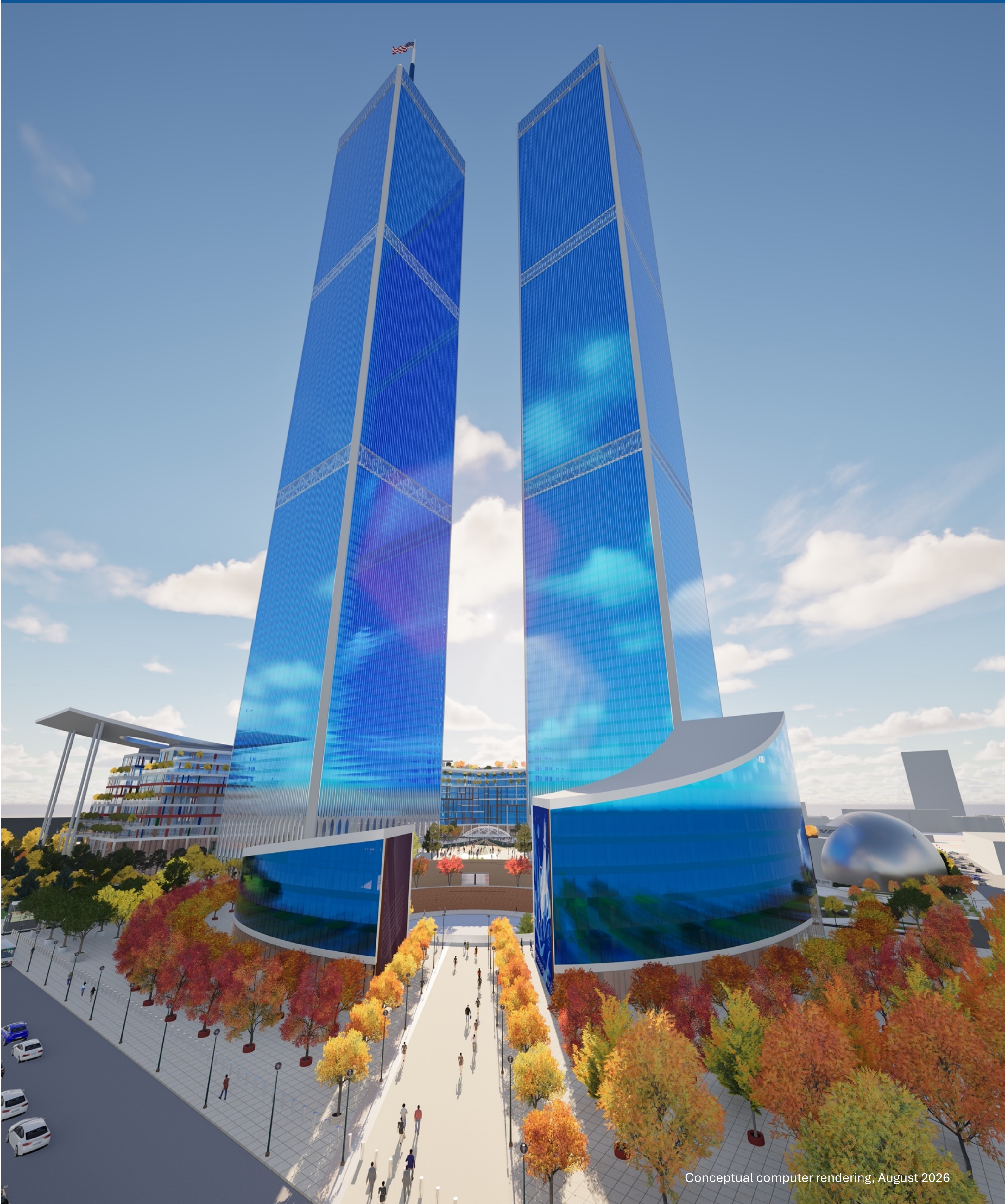
Glossary

- MPa = Megapascal
- UHPC = Ultra-High-Performance Concrete
- ASTM = American Society for Testing and Materials
- WTC = World Trade Center/World Technology Center (context specified in-text)
- ASME = American Society of Mechanical Engineers
- BIPV = Building-Integrated Photovoltaic
- FHA = Federal Highway Administration
- NFPA = National Fire Protection Association
- EAF = Electric Arc Furnace
- PATH = Port Authority Trans-Hudson
- LDMC = Lower Manhattan Development Corporation
- PANYNJ = Port Authority of New York and New Jersey
- ISO = International Organization for Standardization
- HEPA = High-Efficiency Particulate Air filter
- CTA = Chicago Transit Authority
- TMD = Tuned Mass Damper
- STEM = Science, Technology, Engineering, and Mathematics
- MIT = Massachusetts Institute of Technology
- UIC = University of Illinois
- ITAR = International Traffic in Arms Regulations
- EAR = Export Administration Regulations
- NIST = National Institute of Standards and Technology
- ISS = International Space Station
- ASCE = American Society of Civil Engineers
- CERN = [in French: *Organisation Européenne pour la Recherche Nucléaire*] European Organization for Nuclear Research
- IBC = International Building Code
- CATIA = *Computer-Aided Three-Dimensional Interactive Application,* a CAD software package by Dassault Systèmes
- CAD = Computer-aided design
- MW = Megawatt

Part I

Context and Vision

Chapter One — The Vision of the World Technology Center



Conceptual computer rendering, August 2026

Introduction

The **World Technology Center** (WTC), also known as the **World Tech Center**, is a proposed large-scale science, technology, engineering, and mathematics (STEM) campus for the City of Chicago, conceived as a single, integrated urban ecosystem in which research, education, industry, government, and the general public coexist on one site. At its heart stand the Twin Towers — two 110-story skyscrapers that reinterpret the silhouette of the original World Trade Center within an entirely new structural, functional and civic framework. Around them, a constellation of laboratory buildings, workshops, gardens, plazas, a library, a hotel, a performing arts venue and a subterranean mall complete a campus whose stated purpose is to concentrate, accelerate and publicly celebrate the scientific and technological capability of the United States.

The word *Technology* is defined as the application of scientific knowledge to the practical aims of human life — in other words, the strategic use of science to solve problems and to change and improve the human environment.[1] Under this definition, technology **is not** what is often perceived in popular culture that references smart gadgets (i.e. smartphones and electronic devices), the internet and artificial intelligence (and the data centers that fulfill them) - or at least a single industry or type of product – but the *fundamental fabric of civilization itself.* It is an umbrella term that encompasses everything: covering (but not limited to) basic agriculture, medicine, energy, transportation, mining, computing, management, and communication - all of which are advanced when scientific understanding is converted into working practicality.

History demonstrates that this conversion happens fastest where knowledge, talent and means of production are physically concentrated — in the workshops of the industrial revolution, in the laboratory districts of the early 20th century, and in the research parks and innovation clusters of the present day. The vision of the World Technology Center aims to apply this lesson at civic scale with an architecturally significant centerpiece. Rather than scattering laboratories, classrooms, regulators and investors across a metropolitan region and beyond, the project gathers them within a single walkable campus, so that a student, an apprentice, an engineer, a federal certifier and a curious member of the public may all occupy the same buildings, share the same plazas and learn from one another daily.

The program is deliberately broad and interdisciplinary. The Twin Towers would house laboratories, design workshops, software development and simulation facilities, cleanrooms, lecture theatres, art studios and offices for potentially hundreds of tenant organizations, ranging from start-ups to multinational firms and professional and academic societies. In addition to the STEM productivity zones, cost effective residences are included on the upper thirds of both towers. The surrounding low-rise ancillary buildings extend this program into specialized physical sciences: a physics and engineering building dedicated to practical learning and apprenticeships; a chemistry and biological sciences building equipped with medical-grade laboratories and quantum computing facilities; and a federal workshop building in which government agencies would supervise, test and certify new technology alongside the very people who create it.

Public engagement is treated not as an afterthought but as core elements: a five-story public library serving as a nexus of reference STEM materials, an observation deck with rooftop garden at 1,500 feet high, a retrofuturistic-themed shopping mall, a music venue and extensive landscaped gardens are all designed to draw visitors who may know little of science into daily, casual contact with it.

The initiative – comprised of a team led by Raphael J. Chryslar - is presently in its conceptual development and feasibility exploration phase. No planning approvals or funding commitments have been finalized, and the figures presented in this report are design targets subject to refinement through the engineering, regulatory and consultative processes described in Chapter Six.

Nevertheless, the central design intent is fixed: a campus that honors the architectural legacy of Minoru Yamasaki's original Twin Towers; that embodies, in built form, the partnership between science and technology; a symbol of teamwork; and that gives the United States a permanent, public, generational home for discovery. This chapter sets out that vision in detail — the masterplan and its buildings, the public amenities, the engineering systems that make the towers among the most robust civilian structures ever proposed, the sustainability strategy, the architectural philosophy, and the reasons why the City of Chicago is the natural home for it all.

1.1 Masterplan

The campus occupies a rectangular site of approximately 412 by 350 meters (1,350 by 1,148 ft), or 35 acres, situated in Chicago's Near West Side (between West Polk Street, West Harrison Street and West Taylor Street). The masterplan and maps, illustrated in Figures 1.1 and 1.2 (with overall renders in Appendix B), arranges eight major buildings and several auxiliary structures around two principal public spaces: the Richard P. Feynman Plaza at the heart of the site and the Minoru Yamasaki Circle to its northeast. The Twin Towers anchor the northern half of the campus, while the lower academic and government buildings, the Discovery Hotel and the Radio Music Venue define its perimeter. Beneath the entire complex, five basement levels descending approximately 28 meters to bedrock accommodate the mall, the STEM library, parking, logistics, plant rooms and a proposed Chicago Transit Authority (CTA) Blue Line station. More than one hundred trees, together with rooftop gardens and ground-level planting, weave nature through the whole arrangement.

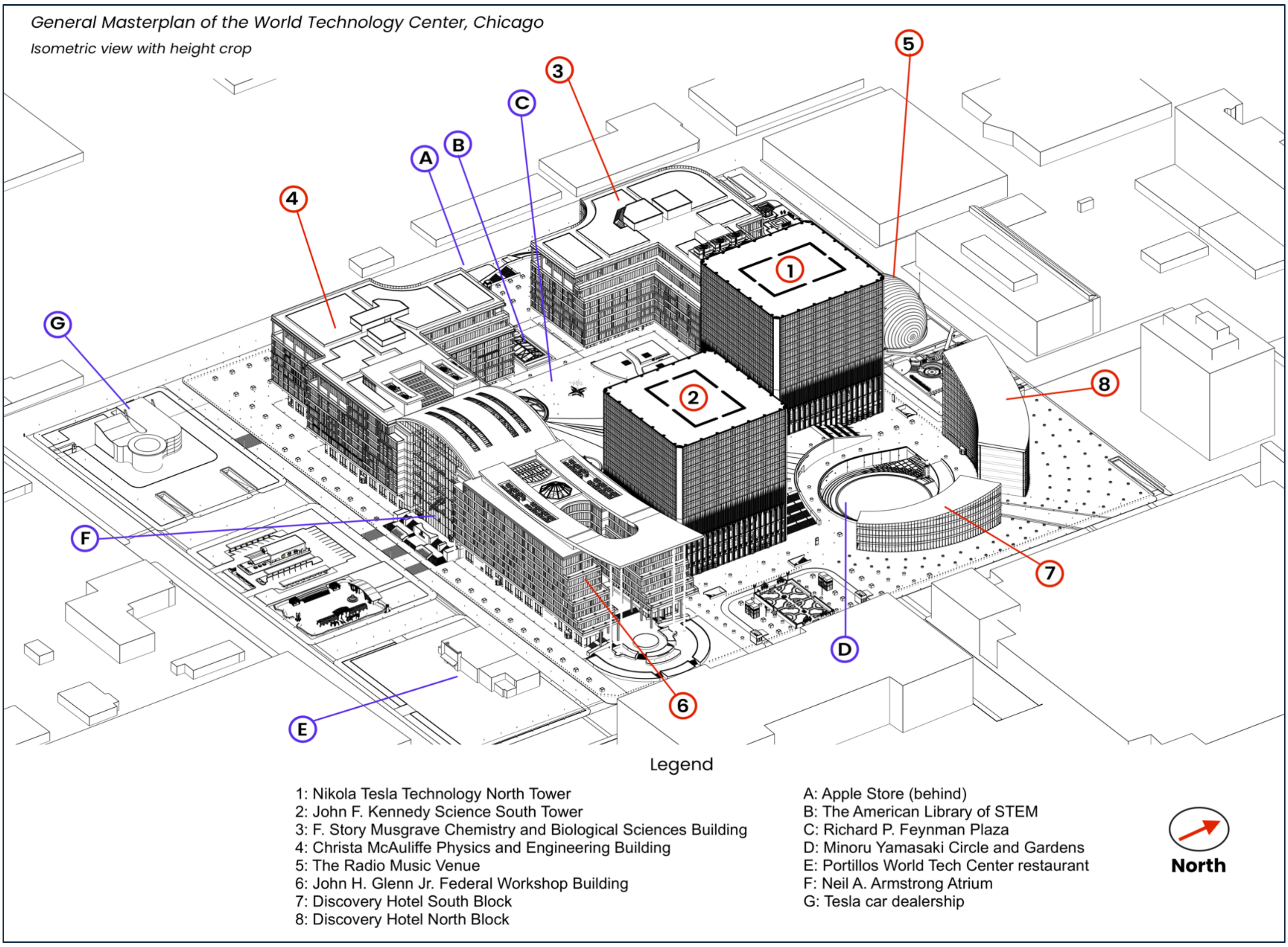


Figure 1.1 – General masterplan isometric of the World Tech Center campus. Full height of towers is cropped, full tree geometry not shown.

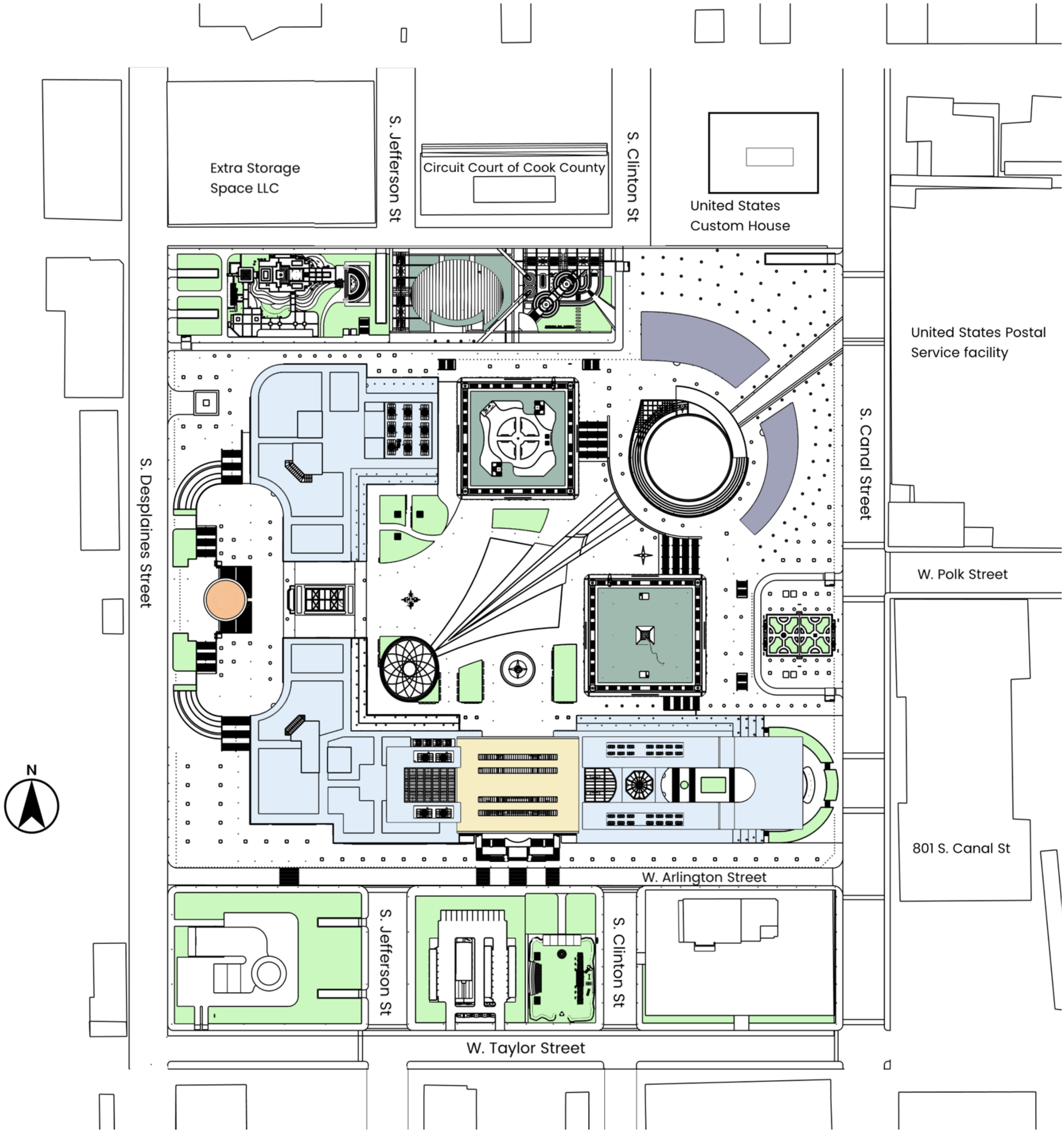


Figure 1.2 – A basic top-view map of the campus' proposed location in downtown Chicago's streets

1.1.1 Technology North Tower

The Technology North Tower is conceived as the campus' hub for information, and industrial and digital technology. Across its 110 stories, the tower would house state-of-the-art laboratories for physics and electronics design, software development workshops, high-fidelity simulation and supercomputing facilities, and lecture rooms in which software engineers, physicists and data scientists develop and collaborate on new applications. The tenant mix is intended to be deliberately dynamic, spanning small start-ups and industry giants alike, from video game developers to aerospace and automotive design houses. An example floorplan (in Figure 1.26 in section 1.3.4) illustrates how laboratory, office and workshop functions can share a single column-free floor plate, and some interior renderings in Figure 1.3.

The tower's defining public amenity is found at its summit. Perched at 1,500 feet is the Open Heavens Observation Deck — planned as the highest outdoor viewing platform and garden in the Western Hemisphere — described in detail in Section 1.2.8. Positioning the campus's most popular visitor attraction atop its technology building is intentional: every tourist who ascends the tower passes through a working center of scientific craft, reinforcing the project's principle that public inspiration and professional practice should share one address. Sky lobbies divide the tower into stacked vertical neighborhoods, each served by the building's complement of double-deck express and local elevators, and each provided with the fire-crew stations, refuge provisions and mechanical floors described in the engineering sections of this chapter. The building would be dedicated to the electrical pioneer Nikola Tesla (1856–1943) — whose alternating-current polyphase system, induction motor and radio-frequency research underpin the modern world of electricity.

Figure 1.3 – Example interior renderings of the Technology North Tower's laboratory and design and digital workspaces.

1.1.2 Science South Tower

Immediately adjacent, the Science South Tower complements its twin as the campus' hub for general scientific research, cleanroom laboratories, and art and design workshops. Interior space examples are shown in Figure 1.4. The dedication honors President John F. Kennedy (1917–1963), whose commitment to tasking the nation of achieving a crewed lunar landing by the end of the 1960s — and that charge be the United States chooses to do such things "not because they are easy, but because they are hard". This remains the defining modern statement of public scientific ambition. As a nexus for discovery and innovation, the building would provide lecture and meeting rooms for teaching and networking, alongside general sciences laboratories, cleanrooms, and offices for prestigious national and international institutions. Candidate tenants identified during concept development include the University of Illinois Chicago (UIC), Purdue University, the American Society of Mechanical Engineers, the American Iron and Steel Institute, the American Society of Civil Engineers, the Royal Society of London for Improving Natural Knowledge, and the Royal Aeronautical Society (RAeS).

Figure 1.4 – Example interior renderings of the Science North Tower's research and development laboratory and workspace facilities

Two features distinguish the South Tower's crown. The first is the spire (Figure 1.5) which rises to a pinnacle height of 1,969 feet (600.15 m). It commemorates the year human beings first set foot on another celestial body during the successful Apollo 11 mission. From this spire the largest waving flag of the United States would be flown — raised tall as a standing symbol of American leadership in exploration and discovery and lowered to half-mast on days of national observance and mourning. The second is the *Wonders of the World* restaurant, a large dining venue on the 107th floor conceived as a reincarnation of *Windows on the World*, the restaurant atop the original World Trade Center. In combination, the two towers express the project's central metaphor: science and technology as equal partners, standing side by side.

Figure 1.5 – The American Flag flying atop the 1969-foot spire.

1.1.3 Chemistry and Biological Sciences building

The F. Story Musgrave Chemistry and Biological Sciences Building (shown in Figure 1.6) is a ten-story facility on the campus perimeter, dedicated to chemical engineering, medicine and the biological sciences. Its namesake, Dr Franklin Story Musgrave (b. 1935), is among the most academically accomplished astronauts in NASA history — a physician, public speaker and polymath holding six academic degrees, a veteran of six Space Shuttle missions (the only astronaut to have flown aboard all five orbiters), and lead spacewalker on the first Hubble Space Telescope servicing mission in 1993.

Figure 1.6 – Exterior rendering of the Chemistry and Biological Sciences building, as viewed from its north-facing curved corner.

The building that bears his name is intended to reflect the same breadth: it would contain the latest sophisticated chemical and medical-grade laboratories and workspaces in which industry professionals and talented students gain practical skills in chemistry and medicine, supported by dedicated quantum computing facilities for research and development.

Four program areas anchor the building's research agenda: general microbial biology; cancer and disease research; materials science directed at new super-alloys, metamaterials and sustainable products; and industrial process improvement. The co-location of wet laboratories with quantum computing resources is a deliberate response to the growing role of quantum simulation in molecular modelling and medical discovery and positions the facility to serve both academic groups and commercial tenants. It incorporates a rooftop green space and balconies overlooking the plaza, extending the campus-wide biophilic design strategy (explored in section 1.4.4) to the wellbeing of its occupants — a population whose working hours in the discipline are typically long and whose access to daylight and nature is, in conventional facilities, often poorest.

1.1.4 Physics and Engineering building

The Christa McAuliffe Physics and Engineering Building is conceived as a ten-story powerhouse for practical learning projects and student industry apprenticeships. It would honor Christa McAuliffe (1948–1986), the American schoolteacher selected from more than 11,000 applicants to become the first private citizen to fly in space under NASA's Teacher in Space Project.

Figure 1.7 – A view of the Physics and Engineering Building from the central plaza and mall dome. Its rooftop garden and balconies are visible in this computer rendering.

McAuliffe's legacy (in the wake of the unfortunate Space Shuttle Challenger disaster) positions education — her vocation and her mission — at the physical and symbolic heart of the project's engineering program.

The building (shown in Figure 1.7) would be equipped with sophisticated laboratories capable of managing multi-discipline space science experiments, together with an array of cleanrooms of varying sizes providing space for the assembly of satellites, major student projects, inventions and advanced machinery. Additional office and learning facilities are planned to host professional and educational bodies, for which candidate occupants include: the Leibniz Institute of Mathematics (LIM), a proposed foundation aiming to revolutionize mathematics education through intuitive, engaging methods augmented by artificial intelligence; a Challenger Learning Center for Space Science Education, continuing the network founded by the Challenger crew's families; and aerospace engineering apprenticeship providers, whose trainees would rotate between the building's workshops and the industrial tenants of the towers. A rooftop garden with a small restaurant brings green space and informal meeting ground to the building's occupants, mirroring the Musgrave Building opposite.

1.1.5 Government Workshop building

> "The most important thing we can do is inspire young minds and to advance the kind of science, math and technology education that will help youngsters take us to the next phase of space travel".
>
> – John Glenn

The John H. Glenn Jr. Federal Workshop Building, also known as the Government Workshop Building — is a unique ten-floor workspace hub intended to unite national and international government bodies on the campus itself. It would be named in honor of John Herschel Glenn Jr. (1921–2016), a US Marine Aviator and war hero whom in 1962 became the first American to orbit the Earth aboard Friendship 7 as part of NASA's Mercury Seven astronauts. Glenn then served four-terms as a United States Senator. Thirty-six years after his spaceflight, he was invited aboard the scientific research space shuttle mission STS-95 at the age of 77 and being the oldest person to fly in orbit. Glenn's legendary career — aviator, astronaut, legislator — personifies the building's purpose: a direct, working link between regulation and innovation.

Figure 1.8 – Exterior views of the Government Workshop Building. The facility features a multi-colored façade with multiple stepped balconies recessed in, along with an overhead arched canopy roof with a hyperbolic curve. It is spanning high over a decorated entrance pedestrian plaza adorned with nature and a US flagpole.

The facility is designed to provide authorities with an efficient path to support, supervise, test, audit and certify new technology, ranging from aerospace software and automation to artificial intelligence and medicine. Candidate tenant agencies identified during concept development include the Federal Aviation Administration (FAA), the U.S. Chemical Safety and Hazard Investigation Board (CSB), the National Aeronautics and Space Administration (NASA), the National Transportation Safety Board (NTSB), the National Institute of Standards and Technology (NIST) and the International Civil Aviation Organization (ICAO), together with workshop offices for cabinet-level departments such as Defense, Agriculture, Health and Human Services, Homeland Security, Energy, and Housing and Urban Development. In this collaborative environment, agency staff would advise students and industry firms directly within the campus, fostering a streamlined path to compliant standards within reasonable timescales — while the agencies themselves gain direct access to talented practitioners and new methods for investigating and resolving industrial, chemical and aviation incidents.

The intended result is a two-way institution: regulation that understands technology, and technology that respects regulation. Exterior views of the building are shown in Figure 1.8.

1.1.6 The Radio Music Venue

The Radio Music Venue is the campus's principal performing arts facility, a retrofuturistic hall whose ellipsoidal massing is shaped, as its name implies, like a vintage radio receiver (shown in Figure 1.9). It is situated directly opposite the Technology North Tower. The form is an affectionate piece of programmatic architecture: a building for sound, shaped like the device that first carried sound into every American home, and a quiet tribute to the broadcast technology that Tesla's neighboring tower commemorates in earnest. Internally, the venue is planned to host a varied calendar of music events, from orchestral performances to contemporary concerts, as well as the graduation ceremonies of the campus's educational programs — ensuring that every apprentice and student who completes a course at the World Technology Center crosses a real stage, before a real audience, in the heart of the campus they trained in. The venue's position on the northern approach also gives the campus an active cultural frontage in the evenings, extending the site's public life beyond laboratory hours and reinforcing the masterplan's principle that a scientific campus must also be a civic one. Its modest height preserves the visual primacy of the towers behind it, while its curved geometry softens the threshold between the orthogonal campus grid and the city streets beyond.

Figure 1.9 – Computer renderings of The Radio Music Venue and its surrounding garden, situated just north of the North Tower.

1.1.7 The Discovery Hotel

Comprising the North and South Blocks that rise from four to twelve stories, the Discovery Hotel is the campus's hospitality anchor — a sleek, curved, four-star establishment offering a space-themed experience in the idiom of science-fiction retrofuturism. The hotel encircles the Minoru Yamasaki Circle, its concave frontage forming the architectural frame of that public space; and at its entrance a model replica of the Space Shuttle Discovery would stand on permanent display. It would be an immediate, photographable statement of the fundamental character of the campus.

The word itself is part of the human psyche that describes creativity and exploration. It is referenced heavily in space exploration and popular culture. The OV-103 *Discovery*, the most-flown orbiter in the space shuttle fleet that twice made the return-to-flight missions (after the *Challenger* and *Columbia* disasters), and the *USS Discovery One* in Stanley Kubrick and Arthur C. Clarke's *2001: A Space Odyssey*, are an apt patron for a building dedicated to travelers. The two blocks are the seventh and eight numbered buildings of the core-campus (Figure 1.10).

Guest amenities are planned to include a restaurant, a gymnasium, a sauna and an indoor swimming pool, with interiors that carry the retrofuturistic hard sci-fi decor through guest rooms and public areas alike. Functionally, the hotel serves the campus's working population as much as its tourists: visiting researchers, conference delegates, agency auditors, guest lecturers and the families of apprentices all require accommodation within walking distance of their workplace. Its spiral-ramp connection to the subterranean mall (Section 1.2.6) ties guests directly into the campus's all-weather pedestrian network, while its position beside the seasonal ice rink and barbecue terraces of the Yamasaki Circle places the city's newest public gathering space literally at its doorstep.

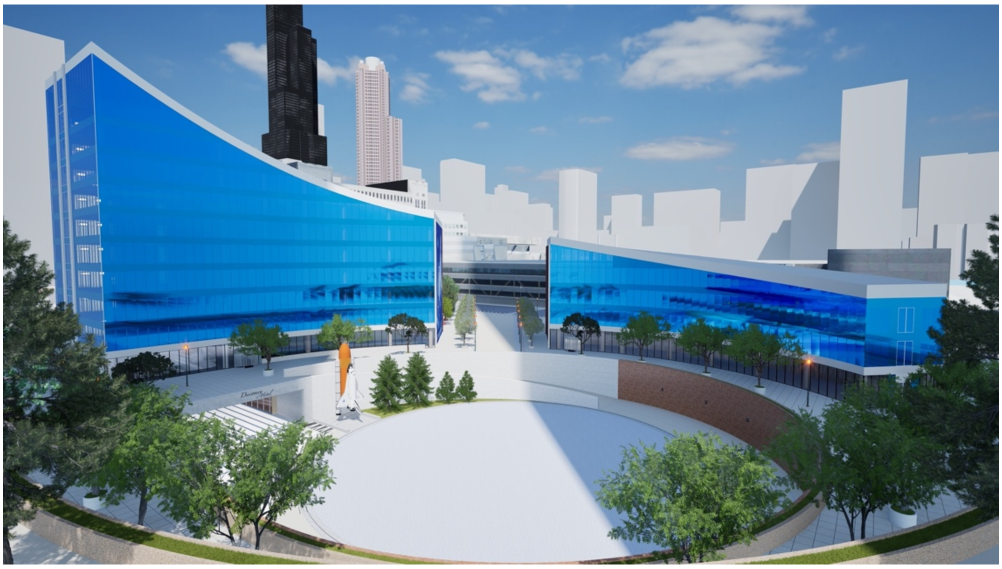


Figure 1.10 – The two-block Discovery Hotel with its central Yamasaki Circle and pedestrian ramp.

1.2 The Amenities

Beyond its principal buildings, the World Technology Center is defined by the quality of its shared spaces. The amenities described below are not decorative additions but are the connective philosophy of the masterplan and are designed to make the campus a welcoming destination for the public as much as a workplace for its tenants.

1.2.1 Richard P. Feynman Plaza

At the center of the campus lies the Richard P. Feynman Plaza. It would be a 5-acre public space dotted with large trees, warm lamps and fountains utilizing an Art Deco patterned design (Figure 1.11). The plaza is named after the legendary physicist Richard Phillips Feynman (1918–1988), who was the recipient of the 1965 Nobel Prize in Physics for his pioneering work in quantum electrodynamics, [2] inventor of the eponymous mathematical diagrams with which particle interactions are visualized to this day, a key figure in the Manhattan Project (one of the twentieth century's most beloved teachers and science communicators), and a decisive investigator on the Rogers Commission into the Space Shuttle Challenger accident — where his famous demonstration of an O-ring in ice water cut through bureaucratic ambiguity with a glass of water and a clamp.

The plaza's signature paving pattern is designed to resemble the tip of a fountain pen, representing the place where new discoveries and knowledge are written; in addition to sculptures cultured to various topics in science (such a molecular structures, Calabi-Yau manifold from string theory, and a globe), would be displayed across the area. Feynman's own words — "*the only way for deep happiness is to do something you love to the best of your ability*" — set the intended tone: a place of serious work, held lightly.

The plaza would also perform practical duties: distributing pedestrian flows between the towers, the academic buildings and the mall entrances below, and providing the principal venue for outdoor ceremonies, exhibitions and remembrance services.

Figure 1.11 – Renderings of the Richard P. Feynman Plaza of the World Technology Center. In between and pointing through the towers is its signature fountain pen design. The mall atrium dome forms its 'root'.

1.2.2 Minoru Yamasaki Circle

Immediately northeast of the Feynman Plaza, the Minoru Yamasaki Circle forms the entrance pedestrian area to the Twin Towers (illustrated in Figure 1.12). The space is named in tribute to Minoru Yamasaki (1912–1986), the architect of the original World Trade Center, whose design philosophy of serenity, delight and human scale the present project consciously inherits; placing his name at the towers' threshold acknowledges that every visitor who approaches them walks, in a sense, through his legacy first. The circle is conceived as a large circular plaza with a spiral ramp descending to a lower level of the mall and to the entrance to the Discovery Hotel, whose curved blocks enclose the space and in perfect symmetrical alignment between the towers when viewed from above.

Figure 1.12 – Aerial view (rendering) of the Yamasaki Circle and surrounding gardens that form an aligned enclave between the towers, plaza, and hotel.

Programmatically, the circle is the campus's seasonal heart. In summer it would host an outdoor barbecue and dining terrace; in winter it would convert swiftly into a stunning ice-skating rink, deliberately bringing the spirit of New York's Rockefeller Center rink to the City of Chicago — a gesture of continuity between the two cities that share the story of American skyscrapers. Between seasons, the circular geometry and alignment with respect to other buildings onsite lends itself to markets, exhibitions and public demonstrations of student and tenant projects. The combination of frontage, mall access, tower lobbies and open-air aspects is intended to keep the circle animated throughout the day and across the calendar year.

1.2.3 The Gardens

A variety of garden spaces, furnished with park amenities, adorn the campus throughout (along its street frontages, between its buildings, on its rooftops and within its atriums) so that nature continually offsets the surrounding urban density, as depicted in Figure 1.13. The masterplan commits to a minimum of one hundred trees at grade, supplemented by the rooftop gardens of the Physics and Chemistry buildings, that of the Open Heavens Observation Deck, and the indoor planting of the Armstrong Atrium and the mall. The gardens are not merely ornamental. As outlined in Section 1.4.4, a substantial body of research links visual and physical access to greenery with measurable improvements in stress recovery, cognitive performance and self-reported wellbeing; for a campus whose population includes students under study pressure, researchers on long experimental campaigns and members of the public seeking respite from the city, distributed garden space is a functional component of the design, on equal footing with its laboratories. Horticulturally, planting would favor hardy native and climate-adapted species suited to Chicago's continental climate, with seasonal variation treated as a feature: spring blossom on the plaza approaches, deep summer shade over the garden seating, autumn color against the towers' blue glass, and evergreen structure through the winter months.

Figure 1.13 – Garden and green spaces flourish throughout the complex (computer renderings).

1.2.4 The American Library of STEM

Spanning five floors below plaza level, the American Library of STEM (Figure 1.14) is planned as a knowledge and reading sanctuary at the literal foundation of the campus — a multi-level library containing a vast collection of books, engineering drawings and research papers spanning the full breadth of science, technology, engineering and mathematics. Its design takes direct inspiration from the Toronto Reference Library in Canada, recognized for its stunning 1970s-era futurist atrium and cascading balconies, warm décor and generous skylight. At the WTC, that skylight becomes a feature of the Twin Towers above: a patterned glass lens set into the paving through which "*daylight pours down into the reading halls through reflection and refraction, and through which evening light glows softly upward*".

The library's holdings are intended to be working collections rather than archives alone. For instance: engineering drawings and standards available to apprentices and students, historical scientific literature alongside current journals, and dedicated reading rooms for schools and visiting groups. It is positioned directly at the plaza's western pedestrian entrance (in between the chemistry and engineering buildings) interconnected to the rest of the facilities and would be a daily, visible statement that the foundation of the entire enterprise above is the written record of human knowledge.

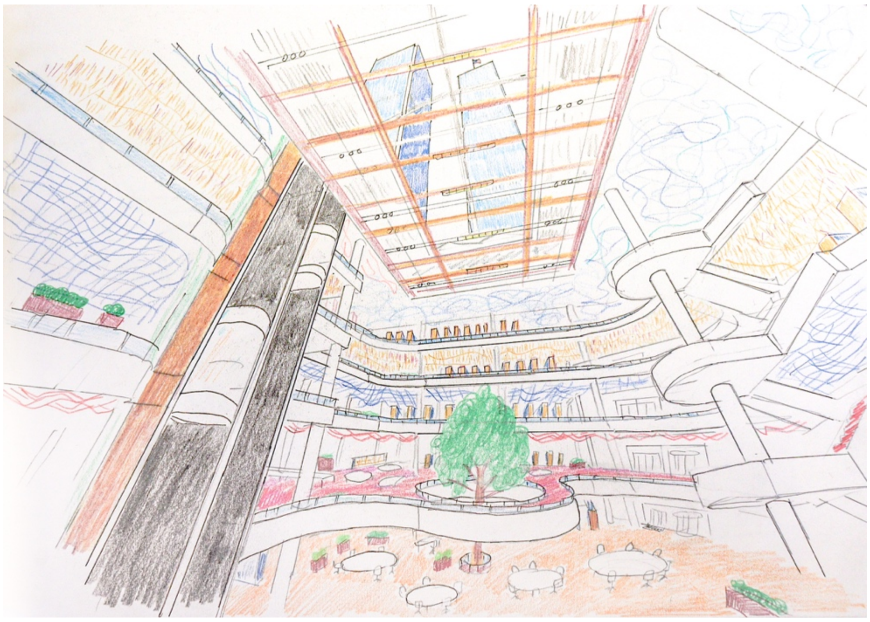


Figure 1.14 – Hand drawn sketch of the interior of *The American Library of STEM*, by Raphael Chryslar.

1.2.5 Neil A. Armstrong Atrium

In between the Physics and Government Workshop buildings at the complex' south face is a 60-metre-high arched atrium adorned with glass, brick, brown and white granite/marble and colorful metal trim (Figure 1.15). Drawing its design language from cathedral architecture, the atrium's layout features large transepts between the buildings that focus upon a central nave with entrance stairs, while indoor plants and trees flourish amongst the glass beneath overhead walkways — a deliberate marriage of the sacred architectural tradition with the secular pursuit of knowledge. The atrium is named after Neil Alden Armstrong (1930–2012), the first human being to walk on the Moon. His not so well-known words: *"Knowledge is fundamental to all human achievements and progress. It is both the key and quest that advances mankind"* would be inscribed upon the entrance wall. The atrium serves as the main entrance to the campus from the southern end.

Figure 1.15 – The glass front of the Neil A. Armstrong Atrium and its stair entrance.

1.2.6 The Mall

Beneath the plaza, the campus bustles with shopping activity with its subterranean shopping mall — a retrofuturistic consumer experience consciously inspired by the production design of Stanley Kubrick's *2001: A Space Odyssey*. The mall links all atriums and building lobbies into a single climate-controlled pedestrian network, lined with a diverse array of shops and eateries and anchored by two large grocery stores, Aldi and Lidl, serving the daily needs of its inhabitants.

Its architectural signature is a central underground atrium rising through five stories to a patterned glass dome, which floods the space with daylight — visitors below looking up through the dome would see the two shimmering blue giants rising overhead (Figure 1.16).

Figure 1.16 – The blue giants of the Twin Towers seen through the glass dome of the mall.

The mall is also the campus's principal transport interchange. A proposed extension of the CTA Blue Line would bring a dedicated subway station directly into the complex, connecting the World Technology Center to the Loop, to O'Hare International Airport and to the wider city with efficient underground transportation, and allowing the majority of daily arrivals to reach any building on campus without crossing a street or encountering weather. In planning terms, the combination of retail, groceries, transit and weather-protected circulation is intended to make the campus genuinely self-sufficient at the pedestrian scale. The mall also would provide large exhibition areas for conventions and conferences.

1.2.7 Flagship Apple Store

At the campus's western entrance (Figure 1.17) the masterplan reserves a site for a flagship Apple Store conceived as a cylindrical glass pavilion — a form inspired by the glass cube on New York's Fifth Avenue, reinterpreted in the round for Chicago. The intent is twofold. Commercially, a flagship store of a globally recognized tech product retailer provides a powerful consumer anchor at the campus edge, drawing daily footfall that benefits the mall and surrounding amenities. The corporation's portfolio of architecturally significant flagship locations demonstrates its willingness to invest in landmark retail architecture of precisely this kind. Symbolically, the pavilion places the most public face of consumer technology — the point where ordinary people meet the products of the industries working in the towers above — at the campus's front door. The pavilion's modest scale and transparency preserve sightlines toward the towers while giving the western approach a luminous, welcoming threshold after dark.

Figure 1.17 – The flagship Apple Store at the World Technology Center's western entrance.

1.2.8 Open Heavens Observation Deck

At the top of the Technology North Tower is the Open Heavens Observation Deck (Figure 1.18). At 1510 feet (460 m) high, it would be the highest outdoor viewing platform and garden in the Western Hemisphere. The deck comprises two levels: the first is the nature floor, a magnificent garden space featuring a variety of plants, shrubs and trees, augmented by a small café and a stage for live performances. A park in the sky would offer visitors the unprecedented experience of standing amongst greenery nearly half a kilometer above the city. The second is the upper platform, enclosed by a glass perimeter, a vantage point from which spectators may admire the city in every direction, sit and relax beneath the stars, or watch the sunset over the prairie horizon in serenity.

The name *Open Heavens* is explicit in its intent: *"an uninterrupted, open-air communion with the sky, refreshing in a market where most supertall observation experiences are fully enclosed"*.

Figure 1.18 – The Open Heavens Observation Deck atop the roof of the Technology North Tower. Shown is the top deck (left) and the lower-level garden (right).

Operationally, the deck would be served by dedicated express elevators (visible on the example floorplan in Section 1.3.4), separating tourist flows from tenant circulation, and its garden level provides the uppermost expression of the campus's biophilic design strategy.

> *"For Chicago — a city that invented the skyscraper and has always invited the public to its summits — Open Heavens continues a proud municipal tradition at a new altitude"*
>
> *– Raphael J. Chryslar*

1.2.9 Wonders of the World restaurant

Near the summit of the Science South Tower, the *Wonders of the World* restaurant is planned as a large dining venue that consciously reincarnates *Windows on the World* — the renowned restaurant that occupied the 106th and 107th floors of the original World Trade Center's North Tower, which became the highest-grossing in the United States. The homage is in the name as well as the altitude: where its predecessor offered windows upon one world city, its successor's name widens the gaze to the wonders of worldwide achievements and innovation – appropriate for a tower devoted to science. The venue is conceived as a destination in the classical sense: a place for celebrations, for visiting delegations, for the conclusion of conferences, and for any member of the public marking an occasion against the backdrop of Chicago (and Lake Michigan) from nearly 1,500 feet.

Its position directly beneath the 1,969-foot spire places diners at the symbolic apex of the campus, beneath the national flag, at the point where the architecture itself gestures toward Apollo. The project initiative positions the restaurant to complement (rather than compete) with the Open Heavens Observation deck on the sister tower.

1.2.10 Residential facilities

While the World Technology Center is first a campus of work and learning, the masterplan recognizes that a STEM community that functions around the clock requires people who live within it. Residential provision is therefore planned in a strategically targeted form: serviced accommodation for visiting researchers and faculty on extended placements; apprentice and student housing allowing trainees from across Illinois, Indiana and beyond to take up positions without prohibitive commuting or rental burdens; and quarters for essential operational staff (building engineers, security and the resident fire crews described in Section 1.3, whose duties require immediate presence on site). The Discovery Hotel's two blocks are optimized for shorter stays. In contrast the residential floors (for long-term and permanent occupancy) are slated to be housed on the upper thirds of both Twin Towers. Exact allocations would be fixed during detailed design and in consultation with city planning authorities.

The approach is consistent with the direction of large mixed-use developments in Chicago where significant residential components (including affordability commitments) are now standard practice in master-planned districts such as the South Loop's emerging developments. Embedding even a modest resident population materially benefits the campus: it animates the gardens, mall and circle outside working hours, improves financial and physical security through constant occupancy, and reinforces the project's ambition to be a genuine urban neighborhood rather than an office precinct that empties at dusk. An interior concept is shown in Figure 1.19.

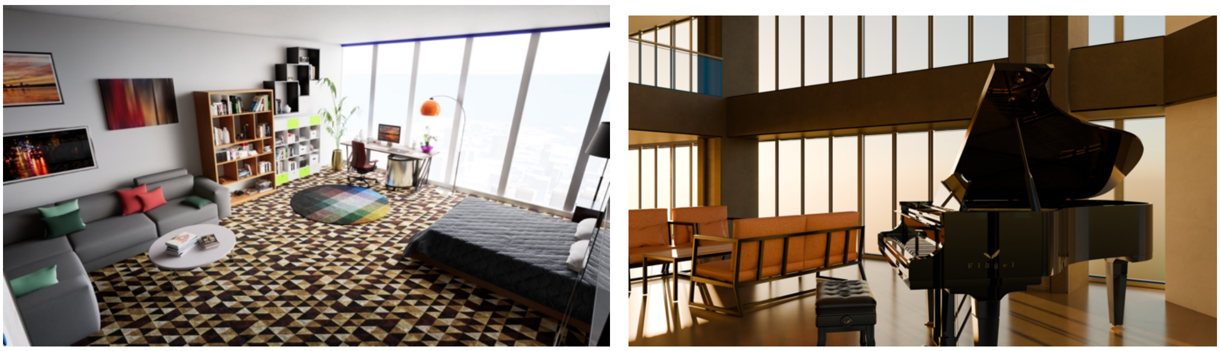


Figure 1.19 – Conceptual renderings of residential interior space of the upper thirds of both twin towers. Illustrated is a modern bedroom (left); and a lounge and piano in a luxury condo (right).

1.2.11 Cleanrooms

Distributed principally throughout the complex are cleanrooms (examples shown in Figure 1.20). In both large and small formats, they constitute one of its most consequential technical amenities. Cleanrooms are environments in which the concentration of airborne particles is controlled to defined limits, classified internationally under ISO 14644-1 from ISO Class 1 (the most stringent) to ISO Class 9, with cleanliness maintained through high-efficiency particulate air (HEPA) filtration, controlled pressurization, regulated temperature and humidity, as well as PPE gowning protocols and disciplined operating procedures. They are the indispensable infrastructure of several of the disciplines the campus is designed to serve: aerospace projects such as satellite assembly and instrument integration (where a single particle can compromise an optical payload); biological and pharmaceutical work (where sterility and cross-contamination control are paramount); and semiconductor research and development - the most demanding application of all - where fabrication processes at nanometer scales require the highest cleanliness classes.

Providing cleanrooms of varying sizes as shared campus infrastructure addresses one of the highest barriers to entry in deep technology: capital cost. A start-up, a student team or a university group that are unable to access or finance a dedicated facility can book certified cleanroom hours within the same complex that houses its offices, its mentors and — in the Glenn Building — the regulators who will one day certify its products. Viewing galleries at selected cleanrooms would additionally allow students and the visiting public to watch real spacecraft and device assembly in progress, converting normally hidden industrial processes into public inspiration.

Figure 1.20 – Inside two example cleanrooms at ISO 6 and 7 standards (left and right images, respectively). Source: NASA image and video library.

1.2.12 Underground facilities

The lowest of the campus's five subterranean stories — reaching approximately 28 meters below grade and resting on bedrock — house the technical ‘organs’ of the entire campus. Major heating, ventilation and air-conditioning (HVAC) plant occupies dedicated halls (sized for the thermal loads of the two towers), laboratory exhaust systems and the conditioned spaces of the mall and library. Adjacent plant rooms accommodate the campus's data servers and the hydrogen fuel cell installations that, together with photovoltaics and an offsite generation facility, form the backbone of its renewable energy strategy (Section 1.4.1). Electrical switch-rooms, water storage, fire pumps feeding the standpipe and suppression systems described in Section 1.3.4, and the campus's recycling, material sorting and energy recovery equipment (Section 1.4.2) complete the technical program, the latter fed by garbage chutes descending through every building.

Logistics would be equally provided for. Just north of the dual-block hotel and beside the Radio Music Venue, truck ramps descend to an underground logistics and delivery zone, removing service traffic from the pedestrian surface entirely; a mail handling facility and a new United States Postal Service vehicle maintenance facility (replacing the existing one that would be demolished to make way for the campus) are incorporated within the basement program, honoring the site's prior civic function. Underground parking is provided for essential personnel, deliberately limited in capacity to favor the campus's transit-first access strategy, which centers on the proposed CTA Blue Line station serving the mall level. Finally, the basement levels contain the substation interfaces and utility corridors associated with the rerouting and upgrade works at the nearby Taylor substation contemplated in the project's delivery strategy (explored in Chapter Six).

1.3 Engineering Insights

The World Technology Center's Twin Towers share a silhouette with their predecessors in New York, but structurally they are modern buildings designed to contemporary codes. This section reviews the engineering of the original towers and the reasons their 1960s design would not satisfy modern requirements; presents the materials selected for the new design and their properties; describes the structural system, fire safety strategy, damping provisions and construction methodology; and demonstrates, with reference to the Chicago Construction Code, [3] the International Building Code's high-rise provisions [4] and the ASME A17.1/CSA B44 Safety Code for Elevators and Escalators, [5] and how the design is intended to meet and exceed the standards applicable to buildings of this class. Throughout, the engineering drawings and computer-aided design (CAD) work produced for the project in CATIA V5 and AutoCAD are used to illustrate the principal components.

1.3.1 Literature review of legacy Twin Towers

The original World Trade Center towers (WTC 1 and WTC 2), designed between 1962 and 1968 under architect Minoru Yamasaki with structural engineering by Worthington, Skilling, Helle & Jackson, were a framed-tube construction, as shown in Figure 2.2. A perimeter 'frame-tube' of closely spaced high-strength columns acting with a conventional column-and-beam core, with long-span floor trusses bridging between the two. [6][7] Each tower rose 110 stories, with perimeter columns formed as welded steel box sections joined by deep spandrel plates into prefabricated three-column panels. The structural steel plans specified fourteen different grades of steel, ranging in yield strength from 248 to 689 MPa; higher grades were reserved principally for the perimeter, while most of the core columns were specified to ASTM A36, the common construction steel of the era with a 248 MPa yield strength. [7][8] The floors outside the core were composite assemblies of lightweight open-web bar trusses — fabricated by the thousands by Laclede Steel of St. Louis — supporting a thin lightweight concrete slab on metal deck. [8] A 'hat truss' between the 107th and 110th floors tied the core to the perimeter and supported the television mast atop WTC 1. [7] The towers were also pioneering in dynamics: roughly ten thousand viscoelastic dampers per tower were fitted at the truss seats to control wind-induced motion, the first such application in a major building.[6]

For its time, the design was extraordinary — it delivered acre-scale column-free floors and survived, in 1993, a large basement bomb and, in 2001, the initial impacts of fully fueled wide-body aircraft, standing long enough for the great majority of occupants below the impact zones to escape. [6] Yet the National Institute of Standards and Technology (NIST) investigation identified characteristics of the 1960s design that fall short of present-day expectations. The lightweight, long-span floor trusses were protected by sprayed fire-resistive material (SFRM) whose coating thickness was irregular, with gaps in coverage documented on the bridging trusses, and whose adhesion proved vulnerable to dislodgement. [6] Egress provision reflected the codes of the era: three stairwells, clustered within the central core and sized for phased rather than simultaneous full-building evacuation, served each 110-story tower. [6] Passive fire protection, evacuation capacity, and the robustness of stair and elevator enclosures were all subsequently identified as areas demanding reform.

Those reforms duly arrived. Code changes adopted in the wake of the NIST investigation — now embodied in the International Building Code's high-rise provisions — require, amongst other measures, an additional exit stairway for buildings exceeding 420 feet or 128m in height (a direct response to the conflict between descending occupants and ascending firefighters in the original towers), impact-resistant construction for stairway and elevator shaft enclosures in very tall buildings, dedicated fire service access elevators, sprinkler riser redundancy and more conservative bond requirements for fireproofing. [4][9] Chicago's modern construction code, aligned with the IBC and in respects more demanding — applying several of its enhanced high-rise requirements from a 400-foot threshold — carries the same provisions into the present project's jurisdiction. [3] In summary, the original towers were masterpieces of their period, but a faithful structural reproduction cannot lawfully be built today. The legacy that the World Technology Center inherits is therefore the silhouette and the spirit; the structure beneath, described in the following sections, is wholly new.

1.3.2 Materials properties

Three principal structural materials define the new towers: ultra-high-performance concrete (UHPC) for the central core, ASTM A514 quenched-and-tempered alloy steel for the primary columns and major beams, and ASTM A992 structural steel for secondary floor members and embedded connectors. Their selection responds directly to the lessons of Section 1.3.1, replacing the lightweight floor trusses and predominantly A36 core of the original towers with materials of substantially greater strength, stiffness, fire performance and impact resistance. Table 1.1 summarizes the comparison.

UHPC is a cementitious composite composed of an optimized gradation of granular constituents: a water-to-cementitious-materials ratio below 0.25 and a high percentage of discontinuous internal fiber reinforcement. The United States Federal Highway Administration (FHA) defines the class by a compressive strength exceeding 150 MPa, which is several times that of conventional structural concrete (ranging from 20 to 40 MPa), together with sustained post-cracking tensile strength above 5 MPa and a discontinuous pore structure that sharply reduces liquid ingress and enhances durability.[10][11] With sufficient fiber content, UHPC exhibits tensile strengths typically between 8 and 15 MPa and strain-hardening ductility, and its exceptional resistance to blast and impact has made it a leading candidate material in the nuclear industry, where it is studied and deployed for containment and safety-related structures and for the modular construction of small modular reactor buildings. [12] These are precisely the properties sought in the towers' core: the 29 by 41-meter core with its one-meter-thick UHPC walls is intended to function as a hardened spine — carrying gravity and lateral loads, enclosing all means of egress, and providing a degree of protection against extreme events that no steel-framed 1960s design could offer.

ASTM A514 is the standard specification for high-yield-strength, quenched-and-tempered alloy steel plate suitable for welding, with a specified minimum yield strength of 690 MPa for plate up to 2.5 inches (51mm) thick and ultimate tensile strength of 758–896 MPa.[13][14] Its yield strength is approximately double that of today's workhorse structural grade and nearly three times that of the A36 steel used in the original towers' core columns — strength that the design exploits in the welded vertical box columns (Figure 1.23) the perimeter horizontal box beams and the one-meter-deep floor 'major' beams, where it permits compact sections, generous reserves and tolerance of locally damaged material. ASTM A992, the preferred material specification for rolled wide-flange shapes in modern practice, provides a minimum yield strength of 345 and ultimate strength of 450 MPa, with ductility assured by a specified maximum yield-to-tensile ratio of 0.85 and weldability by a capped carbon equivalent.[15][16] It is employed for the lateral floor I-beams and the core's embedded corridor-beam connectors, where its proven ductility and economy suit repetitive members. In combination, the palette is conservative in philosophy: every material is a standardized, code-recognized product with decades of service history, while collectively exceeding, by a wide margin, the strength of every material in the buildings the towers commemorate. [7][8]

Table 1.1: *Structural materials of the World Technology Center towers compared with the original World Trade Center (representative specified minimum properties)* [7, 8, 10, 13, 15].

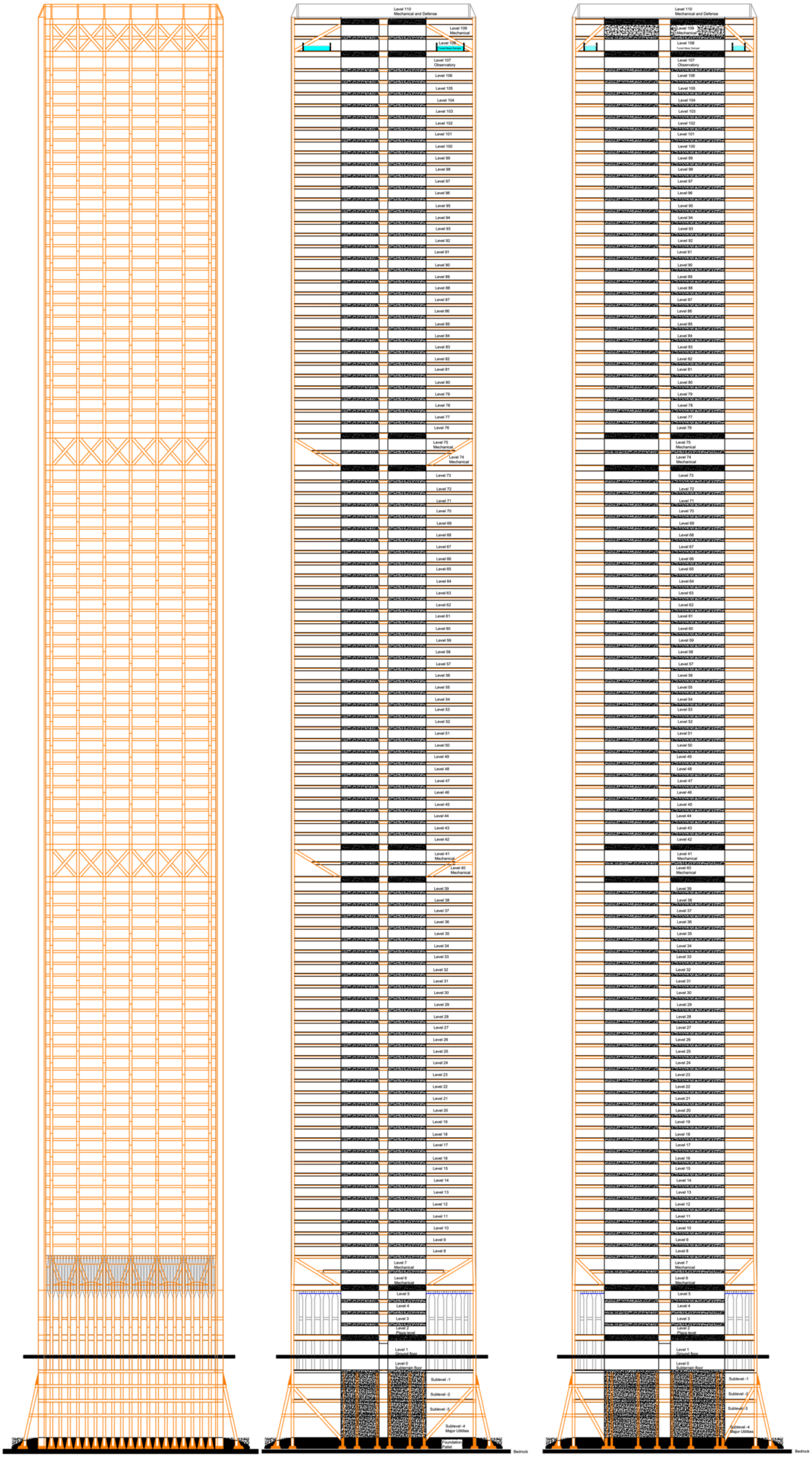
Material	Min. yield / compressive strength	Tensile strength	Principal application
UHPC (fiber-reinforced)	≥ 150 MPa (compressive)	≥ 5 MPa (direct tensile)	Structural core walls and corner mega-columns
ASTM A514 (Q&T alloy plate)	690 MPa (yield)	758–896 MPa	Built-up box columns, box beams and major floor beams
ASTM A992 (structural shapes)	345 MPa (yield)	≥ 450 MPa	Lateral floor beams and core corridor connectors
ASTM A36 (original WTC core, reference)	248 MPa (yield)	400–550 MPa	Original 1960s core columns and floor framing
Original WTC perimeter steel grades (reference)	248–690 MPa (14 grades)	Varies by grade	Original exterior load-bearing wall panels

1.3.3 Structural design

The towers' structural system comprises four interacting elements:

- the UHPC central core
- the I-beam floor system,
- the perimeter columns, and
- the transfer and outrigger trusses at the mechanical floors.

Figures 1.21 and 1.22 present *AutoCAD* drawings of the general structural and exterior elevations of the towers; and a structural floorplan, respectively, and Figure 1.23 shows a structural engineering model section of the core and floor beams developed in CATIA V5 software package.



General Perimeter Wall Structural Elevation (Each side, both towers) | General core structure (axial side) | General core structure (polar side)

Figure 1.21 – General structural and exterior elevations of the Twin Towers showing the facade elevation, the perimeter wall structural elevation with transfer trusses above the trident zone and X-braced outrigger bands at the mechanical floors, and the polar- and lateral-axis core structural elevations.

The central core measures 29 by 41 meters (95 by 134 ft) in overall dimensions with one-meter-thick UHPC perimeter walls. It would be constructed by slip-forming techniques and be provided with reinforcement rebar and embedded steel girders and socket plates (on every level to receive the floor beams). The core contains the four stairwells, elevator banks, ventilation shafts, utility plumbing and restrooms. and is ringed externally by the four-meter-wide polar corridor visible in the example floorplan (Figure 1.22). The floor system spans between core and perimeter using deep steel members rather than the original towers' lightweight bar trusses: longitudinal major beams of A514 steel with an approximately one-meter web depth carry the principal spans, supplemented by A992 lateral beams and connected to the core through embedded A992 connector assemblies. The I-section was retained deliberately for the floor members: its excellent second moment of area per unit mass minimizes deflection under load, while the solid-web, heavyweight format eliminates the fire fragility associated with sparse open-web trusses. All beams are bolted to socket plates on the core and to brackets on the perimeter columns, providing defined, inspectable load paths.

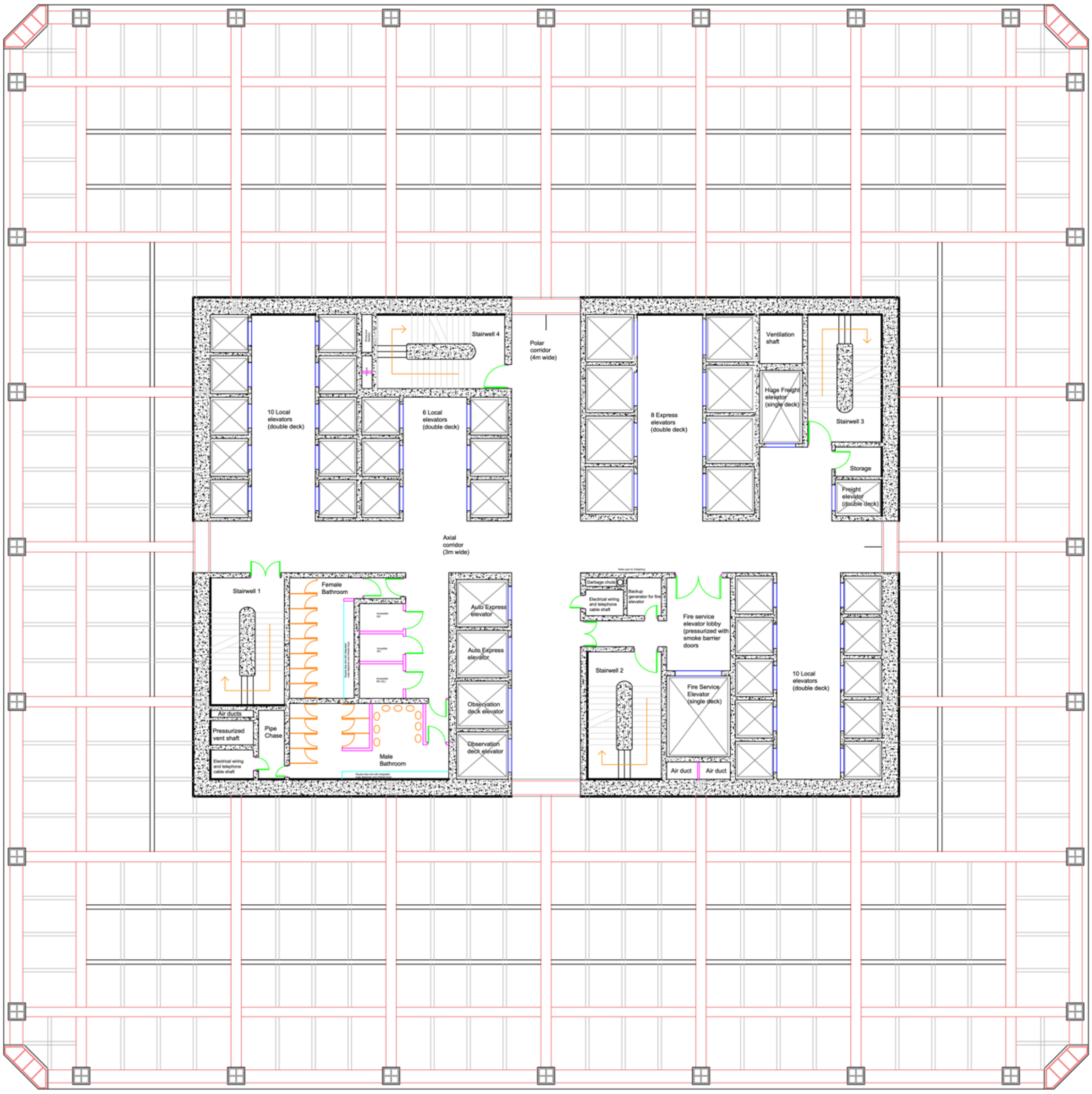


Figure 1.22 – AutoCAD structural floorplan of the perimeter columns and central UHPC core, with elevators, stairwells, and other facilities illustrated.

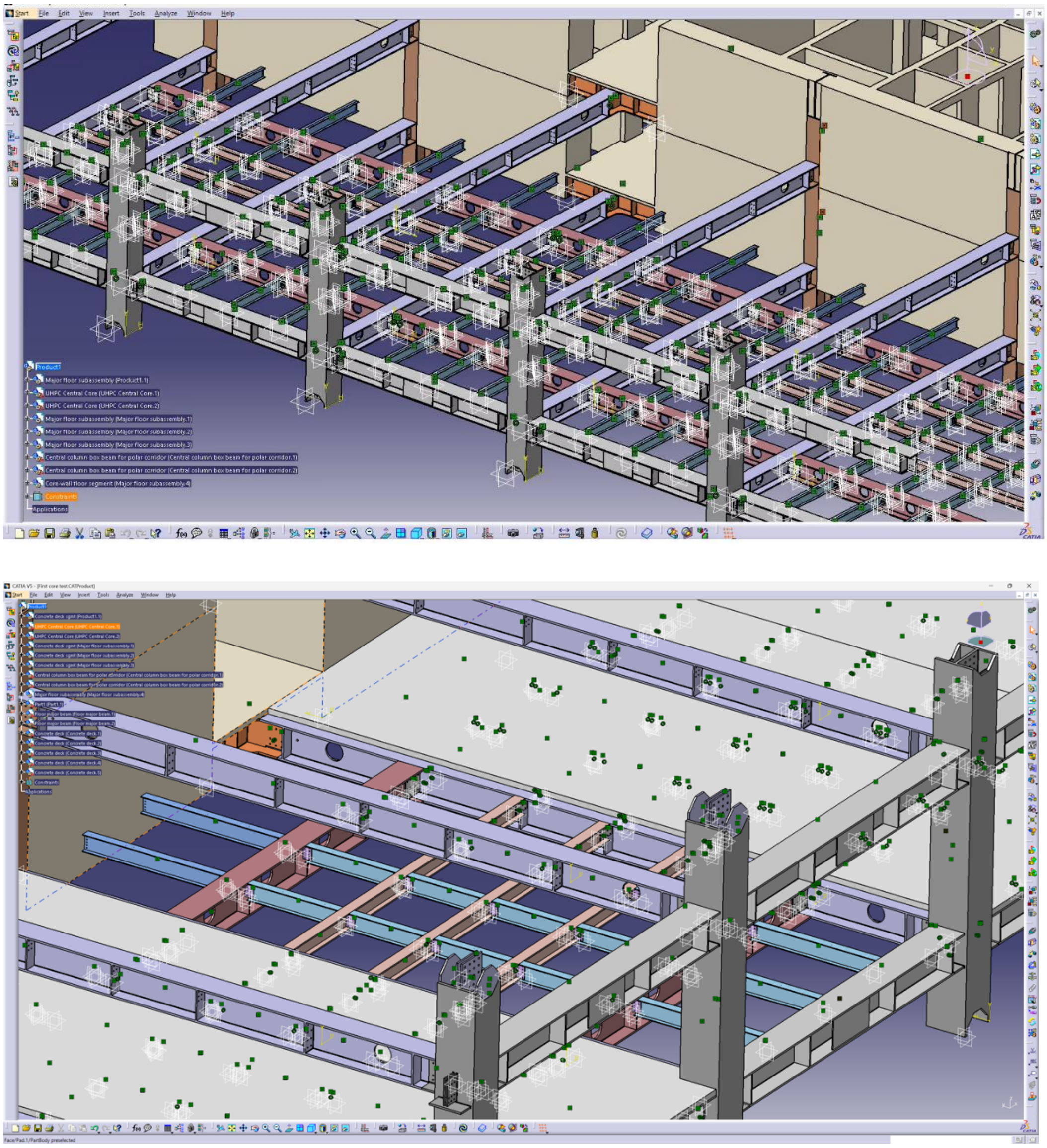


Figure 1.23: CATIA V5 assembly model screenshots of the tower structure, showing the UHPC central core segments, major floor subassemblies, longitudinal and lateral floor beams, and concrete-filled vertical box columns with assembly constraints applied.

The perimeter wall consists of seven major vertical box columns per face. Each one (shown in Figure 1.24) is 90cm square and made from A514 plate sections welded together. They are joined with A514 horizontal box beams into a rugged perimeter frame. At the base, nineteen box columns per face carry the perimeter loads past the multi-story lobby to the foundation, terminating at structural transfer trusses occupying the sixth and seventh mechanical floors. The characteristic trident shapes would be decorative molding covers. X-braced outrigger trusses at the upper mechanical levels tie the core to the perimeter. The corner columns are also steel box columns fabricated from tubular sections in similar manner to suspension bridge towers. The assembly is configured as a highly statically indeterminate structure — one in which internal forces must be resolved through stiffness-based analysis and matrices rather than equilibrium equations alone. This is precisely the property that confers robustness: load shed by any damaged member redistributes through multiple alternative paths.

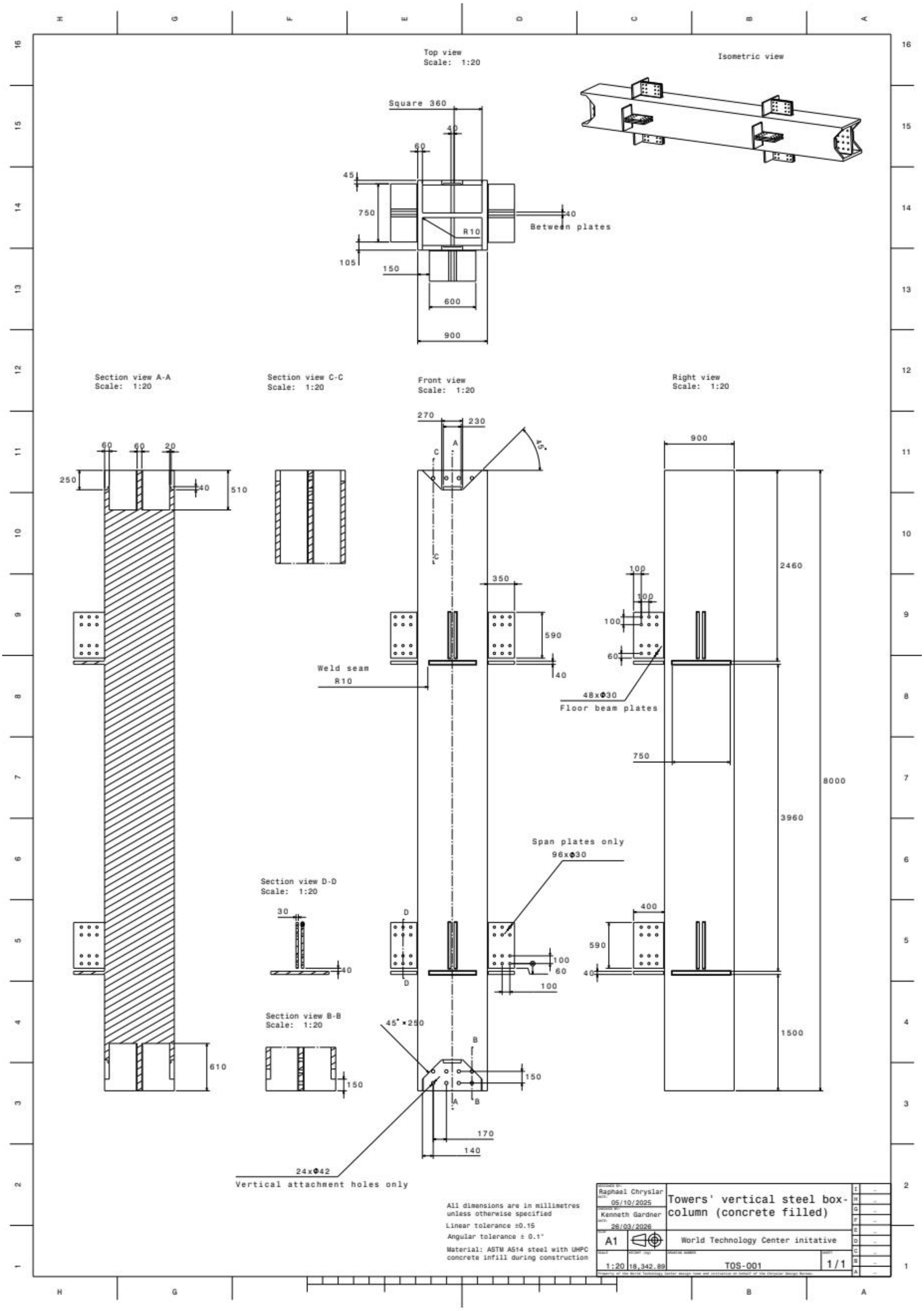


Figure 1.24: Detail drawing of the towers' vertical A514 steel box column with UHPC concrete infill.

Resistance to progressive collapse — the disproportionate spread of local failure and the mechanism that ultimately destroyed the original towers — is addressed through this redundancy in combination with member-level hardening. The concrete infill of the box columns adds compressive capacity, damps local buckling and retains load-bearing function at elevated temperature. The continuous UHPC core provides a second, independent gravity and lateral system protecting all egress routes; and the transfer and outrigger trusses enable story-level loads to bridge across removed columns. In addition, the impact-resistant enclosure requirements for stairs and elevators in tall buildings [3][4] are inherently satisfied by meter-thick UHPC rather than the gypsum assemblies of the original design. Preliminary finite element analysis (FEA) on various structural members (identifying principal and von Mises stresses) are conducted in CATIA V5, as shown in an example in Figure 1.25.

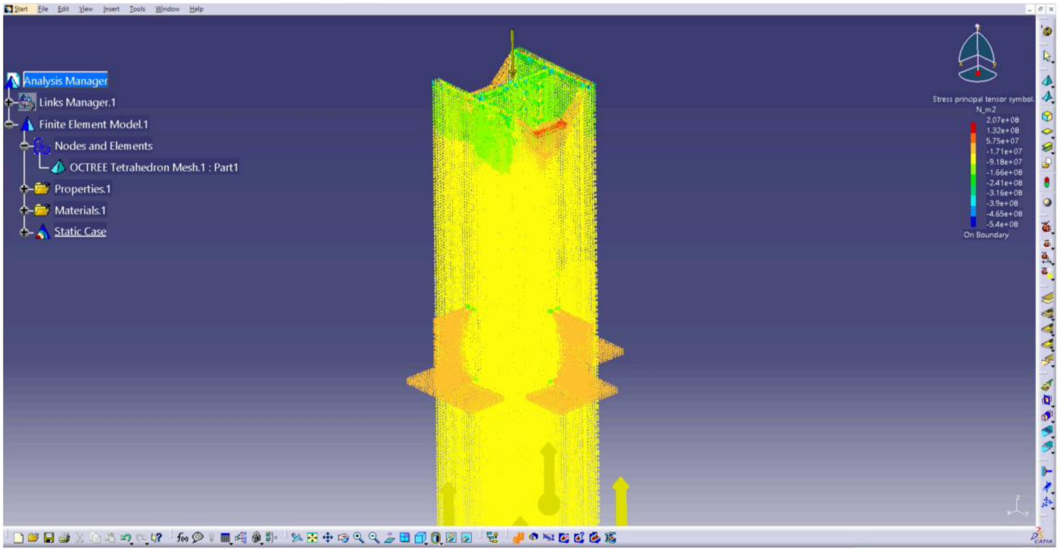
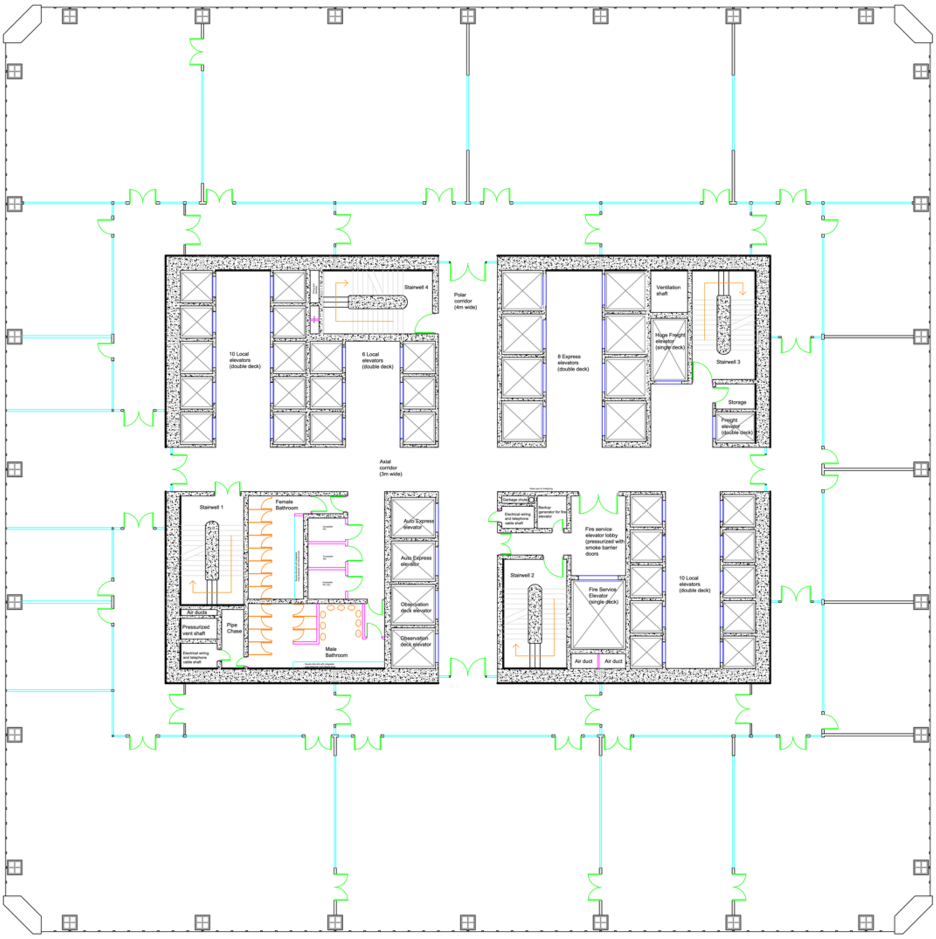


Figure 1.25: *Preliminary CATIA V5 finite element analysis of a vertical box column (principal stress tensor plot, static case, OCTREE tetrahedron mesh), modelled conservatively without concrete infill or attached beams.*

1.3.4 Fire safety and evacuation redundancy

Fire safety is the domain in which the new design departs most decisively from its predecessor, and the project's stated objective is not merely compliance with, but demonstrable margin beyond, the Chicago Construction Code's high-rise provisions [3] and the corresponding International Building Code requirements from which they derive. [4] The strategy rests on hardened passive protection, redundant egress, protected firefighting access, layered suppression, and dissimilar-redundant detection.

Passive protection begins with the structure itself. All structural steel is protected by intumescent fireproofing compounds — coatings that expand many times their thickness when heated, forming an insulating char. They are specified to provide a minimum of four hours of protection (which exceeds the fire-resistance ratings required for the primary structural frame of buildings in this class). [3] Unlike the sprayed fire-resistive material of the original towers, whose irregular thickness, coverage gaps and vulnerability to dislodgement were documented by NIST, [6] intumescent systems are applied as adherent coatings amenable to inspection and measurement, and the heavy solid-web members they protect possess far greater thermal mass than the original lightweight trusses. The meter-thick UHPC core walls, the concrete infill of the perimeter columns and fire-rated doors and barriers throughout complete the passive scheme, with the polar corridor surrounding the core functioning as a protected circulation buffer between tenant space and the egress shafts (Figure 1.26).



WTC Towers typical laboratory and workspace floorplan

Figure 1.26: Example laboratory, office and workshop floorplan for the towers, showing the four stairwells at the core corners, the pressurized fire service elevator lobby with smoke-barrier doors and dedicated backup generator, the polar and axial corridors, elevator banks, service shafts and dedicated firefighting water riser.

Egress capacity is provided by four large stairwells per tower — each 4.25 meters wide and 7 meters long in plan and are positioned nearer the four corners of the core for maximum remoteness — where the code requires three for buildings of this height and occupancy. [3][4][9] Each stairwell is equipped with its own dedicated ventilation system and is maintained at positive pressure behind fire doors (implementing the smokeproof enclosure and pressurization principles of the high-rise provisions so that smoke cannot infiltrate the escape routes even with doors operating). The larger width than typical gives permit large volumes without overcrowding, and counterflow - descending occupants and ascending emergency crews simultaneously. It is the precise conflict that motivated the post-2001 additional-stairway requirement. [9] Evacuation is further supported by a dedicated fire service access elevator in each tower (equipped with backup power sources) and pressurized lobbies with smoke-barrier doors. It has direct stairwell access on every floor, in accordance with the fire service access elevator provisions of the

Chicago code (which requires a minimum capacity of 3,500 pounds or approximately 1,600 kg) and the Phase I/II emergency operation requirements of ASME A17.1/CSA B44.[3][5][17]

Active systems are layered and, in the project's terminology, dissimilar-redundant. Conventional automatic sprinkler coverage throughout the towers is supplemented in laboratory, hangar-type and high-hazard spaces by foam fire suppression systems of the kind employed in aviation hangars under National Fire Protection Association (NFPA) 409, capable of overwhelming flammable-liquid fires within seconds. [18] Standpipes (a built-in piping system that delivers a reliable water supply to strategically placed hose connections throughout a building or structure) and fire hydrant connections on every floor are fed from the building's most distinctive reserve — the 1,000-tonne liquid tuned mass damper tanks near the summit (Section 1.3.5), which double as gravity-fed emergency reservoirs for firefighting. Detection combines traditional heat and smoke detectors with modern AI-assisted detection systems analyzing video and multi-sensor data for dissimilar redundancy (a principle borrowed from aerospace practice). Emergency lighting throughout, voice alarm communication, and permanently staffed fire crews stationed around the clock in each tower's sky lobbies. They complete a strategy whose intent can be stated simply: the original towers asked their occupants to descend alone; these towers are designed so that help is already inside, and ascending, from the first alarm.

1.3.5 Tuned mass dampers

Wind-induced motion in supertall buildings is controlled not only by stiffness but by supplementary damping, and the towers adopt a liquid tuned mass damper (TMD). They consist of large steel tanks on floor 108 of each tower, each holding 1,000 tons of water, sized and baffled so that the water's sloshing frequency is tuned to the building's natural frequency and oscillates in opposition to it which dissipates vibrational energy, as shown in Figure 1.27. [19] The approach is well precedented. To name a few examples: tuned liquid and liquid-column dampers exist at the Comcast Center in Philadelphia, One Wall Centre in Vancouver and the Random House Tower in New York. [19] Probably the most famous solid counterpart — Taipei 101's publicly displayed 728-tonne steel pendulum — has demonstrated damper effectiveness through typhoons and earthquakes, reducing building sway by an estimated 30 to 40%. [20][21] Liquid dampers offer advantages for this project: they require no custom bearings or springs, demand minimal maintenance, less expensive to install, and their working mass is simply water [19] to which the design exploits by connecting the tanks to the towers' standpipe and hydrant network as a gravity-fed emergency firefighting reservoir. Final tank geometry, baffling and tuning will commence in the computation analyses in the detailed design phase.

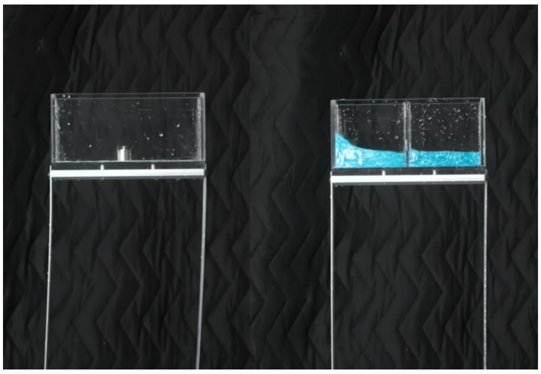


Figure 1.27: A simple demonstration of how fluid sloshing (in a contained tank of a specially tuned mass damper) quickly dissipates harmonic swaying motion in a tall building. Courtesy of Grady Hillhouse, Practical Engineering YouTube channel.

1.3.6 Basic Construction methodology

The construction approach pairs proven methods with deliberate homage. Excavation of the five-level basement to bedrock would employ the slurry trench (diaphragm wall) method: a perimeter trench excavated under bentonite slurry, reinforced and concreted panel by panel to form a watertight retaining wall before bulk excavation proceeds within. The technique's most significant application from an American perspective was the original World Trade Center itself. The teams used it at a scale never before attempted in the United States to create the famous “bathtub” that kept the Hudson River out of the site.[22] A million m^3 of excavated material became the landfill on which Battery Park City now stands.[23] The present project would continue that tradition of productive reuse: excavated material would be shuttled away via the nearby rail yard for land reclamation at distant sites, with the former US Steel Gary Works lakefront among the candidate destinations, alongside ground stabilization works appropriate to Chicago's glacial soils. Above grade, construction will follow modern supertall practice: the UHPC core advances continuously by slip-forming with prefabricated reinforcement; prefabricated steel sections would be lifted by modern high-capacity tower cranes, then bolted into position and welded (depicted in Figure 1.28. Subsequently floor slabs are poured and follow up the building in a rhythmic cycle.

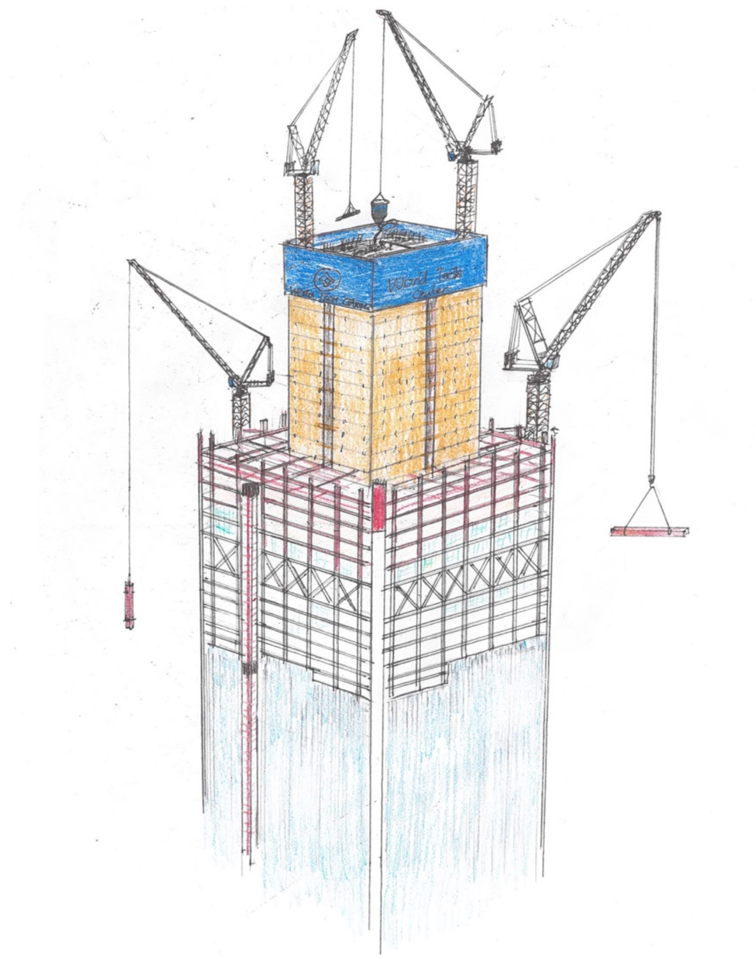


Figure 1.28: A hand drawn sketch depicting the construction process of one of the World Tech Center’s Twin Towers, clearly illustrating the central UHPC core rising by slip forming, followed by tower cranes lifting steel members into position.

1.4 Sustainability goals

The World Technology Center intends to demonstrate, at campus scale, the technologies it exists to advance. Therefore, its sustainability strategy goes beyond regulatory compliance and toward a working exhibition of renewable generation, circular waste management, low-carbon materials and nature-integrated design.

1.4.1 Electricity

The campus's stated target is operation on 100% renewable electricity, supplied through two complementary on-site technologies supported by an offsite generation facility. The first is photovoltaics, including transparent (Figure 1.29) and semi-transparent photovoltaic glazing integrated into the towers' vast façade areas: Building-Integrated Photovoltaic (BIPV) window technologies have advanced rapidly, with laboratory semi-transparent perovskite smart windows demonstrating power conversion efficiencies above 17% while retaining useful visible transmittance. [24] Other systems have even coupled transparent photovoltaics with photo-electro-chemical hydrogen generation and fuel cells into closed-loop building energy platforms. [25] For two towers offering several hundred thousand square meters of glazed envelope each, even modest area efficiencies aggregate into meaningful generation. The second technology is the hydrogen fuel cell installations housed in the basement plant levels, which would provide dispatchable, combustion-free power day and night. It would balance the photovoltaics' intermittency and furnishing inherent backup capacity for life-safety systems. Surplus renewable energy and green hydrogen supply would be secured through the dedicated offsite facility, with final system sizing fixed during detailed engineering. [24, 25]

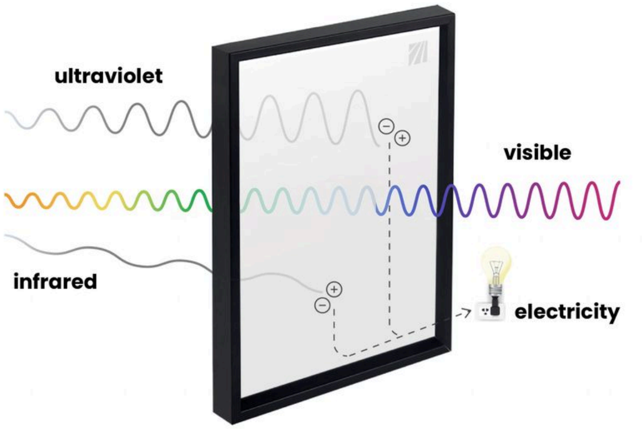


Figure 1.29: Diagram of a transparent window glass photovoltaic panel. The WTC campus buildings would utilize this technology to a large scale. Source: https://ubiquitous.energy/

1.4.2 Recycling and waste management

Waste is treated as an on-campus resource stream rather than an exported problem. Garbage chutes throughout each building descend to basement-level recycling, material sorting and energy recovery facilities, where recyclable fractions are separated, and the non-recyclable residue is converted to useful energy in a waste-to-energy installation fitted with carbon capture machinery. The model for this approach is well established at municipal scale: for example, Copenhagen's Amager Bakke facility (among the most advanced waste-to-energy plants in the world) treats over 400,000 tons of non-recyclable waste annually, generating 2.7 MWh of district heating and 0.8 MWh of low-carbon electricity per ton of waste while recovering metals and reusing bottom ash in road construction. It has also operated a carbon capture pilot since 2021 as a pathway to full-scale capture. [26] Life cycle assessment of that plant indicates that adding carbon capture and storage reduces its climate impact by an average of roughly 850 kg CO2-

equivalent per ton of waste treated, turning waste treatment into a net climate-positive activity. [27] The facilities at the World Technology Center would apply the same principles, appropriately sized, with captured CO_2 routed to storage or utilization offtake. Beyond its direct environmental function, the installation serves the campus's educational mission as a working, visitable example. [26, 27]

1.4.3 Sustainable materials

The towers' enormous steel demand — on the order of hundreds of thousands of tons across the campus — is itself a sustainability decision. The project specifies recycled steel produced in electric arc furnaces (EAFs), the scrap-based route that now accounts for approximately 70% of American steelmaking and whose carbon intensity is roughly 75% lower than traditional blast furnace production. [28] Representative producer data indicate around 0.77 tons of CO_2 per ton of EAF steel against 2.33 tons for the extractive blast-furnace route across emission scopes 1–3. [29] Both A514 plate and A992 shapes are available from domestic EAF producers, and as the American grid decarbonizes, the embodied carbon of EAF steel falls further still. [28] Concrete, however, is the harder problem: UHPC's dense, cement-rich mix carries a higher embodied carbon per cubic meter than ordinary concrete, but this is partially offset by the far smaller volumes its strength permits and by service-life durability that defers replacement and repair. [10] The project's intent is to procure UHPC formulated with supplementary cementitious materials and, where certifiable, carbon-neutral or carbon-mineralized sourcing for the conventional lightweight concrete of the floor slabs — applying to its own fabric the materials-science research agenda of the Musgrave Building's laboratories. [10][28][29]

1.4.4 Greenery and openness

The campus's nature-driven biophilic design is grounded in four decades of evidence that contact with nature measurably improves human function. The foundational study remains Ulrich's 1984 paper in Science, which found that surgical patients with a window view of trees recovered faster, required less pain medication and received fewer negative nursing evaluations than matched patients facing a brick wall. [30] Subsequent workplace research, including the multinational Human Spaces survey of 7,600 workers, associates biophilic environments with approximately 6% higher productivity, 15% higher creativity and 15% higher reported wellbeing. [31] For a campus whose purpose is sustained intellectual work, these are not amenities but performance infrastructure. The design (illustrated in Appendix B) therefore distributes openness as deliberately as greenery: generous balconies, the atriums, the skylights and the 3-metre typical ceiling heights all resist the sealed, artificial character of conventional deep-plan offices. Along with the Twin Towers' windows being 75% wider than the legacy to improve the amount of natural lighting, these ensure that daylight and sightlines to sky or vegetation can be experienced from the great majority of occupied positions — for the mental health and wellbeing of every occupant, from the youngest visiting schoolchild to the longest-serving researcher. [30][31]

1.5 Architectural philosophy

The architecture of the World Tech Center's Twin Towers is symbolic before it is stylistic, and every principal gesture carries a stated meaning. The twin form itself is the foundational symbol: two equal towers — one for technology, one for science — standing side by side, expressing the conviction that discovery and application are partners of equal rank, and that *two* working together exceed either working alone. The 1,969-foot spire encodes the year of Apollo 11, crowned by the largest waving flag in the nation; and the names across the campus assemble a pantheon spanning invention, statesmanship, medicine, teaching, flight and architecture itself. The silhouette and tridents honor Minoru Yamasaki's original composition while everything beneath them is new: the project describes itself as a rebirth, not a replica. Stylistically, the campus weaves three threads: the Art Deco warmth of the plaza and trims that recall the optimism of America's first skyscraper age. The retrofuturism of the hotel and mall - a return to the space age; and the crystalline modernism of the towers' blue glass (with anodized aluminium) speaking for the present. The composition is completed by ritual: the campus will close each September 11th; its flag lowered to half-mast; and the illuminated edges and crown shall change to the nation's observances. It is architecture that does not merely commemorate but participates.

1.6 Chicago – why this city is significant for this project

Chicago is not a fallback location for the World Technology Center; it is the location the project's logic selects. The reasons are historical, economic, technical and practical at once.

Historically, Chicago is the birthplace of the skyscraper. The Home Insurance Building of 1885, designed by William Le Baron Jenney, was the first tall building carried on a metal skeleton frame, and the Chicago School that formed around Jenney's office — Burnham, Root, Sullivan — invented the modern tall building as a type. [32][33] The city has renewed that claim in every era since, from the Art Deco towers of the 1920s to the structural-tube innovations of the 1960s and '70s when the bundled-tube Sears Tower took the world height record in 1973 — the very year the original World Trade Center was dedicated. [33] A project that proposes to advance the art of the supertall building belongs, by lineage, in the city that founded that art.

Economically and scientifically, Chicago is in the midst of a deep-technology ascent that the World Technology Center is designed to amplify. The region hosts two U.S. Department of Energy national laboratories, Argonne and Fermilab; four of the ten National Quantum Initiative research centers (more than any other region) and the Chicago Quantum Exchange, one of the world's largest quantum collaboratives. [34, 35, 36] On the city's Southeast Side, the Illinois Quantum and Microelectronics Park has broken ground on the former US Steel South Works site, anchored by *PsiQuantum*'s billion-dollar quantum computer operations center; alongside IBM, DARPA's Quantum Proving Ground and other tenants, with projected regional economic impact estimated in the tens of billions of dollars. [34, 35, 37] The U.S. federal government has likewise designated the region a national Tech Hub for quantum technologies. [35] The city council's Central Area Plan 2045 calls explicitly for talent pipelines into quantum technologies, life sciences, clean energy, information technology and advanced manufacturing, and for the reactivation of vacant and underutilized central-area property.[38] This means that the project's proposed 35-acre Near West Side site answers almost literally. Nearby, Related Midwest's *The 78* — a $7 billion, 62-acre mixed-use district on the South Branch — demonstrates that master planned development at precisely this scale is considered viable and desirable in central Chicago today. [39][40]

Practically, Chicago offers what New York cannot: land flexibility for a coherent 35-acre, multi-building campus; a central national location within a four-hour flight of both coasts: O'Hare's global connectivity; a transit network into which the campus's proposed Blue Line station plugs directly; and a deep regional pool of engineering talent fed by the universities of Illinois, Indiana and the wider Midwest. There is also a quieter, subjective fitness. New York holds the original towers' memory and holds it well. The city of Chicago, the city of the Great Fire and the Great Rebuilding, is the American city whose identity is renewal through engineering. To raise the twin silhouette again — taller, safer, and devoted to the sciences — in the city that taught the world to build tall, is not a relocation of the legacy but its most natural continuation.

Chapter Two — the History and Legacy of the World Trade Center Twin Towers

Source: Library of Congress, 1964

No proposal to raise the twin silhouette again can be evaluated without first understanding what was raised the first time, by whom, and why. This chapter therefore turns from the World Technology Center's vision to its inheritance: the origins and purpose of the original World Trade Center, the philosophy of the architect who gave it form, and the remarkable catalogue of civil engineering innovations the project contributed to the building art. The original towers were not merely tall; they were an argument — about trade and peace, about the dignity of the people inside a building, and about how far construction technology could be advanced when a public agency committed itself to a generational undertaking. Sections 2.1 to 2.3 examine that argument on its own terms; the chapter's later sections will follow its reception, its afterlife in cultural memory, and the long civic effort to see the towers rebuilt

2.1 The purpose of the original World Trade Center

The World Trade Center was conceived in the confidence of post-war America. The United States had emerged from the Second World War as the anchor of a new international economic order, and the expansion of world trade was understood not merely as commerce but as policy — the binding of nations into mutual prosperity. New York was the natural seat of that ambition, yet by the 1950s the city's growth was flowing almost entirely to Midtown Manhattan while the historic financial district at the island's tip stagnated, its ageing building stock emptying as firms moved north. [23, 42]

The response came from David Rockefeller, then a senior executive of Chase Manhattan Bank. Having committed his bank to Lower Manhattan with the construction of One Chase Manhattan Plaza, announced in 1955, Rockefeller organized the Downtown-Lower Manhattan Association in the late 1950s to marshal the business community behind a comprehensive renewal of the district. The association's 1958 master plan proposed transforming Lower Manhattan through new offices, housing and traffic improvements, and by 1959–60 its centerpiece had manifested as a 'world trade center'. It initially was slated as a roughly $250 million complex on the East River that would gather the scattered institutions of international commerce into a single address. [23][41][42] The concept itself was older, having circulated in New York since the mid-1940s, but it was Rockefeller's association that gave it institutional force. [42]

For the resources to realize it, Rockefeller turned to the Port of New York Authority (today known as the Port Authority of New York and New Jersey, PANYNJ), the bi-state agency chartered by New York and New Jersey in 1921 to operate the region's transport infrastructure within a 25-mile (40 km) radius of the Statue of Liberty. Under its formidable executive director Austin Joseph Tobin, who led the agency from 1942 to 1972, the Port Authority commanded engineering capacity, bonding power and a billion-dollar portfolio of bridges, tunnels and terminals — the only public body in the region capable of an undertaking on this scale. [23, 45] New Jersey's price for authorizing the project reshaped it: Governor Robert Meyner pressed for a site serving New Jersey commuters, and in the bargain struck between the two states the Port Authority agreed to take over the bankrupt Hudson & Manhattan Railroad (renamed to as the PATH, Port Authority Trans-Hudson) system — in exchange for New Jersey's support. This resulting in moving the project from the East River to the west side site above the Hudson Terminal. [43][44] The two state legislatures formally imitated the World Trade Center project in 1962. [41]

The chosen sixteen-acre superblock displaced Radio Row, a dense district of more than three hundred small electronics businesses whose owners fought the condemnation through protest and litigation (an early and instructive lesson), for any successor project, in the human cost of clearance-based renewal.[41] What rose in its place was essentially a vertical port: some 930,000 square meters (10 million square feet) of workspace intended to concentrate exporters, importers, freight forwarders, customs brokers, banks and trade associations under one civic roof. Its animating slogan — peace through trade — was sincere: the complex was conceived as an instrument of international understanding as much as of regional economics. When the $900 million project (equivalent to around $7 billion in 2026) was completed and the complex formally dedicated on April 4th 1973, Governor Nelson Rockefeller — David's brother, and the project's indispensable political patron — pronounced it a dream realized. [23] The World Technology Center's own thesis, that concentrating a dispersed ecosystem in one deliberately designed place multiplies its power, is a direct descendant of that founding idea.

2.2 The Philosophy of the Architect

On September 20th 1962, the Port Authority announced its choice of architect: Minoru Yamasaki of Michigan, working with Emery Roth & Sons of New York as associate architects (Figure 2.1). [53] The selection was itself a statement. Yamasaki was not a member of the East Coast architectural establishment; he was the Seattle-born son of Japanese immigrants, educated at the University of Washington and New York University, who had paid his way through college working summers in Alaskan salmon canneries and had faced racial prejudice through much of his early life and career. [50, 51] By 1962, on the strength of buildings such as the celebrated United States Science Pavilion at the Seattle World's Fair, he had risen to the front rank of American architects — an underdog entrusted with what would become the tallest buildings in the world. [50]

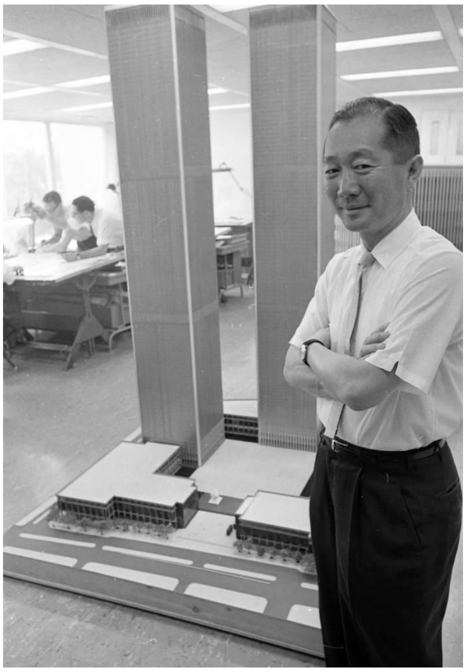


Figure 2.1 – Minoru Yamasaki in his workshop, with a prototype model of the World Trade Center, circa 1964.

Yamasaki's design philosophy had been transformed by personal crisis. A near-fatal illness eight years prior in 1954 (brought on by stress due to overwork) preceded a decisive turn in his architecture away from austere functionalism toward what he described as serenity, surprise and delight: buildings that would soothe and elevate the human spirit through gardens, pools, skylights, fine materials and Gothic-inspired vertical lines. [48][49] Through the late 1950s and 1960s he argued openly against the glass-box International Style then conquering American skylines, insisting that the purpose of architecture was to create an atmosphere in which people could live, work and enjoy their lives. [47][48] The approach came to be known as New Formalism, and it made him simultaneously one of the most popular and most critic-resisted architects of his generation.[51]

His statement for the World Trade Center commission, preserved in the Port Authority's archives, sets out the ethos in his own words. The project's paramount opportunity, he wrote, lay in the relation of world trade to world peace — the communication and understanding implicit in trade being basic to peace — and the buildings should accordingly become “*a living symbol of man's dedication to world peace*”, a representation of belief in humanity, individual dignity and the greatness found through cooperation; and beyond these spiritual requirements, he argued, a project of this scope demanded a positive response to the practical challenge of advancing the art of building itself, through technological progress in construction. [46] He compressed the creed elsewhere to five words: “world trade means world peace”. [47] Interpreting this language suggests freedom and prosperity.

The philosophy reached into the smallest dimensions of the design. Yamasaki suffered from a fear of heights, and rather than concealing it he designed for it: the towers' windows were kept narrow (roughly 46 to 56 centimeters or 18 to 22 inches) between closely spaced columns, glazing only some 30% of the envelope. It is so that a person standing at the glass, able to brace both arms against solid structure, would feel secure a quarter mile above the street. [49, 52, 53] It was an act of empathy executed in steel: the architect designing for the most height-wary occupant rather than the boldest. That instinct — buildings judged by how they make the people inside them feel (together with the conviction that architecture should embody peace, dignity and cooperation), is precisely the inheritance the World Technology Center claims for itself, and the reason the campus's central circle bears his name.

2.3 The civil engineering and technological innovations of the project

The original World Trade Center was as consequential an engineering project as the twentieth century produced. To deliver ten million square feet of internal workspace in two 110-story towers (the tallest buildings in the world on completion, rising to at least 410m) its engineers were forced to innovate in nearly every discipline at once: structure, wind science, foundations, fire protection economics and vertical transportation. Several of those innovations fundamentally changed how tall buildings are designed and remain standard practice in civil engineering today. This section reviews them in turn.

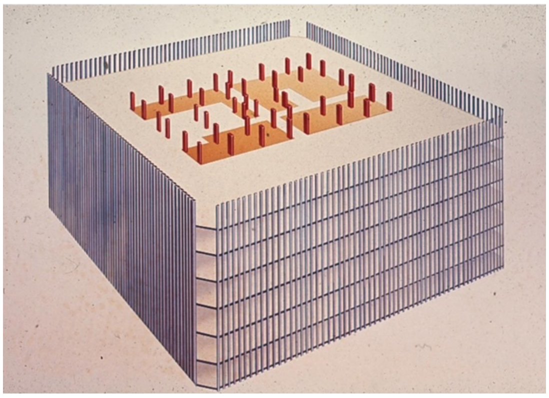


Figure 2.2: Historic engineering concept model of the original towers framed-tube structural system: a load-bearing perimeter tube of closely spaced columns, with interior columns confined to the service core and column-free floor space between.

Arguably the most significant innovation was its structural design. The towers' structural engineers: Worthington, Skilling, Helle & Jackson (with John Skilling and Leslie Robertson in the leading roles) developed the framed-tube system - a perimeter wall of closely spaced steel columns (59 per facade, joined by deep spandrel plates into a Vierendeel lattice) acting as a continuous cantilevered tube that carried the wind forced. An inner rectangular core of columns carried most of the gravity load and housed the elevators and services. [52, 54, 55] Between tube and core stretched up to 18.3 meters (60 feet) of completely column-free office space.[54] In contrast, the Empire State Building (its architectural predecessor) is a forest of interior columns wrapped in heavy masonry, its usable floor area fragmented, and its structure stiffened largely by sheer mass. [54] The tube was at once lighter, stiffer against wind in proportion to its weight, more economical in steel, and — decisive for a commercial developer — far more generous in rentable area. Virtually every supertall tower built since then (including the bundled-tube Sears Tower and the descendants of the present) stands in the lineage the Twin Towers established at full scale. [55] Figure 2.1 shows the original engineering concept model, with the perimeter tube's dense column grid and the core columns standing free within.

The floor system completed the structural logic. As shown in Figure 2.3, each office floor was a prefabricated 'bridge' spanning between core and perimeter: open-web bar-joist main trusses, paired and braced by transverse bridging trusses, supporting a corrugated steel deck and a 10-centimetre lightweight concrete slab. The truss 'top chords' were formed with projecting 'knuckles' that embedded into the slab, making steel and concrete act compositely as a single structural plate. The panels were fabricated off site and lifted into place as a completed unit. This was the early, large-scale exercise in modularized high-rise construction that drastically accelerated erection time. [6] The floors also concealed a world first in occupant-comfort engineering: roughly ten thousand viscoelastic damping units per tower, fitted between the truss ends and the perimeter columns to dissipate wind-induced motion — the first use of engineered dampers in a major building, developed by Robertson in collaboration with the Canadian wind engineer Alan G. Davenport. [6][54]

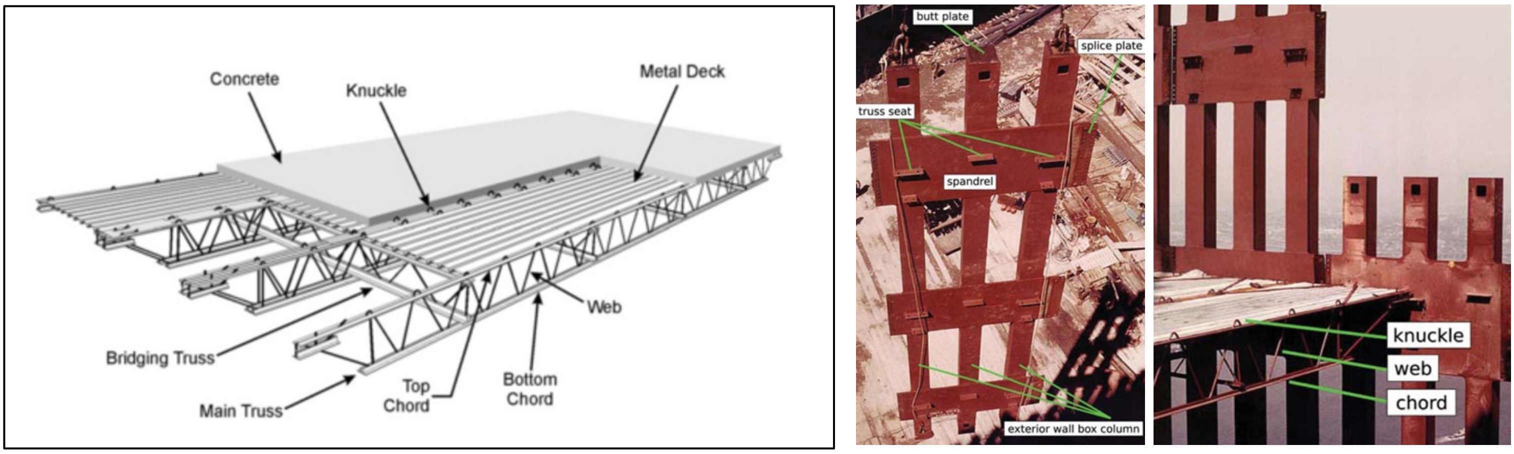


Figure 2.3: A diagram of the original towers' composite floor truss system and annotated pictures of its perimeter column segments. Source: NIST.

The collaboration points to the project's second imitative: the birth of modern wind dynamics practice in high-rise civil engineering. Because the framed tube was so much lighter than masonry-clad frames, its response to wind — both strength and the perception of sway by occupants — became a governing design question that the building codes of the day were simply not equipped to answer. [54][55] This is where aerospace engineering meets architecture for the first time. In 1964 the design team commissioned Davenport to conduct boundary-layer wind tunnel tests of the towers at Colorado State University, which was the first such comprehensive wind study ever carried out for a building project. It involved analyses of flows with a high Reynolds number (turbulent flow), numerous pressure tappings and balance scales, as well as height-varying wind of atmospheric boundary layers (illustrated in Figure 2.4 and Appendix B3). [56] The program, attended by Yamasaki, Skilling, Robertson and the aerodynamicist Jack Cermak, extended to novel human-comfort experiments to measure how much building motion occupants could tolerate. This eventually led to Davenport founding the world's first dedicated boundary-layer wind tunnel laboratory for civil structures at the University of Western Ontario in 1965. Another laboratory was utilized – the National Physical Laboratory in Teddington, United Kingdom. [55][56] Wind testing of every significant tall building on Earth is now standard practice in the architecture industry, augmented with computational fluid dynamics (CFD) on supercomputers.

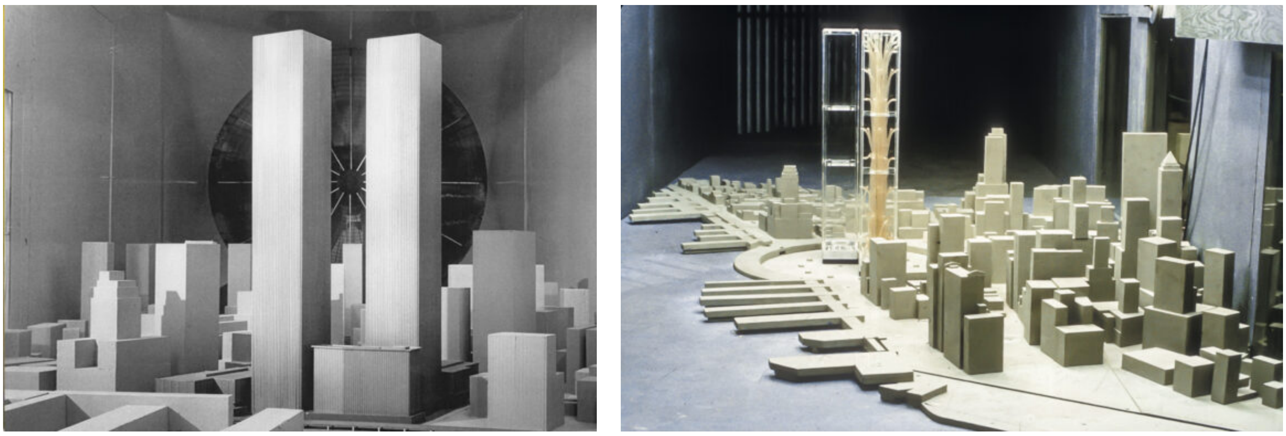


Figure 2.4 – Aerospace 1:400 scale wind tunnel models being used for the World Trade Center at the laboratories in 1965. Source: https://skyscraper.org/exhibitions/giants-twin-towers-and-the-twentieth-century/

Materials and analysis advanced in step. The perimeter tube was graded with extraordinary precision: NIST's later forensic survey documented fourteen different steel grades in the towers, with specified yield strengths from 248 to 690 MPa, deployed plate by plate so that strength followed stress — high-strength steels low on the building and on windward faces, milder grades above — an optimization made tractable by the design team's then-novel recourse to extensive computer structural analysis. [7] The fire protection strategy likewise broke with the masonry past. The towers were the first supertall buildings designed without masonry (their steel protected by lightweight sprayed fire-resistive material and their cores enclosed in gypsum drywall systems). Those were choices that saved enormous weight and cost, however their vulnerability to impact damage would, decades later, be identified by NIST as a central factor in the towers' collapse. [6][57] This lesson is answered in the successor design's hardened passive protection.

Below grade, the project introduced an entire foundation technology to the United States. The site's western half was landfill, with bedrock some 21 meters down (70ft) and the Hudson River water pressure pressing in. Conventional open excavation was impossible because the site would otherwise fill up, eroding the surrounding soil and endangering the ground stability of neighboring structures. The solution was the slurry trench method pioneered by the Italian firm ICOS: a trench excavated in sections around the full site perimeter, held open by bentonite slurry, then displaced by concrete to form a continuous watertight diaphragm wall socketed into bedrock. It functioned as an inverted 'bathtub' (shown in detail in Figure 2.5 and Appendix B4) within which the basements could be excavated in the dry. As material was removed, tensioning sockets were driven at oblique angles through the wall and down to bedrock and connected with steel bars to form a tieback. As the first application of slurry-wall construction on a large scale in the country, the methodology has since become the standard means of building deep basements in waterlogged urban ground worldwide. [22] The excavation itself was turned to civic profit: more than a million cubic meters of spoil were placed in the Hudson to create the land on which Battery Park City now stands.[23] A practical first-use of self-raising 'kangaroo' cranes imported from Australia were utilized for the towers that aided construction speed.[23]

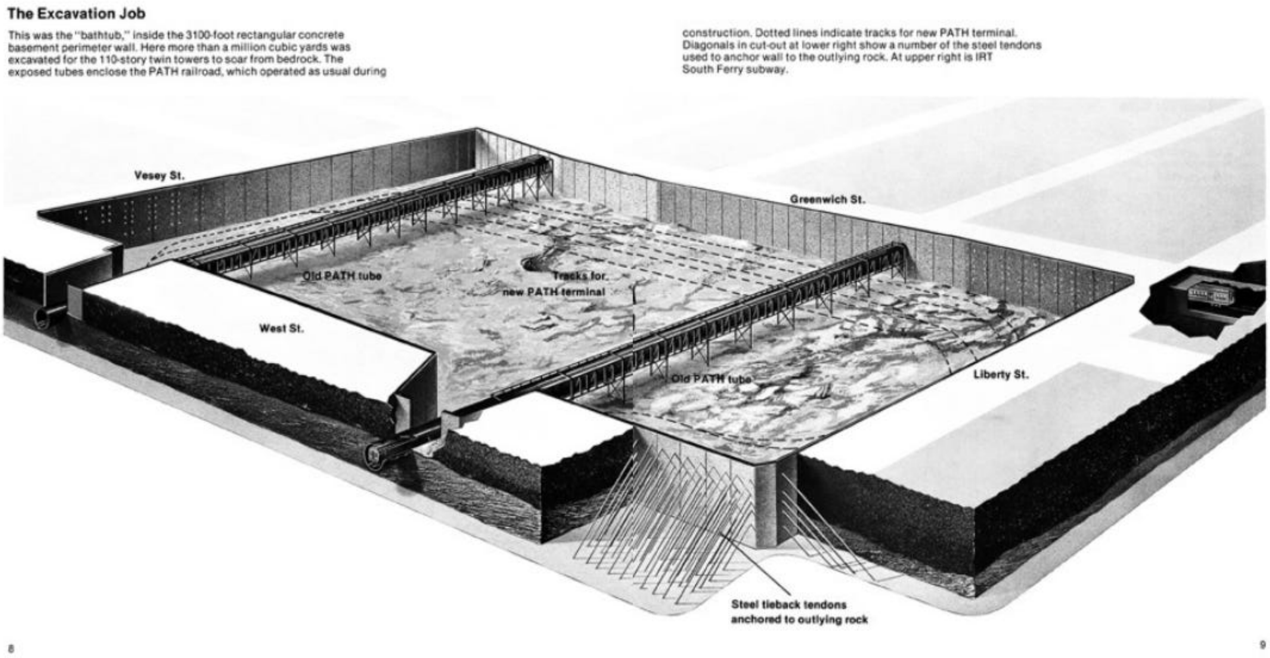


Figure 2.5 — Diagrams of the inverted Bathtub foundation site and excavation methodology for the original World Trade Cetner. Source: https://www.construction-physics.com/p/building-fast-and-slow-part-iii-design

Finally, the towers solved the problem that had capped skyscraper height for a generation: the elevator. Serving 110 stories conventionally would have consumed roughly half of every lower floor in shafts. Working with Otis, the design team instead divided each tower into three vertical zones connected by 'sky lobbies' at floors 44 and 78, where large express cars delivered passengers to banks of local elevators stacked within the same area. This scheme, modelled on an urban express-and-local transit system, nearly halved the shaft count and lifted usable floor area from about 62 to 75%. [53, 57, 58] The Twin Towers were among the very first buildings in the world to employ the sky-lobby system, which is now universal in supertall design [59] — and which the World Technology Center extends through the more recent innovation of double-deck elevator fleets described earlier. The diagram in Figure 2.6 summarizes the system design concept.

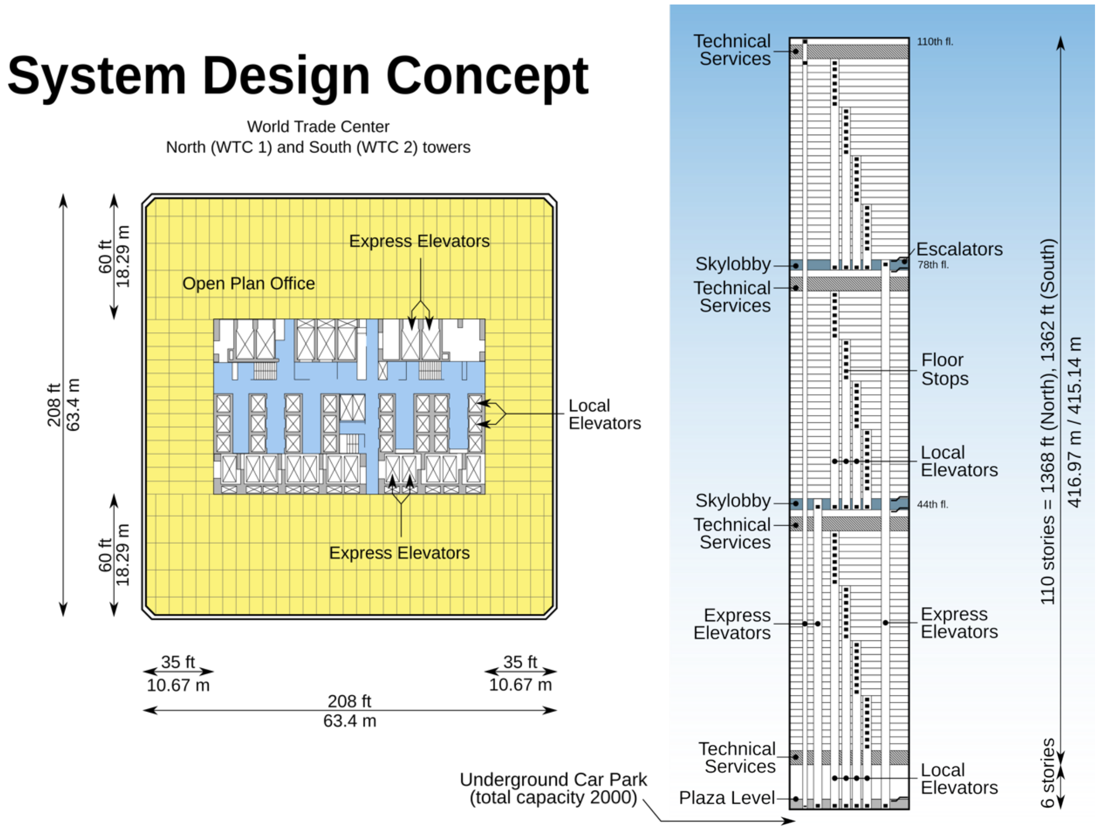


Figure 2.6: System design concept of the original North and South Towers: 63.4 m (208 ft) square plan with column-free office space surrounding the central core (left), and three-zone express/local elevator arrangement with sky lobbies at floors 44 and 78 (right). Source: Wikimedia Commons/Messer Woland

In summary: the framed tube, the composite prefabricated floors, engineered damping, boundary-layer wind testing, graded high-strength steels, computer-aided structural analysis, slurry-wall foundations and sky-lobby vertical transport — the original World Trade Center constitutes one of the densest clusters of civil engineering firsts ever assembled in a single project. It did precisely what Yamasaki's commissioning statement promised: it advanced the art of building. The towers that this report proposes are conceived in the same spirit, inheriting the original innovations where they endure, and correcting them where five further decades of engineering knowledge is learned, at terrible cost, from the towers themselves — demands better.

2.4. Architectural reception

The Twin Towers were not loved by critics when they were new. The architectural establishment, still firmly committed to the orthodoxies of high modernism, found Yamasaki's gigantic minimalism either provocative or simply dull. The American Institute of Architects and other professional bodies criticized the design, and the urban theorist Lewis Mumford — author of The City in History and the most influential architecture writer of his generation — dismissed the towers and their contemporaries as “just glass-and-metal filing cabinets”. [60] The complaint was as urbanistic as aesthetic: by clearing sixteen acres of dense, fine-grained streets to erect two monoliths on a windswept superblock, the project seemed to many to embody everything the emerging new-urbanist critique deplored about post-war planning. [60]

The criticism was sharpened by the stature of those making it. Ada Louise Huxtable, who in 1963 became the first full-time architecture critic at an American newspaper and in 1970 won the inaugural Pulitzer Prize for Criticism, had made the design of tall buildings a matter of public conscience, and her scrutiny — extended over a career to the very question of what a skyscraper should be — set the demanding terms against which the towers were measured. [61][62] To be judged by Huxtable's generation was to be judged severely; the towers' blankness, their sheer repetitive verticality, read to contemporary eyes as a refusal of architecture's expressive duties rather than, as later observers would see it, a radical distillation of them.

Yet the public verdict diverged from the professional one, and over time the professional one softened toward the public. The towers' very abstraction — two identical silver shafts, without ornament or explanation — proved to be the source of their iconic power. They became, with the Empire State Building and the Statue of Liberty, one of the instantly legible symbols of New York, endlessly photographed, filmed and reproduced. Hollywood, as one retrospective observed, treated them almost as characters, featuring them in virtually every film set in the city between 1973 and 2001. [64] Architectural historians came to read the design as the most striking American expression of Le Corbusier's tower-in-a-park ethic and as the seminal statement of Yamasaki's cathedral-inspired Gothic-tinged modernism, a serious work whose reticence was a deliberate aesthetic rather than a failure of nerve. [52] By the time a 2004 survey found that around half of New Yorkers wanted the towers rebuilt — with campaigners citing other polls showing support as high as seventy per cent — the inversion was complete: buildings never much loved as architecture had become, in the Guardian's phrase, beloved precisely when they were gone. [63]

Underlying that affection was the meaning Yamasaki had always intended the towers to carry. Conceived as the architectural embodiment of world trade, and through trade of world peace, the complex was meant to stand for openness, cooperation and human dignity — a representation, in the architect's own commissioning words, of belief in humanity and in the greatness found through the cooperation of nations. [46][53] That symbolism, latent and even unfashionable while the towers stood unremarkably on the skyline, became explicit and inescapable the moment they were attacked. The reception history of the World Trade Center is therefore a cautionary lesson for any successor: the architectural value of such a project is not fixed at its unveiling but accrues over decades, and a form dismissed as austere can become, in the public imagination, sacred.

2.5 The cultural memory post-9/11

The destruction of the towers transformed them instantly from architecture into memory. What had been a familiar, even overlooked, feature of the skyline became an absence so conspicuous that the empty air above Lower Manhattan acquired a presence of its own. In the quarter-century since, that absence has been mourned, memorialized and contested in a manner that places the World Trade Center among the most intensively remembered structures in modern history — a case study, for scholars of collective memory, in how a society commemorates a trauma whose physical site is also a graveyard, a building project and a piece of contested real estate. [71]

The first and most eloquent memorial was made not of stone but of beams of photons. On March 11th, 2002 (exactly six months after the attacks), the Tribute in Light switched on: eighty-eight high-powered xenon searchlights arranged in two squares that projected twin columns of blue four miles into the night sky (echoing the footprints and orientation of the lost towers and visible across a sixty-mile radius). [65][67] Conceived by a group of artists and architects and produced under the auspices of the Municipal Art Society, it was intended as a temporary gesture but proved so resonant that it has been repeated every 11 September since. [66] Its power lay in its very immateriality: it restored the towers' silhouette to the skyline without pretending they had not fallen, an act of remembrance that was also, quietly, an act of defiance. Scholars of memorial culture have read the installation as the paradigmatic example of an "aesthetics of absence" — a mode of commemoration that marks loss by tracing the shape of what is no longer there. [68]

That same logic governed the permanent memorial. Of the more than five thousand entries submitted to the international competition from sixty-three nations, the jury selected Reflecting Absence by Michael Arad and Peter Walker, a design that sank the footprints of the two towers into the earth as a pair of acre-sized voids, their sides sheeted in the largest manmade waterfalls in North America, the names of the deceased inscribed around their rims. [68][69] The decision to preserve the footprints as the centerpiece of the site rather than to build directly upon them, was not merely an aesthetic preference; it was the outcome of a sustained campaign by the victims' families who strived that the specific ground where their relatives had died be treated as sacred space and exempt from commercial development. [70]

The footprints thus became, in the official imagination, inviolable — a fact that would prove decisive for every proposal to rebuild, as Section 2.6 examines. A surviving fragment of the original complex, Fritz Koenig's great bronze Sphere, which had stood at the center of the plaza and was recovered damaged but intact from the ruins, was eventually returned to a site near the memorial, a literal relic carried forward from the old world to the new. [69]

Beyond the official memorials, the towers saturated the wider culture in ways that registered the depth of their loss. In the immediate aftermath, film studios scrambled to excise the towers from completed and forthcoming productions, judging their image suddenly unbearable — an erasure that paradoxically confirmed how omnipresent they had been.[64] Artists and writers responded directly to the void: the cartoonist Art Spiegelman's *In the Shadow of No Towers* (2004) made the haunting after-image of the burning buildings the formal and emotional core of a major work, one of countless cultural reckonings the attacks provoked. The towers' pre-9/11 mythology was retrospectively magnified as well, above all the memory of Philippe Petit's 1974 tightrope walk between the rooftops, which was recast from a curious stunt into a poignant emblem of their lost romance. [23] For the generation that had grown up with them, the towers had been, as one impassioned essay put it, what the Statue of Liberty had been to an earlier age of newcomers — a symbol of arrival, aspiration and the reach toward the sky. [64]

What this dense memorial culture demonstrates is that the World Trade Center now occupies two distinct registers simultaneously. There is the physical site in Lower Manhattan, rightly given over to mourning and remembrance, where the footprints themselves are sacred, and the dominant emotional key is elegiac. And there is the towers' form and meaning as a cultural inheritance — the silver silhouette, the ethos of peace through cooperation, the sheer aspirational ambition — which is portable, which belongs to the nation rather than to a single plot of ground, and which can in principle be honored and carried forward elsewhere.

Distinguishing these two registers is essential to thinking clearly about renewal. To confuse them is to assume that any revival of the towers' form must occur on the graves of the dead, which it need not; to separate them is to see that the memory of the towers can be served both by the solemn voids at *Ground Zero* and, quite differently, by a living structure built for a new purpose in a new place. It is precisely that separation that the present project depends upon, and that the long campaign to rebuild the towers first brought into focus.

2.6 The Civil Efforts to Rebuild the Towers

Almost from the moment the towers fell, a current of public opinion held that the right response was not to mourn them with an absence but to answer the attack by raising them again. This conviction, dismissed in official circles as naive or even ghoulish, never disappeared; it organized itself, produced detailed designs, attracted a celebrity champion and persisted for the better part of a decade. The story of that campaign — and of the objective reasons it did not prevail — is the immediate prehistory of the World Technology Center, and it establishes the central principle on which this project rests: that a beloved architectural form can be made to evolve responsibly rather than be either frozen or erased.

The campaign acquired its definitive shape in the work of two men. Kenneth Gardner, a structural engineer, and Herbert Belton, an architect who had worked in the team on the original World Trade Center while at Emery Roth & Sons, together produced a scheme they called the "*Plan of the People*", also known as *Twin Towers II* and, informally, the *World Trade Center Phoenix* (in reference to the bird). [72][73] Their design (Figure 2.7) revived Yamasaki's silhouette almost exactly but raised it five stories (to 115 floors) and re-engineered it for a new era of safety: a doubled, tube-within-a-tube steel skin with heavier columns intended to withstand aircraft impact, larger windows for occupant comfort, improved fireproofing, six stairwells, and given over to a mix of offices, apartments and a hotel. [72][74] Crucially, the new towers were shifted off the original footprints (as per the families), which the plan preserved as a pair of memorials clad in the recovered steel of the fallen towers and inscribed in granite. [72, 74]

The design was promoted by Team Twin Towers, a New York non-profit co-founded by the television producer Randy Warner, with the venture capitalist Jonathan Hakala — a former tenant of the seventy-seventh floor of the North Tower — as its spokesman. [72][73] Gardner framed the proposal not as nostalgia but as restoration: the returning towers, he argued, would stand for resolve, strength and renewal, and would be a living memorial more powerful than pretending the attack had never happened. [72] The team unveiled its architectural model at a news conference at the Marriott Financial Center Hotel on 18 February 2004, two blocks from where the South Tower had stood. [73]

The campaign's most consequential supporter arrived the following year. Donald Trump — then a New York property developer and television personality — encountered Gardner's model while at the MSNBC studios for an unrelated interview and reached out to the engineer afterward. [76] In 2005 he became the project's sponsor and its most prominent public advocate, displaying the Twin Towers II model in the lobby of Trump Tower alongside a guest book that, by Gardner's account, gathered more than twenty thousand signatures of support. [76] On 18 May 2005 Trump held a press conference at Trump Tower, with by Gardner and Belton in attendance. It was to present the alternative scheme and to challenge the official plan in characteristically vivid terms. [72, 75] He criticized the design then proposed for *Ground Zero* and that his core argument was framed as a contest of national will: "*The terrorists win if we build this job the way it is*", he told MSNBC, whereas rebuilding the towers a story taller and stronger would represent victory. [76] Yet Trump was candid about the limits of his role. He held no stake in the site and committed neither to leasing space in the proposed towers — "I only go in buildings I own", he told the New York Times — nor to financing them, deferring on both counts to the site's leaseholder, Larry Silverstein. [75] His influence, he conceded, rested on "the power of persuasion" alone. [72, 75]

The campaign drew a broad and sometimes unexpected coalition. Fernando Ferrer, the former Bronx borough president and a candidate for mayor, called the rebuilding idea worth serious consideration and argued that the replacement should not look “cowardly”. [77] Greg Manning, who with his wife Lauren had worked in the towers and whom the attacks had nearly killed, wrote a New York Times op-ed in support, arguing that to honor the dead the city needed to return to the sky. [72]

A citizens' watchdog group, the Twin Towers Alliance, co-founded by Richard Hughes and Margaret Donovan, kept the proposal before the public for years, mounting a series of “Kitchen Table Summit” meetings and contending that a twenty-first-century twin-towered complex could be completed in three or four years, for billions of dollars less than the official scheme, while offering a memorial that many bereaved families preferred. [78, 79] The campaign leaned heavily on evidence of popular support, repeatedly citing online polls — one conducted by MSNBC drew over three thousand responses, some eighty per cent favoring rebuilding, and the Alliance later claimed figures above ninety per cent. [[74, 79] Public discontent with the official design was real and was not confined to activists; even Bjarke Ingels, later chosen to design a tower at the rebuilt site, would say that his own instinct after the attacks had been simply to build the towers again as they were, because they had been so central to the identity of Manhattan and “looked very strong”. [80]

Despite this momentum, the Twin Towers II proposal was never built, and the reasons it failed are as important to understand as the passion that drove it. They were, in the main, matters of process, timing, ownership and commemorative principle rather than of the design's intrinsic merit. The official redevelopment had begun almost immediately after the attacks under the Lower Manhattan Development Corporation, which launched an international corporate competition in 2002 and, in February 2003, selected Daniel Libeskind's master plan, Memory Foundations, as the framework for the site. [82][83]

Figure 2.7 — Kenneth L. Gardner presenting the Twin Towers II initiative besides Donald J. Trump (top) and a view of the architectural model by architect Herbert Belton (bottom).

That plan fixed on a cluster of entirely new contemporary commercial towers around the perimeter, where a symbolic 1,776-foot lead tower (dubbed the *Freedom Tower*), designed in detail by David Childs of Skidmore, Owings & Merrill — and, at the heart of the site, the footprints left open as the memorial. [82][89]

In January 2004 a second competition selected Reflecting Absence as that memorial, entrenching the footprints as protected voids. [84, 85]

By the time Gardner and Belton unveiled their model the following month (and intended to formally submit their proposal in the competition), the central commitments of the official plan were already a year old, and the rebuilding effort was, as the New York Sun candidly described it, a “belated entry” to a competition that had effectively closed. [74]

The footprint memorial was the decisive obstacle. Because victims' families had successfully established the original tower footprints as sacred ground exempt from construction, the official site could not accommodate new towers on the spots the public most associated with the originals. [70] Twin Towers II attempted to honor this by shifting its towers aside and memorializing the footprints, but in doing so it collided with the geometry and the politics of a plan already adopted through an extensive public process involving the LMDC, the Port Authority, the state governor, the site's developer and the families themselves. [72] The objection voiced by Thomas Rogér, whose daughter Jean had died as a flight attendant aboard the first aircraft, captured the procedural difficulty bluntly: the rebuilding advocates, he suggested, had arrived years after the master planning was done. [75] Security concerns compounded the timing problem. In 2005 the New York City Police Department's objections forced a redesign of the Freedom Tower, including the addition of a 187-foot fortified concrete base; the revised design was unveiled on 28 June 2005, and construction began in April 2006, physically committing the site to the official plan and effectively foreclosing the alternative. [72]

Finance and ownership sealed the outcome. The rebuilding of the World Trade Center was governed not by public opinion but by the contractual realities of the site, which Silverstein's company had leased only weeks before the attacks for some $3.2 billion, and which was being rebuilt largely with the matching insurance proceeds. [86][87] Twin Towers II, for all its popular backing, never had what a project on this site required: a developer, a financing plan or committed tenants. Trump himself, its champion, had declined to provide any of these. [75] The official towers, by contrast, commanded the insurance settlement, the bonding power of the Port Authority and, from 2006, a division of responsibility in which the Port Authority assumed the Freedom Tower while Silverstein retained the eastern towers; the Durst Organization later took a stake in the lead building [86, 88]. The result was neither cheap nor swift — One World Trade Center eventually cost some $3.9 billion and did not open until 2014. [86][89] Critics of the official effort, including the Twin Towers Alliance, argued precisely that this expense and delay vindicated their alternative. [78] But the reliance of the rebuilding campaign on unscientific online polls, and its lack of any mechanism to actually fund or construct its towers, meant that it remained a powerful expression of public sentiment rather than a buildable proposition. [74][75]

The deeper lesson of this history is not that the towers should have been rebuilt at the sixteen-acre site. There are sound reasons, examined above, why that site became a memorial — but that the impulse behind the campaign was legitimate and remains unfulfilled. That impulse rested on a principal worth stating plainly: that a treasured work of architecture is a cultural inheritance which a civilization may carry forward and improve, not merely a fixed object to be mourned when lost or slavishly copied when rebuilt. History furnishes ample precedent. To name a few examples: Warsaw rebuilt its Old Town from rubble after the Second World War; Dresden raised its Frauenkirche again from a heap of catalogued stones; and NASA (more than once) restarted the Space Shuttle Program after the devastating disasters.

In each case continuity of form was married to discontinuity of substance: the beloved silhouette returned, but stronger, safer and fit for its time. Responsible evolution, in other words, is the historical norm for cherished buildings, not the exception.

The World Technology Center is the mature realization of that principle, and it resolves every tension that stranded Twin Towers II. It does not build on Ground Zero, leaving the sacred footprints undisturbed as the memorial they have rightly become. It does not attempt to resurrect the towers as speculative office space, the program whose commercial logic had grown doubtful even before the attacks. Instead, it carries the silhouette and the spirit of Yamasaki's towers to Chicago and reconceives them entirely — relocating the form, reprogramming it from a monument to commerce into an instrument of scientific benefit, and re-engineering it with tougher materials and modern fire standards that answer directly the structural lessons of the original's loss. The continuity is deliberate and is more than symbolic. Twenty-one years after the unveiling of the 2005 project, Kenneth Gardner (the structural engineer of Twin Towers II), has joined the present initiative, making the World Technology Center the literal continuation of the rebuilding campaign rather than merely its echo. [72] Where Twin Towers II sought to restore a skyline, the World Tech Center seeks to advance a civilization — honoring the ancestors' ethos of peace, cooperation and human aspiration while redirecting it toward the education and scientific ambition of a new century. That is what it means for legacy architecture to evolve responsibly: to keep faith with the form and the spirit of what was lost while changing everything about its location, its purpose and its engineering that wisdom and circumstance require.

Chapter Three — The Case for Renewal

The preceding chapters established what the World Technology Center is and the legacy it inherits. This chapter asks the harder question on which the entire proposal turns: *why does the United States presently need a project of this kind?* The answer is not a single deficiency but a convergence of multiple — a decline in the nation's appetite for long-horizon civic ambition, a fragmentation and dangerous over-concentration of its innovation ecosystem, the economic stagnation of great cities left behind by that concentration, and a growing estrangement between the public and the science that increasingly governs its future. Each of these is examined in turn, set against the historical evidence that bold, generational projects repay the courage they demand. Taken together they form the case for renewal.

3.1 Decline in long-term civic ambition

There was a period within living memory when the United States built at a scale and speed that now seems scarcely credible. The Empire State Building rose in roughly four hundred and ten days. The Hoover Dam — approved in 1928 and completed during the depths of the Great Depression — doubled the volume of any dam previously built, impounded the largest reservoir on Earth, and at a single stroke increased the hydropower of the American West by nearly half, becoming the template for a generation of federal public works. [96] The Golden Gate Bridge was completed in about four years. To these can be added the transcontinental railroad, the Interstate Highway System, the Tennessee Valley Authority and, supremely, the Apollo program. For much of the twentieth century, the capacity to conceive and deliver enormous, long-horizon projects was simply assumed to be part of what the country was.

That capacity has measurably eroded. The historian Marc Dunkelman, in his 2025 study Why Nothing Works, takes the protracted failure to replace New York's demolished Pennsylvania Station — once a monument to metropolitan greatness, torn down in the 1960s and never adequately replaced for half a century — as the emblem of a wider paralysis. [90][91] His diagnosis is that American progressivism gradually turned against the very instruments of public action it had once empowered: the era that built the Hamiltonian state of Robert Moses gave way, after the upheavals of the 1960s and 1970s, to a system deliberately seeded with veto points, in which almost any actor can halt a project but almost none can advance one. [91] The resulting inversion is captured in a single comparison drawn from the same period: the Golden Gate Bridge took about four years to build in the 1930s, yet installing suicide-prevention netting on it took roughly six years in the 2010s. [90] Ezra Klein and Derek Thompson, in their 2025 book Abundance, reach a parallel conclusion from the center-left, arguing that American liberalism has lost the ability to think and build in the long term, strangled by procedural bottlenecks of its own making. [92]

The clearest contemporary illustrations are the great public works that have foundered. California's high-speed rail project, approved by voters in 2008 on the promise of connecting San Francisco and Los Angeles in under three hours for a projected thirty-three billion dollars, has after seventeen years produced only a partial segment through the Central Valley; its projected cost has ballooned past one hundred billion dollars, its federal funding was withdrawn in 2025, and it has become, in one analyst's phrase, an expensive lesson in the limits of infrastructure by aspiration. [93][94] New York's Second Avenue Subway, meanwhile, holds the distinction of being the most expensive subway line ever built; as the Manhattan Institute has noted, even before its cost overruns it would have been roughly twice as expensive as any comparable project anywhere else in the world. [95] These are not isolated failures of management but symptoms of a systemic condition — what the planning scholar Bent Flyvbjerg termed the chronic “strategic misrepresentation” of megaproject costs, compounded in the American case by regulatory complexity, litigation and the diffusion of political power to the point of gridlock. [95]

The deeper loss is not financial but imaginative. A civilization that no longer expects to complete ambitious things gradually stops proposing them, and the horizon of public planning contracts from the generational to the merely electoral. Our project for the World Tech Center is conceived, in part, as a deliberate countercurrent to this drift — an assertion that the United States can still organize itself around a multi-decade undertaking of genuine ambition, and that the muscles of long-horizon civic action, though atrophied, have not been lost. The remaining sections set out the specific national needs such an undertaking would address.

3.2 Fragmentation of STEM ecosystems

American innovation is simultaneously the envy of the world and dangerously concentrated. In his influential study *The New Geography of Jobs*, the Berkeley economist Enrico Moretti documents what he calls the Great Divergence: the tendency of the knowledge economy, contrary to early predictions that digital technology would render location irrelevant, to cluster ever more tightly in a handful of “brain hubs”. [97] By Moretti's reckoning, of some 320 metropolitan areas in the United States, only fifteen to twenty functions as genuine innovation clusters, and into these few cities — San Francisco, Boston, Seattle, Austin and a short list of others — flows a disproportionate share of the nation's patents, venture capital and highly skilled workers. [98] The effect is self-reinforcing: because talent and capital are most productive when concentrated, success accrues to places that are already successful, while the cities of the industrial Midwest and elsewhere are steadily drained of their most ambitious graduates. [97][98]

This concentration is one of two fractures running through the American STEM ecosystem. The first is geographic. Described above: a country in which innovation is a regional monopoly of two coasts, leaving vast reserves of talent stranded in places that cannot, on Moretti's analysis, easily bootstrap themselves into clusters from hope alone. [98] The second fracture is institutional. Even within the innovation economy, the actors who should be collaborating are too often separated — academic research divorced from commercial development across the so-called valley of death, established corporations isolated from the start-ups that might renew them, and government agencies operating at a remove from both. Disciplines themselves are siloed, even though the most consequential modern advances increasingly occur at their intersections, where computing meets biology, or materials science meets energy.

The consequences are both economic and strategic. Talent that is never clustered is innovation that never happens; regional inequality deepens as the divergence accelerates; and a nation that concentrates its entire technological future in two or three coastal regions accepts a profound strategic vulnerability, whether to natural disaster, economic shock or simple over-crowding and cost. The World Technology Center is conceived as a direct structural answer to this fragmentation. By co-locating, within a single integrated campus, the research institutions, start-ups, established firms, universities, government workshops and public that the present system holds apart, it does not wait for a brain hub to emerge by serendipity — the mechanism Moretti shows is otherwise required — but deliberately engineers one, in a part of the country that the prevailing geography has bypassed.

3.3 Urban economic stagnation and unemployment

Chicago is the natural site for such intervention precisely because it embodies the paradox of divergence: a city of immense latent capacity that has nonetheless been losing ground. Its credentials are formidable. It is the birthplace of the skyscraper — the Home Insurance Building of 1885 is generally regarded as the first — and remains home to the second-largest concentration of Fortune 500 headquarters in the nation, a deep base of world-class universities, and two of the country's pre-eminent federal laboratories, Argonne and Fermilab, on its doorstep. Yet over the past several years the city has suffered a conspicuous run of corporate departures: in 2022 alone Boeing relocated its headquarters to Virginia, Caterpillar to the Dallas–Fort Worth area, and Kenneth Griffin's Citadel — the city's largest hedge fund — to Miami. [99][101] Between 2018 and 2023 Chicago lost some 9.5 per cent of its technology workforce, with the steepest decline in the final year. [100] The departures have been accompanied by persistent fiscal strain and well-publicized concerns, voiced even by chief executives who remained, about the difficulty of operating a global business from the city. [99, 101]

The underlying problem is one of competitiveness. For all its assets, Chicago is not yet a first-tier technology hub on the order of Silicon Valley, Boston or Seattle, and in the clustering dynamics described above it risks being permanently outdrawn by them in the contest for skilled workers and venture capital. [100] To compete, the city cannot rely on its existing strengths alone; it must give the most mobile talent in the world a compelling and distinctive reason to choose Chicago over the coasts — an anchor of sufficient gravity to begin reversing the flow.

Crucially, the foundations for exactly such a reversal are now being laid. Illinois has committed to the Illinois Quantum and Microelectronics Park on the long-derelict site of the former US Steel South Works, anchored by a major quantum-computing investment of roughly one billion dollars and reinforced by the existing Chicago Quantum Exchange; the multibillion-dollar mixed-use development known as *The 78* is reactivating a large tract of vacant near-South-Side land; and the City's own Central Area Plan 2045 explicitly calls for building quantum and life-sciences talent pipelines and returning vacant property to productive use. [102, 103] The World Technology Center is conceived as the catalyst that would crown and accelerate this emerging strategy — a landmark of national prominence that reactivates underused urban land, draws skilled workers and investment to the Midwest, and gives Chicago the tier-one innovation magnet it needs to compete on equal terms with the established coastal hubs.

3.4 Lack of public scientific inspiration

Beneath the economic and structural arguments lies a subtler deficit, and in the long run perhaps the most consequential: active science has become almost invisible to the public that funds it and the young people who might be drawn into it. The overwhelming majority of contemporary research and development takes place out of sight — behind security badges in suburban office parks, on gated corporate campuses and in laboratories deliberately sequestered from public view. The result is a society in which the most important work of the contemporary information age is conducted in a manner almost calculated to inspire no one, and in which the average citizen, student or family may pass an entire lifetime without ever seeing science being done.

Educational research literature has given this problem a precise vocabulary. The concept of “science capital” (developed by Louise Archer and colleagues) denotes the accumulated knowledge, attitudes, dispositions and social connections that lead a person to feel that science is “for them”. [104] Studies consistently find that science capital is unevenly distributed and strongly predictive of participation: those who lack it — disproportionately from underrepresented and lower-income backgrounds — are far less likely to pursue science, not for want of ability but for want of exposure and belonging. [104] Critically, the same research shows that this capital is built substantially outside the classroom. The work of John Falk and Lynn Dierking on free-choice and informal learning demonstrates that museums, science centers and other public environments exert a powerful and lasting influence on attitudes toward science, [105] while a much-cited study by Maltese and Tai found that durable interest in science is most often sparked by early, frequently out-of-school experiences rather than by formal instruction alone. [106] Out-of-school encounters, in short, are not peripheral to the formation of a scientist; they are frequently where it begins. [104]

There is, in addition, a specifically inspirational dimension to the deficit. The Apollo program drew an entire generation of young Americans into science, engineering and mathematics through the sheer visible grandeur of the undertaking, and not just the technology advancements and the workforce of around 400,000 individuals at its peak. [108] No comparable public spectacle of science has succeeded in it. The nation has, in effect, allowed the great motivating power of visible, awe-inspiring, accessible science to lapse — and with it a reliable mechanism for replenishing its own scientific talent.

Two further considerations sharpen the need. The first is that innovation is increasingly interdisciplinary: the frontier now runs along the boundaries between fields, and physically co-locating disciplines so that researchers from different domains meet, collide and collaborate is itself a driver of discovery. The second is that the benefits of such an environment multiply enormously when it is made visible — when students, working professionals and members of the public who may know little or nothing of STEM can see real research underway, walk among the people who conduct it, and come to feel that this world is open to them. The World Technology Center project is designed precisely around this conviction. It is conceived not as a sealed research compound but as a campus that is simultaneously a working scientific environment and a public destination — its library of STEM, its observation deck, its exhibition halls, its galleries and the inspirational presence of the towers themselves all serving to place science on open and deliberate display. In such a building, public engagement is not an afterthought bolted on to the side of the enterprise; it is built into the architecture, and the cultivation of science capital becomes a function of the structure itself.

3.5 Case studies

The proposition underlying this entire report — that a civilization should commit to vast, long-horizon projects whose returns are measured in generations — is not speculative. It is vindicated repeatedly by the historical record, and a brief survey of transformational undertakings makes the pattern plain.

The Apollo moon program remains an excellent example. It cost the United States approximately $25 billion between 1960 and 1973 — on the order of $300 billion in today's money — and at its peak in 1966 consumed close to 4% of the entire federal budget. [107][108] It employed around four hundred thousand people and engaged more than twenty thousand firms and universities across the country. [108] Its returns extended far beyond the lunar landings themselves: the integrated circuits developed for its guidance computers helped seed the entire modern computing industry, and the program inspired a generation into technical careers while cementing American scientific prestige for decades. [108] Apollo is the standing proof that an audacious public goal, generously resourced, returns value out of all proportion to its cost.

The pattern recurs in infrastructure. The Channel Tunnel, opened in 1994, created the first fixed land link between Britain and the European continent in some eight thousand years — a 50.5-kilometre crossing that, though it ran substantially over its initial budget, transformed the economic geography of north-western Europe. [109] Switzerland's Gotthard Base Tunnel, opened in 2016 after seventeen years of construction at a cost equivalent of around $12.5 billion, is the longest and deepest railway tunnel in the world; its 57 kilometers required the excavation of 28.2 million tons of rock and, by providing a flat route beneath the Alps, raised Alpine rail-freight capacity dramatically while shifting goods from road to rail. [109][110] Notably, the Swiss delivered this generational project close to budget — a reminder that the dysfunction described in Section 3.1 is a choice, not a law of nature.

International science furnishes equally instructive cases. The International Space Station, continuously crewed for almost thirty years, stands as the largest cooperative scientific endeavor in human history, sustained across geopolitical rivalry by fifteen nations. ITER, the fusion reactor now nearing completion in southern France, draws together thirty-five countries to build the world's largest tokamak from more than a million components manufactured across the globe — a project so multinational it has been called a 'nuclear United Nations'. [111][112] Its serious cost overruns and delays, openly acknowledged, are themselves instructive: such ventures are hard, and pretending otherwise helps no one — but the willingness of dozens of nations to attempt them at all testifies to the enduring conviction that some goals are worth a civilizational effort. [111] The same ambition is visible, at vast scale, in China's construction of tens of thousands of miles of high-speed rail in under two decades and its headlong urban and industrial expansion — a competitive spur that the United States cannot indefinitely ignore.

Finally, the original World Trade Center, examined in Chapter 2, belongs squarely in this company: a megaproject that pioneered a dozen civil-engineering firsts and reshaped the skyline of the world's foremost city. What unites all these undertakings is a quality the United States once possessed in abundance and now too rarely exercises — the willingness, in the phrase that animates this project, to dream big and to be bold. The succeeding initiative is an invitation to exercise it again.

3.6 Summary

Why does society need something like this now?

Because four deficits have converged, and a single sufficiently ambitious project can answer all of them at once. The United States has suffered a decline in its appetite and capacity for long-horizon civic undertakings, retreating from the generational ambition that once defined it. Its innovation economy has fragmented and dangerously concentrated, monopolized by a few coastal clusters while the talent of the rest of the nation goes un-clustered and unrealized. Great interior cities such as Chicago, for all their latent strength, have been losing firms, workers and competitive ground, and need an anchor of genuine gravity to reverse the. And the public that funds science, together with the young people who might one day advance it, has been allowed to drift into estrangement from a scientific enterprise conducted almost entirely out of. The historical record is unambiguous that bold, long-horizon projects — Apollo, the great tunnels, the international science collaborations, the original World Trade Center itself — repay the courage they require, in capability, prestige, inspiration and spillover far exceeding their cost. The case for renewal is therefore not merely economic but civilizational: the World Technology Center is conceived as a single, coherent response to a national moment that calls, once again, for the willingness to build something great

Part II

Philosophy and Principles

Chapter Four — The Underlying Principles

Part I established what the World Technology Center is, the legacy it inherits, and the national needs it answers. Part II turns to the principles beneath the proposal — the ethical, human, civic and philosophical commitments that give the project its shape and justify its ambition. This chapter sets them out in turn. It begins with the most sensitive question of all, the ethics of restoring a form so bound up with grief and proceeds through the project's human-centered design philosophy, its model of scientific collaboration, its symbolism, its long-time horizon, and its commitments to resilience, optimism, safety and international openness. These are the convictions on which everything that follows is built.

4.1 Ethical discussions

No aspect of this project demands more care than the question of whether the silhouette of the Twin Towers should rise again at all. The towers are not ordinary architecture; they are bound inseparably to the deaths of nearly three thousand people and to the grief of those who loved them. Any proposal that invokes their form therefore enters sacred and contested emotional territory, and it must do so with humility, honesty and a willingness to hear every side. This section attempts that — setting out the powerful arguments for renewal, the equally sincere arguments against it, and the reasoning by which the World Technology Center seeks to honor both.

The impulse to rebuild is as old as the attack itself. In the immediate aftermath of September 11th, 2001, prominent leaders including Mayor Rudolph Giuliani and President George W. Bush pledged to rebuild the World Trade Center as a symbol of American resilience and of triumph over those who had attacked it. [68] For a great many peoples, the instinct to answer destruction with reconstruction was immediate and intuitive: to leave the skyline broken seemed to concede something to the attackers that should never be conceded. This conviction animated the long civic campaign described in Chapter Two, and it rested on a cluster of deeply felt arguments about healing, defiance and restoration.

The campaign's advocates framed rebuilding above all as an act of recovery. Kenneth Gardner, the structural engineer behind the Twin Towers II proposal, argued that returning towers would stand for resolve, strength and renewal, and that seeing them rise again would be a living memorial more powerful than portraying the attack had never happened. [72] The Twin Towers Alliance, the grassroots organization that has campaigned for restoration since 2006, expressed the same sentiment in plainer terms: the towers' destruction is a fact that cannot be undone, the Alliance acknowledges, but their silhouette can still be restored “in the skyline and in our hearts” .[113] Supporters spoke repeatedly of the towers as a source of hope whose absence had left not only a gap in the skyline but a wound in the collective spirit.[113] Greg Manning, who with his wife had worked in the towers and whom the attacks had very nearly killed, wrote that to honor the dead the city needed to return to the sky. [72] This was not, in the advocates' view, a denial of grief but an expression of it.

A second argument was explicitly one of defiance. Writing in 2005, the commentator John Avlon contended that there was something psychologically healthy in confronting the terrorists' intentions directly, and that allowing the attack to permanently determine the city's skyline and self-image would hand the attackers a lasting victory they did not deserve. [74] The same reasoning runs through much of the public commentary of the period and through the wider movement: the recurrent insistence that to rebuild, taller and stronger, would be to deny the terrorists their aim, and that to leave the site diminished would be, in effect, to let them win. [64][72] Many who expressed support used precisely this language — the need to heal, to restore what was taken, to defy intimidation, and to refuse the attackers any permanent power over the nation's symbols. These sentiments deserve to be taken seriously and stated with dignity, for they reflect a sincere conviction that resilience is itself a moral response to terror.

The depth of this sentiment was not confined to a handful of activists. Online polling conducted in the years after the attacks, while methodologically informal, returned consistently lopsided majorities in favor of rebuilding — one MSNBC survey found roughly 80% of respondents preferred new Twin Towers, and the Twin Towers Alliance later cited figures above 90%. [74][79] The Twin Towers II model displayed in Trump Tower reportedly gathered more than twenty thousand signatures of support, [76] and a co-founder of the Alliance characterized the backing the cause attracted as fundamentally altruistic — the act of people who believed something had gone wrong and wanted to put right. [76] Crucially, this support extended to some of those most directly affected: the present World Technology Center initiative has itself gathered roughly ten thousand signatures and statements of support, including from some family members of September 11 victims through the Twin Towers Alliance. [118] Notably, the rebuilding proposals preserved the footprints not by leaving them empty but through above-ground memorials of recovered steel — an approach that the campaign's own materials maintained was preferred by many family members. [81] The desire to see the towers restored is, for many bereaved families, an expression of love rather than a denial of loss.

Yet it would be a profound failure of honesty to present this as the only view among those who suffered, for it is not. Many family members held the opposite conviction with equal sincerity and equal moral force, and their position must be given its full weight. For them, the ground where the towers stood is not a site for renewal but a grave. The footprints of the two towers reach down to bedrock, and it was in and beneath them that the remains of many victims were found; more than 30% of those killed were never identified at all, their remains never recovered. [115] To such families, the footprints are quite literally the final resting place of the people they lost, and therefore hallowed ground that no construction should ever disturb. The Coalition of 9/11 Families campaigned under the banner “preserve sacred ground”, and in the face of their advocacy public officials pledged that nothing would ever be built where the towers had stood. [114] When plans threatened to pour a concrete slab across the footprint of the north tower, families went to court to stop it, arguing that the ability to visit the authentic place where their relatives' remains lay would otherwise be lost forever. [115]

This perspective carried its own ethical logic, every bit as compelling as the case for renewal. To rebuild commercial towers atop a mass grave struck many as a desecration; to some, the very idea of restoring the site to bustling normality risked erasing the gravity of what had happened there. Charles Wolf, who lost his wife in the attacks, opposed introducing a museum of broader themes to the site on the grounds that one would not stage a debate about Nazism at Dachau [116] — a vivid statement of the conviction that the place must remain, above all, a place of mourning. Others wanted the entire site to be left empty, and still others believed only a memorial could be appropriate. [117] These were not obstacles to be overcome; they were, and remain, legitimate and honorable expressions of grief, and any ethical treatment of the towers' legacy must hold them in the same regard as the arguments for rebuilding.

The resolution reached at Ground Zero was a compromise between these poles. The footprints of the two towers were designated as sacred ground and given over to the National September 11 Memorial, while the surrounding acres were dedicated to new construction — the office towers, the transportation hub and the museum that stand there today. [117] It was an imperfect settlement that fully satisfied no one, and the practical objection to the rebuilding campaign was, in the end, partly one of timing: as the father of one victim observed of the campaign's most prominent backer, the advocates of new towers had arrived years after the master planning was complete. [75] The official site had already been committed to a different vision, and the moment for the Twin Towers to rise there had passed.

It is precisely here that the ethical foundation of the World Technology Center becomes clear, for the project dissolves the conflict rather than reopening it. The dispute at the site was, at root, a struggle over a single piece of sacred ground: the two camps were locked in opposition because they were contending for the same plot of earth, on which one could build new towers or preserve a grave, but not both. The World Technology Center is not proposed for the original World Trade Center site. It is proposed for Chicago. By relocating the towers' silhouette and spirit to an entirely different city, the project honors the longing to see that form restored — to deny the attackers a permanent victory over the skyline and the national imagination — without laying a single stone upon the hallowed footprints in Lower Manhattan, which remain undisturbed as the memorial they have rightly become. It thereby keeps faith with both bereaved communities at once: with those who have always wished to see the towers rise again, and with those for whom the original ground must forever be a place of rest and remembrance. This is not a rhetorical evasion but a genuine reconciliation, and it is a substantial part of why the initiative has drawn support that includes some of the September 11 families themselves. [118] Where the original rebuilding debate forced a tragic choice between remembrance and renewal, the World Technology Center is designed so that no such choice is required.

None of this is offered with false confidence. Opinions on the towers' legacy still vary, and they always will; grief does not resolve into consensus, and the project claims no authority to speak for all who mourn. What it offers instead is a way of carrying the silhouette's meaning forward that asks no one to surrender their own. The memory of the towers and of those who died in them is treated throughout this project as a sacred trust — approached with humility, with sensitivity to the full range of feeling it evokes, and with the conviction that a form so beloved can be honored most fully not by replicating a tragedy's site, but by giving its spirit a new and constructive life elsewhere. That conviction is the ethical bedrock on which the remainder of this report stands.

4.2 Human-focus

4.2.1 Architectural spirit and Nature integration

The decision to build two towers rather than one is not merely an act of architectural homage; it carries meaning. The pairing expresses, first, the two great and complementary domains the campus is built to serve — science, the disciplined pursuit of understanding; and technology — the application of that understanding to human ends. The North Tower's dedication to technology and the South Tower's to science give physical form to the truth that neither flourish without the other.

More fundamentally, two towers standing as equals embody a principle that the modern evidence on discovery has made unmistakable: that the greatest work is done not by the solitary genius but by people working together. The landmark study by Wuchty, Jones and Uzzi, drawing on nearly twenty million research papers and two million patents across five decades, demonstrated that teams have come to dominate solo authors across virtually every field of science and engineering, and that team-authored work is both more frequently cited and more likely to achieve exceptionally high impact — a shift the authors concluded had fundamentally changed the very process of knowledge creation. [119] Later work has refined the picture, finding that while large teams tend to develop and consolidate science, smaller teams more often disrupt it with radical new ideas [120] — an argument not against collaboration but for an environment that nurtures teams of every size. Two equal towers, rather than one solitary monument, stand for exactly this ethic of partnership and shared endeavor, and for the equality of opportunity that collaboration extends to all who take part.

Set against and within this built form is the deliberate presence of nature. The campus integrates gardens, green spaces and rooftop planting throughout, not as decoration but as a response to well-established evidence that contact with nature measurably benefits human wellbeing and cognition — the foundational demonstration being Roger Ulrich's finding, published in science, that even a view of nature could accelerate recovery and reduce stress. [30] A scientific community asked to do demanding, sustained intellectual work deserves an environment that restores rather than depletes it, and the marriage of soaring structure with living greenery expresses the project's insistence that human flourishing and scientific ambition are not in tension but in partnership.

4.2.2 Education-driven urbanism

The campus is conceived as a piece of city organized around learning. This reflects a documented shift in how the geography of innovation is evolving. The Brookings Institution's influential analysis of the rise of “innovation districts” describes how leading research institutions and companies are increasingly clustering and connecting with start-ups, incubators and accelerators in compact, mixed-use, transit-accessible settings — a deliberate move away from the twentieth-century model of isolated suburban corporate campuses accessible only by car and walled off from public life. [121] The defining feature of such districts is the intentional convergence of functions that older planning kept apart: research, enterprise, housing, education and amenity woven into a single fabric so that the act of learning is not confined to a classroom but diffused throughout the environment. [121]

The World Technology Center takes this principle to its logical conclusion by placing education at the center of the urban design rather than at its periphery. Its library of STEM, its lecture theatres, its exhibition halls, its apprenticeship spaces and its public galleries are not appended to a research facility; they are constitutive of it, arranged so that students, apprentices, working professionals and the visiting public move through the same spaces as practicing researchers. The result is an urbanism in which the city itself teaches — where proximity to discovery, and to the people who pursue it, becomes a continuous and democratizing form of education.

4.2.3 Close proximity to human-driven functional diversity

Underlying the campus's compactness is a principle long understood by urban thinkers and now confirmed by economic research: that mixing functions in close physical proximity is itself generative. Jane Jacobs argued more than sixty years ago, in The Death and Life of Great American Cities, that the vitality of a place depends on a dense diversity of uses and people intermingling at close quarters, [122] and the modern economics of cities has vindicated her: Edward Glaeser's work documents how density and proximity accelerate the exchange of ideas that drives innovation and growth. [123]

The mechanism is the unplanned encounter. The Brookings research on innovation districts describes their value as a “choreography of collisions” — the chance meetings and informal exchanges that proximity makes possible — and notes that the benefits are remarkably sensitive to distance: studies have found the clustering of research activity to be most powerful at very small spatial scales, on the order of a quarter of a mile, with knowledge spillovers that are highly localized and dissipate quickly as distance grows; researchers at Harvard even found that simply working in the same building measurably improved scientific collaboration. [121] Our project is designed around this finding. By co-locating laboratories, workshops, start-ups, established firms, government workshops, lecture halls and public space within a single tightly knit campus, it maximizes the frequency of the productive collisions that a dispersed, siloed arrangement forfeits — turning physical proximity into a deliberate engine of discovery.

4.3 Public-private scientific ecosystems

The campus is built to house, under one roof, the three actors whose interaction modern innovation theory identifies as the engine of a knowledge economy. The “triple helix” model, developed by Henry Etzkowitz and Loet Leydesdorff, holds that innovation in advanced economies arises from the dynamic interaction of universities (which generate knowledge and educate), industry (which converts knowledge into products), and government (which sets the conditions and frequently funds the work) — and that the most productive arrangements are those in which these spheres overlap, exchange roles and spawn hybrid institutions such as technology-transfer offices, incubators and science parks. [124]

The proposed vision is, in effect, a triple helix given architectural form. Its inclusion of dedicated government workshop space where public agencies can collaborate directly with the resident universities, laboratories, start-ups and established firms. It is the deliberate embodiment of this principle, collapsing the distance between the three spheres that the conventional landscape holds apart. By bringing the public and private sectors into sustained physical contact around shared research and commercialization pathways, the campus is designed to accelerate the passage of ideas from basic discovery to real-world application, and to do so within an ecosystem engineered for exactly that flow.

4.4 Architectural symbolism

Every major element of the design is intended to carry meaning, continuing the tradition Minoru Yamasaki established when he conceived the original towers as a living symbol of humanity's aspiration toward peace and cooperation. The twin form itself, as discussed above, symbolizes partnership, equality and the union of science and technology. The campus's commemorative and aspirational features extend the vocabulary: the spire rising to 1,969 feet is a deliberate tribute to the Apollo 11 lunar landing of 1969, binding the project to the supreme example of human scientific ambition; the Open Heavens observation deck gestures toward exploration and the limitless horizon of discovery; and elements named for Yamasaki, Feynman, Glenn, McAuliffe, Musgrave and others honor a lineage of scientists, explorers and creators in whose tradition the campus places itself. A building that means something invites those who encounter it to participate in the meaning — to read in its form a statement about who we are and what we value. Instead of being otherwise ornamental, by encoding aspiration, remembrance, exploration and the dignity of science into its very fabric, the World Technology Center aims to function, as the original towers ultimately did, as a structure that speaks; one whose silhouette communicates resilience and ambition to all who see it, and whose details reward the curiosity of those who come closer.

4.5 Long-term civilizational thinking

The WTC is conceived not for the present decade but for the coming century and beyond, and this long horizon is itself a principle rather than an incidental feature. It is an instance of what has come to be called “cathedral thinking” — the practice, named for the builders of the great cathedrals (during the medieval era), of envisaging and beginning projects whose time horizons stretch across generations, in the knowledge that those who lay the foundations may never see the work completed. The same ethic appears in the “seven-generation” principle of ecological stewardship practiced by some Native American peoples, and in the broader philosophy of intergenerational justice, which holds that the present has genuine obligations to the future — including the safeguarding and advancement of scientific and cultural knowledge. [125]

Such thinking runs directly counter to the short-termism that dominates contemporary planning, where the horizon rarely extends beyond an electoral or financial cycle. Yet, as Chapter 3 demonstrates, the projects that have most transformed human capability were all undertakings of exactly this generational character, requiring decades of sustained commitment and returning value across many more. This vision belongs to this tradition. Its structure is engineered for extraordinary longevity; its purpose, the advancement of science and the inspiration of successive generations, is one whose returns are measured not in quarters but in lifetimes. To build it is to make a deliberate wager on the future — to act, in the language of the long-term movement, as a good ancestor constructing something whose fullest benefits will accrue to people not yet born.

4.6 Cultural sustainability and national resilience

Beyond its scientific and economic purposes, the project is intended as an act of cultural sustainability — the deliberate carrying-forward of a meaningful national symbol so that it endures and evolves rather than being lost. The Twin Towers were among the most recognizable emblems of the United States, and their destruction was felt as a cultural as well as a human loss. To restore their silhouette, transformed and given new purpose, is to refuse that erasure: to demonstrate that a nation's most treasured forms can be renewed and made to serve again rather than surrendered to those who would destroy them. This is, in turn, a statement of national resilience. A society that can absorb an attack on its symbols and respond not with permanent diminishment but with renewed and constructive ambition demonstrates a strength that no act of destruction can reach. The World Technology Center is conceived as exactly such a demonstration — a tangible assertion that the American capacity to build, to aspire and to renew remains intact, and that the nation's cultural confidence can be expressed in the most durable form available: a great work raised for the future.

4.7 Technological optimism

The project rests on a fundamental optimism about technology — a conviction that human ingenuity, properly directed, is a force for the betterment of the human condition, and that the great challenges of the age are to be met with more and better science rather than with retreat from it. This optimism is not naive; it is grounded in the historical record of what science and technology have already achieved in lengthening lifespans, lifting populations out of poverty, expanding knowledge and extending human reach. The same record that includes Apollo and the eradication of diseases is the warrant for believing that the frontier ahead — in computing, in medicine, in clean energy, in materials, in space — holds comparable promise. A building dedicated to this proposition makes a public argument. At a moment when discourse about technology is often dominated by anxiety, this vision asserts, in physical form, that the future is something to be built toward with confidence and ambition. It is designed to gather the people and institutions capable of realizing that future, and to inspire in the wider public — especially the young — the belief that they too can participate in it. Optimism, in this view, is not merely a mood but a practical precondition for progress: a civilization must believe the future worth building before it will build one.

4.8 Technological safety

Optimism about technology, however, must be married to a clear-eyed commitment to safety, for the same ingenuity that produces benefit can produce harm, and the governance of emerging technology has struggled to keep pace with its advance. This difficulty has a name. The "pacing problem", articulated by Larry Downes, captures the structural reality that technology changes exponentially while social, economic and legal systems change only incrementally — so that innovation routinely outruns the rules meant to govern it. [126] Compounding this is the "Collingridge dilemma", the dilemma of control identified by David Collingridge: in a technology's early stages, when it could most easily be shaped, its eventual impacts are unknowable; by the time those impacts become clear, the technology is so entrenched that control has become difficult and costly. [126] The result, as Gary Marchant and colleagues have documented, is a widening gap between emerging technologies and the legal and ethical oversight that ought to accompany them. [127]

This gap is not abstract. It manifests across precisely the domains the project would advance — in medicine, where novel therapies and devices can reach patients faster than their long-term effects can be understood; in the physical technologies of autonomous machines and advanced manufacturing; in artificial intelligence, whose societal risks are difficult to forecast until systems are deployed at scale; and in software, where the speed of deployment vastly exceeds the speed of legislation. In each case the danger is the same: that genuinely beneficial innovation is accompanied by unsafe applications that existing law is too slow to correct or to guide.

The response cannot be either to halt innovation or to abandon oversight, but to develop governance that is itself more adaptive. Scholars of the field advocate what is termed anticipatory or upstream governance — engaging with a technology's risks early, before harms become entrenched, rather than only reacting after something has gone wrong; the bioethicist Wendell Wallach, among others, has argued that such upstream management is far preferable to imposing regulation downstream once a technology is deeply embedded. [128] Approaches such as adaptive regulation, technology-literate institutional capacity, soft-law standards that can evolve as understanding improves, and close public-private coordination together offer a means by which law and ethics can begin to keep pace with invention. [127][128] The World Technology Center is conceived as a natural home for exactly this work. Because it deliberately co-locates researchers, industry and government agencies within a single ecosystem, it is uniquely positioned to host the anticipatory, cross-sector dialogue that responsible governance requires — to ensure that unsafe creations, whether medical, physical, AI-based or software-based, can be identified, corrected and guided even as the underlying science is pushed forward. Safety, in this design, is not a brake on progress but a vital condition of it.

4.9 International collaboration and educational outreach

The final principle is openness to the world. The greatest scientific endeavors of the modern era have been international, and the most instructive model is CERN, the European laboratory for particle physics. Founded in the aftermath of the Second World War as an instrument of reconciliation as much as of research, CERN was conceived to foster peaceful scientific exchange across borders, and it has become the pre-eminent example of multilateral cooperation for purely peaceful ends. [129] Governed today by more than twenty member and associate states and drawing scientists from over a hundred countries, it sustained collaboration between Western and Soviet researchers even through the Cold War, and it gave the world the World Wide Web as a by-product of its commitment to open, shared infrastructure. [129][130] CERN demonstrates that science can serve as a diplomatic bridge — a neutral, universal language through which nations otherwise divided can build trust. [129]

This is the same conviction that animated Minoru Yamasaki's original vision of the towers as a symbol that world trade, and the exchange it represents, are bound up with world peace. The World Technology Center inherits that ethos and extends it to science: by emphasizing freedom of information and global outreach, the campus is designed to attract talent and ideas from around the world and to function as a venue for international collaboration in research and education, much as the great multinational laboratories — CERN, the International Space Station, the ITER fusion project — already do. [111] In an era of geopolitical tension, a landmark explicitly dedicated to open scientific cooperation makes a statement of considerable value: that the pursuit of knowledge is a shared human enterprise that transcends rivalry.

Coupled with this international openness is a commitment to educational outreach whose potential impact is difficult to overstate. A campus that places real science on public display, that offers structured apprenticeships and pathways into technical careers, and that draws students and visitors into direct contact with discovery has the capacity to build science capital at a scale few institutions can match — and to do so for precisely those populations that the existing innovation geography leaves behind. Combining a globally open research environment with a deliberately accessible educational mission is part of the vision for the World Technology Center. It aspires to be more than a national asset but also a place where the next generation of scientists and engineers, drawn from every background and from around the world, can be inspired, trained and welcomed into the shared work of advancing human understanding.

Part III

Feasibility and Impact

Chapter Five — Economic Impact

Part III turns from principle to consequence, examining what the World Technology Center would do for the economy of Chicago, of Illinois and Indiana, and of the United States. The case is broad, because a project of this scale touches almost every economic register at once: direct employment and skills, tourism and hospitality, partnerships and conventions, regeneration and tax revenue, prestige and the long tail of secondary effects that radiate from a major anchor institution. This chapter sets each of these out in turn, grounding the projections wherever possible in regional data and in the documented experience of comparable developments. The figures are necessarily estimates for a project still in its conceptual phase, but the direction and the mechanisms are well attested.

A Note on Methodology and Assumptions

The projections in this chapter are indicative estimates for a project at the conceptual stage, and they rest on three kinds of input, stated plainly so that the reader can weigh them. The first is campus capacity: the programmed floor area of the masterplan and the 600 to 800 tenant organizations it is designed to house, combined with employment densities typical of research, engineering, educational, and hospitality uses. The second is benchmarking: the documented outcomes of comparable large-scale developments and innovation districts (including those examined in Section 5.12) and current regional data on the Chicago-area technology workforce. The third is the established relationships of the economics literature, most notably the local multiplier by which each new innovation-sector job supports roughly five additional jobs in local services. [97]

Where estimates differ, the report deliberately adopts the more conservative figure. The headline projection of roughly 75,000 permanent positions is the project's own capacity-based working estimate; higher figures produced by third-party analyses are noted but not relied upon. Construction employment is treated as additional to, and separate from, permanent employment, and indirect and induced effects are described through multipliers rather than folded into headline totals. All economic projections in this chapter are, accordingly, working figures intended to demonstrate scale and mechanism. They are to be superseded by the independent economic impact assessment commissioned in Phase Four of the implementation strategy (Chapter Six), whose publication is among the project's defined milestones.

5.1 Projected job creation and skills development

At full scale the World Technology Center is envisioned to support tens of thousands of high-value jobs — by one estimate on the order of seventy-five thousand permanent positions (spanning engineering, research, advanced manufacturing, computing, education, public service and the creative industries). These would be additional to the construction employment generated over the build period and to the indirect jobs created in the surrounding economy, where the established multiplier for innovation work is substantial: the economist Enrico Moretti has shown that each new innovation-sector job in a city tends to generate roughly five additional jobs in local services over time. [97] The campus would land in a region well prepared to supply and absorb such employment. Chicagoland's digital technology sector already generated more than thirty-nine billion dollars of economic output and employed over ninety-nine thousand people in 2024. [131] Illinois is a consistent national leader in producing STEM talent, conferring thousands of engineering, computing and science degrees each year and retaining a majority of its data and computer-science graduates, who are several times more likely to begin their careers in Chicago than in any other city. [132] Across the state line, Indiana adds deep strength in advanced manufacturing and semiconductors, anchored by Purdue University and the nation's first comprehensive semiconductor-degree program. [133]

The project's most distinctive contribution to skills, however, is its integrated apprenticeship and vocational model. The campus is designed to also function as a living training environment, in which students, graduates and early-career professionals undertake structured, paid apprenticeships embedded directly in the live research and development projects of resident companies and institutions — gaining genuine hands-on experience in fully equipped laboratories, mathematics and computing facilities and engineering workshops, while simultaneously pursuing high-quality academic study on the same site. This earn-while-you-learn approach, uniting real corporate R&D work with formal on-site education, offers a direct pathway into full-time employment, lowers the barriers to entry for groups historically underrepresented in science and engineering, and aligns training tightly with the actual needs of industry. It builds on a regional strength: Illinois already operates more than four hundred and fifty registered apprenticeship programs serving some 22,000 apprentices, and was ranked the leading state in the Midwest, and third in the nation, for workforce development. [134] The World Technology Center would extend and elevate this infrastructure, creating one of the most ambitious vocational-academic pipelines in the country.

A final, often overlooked, economic dimension lies in the campus' working environment itself. The extensive integration of natural greenery — gardens, planting and green space woven through the interiors and across the grounds — is not merely aesthetic but a measurable contributor to productivity. A landmark series of field experiments by Nieuwenhuis, Knight and colleagues, published in the Journal of Experimental Psychology: Applied, found that simply enriching a sparse office with plants raised staff productivity by around 15%, alongside gains in concentration, wellbeing and satisfaction. [135] A controlled study by Allen and colleagues at Harvard went further, recording cognitive-function scores roughly sixty to one hundred per cent higher for workers in green, well-ventilated building conditions than in conventional ones. [136] For an enterprise whose output is fundamentally intellectual, a working environment engineered to enhance cognition and wellbeing is a direct economic asset, not a soft amenity.

5.2 Impact on tourism, hospitality and retail

A landmark of this stature would become a destination in its own right and a substantial generator of visitor spending. The original Twin Towers drew enormous numbers of sightseers to their observation deck, and the World Technology Center is conceived with comparable attractions — the Open Heavens observation deck, library, exhibition and nature areas (and amongst many other amenities), are explicitly designed to invite and welcome the public. A distinctive, instantly recognizable silhouette also reshapes a city's image: just as the Sears Tower and the Bean have become shorthand for Chicago, twin towers reaching above the skyline would give the city a powerful new architectural emblem (just as the originals rose at the same time as the Sears Tower) and strengthening its tourism brand and its standing as a destination for architecture and science alike. The visitors such an icon attracts spend on hotels, restaurants, transport and retail throughout the surrounding district, and the campus's own hospitality and retail components — the Discovery Hotel, the mall and the dining venues — would capture a share of that spending directly while seeding demand for the wider South Loop economy. Conference delegates, visiting researchers and the families of apprentices and staff would add a steady, year-round base of hospitality demand to the episodic flow of tourists.

5.3 Partnerships

The campus is conceived as a hub of partnerships across three communities. The first is academia. The World Technology Center would seek affiliations with leading universities both in the United States and internationally — institutions of the caliber of MIT, UIC, Purdue, the University of California campuses at Berkeley and Los Angeles, and, in the United Kingdom, Oxford, Cambridge, Nottingham and Hertfordshire, among others — enabling joint research, shared facilities, visiting appointments and student placements. The second community is local education: partnerships with Chicago's public schools and community colleges would open the campus to younger students through outreach programs, school visits and pre-apprenticeship pathways, ensuring that the surrounding population, and not only a global elite, benefits from proximity to the work.

The third and largest community is industry. The campus is designed to host resident organizations spanning the full breadth of advanced technology and science, and plausible candidate tenants illustrate the intended range:

- Aerospace and space firms such as SpaceX, Lockheed Martin, Axiom Space and the emerging VAST; established technology and engineering companies including Microsoft, IBM, Alphabet, Siemens, Wärtsilä, Samsung Engineering and the Expleo Group;
- Software and design houses such as Autodesk, Dassault Systèmes, MathWorks and Valve Corporation; Energy and fusion ventures such as Helion;
- National laboratories and agencies including NASA, NIST and Los Alamos; and
- Development and design partners such as Related Midwest and Foster + Partners.

The deliberate co-location of organizations of this kind — public and private, established and emerging, across disciplines that rarely share a campus — is precisely the mechanism by which the project aims to accelerate innovation.

5.4 Convention and research economy

With its lecture theatres, exhibition auditoriums and conference facilities embedded among working laboratories, the World Technology Center is positioned to become a significant venue for the convention and research economy. Scientific conferences, industry summits, product launches and academic symposia draw high-spending professional delegates who fill hotels and restaurants and generate substantial economic activity wherever they convene. A campus that can host such gatherings in immediate proximity to active research — allowing delegates to tour laboratories, meet practicing scientists and engage directly with live work — offers a setting that conventional convention centers cannot match. This research-adjacent convention capacity would establish a recurring, high-value stream of visitor activity, while simultaneously raising the campus's profile as a global meeting point for science and technology and reinforcing Chicago's standing on the international conference circuit.

5.5 Networking and information freedom

One of the campus's central economic purposes is to lower the barriers to the exchange of scientific information — barriers whose costs, though rarely tallied, are considerable, and whose removal can carry benefits far beyond any single nation. International collaboration reliably produces higher-impact, more widely cited science than single-institution work, yet a thicket of bureaucratic obstacles impedes it. Restrictive visa and mobility policies routinely prevent researchers from attending conferences, undertaking visits or joining joint projects, distorting the cross-border flow of knowledge and weakening collaboration networks. [137] In the United States, export-control regimes such as the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations sharply constrain the sharing of technical data deemed related to defense, to the point that researchers report routine federal scrutiny of their foreign collaborations. [138] Layered on top are the sanctions administered by the Office of Foreign Assets Control, whose prohibitions on contact with designated persons and states carry the threat of substantial fines and even criminal penalties — a regime that scientists themselves have argued urgently needs to be clarified and simplified if research is to flourish. [139]

The World Technology Center cannot rewrite federal regulations, but it can serve as a physical and institutional environment expressly designed to maximize the lawful, open exchange of ideas. Via emphasizing freedom of information, gathering researchers from many nations and institutions in one place, and providing the in-house expertise to navigate compliance efficiently, the campus is conceived to reduce the friction that elsewhere slows collaboration to a crawl. The model is the openness that has made the great international laboratories so productive — CERN, whose commitment to shared, public infrastructure famously gave the world the World Wide Web, stands as the pre-eminent example of what becomes possible when scientific information is allowed to move freely. [130] A campus built on that principle aims to convert the suppressed value of obstructed collaboration into tangible global benefit.

5.6 STEM incubation

The campus is designed to function as a national incubator in the fullest sense — a place where new scientific ventures are conceived, supported and brought to commercial life. Merging start-ups and scale-ups alongside established firms, university researchers, government agencies and a deep pool of apprentices and graduates, it provides the ingredients that successful incubation requires access to specialized laboratory and workshop facilities that a young company could not afford alone; proximity to potential mentors, partners and customers, and a continuous supply of emerging talent. The integrated apprenticeship model feeds this ecosystem directly, producing technically skilled people already embedded in live projects and well placed to spin out ventures of their own. Crucially, the campus is engineered to shorten the path from discovery to application — the so-called valley of death that strands so many promising ideas between the laboratory and the market — by ensuring that the research, the capital, the manufacturing capability and the commercial expertise needed to cross it are all present within a single connected environment. The intended result is a steady generation of new companies, new products and new industries taking root in Chicago.

5.7 Surrounding district regeneration

A development of this magnitude acts as a powerful catalyst for the regeneration of its surrounding district, and the World Technology Center is conceived to reactivate underused urban land while lifting the architectural and environmental character of its setting. It would not arrive in isolation: the near South Side of Chicago is already the focus of major investment, most notably The 78, a roughly seven-billion-dollar, sixty-two-acre mixed-use development by Related Midwest — the Chicago arm of the same Related family responsible for New York's Hudson Yards — which is transforming a long-vacant riverside tract into a new neighborhood of housing, offices, research space and public realm. A landmark science campus alongside such projects would reinforce and accelerate this momentum, drawing further investment, raising surrounding property values and stitching new activity into the existing urban fabric. The project's extensive greenery, rooftop gardens and landscaped public spaces would also enhance the environmental quality and image of the district, contributing to Chicago's broader ambitions for sustainable South Loop development and presenting the city to the world as a place willing to build boldly and greenly for the future.

5.8 Streamlined regulation and supervision/collaboration by authorities

A distinctive feature of the vision is its provision of dedicated workshop space in which government agencies can collaborate directly with the resident universities, laboratories and companies. This co-location offers an economic benefit that is easily underestimated: the opportunity to streamline regulation and supervision by bringing regulators into continuous, early contact with the innovators whose work they oversee. When agencies are physically present within the research ecosystem, oversight need not be a slow, adversarial process conducted at a distance after the fact; it can become an anticipatory, collaborative function, in which standards are clarified, approvals expedited, and safety concerns addressed as work proceeds rather than years later. Such proximity allows authorities to keep far closer pace with fast-moving technology — reducing the regulatory lag that elsewhere delays beneficial innovation while still guiding it responsibly — and lowers the compliance costs and uncertainty that burden firms operating at the frontier. For resident organizations, a setting in which supervision is constructive and efficient rather than remote and unpredictable is itself a meaningful economic advantage.

A further, less visible economic advantage lies in the administration of export controls. Firms working in aerospace, defense-adjacent, and dual-use technologies operate under the International Traffic in Arms Regulations (ITAR), administered by the Department of State, and the Export Administration Regulations

(EAR) administered by the Department of Commerce. For these firms, compliance represents a substantial fixed cost: licenses and technical assistance agreements must be prepared and adjudicated, controlled technical data must be segregated, and even the release of such data to foreign nationals within the United States is treated as an export. These burdens fall hardest on startups and mid-sized enterprises, which rarely maintain dedicated compliance departments, and they slow legitimate collaboration with allied nations even as federal policy moves in the opposite direction — most recently through the *AUKUS* exemption at ITAR § 126.7, which established license-free defense trade among authorized users in the United States, the United Kingdom, and Australia, and codified 30-to-45-day adjudication targets for remaining license applications from those partners and Canada, [148] with parallel relief issued under the EAR. The World Technology Center is positioned to translate this policy direction into daily practice. Its on-site federal workshop would place licensing and compliance authorities within walking distance of the companies and researchers they oversee, so that commodity classification, pre-license consultation, and technology control planning proceed by conversation across a plaza rather than by correspondence across months. Campus-level compliance infrastructure — access-controlled laboratories, segregated information systems for controlled technical data, and export compliance expertise offered as a shared service — would spread these fixed costs across hundreds of tenant organizations, lowering the barrier for smaller firms to enter allied markets lawfully. The campus design further permits open fundamental research, whose results are excluded from control when ordinarily published, to proceed alongside controlled applied programs in architecturally separated zones, allowing international talent and regulated work to coexist on a single site. The efficiency gain is not deregulation. It is the removal of friction from regulation that remains fully in force.

5.9 Tax base expansion

The concentration of high-value economic activity that the campus would create represents a substantial expansion of the local and state tax base. Tens of thousands of well-paid employees generate income-tax revenue and, through their spending, sales-tax receipts across the wider economy; resident corporations contribute business taxes; and the development itself, together with the rising property values it induces in the surrounding district, enlarges the property-tax base on land much of which is currently underused. The scale of such contributions is evident from comparable developments — New York's Hudson Yards, once complete, is projected to contribute on the order of nineteen billion dollars annually to that city's gross domestic product. [140] For a city and state that has in recent years contended with corporate departures and fiscal pressure, a new and durable anchor of taxable economic activity on this scale would materially strengthen public finances, helping to fund the schools, services and infrastructure on which the wider community depends.

5.10 International prestige

Beyond its measurable economic returns, the World Technology Center would confer on Chicago, and on the United States, a substantial gain in international prestige — an intangible asset with very tangible consequences. Iconic landmarks shape global perceptions of the cities that host them, and a striking, internationally recognized center dedicated to science and technology would announce Chicago as a world capital of innovation, much as celebrated structures elsewhere have come to define their cities in the global imagination. This reputational dividend is not merely symbolic: it influences where multinational firms choose to locate, where the most talented researchers and graduates choose to work, where international investment flows, and which city secures the conferences, partnerships and institutions that follow prestige. A bold architectural statement of scientific ambition functions, in effect, as a permanent advertisement for the city and the nation — drawing talent, capital and attention in a virtuous cycle, and projecting an image of American confidence and capability to the wider world.

5.11 Long-term secondary economic effects

Beyond its direct and immediate effects, a project of this kind sets in motion a long tail of secondary economic consequences that, while necessarily harder to quantify, may ultimately prove the most significant of all. The historical pattern of major anchor institutions suggests that the spin-off companies, supply chains and skilled-worker networks generated compounds over decades, seeding entire new industries that could not have been predicted at the outset (as the integrated circuits of the Apollo program seeded modern computing). A successful World Technology Center could, by similar logic, reverse the brain drain that has drawn talent away from the Midwest, attract further high-technology investment to the region, inspire comparable hubs elsewhere in a networked national system, and lift the long-run innovative capacity and patent output of the entire area. These extrapolated effects are speculative and are presented as such; but they follow directly from well-documented mechanisms of agglomeration and spillover, and they represent the kind of generational return that justifies an undertaking of this ambition.

5.12 case studies

The economic logic set out above is borne out by the documented experience of comparable large-scale developments, three of which are instructive.

Hudson Yards, in New York, is one of the largest private real-estate developments in U.S. history — a roughly $25 billion, 28-acre, sixteen-building district constructed over an active rail yard on Manhattan's West Side, developed by the Related Companies with Oxford Properties. [140] Its first phase opened in 2019, and on completion the development is expected to draw some one hundred and twenty-five thousand people daily and to contribute on the order of nineteen billion dollars a year to New York's economy, anchored by major corporate tenants and supported by a public investment that included a multibillion-dollar subway extension. [140] It demonstrates how a single coordinated megaproject can manufacture an entire new district of high-value activity where little existed before — and its developer's Chicago arm is the force behind *The 78*.

Canary Wharf, in London, offers a longer-run illustration. Built from the 1980s onward on the derelict West India Docks, it transformed a swathe of abandoned industrial waterfront into one of the world's foremost financial districts, today home to global banks and professional firms and a workplace for well over a hundred thousand people. Once an emblem of post-industrial decline, the Docklands became, within a generation, a byword for urban regeneration — so much so that Hudson Yards itself was conceived by its backers as a “Canary Wharf New York”. [140] The example shows how a determined development on neglected land can permanently shift a city's economic geography.

SpaceX's Starbase, in South Texas, illustrates ecosystem growth from a single anchor. Beginning barely a decade ago as a sparse stretch of coastline with a few dozen homes, the site has grown around SpaceX's rocket factory, headquarters and launch facilities into a community that in May 2025 voted to incorporate as a city in its own right. [141] The complex now employs several thousand people directly and supports some twenty-four thousand direct and indirect jobs across the surrounding region, having added more than thirteen billion dollars to the South Texas economy in just two years. [141] Starbase shows how a single ambitious technological enterprise can catalyze an entire local economy — precisely the dynamic the World Technology Center is intended to set in motion for Chicago and the Midwest.

Chapter Six — Our Strategy

The strategy by which the World Technology Center would be realized is itself one of the project's most deliberate and distinguishing features, and it is the clearest expression of the realism and maturity behind the proposal. It begins with the recognition that this is not, in the ordinary sense, a real-estate development at all. It is a mixed-use civic and scientific undertaking conceived for the mutual benefit of the public and private sectors alike — a place where government agencies, universities, established firms, start-ups, students and the public each pursue their own purposes within a single shared environment, and where success is measured not just in rentable square footage and return on investment – but more importantly in scientific capability, education, employment, inspiration and national benefit. Because the goal is a public-private mutual advantage rather than private profit, the process of bringing it into being must itself be open, evidence-led and de-risked from the outset.

This produces a strategy that deliberately inverts the conventional sequence. In the traditional model or norm, a major developer and financial backing are secured first, and the design is then worked out behind closed doors, with the public presented only with a finished scheme. The World Technology Center reverses this order: thorough conceptual design and transparent public outreach come first, and then financial commitment follows once the vision (with its scope, its benefits and its public acceptance) have all been established in plain view. The approach is borrowed from aerospace and systems engineering, disciplines in which a design is exhaustively modelled, tested and frozen through a sequence of staged reviews before any commitment is made to costly manufacture — precisely because the expense of changing a design rises steeply the later that change occurs. Applied to a civic megaproject, this front-loading of design, scope and consent serves to de-risk the entire undertaking and to avoid the ruinously expensive redesigns and restructurings that so often follow when a project is rushed into commitment before it is properly understood.

The empirical case for this caution is overwhelming. The Oxford scholar Bent Flyvbjerg, drawing on the largest database of its kind, has shown that megaprojects fail with extraordinary consistency — over budget, over time, under benefits, over and over again — with between 70 and 90% suffering cost overruns, and the probability of meeting budget, schedule and benefit targets together falling to roughly one in a thousand. [142] The principal cause, he finds, is weak front-end planning followed by a reactive "break-fix" model in which problems are addressed only after they have become entrenched. [142, 145] His remedy, distilled in the maxim "think slow, act fast", is to invest heavily in planning and simulation at the start, because projects do not merely go wrong during execution — they start wrong, their failures seeded at the very beginning. [143] Our project's concept-first strategy is a direct application of this principle, and stands in pointed contrast to the original Freedom Tower, whose design was settled by private developers largely without public competition or debate and then revised repeatedly, at great cost and to widespread public dissatisfaction, once construction was already under way. [68]

Transparency serves a second function beyond technical de-risking: it builds what is known as a social license to operate — the ongoing acceptance and support of the affected community, which depends not on legal permits alone but on trust, openness and meaningful engagement, and the absence of which exposes a project to opposition, legal challenge and the erosion of investor and partner confidence. [144] In making its case openly and seeking public endorsement from the very beginning, the project aims to secure that legitimacy at face value, long before the first foundation is poured. The phases that follow set out how this strategy would unfold in practice.

6.1 Phases

Phase One

The first phase, which is in one of two of the project's current stages (2023-present), concentrates on building public awareness and maturing the conceptual design in parallel. Awareness is pursued through transparent outreach — a public website, media engagement, documentary material and a petition through which supporters, including members of the public and some families of September 11 victims, can register their endorsement, of which roughly ten thousand have already been gathered. This open campaign is the foundation of the project's social license, allowing the merits of the vision to be tested in public debate and refined in response to it. [144] In tandem, the conceptual design is being developed and refined using professional engineering and design software, advancing the architectural form, the structural concept and the masterplan from initial sketches toward a coherent and defensible scheme. The deliberate purpose of this phase is to establish, in full public view, exactly what is being proposed and why — so that every subsequent step rests on a clear, scrutinized and broadly supported concept rather than on a proposal still hidden from those it would affect.

Phase Two

The second phase (2025-present) broadens the effort from public awareness to the active cultivation of the specific stakeholders whose involvement the project requires. This means opening dialogue with the universities, companies, national laboratories and government agencies identified as potential partners and tenants; with the City of Chicago, the State of Illinois and the relevant federal authorities; and with the civic organizations, community groups and advocacy bodies — among them the Twin Towers Alliance and members of the September 11 community — whose support lends the project legitimacy. The aim is to assemble, step by step, the coalition of aligned interests on which a venture of this scale depends, bringing together the academic, industrial and governmental spheres in the manner that the project's triple-helix philosophy (Chapter 4) demands. Early, sustained relationship-building of this kind ensures that when the project advances to formal partnerships and funding, the necessary parties are already engaged, informed and invested, rather than approaching cold at a late stage. It is the human and institutional groundwork that underpins everything that follows.

Phase Three

With public support established and stakeholders engaged, the third phase forms the professional consortium that would carry the design from concept to construction-ready detail. A project of this complexity requires the coordinated expertise of architects, structural engineers, mechanical and electrical engineers, geotechnical specialists, fire and life-safety consultants, urban planners and environmental scientists, working as an integrated multidisciplinary team. This consortium would build directly on the conceptual design and engineering analysis already produced — including the structural modelling and computer-aided design work developed in the project's earlier stages — developing it through the staged design reviews characteristic of the aerospace method until the scheme is fully resolved and verified. Assembling this consortium openly, and on the foundation of a publicly understood concept, is itself a de-risking measure: it ensures that the detailed design is undertaken by the right specialists working toward an agreed and tested vision, rather than being repeatedly reworked to satisfy a developer's shifting commercial requirements. The output of this phase is a mature, technically sound design ready to be subjected to formal feasibility and environmental scrutiny.

Phase Four

The fourth phase subjects the resolved design to rigorous, independent examination before any commitment to build. Feasibility studies would test the technical, logistical and financial viability of the scheme in detail — geotechnical investigation of the site's soils and the depth to bedrock, structural and wind-engineering verification, transport and utilities capacity, and construction sequencing and cost. In parallel, a formal environmental review, conducted in accordance with the established framework of environmental impact assessment, would evaluate the project's effects on air quality, traffic, noise, ecology, drainage and the surrounding community, and identify the measures needed to mitigate them. This phase is the heart of the de-risking strategy: it exists precisely to surface and resolve the technical and environmental unknowns that, left undiscovered until construction, are the very source of the catastrophic overruns that afflict conventional megaprojects. When confronting these questions thoroughly and early (thinking slow so that the project may later act fast) the strategy converts uncertainty into knowledge while changes remain inexpensive to make.

Phase Five

The fifth phase moves from validating the project to securing the commitments that will populate and sustain it. Having engaged potential partners in earlier phases, the project would now formalize those relationships — converting interest into letters of intent, memoranda of understanding and conditional tenancy agreements with the anchor institutions and organizations that would occupy the campus. These would span the academic, industrial and governmental partners discussed in Chapter 5: leading universities prepared to establish a presence or collaborate on research; established technology, aerospace and engineering firms, start-ups and national laboratories prepared to take space; and government agencies prepared to site the collaborative workshops that are central to the concept. Securing these commitments before construction serves a vital strategic purpose: it demonstrates concrete demand for the campus, validates its economic premise to prospective funders, and ensures that the completed buildings open with their purpose already alive within them, rather than as speculative space awaiting occupants. Demonstrated demand, established in advance, is among the strongest assurances a project can offer those asked to finance it.

Phase Six

Only in the sixth phase — once the design is resolved, validated and supported, and tenancy commitments are in hand — is financial backing actively pursued. This is the deliberate inversion of the conventional sequence, and it places the project in a position of strength: funders are approached not with a speculative idea but with a de-risked, publicly endorsed scheme of demonstrated demand. Given the project's public-private character, its funding would be assembled from a correspondingly diverse range of sources — public-private partnership structures, federal and state grants and incentives, tax-increment financing tied to the regeneration of the site, institutional and philanthropic capital, and mechanisms such as the EB-5 immigrant-investor program that helped finance comparable developments including New York's Hudson Yards. [146] Crucially, the implementation itself would be phased: the campus would be designed to be built and brought into use incrementally, so that early components can be completed, occupied and generating value while later phases proceed. This phased approach spreads cost and risk over time, allows the project to demonstrate success and build confidence progressively, and avoids the all-or-nothing exposure that makes single-stage megaprojects so perilous.

Phase Seven

The final phase is construction itself, conceived from the outset as a long-term, generational undertaking to be approached with patience, realism and meticulous planning rather than haste. The project does not pretend that a campus of this magnitude can be completed quickly or cheaply; it embraces, instead, the discipline of phased realism, in which a credible multi-decade roadmap is followed stage by stage, each step consolidated before the next begins. Throughout, construction would proceed in close and continuous collaboration between the project's professional teams and the relevant authorities — the city, the state, utility providers and regulatory agencies — so that approvals, inspections and infrastructure works are coordinated rather than contested, in keeping with the constructive relationship with regulators described in Chapter Five.

The primary proposed site is a parcel of approximately thirty-five acres on Chicago's Near West Side, bounded by West Polk, West Harrison and West Taylor streets — at present a tired and underused tract whose redevelopment would itself regenerate the surrounding district and reinforce the wider regeneration of Chicago's central area already under way nearby, including Related Midwest's multibillion-dollar development of *The 78*. Preparing and building on it would be a substantial program in its own right. Existing electrical infrastructure crossing the site would need to be rerouted, and the nearby Taylor Street substation upgraded, to free the land and to supply the considerable power the completed campus would draw; this would be followed by demolition of the structures presently on the site, deep excavation down to the bedrock that will anchor the towers' foundations, and then the long sequence of construction itself, rising in the phased manner described above. Each of these stages — utilities, demolition, excavation, foundations and superstructure — carries its own engineering and logistical demands, and each would be planned and de-risked in advance rather than improvised.

Finally, the strategy retains a deliberate adaptability. Chicago is the primary and strongly preferred location, chosen for the strategic, economic and historical reasons set out throughout this report, but the project's design and concept are not inseparable from a single site. Should the Chicago location ultimately prove unsuitable — whether for reasons of land, permission, infrastructure or cost — the model could be carried to another suitable city, just as the relocation from New York to Chicago was itself a pragmatic response to changed circumstances. This built-in contingency is a further expression of the project's realism: its purpose is to advance science, education and national capability, and while it has a preferred home, its mission is larger than any one parcel of ground. The roadmap is long, but it is deliberate, and every stage is designed to bring a generational vision steadily and responsibly into being.

6.2 Measurable milestones

Each phase of the strategy is defined not only by its activities but by concrete, verifiable objectives, so that supporters, partners, and prospective funders can follow the progress of the project and hold it to its own standard. Table 6.1 summarizes representative milestones for each phase. They will be refined and extended as the work advances. The independent economic impact assessment of Phase Four will replace the project's working economic estimates with externally validated figures — and progress against them will be reported openly through the project's public outreach.

Stage	Representative milestones
(1) Public Awareness and Conceptual Development	Public release of the complete report, film, and press kit; completed conceptual design package (masterplan, elevations, structural concept, and CAD models); continued growth of public endorsements beyond the roughly ten thousand already gathered; presentations at national technology and civic forums.
(2) Stakeholder Networking	Expanded advisory network across academia, industry, finance, and government; first memoranda of understanding with universities and research institutions; preliminary registrations of tenant interest; formal briefings with the City of Chicago and the State of Illinois.
(3) Consortium Formation	Appointment of an architect and engineer of record on the team; multidisciplinary design consortium under agreement; completion of staged design reviews (conceptual, preliminary, and critical); construction-ready design frozen.
(4) Feasibility and Environmental Review	Publication of an independent economic impact assessment; completed geotechnical and wind-engineering studies; environmental review concluded with an agreed mitigation plan; validated cost model and construction sequence.
(5) Tenant and Institutional Partnerships	Letters of intent and conditional tenancy agreements covering a defined share of campus space; anchor academic, corporate, and laboratory partners committed; government workshop tenancy agreed.
(6) Funding and Phased Implementation	Public-private funding structure established; first-phase capital committed; enabling works contracted, including utility relocation and substation upgrading; groundbreaking.
(7) Long-Term Construction	Excavation and foundations complete; first campus buildings occupied and generating value; towers topped out; progressive opening of the campus, with each stage consolidated before the next begins.

Table 6.1: Representative measurable milestones for each fundamental stage of the implementation strategy.

6.3 Risk Acknowledgment and Mitigation

No undertaking of this scale is without risk, and the project regards candor about uncertainty as a component of credibility rather than a concession. The principal risks are identified in this section, together with the means by which the strategy is designed to manage them. None, however, can be eliminated. However, each can be bounded, and the concept-first sequence described in this chapter is itself the project's primary instrument for doing so, since it converts the largest unknowns into clear knowledge before irreversible commitments are made.

The first cluster of risks is financial and market related. Financing risk arises from the sheer scale of capital required and the length of the horizon over which it must be committed. It is mitigated by the diversity of the funding pathways described in Phase 6 (by phased implementation that avoids any single all-or-nothing commitment, and by the deliberate sequencing that secures anchor partners before capital is sought). Thus, funders would be approached with demonstrated demand rather than speculation. Tenant-acquisition risk — the possibility that occupancy falls short — is addressed by placing partnerships ahead of construction in the phase sequence, by the breadth of the intended tenant base across academia, industry, and government, which avoids dependence on any single occupier or sector, and by the campus's own incubation pipeline (which generates future tenants from within). Exposure to economic cycles is inherent in a multi-decade program; the phased roadmap allows the pace of development to flex with conditions rather than forcing distressed decisions at unfavorable moments.

The second cluster concerns construction, regulation, and politics. Cost overruns are endemic to megaprojects — the great majority exceed their budgets, many severely [142] — and the project's response is the front-loaded discipline already described: exhaustive design development through staged reviews to a frozen, construction-ready scheme, and independent feasibility, geotechnical, and environmental investigation before commitment, in keeping with the maxim to "think slow, act fast". [143] Regulatory risk — zoning, permitting, and environmental approval — is managed by treating the environmental review not as an obstacle but as a designed gate in Phase Four, and by the early, continuous engagement with city, state, and federal authorities that the strategy builds in from the outset, later institutionalized in the campus's co-located government workshops. Political risk - the shifting of public priorities across administrations - is addressed by the project's deliberately civic and non-partisan framing by the social license it builds through open public endorsement, [144] and by a funding and governance design that does not depend on any single electoral moment. As a final safeguard, the strategy retains deliberate site adaptability: the concept is not inseparable from a single parcel of ground.

The third cluster is operational and long-term: the maintenance of a large campus across decades, the evolution of technology over the project's lifetime, and the sustainment of tenancy and relevance far into the future. These are mitigated by a mixed-use revenue base (tenancy, hospitality, education, and the visitor economy) rather than reliance on a single income stream; by the exceptional structural design longevity; by the governance and institutional structures described in the following section, which are designed to steward the project beyond any individual; and by periodic review embedded in the long-term roadmap itself. Uncertainties will remain, as they do in every generational undertaking. The project's answer is not to promise their absence but to manage them in the open: transparency, phasing, and verification at every gate.

6.4 Governance and Institutional Structure

In its present conceptual phase, the initiative is developed in a charitable manner through a focused, non-profit design team under the auspices of Raphael Chryslar, and with the support of collaborators and independent external reviewers. This is appropriate to the current stage in which the coherence of a single guiding vision is an asset. But a civic undertaking of this scale must be built to outlast and outgrow any individual, and the project's governance is therefore planned to evolve deliberately with its phases, in step with the growth of its responsibilities. That evolution has four planned elements:

- First: a formal advisory board drawing on academia, industry, finance, civic life, and the September 11 community, to broaden oversight and counsel as stakeholder engagement expands;
- Second: technical advisory committees — in structure and safety, sustainability, and education and outreach — convened as the design matures toward the consortium phase;
- Third: the establishment of a dedicated nonprofit foundation or institute to hold the project's mission, receive philanthropic and grant funding, and steward public engagement and education in perpetuity, and;
- Fourth: for delivery, a public-private structure with participation by the city and state, of the kind long used for major American civic development — giving the triple-helix partnership of university, industry, and government described in Chapter Four an institutional form.

Separating the stewardship of the mission, held by the foundation, from the commercial delivery of the buildings protects the project's purpose from the pressures of the build.

Whatever final form these institutions take, they will be bound by the same principles: transparency in plans and finances; accountability to the public supporters whose endorsement constitutes the project's social license; and continuity across decades. Clearly defined governance is, in the end, the practical mechanism of “cathedral thinking” this report describes how a generational vision survives and is faithfully carried across the generations that will build it.

Conclusion

This report has set out the case for the World Technology Center across its full breadth — from the vision of the campus and the legacy of the towers whose silhouette it would restore, through the national needs it would answer and the principles that give it shape, to its economic consequences and the phased strategy by which it would be built. Beneath the detail lies a single, coherent idea. The World Technology Center proposes to take one of the most beloved and most mourned forms in the American imagination, and to give its spirit a new and constructive life: not by rebuilding on the hallowed ground in Lower Manhattan, which is rightly preserved as a place of remembrance, but by raising twin towers anew in Chicago and reconceiving them entirely as an instrument of science, education and human aspiration. In doing so it seeks to honor the memory of those who were lost, to answer the longing of those who have always wished to see the towers rise again, and to keep faith with Minoru Yamasaki's founding conviction that such a structure should stand as a living symbol of human dignity, cooperation and peace.

Its motive is at once commemorative and forward-looking. It responds to a decline in the nation's appetite for long-horizon ambition, to the fragmentation and over-concentration of its scientific enterprise, to the economic stagnation of a great interior city, and to the estrangement of the public from the science that shapes its future — and it offers, in answer to all of these, a single bold undertaking. Its mission is civic in the fullest sense: to gather the public and private spheres around a shared purpose, to open the work of science to the people who fund it and the young who might be inspired by it, to draw talent and investment to a region the prevailing geography has bypassed, and to assert that the American capacity to build something great remains intact.

Such an undertaking is necessarily the work of generations. It is conceived in the spirit of those who raised the cathedrals and dug the great tunnels and reached for the Moon — an exercise in cathedral thinking, begun by people who understand that its fullest benefits will accrue to those who come after them. It asks for patience, for realism and for a willingness to plan and build across decades rather than electoral cycles. But the returns it offers — in scientific capability, in educational opportunity, in economic renewal, in national resilience and in sheer inspiration — are of exactly the kind that justify so long an effort.

The towers that fell were an argument in steel and glass: about trade and peace, about the dignity of the people within them, about how far human ambition could reach. The World Technology Center would be an argument too — that destruction need not have the last word, that a nation can answer loss with creation, and that the future is something to be built toward with confidence rather than feared. It is, in the end, an act of hope: a wager that the United States can still dream big, build boldly, and raise once more, in a new place and for a new purpose, a structure worthy of the people it serves and of the generations who will inherit it.

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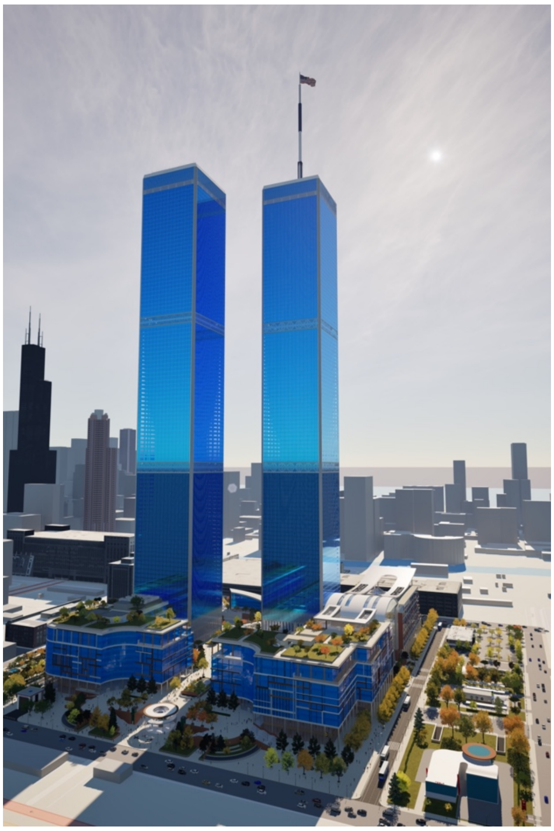
Appendix A

1. **Notes about the early media interpretations**. In contemporary popular usage, the word "technology" has narrowed considerably, becoming near synonymous with digital computing, software, the internet, and information infrastructure. The objective definition is broader: technology is the application of scientific knowledge to the practical aims of human life. [1] It is in this classical sense that the World Technology Center bears its name — a campus encompassing laboratories, workshops, aerospace and materials research, engineering education, and public science engagement across the full breadth of the STEM disciplines. The distinction acquired practical relevance in March 2026, when early third-party media reports characterized the project as a proposed data center. The characterization was inaccurate. While the campus program includes data servers and computing laboratories, these represent a small fraction of the overall facilities. The misreading appears to have originated in a social media conflation of "science" with "science data," compounded by the very narrowing of the word "technology" and the common shorthand form “tech” that this note describes. The episode is itself an illustration of semantic drift. The World Technology Center is not a data center. It is a campus for science and technology in its fundamental sense.
2. **Clarification Regarding Early Defense-System Concepts.** Certain early-stage ideas associated with the World Tech Center have received disproportionate attention in external media, particularly the proposed multi-megawatt laser or missile defense system and its radar aerial threat-detection components. These elements should be understood as **preliminary, exploratory topics** developed during the project's introductory wider technical ideation process and do not constitute core or defining components of the vision. Their inclusion within the broader conceptual material is intended to explore potential future technological applications and should not be interpreted as a finalized system, operational proposal, or principal objective of the project. The central vision of the World Technology Center remains focused on technology, engineering, scientific education, research, innovation, and public STEM development.

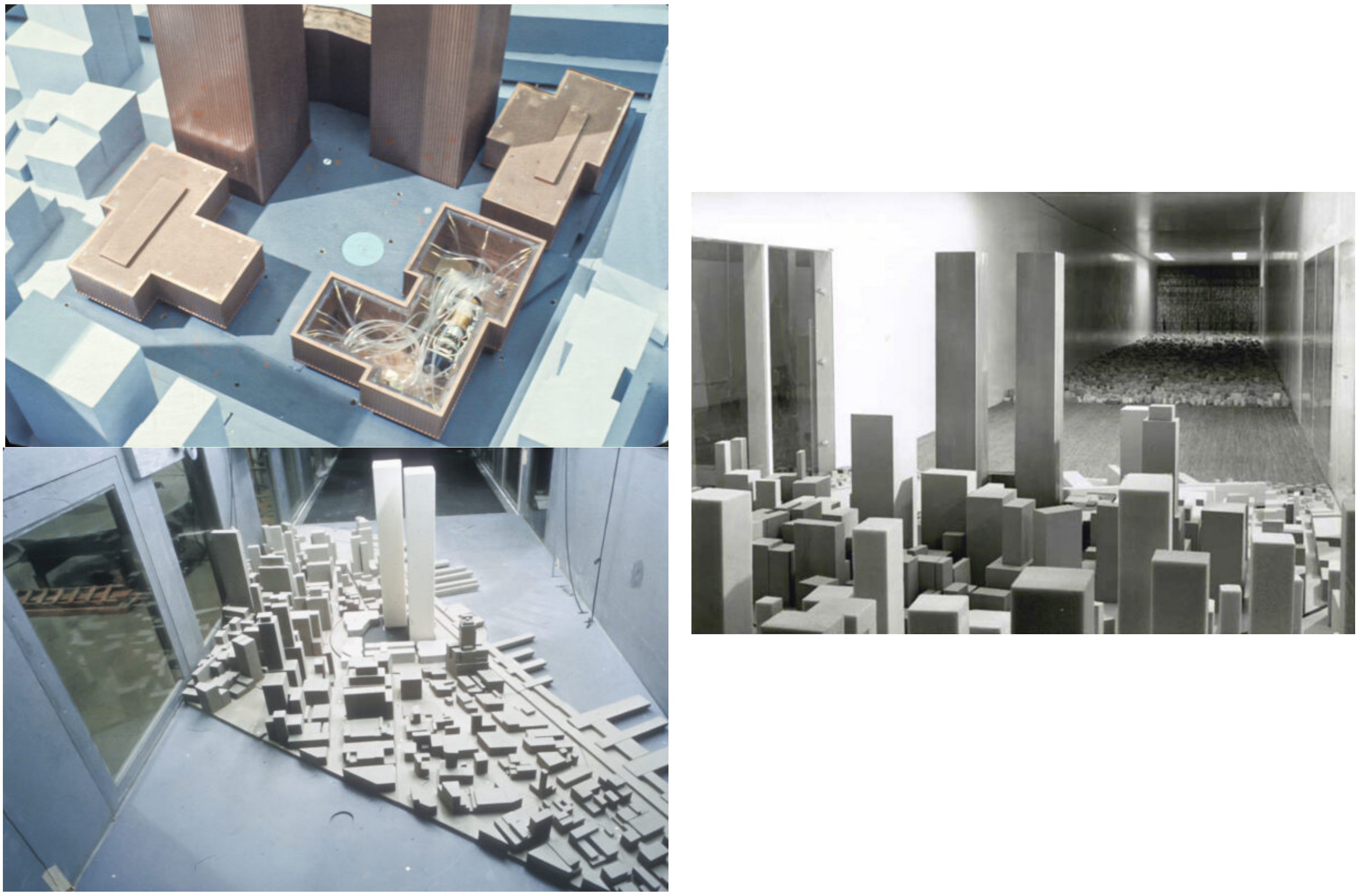
Appendix B

1. Overall renders of the World Tech Center campus on the Chicago Skyline, viewed towards northeast and showing the blue giants and surrounding auxiliary buildings and nature amenities.



2. Low-rise aerial view of the World Tech Center above W. Taylor Street, looking north, showing plentiful of greenery.

3. World Trade Center wind tunnel testing model at various laboratories in the 1960s



4. Diagram depicting the slurry wall excavation methodology