



PDHonline Course S258 (8 PDH)

World Trade Center: Magnificent Ambition

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World Trade Center



MAGNIFICENT AMBITION,

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Part 1

Origins



1 2 3 5

SEMI-ANNUAL + INTERNATIONAL

LEIPZIG TRADE FAIRS

FOR 700 YEARS
THE WORLD'S MARKET PLACE

1 9 3 5



“The WTC took for its first model Germany’s Leipzig Fair dating to the 1300’s. The venerable Leipzig Fair had enjoyed 700 years of state subsidy. Why not create a Leipzig-on-Hudson, in the heart of New York’s booming postwar manufacturing and transport economy? Financed on the basis of revenue from the continuous exhibits of merchandise.”

RE: excerpt from: *Divided We Stand*, concerning the origin of the WTC idea. Highlighted in a memo from the *Port Authority of New York Division of Development* to Austin Tobin – Port Authority Director, in 1955. The memo was based on an idea first floated in 1945 by David Schultz – a real estate investor and former Florida Governor.



“Establish and develop a World Trade Center to be located within the State of New York for exhibiting and otherwise promoting the purchase and sale of products in international trade”

NYS Governor Thomas E. Dewey, 1946



“We don’t want to compete with existing office space. We want to provide some new use. A WTC seems logical and it seems logical to have it near the banks that service the bulk of U.S. foreign trade.”

David Rockefeller

“Trade Centers help not only to facilitate international trade and build economic well-being, but they foster a higher level of harmony and peace among the nations of the world. The practical day-to-day commerce and business conducted in and through World Trade Centers transcends narrow nationalism as well as ethnic and political barriers of the past.”

Guy Tozzoli – WTC Director

RE: Excerpt from a speech to the *World Trade Centers Association (WTCA) General Assembly* meeting in Geneva, Switzerland in 1989. Tozzoli – head of the PA’s WTC Dept., founded the WTCA in the late 1970s. The WTCA is a membership organization of approximately three-hundred WTC’s in 97 countries.

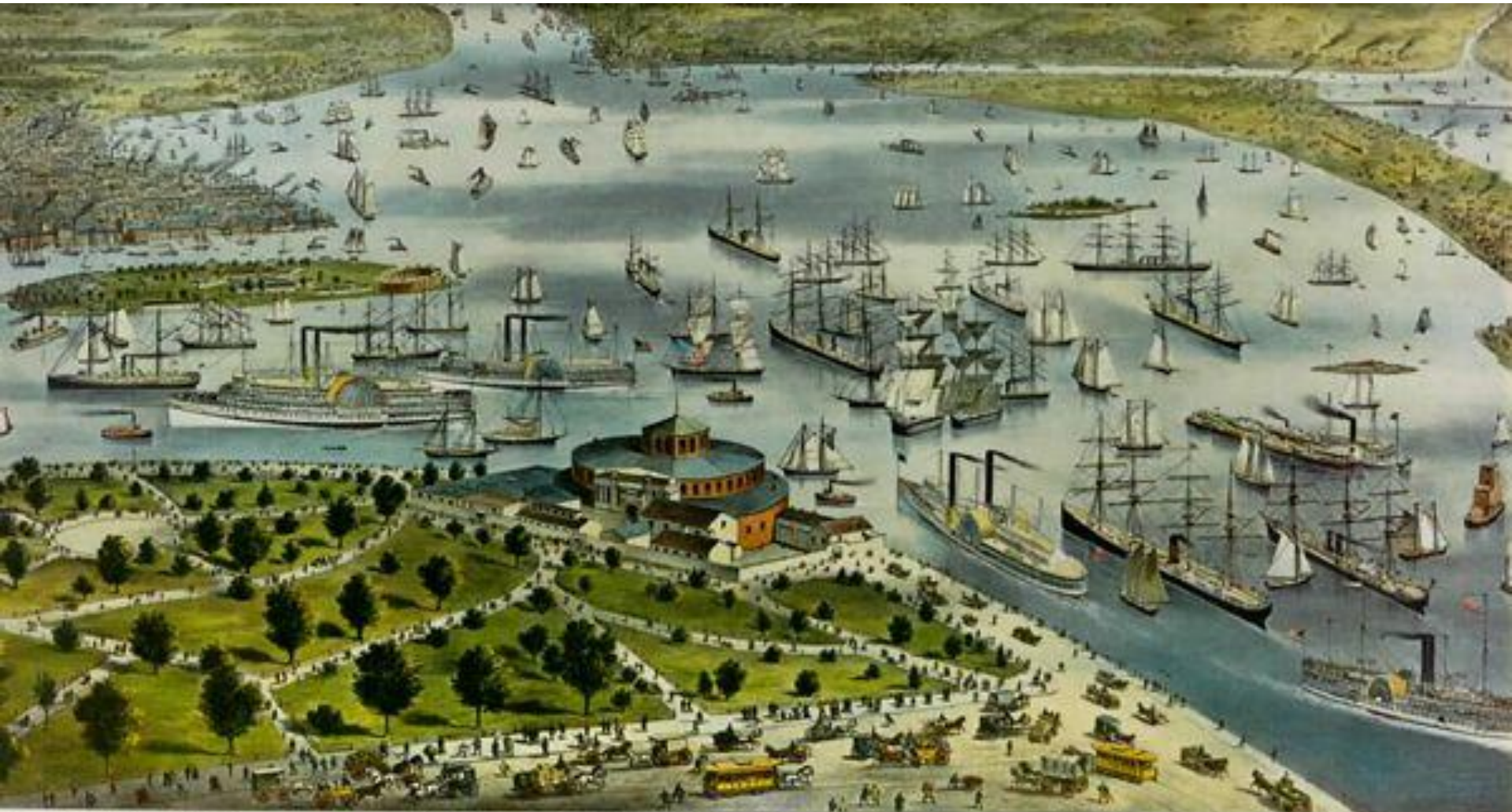


**World Trade Centers
Association**



“The opening of the Erie Canal in 1823 launched New York’s first real estate boom. One hundred & fifty years later, the rise of the WTC coincided with the decline of New York’s port which had, by virtue of being a day closer by ship to Europe than any major harbor in North America, helped New York become the global center of finance.”

RE: excerpt from: *Divided We Stand*



**The Port of New York
(Castle Clinton and Battery Park in foreground)
(ca. 1840)**





Chelsea Piers



“An unexpected eruption of commercial real estate emerged out of Lower Manhattan’s bedrock in the early 20th century, moved northward into midtown and, with the advent of the WTC, returned to its roots at the harbor’s shore.”

RE: excerpt from: *Divided We Stand*



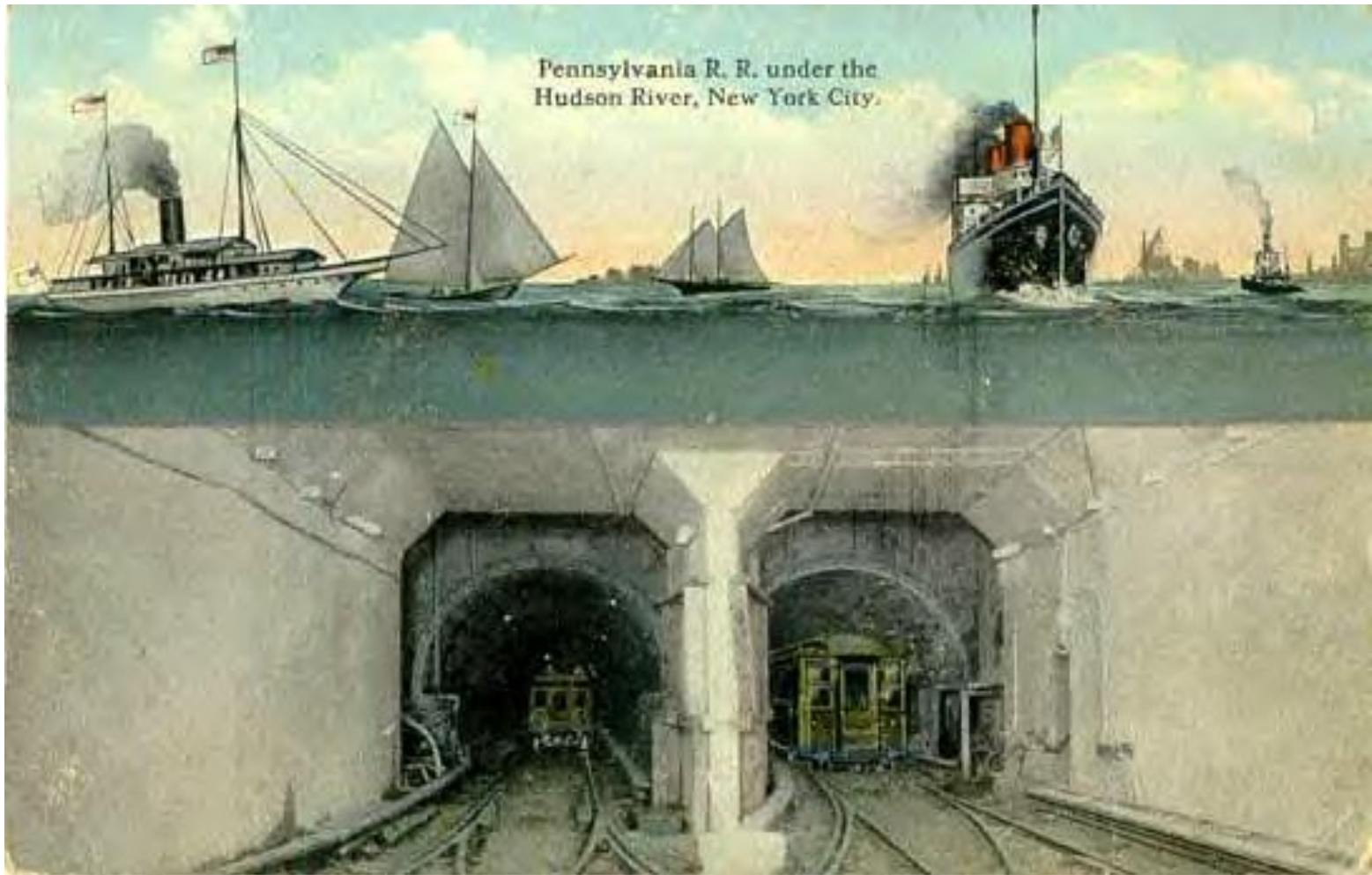
“It is plain that Newark has the railways in greater competitiveness than the city has the ships. Newark’s competitive effort is to get access to the ships, just as the competitive effort by the city administration is to get access to the railroad feeders of its docks. Newark has better access to deep water than NYC has to the railways across the Hudson.”

New York Times, 1922

“Our port problem is primarily a railroad problem...A complete reorganization of the railroad terminal system is the most fundamental physical need of the Port of New York...connecting NJ & NY by tunnel under the upper bay...an underground railroad system”

Joint Report, 1926

RE: primary need/purpose of the PA (the WTC diverted this project)



Trans-Hudson (passenger-train) RR Tunnels

Not just BRIDGES...

not just TUNNELS... but a

\$225,000,000 BUSINESS



How the Port of New York Authority gets things done with paper... by RALPH HENNERBERT



Marathon days of engineering, to be sure, but their secret weapon was that—like the George Washington Bridge, the Hudson and Manhattan Tunnel and other projects of the Port of New York Authority. They are among the marvels of the century, reflecting the advancement of distribution and the ability of man to overcome the elements.

It took from 1916 through 1928 and New Jersey, alongside this uncertainty... and to the 1,000 regular employees who head these activities.

Other aids also are needed in carrying on this mammoth work—millions of pounds of paper each year for printed forms and correspondence in its responsibility and just the possibility of error, and to coordinate material, between one department head and another and to transmit plans and orders. Today, the Port is a remarkable sight.

THE PORT OF NEW YORK AUTHORITY... (text partially obscured by circular image)

Moreover, we had in the hands of this self-government agency one of the biggest businesses in a country famous for doing big things in a big way—a \$225,000,000 enterprise.

Most, if not all, is a problem of management... a problem of getting things done... by the right people... on the right time... at the right place. Why not use Hammermill?

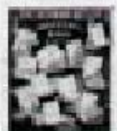
Thank you, Mr. Hammermill, with the production of the Port of New York Authority... (text partially obscured by circular image)

about the same... (text partially obscured by circular image)

WORKING WITH... (text partially obscured by circular image)



HAMMERMILL BOND



“Blunted in its initial efforts by the rail carriers themselves, the PA turned its back on the coordination of the port’s rail freight and the cross-bay tunnel. Instead, PA planners looked to projects that could be more readily accomplished. The PA began constructing a series of bridges, tunnels and depots to augment the spreading arterial network of automotive transport – and it began raking in tolls and rents.”

RE: excerpt from: *Divided We Stand*

“Thus in New York the original recommendation of an underground automatic electric system for the distribution of railroad freight from the New Jersey yards to Manhattan was made obsolete by the tremendous development of the motor truck...Our own planning in the field of arterial highways for the New York metropolitan areas today is being shaped almost entirely by the motor vehicle. With mass production of the auto, the truck and the bus, the suburbanite has been freed from his absolute dependence upon fixed rails with their inflexible routes.”

Austin Tobin - PA Director, 1947

RE: excerpt from: *The Why and Wherefore of the Port of New York Authority*

“Projected into the 1990’s, estimates were that the rail-tunnel would result in 1,700 fewer trucks and cost an estimated \$1 billion. Ironically, the final price tag for the WTC.”

RE: excerpt from: *Divided We Stand*. Concerning a 1980 PA feasibility study for a rail-tunnel first proposed under the PA’s charter in 1921

The Regional Plan Association

“Breaking up unwieldy centers creating new centers and sub-centers, as well as dispersal of some industry from its overcrowded centers to those that have space to permit of economic functioning and expansion. The economic benefit will be certain and considerable if, in promoting the right kind of dispersal, the city succeeds at the same time in arresting the wrong kind...If it were practicable for New York to encourage the movement to outside areas of those industries that are the least valuable to it, it would probably prevent the removal of others that are of greater value.”

RE: excerpt from the *Regional Plan Association’s (RPA) report entitled: Regional Survey of New York and its Environs, 1931*



**19th Century Tenement Housing, Lower Manhattan
(ca. 1935)**



“In 1931, the RPA presented this Rendering of the ‘Christie-Forsyth Parkway’ for the Lower East Side. The RPA proposed that this seven-block stretch be transformed from tenement housing to modern art-deco skyscrapers with a sunken parkway.”

RE: excerpt from: Divided We Stand

“One of the fundamental causes of congestion is the convergence of too many transportation facilities, including harbor extensions, at places already congested...injurious to the industries that must remain for sounder economic reasons. Much of the waterfront cannot be connected efficiently with the railroads without prohibitive costs; and much of it, in any event, should be reserved for recreation in the interests of commerce itself...the greatest opportunities for the port’s future growth appear to lie in the New Jersey counties adjacent to the waterfront.”

RE: Regional Plan Association (RPA) Survey, 1931



**Lower Manhattan Waterfront
(ca. 1931)**

The Brothers Rockefeller

“Some of the poorest people live in conveniently located slums on high-priced land. On patrician Fifth Avenue, Tiffany & Woolworth, cheek by jowl, offer jewels and gimcracks from substantially identical sites. Childs Restaurants thrive where Delmonico’s withered and died. A stone’s throw from the stock exchange, the air is filled with the aroma of roasting coffee; a few hundred feet from Times Square, with the stench of slaughter houses. In the very heart of the “commercial” city on Manhattan Island south of 59th Street, the inspectors in 1922 found nearly 420,000 workers, employed in factories. Such a situation outrages one’s sense of order. Everything seems misplaced. One yearns to rearrange the hodge-podge and put things where they belong.”

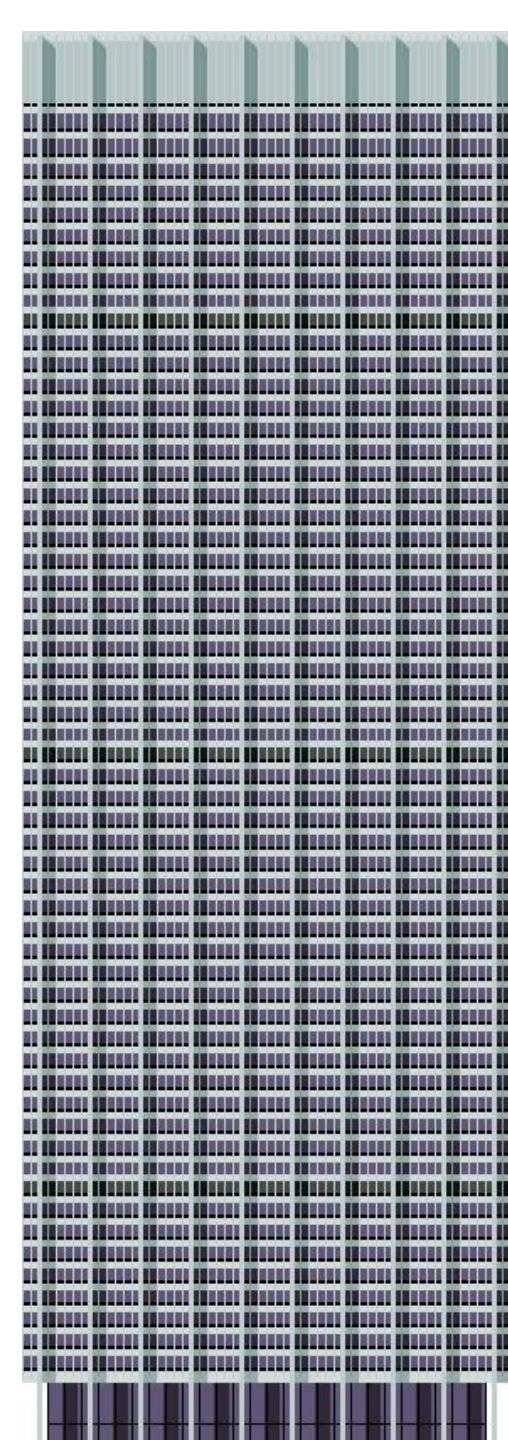
RE: excerpt from: *Major Economic Factors in Economic Growth and Arrangement, Volume I*

- 1) The Financial District**
- 2) The Best Retail Businesses**
- 3) The Best Residences**
- 4) Inferior Retail Businesses**
- 5) Wholesaling & Some Industries**
- 6) Other Industries, Residences for Low-Paid Workers**

RE: NYC's *Land Use Order of Precedence*



**“Residences for Low-Paid Workers”
Lower West Side, Manhattan
(ca. 1935)**



“David Rockefeller’s gamble on One Chase Plaza (1955) entailed extraordinary risk. If it were not supported by positive momentum throughout the whole Lower Manhattan real estate market, the first financial district office tower to be built in a generation could well prove a disaster for Chase and a serious blow to the family fortune. Accordingly, David mobilized the downtown business elite around a high-profile strategy for redeveloping the entire district in the image of international corporate modernity. To this end, in 1956 David Rockefeller founded the Downtown Lower Manhattan Association (DLMA).”

RE: excerpt from: *Divided We Stand*

“A proposal to build a World Trade Center in the financial district of downtown Manhattan generated widespread enthusiasm among New York business executives and government officials last week. Estimated to cost \$250 million, the center would be the first stage of a \$ 1-billion redevelopment program for lower Manhattan proposed over a year ago. The plan calls for clearing a 13-acre site on the East River. Only two existing buildings would remain. An elevated plaza, two stories above grade, would cover the entire site. Three buildings would rise out of the plaza nine-story World Trade Mart, 880 x 365-feet in plan, with two interior courtyards; a 50-to-70-story commerce office hotel building; and a Central Securities Exchange Building. The giant World Trade Mart would provide office and display space for international trade activities, offices for insurance brokers and travel offices. It would contain exhibit space for governmental trade missions, space for commodity exchanges and an international clearing house for merchants...”

RE: excerpt from: Engineering News Record (February 1960) ³⁰



“...The commerce building would house U. S. and foreign business, banking and brokerage firms in international markets. A world trade club would provide meeting rooms for foreign and American citizens engaged in this field. Ten floors at the top of the building would furnish 500 to 700 hotel rooms to accommodate transient shippers and international merchants. Planners hope to have the New York Stock Exchange as .a tenant in the Central Securities Exchange Building to be a world trading center. Stock Exchange officials have made no commitment yet. Shopping arcades occupy the main concourse at street level and the floor above. One underground level contains parking, loading and storage areas. A proposed heliport, adjoining the site on the East River, would provide rapid access to metropolitan airports...”

RE: excerpt from: ENR (February 1960)



Rendering of Proposed East-Side WTC

“...The Lower Downtown Manhattan Association, a civic organization representing business firms and real estate owners in downtown New York, sponsors the redevelopment studies. The association's report recommends that the Port of New York Authority make detailed studies on planning, financing and putting the center into operation. This recommendation was sent to Governor Rockefeller of New York, Governor Meyner of New Jersey and Mayor Wagner of New York City. Association Chairman David Rockefeller said he expected most, if not all, development money to represent private investment. There is no target date for construction. But Mr. Rockefeller expressed hopes that the Trade Center could start taking leases when foreign visitors arrive for the New York World's Fair in 1964. Skidmore, Owings, and Merrill, New York City architects, are planning consultants for the Lower Downtown Manhattan Association.”

RE: excerpt from: ENR (February 1960)

Rockefeller Time

“‘Rockefeller Time,’ like that of the medieval builders who envisioned the cathedrals they never expected to see completed, was reckoned in multiple generations. Their aggressive impulses tempered by enormous patience. The Rockefellers proved adept at minimizing the damage caused by short-term reversals and then, moving on.”

RE: excerpt from: Divided We Stand

The WTC Moment

“In the WTC ‘moment,’ it became possible to further dispense manufacturing from downtown, move what remained of New York’s port to New Jersey and bury Lower Manhattan’s rundown piers under virgin real estate. Also, immured were any lingering hopes for a cross-bay freight tunnel.

The WTC ‘moment’ occurred between 1957 & 1958 and entailed several key events:

- Robert F. Wagner (Independent) was elected NYC mayor in 1957 thus, the Longshoreman’s Union lost their Tammany Hall support which was the port’s last line of defense*
- Developers/contractors such as Tishman formed a strategic alliance with building trades unions guaranteeing work and no strikes*
- Nelson Rockefeller – David’s brother, was elected NYS governor in 1958”*

RE: excerpt from: *Divided We Stand*



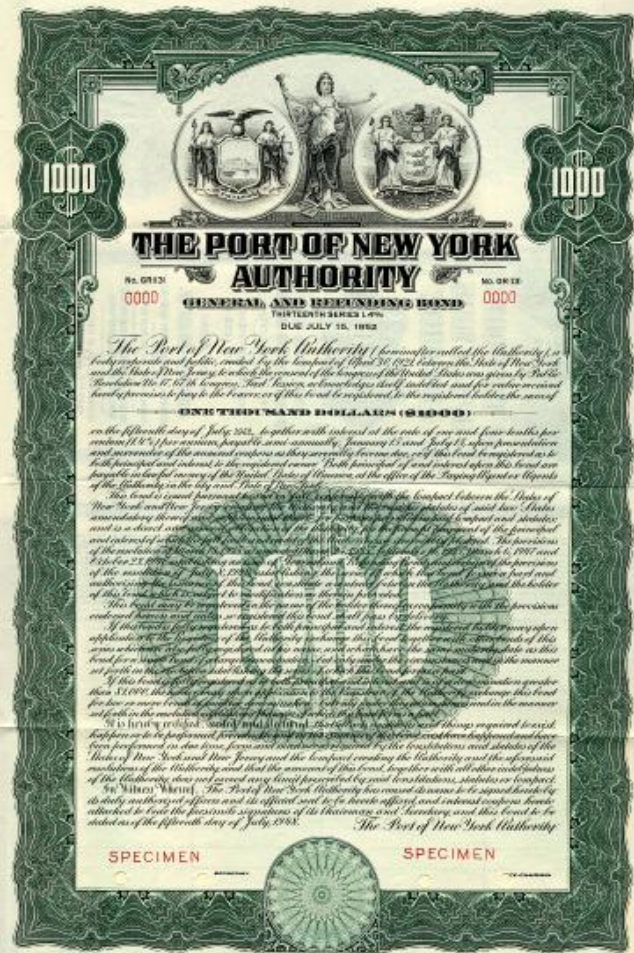
**The Brothers
Rockefeller
(David, at left)
celebrate Nelson's
(at right) 1958
New York State
Gubernatorial
Victory**



“Governor Rockefeller used public corporations to push forward a vast array of development projects he deemed essential to the state’s future. Eventually, forty-one new state authorities were created. To fund the governor’s public works extravaganza, NYC bond lawyer John Mitchell – later Nixon Administration Attorney General – invented the ‘moral obligation’ bond, a clever financial instrument that shifted the ultimate obligation for authority debts onto taxpayers. Only a public corporation with a fifty-year track record would be capable of raising a billion dollars to replace Lower Manhattan’s piers with immense twin towers of office space. A private firm or consortium could not have attempted, nor would it have dared, to undertake such a feat. But an entity shielded from risk by public subsidies and the taxpayer’s ‘moral obligation’ could do it.”

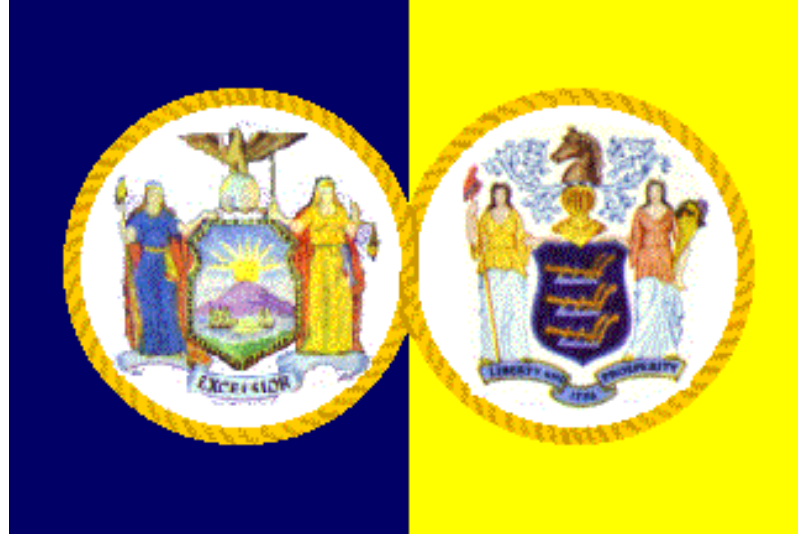
“The work of authorities is carried out in the name of the public. Yet, the deliberations of an authority’s executive board and committees remain screened from public oversight, as do the details of its finances, which frequently generate a bonanza of private capital flows. Projects undertaken by authorities purportedly yield a public good, but an authority’s board is under no legal obligation to undertake a project it deems unfit, however demonstrable its public value may be. The enormous flexibility and power of authorities derive from the confluence of the public corporation’s mission with the workings of private sector finance. Given this linkage, it’s not surprising that the development strategies driving an authority’s activities frequently dovetail with the financial interests of its bondholders. The financial beauty of a public corporation like the PA is that it capitalizes its projects through the sale of bonds. This allows for enormous public investments that do not directly raise taxes, since the debt an authority incurs never appears on the state budget’s balance sheet.”

RE: excerpt from: *Divided We Stand*



Part 2

The Port of New York Authority



“The Port Authority’s mission is to identify and meet the critical transportation infrastructure needs of the bi-state region’s businesses, residents and visitors: providing the highest quality, most efficient transportation and port commerce facilities and services that move people and goods within the region, provide access to the rest of the nation and to the world, and strengthen the economic competitiveness of the New York-New Jersey metropolitan region.”

RE: Mission Statement: Port Authority of New York & New Jersey
Formerly: The Port of New York Authority (PNYA)

The Greatest Port in the World

With \$1,916,934,800 worth of foreign trade in the year ended June 30, 1914, New York surpassed London by \$125 million, Hamburg by \$242 million and Liverpool by \$279 million, firmly establishing its position as the greatest port in the world. With 392-miles of developed waterfront and 978-miles altogether, measured around the piers, New York is unrivaled in its facilities for shipping. On its waters in 1913, 175 million tons and 4,223 foreign vessels of 14,464,161 tons traded here. The state canals deliver 2,602,000 tons of freight valued at \$36,865,451. Its strategic location makes the port the focus of the great trade coming through the Panama Canal and it is the center of the intra-coastal waterway of which the Cape Cod Canal, Long Island Sound and the proposed ship canals across New Jersey and Delaware are links.

RE: excerpt from: *King's Views of New York, 1915*

“The great terminals of the Port of New York be made practically one, and that the separate interests of the individual carriers be subordinated to the public interest”
Federal Interstate Commerce Commission, 1916

“...full power and authority to purchase, construct, lease and operate terminal, transportation and other facilities of commerce within the port districts as defined by law...”

RE: excerpt from the charter written by NY & NJ in 1921 and approved by Congress to form the first interstate agency: *The Port of New York Authority*. In 1971, it was renamed: *The Port Authority of NY & NJ*



The terms of the charter were not intended to give the PA carte blanche to engage in real estate speculation, but the phrase: ‘other facilities of commerce,’ formed the tunnel-sized loophole through which the agency eventually incubated and gave birth to the WTC.”

RE: excerpt from: *Divided We Stand*



“...a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise”

**President Franklin Delano Roosevelt, 1933
RE: *The Tennessee Valley Authority*. The TVA was modeled after the *Port of New York Authority* - established in 1923, as a “quasi-governmental agency”**

“Though it is created as a political subdivision of the states and has many of the powers and immunities of a municipality, the PA’s form is more closely that of a corporation and its management, its methods and its techniques are those of a modern business corporation.”

Austin Tobin – PA Director, 1947

RE: excerpt from: *The Why & Wherefore of the Port of NY Authority*



“...something above democracy, absolutely. That’s why it was invented by politicians, to keep the people away from the operation and to insulate the politicians.”

**Former NYS Governor Mario Cuomo
RE: excerpt from a 1996 radio interview
discussing the PA**

“Between 1949 and 1955, the PA continued to study and refine the concept of a WTC designed to function as a port development facility. The agency’s efforts were spurred in this direction by the development of several International Houses, International Trade Marts & World Trade Centers in the competing ports of New Orleans, Philadelphia, Boston, San Francisco and Miami.”

RE: excerpt from: *Divided We Stand*

The Sun God



“A real estate attorney freshly graduated from Columbia Law School, Austin Tobin would spend his entire career at the PA, assuming directorship in 1942. During his three decade tenure, Tobin placed his stamp on the Wilsonian model of centralized executive style. The PA - whose power radiated out across the entire port region - had Austin Tobin for a hub.”

RE: excerpt from: *Divided We Stand*

“He was not how I imagined a New York harbor man. He was a small solid lawyer, weathered but cherubic, like an American Buddha. His voice was gentle but there was a steeliness in his eye, imperfectly disguised in humor. I had been told that he was one of the most powerful men in New York, and it seemed to me that while he would be a mellow and witty dinner host, he might be an awkward opponent to handle, face-to-face across a conference table.”

James Morris, Journalist

“During Tobin’s long leadership, the PA grew into a public agency of tremendous political and financial power. When he was forced into retirement by Nelson Rockefeller in 1972, Tobin left behind him an agency whose staff had mushroomed from 300 to more than 8,500, an annual budget exceeding \$3 billion and the potential to issue another \$1 billion worth of bonds at any time.”

RE: excerpt from: *Divided We Stand*

“The marginal financial return from the proposed WTC suggests that its success could only be achieved by a public agency. The very nature of the WTC and its importance to the general community requires that its operation be motivated not by the development of maximum economic return, but by the improvement of the competitive position of the port to assure its continued prosperity...to centralize at one location a vast number of critically important services and functions relating to the foreign trade of the NY/NJ port”

Austin Tobin, 1961

“No longer under the iron control of Austin Tobin, the PA faced a series of interlocking scandals that culminated in the late 1970s with a state comptroller’s audit and criminal investigations into its lavish perks, including around-the-world junkets for its top executives and their families. PA officials were accused of retroactively altering expense vouchers, ‘massive abuse’ of the agency’s fleet of nearly 600 vehicles and inside bidding deals on purportedly competitive service contracts.”

RE: excerpt from: *Divided We Stand*

Part 3

Not Without a Fight

“For more than three centuries, foreign trade has been the lifeblood of the Port of New York. The port has been the magnet which has attracted many other businesses and industries which made this metropolis the world’s largest and made it prosper as a center of finance, publishing, communications and the arts...Certainly no one would question the need to continue to promote and strengthen the facilities and institutions of the Port of New York. This is the sole purpose of the Trade Center...We all recall how Rockefeller Center turned a stagnant Sixth Avenue into the gleaming skyscraper city it is today. We all recall how the UN turned the old gas house district along the East River into a soaring symbol of man’s hopes for peace. In the same way, the Trade Center will dramatically revitalize a drab and decaying area of Lower Manhattan and transform it into a magnificent international marketplace for people from all over the world.”

Austin Tobin – PA Director

RE: May 1, 1961 testimony to the NYC Council



“What’s in it for me?”

NJ Governor Richard B. Meyner, Spring 1961

RE: comment made upon viewing the plan to locate a WTC on Manhattan’s east-side

“After decades of shunning railroads as a bottomless pit, Austin Tobin and the PA finally bought in. The new WTC was born legislatively joined at the hip to the Hudson Tubes, New Jersey’s bankrupt commuter life-line to thousands of Manhattan jobs. The WTC had been extracted from the east-side renewal scheme and plunked down a mile across town on top of Radio Row. As part of the package for New Jersey, the PA would build a transportation center and office complex at the tube’s terminal in Jersey City. But implicit in the deal - though it could never be publicly acknowledged, was that New Jersey got what remained of the Port of New York.”

RE: excerpt from: *Divided We Stand*



**“Radio Row”
(outlined)**



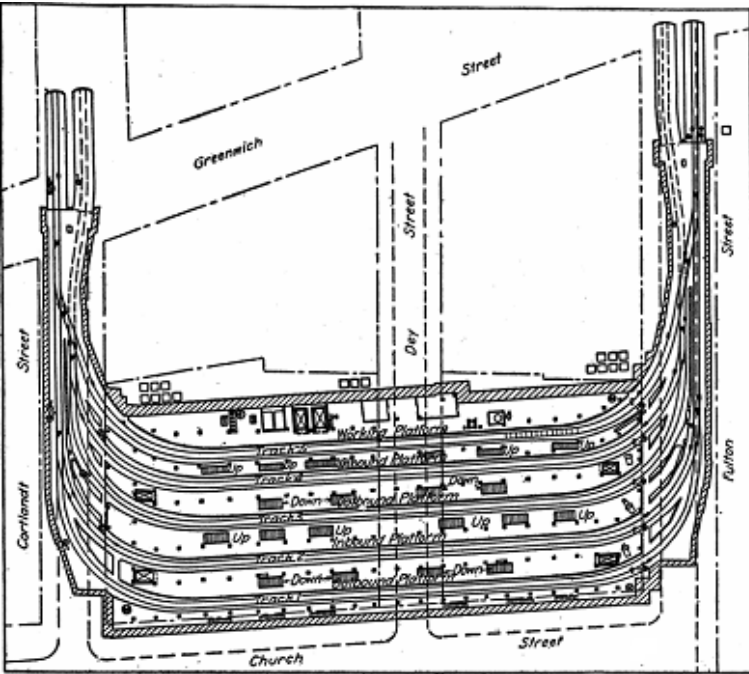
Hudson Terminal Buildings (left rear)

Hudson Terminal and Tubes.
New York City.



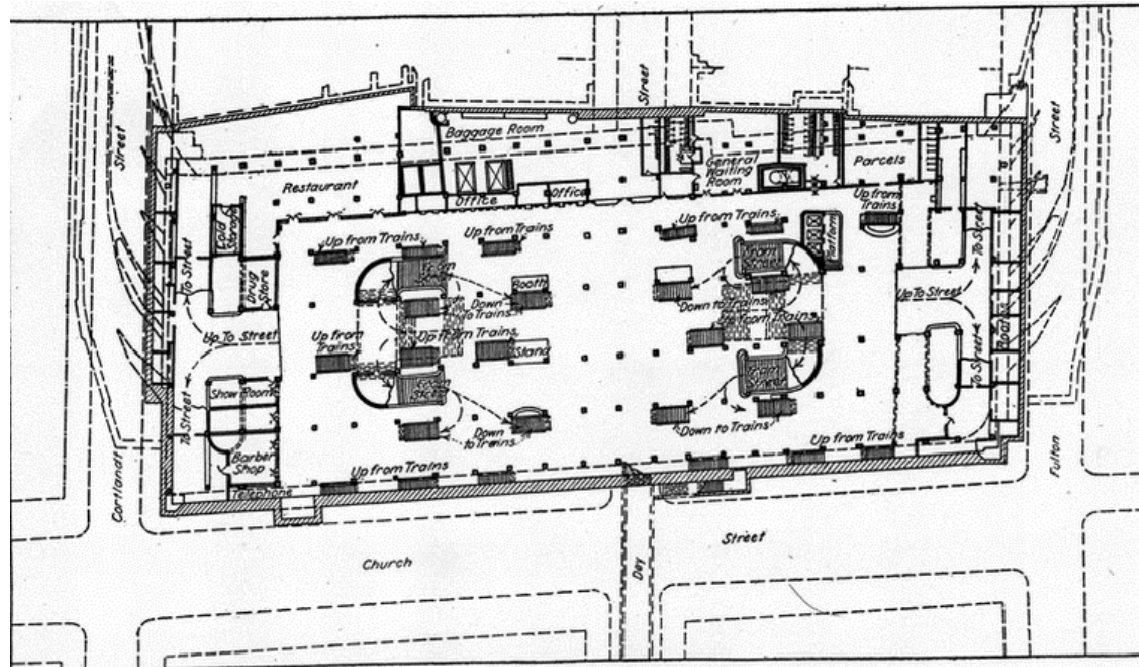
HUDSON TERMINAL BUILDING,
showing Underground Section,
New York City





Track layout of the Hudson & Manhattan Station.

Track Level Plan



Plan of concourse—Hudson & Manhattan Station.

Concourse Level Plan





**Port Elizabeth, New Jersey
(container cranes at work)**

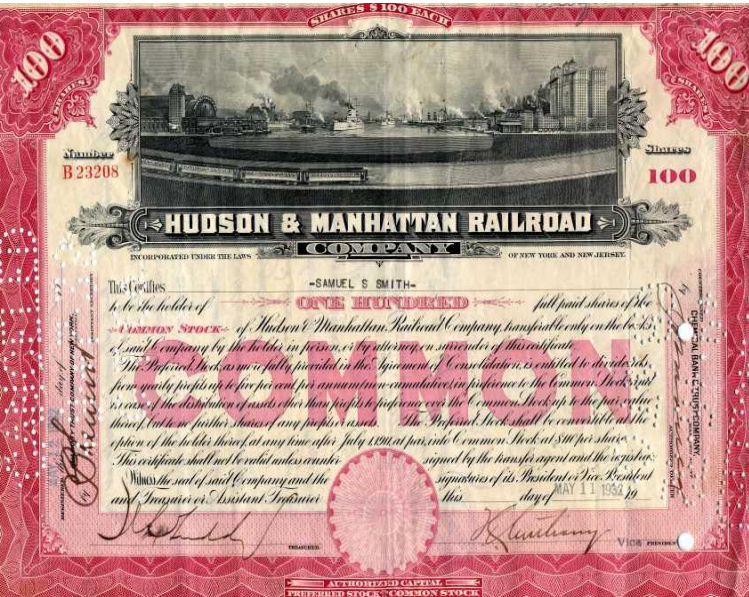


Brooklyn Waterfront
(ca. 1980)



Passenger Ship Terminals West Side (Manhattan)

“The states rewrote the PA’s charter in 1931 to allow it to support deficit-generating projects such as the PA’s first projects: the Outerbridge Crossing & Goethals Bridge (both opened the same day in 1928 – they did not become profitable until 1964 when the Verrazano-Narrows Bridge opened) with funds from profitable ones such as the Holland Tunnel (NY & NJ transferred title of the tunnel to the PA in 1931). This provided the legal framework for the 1962 legislation that enabled the PA to build the WTC – in anticipation of rental profits – while simultaneously acquiring the bankrupt Trans-Hudson commuter railroad.”



RE: excerpt from: *Divided We Stand*⁶⁹



“The beauty of the compromise is that while substantially meeting New Jersey’s objections, it gives New York all it really wanted in the first place”

Newark Sunday News

RE: PA’s proposal to move the proposed WTC from the east-side to the west-side of Manhattan – above the 15-acre site of the *Hudson & Manhattan Railroad* which the PA had taken over. It provided better subway connections and a direct-link with New Jersey, which saved-face for New Jersey politicians. PATH: *Port Authority Trans Hudson*, was born.

“At least now we can see the damn thing”

Richard Meyner - Governor of New Jersey, 1962

RE: moving of the WTC from the east-side of Manhattan Island to the west-side (across the Hudson River from NJ)



“...would exempt property, buildings and facilities from NYC taxation...would authorize payments in lieu of taxes (PILOT) subject to negotiation between the PA & NYC. The city is not even in a position to turn down the proposition and must take it whether it wants it or not. We want the WTC to succeed, but we must be in on the takeoff as well as any crash landings.”

**NYC Mayor Robert F. Wagner,
February 1962**

RE: enabling legislation that created the WTC made it a ward of NY & NJ – not within the jurisdiction of NYC where it would be located ⁷²

“...Among the other agreements by the PNYA; payments to the city of \$1.7 million annually during construction, in lieu of taxes previously received from private owners; payments amounting to about \$6.7 million annually after completion (this figure is subject to adjustment to keep it in line with taxes that would be paid by private developers of similar properties); about \$7 million in area improvements such as street widening and straightening.”

RE: excerpt from: ENR

“Austin Tobin must have misinterpreted what I said to him. I’ve done everything in my power to reach agreement with them. Austin wants to build first and reach agreement later. Of course, if we were willing to give away Manhattan, they could start digging up the city any time. The door is open, wide open. The conference table is sitting there. All Austin has to do is come in and sit down.”

NYC Mayor John Lindsay – July, 1965

RE: deadlock between NYC & the PA over compensation to the city. A PILOT (Payment In Lieu Of Taxes) deal was made whereby the PA made an annual payment to the city equal to the taxes that would be paid by a private developer, but only on the percentage of the building leased to private tenants. The PA projected that in the first year, only 40% of the leased space would be for private tenants – the rest to state and federal agencies (about \$6.2 million as payment). Also, the PA agreed to \$146 million worth of improvements around NYC, including at the WTC which otherwise would be NYC’s responsibility.



“...Negotiators for New York also obtained agreement for authority-financed improvements within the city that will cost an estimated \$146 million. Other points of the agreement include:

- Expenditure of \$7.5 million by the Port Authority to improve public facilities during construction of the trade center. The authority will widen streets, improve sewerage lines, install larger water mains and construct three pedestrian underpasses. In addition, the authority will pay for all on-site utilities relocation and traffic control systems;
- Widening streets surrounding the trade center, which will involve conveyance to the city of approximately 160,000 square-feet of authority property;
- Creation of 28-acres of new land for the city along the lower Manhattan waterfront by filling the site of some obsolete piers along the Hudson River between the southern tip of Manhattan and the trade center. Officials estimate that sale of this land to private developers will bring \$30 million to the city treasury. Among proposals for this site is a middle-income housing project.

RE: excerpt from: *ENR* (August 1966)



“Several Harlem-based civic, community and political leaders; including future NYC Mayor David Dinkins, proposed that the governor move the Trade Center uptown where the only public works project planned was a sewage treatment plant. Eventually, as a result of Albany deal-making, 125th Street got the Adam Clayton Powell Jr. State Office Building and a park and playground atop the sewage treatment plant.”

RE: excerpt from: *Divided We Stand*

“No tenants other than those who are engaged in overseas trade and commerce and the services which support that commerce are eligible for occupancy of the trade center”

Austin Tobin - PA Director, 1965

“The Port of New York Authority’s claim that it will have no trouble in renting the ten million square feet of the World Trade Center is based on a New York State commitment that would make it the principal tenant of the \$575-million complex. Last week that commitment came under scrutiny. State Comptroller Arthur Levitt (D) said he is studying whether it would be cheaper for the state to build its own office building at either the Brooklyn Navy Yard or the Brooklyn Army Terminal than to rent space in the 110-story, twin-tower trade center. Both federal reservations have been turned over for disposal. Gov. Nelson A. Rockefeller (R), in an arrangement that made it possible for the Port Authority project to go ahead, three years ago said that state offices in New York City, which occupy two million square-feet in thirty-five locations, would be centralized in the trade center. Levitt says, however, that the state cannot sign a valid lease without his approval. He is awaiting results of a cost study to help decide whether to give approval.”

RE: excerpt from: ENR (January 1967)

“The basic policy decision of whether the state ought to have its office in a trade center is up to the governor. But the cost factor is a very important consideration. I’m not suggesting that I would withhold approval arbitrarily but I regard the responsibility to approve as a very important one, and I’ll only make a decision after we have all the information.”

Arthur Levitt – NY State Comptroller, January 1967

“And when they find they can’t, they’re going to dump the space on the open market at reduced rents”

Harold Uris, Real Estate Executive

RE: commercial developers well-founded fear of the WTC glutting the market with excess office space rather than its stated/proposed exclusive use for firms, agencies etc. involved in “World Trade”



“Lawsuits seeking to block the WTC were making their way through the courts. Tobin responded as he generally did when faced with any attempt to constrain the PA or render it accountable; he simply ignored it. Tobin proceeded as though by divine right; issuing contracts for test borings, promoting Guy Tozzoli to head the WTC department and signing on ‘gothic modernist’ Minoru Yamasaki as chief architect with the firm of Emery Roth & Sons acting as associate architects.”

RE: excerpt from: *Divided We Stand*

The Committee for a Reasonable Trade Center

“This bloated project – these Tobin Towers”

Robert Kopple, Attorney

RE: *Empire State Building* owners Lawrence Wein & Harry Helmsley’s lawyer and WTC chief antagonist. Kopple made *The Committee for a Reasonable Trade Center’s* case in state court and, in the court of public opinion.



“Wein is causing all this commotion because he doesn’t want his building to be the third tallest in the city”

Austin Tobin, PA Director

RE: Lawrence Wein led *The Committee for a Reasonable WTC*. His and partner Harry Helmsley’s goal was to maintain their prize property – the Empire State Building, as NYC’s and the world’s tallest building.



Guy Tozzoli: *“Can you please tell me what a ‘reasonable’ World Trade Center is?”*

Harry Helmsley: *“A hundred floors high”*

Guy Tozzoli: *“A hundred floors high when the Empire State Building is 102 floors!”*

RE: exchange between WTC Director Guy Tozzoli & ESB owner Harry Helmsley



“They were really concerned with losing their income from the observation deck. I told them I was going to put an observation deck on one building and a restaurant-club on the other...I told them: ‘I don’t know what you’re all excited about. You’re in mid-Manhattan. I’m going to have a bunch of different customers from you. Yours are uptown where all the hotels are. It’s like two different cities.’”

Guy Tozzoli, WTC Director



00101001423765

ADULT
13.50

TOP OF THE WORLD
TRADE CENTER
OBSERVATORIES

07/24/01 14:33 001 18140

Tax Included

TOP OF THE WORLD

Top of the World
Trade Center
Observatories
is proud to present
the following sponsor
J&R MUSIC WORLD

ADULT
13.50







“...Recently, TV interests protested on the grounds that the towers will interfere with reception in many local areas. In answer, the PNYA offered to allow the networks to put their antennas on the towers, rent-free until current leases on the Empire State Building expire.”
RE: excerpt from:
ENR



Rooftop Observation Deck (South Tower)



**View to the North
(ESB at left)**



View to the Northeast
(Brooklyn Bridge at right, Manhattan Bridge at left) 92



107th Floor Observation Deck (Interior) & Shops (South Tower)



“I am sure it never occurred to those progressive Americans that the height of their building would forever limit the height of future construction in New York City, any more than it ever would have occurred to them that the Woolworth Building had placed limits on their own plans...Al Smith would have been waving his brown derby to hail New York’s great Trade Center – and yes, waving it from the observatory of his own Empire State Building. But then, Al Smith was a broad gauge, unselfish, forward-looking New Yorker.”

Austin Tobin – PA Director, 1966 - speech at the *Roosevelt Hotel*

RE: “Committee for a Reasonable Trade Center” leaders Lawrence Wein & Harry Helmsley – owners of the ESB, who wanted the height of the WTC limited. Al Smith – former NYS Governor and presidential candidate, was President of *Empire State Inc.* - the corporation that built the ESB in 1931.

“It’s a magnificent project”

**Harold Bernhard, Partner - *Shreve, Lamb and Harmon Associates*,
January 1964. SLH was the architectural design firm of the *Empire
State Building***

RE: WTC

“On Monday, Oct. 19, at 2:51 p.m., New York City’s World Trade Center became the tallest skyscraper in the world, reaching a height of 1,254-feet and surpassing the Empire State Building by four-feet. A 10-ton, three-story-high wall panel, consisting of three box columns and three spandrel girders, was the first section of the 103rd-story level to be lifted into place on the north tower. When completed, 5,828 panels will compose the two 110-story, 1,350-ft-high towers, topping the Empire State Building by 100-feet.”

RE: excerpt from: *ENR* (October 1970)

- **The Trade Center will dramatically revitalize a drab and decaying section of Lower Manhattan and stimulate the development of the entire area**
- **In the immediate future, the construction of the Trade Center will provide much needed jobs for construction workers, involving some \$200 million in wages with as many as 7,000 to 8,000 workers on site at one time**
- **The completed WTC will be a place of employment for 50,000 people**
- **The city will receive greatly increased revenues not only from the WTC itself, but by virtue of the increased values of real estate and the new construction which will result from the Trade Center's transformation of the downtown area**

Austin Tobin – PA Director

RE: May 1, 1966 testimony to the NYC Council

“The prime objective of the WTC is to simplify and expand international trade by centralizing and consolidating within the center essential world trade services and activities...The WTC will contain only government agencies and private firms which play a part in international marketing and in the administrative processing of world trade”

NYC Planning Commission, 1966

RE: by 1993, a PA survey found that only 5% of all the WTC's tenants were involved in world trade

“Such a center is not a private purpose but a public purpose, so long as it is reasonably considered essential to the life of the port. It is no more a ‘real estate project’ as opponents would characterize it, than is a state fair or municipal public market.”

NYS Supreme Court

RE: judgement in the case of ESB owners Larry Wein & Harry Helmsley’s *Committee for a Reasonable Trade Center* lawsuit against a 110-story WTC



“What they were picketing may turn out to be New York’s dominating landmark...seen from any angle, they would overshadow all of Manhattan’s celebrated skyscrapers and become the new focus of the city’s famous skyline. The controversial elements of the scheme are human, not architectural. From the design aspect this is not only the biggest but the best new building project that New York has seen in a long time. It represents a level of taste and thought that has been distressingly rare in the city’s mass of nondescript post-war commercial construction.”

Ada Louise Huxtable – *NY Times* Architectural Critic

RE: comments made after viewing the 8-ft tall model of the WTC in the Ballroom of the *NY Hilton*

“New York provides us with a dire warning. The latest and most terrifying stage in that relentless process, which in American cities seems to know no bounds, of putting more and more accommodation on less and less land...The ultimate sterility toward which monumental redevelopment is heading is of no concern to the developers. They are gamblers on a giant scale, whose only interest is in the next fall of the dice.”

Architectural Review (English Journal)

“Architects, engineers and PA planners have surpassed themselves in designing the proposed WTC. They have achieved a thing of beauty, laid the groundwork for vast new profits and jobs for New Yorkers and insured our city its dominant role as the capital of world trade.”

The Journal American, 1966

Radio Row

AT CITY RADIO STORES

Money Back

THEY'RE BETTER OR
YOU DON'T PAY



CeCo
Radio Tubes

**NEW
LOW
PRICES**

Try one or more CeCo Radio Tubes—if they aren't better we'll be glad to refund your money. Here's the finest guarantee anyone can give. You try them—in your radio—you are the sole judge. Come to City Radio today.

YOUR OLD TUBES TESTED FREE

Bring your old tubes to City Radio. Very probably they are the fault of whatever trouble you may be having. Let us test them free.

CITY RADIO STORES

12 MONEY-SAVING RADIO STORES

DOWNTOWN, 43 Cortlandt St. Bronx, 21 East Fordham Rd.
DOWNTOWN, 43 Cortlandt St. Bronx, 1881 Southern Blvd.
DOWNTOWN, 128 Fulton St. 1124 Street, 2529 34 Av. (N. W.)
(Abe Cohen's Exchange) (Cor.) (Bassman & Co.)
Times Square, 119 W. 42d St. Brooklyn, 924 Flatbush Av.
25th Street, 744 Lexington Av. Jamaica, 163-24 Jamaica Av.
36th Street, 2387 Broadway Newark, 163-09 Market St.

ALL STORES OPEN EVENINGS

“Radio was a novelty. Most people were intimidated by it. You know, the idea of information coming through the air, through the ether, was something that was one step away from Black Magic. Within a few years people regarded it as the greatest thing since flush toilets...It wasn't just a street. It wasn't just some buildings. It represented a way of life. All of that was incorporated into this Radio Row. You know, I could wax poetic about it.”

Bill Schneck, son of Henry L. Schneck who started the first radio store on Cortlandt Street in 1921

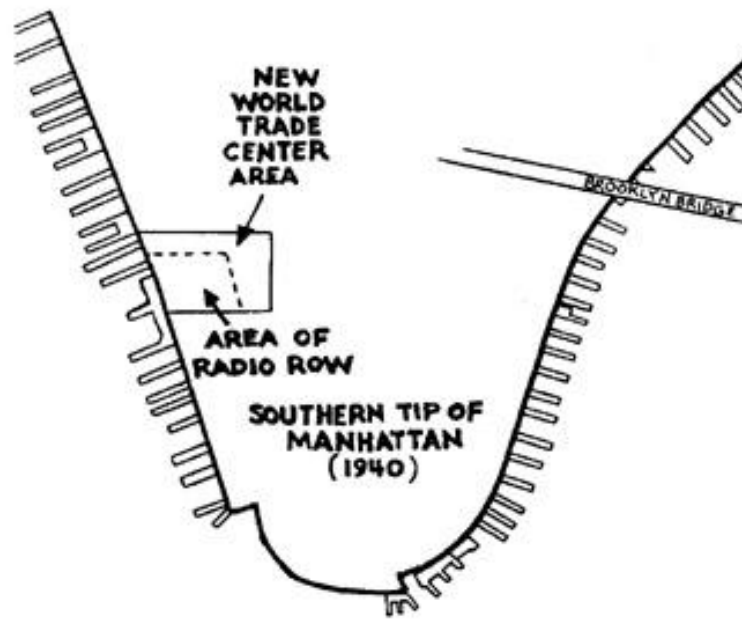


Cortlandt Street's "Radio Row"



“The area is now a daytime enclave of 350,000 employees who disperse at nightfall to other parts of the city or the suburbs leaving the area lifeless except for a few policemen, countless wharf rats and the residents of the fringe of tenement houses”

New York Times - June 5, 1958



“We were aiming toward one world with free trade... We were not very happy at displacing people, but to build a project of this size, it had to displace someone. We agreed to give the Radio Row people new business places, so we helped relocate them... David (Rockefeller) really wanted to create an economic development entity in Lower Manhattan that would also be a symbol of international business.”

Guy Tozzoli - WTC Director



“The Port Authority released a study saying that most of the 158 buildings to be torn down were more than 100yo and 89% of them were not fireproof – the rest in bad shape. Guy Tozzoli set up a storefront to help people find places nearby to move to and offered each of them up to \$3,000.00 for moving expenses. But to most, it was a lame gesture.”

RE: excerpt from: *Divided We Stand*



THE PORT OF NEW YORK AUTHORITY

111 Eighth Avenue at 12th Street New York, N.Y. 10011

TEL. 620-7200

DEPARTMENT OF REAL ESTATE

ACQUISITION & PROPERTY MANAGEMENT DIVISION

Rickrey Salen

MANAGER

William M. Schwarz

DIRECTOR

October 8, 1965

To World Trade Center Site Occupants:

To permit construction of the World Trade Center, the Port Authority has made application to acquire by condemnation the property which you occupy. As an occupant you may be eligible for payments in connection with your relocation from the project site under the terms of the Port Authority relocation program, explained in the attached schedule, when you move after acquisition of title by the Port Authority.

Upon such acquisition, we shall be pleased to work with you in effecting a convenient relocation within construction time-limits, about which we hope to keep you informed.

If you have any questions with regard to your occupancy or intended move, please contact our Tenant Relocation Office, 50 Church Street, New York, New York, 10007, Telephone Number BARclay 7 - 0970-1-2.

Very truly yours,

S. Anton, Manager

Attachments:

1. World Trade Center Tenant Relocation Payment Program
2. Instruction Sheet for Commercial Tenants
3. Form of Notice for Commercial Tenants



“The personalized relocation program will be similar to those successfully carried out by the PA in connection with construction projects at its midtown bus terminal”

Austin Tobin – PA Director, 1965



“It’s just as though we were living in Russia or Cuba, where a man doesn’t have anything to say about what happens to him. If it were for the betterment of the city, that would be one thing. But this is simply big business running over us.”

**Oscar Nadel – Radio Row shop owner and WTC opposition leader
RE: at 57yo, he lamented the loss of his business to a *World Telegram* reporter**

“Among other possibilities, it was suggested to them that they accept the offer of city officials to explore for them the possibility of relocation as a group to the adjacent Washington Street Market area...Unfortunately, at that time the merchants were too dedicated to their course of litigating to thwart the WTC project to be receptive to help from either the city or the PA”

Austin Tobin – PA Director

RE: May 1, 1966 testimony to the NYC Council



“More than half of the shopkeepers who are in the area now have been located there in excess of fifteen years. About a third of them had been in the area more than twenty-five years. Of the 157 shopkeepers who responded to this question, 112 claimed they had no relocation plans, 34 stated that they were going out of business and 11 reported that they had definite relocation plans...The large majority of storekeepers appeared hopeless, immobilized and powerless in the face of the forthcoming changes.”

NYC Planning Commission report – March 1966

“In July 1962, the corporation counsel of the City of New York joined the PA counsel in defense of the action instituted by Mr. Oscar Nadel and a group of his fellow merchants on the site to have the enabling legislation declared unconstitutional. Judge Adrian Burke wrote the decision of the Court of Appeals upholding the statute in every respect. In declaring the Trade Center’s purpose of: *‘the gathering together of all businesses relating to world trade’* to be a public purpose, Judge Burke noted that: *‘the history of western civilization demonstrates the cause & effect relationship between a great port and a great city.’*”
RE: excerpt from: *Divided We Stand*

SUPREME COURT OF THE STATE OF NEW YORK
COUNTY OF NEW YORK

-----X
IN THE MATTER OF THE APPLICATION OF :
THE PORT OF NEW YORK AUTHORITY to :
acquire title to certain real property :
in the County, City and State of New :
York for World Trade Center purposes. :
-----X

Index No. 41716/65
DAMAGE PARCEL 117

NOTICE TERMINATING TENANCY AND FOR REMOVAL

TO: ~~Julius Liebling and Edward Liebling d/b/a Radio Dealers Supply Co.~~
AND TO ALL PERSONS HOLDING THROUGH OR UNDER SUCH PERSON
IN OCCUPANCY OF THE FOLLOWING PREMISES:

~~154 Greenwich Street
New York, New York~~

BLOCK 58 LOT 23

Pursuant to an order of the Supreme Court, New York County,
in the proceeding entitled, "SUPREME COURT OF THE STATE OF NEW YORK,
NEW YORK COUNTY, IN THE MATTER OF THE APPLICATION OF THE PORT OF NEW
YORK AUTHORITY to acquire title to certain real property in the
County, City and State of New York for World Trade Center purposes,"
Index No. 41716/65, entered on December 1, 1965, title to the property
which you occupy vested on December 1, 1965 in The Port of New York
Authority. In accordance with the law, all tenants in possession
become "tenants at will" of The Port of New York Authority unless
"within ten days after the vesting of title" they "elect to vacate."

PLEASE TAKE NOTICE that because prompt possession of the
property, which you now occupy, for World Trade Center purposes is
imperative for construction of this vital public improvement, your
tenancy (if any) of the above premises is hereby terminated effective
~~NOVEMBER 15 1966~~

PLEASE TAKE FURTHER NOTICE that, unless you remove from
the premises on or before the termination date of NOVEMBER 15 1966
appropriate proceedings will be taken by The Port of New York
Authority to obtain possession of such premises.



SITE OF WORLD TRADE CENTER TO BE BUILT BY THE PORT OF NEW YORK AUTHORITY IN LOWER MANHATTAN

“One day, a group of merchants built a coffin containing the body of ‘Mr. Small Businessman’ and conducted a mock funeral procession along Church Street.”

RE: excerpt from: *Divided We Stand*



“This is a rotten deal. This is the garden center of the city. Everybody comes to me for special plants. I’m washed up after this.”

Bob Miller – owner of *Bob & Walter’s Flower Shop*

RE: eviction of Radio Row store owners

“In reversing this decision, the high court noted that the statute allows only parts of the public buildings to be used for incidental revenue to cover all or part of expenses of the project. Thus, the majority held, the legislation does not allow unfettered construction of structures that would be solely revenue-producing. The plaintiffs will appeal to the U.S. Supreme Court. Confident that the Supreme Court will not even hear the case, however, Port Authority officials are moving to advance architectural work on the Trade Center and revive plans for the transit line...The U. S. Supreme Court last week refused to hear an appeal aimed at barring a start on New York City's \$270-million World Trade Center. The Port of New York Authority immediately announced that it would order the architects to start work on functional planning and architectural design. Activity halted February 20th when businessmen in the 16-acre area to be condemned brought suit on grounds that the legislation authorizing the project violates constitutional limits on the right of eminent domain.”

RE: excerpt from: ENR (April 1963)

“The opposition spent more than a year in court battling the Port Authority. In February 1963, a state appeals court ruled that the Port Authority’s plan was unconstitutional because it amounted to a public agency taking land by eminent domain for a project that would be for the primary benefit of private enterprise. But five weeks later, the Court of Appeals, the state’s highest court, reversed the decision. Later that year, the United States Supreme Court declined to take the case. The fight for Radio Row was over.”

RE: excerpt from: Divided We Stand



“By the fall of 1966, the demolition of Radio Row was in full swing. One building per day was coming down and its remains were being hauled away unceremoniously by the truckload.”

*RE: excerpt from: **Divided We Stand***

“I’ve begun to work on the west side and in Washington Market I have somewhat of a jump on the demo men. The Trade Center is practically impossible to work in. PATH has the ruins guarded quite seriously and the wrecking is going so fast that buildings disappear overnight. As I see it now, I might weave a song of destruction. The base of it would be a documentary record of demolition work. There will be portraits of house-wreckers and anyone left in the neighborhood. In a way, the whole project is sad; except for the demolition men and their work.”

Danny Lyon - Photographer

RE: excerpt from his book about the WTC: *The Destruction of Lower Manhattan*

*“No war declared
No storm had flared
No sudden bomb so cruel
Just a need for land
And a sign that said: ‘Urban Renewal’”*

RE: sign posted on a fence around a vacant lot, 1971

Part 4

The Plan



“Make no little plans for they have no power to stir men’s blood and probably will not themselves be realized. Make big plans; aim high in hope and work, remembering that a noble, logical diagram once recorded will never die...Let your watchword be order and you beacon beauty.”

Daniel Burnham, Architect



“I am an American”

**Charles Edouard Jeanneret
a.k.a. *Le Corbusier* (The Crow)**

**RE: his proclamation upon
arriving in New York harbor &
sighting the skyscrapers of NYC
in the early 1930’s**



“THE PLAN MUST RULE...Our streets no longer work. Streets are an obsolete notion. There ought to be no such thing as streets; we have to create something to replace them...to breathe! TO LIVE!...The present idea of the street must be abolished: DEATH TO THE STREET! DEATH TO THE STREET!

Le Corbusier

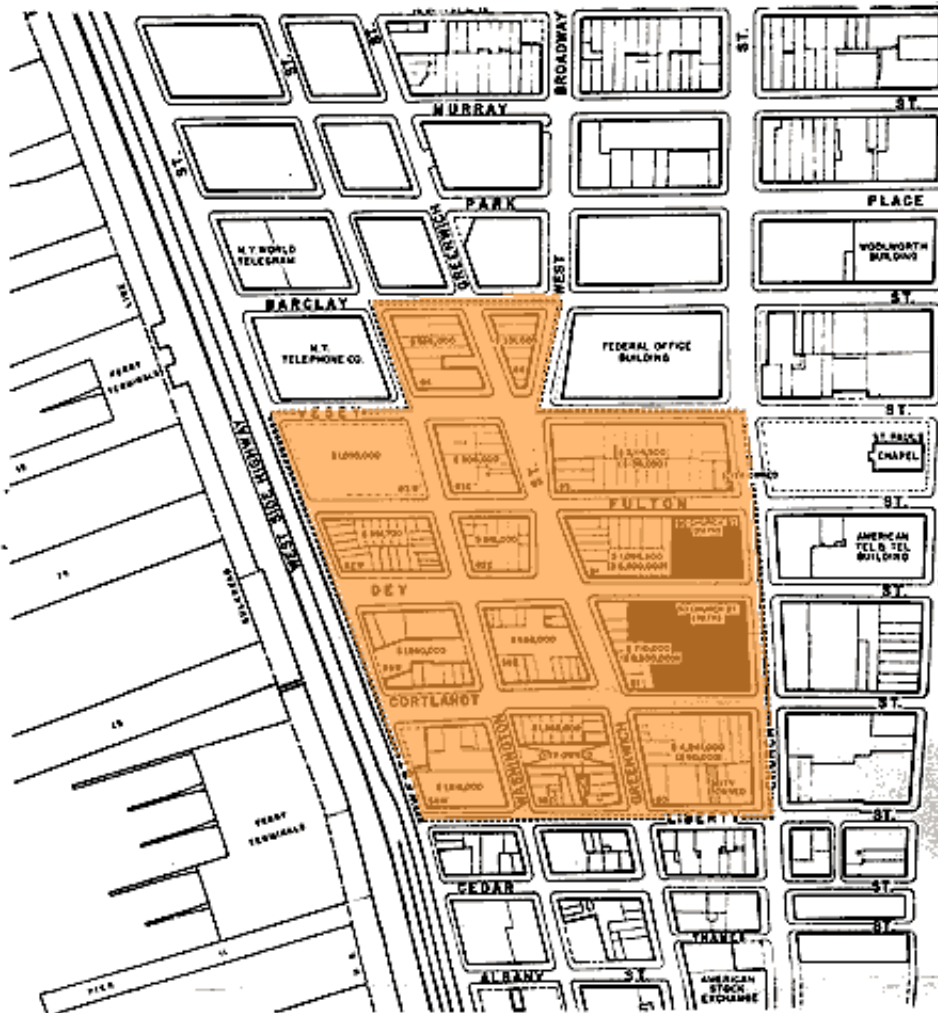
RE: excerpt from: *The Radiant City*, 1933. In 1958, *One Chase Plaza* would eliminate a single block while the WTC would engulf 16 blocks. Le Corbusier was a champion of the “Super-Block.” ¹²⁷



**Model of Le Corbusier's: *Towers in the Park*
(Paris)**

“...This unusual owner is also willing to invest more heavily, even sacrifice some financial returns, for public relations and political purposes than would an ordinary owner. Thus, the PNYA will not build as high as permitted all over its property, despite the high land costs in downtown Manhattan. Instead, the twin towers will occupy only 12% of the site. This plan should please the numerous vociferous critics of other recent New York projects not surrounded by large open spaces. It also permits the towers to be built with no setbacks without violating zoning regulations. Over-all, the design not only appears to be esthetically preferable to a set-back silhouette, but also lends itself to more economical construction and use of space...”

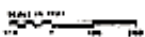
RE: excerpt from: ENR (January 1964)



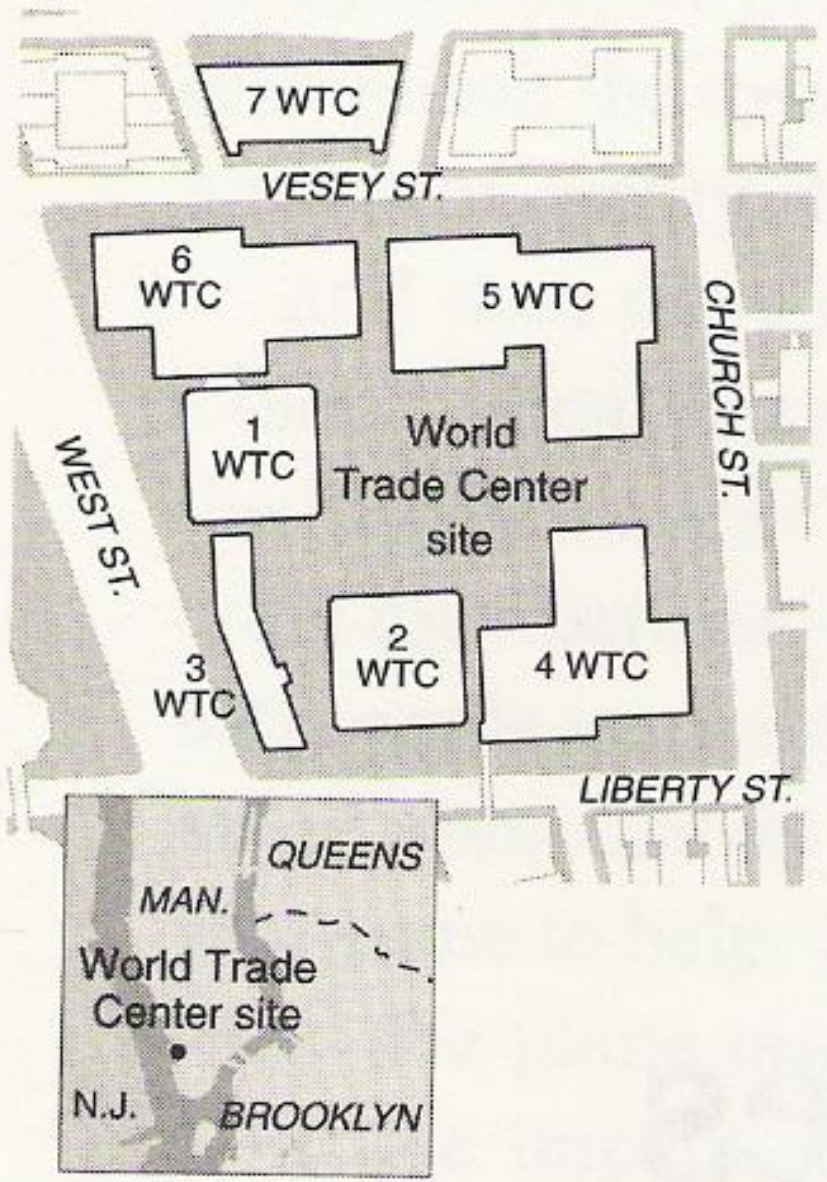
■ Property condemned in Courtesy-PATH



ASSESSED VALUATION
WORLD TRADE CENTER AREA
 DEPARTMENT OF CITY PLANNING
 MARCH 1984



Before WTC



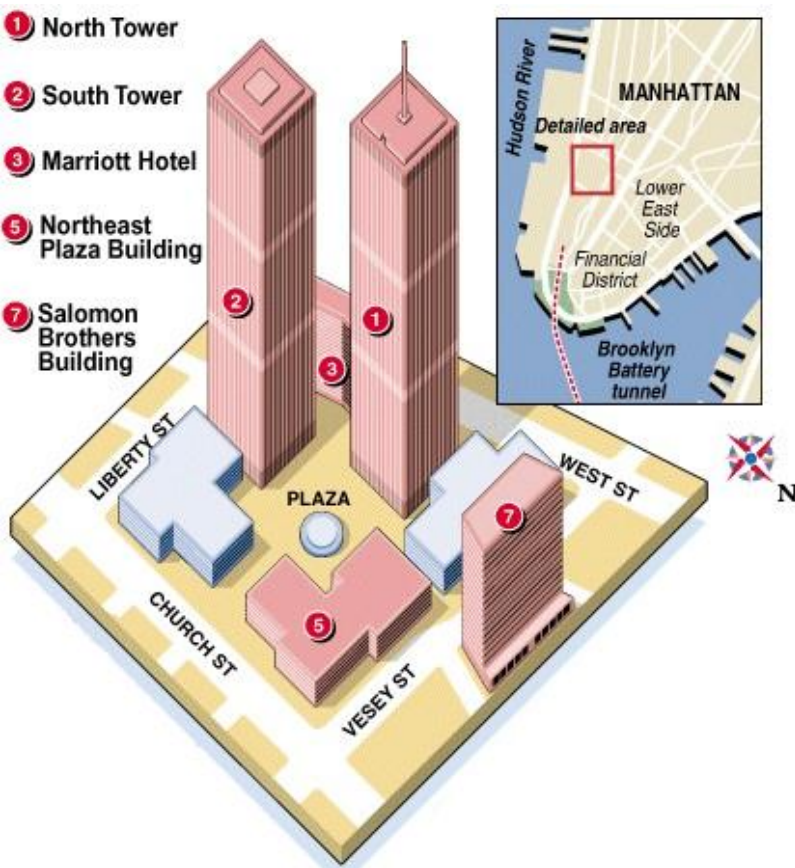
After WTC

“One of the ironies at the heart of the WTC was that by the time it was completed, the drive for large-scale urban planning projects had begun to stall. Massive renewal schemes had come to be widely viewed as either unattainable, undesirable or both.”

RE: excerpt from: *102 Minutes*

“In the early 1960s, when PA engineers studied the environmental impacts of the WTC, they estimated that it would produce over two million gallons of sewage a day. Because of delays in the completion of a city treatment facility, this waste would be pumped directly into the Hudson River. The mayors of ten of New Jersey’s shore towns considered a lawsuit to block tenant occupancy of the WTC but withdrew their threat under pressure from Trenton which was more concerned with PATH and Jersey City development than polluted coastal waters.”

RE: excerpt from: 102 Minutes



“PA engineers ended-up designing a dual sewage system for the WTC based on its proximity to the river and the need to cut construction costs. Storm sewage from the west side of the complex; the Vista Hotel, Tower One and the Customs Building, drained into the Hudson as did the WTC’s A/C runoff. A pipeline was built that channeled the remainder of the waste water to the Newtown Creek plant on the Queens/Brooklyn border. Because it operates as a politically autonomous entity, the PA never seriously considered building a dedicated treatment plant for the municipality of 50,000 it raised at the Hudson’s shore.”



“Guy Tozzoli had a unique role in that not only was he responsible for the 1964-65 New York World’s Fair but, at the same time, the World Trade Department was starting to get various concepts for what the Trade Center would look like and he would be involved with that as well. He was a dynamic individual, there was no question about it. People who first encountered him had to be extremely impressed and, as they got to know him more, had to be even more impressed. He was a fellow who could come up with new ideas every day.”

Al Pettenati -WTC Guides Manager





“As thanks for not building its own generators beneath the WTC, the PA had been awarded a ‘bulk rate’ by Con Edison. Built before energy conservation became a concern to architects and developers, the WTC consumed enough wattage for a city of 100,000.”

RE: excerpt from: *102 Minutes*

“Electrical needs are estimated to total 60,000 kw, equivalent to that of a city with 400,000 population, such as Syracuse, N. Y. Pressure in water pipes may exceed 500 psi...”

RE: excerpt from: *ENR*

“The Port of New York Authority’s World Trade Center has produced another in its series of superlatives - the largest contract ever for heating, ventilating and air-conditioning work. A contract for \$38,670,000 went last week to a joint venture of H. Sand & Co. and Courter & Co., both of New York City, for provision and installation of HVAC equipment in the two 110-story towers. The work will involve some 100,000 supply and return air-conditioning outlets to be integrated with interior lighting fixtures and 24,000 under-window induction units. The combined air-conditioning capacity of the two towers calls for 32,000-tons of refrigeration with continuous filtration and cooling of eight-million cubic feet of air per minute for circulation. Chilled water will come from a subgrade refrigeration plant being installed under separate contracts. Water pumped from the nearby Hudson River will make the installation of a cooling tower unnecessary...”

RE: excerpt from: ENR

“...Even though everyone for miles around New York City will be able to see the twin 1,350-foot-high World Trade Center towers glistening in the sun, most persons will never see the product of the largest single contract in the \$700-million project. But everyone entering the complex's buildings will be more comfortable because of the \$41-million contract that covers the trade center's HVAC systems. The systems will circulate and filter nine-million cubic feet of air per minute to serve more than nine-million square-feet of office space. The owner, the Port of New York Authority (PNYA), says the \$41 million, awarded to a joint venture of Courter & Co., Inc., and H. Sand & Co., Inc., both of New York City, represents the largest HVAC contract ever let. Its size is due, of course, to the height of the buildings, but also adding to the loads on the system are four low-rise buildings in the complex, a concourse below a central plaza, and a subway station, the first ever to be air-conditioned. The air conditioning system's heart is a 2.5-acre underground refrigeration plant. For heating, PNYA will buy steam from the city's public utility...”

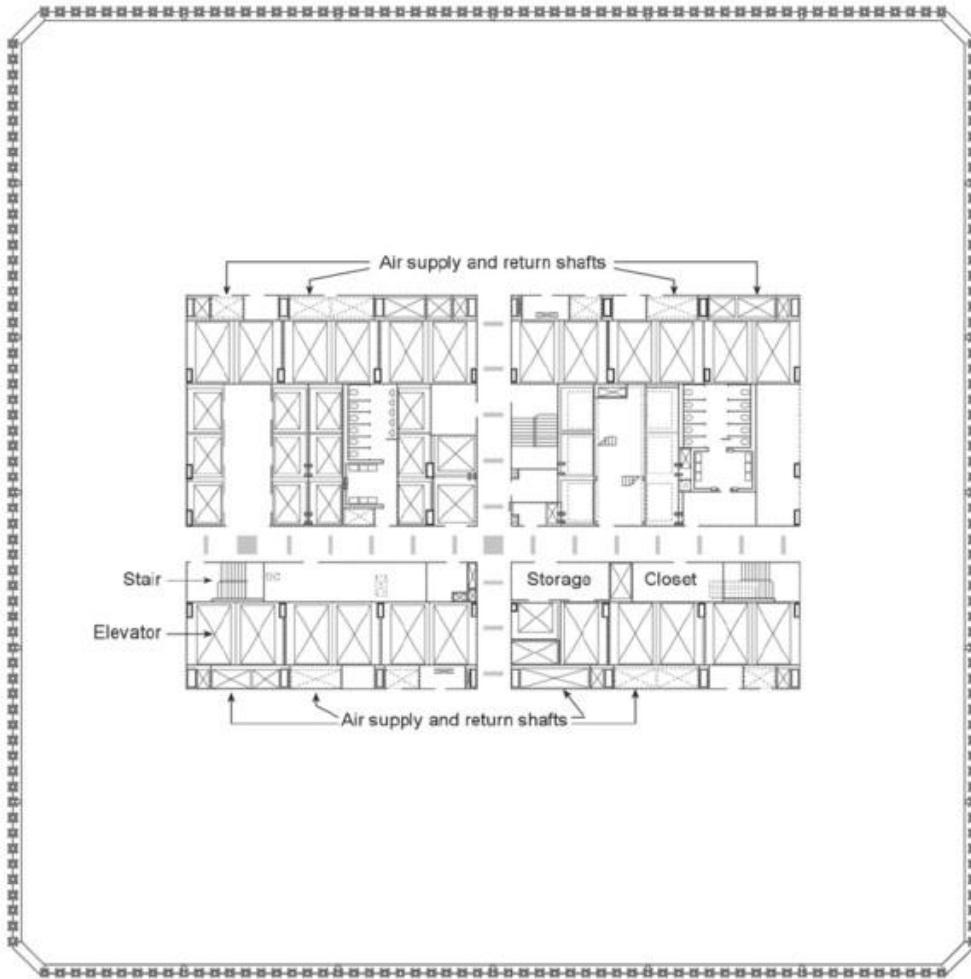
RE: excerpt from: ENR

“...Located at the fourth basement level, the refrigeration plant receives cooling water from the Hudson River, which is just west of the project. When PNYA engineers and consulting mechanical engineers, Jaros, Baum & Bolles, New York City, looked at the problem of air conditioning the identical towers and other areas, they considered conventional cooling towers rising from a refrigeration plant, along with supplemental cooling towers at various levels in the structures. But because the Hudson River is within 150-feet of the site, the engineers decided to construct the underground plant and run the intake and outflow pipes to the Hudson. The engineers’ added incentive for eliminating the cooling towers was the great amount of space they would consume and the towers’ negative esthetic effect on the project. The \$6.2-million plant is centrally located between the two towers. It will serve the towers, an eight-story U.S. Customs Building, two nine-story office buildings, a hotel whose design is not yet complete, and a 400,000-square-foot sub-plaza concourse...”

RE: excerpt from: ENR

“...Mechanically, the entire complex is divided into two zones: the high zone, which covers the towers starting at the 59th floor, and the low zone, which takes in the lower tower floors, the low-rise buildings, and the sub-plaza concourse. During the design stages, engineers’ calculations showed that the upper zone required 17,000-tons of refrigeration and the lower zone 32,000-tons, for a total of 49,000-tons. Normally, eight refrigeration machines would be used: two 7,000-ton units and one 3,000-ton unit for the high zone and four 7,000-ton units and one 4,000-ton unit for the low zone. However, PNYA engineers and the York Division of Borg-Warner Corp., Chicago, supplier of the units, came up with a double-shell unit design that serves both the high and low zones with the required capacity, thus reducing the required number of units to seven. A shell is a heat exchanger in the shape of a cylinder through which copper tubing runs. Refrigerant gas surrounding the tubes extracts heat from the water that flows through the tubes. The total surface area of the tubes is proportional to the capacity produced...”

RE: excerpt from: ENR



“By using the dual-shell design, we have a single 7,000-ton unit that provides 3,000-tons to the high zone and 4,000-tons to the low zone. We’ve eliminated one unit but another advantage of the design is that all critical parts are the same except for the two shells.”

**Frederick DiPaolo - PNYA
Mechanical Projects
Administrator**

“...Located on land fill on the east shore of the Hudson, a pump house will provide the refrigeration plant with 90,000gpm...When the refrigeration plant is in operation, ten pumps will pump chilled water to all Mechanical Equipment Rooms, called MERs, in the structures. The MERs run from the seventh to eighth floors, 75th to 76th and the 108th to the roof in each tower. The levels below the plaza and the low-rise buildings have their own mechanical rooms. In the towers, the MERs serve sixteen floors above and sixteen floors below their location with three HVAC systems. The peripheral system covers the perimeter and fifteen feet of interior space; the interior system serves the area from the fifteen foot mark to the core; and the core system supplies the core and elevators...”

RE: excerpt from: ENR

“...Tying all of the trade center’s systems together is a computer that will receive data from 6,500 sensors that monitor temperatures, pressures, power input, humidity, and chilled water flows. The computer has 2,100 alarm contact points to pickup any malfunction. The computer is located adjacent to the refrigeration plant. If anything goes wrong in any of the systems, a light goes on at the console and a schematic of the key system involved appears on the console monitors. A high-speed typewriter prints the number of the trouble point, which then can be located on the schematic. Also tied to the computer is the smoke detection system. If smoke is detected, its location will be shown by lights on the console. An audible alarm is also sounded. A remote unit shuts down the fans in the area of the fire and the operator at the console turns on the fans that will be required to exhaust the smoke-filled areas.”

RE: excerpt from: ENR

“With the computer, a single operator can detect a problem and shut off or turn on any system on any floor. The whole system is on a 365-day program that shuts down appropriate systems at the end of a day, on weekends and during holidays. But if one tenant wants his space served after working hours, it can be done by pushing a few buttons.”

Frederick DiPaolo - PNYA Mechanical Projects Administrator

BATTERY PARK CITY



“Back in the early 1970s, the architectural and economic consequences of the WTC were just beginning to ripple outward. To the south, Banker’s Trust combined a super-block between Liberty & Thames Streets, filling it with a 40-story modernist box. To the east, across Church Street, Liberty Plaza consumed another two blocks; one for its tower and the other for its plaza. To the west, atop the excavation of the ‘Bathtub’, a satellite city: Battery Park City, was being mapped out.”

RE: excerpt from: 102 Minutes 146



**Bankers Trust Building
(Post 9/11)**



One Liberty Plaza



“Designed by Skidmore, Owings & Merrill, Hilton International opened the 825-room Vista Hotel (a.k.a. 3 WTC) in 1981 at a cost of \$70 million. For guests facing southwest, the ‘Vista’ lived up to its name. But from plaza level, it curtained off the harbor view that the towers had initially framed. The PA purchased the Vista for \$78 million in 1989 and began a \$28.5 million renovation program in 1992. The ‘incident’ – as the hotel manager described the 1993 terrorist bombing beneath the hotel, caused a nearly two-year shut-down and loss of \$80 million in revenues.”

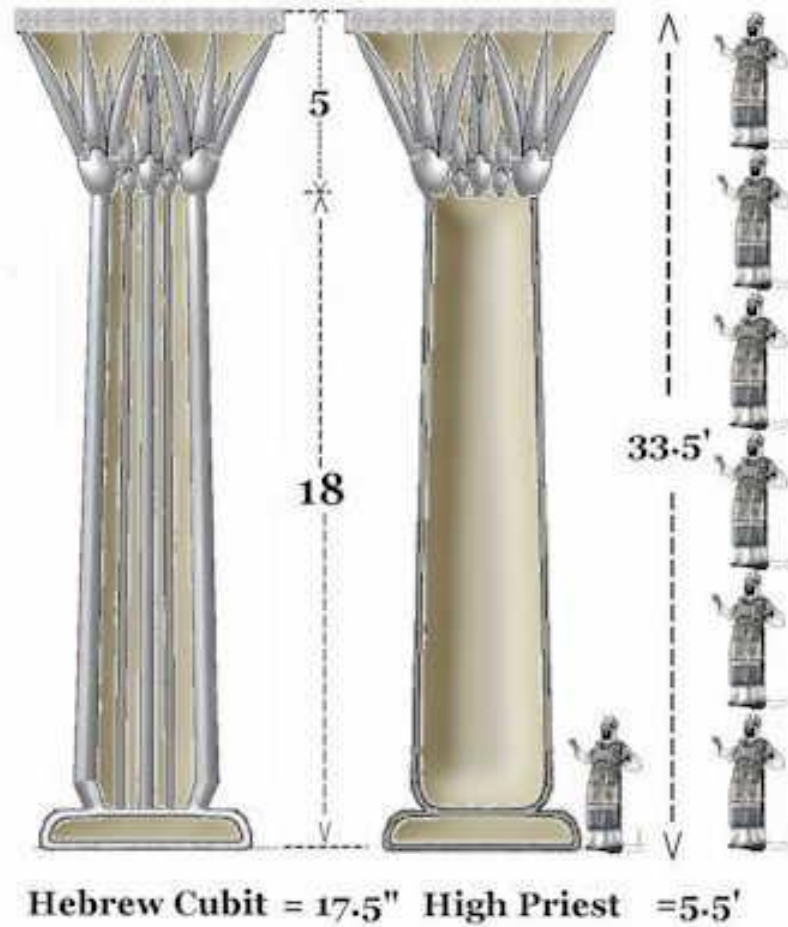
RE: excerpt from: 102 Minutes¹⁴⁹





“The placement of the Vista Hotel ended a profound psychological experience that the twin towers carried forward from ancient times; the passage across a symbolic threshold framed by two massive columns. Walking through such a space signified a transformation of the spirit.”

RE: excerpt from: *102 Minutes*



“Joachim & Boaz”

Twin Columns at the Entry to Solomon’s Temple, Jerusalem





**View of rear of the Vista Hotel from Austin Tobin Plaza
(barricaded area was damaged by the '93 bombing)** 154



“Nearly against the rear wall of the Vista Hotel stood sculptor Ellen Zimmerman’s circular granite memorial to the 1993 bombing victims, placed directly above the epicenter of the blast in the garage below. There were days when the plaza winds blew garbage into its concentric marble rings faster than the maintenance crews could clean them out. Some visitors – despite the inscriptions in English and Spanish around its rim recording the names of the seven fatalities that the memorial commemorated, threw their garbage into it as though it were a dumpster.”

RE: excerpt from: *102 Minutes*

“The final component of the original WTC complex to be built and the PA’s last major real estate acquisition, the Vista Hotel was also the first property to be sold as the PA began to sell off or lease its holdings – a process that put the WTC itself on the block. To help pay the immense costs of the post-bombing renovations underwritten by bond debt, the Vista was sold to Marriott for \$141.5 million in January 1996.”

RE: excerpt from: *102 Minutes*



“Thus from the air would be taken wealth”

**William J. Wilgus – former
Chief Engineer & VP, *NY
Central & Hudson River RR***

**RE: quote from his memoir
concerning the plan to build steel
framed buildings over the rail
yard to the north of *Grand
Central Station***

Part 5

The Site

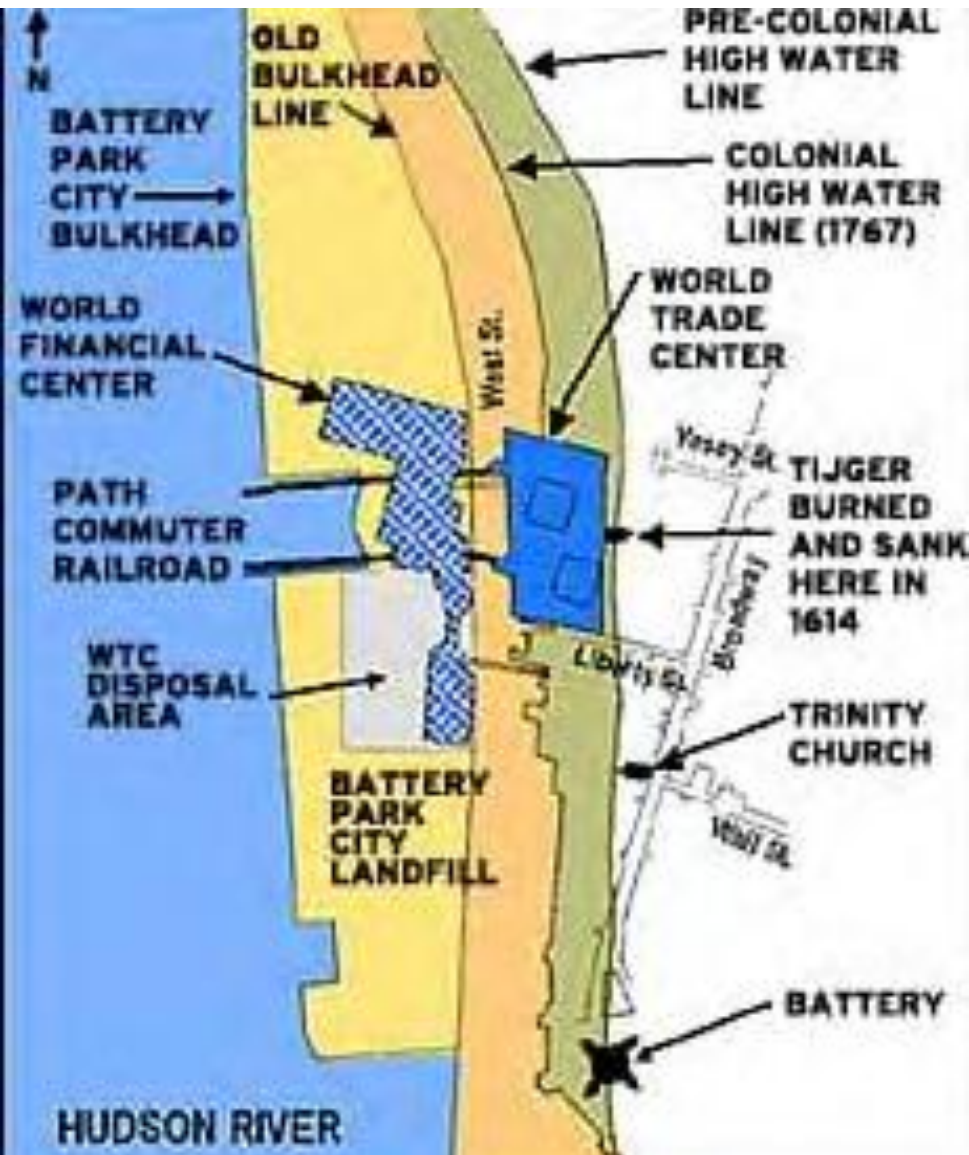


“Above 14th Street, the as-yet undeveloped reaches of the city were to contain twelve straight north-south avenues and 155 perpendicular streets – approximately 2,000 blocks of uniform size, each divisible into dozens of lots.”

RE: NYC’s Common Council grid plan, 1811

“The lower Manhattan site of the World Trade Center is suited more to an archaeological expedition than foundation construction. During the past 180 years, fill has extended the shore line about 600-feet westward into the Hudson River. Excavators may hit boulders, timbers of old wharves, or even a buried ship. Soil profiles indicate layers of fill, organic silt, and sand and gravel above the rock stratum of Manhattan schist about sixty-five feet below grade. The gravest problem confronting a foundation contractor using conventional procedures would be the hazard to streets and structures caused by lowering of the surrounding groundwater level. Dewatering the area to the required depth with well-points or deep wells might settle West Street as much as eighteen inches. West Street runs parallel and adjacent to the shoreline. Since the overburden above compressible soils would no longer be buoyant after lowering of the groundwater level, and therefore increase soil pressure in those lower strata, buildings on spread footings above the rock level could settle.”

RE: excerpt from: ENR



“From within the ‘Bathtub’ excavation came the detritus of early European settlement, for this part of the Hudson was first used as a garbage dump and then filled in to extend the island westward. Here were discovered burned and capsized vessels and their anchors, clay pipes, hand-blown bottles, drinking glasses, empty salt-glaze pots and shoes – made as they were in those days to fit either foot, and the bones of countless animals.”

RE: excerpt from: *102 Minutes*

“I must tell you about a hand-made time capsule that we dug up in which the barristers put cards from the eighteen people that worked in the Irish Foundry Works. When I opened the time capsule, it was very interesting. The barristers said: ‘We are here and we wanted to put this capsule in the ground. We only hope that whoever reads this little note will be building a greater marketplace than the Washington Market that is here.’ The year was 1883.”

Guy Tozzoli – WTC Director



“I could stay down here for a week”

Leo Hershkowitz, Queens College

History Professor

RE: PA allowing archaeologists & historians into the excavation site where they found artifacts dating from the 17th to the 20th centuries



“...wish to be remembered that we were doing business in it and hope that it may long remain as it is, built for and not to be changed into any other thing but a market”

RE: letter in a canister containing a time capsule found in the cornerstone of the Washington Market built in 1884. It was signed by thirty-six occupants of the market. The market building filled an entire square block between Fulton & Vesey Streets on the east side of Washington Street. It was torn down in 1956 and made into a parking lot.



“Two rail tunnels – the tubes for the PATH train to New Jersey – ran right through the foundation site. Trains carrying nearly 80,000 passengers ran through the 500-foot iron tubes that traversed the site. The excavation would unearth and expose them, and a way had to be found to jack them up as the foundation was constructed around them.”

RE: excerpt from: *102 Minutes*

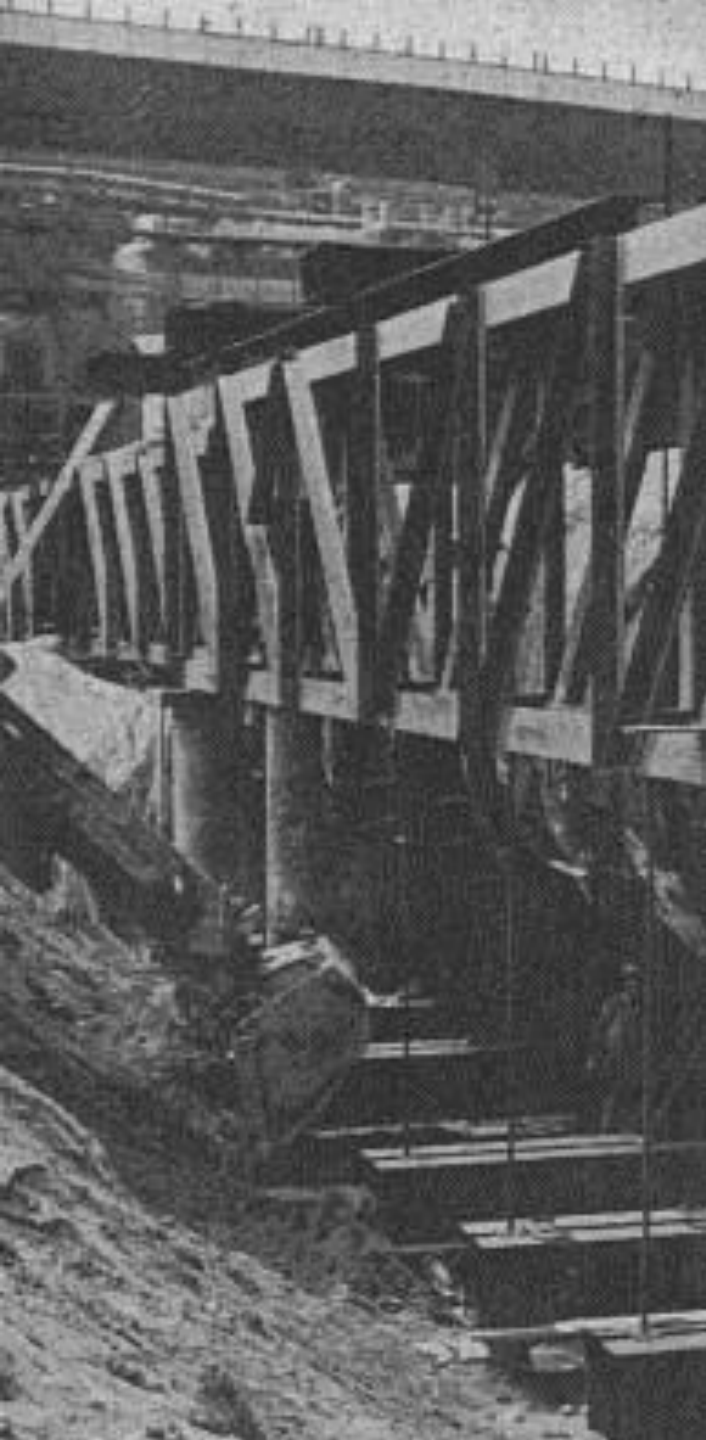


“All of the digging must be done over, under and around a pair of subway tunnels that carry nearly 600 commuter trains through the excavation daily. Without interruption of train traffic, the live and dead loads of about 1,000-feet of each tube must be transferred from the soil to a suspension system that will hold the tubes about thirty feet in the air for the next two years.”

RE: excerpt from: *ENR*

“To support the tubes as the earth was removed from under them, the contractor installed a line of 24-inch diameter caissons 40 to 50-feet center-to-center on either side of each tube. These were socketed into rock two-feet below final sub-grade, cleaned, and filled with a steel core and concrete before any excavation was done. During this operation, the PNYA had manned listening posts inside the tubes with telephone connections to the rigs above. Telephone communications were also maintained whenever work was performed within ten-feet of the tubes. The contractor was allowed to excavate to two-feet below the spring line, cutting off the caissons as he excavated to keep them out of his way. At this point the contractor cut the caissons and capped them with steel plates. American Bridge Division of U.S. Steel Co. spanned the caissons with trusses eight-feet deep and spanned the tube with WF beams. The contractor then cut a five-foot-wide transverse trench under the tube and slid a saddle through it. The saddle was attached to high-strength rods extending from the cross-members above, and the rods were tensioned to pick up the load of the tube...”

RE: excerpt from: ENR



“...To prevent settlement, the contractor was allowed to dig only one trench at a time in each bent, since ten-feet was determined as the maximum length of tube that could be left unsupported. To speed the work, however, the contractors used wide, flat steel straps that would be slid under the tubes at the edge of each hole to temporarily support the tube while another trench was cut for another cradle. With the tubes safely supported, the contractor covered each with 3x12 fire retardant plank decking supported on 12x12 timbers. This will provide the tubes with protection against falling objects. The tubes then will be removed and replaced by new tracks in a new PATH terminal under the new buildings.”

RE: excerpt from: ENR

“The tubes were unearthed nearly three-quarters of a century after they had been built, and after all that time in the cool cocoon of the earth, the summer heat was a shock to their cast-iron skin. The sudden heat caused the iron to expand, so it was decided to cut a two-inch slot in each of the tubes to relieve the pressure. With the tubes continuing to run, the tunnels were nestled on cradles deeply rooted in bedrock. Soon after the two-inch slots were cut in the PATH tubes, a passenger who saw sunlight pouring through the slot got off at the nearest station hysterical that the tunnel was breaking apart, not knowing of the existence of the open trench they had just passed through. The PA decided to wrap sheet metal around the slot openings.”

RE: excerpt from: 102 Minutes

“Some foundations - like those of the Empire State Building, are so routine they aren’t interesting. But on this kind of filled land there is nothing but trouble...ten or fifteen feet of fill near the surface; rubble, old bricks, old anything. Then you have five to twenty-five feet of Hudson River silt; black, oozy mud often covering old docks and ships. Below the silt, there’s maybe a dozen feet of red sand called ‘bull’s liver’, which is really quicksand – the bugbear of excavating. The more you dig in it the more everything oozes into the hole. We expect to find it here, but we know how to deal with it. Under that is hardpan; clay that was squeezed dry by the glacier and its accompanying boulders. Finally, beneath the hardpan, there’s Manhattan schist.”

Robert White – Spencer, White & Prentis, Summer 1966

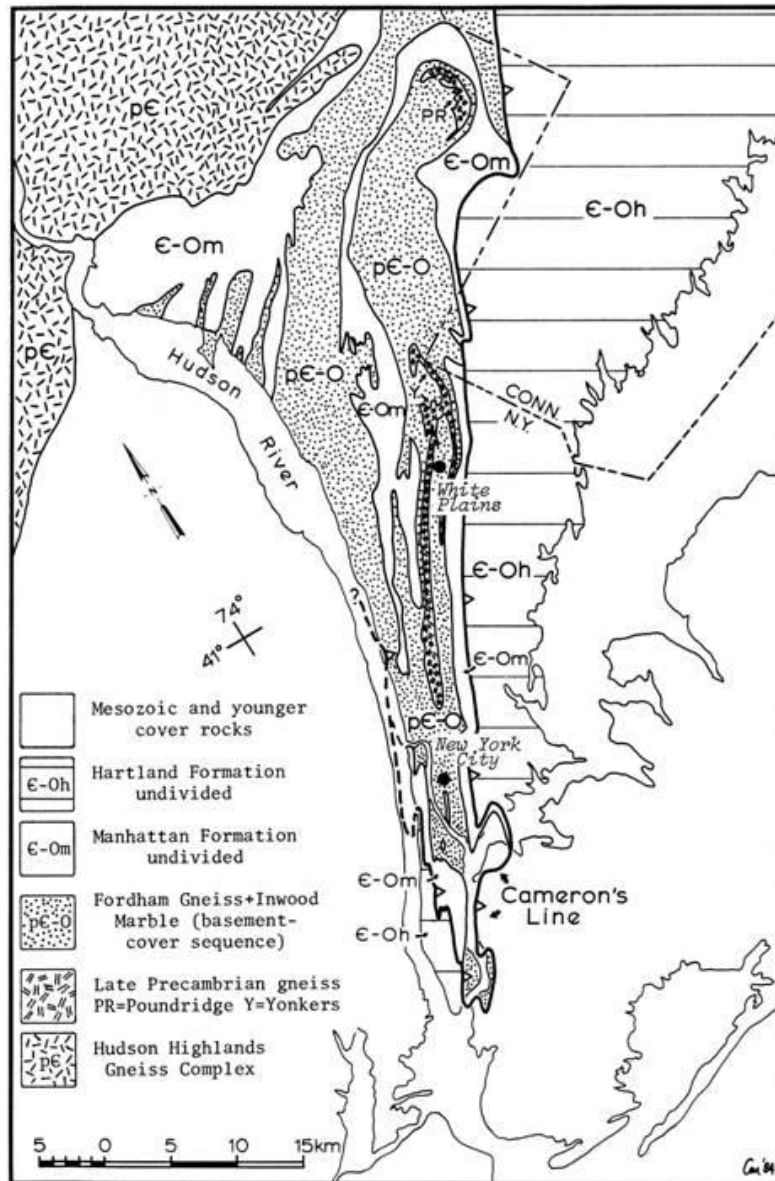
RE: comments by foundations expert Robert White to a writer for *The New Yorker* magazine while touring the site of the WTC



“Under the site of the World Trade Center ran the main trunk lines that connect New York and other major cities in the United States with the rest of the world. Even the hotline to Moscow was down there, somewhere under Greenwich Street.”

RE: excerpt from: *102 Minutes*

Substructure



“Manhattan schist is the end of the line: bedrock. It’s what lays beneath the surface of the city, a gradually inclining rock ledge whose depth varies widely, actually, breaking through the surface in Central Park while descending below sea level at around 14th Street and staying down there all the way to Pennsylvania. That’s why mid-town Manhattan was such an ideal place for the early skyscraper: the schist is close at hand in that area, in some places so close that the blasters union had to be called in to allow buildings to have basements. At Rockefeller Center, the bedrock is only eight feet below the street.”

RE: excerpt from: *102 Minutes* ¹⁷³

“Going down seventy feet meant digging a big hole. Digging a big hole meant Hudson River water seeping into it. Aside from the hopeless task of trying to pump it out, the falling water table could cause streets to sink and buildings to move. The most common method would be to drive steel sheathing down to rock and then pour in concrete, but that would involve laborious bracing and shoring. Considering the size of the foundation required, this approach would take longer and be more difficult than building the towers themselves.”

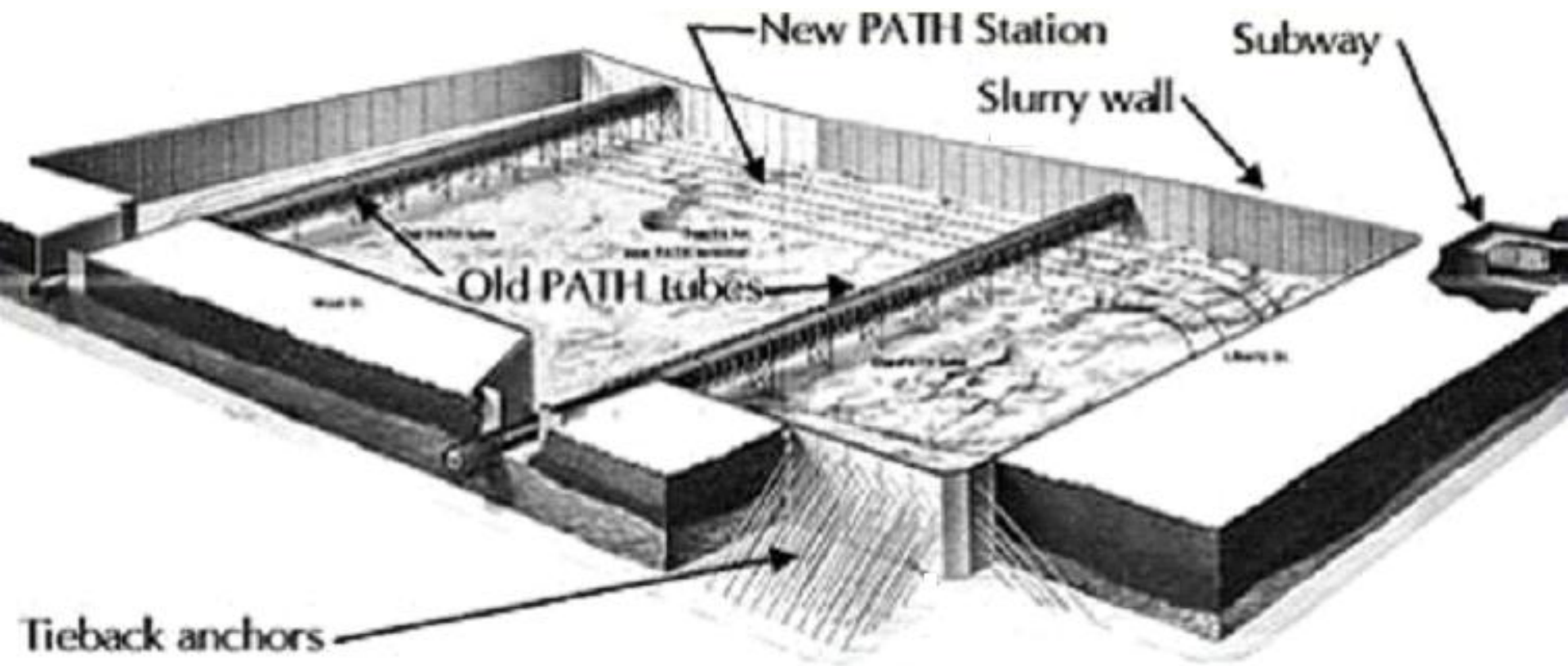
RE: excerpt from: *102 Minutes*

“And still another disadvantage of conventional construction would be the need for a heavy pressure slab (about fifteen-feet thick) to resist the hydrostatic pressure. A thinner slab designed to resist this pressure would require permanent anchors. Use of these anchors would be questionable because of possible corrosion. Normal methods of deep basement construction can’t solve these problems. Boulders and other obstructions could buckle the steel sheet-piles or soldier beams as they were driven. Other modifications, including water recharging (restoring the water table outside an excavated dewatered excavation by re-circulating water through a supplementary well-point system), freezing and chemical grouting, do not appear practical or economical...”

RE: excerpt from: ENR

“Foundation and substructure work on New York City’s huge World Trade Center will be able to proceed inside a 3,400-foot long perimeter wall unhampered by interior supports because of a pre-stressed tieback system. Reinforced concrete perimeter or cut-off walls, constructed by the slurry trench method, enclose the \$575-million Trade Center’s approximately 600 x 1,100-foot site. This permits excavation to bedrock for the foundations of the two 110-story towers and will seal off water and loose soil from future basement areas. Workers formed the walls to bedrock, an average depth of sixty-five feet, where pressures are expected to exceed 5,000psi. To counteract these tremendous pressures, the prime contractor for the \$8.4 million perimeter wall, Icanda, Ltd., of Milan, Italy, constructed it three-feet thick and is supporting it with 1,500 tieback tendons angled and anchored into bedrock sixty-five feet below grade. When permanent basement floors are placed to support the perimeter walls, the tiebacks will be cut.”

RE: excerpt from: ENR



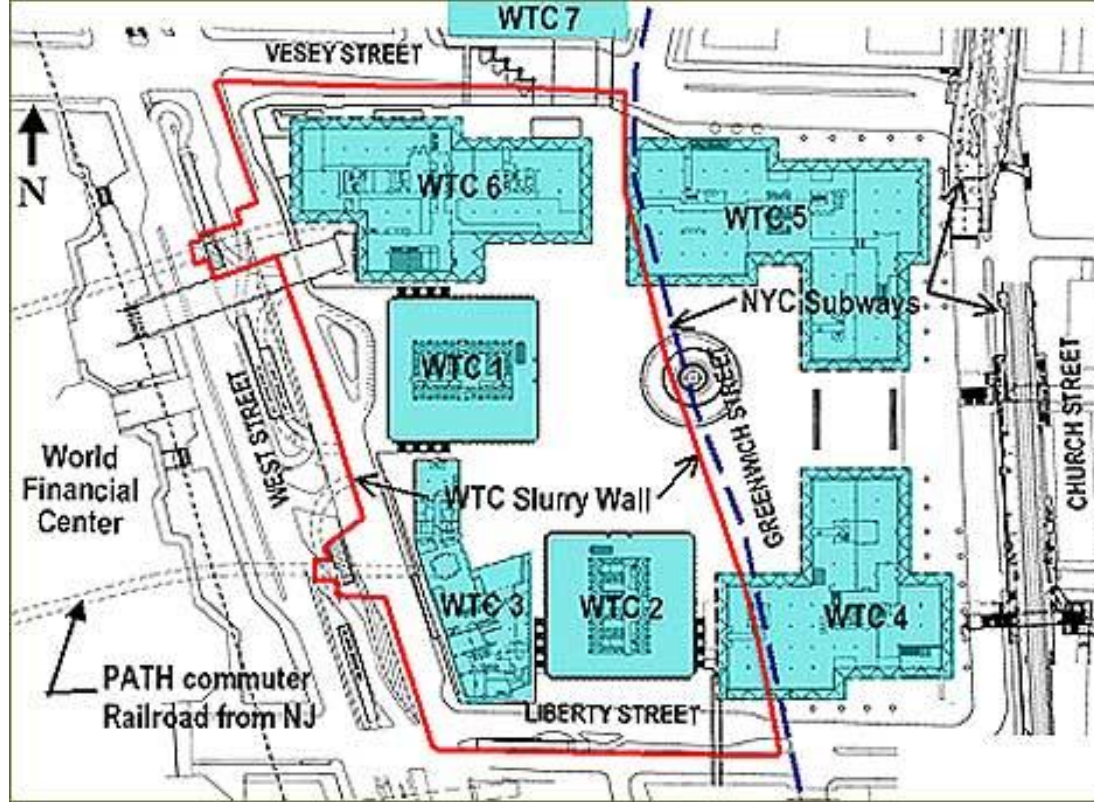
“Because the cut-off walls are virtually impervious, the contractors’ water problems are limited pretty much to handling the water trapped within them. Therefore, except in the areas of the subway tubes, where water elevation was extremely critical, the dewatering is routine. Initially the contractor installed four deep-well sumps eight-feet square. The sumps did dewater adjacent areas, but no more, because of the impermeability of the ground. This was not serious, however, since two-inch, and four-inch, centrifugal pumps in local areas controlled the water. PNYA specifications called for lowering the water table outside the excavation to a depth of five to ten-feet. Rather than install well points all around the perimeter, the contractor had Icanda cast a four-inch hole in each twenty-two foot wall section. With these open, the water from outside ran into the excavation, where the pumps sent it through a header system to the Hudson River nearby...”

RE: excerpt from: ENR

“...Handling water near the two subway tubes was another matter. The tubes, sixteen-feet, seven-inches in diameter, carry the Port Authority Trans-Hudson (PATH) tracks under the Hudson River between New York and New Jersey. Around the tubes, the contractors had to maintain a delicate balance between water and earth. Without the proper balance, the tubes might have floated or sunk. To maintain balance, a three-stage ejector well-point system was installed on both sides of each tube. One stage went to the spring line, one went a little below it and one to rock. By the extensive use of Piezometers and some extremely accurate calculations, the contractor was able to maintain a vertical balance. To prevent any horizontal movement, PNYA specified that there never be more than a three-foot variation in ground elevation on either side of a tube.”

RE: excerpt from: ENR

The Big Bathtub

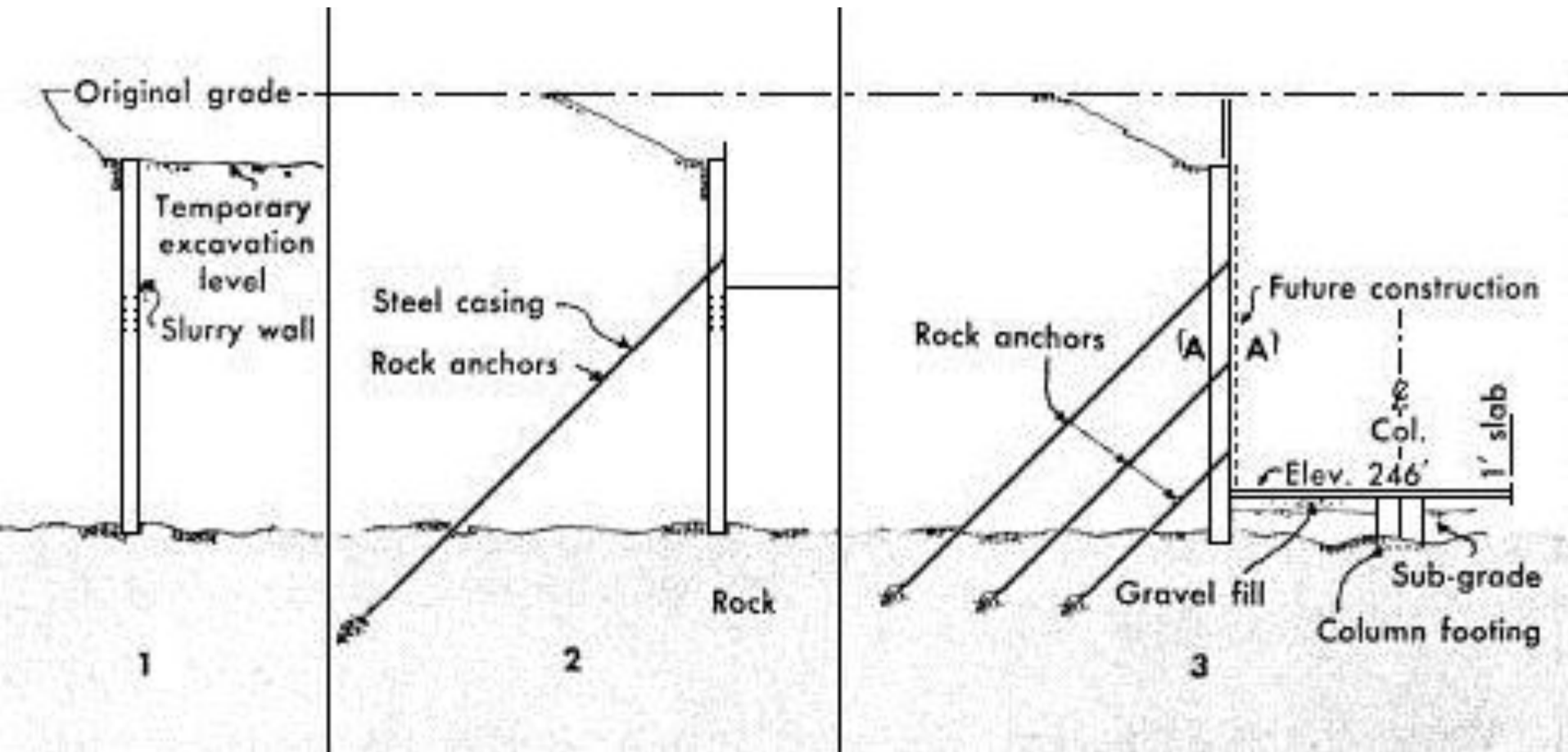


“The Port Authority’s Division of Soils & Foundations decided the best solution was a gigantic concrete enclosure essentially, a four-sided dam that would wall-off the western half of the site. At 980-feet by 510-feet, it would be the world’s biggest basement or, as the engineers of the Port Authority preferred: ‘The Big Bathtub’. It would have concrete walls and a bedrock floor but this ‘bathtub’ was meant to keep water out, not in.”

RE: excerpt from: *102 Minutes*

“...Soil problems in the lower Manhattan site of the world’s tallest buildings, the twin 110-story skyscrapers planned for the Port of New York Authority’s \$350-million World Trade Center, require construction techniques no less unusual, if less spectacular, than the erection of prefabricated steel framing planned for the superstructure. The chance of settlement of surrounding structures caused by conventional dewatering for construction in the dry favors the slurry-trench method of building the deep foundation walls. In this method, a Bentonite slurry pumped into an excavated trench retains the earth, while Tremied concrete forms the walls...The cut-off wall, which Icanda, Ltd., an affiliate of Icos of Milan, Italy, installed by the slurry methods, is roughly three-feet thick and completely encircles a 1,000 x 500-feet area. Though its base is keyed about three feet into rock, the wall itself will not withstand the hydrostatic pressures from without. Therefore, the PNYA engineers designed a system of exterior anchors that will support the wall until the complex’s heavily reinforced sub-floors take over the job...””

RE: excerpt from: ENR



Slurry-Trench Method

- (1) Special excavation rig churns up material from trench;**
- (2) Tremie pipes place wall concrete;**
- (3) Displaced slurry is pumped into another trench.**

“Before construction could begin, a seventy-foot high, three-foot thick concrete wall was built below ground around an eight-block area by the slurry-trench method. Then, 1.25 million cubic yards of rock and earth within were excavated. In the hole, contractors are building what is undoubtedly the world's largest basement. It is 980-feet long, 510-feet wide and close to seventy-feet deep. Its six levels provide a total of 48-acres of floor space and will house, among other things, a 2,000-car garage. And through the basement now are two ancient subway tubes through which run commuter trains between New Jersey and New York. New tubes and station. Before the center is finished, and after a new station is built in its basement, the presently exposed sections of the old tubes will be removed...”

RE: excerpt from: ENR

“...In the slurry-trench method, a shallow trench is excavated in segments around the perimeter of the basement. A special drilling, chopping and excavating rig set up over the trench churns up and sucks out material from a three-foot-wide trench section, twenty-feet long (excavating the trench in segments adapts it for the delays in property acquisition or utility relocations). Pumped in and, re-circulated while the excavation work proceeds, Bentonite slurry retains the sides of the trench. It has a higher specific gravity than the soil it replaces. After the contractor has excavated the trench into rock, a prefabricated reinforcing cage is lowered into the slurry. Concrete is then tremied in, displacing the slurry, which then may be piped into an adjacent segment as excavation proceeds. Alternate panels are completed this way, and when the concrete has set, the space between wall panels is completed in the same way. The end result is a reinforced concrete cut-off wall, thirty-six inch thick, socketed into the rock and serving as the outer, structural part of the basement wall.”

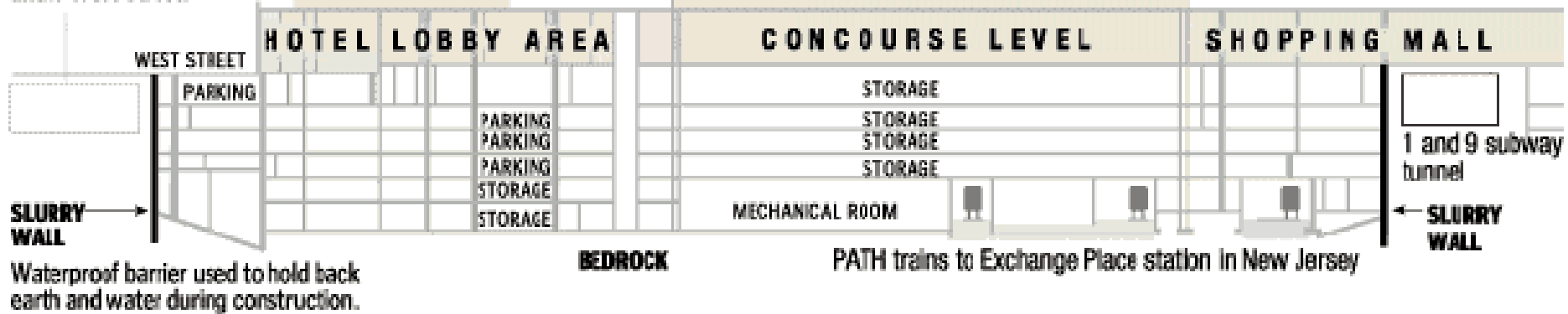
RE: excerpt from: ENR

“Though it has been previously been used for subway and building foundation construction in Europe and Canada, the Port Authority believes that the World Trade Center will mark the first U. S. slurry-trench operation for buildings. The contractor will remove existing buildings and excavate to water level simultaneously with the wall construction. The completed wall will seal the basement from the outside. Excavation continues inside. Pumping is required only to expel the entrapped water, thus leaving the water table outside the basement area unaffected.”

RE: excerpt from: *ENR*

CROSS SECTION

Sewage, electric, water and gas lines are located about 10 to 20 below the concourse level under West Street.



“Besides solving the problem of creating a foundation that could withstand the external pressures of water and earth, the ‘Bathtub’ would provide half-a-million square feet of usable space: six underground levels accommodating a new and bigger PATH station, a shopping concourse, mechanical rooms housing the tower’s A/C equipment and other utilities, truck docks, storage space for tenants and a parking garage with 2,000 spaces.”

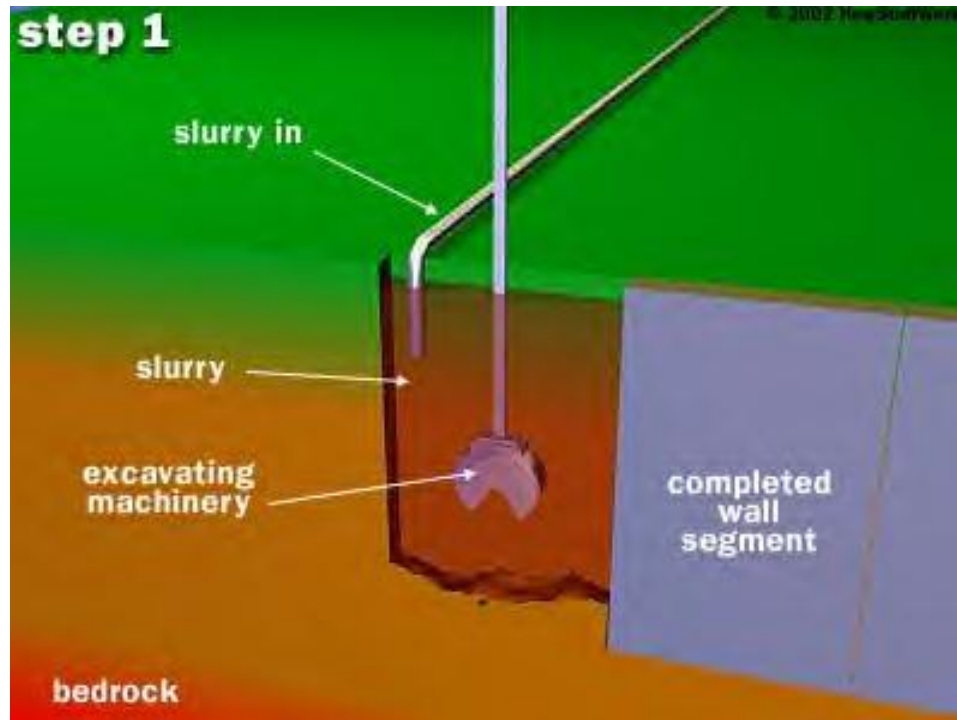
RE: excerpt from: 102 Minutes

“An ingenious new technique called The Slurry Trench Method was a European inspiration virtually unknown in the United States but based, ironically, on the use of a fluffy gray clay found in Wyoming: Bentonite – named after the town of Fort Benton where it was discovered in the mid-19th century and used by gas and oil drillers around the year 1900. The ‘slurry’ mixture, 94% water, expanded the Bentonite rock to the consistency of pea soup. When poured into a trench, it had the ability to absorb huge quantities of groundwater while simultaneously maintaining enough strength to hold back the earth, keeping the trench from caving in until concrete could be poured into the trench thus displacing the Bentonite.”

RE: excerpt from: 102 Minutes

“Using the Slurry Trench Method, a system was devised for creating the bathtub’s walls in 152 sections. Drilling machines churned the earth, burrowing a trench 22-feet long and three-feet wide, digging seventy-feet deep until it hit bedrock. With each scoop of earth removed from the trench, it was replaced by an equal volume of slurry mixture, so that the trench was always full and the sides intact. When all the earth was removed and the trench filled with slurry, a crawler crane lifted a 25-ton steel cage – shaped and sized to fit the space exactly – 100-feet in the air and then slowly lowered it into the slurry-filled trench. Then, the much heavier concrete was piped into the bottom of the trench, forcing slurry up by an overflow pipe where it was sucked-out by an overflow pipe and pumped to the next section.”

RE: excerpt from: 102 Minutes



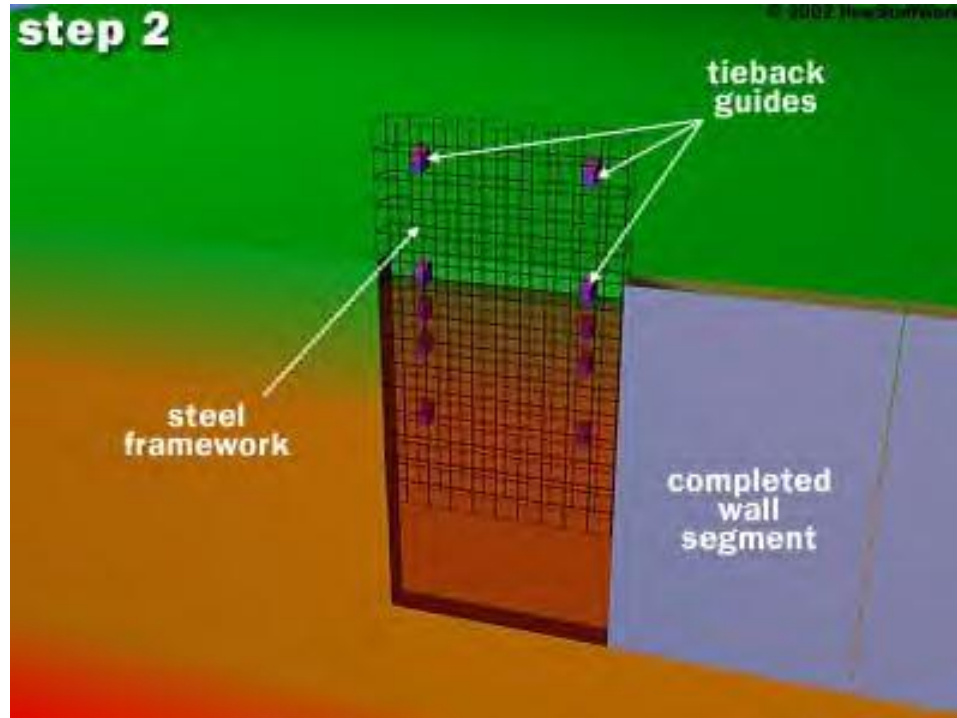
“...Obstructions, below the ten-foot level are still legion. Vertical piles are easily pulled out by the trenching bucket; horizontal timbers perpendicular to the trench have been a real headache. It took Icanda two shifts to chew through one 2x2-foot oak timber. It took three shifts to get through a laminated timber deck...”

RE: excerpt from: ENR



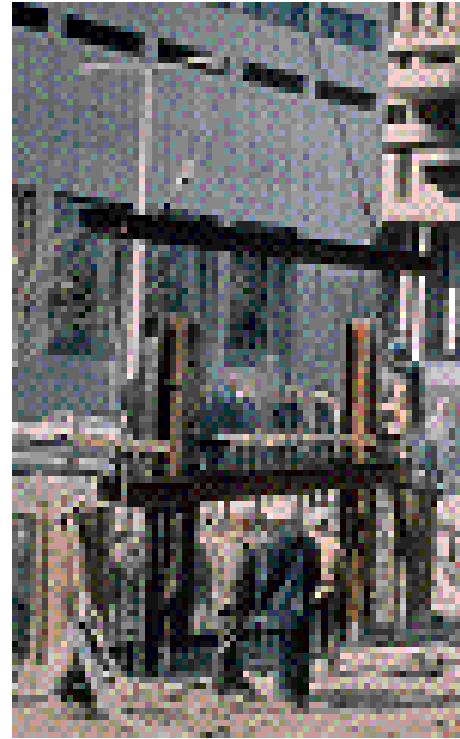
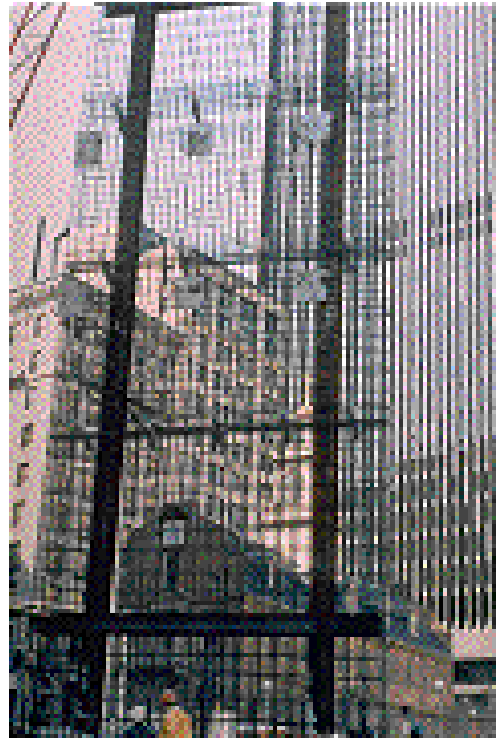
“...Oddly enough, the most troublesome obstruction is the easiest to remove. It is the ten to fifteen-foot-thick layer of small ballast stones dumped over the side of sailing ships when the river covered what is now the job site. The stones are no problem for the bucket, but those adjacent to the trench area continue to roll into the cut, causing tremendous over-breaks. In one section the overbreak was 85%, according to Icanda’s field engineer. Because Icanda must provide an on-line, relatively smooth inside wall, overbreaks cannot be filled with regular 6,000psi wall concrete. The projections would be too difficult to remove. To lick the problem, Icanda fills the entire area, trench and over-break, with a one-bag concrete. When this has set up, the contractor re-digs the trench through the lean concrete. The material outside the wall will stay in place to stabilize the soil; the lean concrete inside will easily spall off the good concrete in the wall...”

RE: excerpt from: ENR



“...Other noteworthy features of the cut-off walls are the 25-ton reinforcing cages that will go into them. Formed of high-strength steel (60,000psi yield strength), each cage contains ninety-two vertical rods set six-inches center-to-center on each of the two faces to form a box twenty-one inches wide, twenty-one feet long and up to seventy-five feet high. Horizontal rods are also set on six-inch centers. The cages are made lying flat and are set by a 150-ton crane using an eight-point pick-up at the upper end. Spacers, to position the cage properly within the trench, are provided by seven-inch diameter concrete wheels threaded on horizontal rods before they are wired on. These wheels, set four-feet on centers both vertically and horizontally, are free to roll on their rebar axles as they contact the side of the trench while the cage is lowered. The cages include insert ports through which tie rods will be placed to anchor the wall to rock outside the excavation area, making internal bracing unnecessary...”

RE: excerpt from: ENR





Track Drill at Work



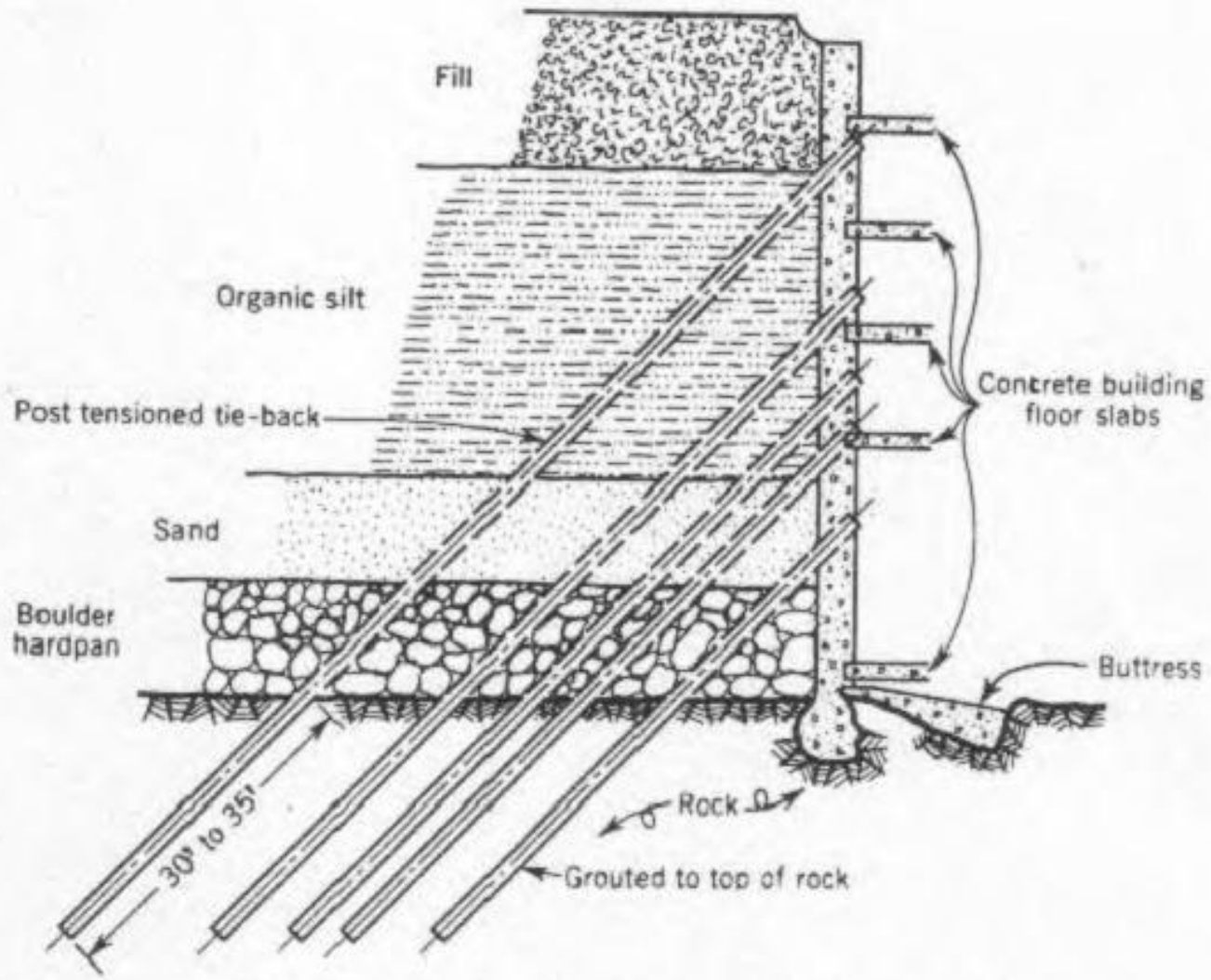
“Slanted holes were drilled that extended through the concrete and then through the earth outside the bathtub and diagonally down straight into bedrock. Then, steel tie-back tendons were inserted through the holes with one end socketed in the rock and the other anchored to the wall. The tie-backs braced the wall without taking up space inside the bathtub.”

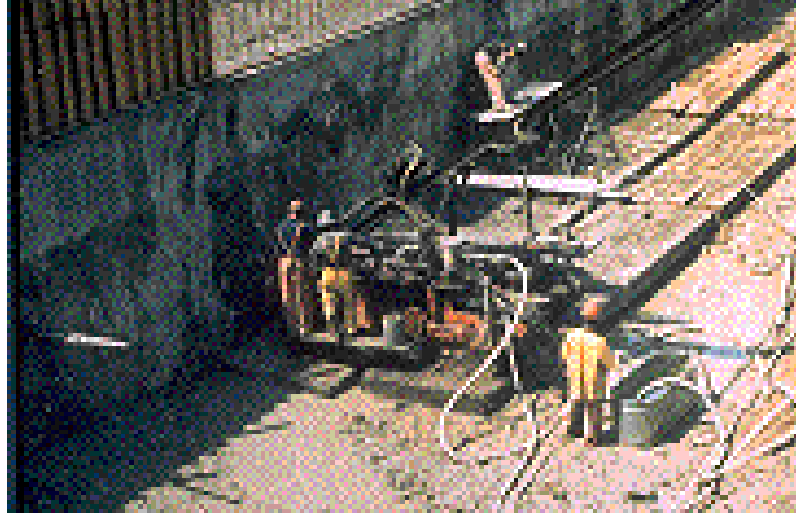
RE: excerpt from: *102 Minutes*



“...The key to the anchoring system is five tiers of tendons sloping down through the wall and the earth outside it into about 35-feet of rock, where they are grouted. The tendons, comprising eight to twenty-four high-tensile steel strands, are subsequently stressed, then locked to the wall. The wires are grouped around a plastic tube which carried the grout to rock sockets before being extracted from the hole for reuse. The contracting group began excavations in interior areas even before the walls were completed. As wall sections were finished, the contractors followed with excavation adjacent to them...”

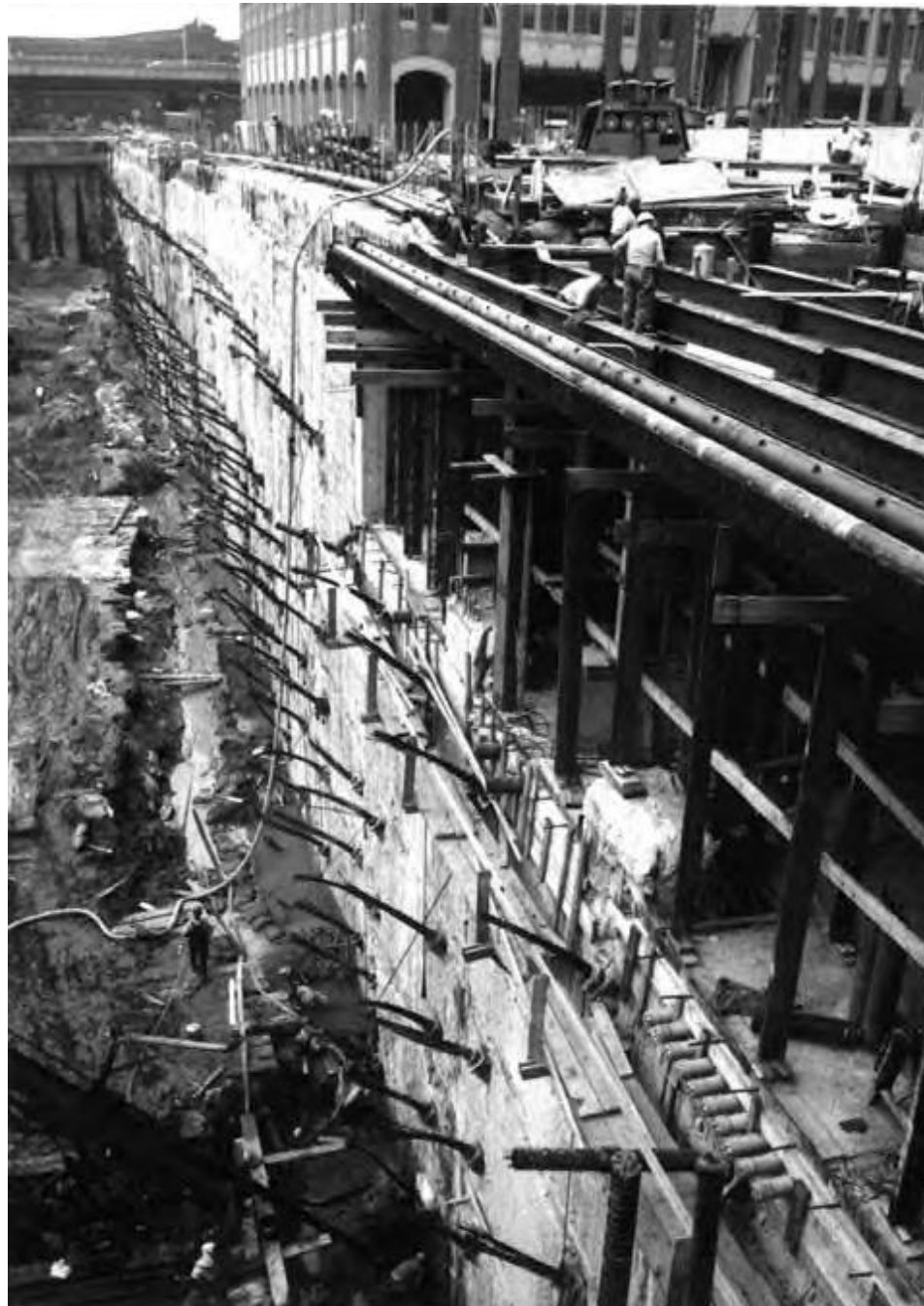
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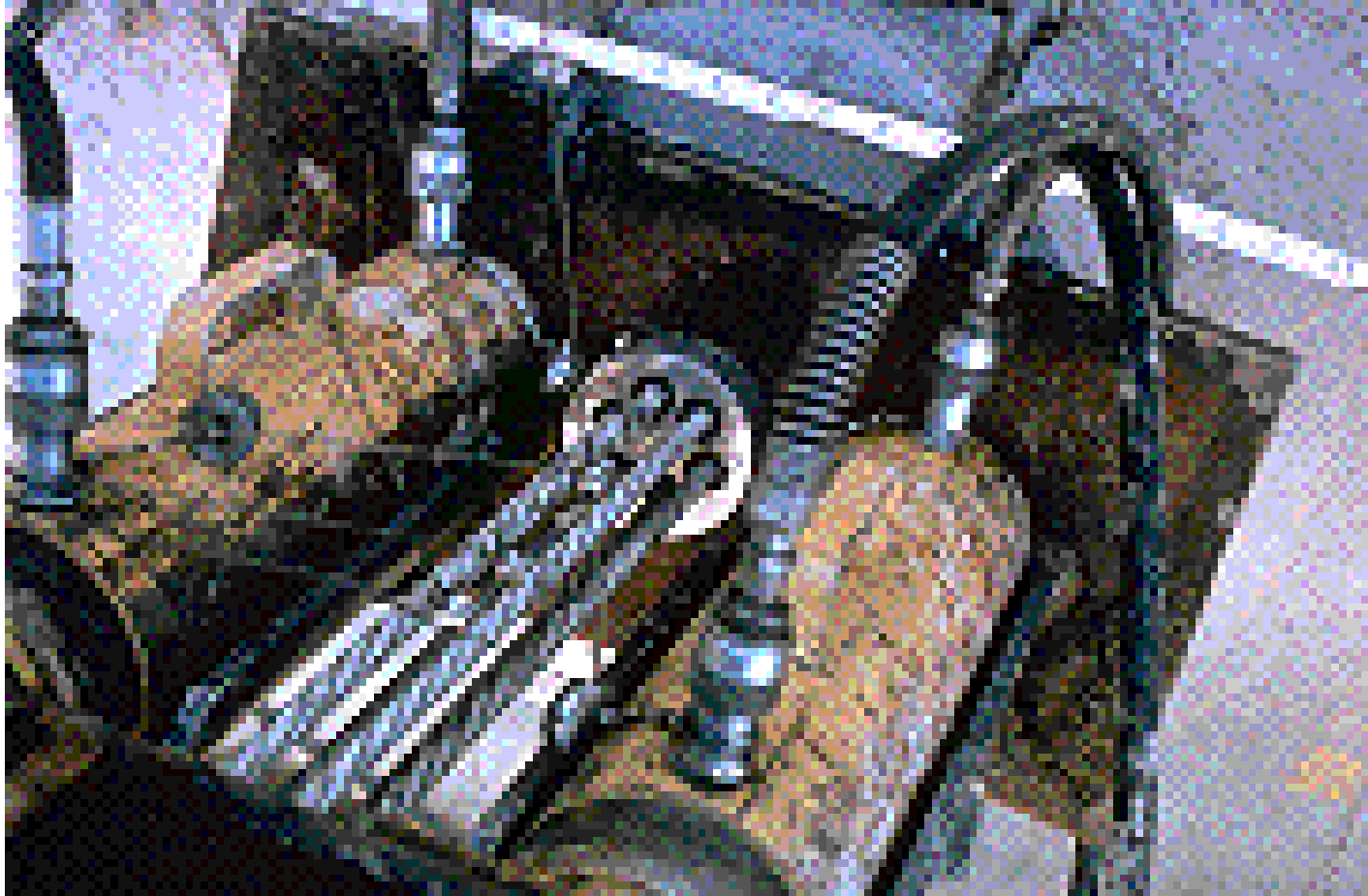
“Because the length of each tendon varied with the depth of the rock, there was no way to determine tendon length until each hole was drilled. Therefore, after the depth of each hole was determined, the contractor telephoned the tendon fabricator, Carroll-McCreary-National Prestress, of Corona, N.Y., to give the hole number and length. Since the sockets could not be left open too long, fast delivery of tendons was a must. Carroll worked around the clock to deliver individual tendons within four to six hours after receiving information. The firm delivered more than 1,400 tendons, ranging from 100 to 150-feet long, at the rate of six to eight per shift, with a maximum of twenty-two in a single day...”

RE: excerpt from: ENR



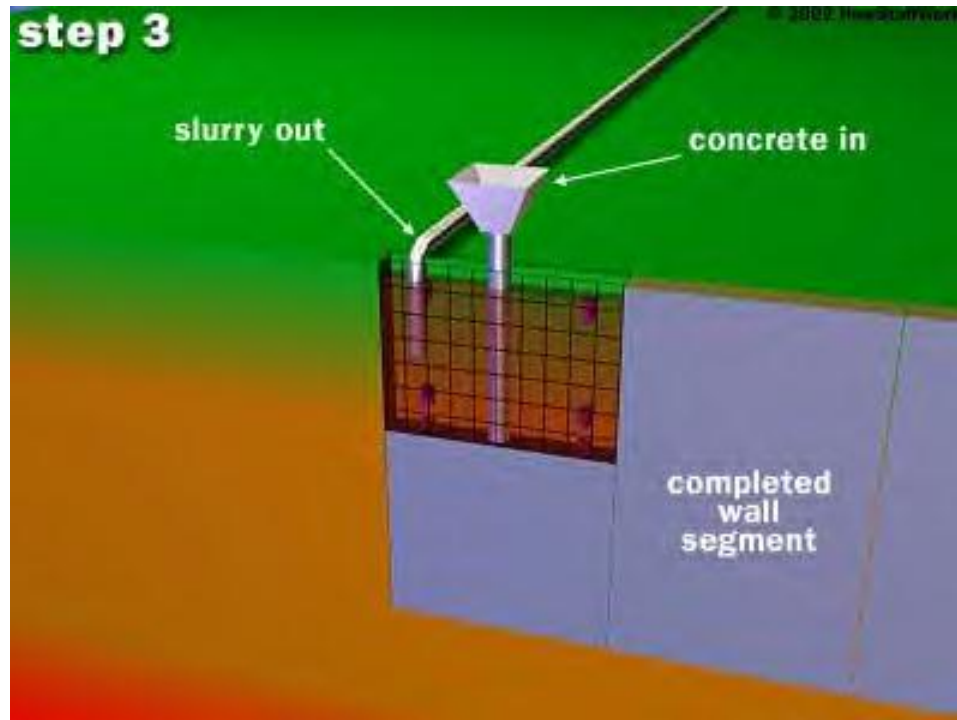
“...Tendon placement was simple. Workmen set the reel on an A-frame stand and fed the tendon into the proper hole. To keep the strands from getting away, the stand was equipped with a hand brake. The contractor then grouted the socket from the bottom to a distance about two-feet above rock with a mixture of high-early strength cement, water and fly ash. The required 3,000psi concrete was usually obtained in seventy-two hours. The contractor could then stress the tendons. To test each tendon, the contractors stressed it to 80% of its ultimate strength, then relaxed it to a tie-off load of about 65%. For the most part, the tendons are designed to withstand loads of from 200,000 to 600,000 pounds During the tests many were successfully stressed to as much as 800,000 pounds With the tendons stressed end locked, the contractor filled the empty casing with a Bentonite slurry to prevent the intrusion of salt water or other corrosive materials. The tendons contain a heavy zinc anode for cathodic protection...”

RE: excerpt from: ENR



“...the tiebacks consist of high-strength wires, each with an approximate diameter of 0.165 in. (270,000psi minimum ultimate strength) and an allowable design stress of 175,000psi. The high unit stress required in the small wires, says Kennedy, creates a sensitivity to loss of metal through corrosion that needed to be counteracted as easy and inexpensively as possible. Groundwater at the site is brackish and only one-foot below grade. This, plus stray electric currents flowing through the site that originate in subways and power stations in the lower Manhattan area, make corrosion a real threat. Field tests conducted by consulting engineer, Leon P. Sudrabin, of Berkeley Heights, N. J., provided the solution: a continuous length zinc anode material attached to the tendons to provide corrosion protection along the entire length of each tieback. The anode system is a steel wire core covered with an unalloyed, low-iron zinc for cathodic protection of the tendons. According to Sudrabin, it will guard against formation of hydrogen on the steel tendons, which could contribute to hydrogen stress cracking. Each tieback tendon consists of up to twenty-four high tensile strength strands, ranging from 40 to 115-feet in length.” ²⁰⁵

RE: excerpt from: ENR







“When the excavation has reached sub-grade elevation, the footings for the tower foundations and the plaza structure foundations are carried into the rock. Piers for these foundations will then be concreted, a gravel drainage blanket placed over the site, and a twelve-inch thick floor slab cast. Then the site is ready for erection of columns and floor framing, which will brace the walls and make the rock anchors no longer necessary. A permanent pumping system will be used to take care of the small amount of seepage filtering through the wall and the rock.”

RE: excerpt from: ENR









“Before the towers could rise, a vast multi-level structure took shape equal in volume to two Empire State Buildings built underground. The Basement housed a diverse subterranean complex including a Secret Service ammunition depot, NYPD communication’s high-security ‘White Room’, a PA police holding pen, a NYNEX switching station and FAA communication link for the three metropolitan area airports, the WTC’s huge generator and A/C plant and the central computer that coordinated data from thousands of sensors and regulates its environmental systems.”

RE: excerpt from: *102 Minutes*

Battery Park City



“Having concluded that the only way to safely anchor the towers in the mushy earth of Lower Manhattan was to dig a seventy-foot deep hole reaching all the way to bedrock, the PA had to figure out what to do with all that dirt. The solution: give it to the city.”

RE: excerpt from: *102 Minutes*

“A three-sided box of cellular cofferdams and spoil from the World Trade Center foundations are giving New York City twenty-three acres of what may be the least expensive, but most valuable land in the country. The land is being reclaimed by the Port of New York Authority from the Hudson River right next to Manhattan’s financial district. The actual value of the new land will depend largely on its use, but it is in an area where vacant land is nonexistent and where land that has to be cleared of old buildings sells for thousands of dollars a front-inch. Consequently, some estimates put the value of the new land to the city at as much as \$90 million. And it is costing the city nothing. Its creation results from an overall agreement that cleared the way for the Authority to erect the \$575-million World Trade Center. The city is not the only beneficiary, however. PNYA has undoubtedly saved hundreds of thousands of dollars in excavation costs and a considerable amount of time as well...”

RE: excerpt from: ENR



“The excavation for the ‘Bathtub’ – the foundation of the World Trade Center, actually created new land on Manhattan Island, twenty-eight acres of it, by trucking the excavated material to the site of a group of abandoned Hudson River piers just a couple of blocks away. The city could then sell the land to developers – appraisers figured it could be worth up to \$90 million – and middle-income housing could be built. It was an inspired idea for both the city and the PA, and it made perfect sense: the site was a landfill to begin with.”



“After the center itself, the largest single boon to the city will be construction of a 23.5-acre landfill extending from the pier-head line to the bulkhead line in the Hudson River adjacent to the site. The PNYA will supply the landfill from the 1.1 million cubic yards of material to be excavated for the center’s foundations under a \$4.4-million contract. This concession is hardly a total loss to the authority. Without the landfill, a good part of its cost would be spent on long-distance truck hauls or re-handling for barge removal of the spoil from the city...”

RE: excerpt from: *ENR*

“...Without the landfill as a spoil area the contractors would have to truck the spoil to riverside for loading on barges that would carry it out to sea, or truck it ten to twelve cubic yards at a time to the Jersey meadows, eight to nineteen miles away. Either process would be at least as expensive and certainly more time consuming than hauling the material directly to a spoil area adjacent to the site, and would provide no financial return...”

RE: excerpt from: ENR

“The fill projects about 700-feet into the Hudson from the existing shore line and is 1,484-feet long, about six city blocks. Enclosing the reclaimed area are cellular cofferdams made up of some 8,500-tons of steel sheet-piling. There are more than 7,800 individual sheets ranging from 56 to 64-feet in length set into 40 cells, each 64-feet in diameter. Before the cofferdam work could be done, the old piers, ferry slips and head houses had to be removed. This was no small task...Each of the piers contained 1,600 to 2,000 piles. In the out-shore end and in the areas of the cofferdams, the contractor had to pull the old piles. In the area within the cofferdam he had to cut or break them off at the mud line...Because of tidal flow there is little silting near the east bank of the Hudson. However, to insure the integrity of the cofferdams, PNYA required that on the long line of cofferdams, the bottom of the river be dredged ten to twelve-feet deep for a width of 114-feet and the area filled with sand...As each cell was finished, the contractors filled it with 5,500 to 6,000 cu yd of sand-seven barge loads...started filling the area as soon as there were enough cells inshore to contain the spoil.”

RE: excerpt from: ENR





“We’re adding more land because we’re not satisfied with the size of the island we bought”

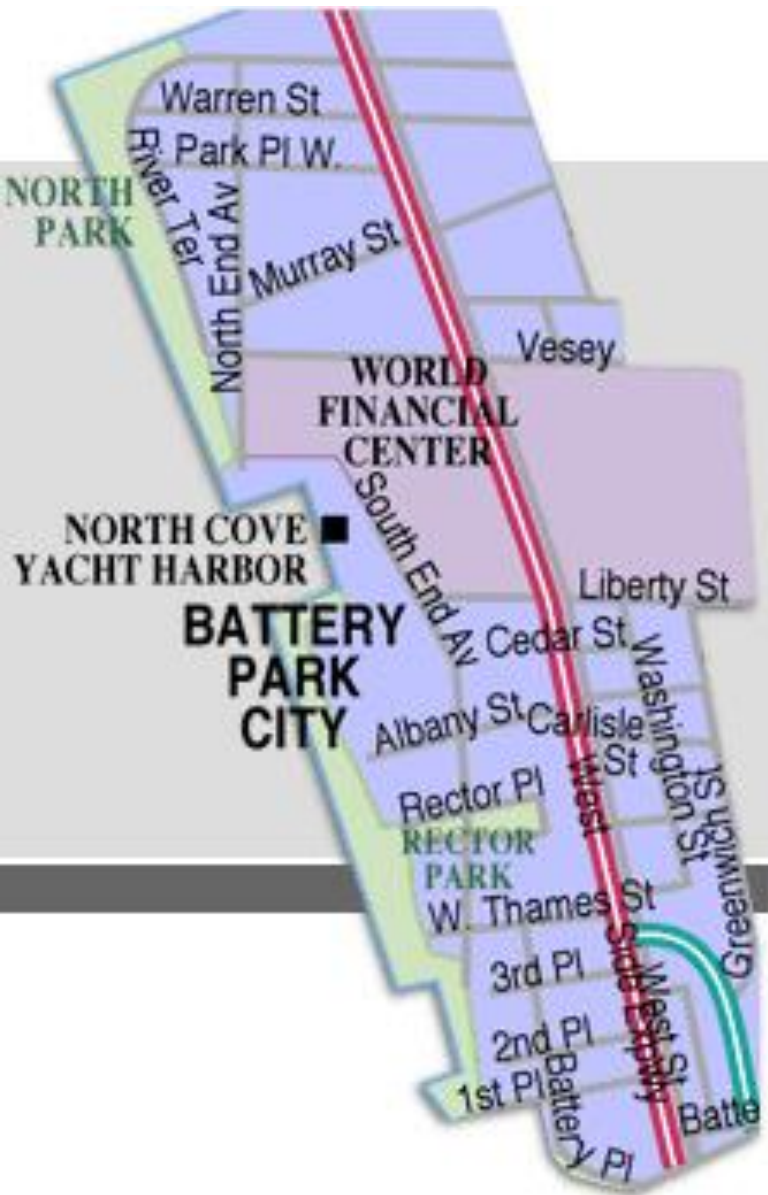
NYC Mayor John Lindsay, 1967

RE: *Battery Park City*









“Battery Park City is a planned community being developed by a non-profit public corporation established by the New York State Legislature.

Battery Park City is rising from 118 acres of urban wasteland along the Hudson River in Lower Manhattan. Eventually, it will provide housing for 55,000 New Yorkers of all income levels. Some 35,000 people will also work in Battery Park City.

Battery Park City will not just be a development on a bigger scale than others. It will be a complete community, designed by sociologists and city planners as well as architects and engineers. It will have everything a self-contained community needs; schools, fire & police stations, stores, services, amusements, restaurants and parks.

**Is this any way to plan a city? YOU BET IT IS!”
RE: *NY Times* advertisement sponsored by the *Battery Park City Authority (BPCA)***

June 5, 1969

“Because of the great height of the structures and the relative flatness of the surrounding territory, the panels may be seen glistening in the sun from almost anywhere within a 5,000 square-mile area. Visibility will extend from past Jones Beach (on Long Island) on the east to the Delaware Water Gap (between New Jersey and Pennsylvania) on the west. On the north-south axis, visibility will extend from Asbury Park on the central New Jersey shore to New York’s Bear Mountain on the west side of the Hudson River, near West Point.”

RE: excerpt from: *ENR*



“The PA made sure its monumental towers would continue to be ‘noticed’ by mandating that commercial buildings on the landfill rise only half the height of the WTC or less.”
RE: excerpt from: *102 Minutes*



World Financial Center (under const.)
Wintergarden (at right, T&B)



“The Manhattan waterfront is a priceless asset. Instead of being wasted on obsolete functions, it should be opened up to new uses. In addition to passenger shipping, we believe it has great potentials for recreation, commerce and housing.”

**NYC Mayor John Lindsay,
1969**



Promenade (BPC)



World Financial Center (BPC)



Yacht Basin (BPC)



“From the wealth we derive from the wealthy people who live here, we will rip-off as much as we can and put it into affordable housing”

NYS Governor Mario Cuomo, 1987

RE: response to a soviet dignitary’s question while touring *Battery Park City* to then Governor Cuomo: *“Why was he proud that the government built housing for rich people?”*



**View from across the Hudson
before BPC (left)
after BPC (above)**

Part 6

The Tallest Buildings in the World



“There is an attractive element to the colossal...What visitor is insensitive before the pyramids? And what is the source of this admiration if not the immensity of the effort and the grandeur of the result? The tower will be the tallest structure ever built by man. Will it not be grand in its own right?”

Gustav Eiffel

World Trade Center, 1975
1,350' (414 meters)

Empire State Building, 1931
1,250' (375 meters)

Chrysler Building, 1930
1,048' (314 meters)

40 Wall Street Building, 1929
927' (278 meters)

Woolworth Building, 1913
792' (237 meters)

Metropolitan Life Building, 1909
680' (204 meters)

Singer Building, 1908
615' (184 meters)

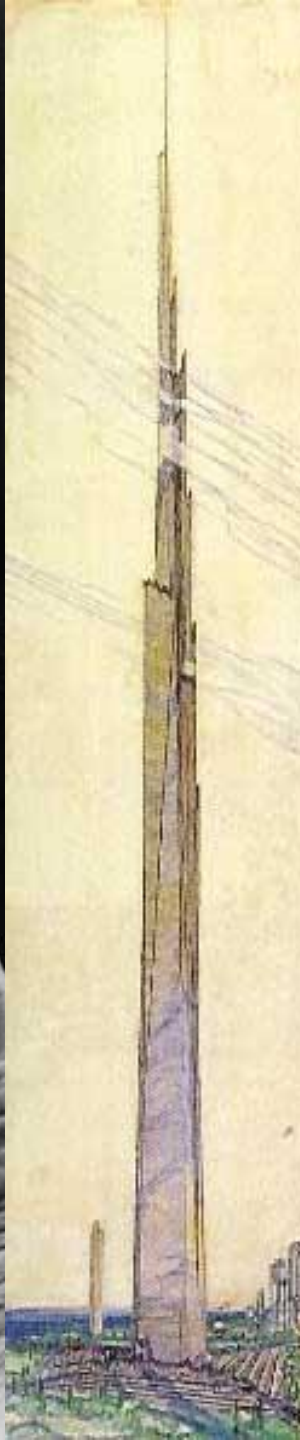
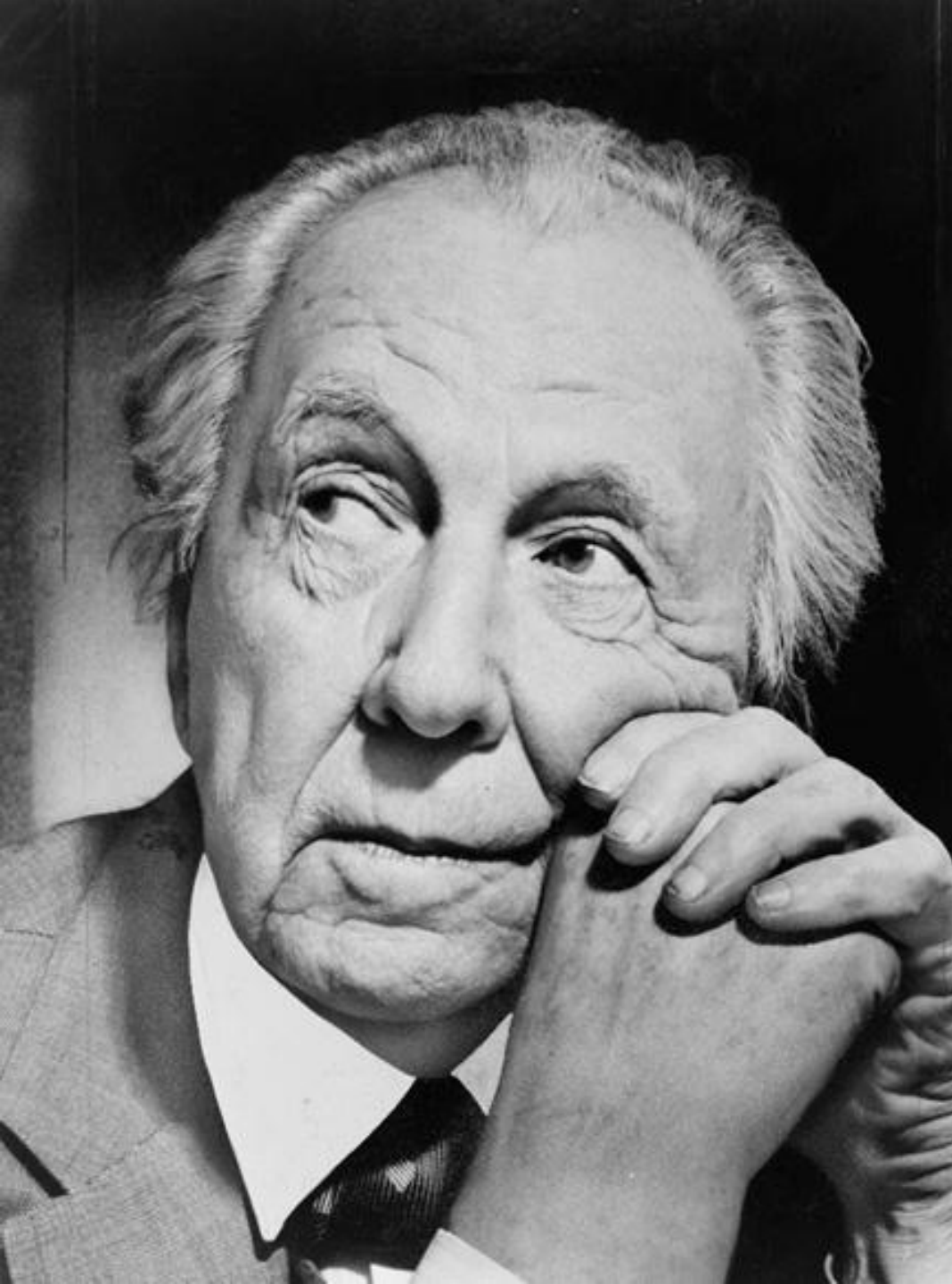
World (Pulitzer) Building, 1890
375' (112 meters)

Tower Building, 1889
120' (36 meters)



“In 1960, when the Port Authority was first considering the Downtown Association’s entreaty to build the World Trade Center, Lee Jaffe – publicist for the PA, had written an internal memo in which she had said, almost in passing, that if the PA was going to build a great project, it should be the world’s tallest building. That sentence stuck in Guy Tozzoli’s mind.”

RE: excerpt from: *102 Minutes*



“The skyscraper envelope is not ethical, beautiful or permanent. It is a commercial exploit or a mere expedient. It has no higher ideal of unity than commercial success.”

Frank Lloyd Wright, Architect

At left: FLW’s proposed “mile-high” skyscraper: *The*

Illinois



“There’s nothing revolutionary about the WTC. Tall buildings are outmoded concepts; this is Victorian thinking.

Skyscrapers have always been put up for reasons of advertisement and publicity. They are not economically sound or efficient – in fact, they are ridiculously unprofitable.”

Lewis Mumford,
241
Architectural Historian



*“A breakthrough in terms
of New York’s
architectural trademark –
skyscraper design...A
second great period of the
skyscraper because the
two factors that have
limited the height of the
tall building until now;
construction cost and
elevator space, have been
solved”*

**Ada Louise Huxtable – *NYT*
Architectural Critic**

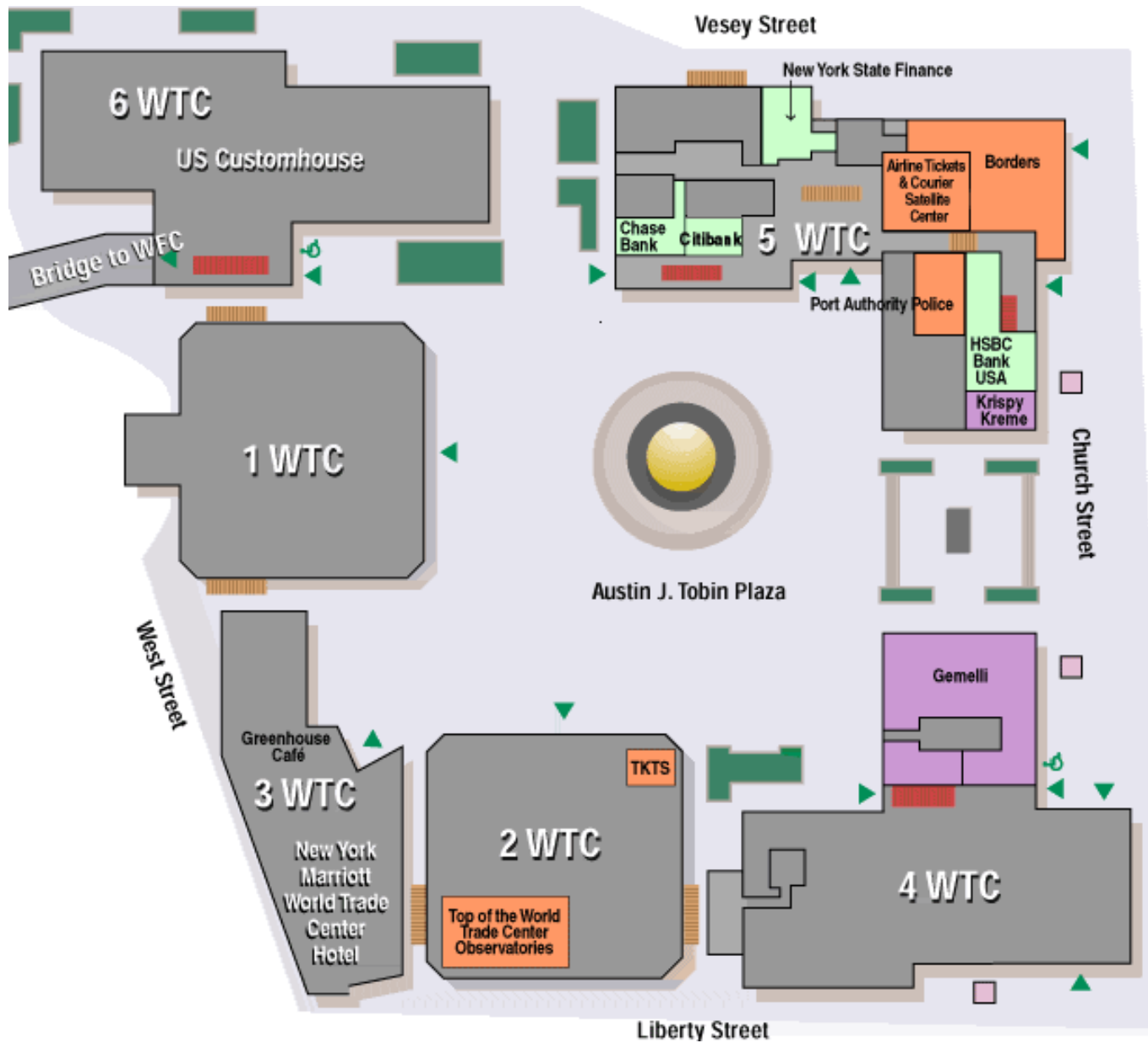
RE: WTC



“The two great towers of the WTC are 1,350’ high and 209’ square. They will rise from a very large open plaza about five acres in extent – that’s about as large as the Piazza San Marco in Venice. And like that lovely plaza in Venice, it will also be surrounded by a great square of low-rise plaza buildings beautifully designed.”

Austin Tobin – PA Director

RE: excerpt from a speech to the Building Trades Employers Association. The plaza was actually 3x the size of Piazza San Marco and was named *Austin Tobin Plaza* in honor of the WTC’s main proponent.





“What was a site-encircling podium building in an earlier concept is now four separate ten-story buildings distributed about the circumference of the sixteen-acre site. The reason for the change is to give maximum attention to the two world's tallest buildings and to improve pedestrian circulation through the whole center. Mr. Yamasaki also created new facades of dark gray concrete for the four low buildings that make them more contemporary and suits them better to New York's dirty atmosphere...

Either aluminum or stainless steel will clad the tower walls in gleaming contrast to the low buildings.”

RE: excerpt from: *ENR* 245

“The U.S. Customs will rent one of the four buildings; another will be a hotel-information center; the remaining two will be rented as commercial space...Large areas below grade will be assigned to U.S. Customs examination and cargo pickup. Also below the plaza will be tenant storage areas, five parking levels for 1,600 automobiles, and mechanical and refrigeration equipment. The project will require 40,000-tons of refrigeration for air conditioning. At ground level, sheltered archways will form galleries around all four sides of the plaza. These glassed-in, air-conditioned spaces will house offices.”

RE: excerpt from: ENR





“In the plaza’s center, Fritz Koenig’s massive bronze sphere; fifteen-feet in diameter, appeared somehow to have ruptured threatening to collapse its innards into the surrounding fountain. It was supposed to rotate 360-degrees every hour, but the mechanism didn’t work for years.”

RE: excerpt from: *102 Minutes*

“The plaza, too, has changed character. Off-center concentric circles, like those of the Campidoglio in Rome, and a paving design related to the towers will line its surface. Instead of lagoons (often just refuse collectors in a city) bordering on the low buildings, small courts richly landscaped will dot the five-acre plaza, with an eighty-foot diameter pool and fountain at its focus. The Port Authority hopes to make the center a tourist magnet like Rockefeller Center and expects to attract 80,000 tourists a day. The primary entrance to the Trade Center remains, but the new design opens the plaza to streets on the north, south and west sides. The west entrance opens the center to the Hudson River waterfront, scheduled for development after the elevated West Side Highway is depressed, as presently proposed by the New York City Planning Commission.”





“Among the things awaiting final design are a communications system to direct 50,000 workers through the center and \$2 million to \$5 million worth of sculpture and other art.”

RE: excerpt from: *ENR*









“A shattering breakthrough that would influence the course of world architecture”

RE: internal PA report concerning WTC design goals

“From the beginning of our work on the Trade Center, we had determined that, despite our tremendous space requirements, the WTC should be a thing of grace and beauty that would enrich the lives of all who worked in it and visited it and of which we could all be proud. This criteria was given to Mr. Yamasaki and the Roths in our first conversations with them. And when Yamasaki began to design the wide plaza and then, to meet our space requirements, to throw his towers toward the sky, we knew that our objective of a beautiful as well as functional complex of Trade Center buildings was going to be accomplished.”

Austin Tobin – PA Director

“The most exciting thing we or anyone else in the architectural profession will have the opportunity of working on for a long time to come.”

Minoru Yamasaki, WTC Design Architect

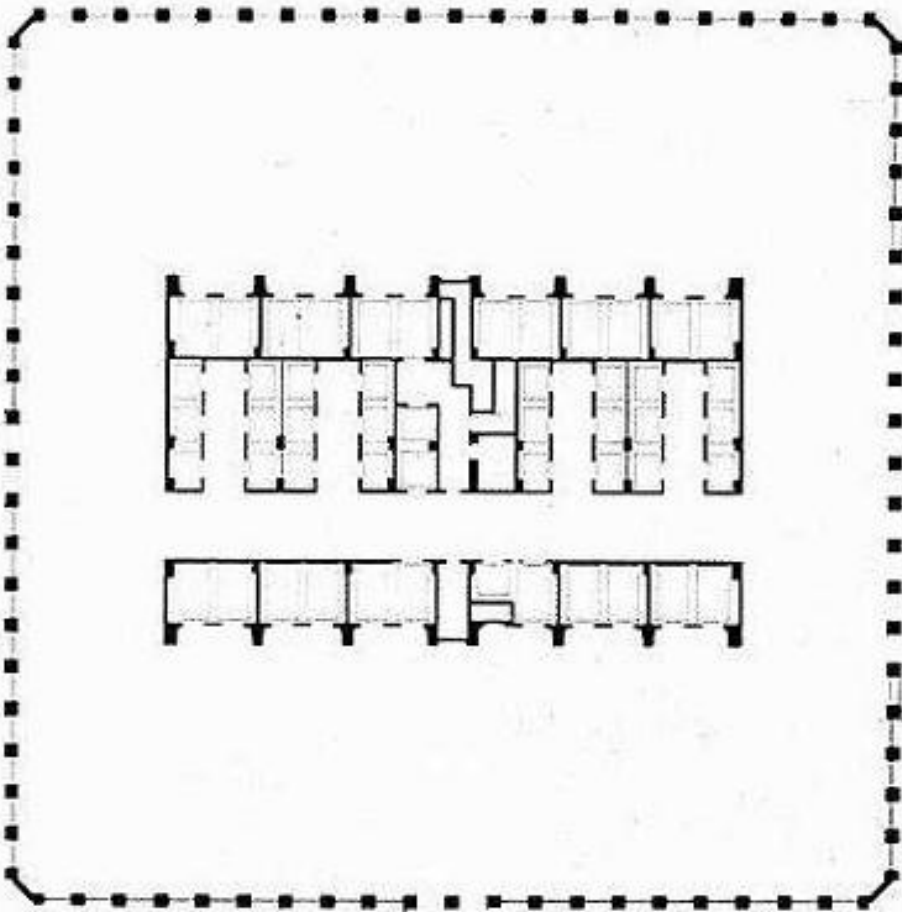


“You must abandon the anachronistic structure of the old skyscraper. Instead, emulate the hollow, fibrous structure of the bamboo stalk. Shape your tube into a square. Then you can build prairie upon prairie of column-less stories, as high as you want to go. No limit.”

Minoru Yamasaki,
Architect²⁶⁰

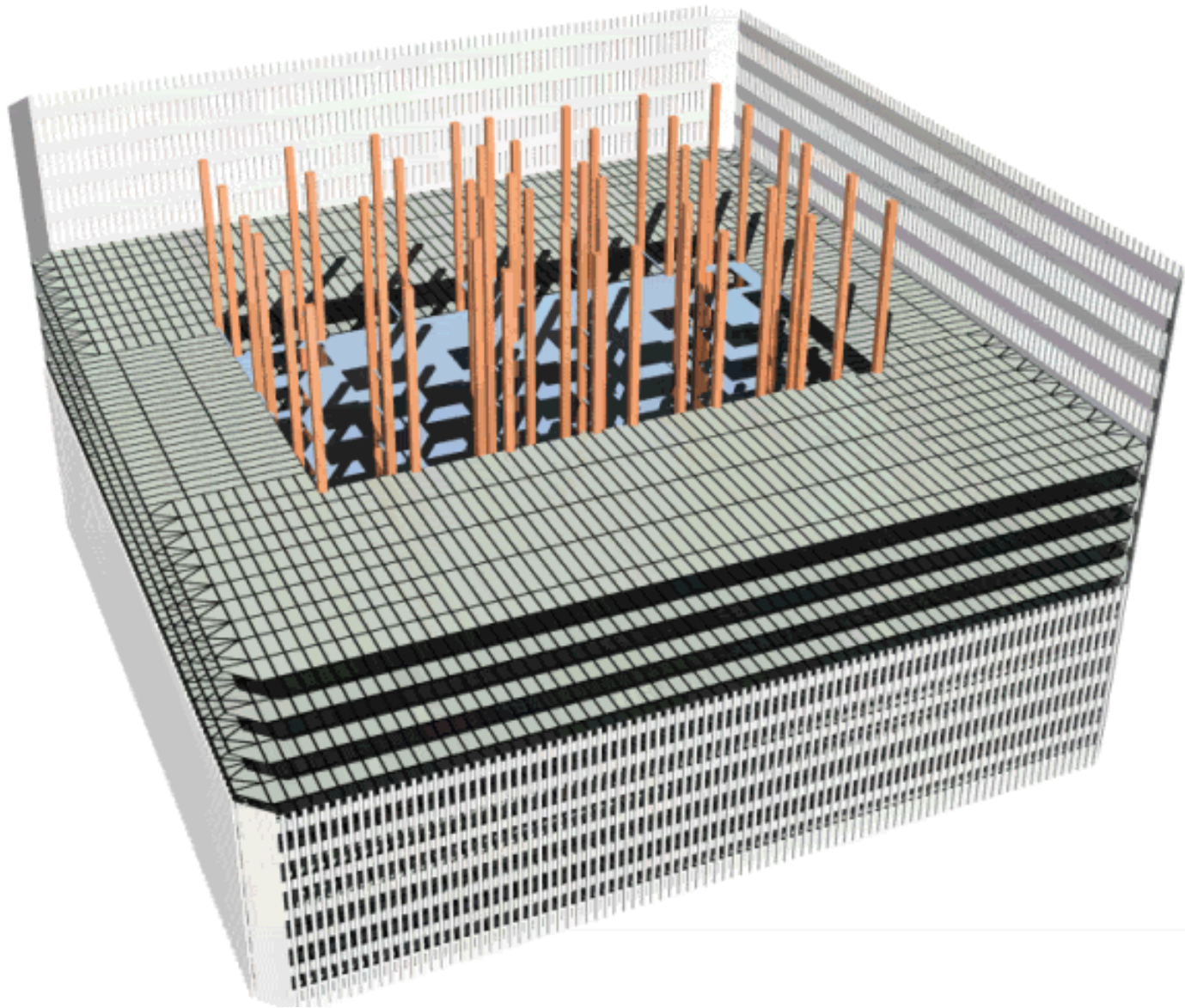


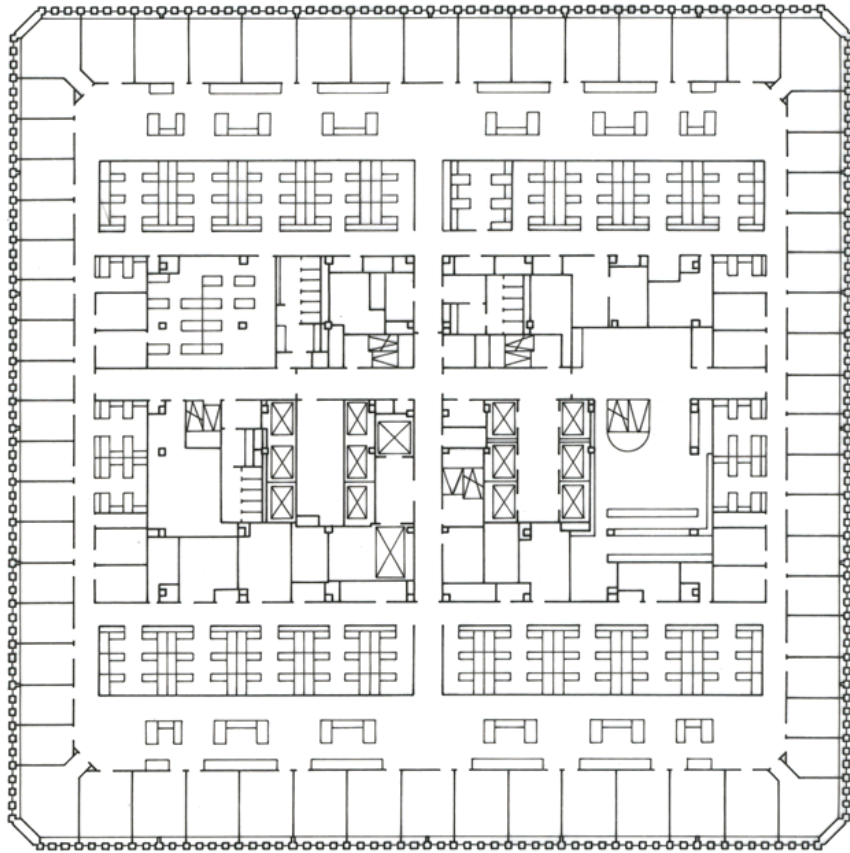
Taipei 101
Taipei, Taiwan
(design based on a bamboo stalk)



“Radically different in that the structural design of the towers uses the exterior walls as the load-bearing walls. Most of the steel is on the outside instead of the inside. The only interior columns are in the core, which contain the elevators. Thus, there is a maximum column-free floor space. The outer wall carries the building’s vertical loads and provides the entire resistance to the wind. The wall consists of closely spaced vertical columns tied together by massive horizontal spandrel beams, which girdle the tower at every floor. On the inside of the structure, the floor sections consist of trusses spanning from the core to the outer wall. In effect, the towers are a huge four-sided lattice bound together for enormous strength.”

RE: excerpt from a PA publication entitled: *The WTC: A Building Project Like No Other*





“The WTC was a marvel for the construction industry in many ways, but its singular triumph was in its use of space. The tight bundling of the building systems made it possible for the PA to offer 75% of each floor rather than the standard 50%.”

RE: excerpt from: *102 Minutes*





“A Lower Manhattan cultural program turned 40,000 of the one million square feet of unoccupied space in the WTC at the end of the 1990s into rent-free artist’s space. One story above the opulent offices of a Japanese securities firm, a group of artists filled bare walls with boldly colored images and hung sculptures from exposed floor trusses.”

RE: excerpt from: *102 Minutes*



“Minoru Yamasaki and Associates, Birmingham, Mich., and Emery Roth & Sons, New York City, are the Architects. Worthington, Skilling, Helle and Jackson, of Seattle, are, the consulting structural engineers; Jaros, Baum and Bowles, of New York City, the consulting mechanical engineers; and Joseph R. Loring and Associates, New York City, the consulting electrical engineers. These firms were assisted in the design by the World Trade Center Planning Division under the direction of Malcolm P. Levy, and the PNYA engineering department, John M. Kyle, chief engineer.”

RE: excerpt from: *ENR*

Minoru Yamasaki, Architect



“I so enjoyed the experience of drawing and painting, and I found myself deeply attracted to these more emotional arts...While I had been raised in a family where hard work was the rule and luxuries the occasional reward, still I was motivated by a clear understanding that life could be lived more beautifully – not solely a material life, but one in which aesthetics and gentility were much more involved, no matter at how fundamental a level.”

Minoru Yamasaki,
WTC Design Architect²⁷⁰



“I know you wouldn’t be in this public area if you were, but that woman over there insists that I find out whether or not you’re spies”

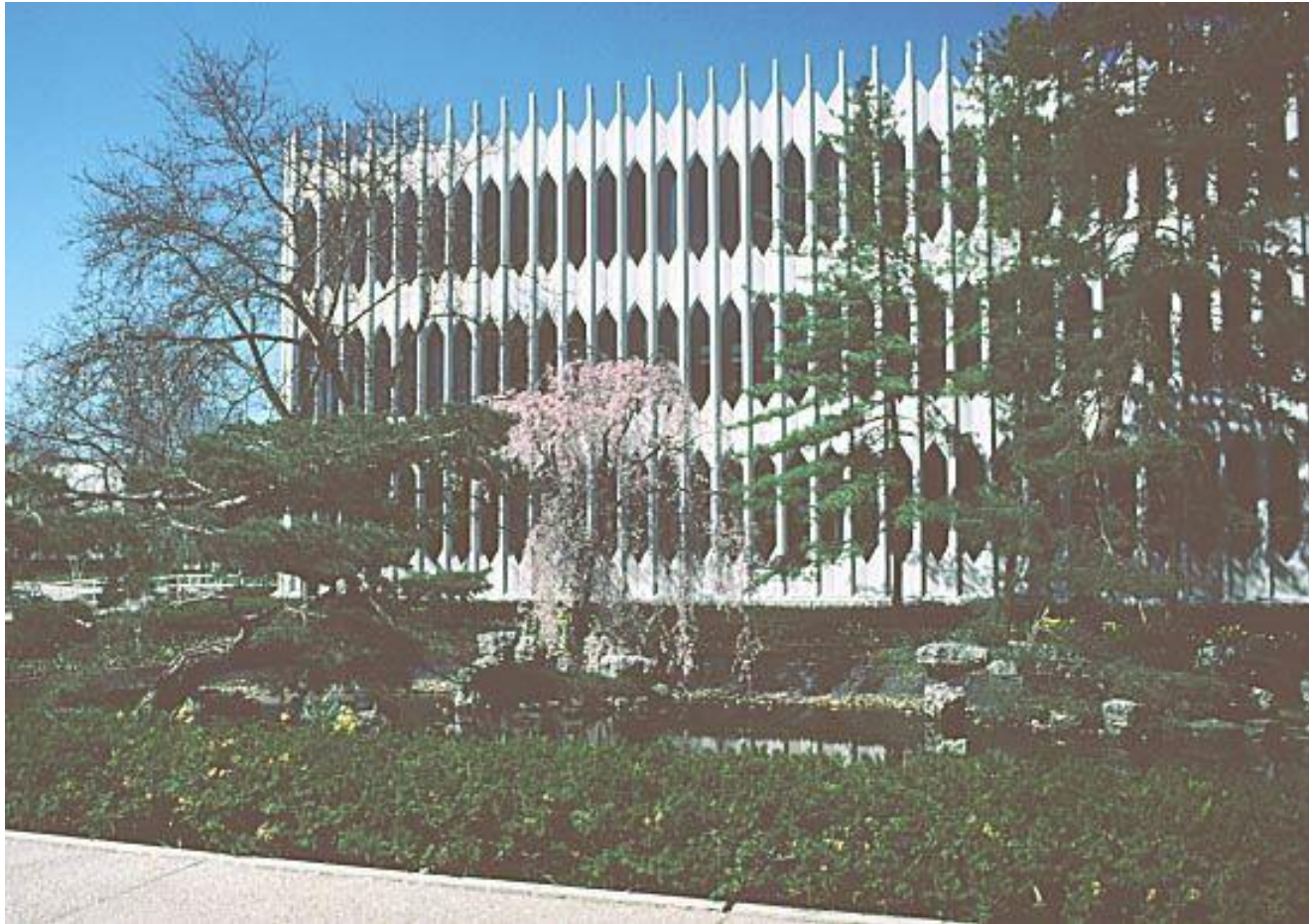
RE: during an air-raid drill in 1941, Yamasaki & his wife were confronted by a policeman. He showed the cop his War Department ID. The Yamasaki’s were not interned during WWII as were other Japanese-Americans due to his work as an architect for the federal government.

TWENTY-FIVE CENTS

JANUARY 12, 1963



VOL. LXXIII NO. 2



The Conservatory of Music at Oberlin College



“I learned that good architecture makes you want to touch it. The Taj Mahal made me want to touch it. And I learned that behind beauty there has to be a cultural concept...What I decided to do, the only thing I would get fun out of doing, was the beautiful thing; beauty through structure and technology, because that’s our culture.”

Minoru Yamasaki,
Architect



**ING Reliastar Building
Minneapolis, Minnesota**

“There are very few influential architects who sincerely believe that all buildings must be ‘strong’. The word ‘strong’ in this context seems to connote ‘powerful’ – that is, each building should be a monument to the virility of our society. These architects look with derision upon attempts to build a friendly, more gentle kind of building. The basis for their belief is that our culture is derived primarily from Europe, and that most of the important traditional examples of European architecture are monumental, reflecting the need of the state, church or the feudal families – the primary patrons of these buildings – to awe and impress the masses. This is incongruous today...”

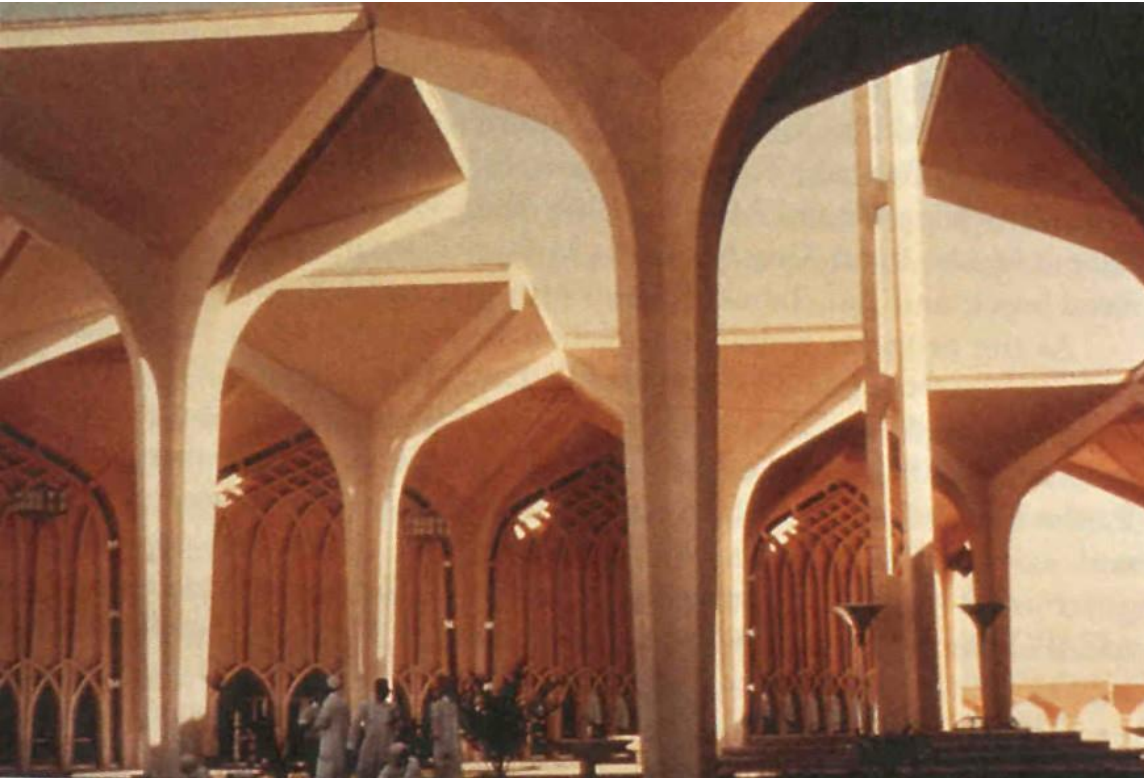
Minoru Yamasaki, Architect



**IBM Building
Seattle, Washington
(1964)**



Rainier Tower
Seattle, Washington
(1977)



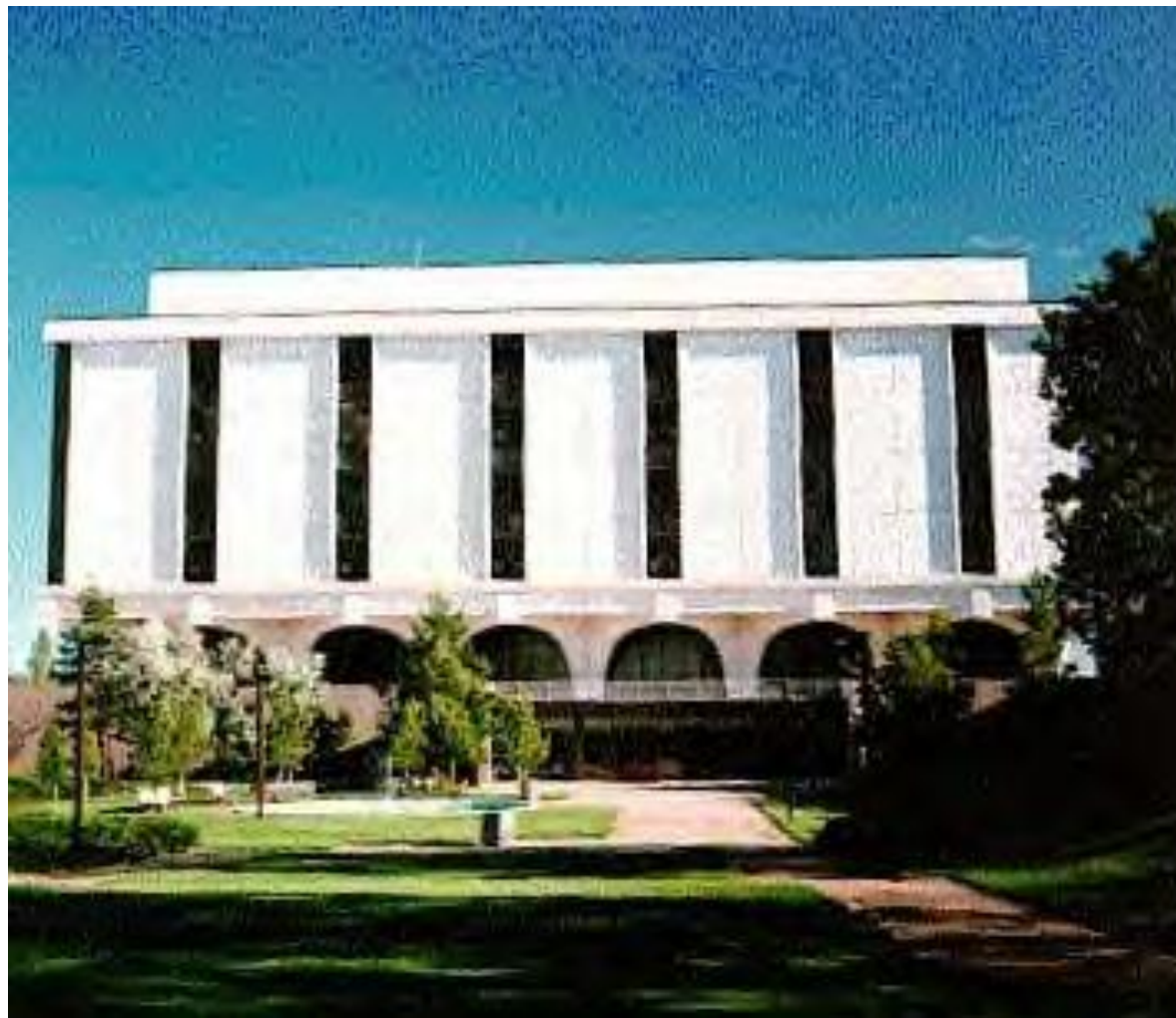
*“When people go into
good buildings, there
should be serenity and
delight”*

**Minoru Yamasaki,
Architect**

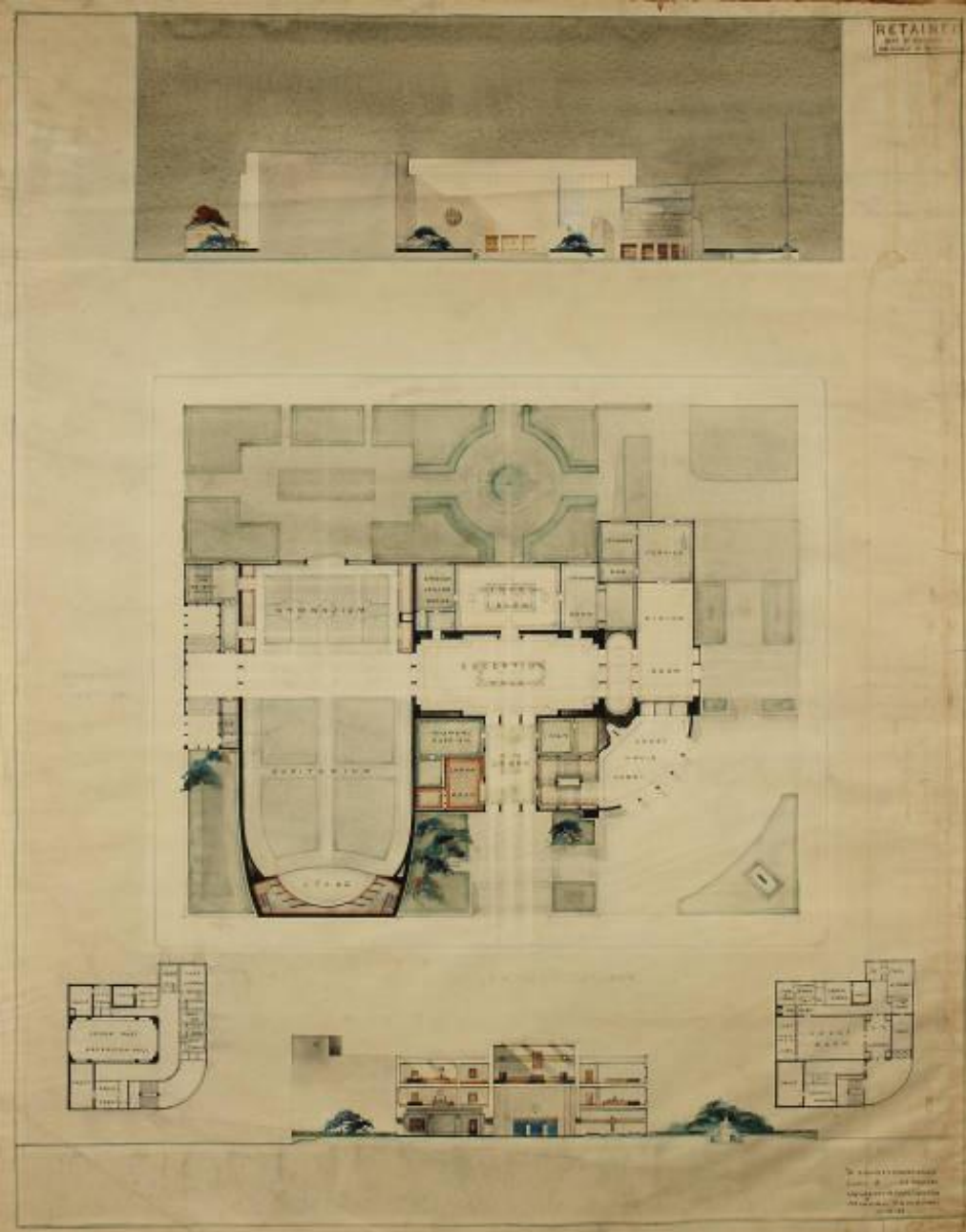
**Interior of terminal building at airport
Dhahran, Saudi Arabia**



**Airport Terminal Building
Dhahran, Saudi Arabia, 1965
(on Saudi currency)**



**University of Regina Library
(1967)**



“As an architect, if I had no economic or social limitations, I’d solve all my problems with one-story buildings. Imagine how pleasant it would be to always work and plan spaces overlooking lovely gardens filled with flowers.”

Minoru Yamasaki, Architect

Student Drawing of a County Courthouse



“One of the sorriest mistakes I have made in this business...social ills cannot be cured by nice buildings”
Minoru Yamasaki, Architect
RE: St. Louis’ *Pruitt-Igoe* public housing project, 1955 – it was later demolished by the city



**Demolition of the *Pruitt-Igoe* Housing Project
St. Louis, Missouri
(July 15, 1972)**



“The many speakers have said everything, so I have nothing to add”

Minoru Yamasaki, Architect

RE: at the dedication of one of his buildings in Detroit – he received a standing ovation



Century Plaza Towers
Los Angeles, California

“I said; ‘I want you to find me a great architect – one great architect.’ And I told them that when they recommended someone to me I hoped it would be someone who would live more than twenty years, because this project was going to take that long...There wasn’t a major architect in the world that we didn’t speak to, but I kept coming back to Yamasaki.”

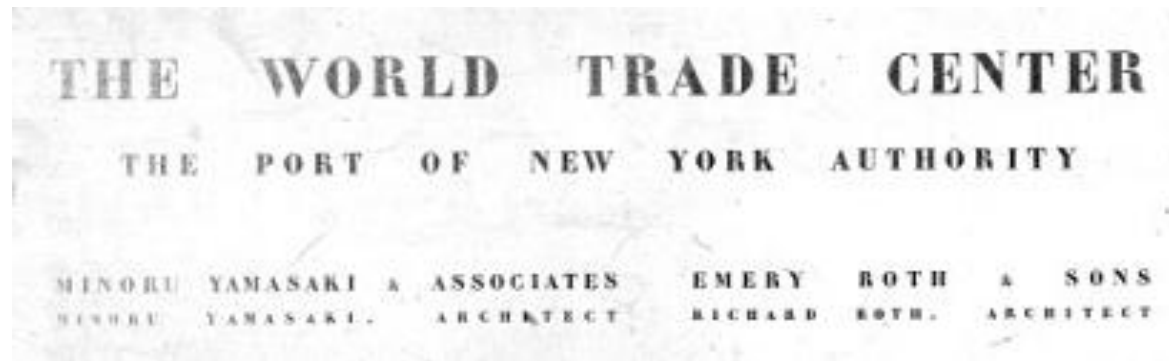
Guy Tozzoli - WTC Director, 1962

RE: directive to his search committee to find the right architect for the WTC

“Yama, President Kennedy is going to put a man on the moon. I want you to build me the tallest buildings in the world.”

Guy Tozzoli - WTC Director

“The Port Authority gave Yamasaki its basic order: ‘*We need twelve million square feet of floor area and accommodations for the Hudson tubes and subway connections. We have 16 acres and \$500 million.*’



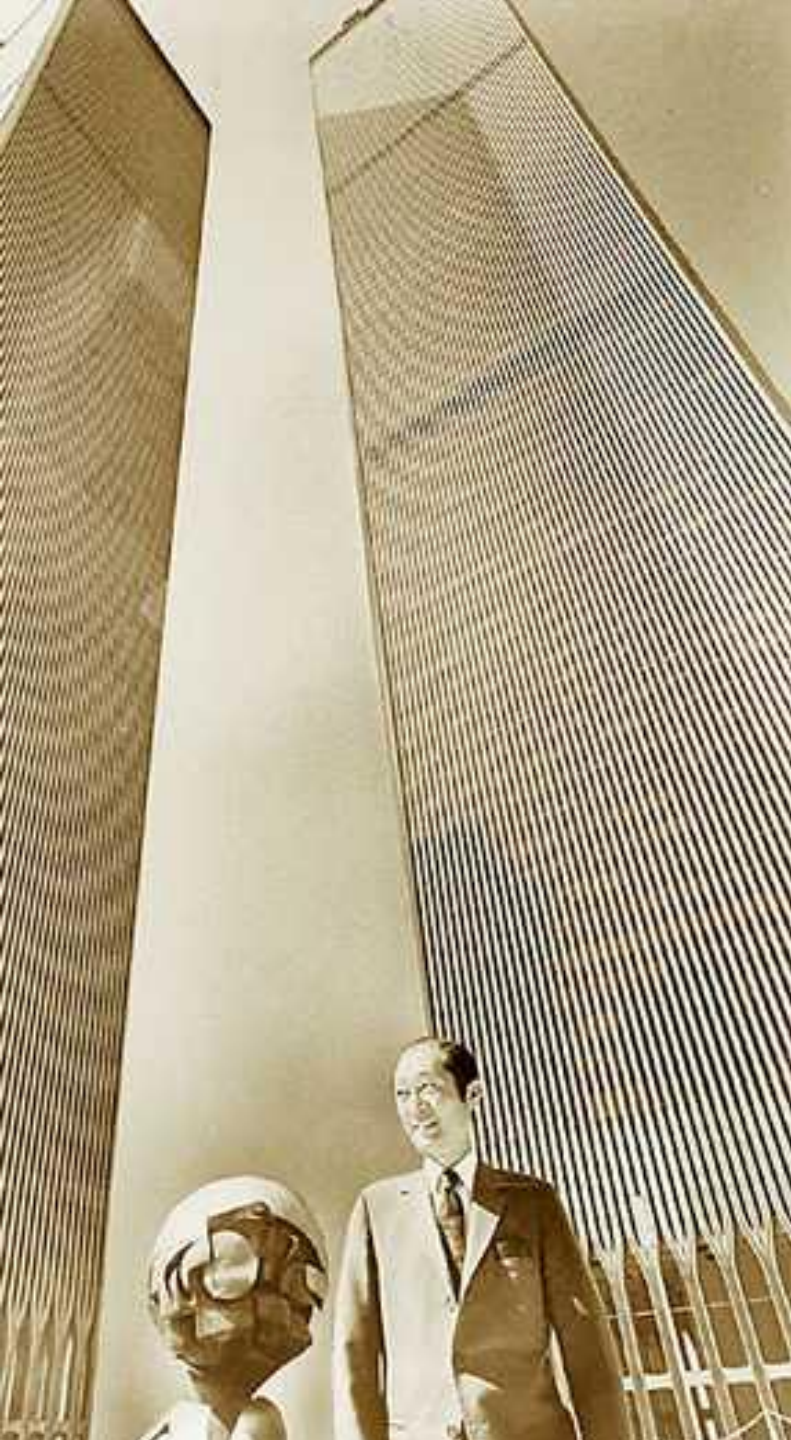
Tozzoli figured he’d better hedge his bets. He decided to team Yamasaki up with *Emery Roth & Sons*, a venerable New York firm that had built more office buildings after the war than any other architectural agency. Roth was considered tops in the field for designing buildings that made the best use of space.”

RE: excerpt from: *102 Minutes*



“From the outset, Yamasaki believed there should be an open plaza from which one could appreciate the scale of the towers upon approach. There is little or no sense of scale, for instance, standing at the base of the Empire State Building. Yamasaki’s plaza was sheltered from the river winds and contained by five-story buildings which housed shops, exhibition pavilions and a 250-room hotel.”

RE: excerpt from: 102 Minutes



“Yamasaki felt that in Manhattan it didn’t really matter how high you went up. What counted more was how the scale of the buildings felt at ground level. He concluded that people feel as comfortable standing next to an eighty-story building as a forty-story one. And, if the bases of the towers he had in mind had an open feeling, the issue would be diminished that much more.”

291

RE: excerpt from: 102 Minutes



“A couple of them went to stand next to and walk around the Empire State Building, as I had. They came back convinced, as I was, that there was no diminution of the soul, no ant-like feelings in the face of such a large object. Man had made it and could comprehend it...There was a wish and a need to be able to stand back from it, to see and comprehend its height.”

Minoru Yamasaki, Architect



“People are not afraid of height when the width of the window is not much more than that of their shoulders”

Minoru Yamasaki, Architect

RE: perimeter window width of only 22-inches at WTC. When it came to skyscrapers, Yamasaki’s abandonment of the International Style was personal: he was afraid of heights.



**South Tower Observation Deck
(107th Floor)**

**North Tower Restaurant
(*Windows on the World*)**

“The windows on the 107th floor were 33-inches wide; one & one-half times the width of the standard 22-inch windows. The PA required these extra-wide windows to allow for more expansive views at the top of each tower where the observation deck (south tower) and restaurant (north tower) would be located.”

RE: excerpt from: *102 Minutes*





“Back when the WTC was being built, the PA had intended to make Windows on the World a private use enclave for its top brass and the downtown FIRE (Finance, Insurance & ReaEstate) crowd. But when the news got out that WTC chief Guy Tozzoli was spending \$6 million of public money to feather his crow’s nest for the elite - \$3,500 of it on four chairs alone, it triggered a storm of protest that eventually forced a compromise: Windows would remain a private club during lunch, but those members of the general public who could pay their way were welcome to come up for dinner.”

RE: excerpt from: 102 Minutes

“Beyond the compelling need to make this a monument to world peace, the World Trade Center should, because of its importance, become a representation of man’s belief in humanity, his need for individual dignity, his beliefs in the cooperation of men, and through cooperation, his ability to find greatness.”

Minoru Yamasaki, Architect



“I feel this way about it: World Trade means World Peace and, consequently, the World Trade Center buildings in New York had a bigger purpose than just to provide room for tenants. The World Trade Center is a living symbol of man’s dedication to world peace, the World Trade Center should, because of its importance, become a representation of man’s belief in humanity, his need for individual dignity, his beliefs in the cooperation of men, and through cooperation, his ability to find greatness.”

Minoru Yamasaki, Architect

Leslie Robertson, Structural Engineer



“I want your structure to be part of my architecture”

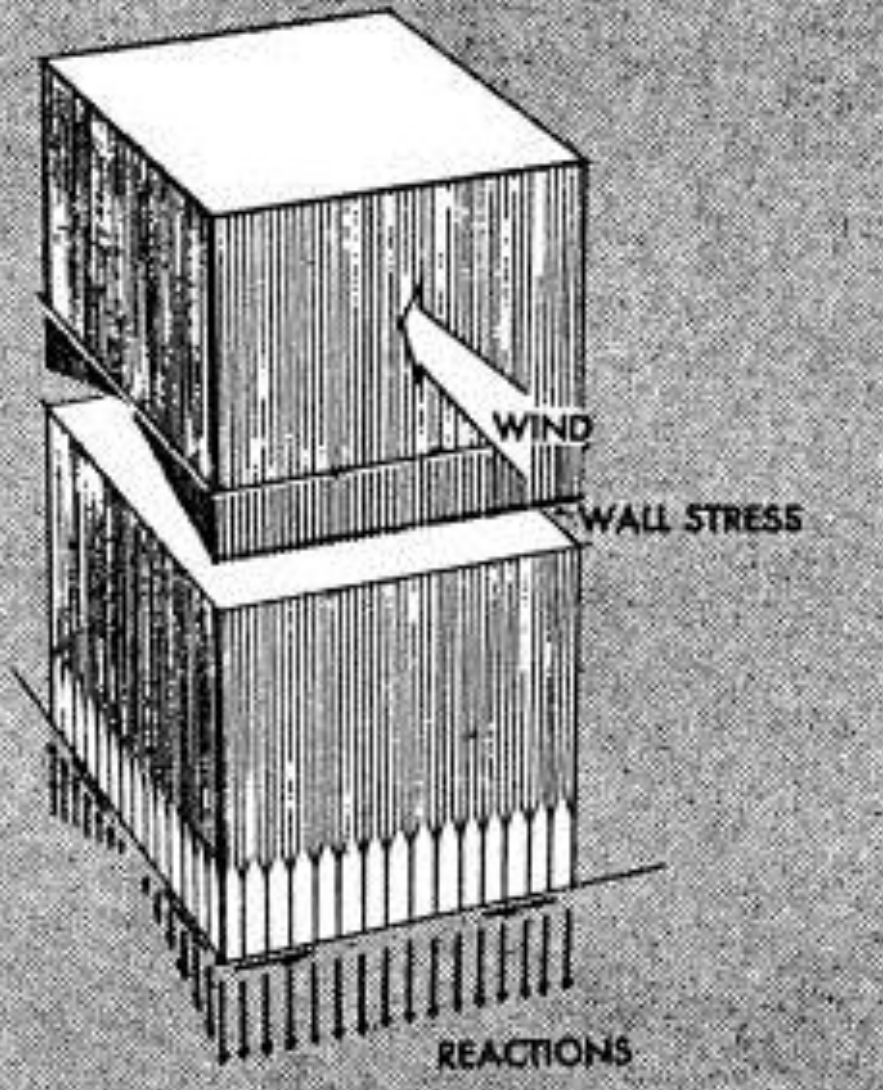
Minoru Yamasaki, WTC Design Architect

**RE: directive to John Skilling & Leslie Robertson –
WTC structural engineers**



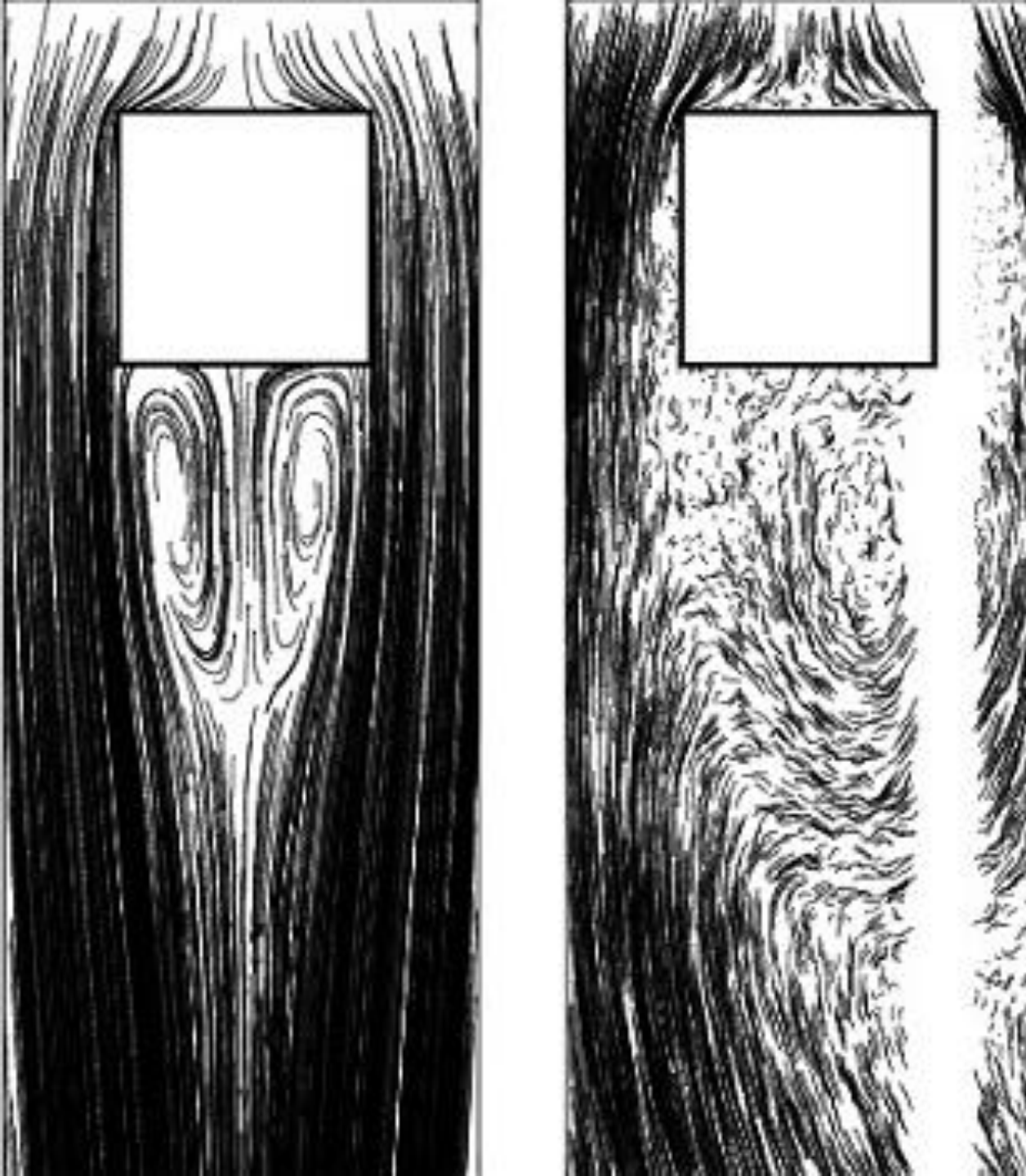
“In designing the record-height towers against wind, Worthington, Skilling, Helle and Jackson adopted a scheme that does not rely on the core at all to take wind. Each tower will act as a vertical, cantilevered hollow tube. The giant Vierendeel trusses forming the load-bearing exterior walls will provide the required rigidity and strength to resist wind. All the horizontal shear will be resisted by the sides of the building parallel to the wind, and most of the overturning moment will be taken by the exterior walls normal to the wind. For economy in resisting the stresses, the wall columns will be made of high-strength steels.”

RE: excerpt from: ENR



“...Rising the full 1,350-foot height without a setback, each tower will be 208 feet square. It will be designed to resist a 45-psf wind, with both low sway and low acceleration.”
RE: excerpt from: *ENR*

Under wind loads, the tower/s act as a cantilevered hollow tube



“The square cylinder is a shape which is known to be subject to the excitation of the Karman Vortex street type and is known to be subject to ‘galloping’ instability if the mechanical damping of the system is low”

**Worthington,
Skilling, Helle &
Jackson, Civil
Engineers**

**RE: *Wind Orogram
Interim Report (PA),
1964***

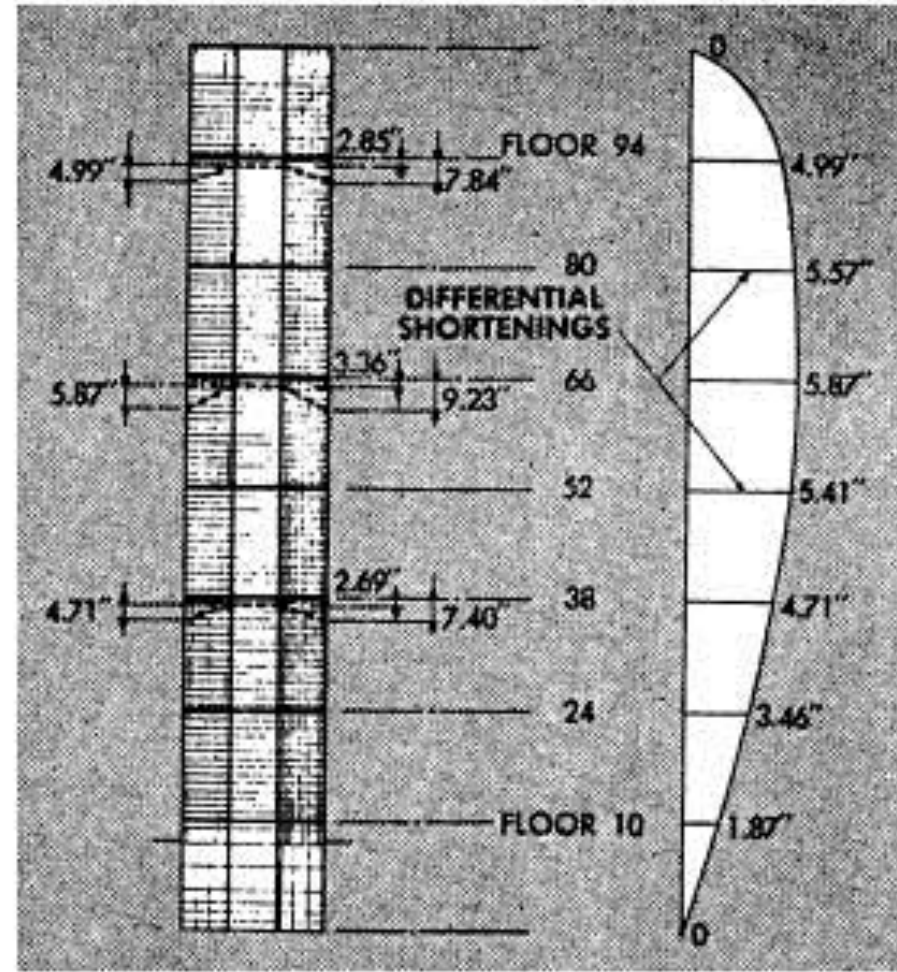
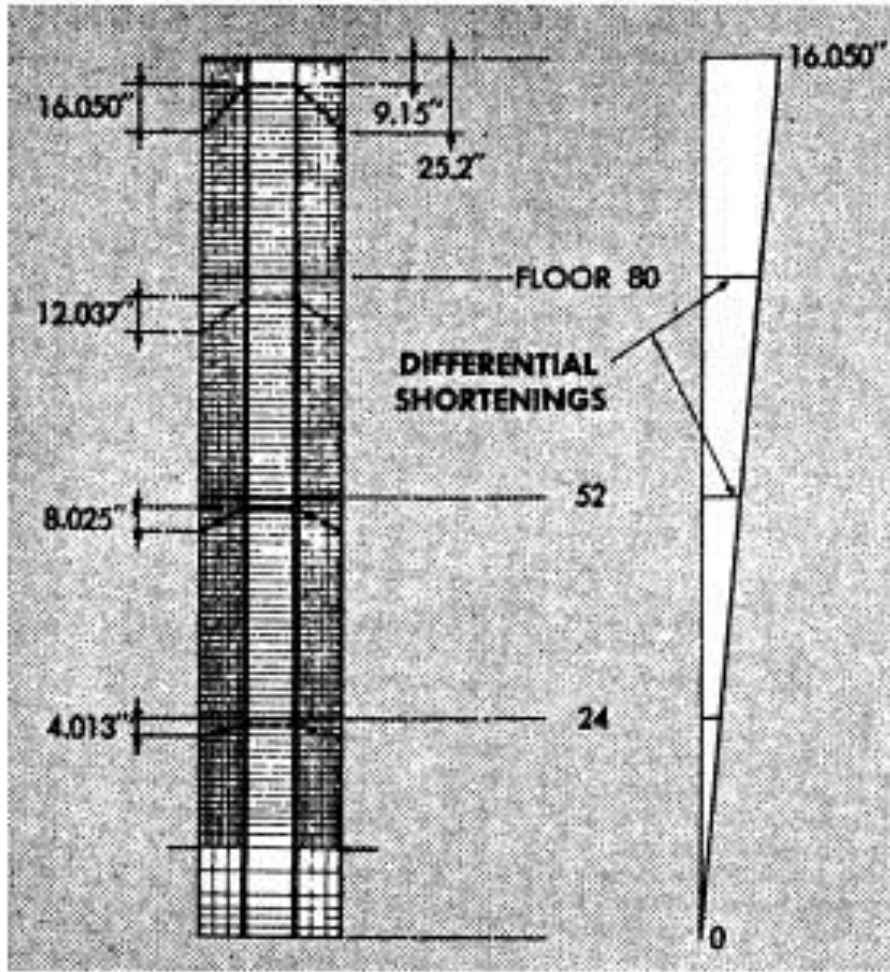


“Gravity was actually a lesser force to be reckoned with than the wind. The towers stood like huge sails at the foot of Manhattan Island, with each face built to absorb a hurricane-force wind of 140-mph. The wind-load on an ordinary day was 30x greater than the force of the airplanes that would hit the towers on 9/11. The mass of the towers was 1,000x greater than that of a 767. Given the sheer bulk of the towers, it is not surprising that the towers continued to stand after the planes hit.”

RE: excerpt from: *102 Minutes*

“For the record-height towers of New York’s World Trade Center, engineers proportion columns to avoid floor warpage when high-strength steels are used for exterior columns and A36 steel for interior columns. A design procedure that will be used for structural framing of the 1,350-foot high twin towers of the World Trade Center in New York City gives the exterior columns tremendous reserve strength. Live loads on these columns can be increased more than 2,000% before failure occurs. The procedure calls for proportioning of columns in each story for the same unit stress under gravity loads, regardless of the grade of steel in the columns. Thus, all columns will shorten the same amount, and differential shortening will be eliminated as a possible cause of floor warpage. The reserve strength of high strength steel members will then be available to resist wind stresses. The structural engineers adopted this particular design because of the great length of the columns, use of different grades of steel and their plan to take wind stresses in the exterior columns only...”

RE: excerpt from: ENR

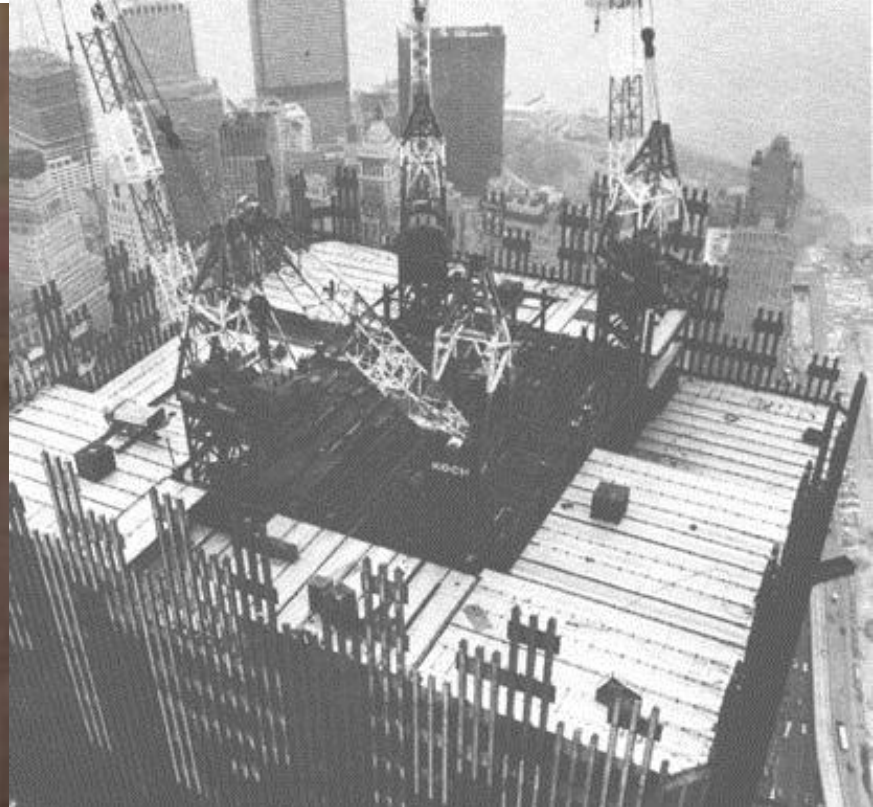


FLOOR WARPAGE is biggest at top of skyscraper, if loads are applied suddenly.

FLOOR SLOPE is not so severe, however, if columns take load gradually.

“...Because of the great length of the columns, the difference in shortening of the exterior and interior columns under gravity loads could cause undesirable floor slopes. For example, a 1,400-foot long column of A36 steel will shorten eight-inches under a design stress of 15,000psi. The same column when made of heat-treated, low-alloy steel would shorten twenty-four inches under a design stress of 45,000psi. Assume that A36 steel is used for core columns and high-strength steel for wall columns and that these columns are not loaded until the entire structure is completed, a situation clearly not possible to achieve in practice. Assume further that each floor is constructed level. Then, after application of the load, at the top of the building the core columns will compress eight-inches and the wall columns twenty-four inches. Hence, the top floor will slope downward sixteen-inches. But in practice, this extreme can't happen, because the loads go on the columns as the floors are complete...”

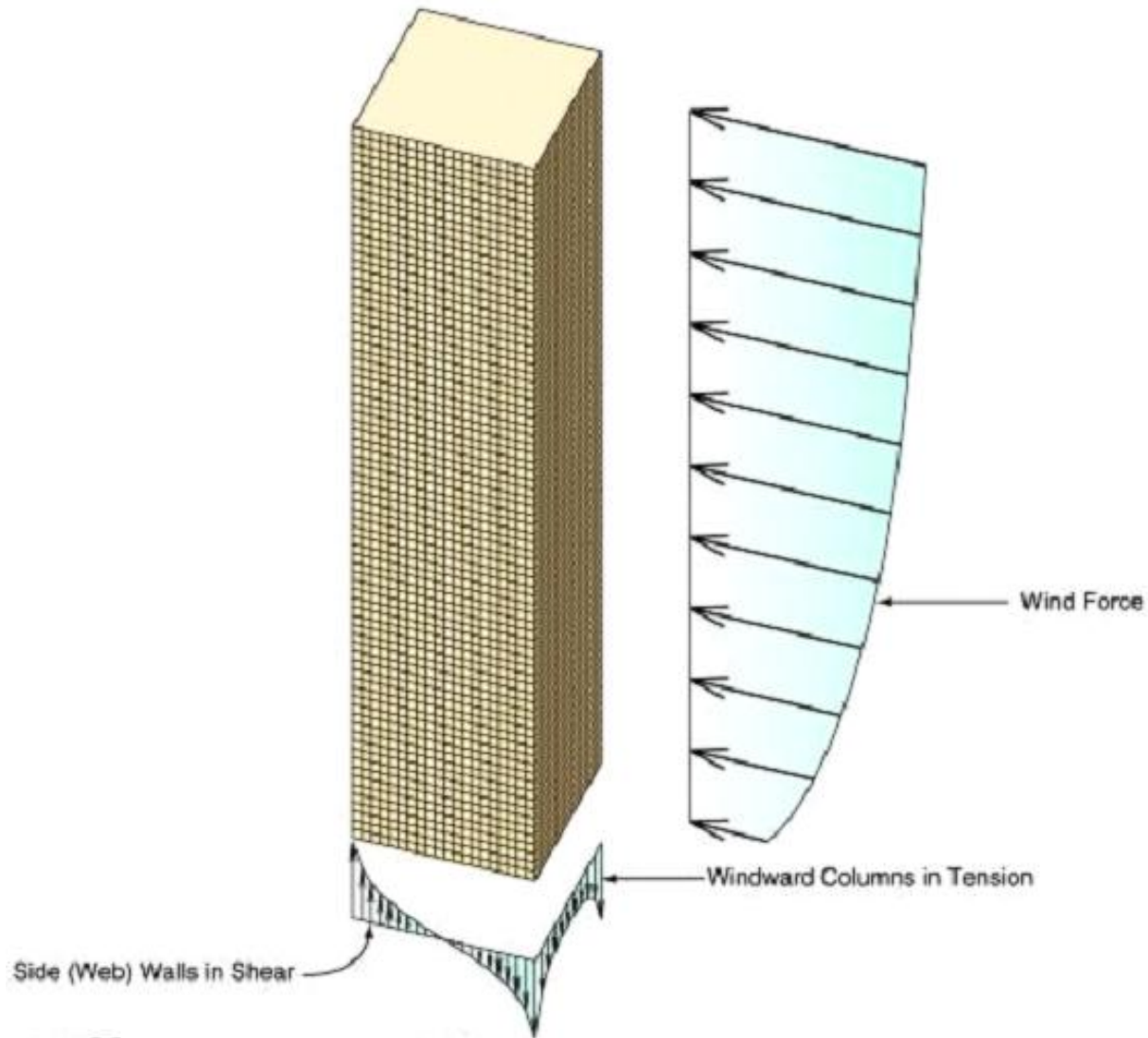
RE: excerpt from: ENR



Core Column/s

“...With each floor constructed level, there will be no differential shortening of columns and hence no floor slope at the top. The largest differential shortening will occur about 0.6 of the way up the building and be about 6 inches. Even this smaller floor slope, however, is objectionable. To eliminate the undesirable floor warpage, WSHJ decided to design all the columns in each story for the same unit stress under gravity loads. The excess capacity of the exterior columns, then, can be used to resist moments and shears due to hurricane winds.”

RE: excerpt from: *ENR*



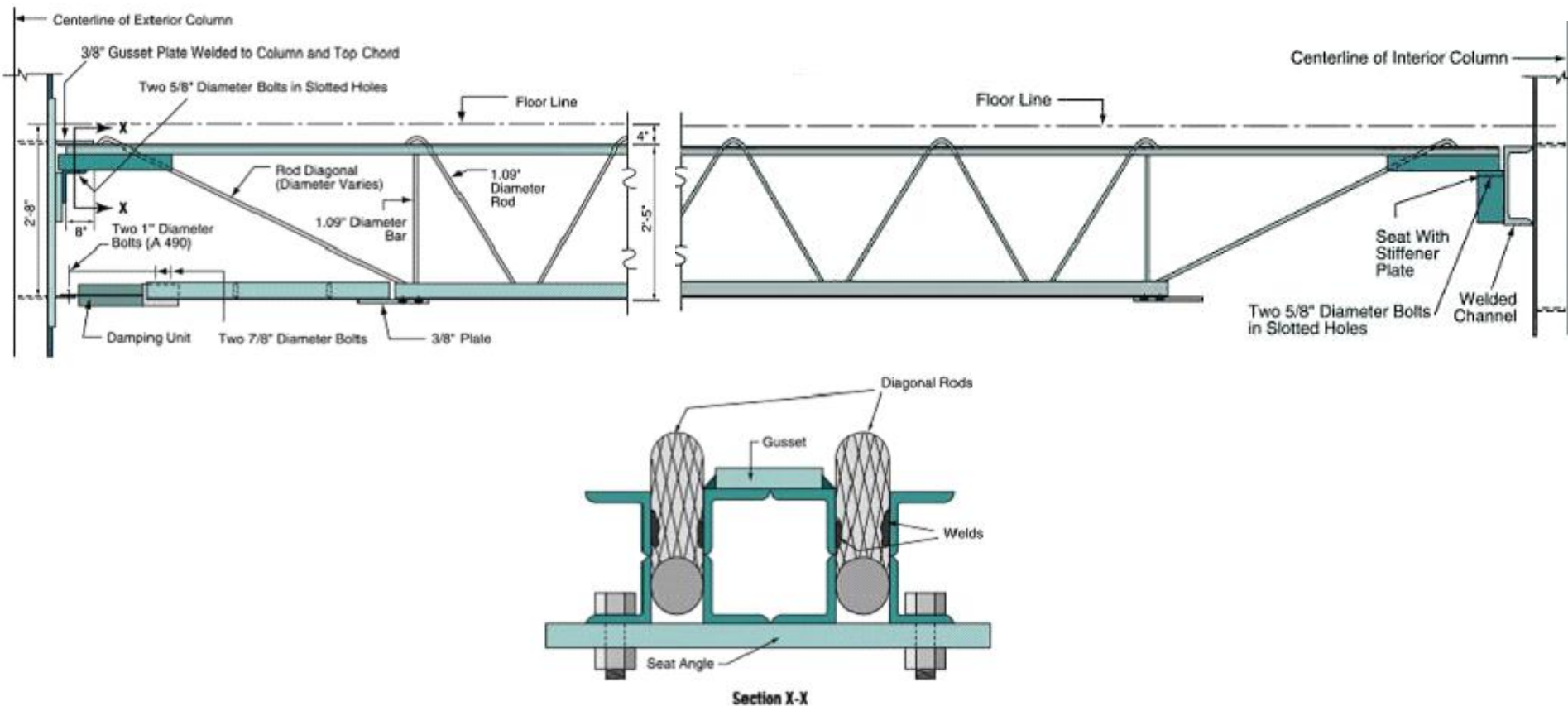
Behavior of a Structural Tube Frame (to Dynamic Wind Force/s)

“During the design phase, engineers in Oregon lured people into a trailer behind an old car dealership with promises of a free eye exam. To test motion tolerance, the trailer was rigged with springs that made it sway. Meanwhile in New York, an office dangling from a cable was placed in an air shaft of the Lincoln Tunnel to see how people would react. It seemed they had a high tolerance; they wouldn’t notice up to eleven inches of sway.”

RE: excerpt from: *102 Minutes*

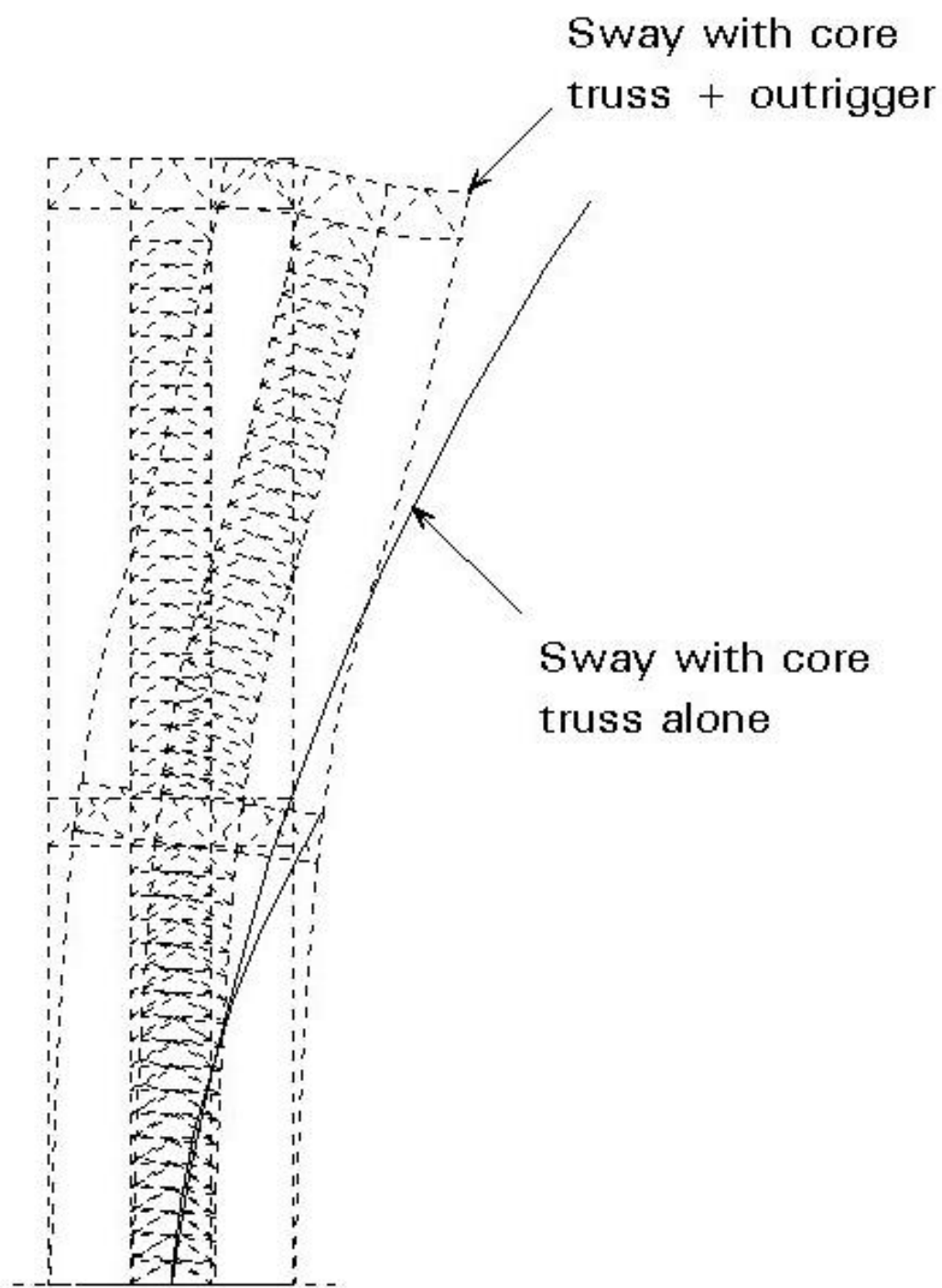
“On gusty days, the closer to the 110th floor one got, the more palpable the sensation of swaying became. The towers had so much give that when the wind velocity was high, the outer elevators knocked against their shafts; once, during a particularly violent storm, they seized up altogether. Under high-wind conditions, only the elevators closest to the core operated and they had to run at half-speed. When the wind hit the towers at certain angles, a remarkable range of pitches emanated from what became, in effect, a set of immense panpipes.”

RE: excerpt from: *102 Minutes*

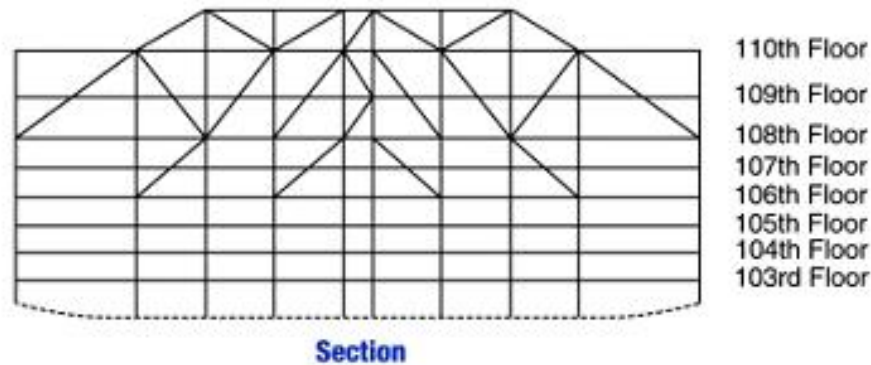
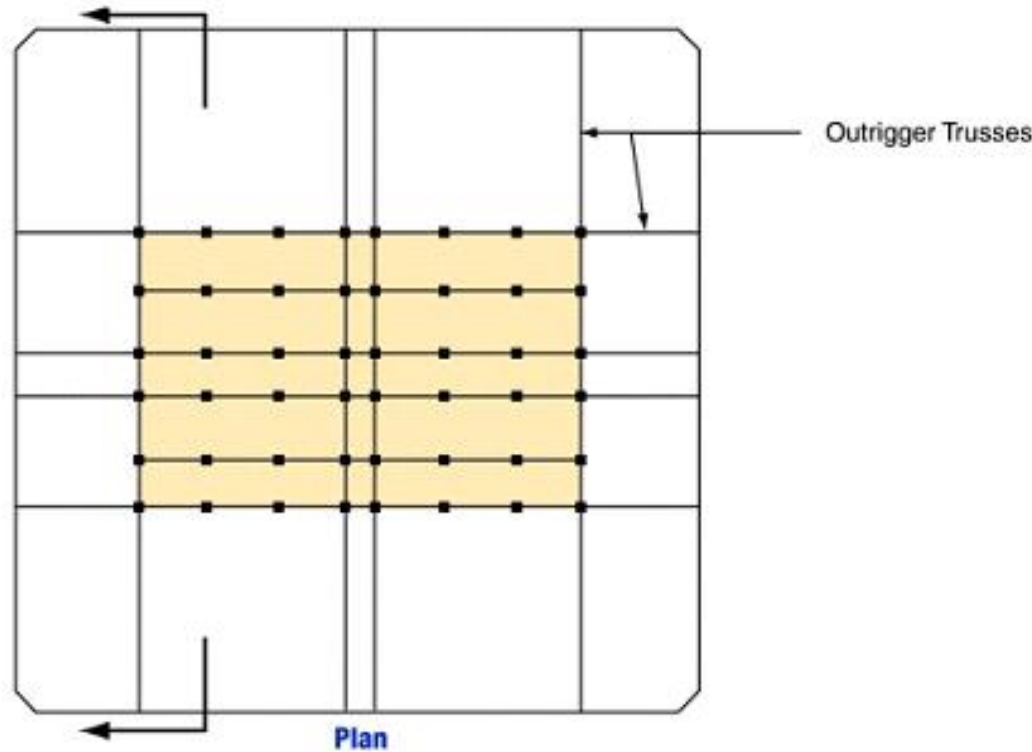


**Typical Truss Top-Chord Connection/s
To Column/Spandrel (left) and to the Core Column (right)
(NOTE: wind-sway damping unit at column/spandrel)**

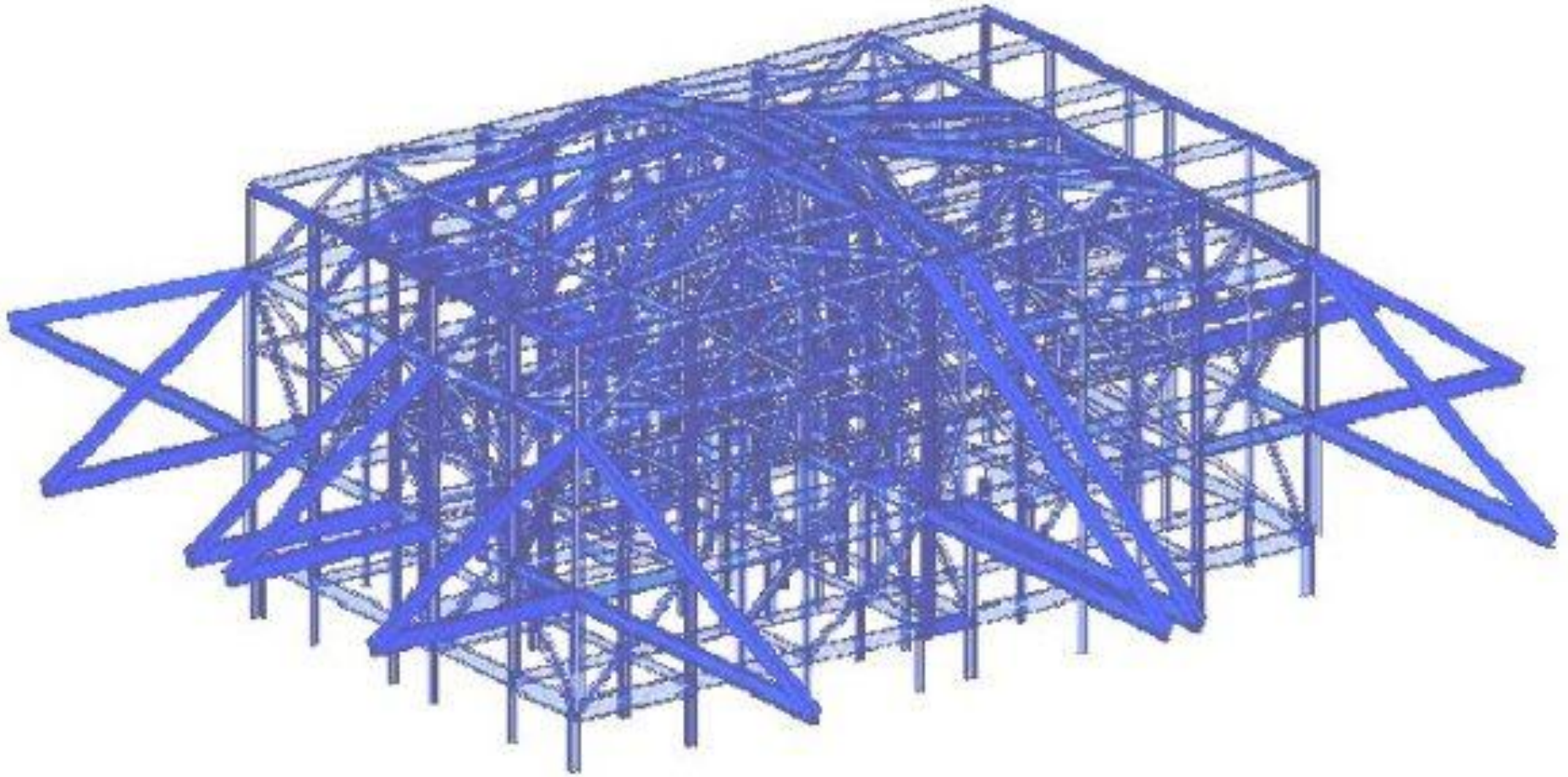
Hat Truss



Between the 107th floor and the roof, a latticework of large, horizontal and diagonal I-beams known as an “Outrigger Truss” (a.k.a. “Hat Truss”) tied the core to the perimeter wall/s thus unifying and strengthening the entire structure. The additional core strengthening was necessary to support the weight of the north tower’s TV antenna, but was applied to the south tower as well. This truss system stiffened the frame for wind resistance and provided stability against wind-induced overturning.



The Hat/Outrigger Truss connected core columns to each other, and connected the core to the perimeter walls. Most of the beams connected core columns to each other thus increasing the strength of the core significantly. A set of sixteen horizontal and sloping beams spanned the distance between the core and perimeter walls. Eight of these, the outrigger trusses, connected the corners of the core to the perimeter walls, while another eight connected the centers of the core's periphery to the perimeter walls. A total of ten outrigger truss lines were present in each building; six extending across the long direction of the core and four extending across the short direction of the core.



Hat/Outrigger Truss Isometric



Hat/Outrigger Truss Diagonals

“The structural design of the towers placed the most weight at the bottom; 60% of the tonnage of the entire tower was concentrated in just the first fifteen floors, from the grillages six stories below ground up to the treetops at the ninth floor. The rest of the tower – all 100 floors, had only 40% of the load-bearing weight. The bottom fifteen floors averaged 4,000-tons per floor compared to just 400-tons per floor the rest of the way up.”

RE: excerpt from: *102 Minutes*



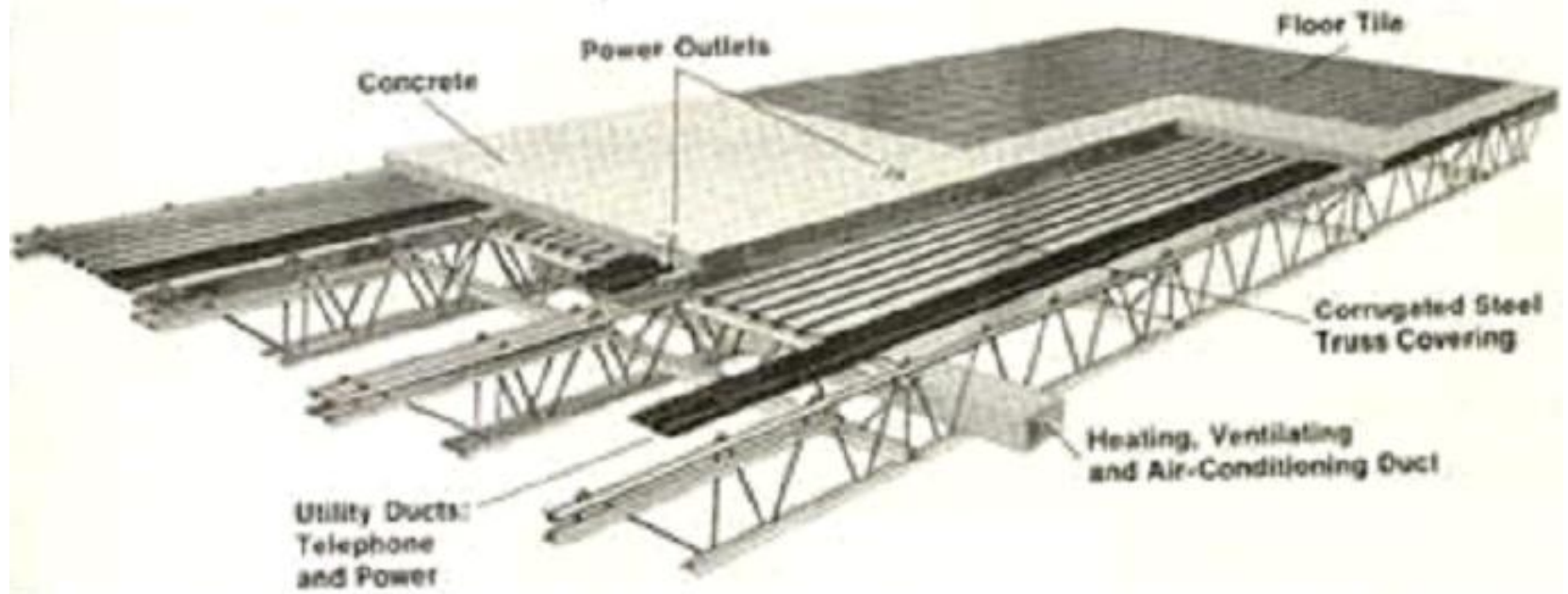
“My responsibility was to conceive and direct the various research activities. The robustness and stamina of the buildings is my responsibility. All the drawings have my name on them.”

**Leslie Robertson – WTC
Structural Engineer**

One Man's Ceiling is Another Man's Floor

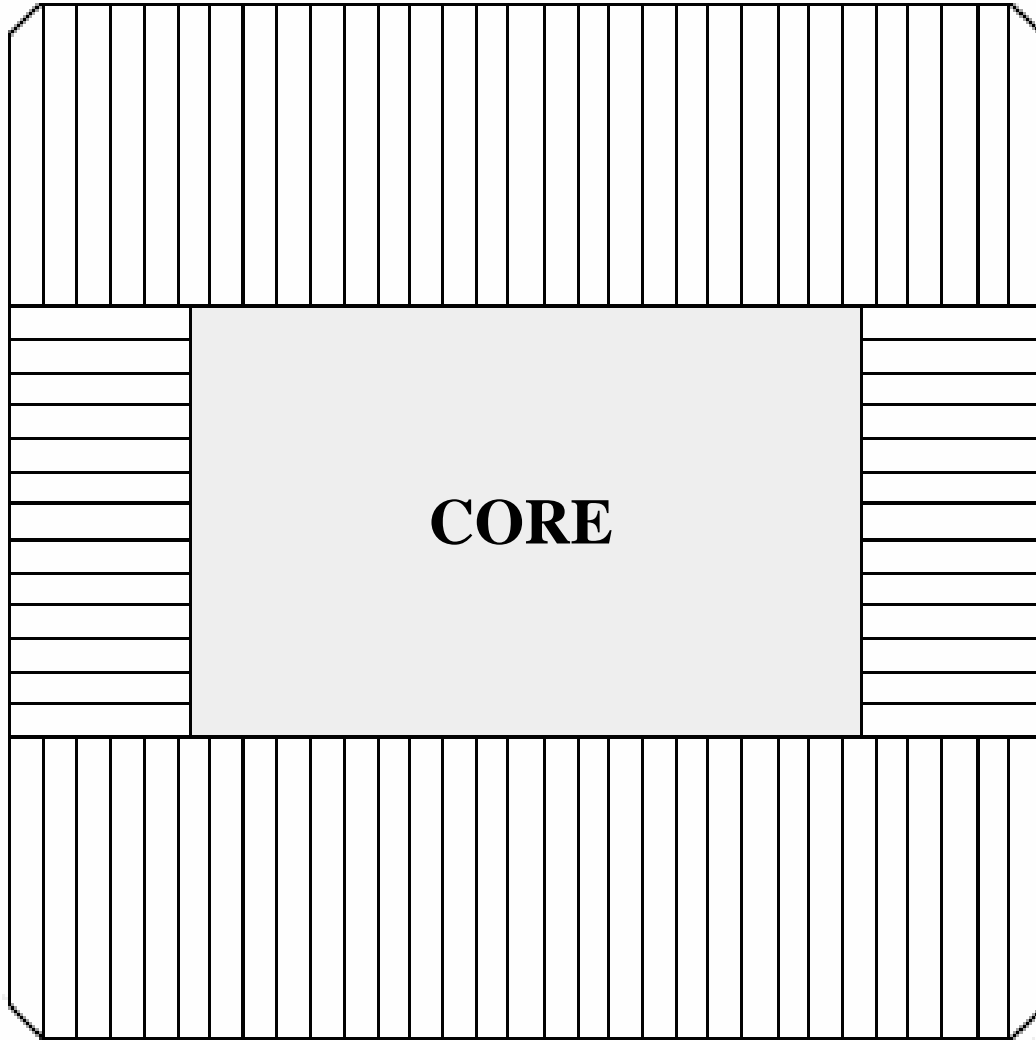
“In a typical floor, open-web steel floor-beams generally will span from exterior to core columns, to provide column-free space at about the same cost as short-span conventional framing. Two or more beams will be pre-assembled with steel decking and erected as a unit, to save erection time. This floor system will be a space structure, with all elements, including the lightweight concrete floor slabs, participating in carrying loads. Its three dimensional behavior will permit large concentrated loads, such as law libraries, file rooms and safes, without requiring the usual strengthening of existing areas. And the open grid permits passage of ducts and piping, thus keeping story heights down without sacrificing stiffness in the floor system. Clear span of the floor-beams is as much as sixty feet. They will be fabricated of high-strength low-alloy steels.”

RE: excerpt from: ENR



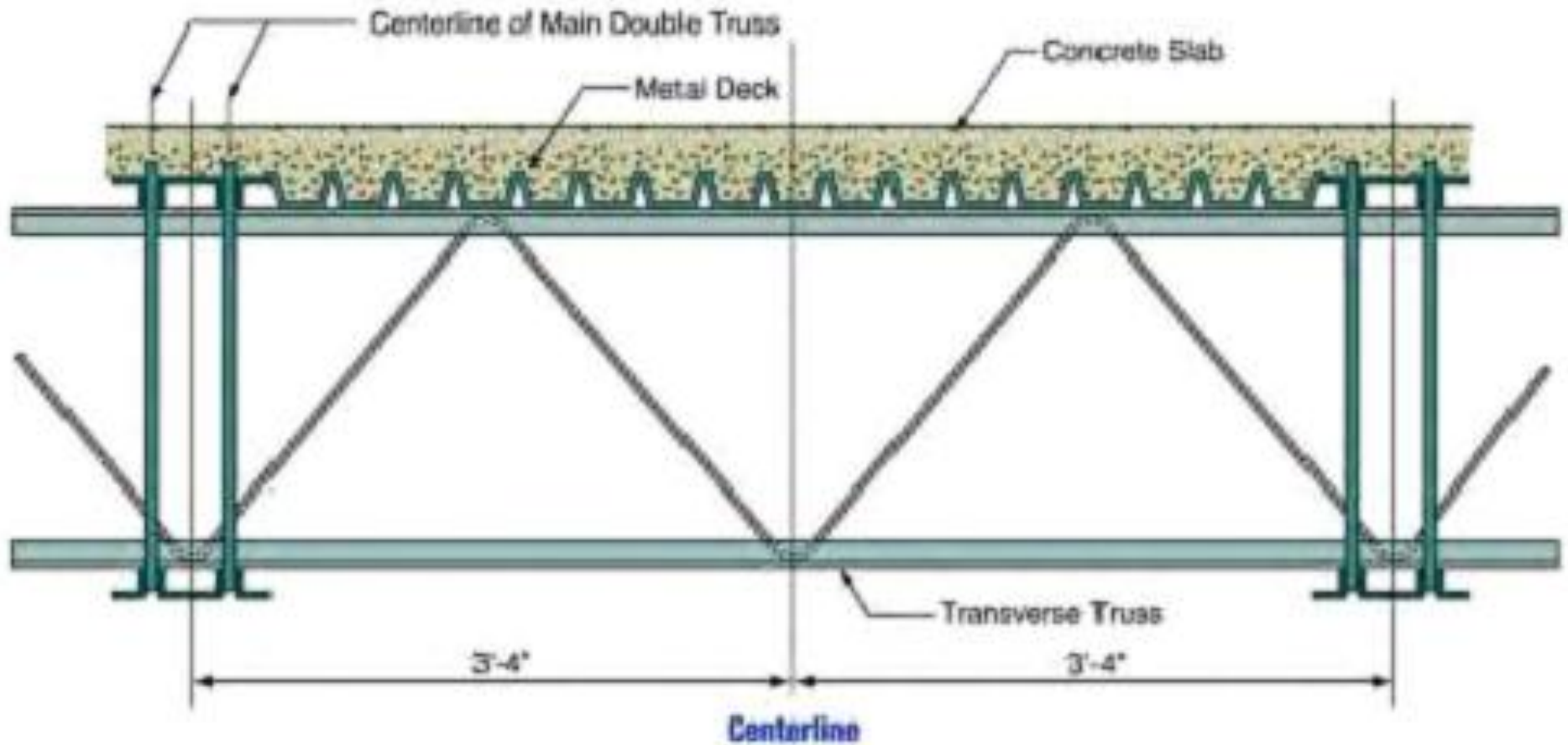
“The floors were giant pre-fabricated sections of decking in which telephone jacks, power outlets, trays for phone and electrical power lines and HVAC ducts all came in one neat package. Each twenty-foot wide panel consisted of six supporting bar joists designed to bear the load of the floor decks and hold their duct and utility work. The joists were nearly three-feet deep and were welded to corrugated steel decks. Floor sections were either sixty or thirty-three feet long, depending on where they were located in the towers, and their width varied between ten and twenty feet. They were designed to extend from the building’s core to its outer wall providing it with lateral support. After the decks were bolted to the wall panels and the core columns, a four-inch layer of concrete was poured over them to be followed by a finish floor above and a suspended ceiling below.”

RE: excerpt from: 102 Minutes



Pre-Fab Floor Deck Plan
(typical tower floor)

Typical floor construction consisted of four-inches of lightweight concrete over 1&1/2-inch by 22-gauge non-composite steel deck (in the core area slab thickness was five-inches overall). The floor system design was atypical of open-web-bar-joist floor systems. It was well braced with transverse members and considerably more redundant. Trusses were placed in pairs, with a spacing of six-feet, eight-inches and spans of approximately sixty-feet (to the sides) and thirty-three feet (at the ends) of the central core. The metal deck spanned parallel to the main trusses and was directly supported by continuous transverse bridging trusses spaced at thirteen-feet, four-inches and intermediate deck support angles spaced at six-feet, eight-inches from the transverse trusses. This combination enabled the floor system to act as a grillage to distribute load to the various columns.



**Cross-Section Through Main Double-Trusses
(showing Transverse Truss)**





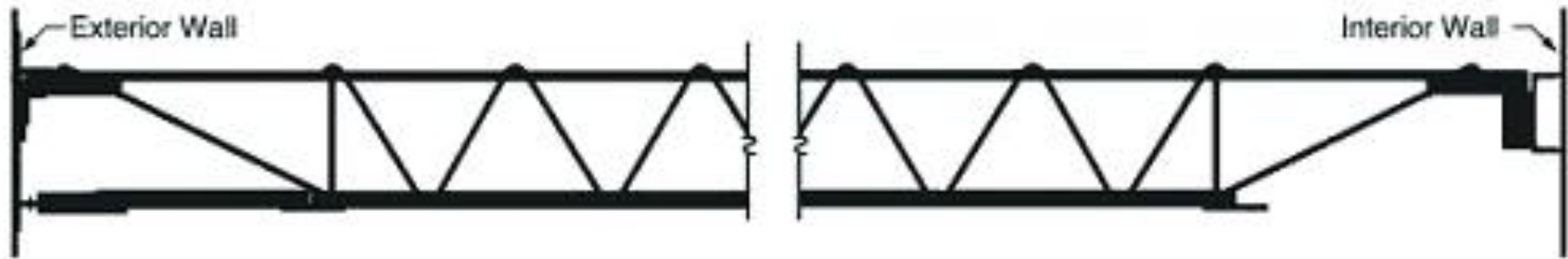




Each sixty-foot span of double truss had about fifteen pairs of “shear studs” (each pair of studs separated by forty-inches). Each thirty-three foot span of double truss had about eight pairs of shear studs.



“Engineers and architects working for the PA in the 1960s did not know if the innovative floors proposed for the towers; lightweight webbed trusses known as Bar Joists, would survive a fire. No one had experience in fireproofing the bar joists with a spray-on mixture of mineral fibers and adhesive at the time. Both the architect and structural engineer for the WTC refused to vouch for the ability of the floors to withstand fire. The PA has no records of any tests to determine if the bar joists were adequately protected – an assurance the NYC code requires. This despite the fact that the PA had announced it would ‘meet or exceed’ NYC’s building code requirements.”

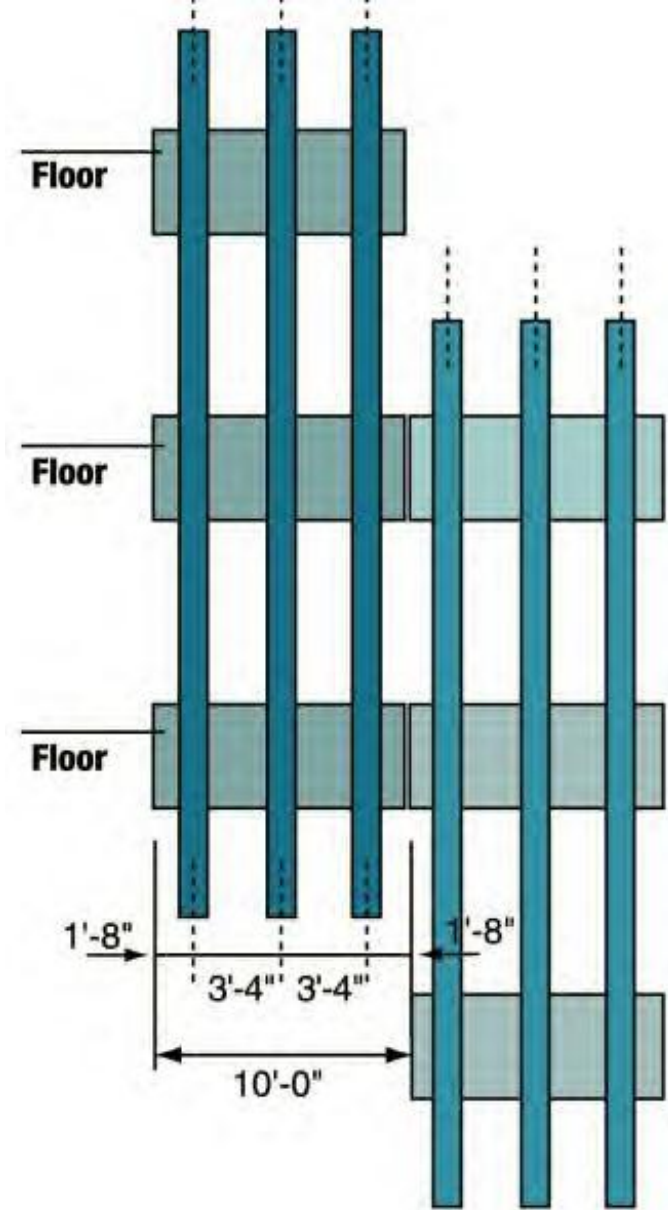
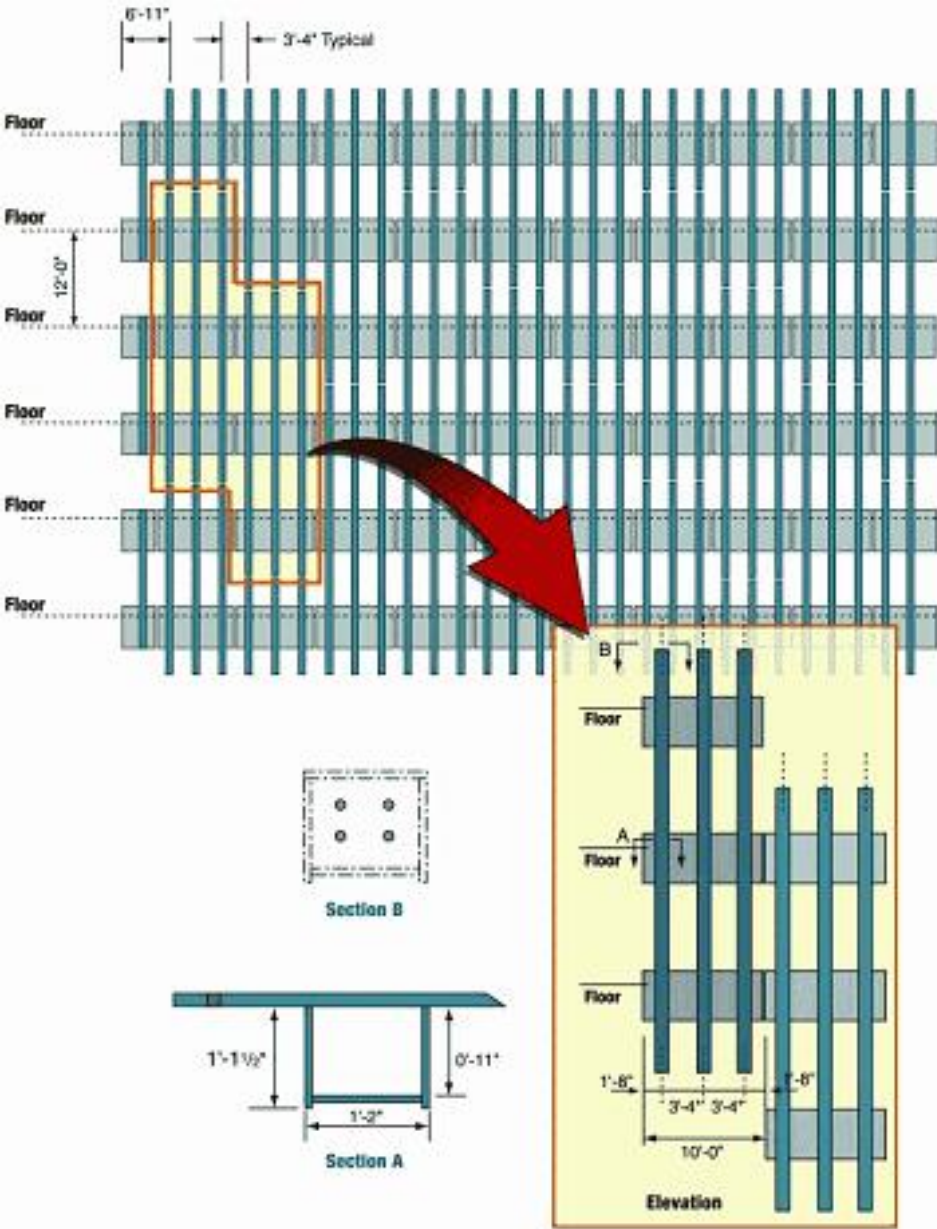


Structural elements such as floor trusses and beams received a coating of SFRM (*Sprayed Fire-Resistant Materials*). Core columns were protected from fire with fire-rated gypsum assemblies alone and/or with a combination of gypsum board and SFRM. Perimeter columns were fire-rated using *vermiculite plaster* on the interior face and SFRM on the other three faces. In April of 1970, the *New York City Department of Air Resources* ordered a halt to the spraying of SFRMs containing asbestos.

Vierendeel Trusses

“The exterior walls will comprise giant Vierendeel trusses, designed to act like huge cantilevered hollow tubes. They will be pre-assembled in units two-stories high and about ten-feet wide, spliced at mid-height of the columns and mid-span of the deep spandrel beams. The closely spaced columns will consist of fourteen-inch-square hollow box sections, providing high-torsional and bending resistance.”

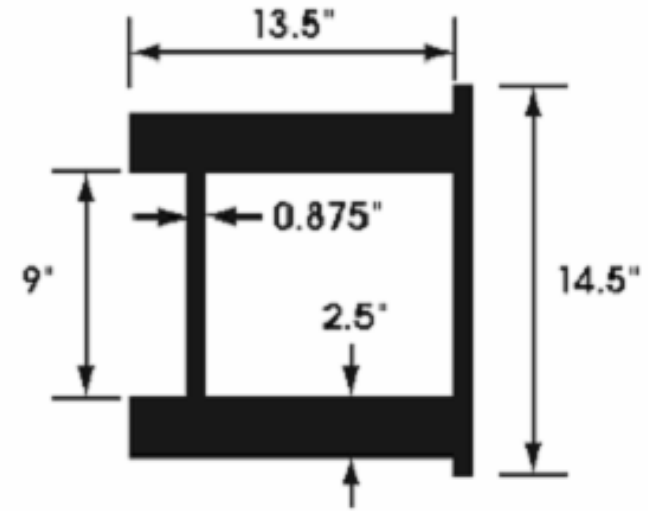
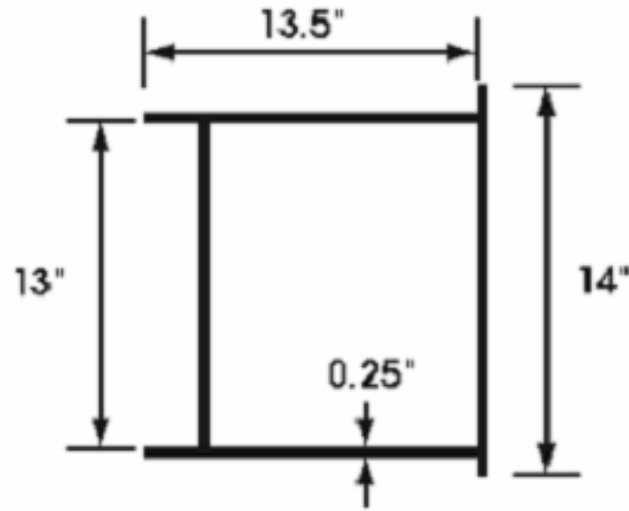
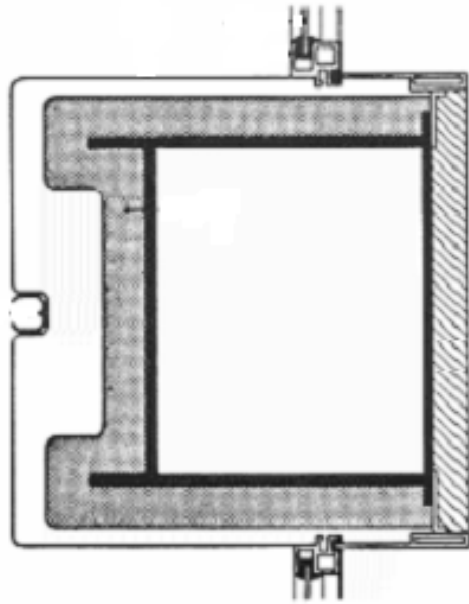
RE: excerpt from: *ENR. Vierendeel Action* occurs in rigid trusses that do not have diagonals. In such structures, stiffness is achieved through the flexural (bending) strength of the connected members. In the lower seven stories of the towers, where there were fewer columns, vertical diagonal braces were in place at the building core/s to provide this requisite stiffness.



**Partial Elevation of Interior Bearing-Wall Frame
(showing Exterior Wall Module Construction)**

“Exterior columns will be spaced thirty-nine inches center-to-center. Made of various high-strength steels, they will be fourteen-inch square hollow-box sections, for high torsional and bending resistance, and windows will be set between them. Spandrels welded to the columns at each floor will convert the exterior walls into giant Vierendeel trusses. Interior columns are all in or around the elevator-stairway core. Thus, the office areas are free of columns. All the core columns will be made of A36 steel (36,000psi yield point). As a result, corner columns at the base of the core may be solid steel as large as 2 x 8-feet in section.”

RE: excerpt from: ENR



Horizontal Section Through External Column/s
(at left: ext. cladding, window frame connection and fireproofing)

The World's Biggest Aluminum Siding Job

“In addition, officials awarded a \$210,000 - \$250,000 contract to the Aluminum Company of America, Pittsburgh, Pa., to fabricate and erect the towers’ aluminum curtain walls. Alcoa will assign the work to Cupples Products Corp., St. Louis. The contract includes 43,600 windows with 620,000 square-feet of glass and vermiculite plaster fireproofing on the interior face...”

RE: excerpt from: *ENR*

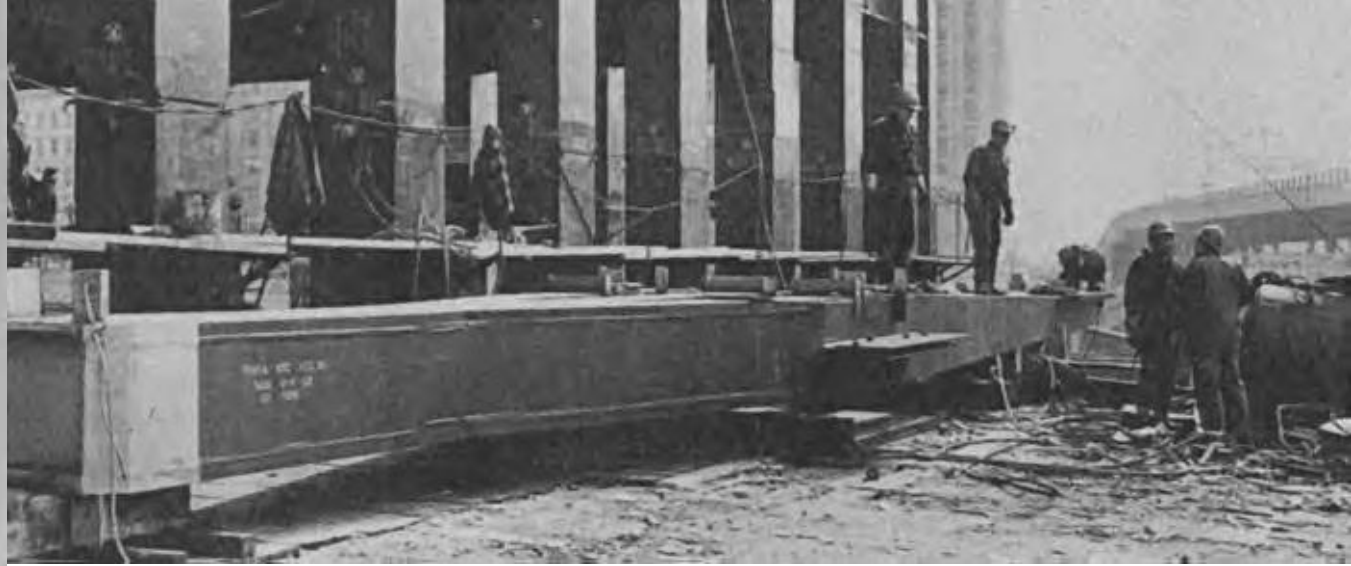
“...But of all the components, none will be more conspicuous than the 43,600 aluminum curtain wall panels that cover the exterior structural steel and support more than 43,000 narrow, bronzed-glass windows. The column covers, which are the major part of the wall system, are U-shaped, twelve-inches deep, eighteen-inches wide, and for the most part twelve-feet long. They are made of 0.09-inch thick anodized aluminum sheets and weigh about 100-lbs. each. Each consists of four parts: the main sheet, two jamb pieces (which take the glass and the horizontal spandrel covers) and a stainless steel track that will accommodate an automatic window washing machine capable of cleaning and drying seven floors of windows per minute...The entire wall covering system is designed for pressure equalization, mainly to prevent water from being drawn in through joints in the covers into the interior of the walls. To accomplish this, every vertical panel has a horizontal baffle at the top and every tenth spandrel cover has a vertical baffle...”

RE: excerpt from: ENR



“...There are also some almost unnoticeable, atypical cover sections at the ninth floor and at the mechanical floors. The most spectacular of the atypical sections, though, are the huge, three-tined tree covers that encase the lower floors. These are up to seventy-two feet high, ten-feet wide at the top and weigh about 3,500 lbs. each...”

RE: excerpt from: *ENR*



**“Tree” Column Awaiting Hoisting
(above)**

Hoisting Tree Column

(to Atop 5th Floor Column, left)

**Each Tree Column was fifty-one feet
long and weighed up to fifty-one tons**

“...A \$21-million contract covers the supplying and installing of the curtain wall system, which includes about nine million pounds of aluminum castings, extrusions and sheets. The contract includes fireproofing of the exterior columns and the installation of about 620,000 square-feet of bronze-tinted glass. Aluminum Company of America (Alcoa) supplies all the aluminum, including the 2.2 million square-feet of sheet needed for the column covers, and is fabricating the special castings that hold the panels in place. The panels, however, are being fabricated in St. Louis, Mo., by the Cupples Products Division of the H.H. Robinson Company...A major problem facing the contractors at the outset of the job was development of a safe and fast way to attach the column covers to the structural steel. Cupples solved this by designing a three-piece, die-cast mounting assembly. Two of the pieces are left and right aligning pins that are welded to the top of each column cover during fabrication. The third unit is a column cover anchor that bolts to the outside of the structural steel spandrel just above floor level to hold the covers...”

RE: excerpt from: ENR

“...liner adapters are welded to the columns...also serve as guides for the fireproofing, which must be applied with unusual precision. If the fireproofing extends outward too far it will interfere with the placement of the column covers. If it is too thin it will not be in contact with cover baffles and will at least partially negate the effectiveness of the pressure equalization system. It will also fail in one of its primary functions, that of providing a thermal factor needed to control column temperature. By design, the temperature of the structural steel columns is limited to a minimum of 50 F with an interior temperature averaging 70 F and an outside temperature of 0 F. So the fireproofing is important. It has also been troublesome. Some of the material applied last winter froze and spalled off with the first thaw. This called for the removal of several floors of column covers and the reapplication of the fireproofing. The time lost from this was not as great as it might have been, however, because it came at a time when New York City banned use of fireproofing containing asbestos and forced contractors and suppliers to find other materials.”

RE: excerpt from: ENR

Subway in the Sky

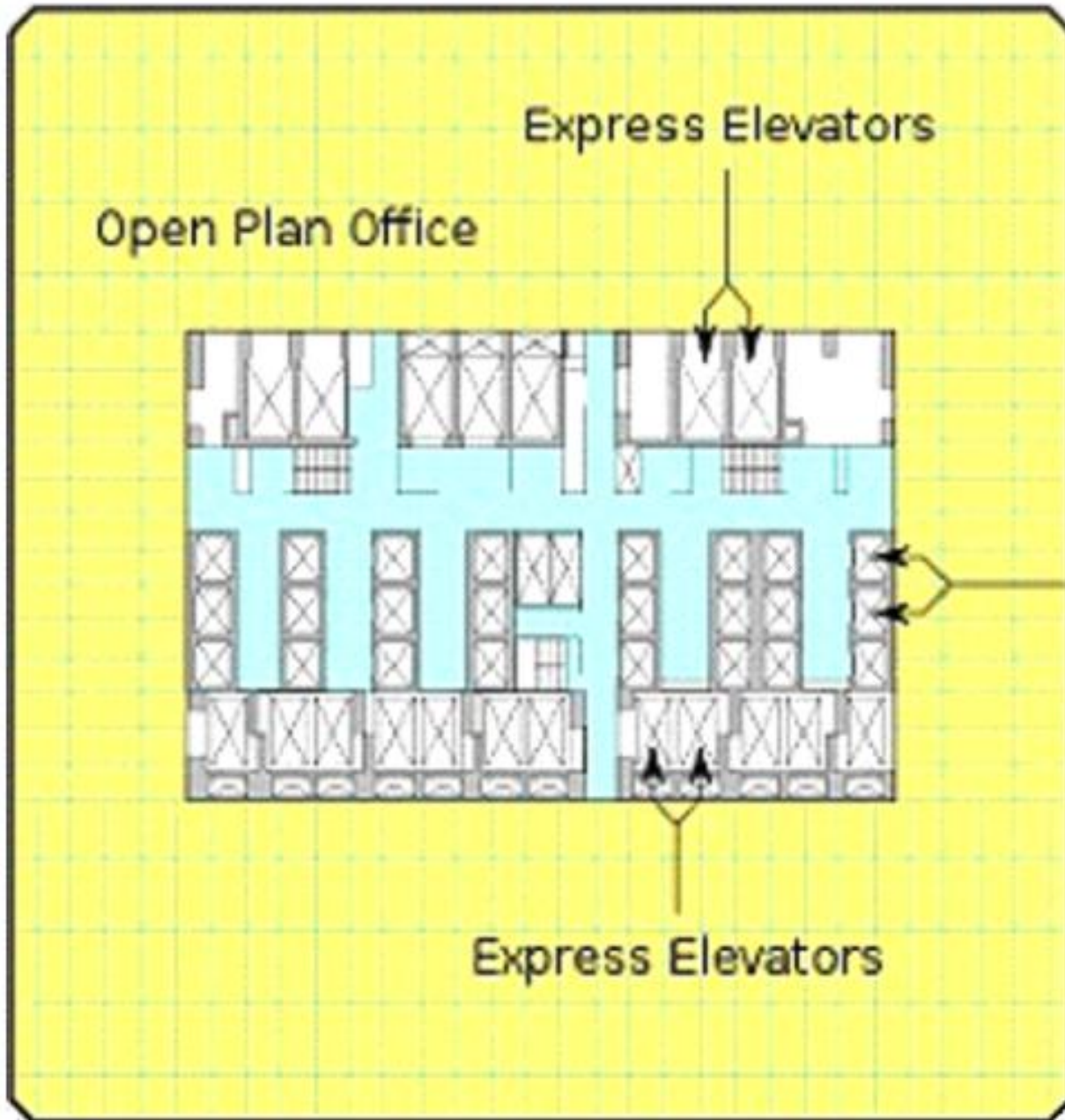
“Say you take the Eighth Avenue subway downtown and you want to go to 50th Street. Well, you go from 125th Street to 59th Street, then you get off and cross the platform to another train that takes you to the local stop at 50th Street.”

Herb Tessler, PA Architect

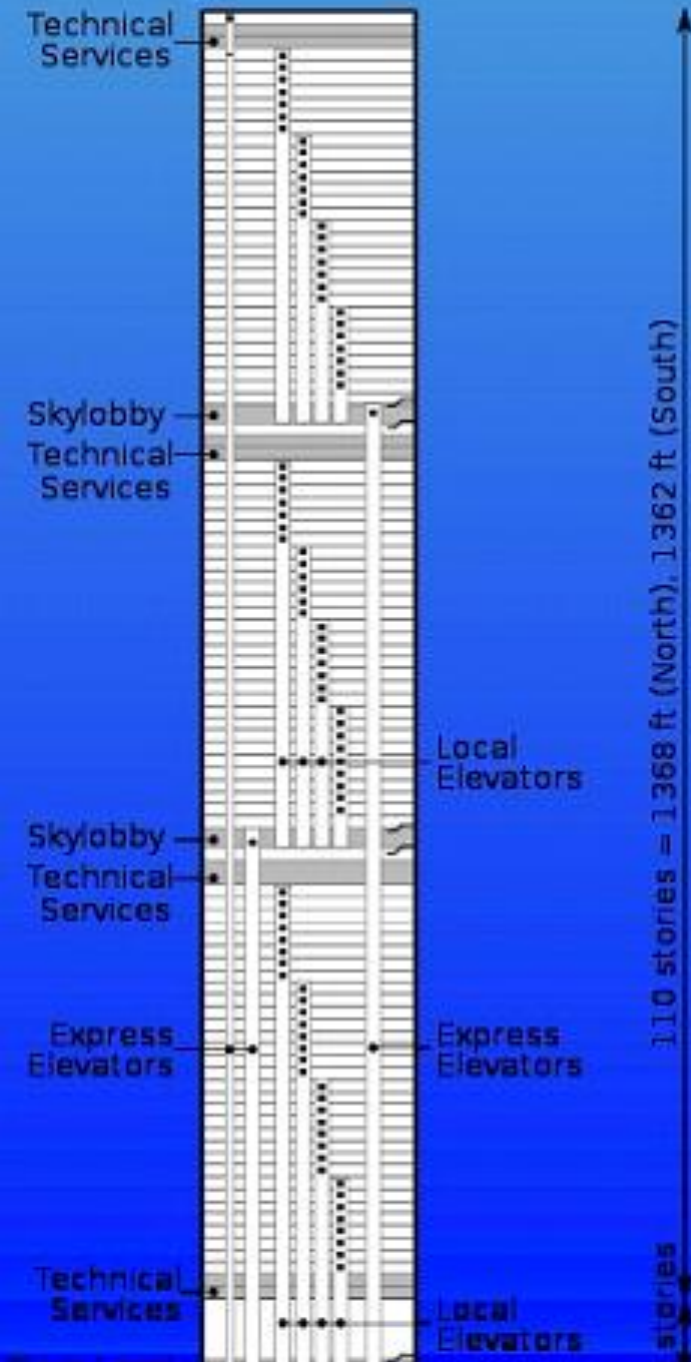
RE: his idea to divide each tower into three “zones” having express and local elevator service within each – akin to the local & express service on NYC’s subway system

“Each tower is 209 x 209 feet in plan and is column-free between the exterior walls and the 79 x 139-foot core, thus providing thirty-five feet clear spans on the east and west sides and sixty-five foot clear spans on north and south sides. In addition to the usual service and utility rooms, the core of each tower will contain 104 elevator cabs running in thirty-six shafts. This unusual arrangement is made possible by the use of twenty-three shuttle express elevators which will discharge passengers into so-called sky-lobbies where they transfer to local elevators. As a result, as many as three elevator cabs will use a single shaft...Elevators will be the world’s fastest, at 1,700 feet per minute, and have by far the largest high-speed cabs ever installed ”

RE: excerpt from: ENR

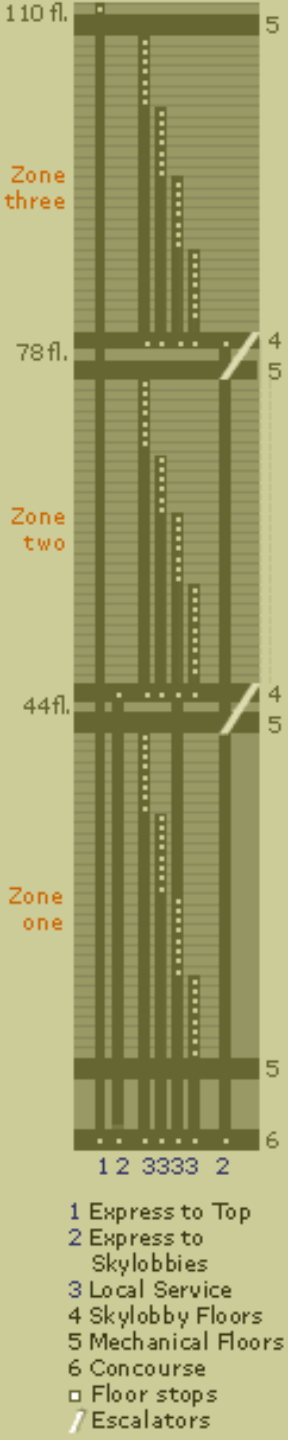


**Local
Elevators**



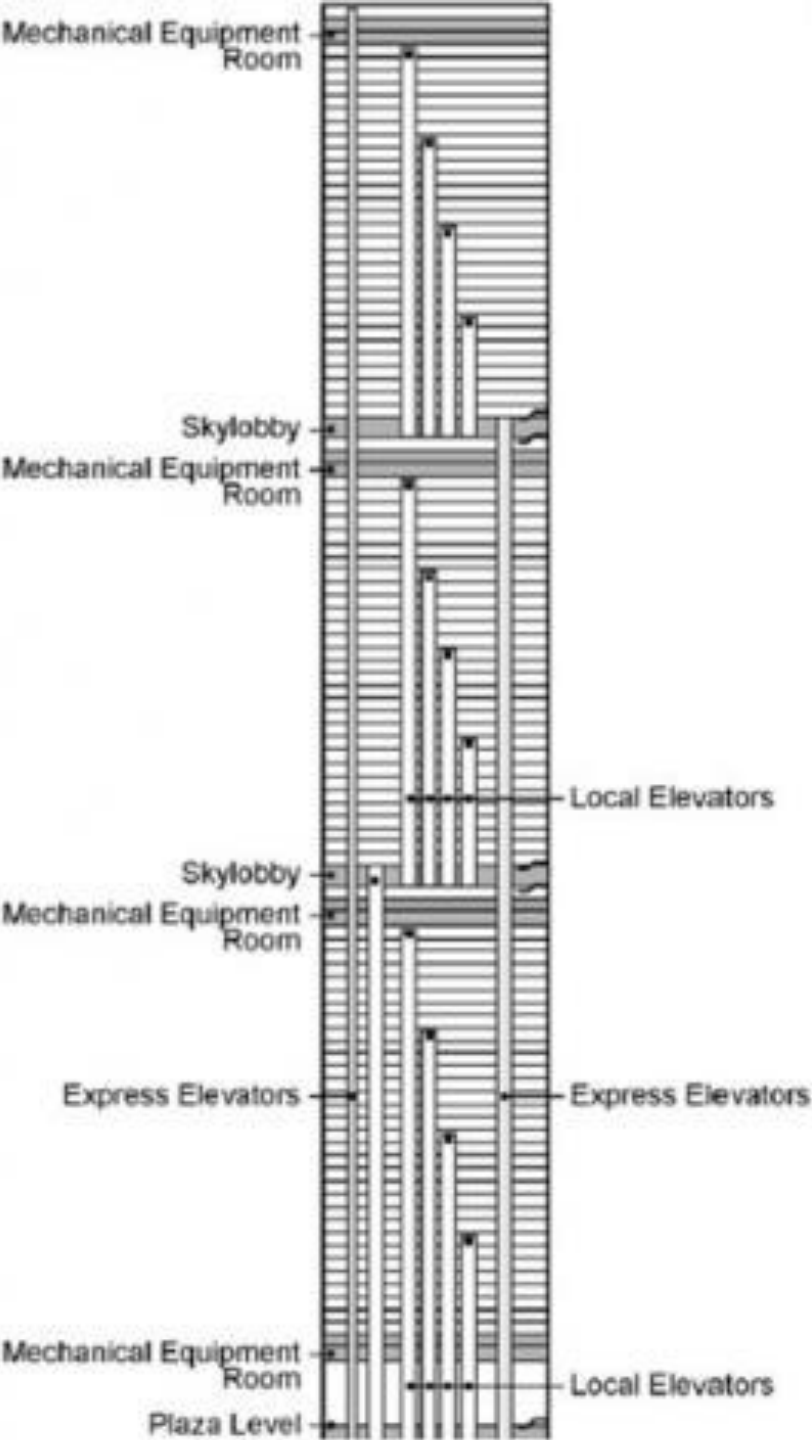
“The elevators would be huge, the largest ever made - capable of holding as many people as a subway car. The twelve local elevators interfaced with the express elevators at two Sky Lobbies. Rather than requiring twelve individual shafts, the twelve local elevators shared four shafts within the three vertical ‘zones’ of each tower. This configuration eliminated the problem of losing too much floor space to elevator shafts in such a tall building.”

RE: excerpt from: *102 Minutes*



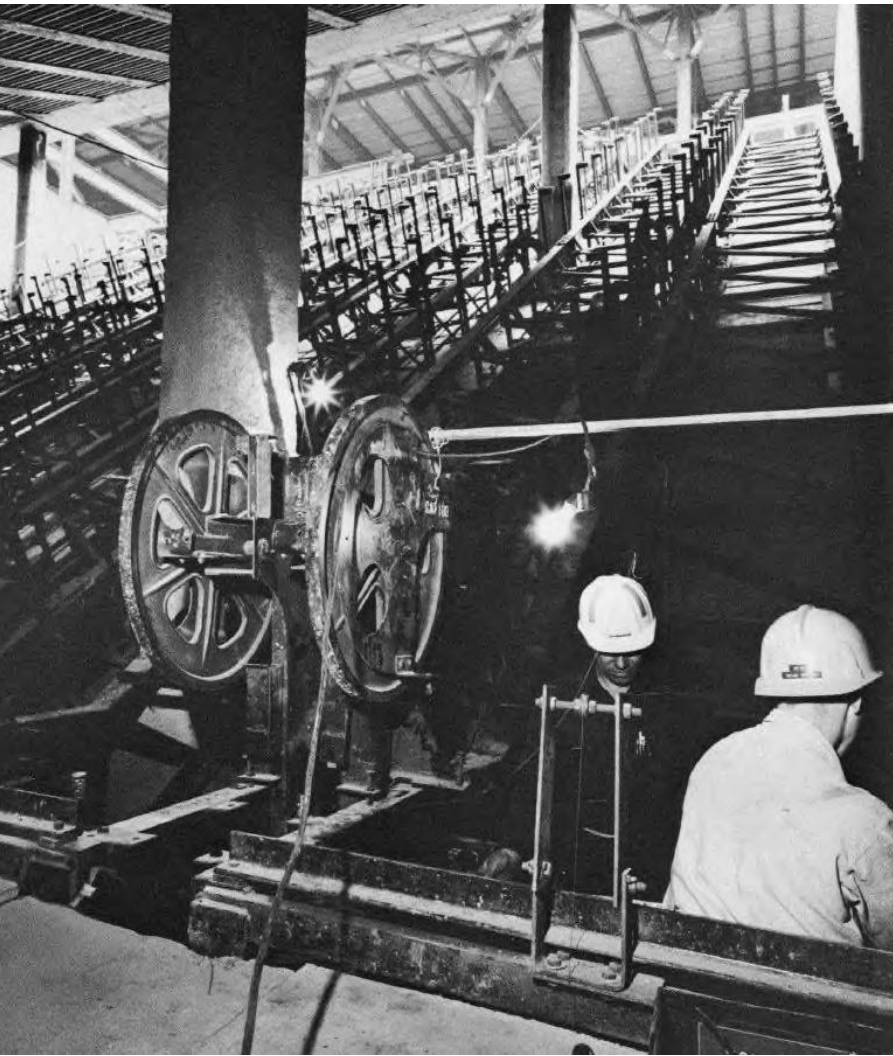
“Each tower was divided into three zones: up to the 44th floor; up to the 78th floor; up to the 110th floor. Banks of express elevators with each car able to hold fifty-five people ran directly to the staging points on floors 44 & 78; the Skylobbies. There, the passengers could catch shuttle elevators to the intermediate floors. A single passenger car in each building ran all the way from the bottom to the top, serving the restaurant in the north tower and the observatory in the south tower. In addition, a freight elevator also had a clear run from the ground to the top. In all, each tower had ninety-nine elevators.”

RE: excerpt from: 102 Minutes



“...The Trade Center will be served by 230 passenger elevators. The towers will incorporate an unusual elevator system to maintain a high ratio of rentable floor area to vertical-transportation area. Each tower building is divided into three zones, one above the other...Each zone will be served by twenty-four elevators, arranged in four banks of six each. But upper-zone elevators will not serve the ground floor. Instead, 55-passenger express elevators will speed at 1,700-feet per minute, from ground level to the 41st and 74th floors, where transfer lobbies will be provided. The lower ‘Sky Lobby’ will be served by eleven express elevators, the upper one by twelve.”

RE: excerpt from: ENR



“The Port Authority began taking bids on more than \$100 million worth of construction work. The first contract awarded was for \$35 million; for the largest contract in the history of the elevator industry, would be awarded to the Otis Elevator Company to design, manufacture and install 46 of the largest high-speed elevator cars ever built, plus 162 standard cars and 49 high-speed escalators, half of which were to serve the PATH station.”

RE: excerpt from: 102 Minutes

“Also included in the Trade Center will be a 250-room hotel and a new Manhattan terminal for the Port Authority Trans-Hudson system, the former Hudson and Manhattan Railroad. It carries over 28-million passengers a year between New Jersey and New York City. The new terminal will replace outmoded facilities nearby. Underground passageways will connect every subway system in lower Manhattan with a concourse beneath the Trade Center plaza. High-speed moving stairs will connect the air-conditioned concourse with street level.”

RE: excerpt from: *ENR*



“The Otis engineers found that the plan was a winner. It would leave 75% of the total floor area available for renting rather than the 50% that would have come with a conventional elevator system. It would even provide more elevators than was necessary to carry the 50,000 people who might work in or visit the towers each day. Not only could the Otis people engineer the express elevators to hold fifty-five people and 10,000 pounds, but they could design them so that there were doors on both sides, allowing the first passenger in to be the first out.”

RE: excerpt from: *102 Minutes*

Part 7

Codes & Consequences



“In April 1962, NYC Mayor Robert F. Wagner appointed the Brooklyn Polytechnic Institute to overhaul the 1938 code. The New York Building Congress, a trade organization of construction unions and real estate interests, paid \$200,000 towards the costs of the revisions for which it had long lobbied arguing for years that the 1938 code did not anticipate improvements in technology and materials that would allow for lighter-weight materials to serve just as well as the masonry prescribed by the 1938 code. Another part of the revision agenda was to reduce the amount of space required for building egress. The new code would quietly turn back some of the square footage the real estate industry had lost to the old code.”

RE: excerpt from: 102 Minutes

“The projected WTC is designed for use of materials and engineering principles which will be found in the proposed code. The fact that the PA is not bound by the requirements of the present NYC building code makes possible the savings involved. Our existing building code does protect the public safety and welfare but it most certainly does not allow for all the efficiency and economy that industry and enterprise find necessary...The proposed code more accurately evaluates the hazards and need for fire protection...The wall must withstand flames for a stated number of hours. The wall can be made of brick, specially treated wood or shredded wheat – so long as it can resist fire.”

Harold Burns – NYC Building Commissioner, 1965

RE: excerpts from a speech to the *New York Building Congress*

“Because the PA was a public corporation, it did not have to comply with local building laws. Even so, the PA decided in May of 1963 that the WTC would be built according to the 1938 NYC building code. Had that code been used, it is likely that a very different WTC would have been built. In fact, it is likely that no one at the PA expected the old code to be law when the work actually began.”

RE: excerpt from: 102 Minutes

“The new code significantly lowered the requirements for fire resistance in office buildings. The 1938 code required that columns be four-hour rated, the new code reduced that to three-hours. For floors, the 1938 code required three-hours, the new code two-hours.”

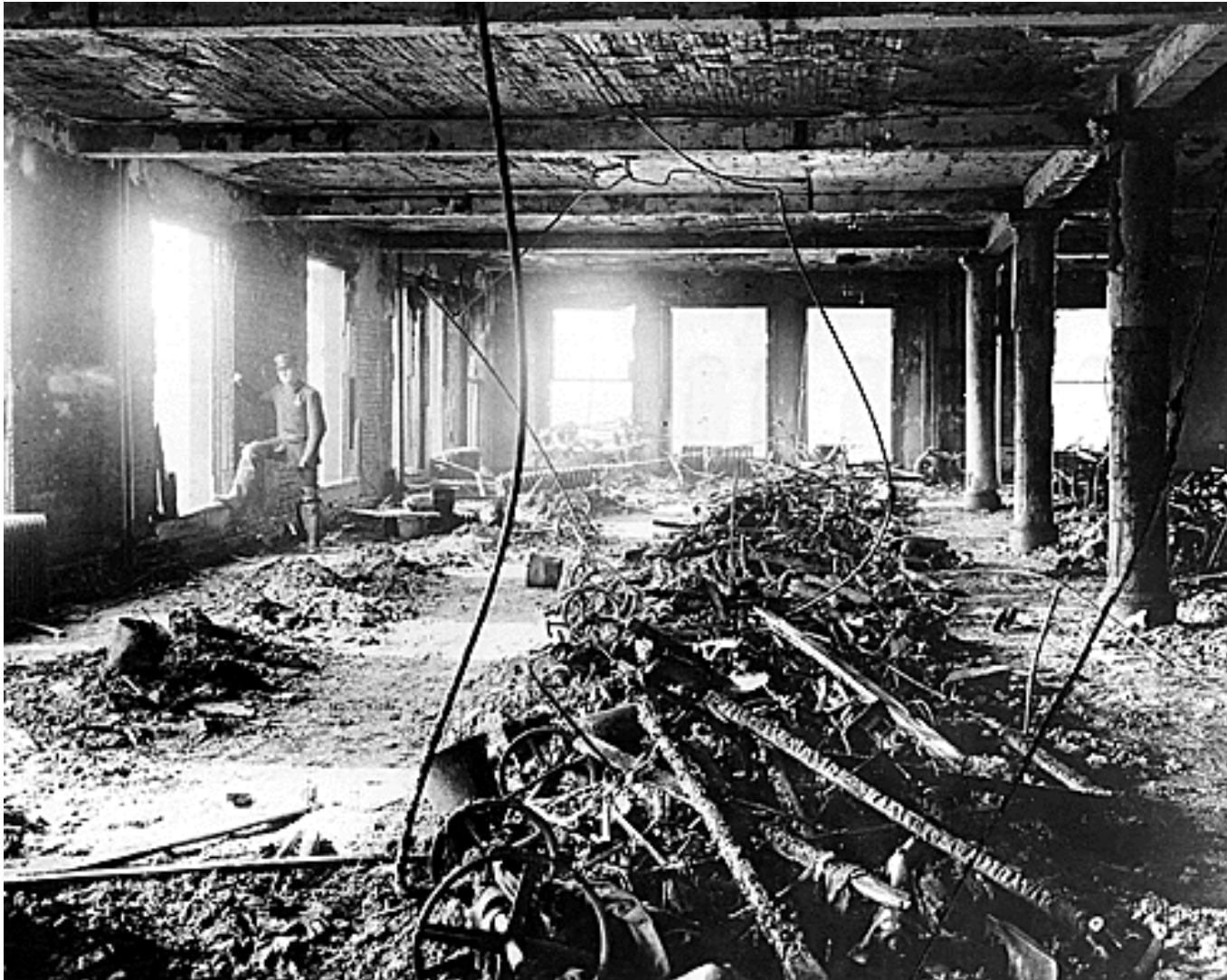
RE: excerpt from: *102 Minutes*



“The heavy-duty stairwells demanded for high-rise towers by the 1938 code served as psychic life rafts in the wake of disasters like the Triangle Shirtwaist Factory fire in 1911. Thirty years later, these structures were seen as artifacts of an earlier, more plodding age and the 1968 code eliminated the need for reinforced staircases and vestibules. Not only did the fire towers disappear, so did half the staircases. The 1968 code reduced the number of stairways required for buildings the size of the twin towers from six to three. As well, those three would require less protection since the new code lowered the minimum fire resistance for walls around the stair-shafts from three-hours to two.

363

RE: excerpt from: *102 Minutes*



**Aftermath of the Triangle Shirt-Waist Factory Fire
(the structure was fireproof, but not the contents)**



“The previous generation of skyscrapers in NYC were required to have at least one ‘fire tower’ – a masonry enclosed stairwell that was entered through a 107 square-foot vestibule. Upon entering the vestibule, any smoke that trailed in would be captured and vented out the top of the building. Then, to enter the stairway, occupants had to pass through a second doorway leading to the stairway itself and safe exit. Also, the 1938 code generally required that exits on each floor be ‘remote’ from each other. The new code – and real estate economics, encouraged the use of a single core in the center of the building housing all elements that did not directly produce rent revenues: elevators, shafts, toilets & stairs. The 1968 amended the term ‘remote’ in a small but significant way; each egress stair was to be ‘as remote from the others as practicable.’ Not until 1984 would the NYC building code require explicitly remote stairways in office buildings – too late for the WTC which opened over a decade earlier. The three stairways in each tower were all in a triangle, with no exit more than 45-feet away from another except where they took a detour to accommodate EMRs.”

RE: excerpt from: 102 Minutes



“After a November 1980 fire at the MGM Grand hotel in Las Vegas killed 87 people, many of them trapped by poorly designed exits, the FDNY seized the moment to fix a law it had long opposed. NYC set a new formula that doubled the required space between exits in tall buildings, but they did not take effect until 1984 and the law was not retroactive. To install new exits in existing buildings would be extremely difficult to do.”



Fire Trap

Sprinklers Urged for Trade Center

My MARY BREASTED
Fire Commissioner John T. O'Hagan said yesterday that he would make a vigorous effort to have a sprinkler system installed in the World Trade Center towers as a consequence of the fire that burned for three hours in one of them early yesterday morning.

The towers, each 110 stories tall and the highest structures in the city, are owned and operated by the Port Authority of New York and New Jersey, which is not subject to local safety codes.

As Commissioner O'Hagan stood in the sooty puddles of the North Tower's 11th-floor hallway, he told reporters that the fire would not have spread as far as it did if sprinklers had been installed there.

The fire spread throughout about half the offices of the floor and ignited the insulation of telephone cables in a cable shaft that runs vertically between floors. Commissioner O'Hagan said that the absence of fire-stopper material in gaps around the telephone cabinets had allowed the blaze to spread to other floors within the cable shaft. Inside the shaft, it spread down to the ninth floor and up to the 16th floor, but the blaze did not escape from the shaft out into rooms or hallways on the other floors.

The fire prevention and containment equipment now in the towers — comprising internal water pumps and smoke-detection systems — have long been considered inadequate by Commissioner O'Hagan. He said yesterday that he had attempted to persuade Port Authority officials that they must take additional fire-prevention measures in the towers and that about a month ago the officials promised him they would invest \$5-million in safety improvements.

A Port Authority spokesman said the installation of a sprinkler system would be extremely expensive and would inconvenience tenants. He said that on 60 floors in the South Tower, tenants working for state agencies are considering having a sprinkler system installed at their own expense.

The cause of the fire was still undetermined late yesterday, but fire marshals tentatively concluded it had started under a desk in a record storage room on the east side of the 11th floor.

A spokesman for the Port Authority said that the fire had caused about \$1-million in damages and that, as a result of it, nine concerns with offices on the 11th floor of the North Tower would be relocated within the Trade Center complex. Only the 11th-floor office area was burned, but extensive water damage occurred on the ninth and 10th floors, and smoke damage ascended as far as the 15th floor, the spokesman said.



The New York Times/Terrace Dubois
A Port Authority workman stringing temporary lighting wires inside storage and telephone switching room of R. J. Saunders, Inc., on eleventh floor of north tower of World Trade Center. Fire may have started here.

Although there were no direct casualties, 28 of the 150 firemen called to the scene suffered minor injuries. And one man who came to work this morning only to learn that his office had been burnt out apparently had a heart attack.

The man, Albert Ullman, an export specialist with R. J. Saunders, Inc., Customs house brokers and freight forwarders, was taken to Beekman Downtown Hospital, where he was pronounced dead on arrival.

Two City Councilmen have been working on a proposal for a home-rule measure that would ask the state Legislature to require the Port Authority and other state-chartered agencies to comply with local safety codes used in the burned south tower fire as an example shaft.

“Executives of the PA often boasted that the agency had voluntarily used the 1968 code in the construction of the towers, even though it was not required to do so because the PA was not bound by the laws of the two states that had created it. When it came to complying with Local Law 5, the PA was sporadic. The real estate industry had challenged the legality of the new requirements in court and not until the New York courts dismissed the case did the PA move to install sprinklers at the WTC, which are generally regarded by fire-safety experts as the most critical and costliest.”

RE: excerpt from: 102 Minutes



“Just as the Titanic was required by the British Board of Trade to have the same number of lifeboats as a ship one-quarter its size, the 1968 building code required the same number of exit stairways; three, for a building 75-feet tall as for one 1,350-feet high. In effect, a 110-story skyscraper had to provide no more capacity for safe egress than did a six-story building.”

RE: excerpt from: *102 Minutes*

“Modern, super-tall buildings have special ‘refuge’ elevators made of more durable construction to serve rescuers and the disabled during emergencies. In the late 1960’s, when the final details of the WTC were being worked out, no such elevators were called for.”

RE: excerpt from: *102 Minutes*

WINDOWS ON THE WORLD



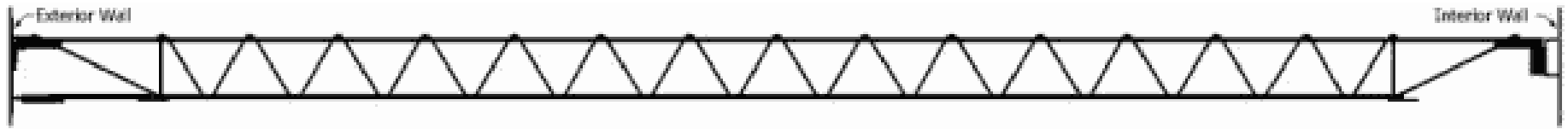
“The PA refused to permit natural gas lines in the building over concerns of what a fire supplied with such a potent fuel might do to the tower’s structure. Windows on the World relied on electricity rather than gas to cook with.”

RE: excerpt from: *102 Minutes*

373

Don't Trust the Truss

“Few people could have imagined that the fire-resistant system of two of the world’s tallest buildings had never undergone a trial by fire. As investigators reviewed how the towers were conceived and built, it turned out that no one had relied on any technical standards or done any tests to determine how long the Sray-On Fire Proofing could protect the floor system that connected the building’s core to the exterior. The thickness of the SOFP applied in two of the world’s tallest buildings seemed to have been based on little more than a hunch.



Not until the summer of 2004 was the SOFP tested by the National Institute of Standards & Technology. The results showed that the SOFP was sufficient to protect a 17-foot length of steel for two-hours, which met the requirement of the code at the time. But the towers had not been built using seventeen-foot lengths of steel; the actual pieces in the floor were at least 2x that length. When a thirty-five foot length of steel – the true size used in constructing the floors was tested in 2004, the federal investigators found that the SOFP could not provide the two hours of protection required by code.”

RE: excerpt from: 102 Minutes

TRADE CENTER HIT BY 6-FLOOR FIRE

Blaze Starts on the 11th
—16 Men Are Injured

A three-alarm fire broke out in the 11th-floor offices of the B. F. Goodrich Company in the north tower of the World Trade Center just before midnight last night, and spread through an inner-service core to the ninth and 14th floors.

"It was like fighting a blow torch," according to Capt. Harold Kull of Engine Co. 6, who said all of his men "got their necks and ears burned" trying to get into the 11th Floor hall from a stairwell. None of the firemen were seriously injured.

Mainly on One Floor

The fire appeared to be confined primarily to 11th-floor office equipment, according to Deputy Assistant Fire Chief Homer Eishop. The damage to the service core was apparently confined to electrical wiring in and near the core.

The building is not equipped with a fire sprinkler system.

A total of 24 pieces of fire-fighting apparatus and 132 firemen fought the fire. Sixteen firemen were treated at the scene for smoke inhalation.

New York Times

Feb. 14 1975 p 41

To reach the fire, the men boarded a freight elevator to the ninth floor, attached hoses to standpipes in stairwells on the 10th floor then advance on the fire. Flames could be seen pouring out of 11th-floor windows on the east side of the building.

Fifty people, mostly maintenance men, were evacuated.

New York City's new fire code for office towers requires that floors lacking sprinkler systems be divided into units no larger than 7,500 square feet unless buildings possess special fire detection devices.

The new fire laws also requires smoke-detection systems that in the event of fire will shut down the air-conditioning system, which can spread smoke and gases through the building, and return all elevators to the lobby floor.

The elevator provision is intended to override heat-sensitive elevator call-buttons which can summon elevators to fire floors as happened in 1970 at One New York Plaza and 919 Third Avenue, where a total of five deaths in two buildings were elevator-related. It was after those fires that the new fire law was enacted.

Fire Commissioner John T. O'Hagan has stated that he considers sprinkler systems, which are activated by high temperatures, to be the most effective means of fire-fighting in high-rise buildings.

"I'd sleep a lot better at night if the World Trade Center had sprinklers," he commented recently while discussing the plausibility of skyscraper fire such as that depicted in the current film, "The Towering Inferno."

"In 1966, Emery Roth & Sons stated that the fire rating of the floor system could not be determined without testing. In 1975, Skilling, Helle, Christiansen & Robertson — the WTC's structural engineers, made the same general statement. Despite these statements, a federal investigation found that such tests were never done. In February 1975, an arsonist set small fires that caused parts of floors to buckle damaging sections of the 9th through 16th floors in one of the towers."

“In 1969, a PA executive ordered that the steel be protected by Spray-On Fire Proofing one-half inch thick. Also in 1969, an architect from Emery Roth & Sons noted that PA officials had deleted a requirement that the steel in the towers be able to withstand three or four hours of fire, depending on the part of the structure. Emery Roth & Sons renounced responsibility and complained about the deletion which had, in effect, turned the carefully prepared specifications into meaningless documents.”



By 1999, the PA ordered the density of the SOFP tripled from one-half inch to one & one-half inches thick. The work would be done only as tenants renovated their floors, when the floors and ceilings could be exposed for the messy work. The PA would pick-up the cost, about \$1 million per floor.”

RE: excerpt from: 102 Minutes

Additional SFRM was added after the February 1975 fire that spread to six floors before being extinguished. After the 1993 bombing, inspections found the SFRM to be deficient. The PA was in the process of replacing it, but replacement had been completed on only eighteen floors in 1 WTC (north tower), and on thirteen floors in 2 WTC (south tower). The 1968 NYC building code did not require sprinklers for high-rise buildings, except for underground spaces. In accordance with building codes, sprinklers were originally installed only in the underground parking structures of the World Trade Center. Also following the fire in February 1975, the PA decided to start installing sprinklers throughout the buildings. By 1993, nearly all of 2 WTC and 85% of 1 WTC had sprinklers installed. By 2001, the entire complex was retrofitted to include sprinklers per Local Law 5 requirements.



**WHEN THE FIRE ALARM WENT OFF,
IT TOOK TWO HOURS TO EVACUATE
NEW YORK'S WORLD TRADE CENTRE.**

**Advertisement featuring the
Twin Towers of the WTC
Asbestos Magazine
(November, 1981)**

The bigger the building, the more important fire-proofing becomes.

That's why today's buildings have asbestos-cement walls and even floors containing asbestos.

Asbestos contains fire, cannot burn and holds up after metal and glass have melted down, giving vital time for people to escape.

You'll also find asbestos sealing plumbing joints, insulating heating pipes, electric motors and emergency generators.

Asbestos. We couldn't live the way we do without it.

ASBESTOS

When life depends on it, you use asbestos.

Asbestos Corporation Limited,
Sun Life Building,
Montréal, Québec H3B 2X6,
Canada.

Represented by:
Becker & Haug (GmbH & Co.)
P.O. Box 100 548, Spadenreich 1-5
2000 Hamburg 1, Germany (FOR WEST GERMANY,
EAST GERMANY, AUSTRIA AND HUNGARY)
Other representatives world-wide.



“Two of the three stairwells in each tower did not bring people out to the street. Rather, they deposited them on the Mezzanine lobby – a major design flaw according to the FDNY. These Mezzanine exits required people to take escalators to bring them to the street level, causing backups in the stairwells that stretched up for multiple floors during the 1993 evacuation.”

RE: excerpt from: *102 Minutes*

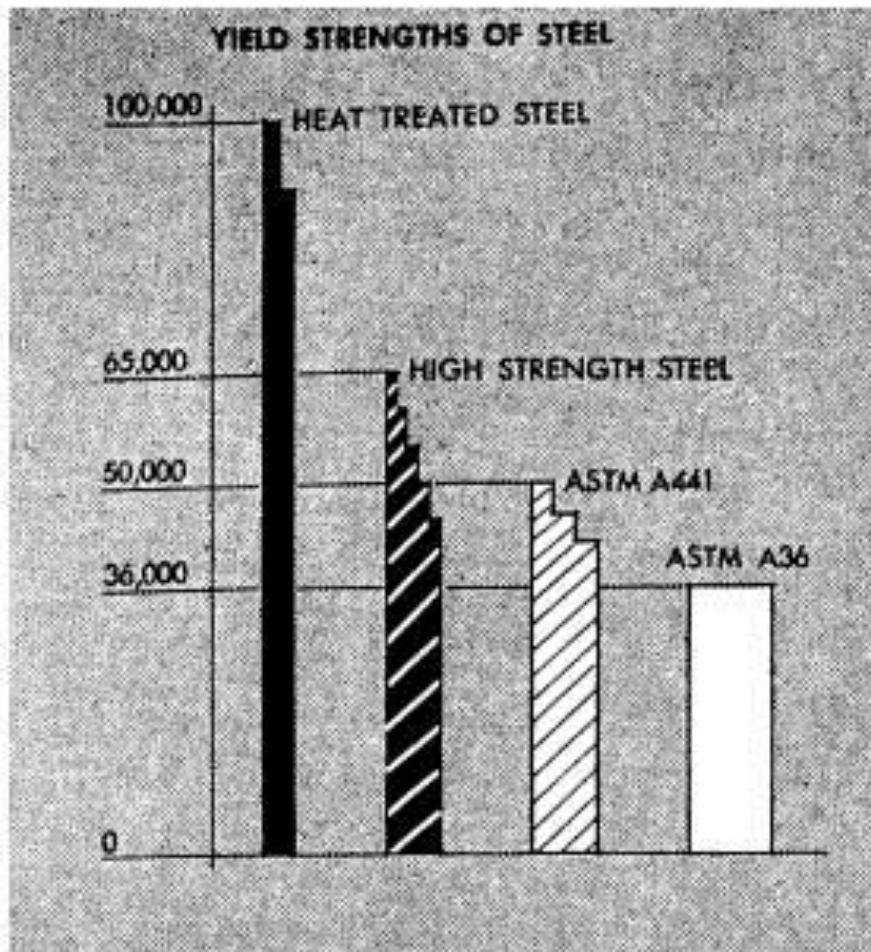


Part 8

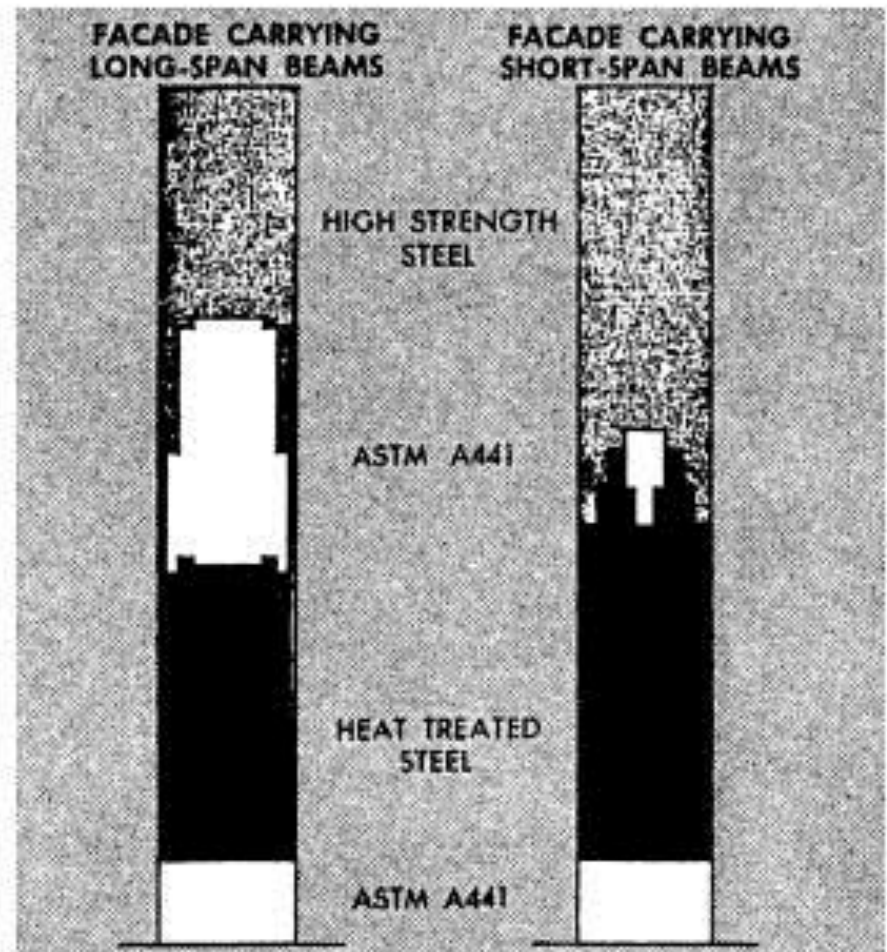
200,000 Tons of Steel

“Into the towers rising from the excavation are going some 200,000 pieces of steel having a total weight of about 200,000 tons (about 1/5 of the total weight of the structures). Individual columns in the lower core section, measuring 52 x 22-inches in plan, are formed of five and three-inch plate into almost solid steel shafts that weigh up to 56-tons...The steel superstructure rising from the continuous foundations will contain steels of four basic stress grades A36 (36,000psi yield strength), A441 (50,000-psi yield strength), high-strength steel (65,000-psi yield strength) and heat-treated constructional alloy steel (100,000-psi yield strength).”

RE: excerpt from: ENR



YIELD POINTS of steels in World Trade Center columns will soar to 100,000 psi.



HIGH-STRENGTH STEELS will be used for exterior columns to take wind stresses.

“Over about half the building, steels in the yield-point range from 42,000 to 65,000psi will suffice for the wall columns. In the lower portion of the building, heat-treated, low-alloy steels will be needed. At the base, where large columns can be used, a lower-yield-point steel will again be satisfactory. The actual vertical-load stress to be used for each story will be determined from a consideration of costs for each column in that story. Thus, the World Trade Center towers will have an inherent capacity to resist unforeseen calamities. This capacity stems from its Vierendeel wall system and is enhanced through the use of high-strength steels.”

RE: excerpt from: ENR

Consultant-Contractor

“I asked myself: why should I not assume the functions of a general contractor if I have the advice of experts in the field?”

Guy Tozzoli – WTC Director, 1964

“The Port of New York Authority’s construction committee this week recommended that the agency hire Tishman Realty & Construction Company, Inc., of New York City, as general contractor for the \$575-million World Trade Center in lower Manhattan. Tishman would receive a fixed fee of \$3,250,000, plus reimbursement of direct field costs, now estimated at \$16 million. Tishman has been involved with the project almost from its conception...Tishman’s appointment as consultant-contractor does not mean that the company will be general contractor for the over \$500-million project, says the Port-Authority. Nor does it mean they will not. Tishman’s experience as an owner’s builder in many cities across the country has led to several recent contracts as construction consultant on large building projects. Currently the firm is consultant-contractor on the Madison Square Garden complex in New York City and the 100-story John Hancock office and apartment building in Chicago. Besides its duties as consultant on these two jobs, Tishman is General Contractor for the entire John Hancock project and for the office portion of Madison Squares Garden.”



CONSTRUCTION

“Tishman Realty and Construction, one of the firms the PA had hired to serve on its construction advisory committee, was promoted from the group of advisors which included Fuller, Turner and Diesel, to ‘Consultant-Contractor.’ Officially, Tishman was given a 16-month contract for \$250,000.00 to review bid documents and to advise the PA on cost estimates, construction timetables and material delivery schedules. Guy Tozzoli planned to keep the management of major contracts – like the steel fabrication and erection, in-house but, eventually, he wanted to have a General Contractor to supervise the hundreds of specialized companies that would be involved with the project.”

“...Fewer surprises will turn up in the construction of the World Trade Center because the owner of this proposed world’s largest office complex has hired one of construction’s new breed, a contractor-consultant. The \$250,000 that the Port of New York Authority will pay Tishman Realty and Construction Co., of New York City, for 16-months’ worth of its expertise may turn out to be the best money spent in constructing the ten million square-foot center in lower Manhattan, even though PNYA already has a design team of top architects and engineers. For nobody knows field construction like a contractor. If he is good, he has prices, material delivery times and all the techniques of scheduling and construction at his finger tips. The Port Authority’s and its contractors’ paths through this \$525 million construction project are certain to have fewer surprises...”

RE: excerpt from: ENR (March 1967)

“Tishman will begin immediately to coordinate and supervise construction and assume responsibility for all field contracts exclusive of the foundation work. Subject to authority approval, the company also will arrange for all remaining subcontracts.”

James C. Kellogg III - Vice Chairman, PANY, March 1967

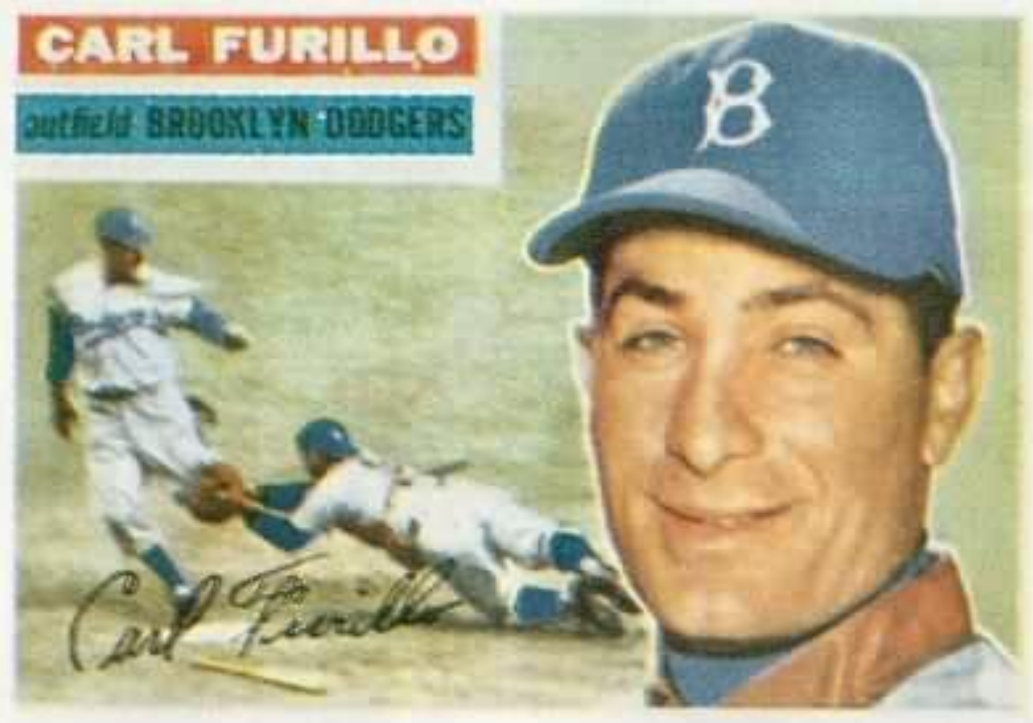
“Tishman assumed responsibility for coordination of trades, supervision of construction, and movement of men, materials and machinery on the site. And the Port Authority, acting pretty much as its own General Contractor, let two-hundred prime contracts for WTC...For each of the two-hundred prime contracts, prospective bidders were called in individually to discuss the total project and the work they might do in it. Interested contractors were asked to submit a proposal as outlined in bid documents and also, since they were the experts, any alternate proposals for more efficient or less expensive construction. Contractors that came up with the best plans and prices got the jobs. Some benefits of this time-consuming process were:

- The elimination of some expensive caissons in the foundation of the South-east Building;*
- A cost reduction in extension of temporary power throughout the buildings;*
- Improved distribution systems for HVAC;*
- Improved slab support for the foundation walls.”*

RE: excerpt from: ENR

“There were thousands of parts; 42,000 doorknobs, 21,800 windows and 250,000 square feet of travertine marble. Somebody figured out that the WTC would have 3,000 miles of wiring and 10,000 lighting fixtures – enough to illuminate a highway from New York to San Francisco. The towers A/C could cool 15,000 homes and enough connecting pipe was used to connect Knoxville, Tennessee with Baghdad, Kentucky.”

RE: excerpt from: *Men of Steel*



“Carl Furillo, a former right fielder for the Brooklyn Dodgers, spent three years installing 2,000 elevator doors at the WTC. Fired by the Dodgers after a leg injury in 1960, Furillo sued to collect the \$21,000 owed him on his contract. Branded a ‘Bolshevik’ in the press by Dodger’s management, after recovering from his injury he found himself blacklisted by professional baseball.”

RE: excerpt from: *Men of Steel*

“Dozens of mysterious fires broke out around the site. Several bombs; including one that blew a Tishman company trailer to smithereens, were set-off; apparently by disgruntled subcontractors. Over the course of construction, the WTC racked-up several times its expected quotient of injury, death, sabotage and corruption.”

RE: excerpt from: *Men of Steel*

“The elevator shafts were the most hazardous places in the towers. It was a sheer drop of sixty to one-hundred stories with minimal protection. There were guardrails, but they were always being knocked over or broken without being replaced. Over the course of the job, six elevator men fell down those shafts to their deaths. Five sheet metal men and several concrete workers also fell to their deaths. Two pedestrians were killed when a load of planks rolled off a truck as it was coming out of the ‘hole.’ By the end of construction, seventeen people had lost their lives but not one of them was an ironworker. Considering the history of the trade and the number of men involved, it is almost beyond belief. Even with the occasional mishap, the largest steel erection project ever turned out to also be the safest.”

RE: excerpt from: *Men of Steel*

Construction Man of the Year

“The World Trade Center (WTC) is remarkable not only for its architectural and engineering advances, but for the program of construction management that brings together the right men, materials and tools at the right place for the right work at the right time over a seven-year program. The man who established this plan and is carrying it through is forty-one year old Ray M. Monti, construction manager on the WTC for the Port of New York Authority (PNYA). Monti, a civil engineer with PNYA since 1952, was brought into the WTC project in 1964, when Minoru Yamasaki and Associates, Birmingham, Mich., and Emery Roth and Sons, New York City, were still preparing architectural plans. Actual construction began in 1966...”

RE: excerpt from: ENR (February 1971)

“When I was an engineering student I thought that engineers did two things: they designed welded steel bridges and they poured concrete. Since then I’ve found that as an engineer’s job gets bigger and more complex, the percentage of time he devotes to administration increases. I’m involved in purchasing, labor relations, site security and public relations. I’m a part-time lawyer, accountant, salesman, architect and personnel man. Although it’s all administration, without my engineering and construction background I couldn’t have made these administrative decisions.”

Ray Monti – WTC Construction Manager

“...Monti spent a year and a half organizing a 128-man construction team and preparing a critical path method (CPM) construction plan that not only schedules the thousands of elements of WTC construction, but rides herd on construction materials and up to \$10 million monthly in contractor payments. The CPM program for the World Trade Center is operated from a PNYA computer because it is too vast to be committed to paper. The WTC construction division is made up of supervising and senior engineers who operate as resident engineers on the major elements of the project, such as North Tower, South Tower, below grade, Customs Building, and they are backed up by staff units devoted to contract management, logistics and offsite inspection, and safety.”

RE: excerpt from: ENR

“Once the plan was developed and the top men knew what their responsibilities were, I began a management by exception operation. As a result, I deal entirely in crises. No good news ever crosses my desk. I don’t even want to hear about things going well, except at weekly meetings.”

Ray Monti – WTC Construction Manager

The Critical Path Method

“The first man that Monti recruited for his staff was Charles Smith, a former Seabee officer and an expert in CPM. Next came Francis H. Werneke, also an ex-Seabee, and now Monti's second in command. As each contract was let, Monti and Smith got a CPM plan from the contractor, a sequence in regard to time and cost. For contractors with no CPM background, the World Trade Department ran a free course of instruction. All the CPMs submitted by contractors were integrated into an overall network that contains every item of work in the most efficient sequence. The result is a master construction plan that is resilient enough to adjust to changes, redesign, strikes, bad weather, accidents, labor shortages, late deliveries and transportation failures without losing time. When something goes wrong, Monti's staff can work around it to avoid losing time. Once the bones of construction planning were established, Monti and Smith did a dry run on the computer on construction of the North Tower.”

RE: excerpt from: ENR

“We came up with twenty-four months per tower, with a seven-month lag for the second tower. It took twenty-eight months for the North Tower, which topped out late in December. We expect to top out the South Tower in June. We’re behind schedule. The strike of elevator constructors in 1969 lasted almost exactly four months. We were able to keep a lot of contractors going, but we lost production.”

Ray Monti – WTC Construction Manager, 1971

“I see my role as primarily one of motivating people to get the job done. The motivation I use is whatever motivation will work best, friendliness, saying please, telling jokes, shouting and yelling where it’s needed, threatening where it’s needed. I’ve got to see that things get done, not only on a day-to-day basis, but to anticipate the needs of six months from now”

Ray Monti – WTC Construction Manager

Prime Contract



“Gentlemen, we are going to forgo the usual bidding procedures because you are the big boys and we need you. So congratulations, you have no competition other than yourselves.”

Austin Tobin – PA Director, 1964

RE: PA decision to offer only *U.S. Steel & Bethlehem Steel* the opportunity to place bids for the fabrication and erection contracts for the 400 million pounds of steel for the WTC. Tobin would come to regret this decision.

“All of a sudden during a meeting with United States Steel they tell me; ‘The job is so big, why don’t you give us each a tower’. I said; ‘I don’t understand, you’ve been talking to me for three years. Now you’re telling me the job is too big, maybe we should split it up?’”

Guy Tozzoli - WTC Director

RE: U.S. Steel & Bethlehem Steel were invited; in 1964, to be exclusive bidders on the steel contract. Their “estimates for budget purposes” were \$83 & \$81 million respectively. In August of 1966, formal bids were taken from the two; now the bids were \$119 & \$122 million respectively – exactly 47% higher than one-and-one-half years before. Suspecting collusion on the part of the two bidders, the PA determined not to give either one the contract.

“The usual bidding procedure would be inappropriate for this work because of the work’s complexity and the necessity of continuing interchange of information between the prospective contractors and the Port Authority.”

Austin Tobin - PANY Director

RE: explanation to the PA’s *Board of Commissioners* concerning the steel bid fiasco

“All of the steel erection and much of the steel for the World Trade Center’s twin 110-story towers were included in contracts totaling \$74,079,000 awarded last week by the Port of New York Authority. Of the six contracts, five involved the steel fabrication and erection. They represented a second go-around on the steel for the 1,350-foot skyscrapers, to be the world’s tallest. The Port Authority initially sought to have the steel fabricated and erected under a single contract. Last August it received proposals from Bethlehem Steel Corp. and United States Steel Corp. These proposals were rejected as too high, and the job subsequently was broken up into packages in an effort to get a lower price...”

RE: excerpt from: ENR (February 1967)

“Guy Tozzoli let it be known in the industry that the Port Authority was slicing up the steelwork of the Trade Center and that it would take no bids from U.S. Steel and/or Bethlehem Steel. There was a bit of vengeance involved, but the more practical reason for freezing them out was to ensure that they did not cause any further trouble by scaring off the smaller companies into whose hands the PA was now placing the destiny of the World Trade Center.”

RE: excerpt from: *Men of Steel*

“...Price of the big two’s rejected offers were not disclosed. But the Committee for a Reasonable World Trade Center, a gadfly critic of the project, in a full-page newspaper advertisement last October said that the rumored low bid for the steel was more than \$650 per ton, compared with authority estimates of \$400 per ton. The same advertisement said the rumored requirement was 220,000-tons as against an estimated 180,000-tons. The Port Authority spokesman declined comment on its critic’s figures...”

RE: excerpt from: ENR

“People thought we weren’t doing this for real, that we were just fooling around. I had to put a letter out there to everybody; ‘This is to advise you that U.S. Steel & Bethlehem Steel cannot bid on these projects.’ Tobin had the guts to let me burn that bridge because, there was no other way.”

Guy Tozzoli, WTC Director

“...The steel contracts awarded:

- Fifty-five thousand tons including all exterior steel (columns and spandrels) from the ninth floor to the top - *Pacific Car & Foundry Co.*, Seattle, Wash., \$21,790,000;**
- Erecting the entire 192,000-tons of structural steel in the twin towers and the center’s sub-grade area - *Karl Koch Erecting Co.*, Bronx, N.Y., \$20 million;**
- Floor system - *Laclede Steel Co.*, St. Louis, Mo., floor space trusses and miscellaneous steel, \$6,650,000; *Granite City Steel Co.*, Granite City, Ill., steel deck and power and telephone ducts, \$1,889,000; and *Karl Koch Erecting Co.*, assembly and delivery of the deck panels combining the two components, \$2.5 million.”**

RE: excerpt from: *ENR* (February 1967)

“...the builders of WTC ended up with fifteen fabricators spread across the country. Despite the breakdown of the steel contract, the orders were still so big that WTC had to give them an OK to start 18-months before their steel was needed. As further complication, there’s no place to store steel on the cramped WTC site. In fact, unloading space is so limited that a piece of steel has to arrive only minutes before a crane is ready to pick it up. Monti, with William Borland, a former Army engineer, developed a program that keeps tabs on steel from its raw state through to installation. A data processing system permits them to monitor the fabrication of steel, know when it has been accepted by a WTC inspector at the plant, know when it was shipped, when it arrived at a New Jersey storage yard and is to be shipped to the job site within minutes of when it will be needed for erection. This computer-operated program enables the arrival, hoisting and installation of an average of 600-tons of steel a day by Karl Koch Erecting Co., New York City. Under this system, WTC can anticipate trouble, can know if a piece of steel is missing long before it should be under the hook.”

RE: excerpt from: ENR

“There was one package for the base plates, another for the steel that would be erected below street level; six stories down to bedrock. There were three packages for the exterior steel, two for the modular floor system and one for the elevator shafts. A dozen packages in all, each to be completed in a different corner of the United States and then shipped by rail to a central receiving point across the Hudson in New Jersey. All told, more than 200,000 separate pieces of steel to be fabricated and delivered on-time. When all twelve contracts for fabricating and erecting the steelwork were added up, the total would be \$85.4 million; \$33 million less than Bethlehem’s official bid and \$37 million less than U.S. Steel’s. Actually, it was not much higher than what both companies had ‘budget estimated’ two years earlier.”

RE: excerpt from: *Men of Steel*

“The secret was getting a small contractor with a very big bond. My board said; ‘Tozzoli, you’d better get a bond’...I was ready to finance anybody that would do it. All I needed was a guy who knew how to erect steel. You guys, to me, weren’t a contractor, you were a partner. You took big chances because you were a little bunch of guys. I knew in my heart that I had to keep you alive.”

Guy Tozzoli, WTC Director

RE: conversation w/Karl Koch III 35-years after the completion of the WTC



“We had nothing to compare it to, you were the only bidder. Everybody was afraid to come into New York. We were looking for independent steel erectors. You had a marvelous history and you were very strong with the unions...we were lucky to find you.”

John Tishman – President, *Tishman Const. Co.*

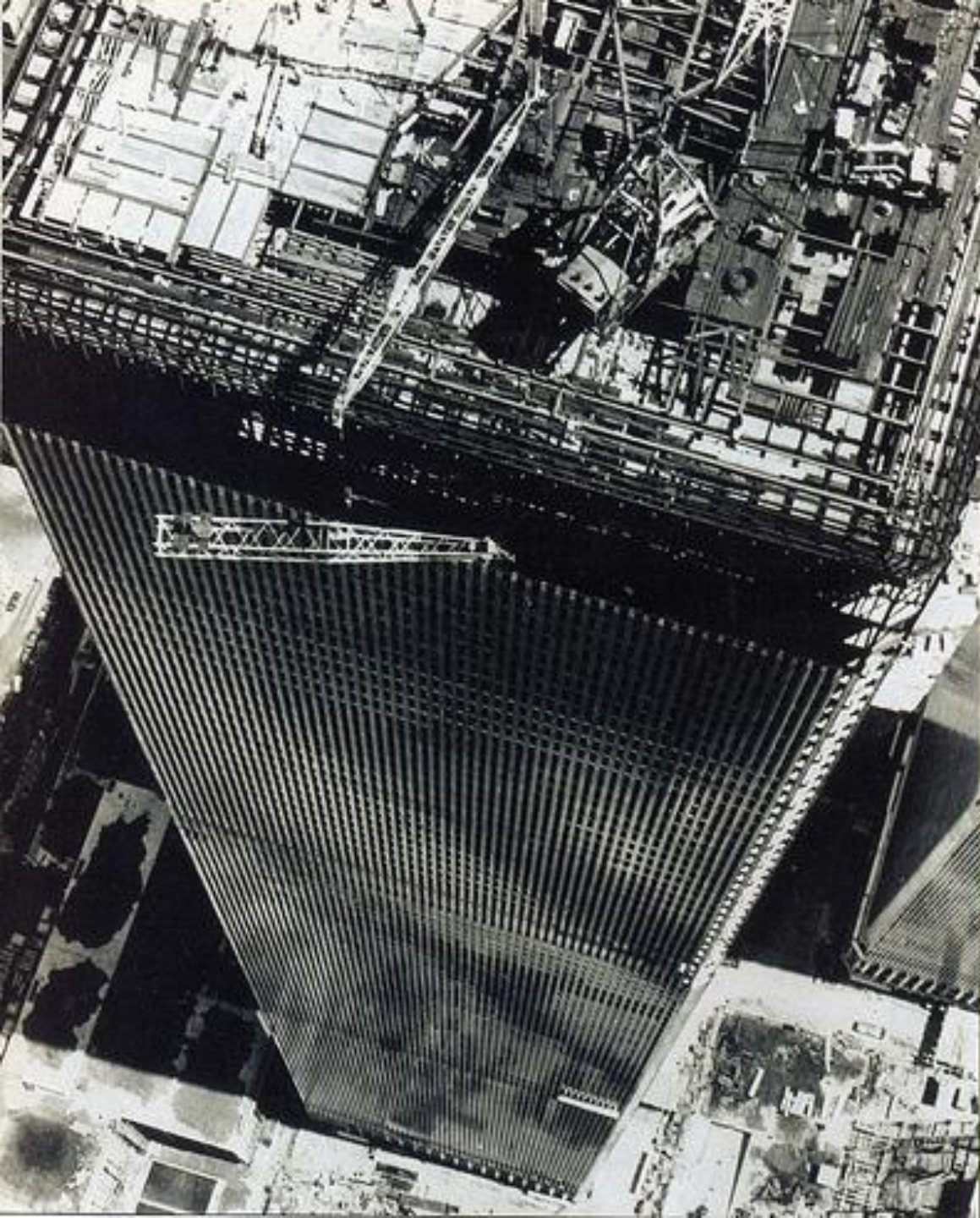
RE: recalling events in 1966 with Karl Koch III of the *Karl Koch Erecting Co.* concerning the awarding of the steel erection contract for the WTC’s twin towers



“What none of us knew – what I didn’t find out until 36 years later, was that we were actually in a powerful bargaining position...But Guy Tozzoli had the omnipotent aura of the Port Authority of New York and he was a much better poker player than Bob Koch. He managed to keep us from finding out that we weren’t the low bidder. We were the only bidder.”

Karl Koch III

RE: Karl Koch Erecting Company’s \$20 million bid to erect the steel for the twin towers. Ultimately, the PA would pay them \$30 million, but only after KKE nearly went bust from the bad-bid submitted for the project. In reality, the steel erection contract was worth around \$40 million.



“Wait until Koch tries to pick steel once they’re over 60 floors. The wind will be blowing, the clouds will be sailing by and the pieces will be flying like kites. Koch has no idea what it’s going to be like, and that’s when they’re going to find out how to price that kind of job.”

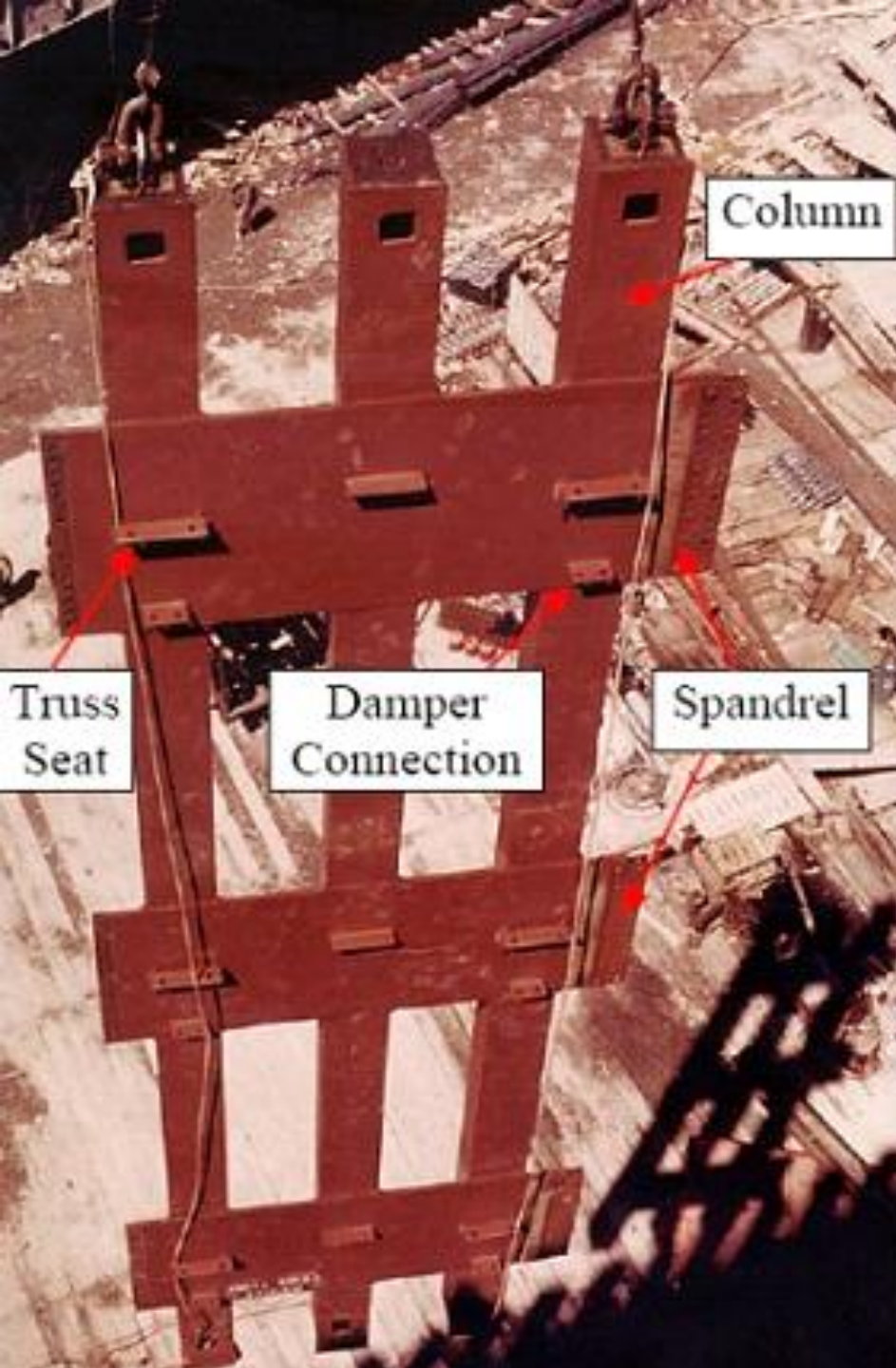
Bethlehem Steel Co.
Executive 420

“That was the carrot the PA held out; everyone wanted to get in on the world’s tallest buildings. The scuttlebutt around the job later on was that almost everyone had lost money and that Karl Koch Erecting was the only one who got out with their skin because they were so central to the construction. They’re fall was so dramatic, the PA had to save them. It was a strange turn of events given that the PA was known for its ruthless legal department and airtight contracts.”

RE: excerpt from: *Men of Steel*

“The largest contract for fabrication of structural steel is held by Pacific Car and Foundry Co., of Seattle. It is \$21.79 million for 55,000 tons of steel for the towers’ bearing wall panels from the ninth floor up. In all there are 5,828 of these panels, each about ten feet wide, thirty-six feet high, with the heaviest individual panel weighing about twenty-two tons. Each panel consists of three box columns, fourteen inch square, made up of plate up to three inch thick and, connected by fifty-four inch deep spandrels. When the panels are delivered to the site, Koch lifts them off the trucks and raises them to their proper locations with one of eight Australian climbing cranes the company purchased especially for the job. (PNYA recently bought the cranes from Koch to simplify their use by other trades when they are not needed for steel erection). Succeeding panels are bolted together by means of high-strength bolts installed through hand-holes in the box columns, which are accessible from inside the building. Gusset plates and high-strength bolts connect adjacent spandrels, and these connections are also made from within the building.”

RE: excerpt from: ENR



“It’s a more complex job than we anticipated. We don’t expect to make any money”

C.M. Pigott – President, Pacific Car & Foundry

RE: WTC’s largest steel contract; \$21.8 million - for the 55K-tons of exterior wall panels

“The contract included penalties for failing to finish certain work by certain dates; requirements whose satisfaction would depend as much on the fabricator’s performance as on ours. Missing, meanwhile, was a standard provision to cover escalations in labor costs...our three-year contracts with the ironworkers’ locals were negotiated by a group representing all the contractors in the city, we had little control over increases in our labor costs.”

Karl Koch III

RE: *Karl Koch Erecting Company’s* concerns over the PA’s WTC steel contract provisions. When the Ironworker’s contract came due in the summer of 1969, rather than the average 3 to 5% escalation included in their bid, the ironworker’s union - taking advantage of the boom in NYC high-rise commercial construction at the time, negotiated nearly a 20% increase in wages in their new contract.

The Kangaroo Jump

“The boom’s load is all pleasantly balanced in the center, in the middle of the tower. Now, as we boom up into the air, the cable pulls the counterweight up the inclined plane. When the boom is straight up, nearly perpendicular to level ground, the counterweight is very close to the center of gravity of the crane. In this way we always keep the center of gravity inside the tower of the crane...That’s why our crane can be made so light, and that’s why the buildings that our cranes go into need practically no temporary support steel to take these reactions that a normal crane would throw into the building.”

Eric Favelle – President, Favco Industries, 1967

RE: explaining to Karl Koch III & Robert Koch of Karl Koch Erecting why their tower crane was superior to other cranes and ideal for the WTC project. They could pick-up 50-tons 50-feet out.



“They dropped the bases to the connectors on the floor, who guided them into position inside the four corners of the elevator core and anchored the bases to the concrete. The four crane towers were constructed of four, 32-foot sections bolted together to reach the full height of 120-feet. They perched the machinery deck and cabin on the top of the tower and attached the counterweight and then the boom and the hoisting and working cables followed. Later, jumping beams and ladders would be attached to the base of the tower so that eventually it could be released from the concrete anchors and make three, 12-foot jumps up the climbing ladders to a new perch 36-feet higher up the building – a jump every three stories. They didn’t call them ‘Kangaroos’ for nothing!”

RE: excerpt from: *Men of Steel*



THEY LIFT, LUFF AND SLEW



“The crucial parts were the crane’s three sizes of hydraulic pumps, each powering a different motion of the crane. The largest one, the main pump, was for Lifting; commonly referred to as Hoisting. The two smaller pumps were for Luffing; moving the boom up and down and Slewing; rotating or swing the entire crane.”

RE: excerpt from: *Men of Steel*



Raise load



Lower load



Raise boom



Lower boom



Raise load
small amount



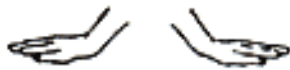
Lower load
small amount



Raise boom
small amount



Lower boom
small amount



Stop



Hold (dog) everything



Swing load or travel
hand gives direction



Travel as directed



Raise load and
lower boom



Lower load and
raise boom



Hold load and
raise boom



Track motions
turning caterpillar

Ironworker's Hand Signals (to crane operator)

“It seemed the kangaroo cranes were not big fans of cold weather. By early December, the night-time temperatures were already dipping to near freezing and when men arrived in the morning, they found the oil congealed, thick as grease. The pumps had small radiators to keep the oil warm, but they were already blown. They couldn’t handle the New York winter. In fact, they couldn’t handle the late fall. You got the impression the Australians didn’t know how cold it got here.”

RE: excerpt from: *Men of Steel*

“Before the week was out, we had switched the main-hoist pumps in all eight of our cranes and just like that, the oil stopped spewing and the kangaroos got well. They lifted & luffed & slewed as if they’d had heart transplants, as if they’d been reborn...whichever size pumps were in there, the kangaroos still gave us a line speed far beyond what we would have had with guy derricks. Even at a slower speed, the kangaroos could do in four or five minutes what might take a guy derrick thirty minutes, because the kangaroos could lift a piece of steel with one length of cable. Guy derricks would need to use four separate parts.”

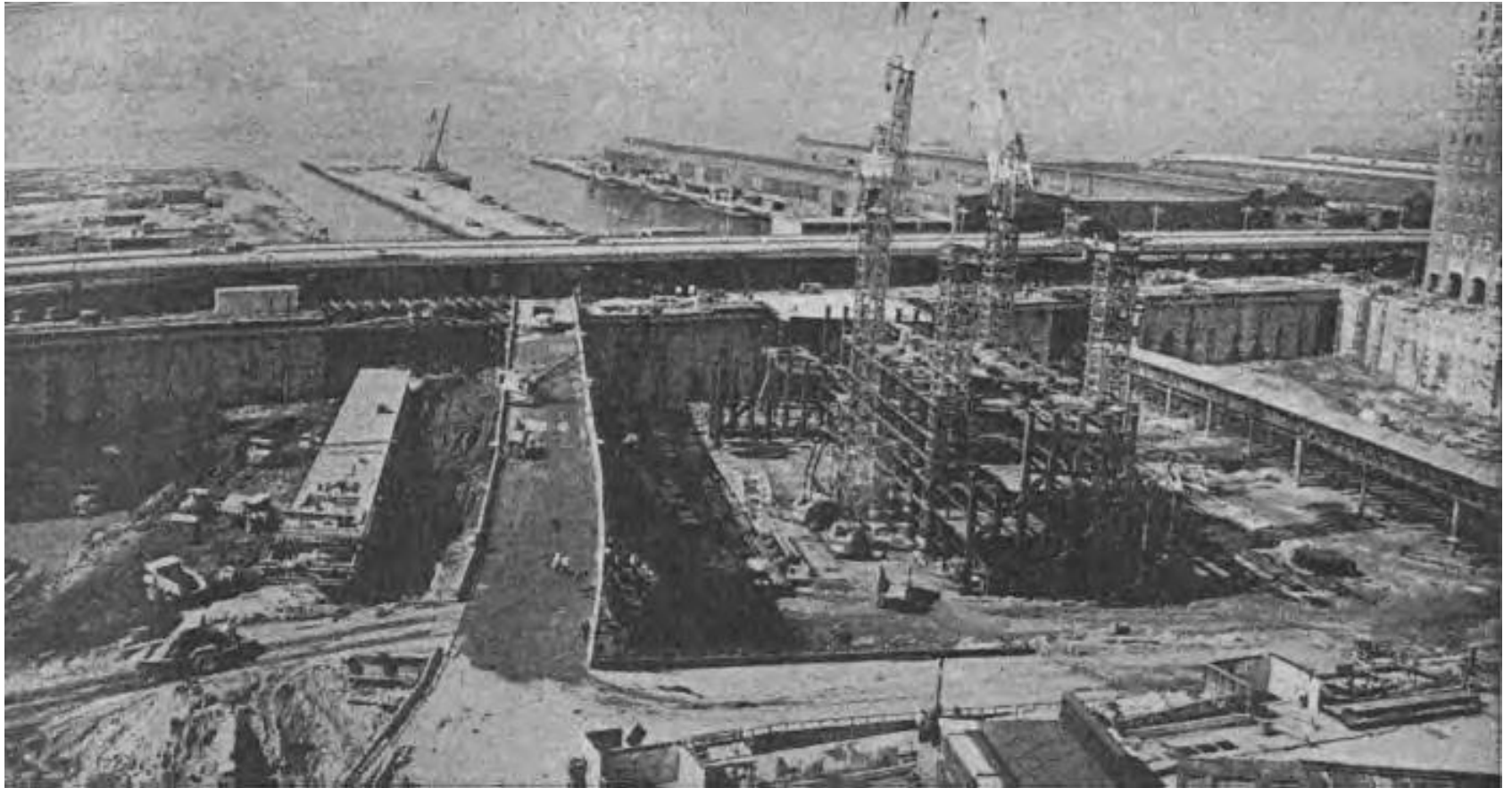
Karl Koch III

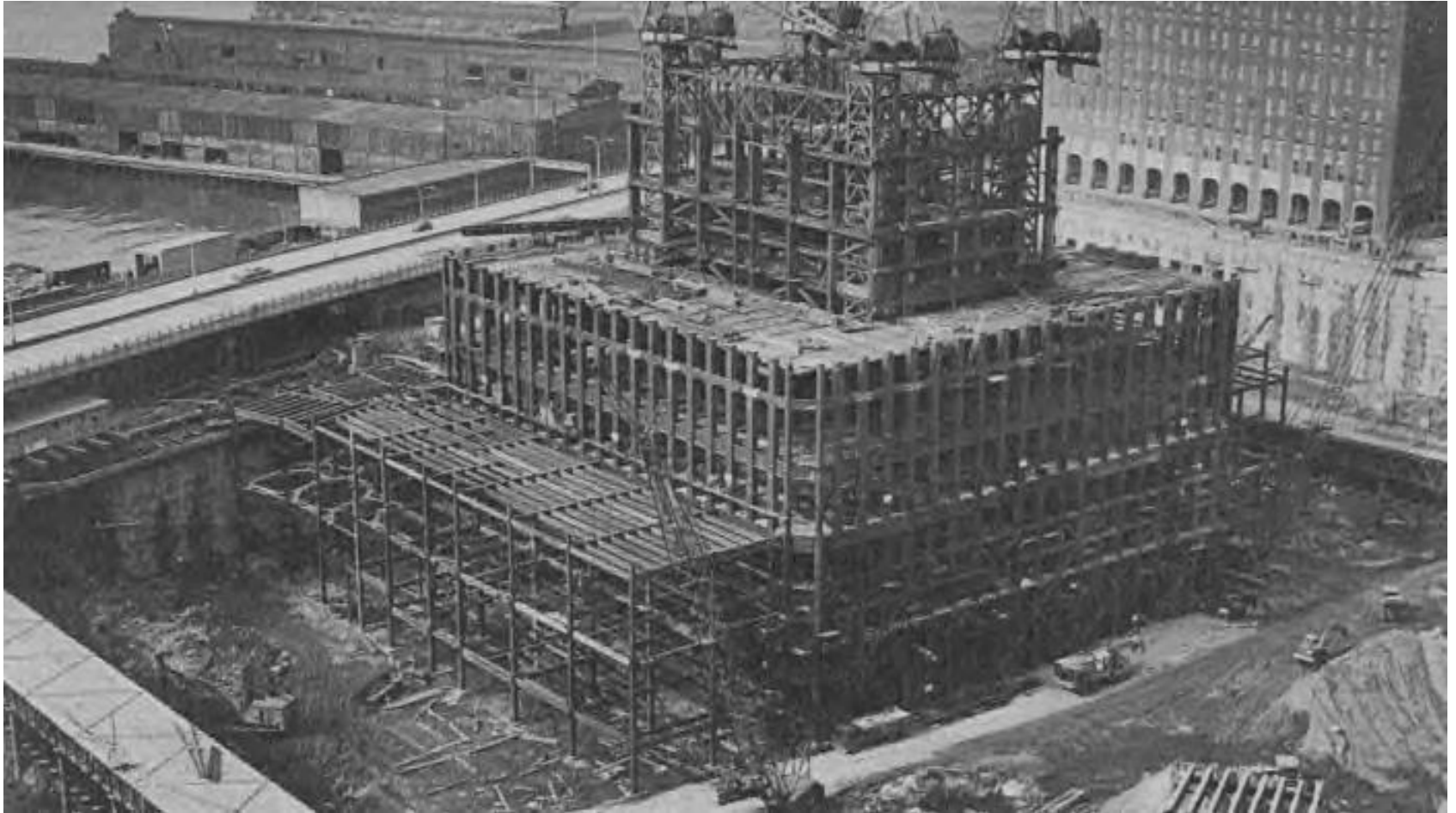
RE: wanting to achieve a lift-speed of 400fpm, the hydraulic pump manufacturer – Lucas, used a prototype pump - unbeknownst to KKE initially, that could not take the pressure. After continuous failures, the IG (Imperial Gallon) 4000 pumps were replaced with the proven, but slower, IG3000 pumps in all eight cranes at Lucas’ expense. The IG4000 was an unproven prototype, it cost KKE +/- \$1 million in overtime and downtime.

“Hour after hour, section after section, the four cranes lifted the pieces of steel up the sides of the tower, each responsible for a quadrant. Then, when the point came when the cranes had nearly disappeared behind the steel curtain they had erected around themselves, they performed their most famous and spectacular maneuver; The Kangaroo Jump. After seeing that all was ready, the pusher gave the order for the lifting to the signalman who was always in radio contact with the operator who worked the controls for the pumps running the hydraulic jacks. The hundred-ton jacks pushed against the central jumping beam hoisting the entire two-hundred tons of tower and crane twelve feet straight up in a smooth, silent movement – like a child holding the stem of a frozen push-pop up through the cardboard cylinder.”

RE: excerpt from: *Men of Steel*







“The site creates logistics problems. City streets adjacent to the site are narrow and congested. There is little or no room at the site to store materials. Therefore, every piece of structural steel must arrive at the right place at exactly the right time. Currently, there are twelve receiving points on the job for the 600-tons of steel that are trucked to the site daily. Eight of these are under the booms of the four climbing cranes atop each tower. Four others are under the booms of mobile land rigs that roam the site as needed. A mistake in the time, sequence or place of arrival of a single vital part could stop erection of either tower. Preventing this is not easy. Raw steel is shipped to some fifteen fabricators around the country and from several foreign countries. Unofficial estimates of foreign steel being used in the trade center range from 30 to 60% of the total. The fabricators ship completed units to the Greenville railroad yard in New Jersey, just across the Hudson River, where they are stored before being trucked to the site.”

RE: excerpt from: ENR

“Japan’s largest steelmaker, Yawata Iron and Steel Co., recently shipped to New York City’s World Trade Center part of an order of a special grade high-strength steel. Under contract between Seattle-based fabricator Pacific Car and Foundry. Yawata and Kawasaki Steel, the two Japanese firms, will supply 44,100-tons (worth \$8.3 million), mostly in the form of steel plate.”

RE: excerpt from: *ENR* (November 1967)

“Ray Monti’s deputy ran a staff of fifteen engineers who traveled to all the fabricating plants around the country to inspect their materials and workmanship and to make sure they were producing what they were supposed to be producing and on schedule. Up to fifty truckloads of steel each carrying an average of eighteen-tons had to be delivered at precisely the right time with the goal of keeping steel deliveries to the site within one-half hour of their scheduled times.”

RE: excerpt from: *Men of Steel*



“...every piece has reached Greenville on time and in proper sequence, computer-controlled. This record is attributable largely to a computer-programmed control system set up by PNYA engineers in a six-month period of concentrated planning, testing and debugging. Under the program, each fabricator gets, with its basic contract plans, a schedule that tells when individual segments of material are to be produced. The fabricator then prepares shop drawings and shipping lists for PNYA. PNYA feeds information on each individual piece into its program, showing scheduled completion at the plant, expected time for rail delivery to Greenville, a month's contingency lay-over in Greenville and the actual erection date. Follow-up data from representatives of independent inspection laboratories stationed in each fabrication plant and from PNYA men at Greenville and the job site are fed into the program daily to keep it current. So detailed is the program that PNYA engineers can get schedules on a hourly basis if necessary. Because of the tremendous volume of information in the program, printouts work only by exception, i.e. they report on only the material that is behind schedule at any point in the production chain...”



“The Greenville, NJ yard wasn’t big enough to be a warehouse. It was a staging area from which the steel would be delivered to the site, most of it aboard trucks rumbling through the Holland Tunnel. Pieces that were too large to be trucked were sent across the river on barges and held at Pier 13, adjacent to the construction site.”

RE: excerpt from: *Men of Steel*







“On a clear day, you could see up to West Point, out to the Robert Moses Bridge”

**Tom Roemer
WTC Crane Operator**

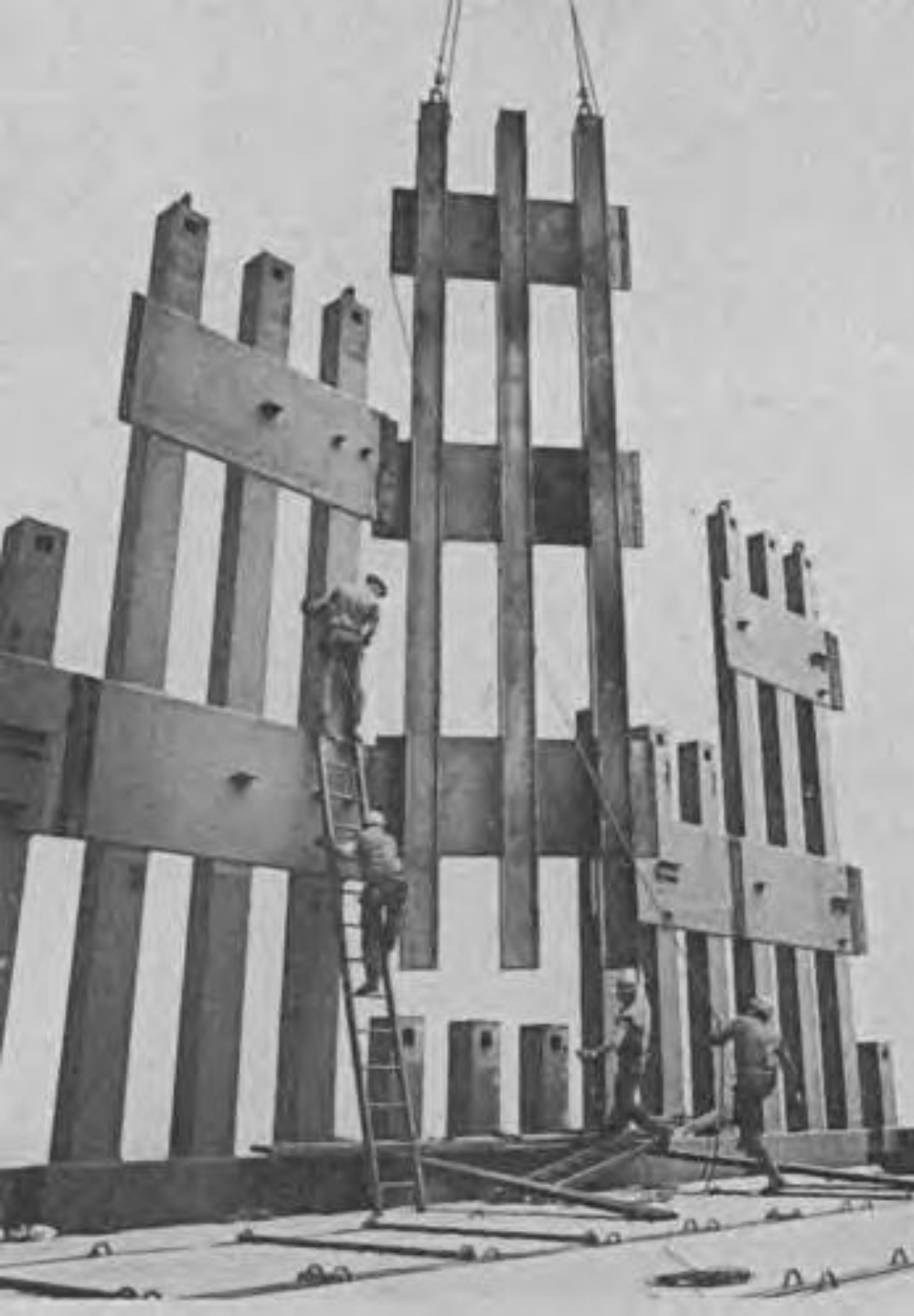




“From the 10th floor to the roof, it was a matter of sustaining the pipeline of steel and floor panels, truck after truck rumbling through the Holland Tunnel and barge after barge floating up the Kill Van Kull to keep the kangaroos fed and the vertical assembly line moving. It would be 100-stories of setting columns and beams, placing floor panels and jumping the cranes.”

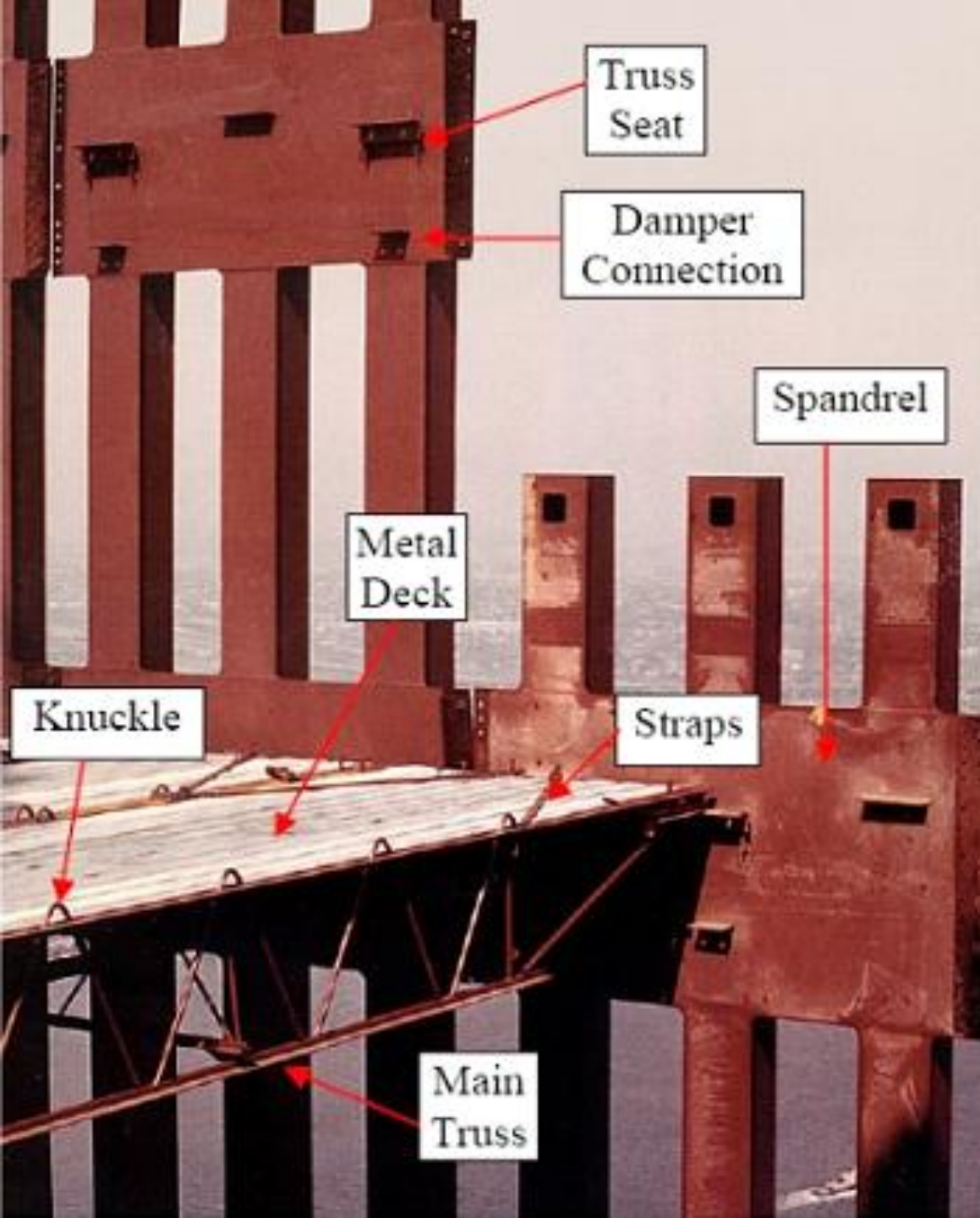
RE: excerpt from: *Men of Steel*





“Typical office floors have four-inch thick slabs of composite construction using top chord knuckles of the joists, which extend into the slab, as shear connectors. On mechanical floors, composite action is provided by welded stud shear connectors.”

RE: excerpt from: *ENR*



“The floor panels were hoisted flat off the ground and sometimes, when they reached the roof, the wind would catch them and they’d stand on end 1,000-feet above the street. The operator had to handle the controls just right to bring the panel into the wind; like a ship at sea, gaining enough control so that men below could handle the panel without being knocked off the building. The crane operators on the west side of the building had it worst. In order to get past the lugs on the spandrel plates for the columns, the panels had to come up at a fifteen-degree angle. The wind would come rushing down the Hudson blowing from NW to SE driving the panels against the side of the building as they were lifted. The operators had to boom way out to keep the panel away from the building.”

RE: excerpt from: *Men of Steel*





“A single construction elevator brought both men and material upstairs. But when we and these trades following us started to reach the higher floors, the trip upstairs and the waiting line downstairs got longer, especially when a load of material had to be off-loaded onto a floor. The PA proposed to use the kangaroos at night to hoist materials for the other trades on the upper floors and they would pay all costs as well as pay us a fee for doing so. The lines of waiting workmen disappeared.”

Karl Koch III



“Do you realize that they have a \$650 million job and if they lose us, they lose everyone? We own the kangaroos. It took us two years to build them...we’re going to tell them that if they have any ideas of throwing us off the job or calling in the bonding company, they can forget them because we have the title to the cranes. If they throw us off, the cranes go with us. It’ll cost them millions in lost time to replace them. If they try to take the cranes, we can tie them up in litigation. They’ve got to support us! They have no choice!”

Karl Koch III, December 1968

RE: with cost overruns, Karl Koch Erecting Co. was facing bankruptcy and default on their bond. Rather than go bust, they would ask the PA for financial assistance - and get it. Ultimately, the PA would pay KKE \$30 million, half again as much as their bid. But when all was said and done, when direct union labor, overhead, equipment, temporary material and profit were considered etc., a correct bid would have been about \$40 million.



A Welder's Paradise

“One of Karl Koch Erecting Company’s most notable projects was the GE building in Pittsfield, MA. In 1940, it was the first all-welded building in the country. It demonstrated that welding a building’s steel joints was more economical than bolting them and, if performed properly, every bit as effective. Welding the connections joined the columns and beams so seamlessly that it was as if the entire building were one solid continuous piece of steel. But it had never caught on because there was one string attached and it made the architects, engineers and builders uncomfortable; it shifted much of the burden of quality control from the shop to the field, where it was more difficult to maintain.”

RE: excerpt from: *Men of Steel*

“The WTC called for most of its steel connections to be welded rather than bolted, two-thirds of the ironworker work force in the early stages needed to be welders and their helpers. But welded steel jobs were so uncommon in New York that few members of the ironworkers local bothered to go through the training necessary to be certified in the specialty. Knowing about two-hundred welders would be needed in the north tower alone, every ironworker with a NYC welding certificate was invited to work on the WTC. Those with certificates were mostly West Indian immigrants who had learned their craft working at the refineries back home. Still 170 welders short, Koch asked the men to get the word out back home. The call spread like wildfire – from St. Croix and St. Lucia to Jamaica. It was the answer to finding talented and experienced welders, but also to the PA’s 10% requirement for employing minorities (native Americans did not count as minorities in 1968).”

RE: excerpt from: *Men of Steel*

“BLACK CONTRACTOR WINS \$1.1-MILLION CONTRACT
Minority contractor Electrotorque Associates, Inc., of Brooklyn, N. Y., has won a \$1.1-million electrical contract from the Port of New York Authority. The contract involves the installation of the refrigeration plant for the World Trade Center, which is presently under construction. The contract, the largest yet performed by Electrotorque, is part of an overall effort by the Port Authority to involve minority contractors in its projects. In this case, the authority contacted five minority contractors who were qualified to perform the work. Two submitted bids and Electrotorque was low bidder...”

RE: excerpt from: ENR (July 1969)



“Already employing every available ironworker in NYC, Karl Koch Erecting Co. started taking men from other parts of the country who were allowed to work by permit from the New York locals. The WTC would turn out to have the largest number of out-of-town ironworkers of any job in the history of NYC.”

RE: excerpt from: *Men of Steel*

“There just were not that many welders in New York, at least not as many as Koch needed. Each perimeter column from the grillage to the fourth floor had three spliced joints; three columns standing on top of each other so that meant 240 places that had to be fused together. With each joint requiring a dozen passes of the welding torch, there were three-and-one-half miles of welding just to that point.”

RE: excerpt from: *Men of Steel*



“Midway between the front doors and the arches formed by the bottom of the treetops, extending around the entire 832-foot girth of each tower, was a spandrel of steel called the ‘Belly Band.’ The belly beam was a strong band wrapped around the bottom to help contain it. It was composed of eighty bowtie shaped sections, twenty per side that were five-feet high by ten-feet wide. The panels had to be welded; each piece to the one next to it and to the column between them. It came to two-thousand linear feet of one-inch weld, an overwhelming job.”

RE: excerpt from: *Men of Steel*





“Hobart used a fully automated welding machine called an electroslag welder. What made it unique was that the slag bath (melted metal) was electrically charged. It could fuse joints in one continuous operation at a speed light years ahead of manual welders. Hobart was aware of the WTC’s showcase potential and if they could make it work, it could save thousands of dollars in man-hours. Again and again it failed in the field. The problem seemed to be the size of the joint which was enlarged to two-inches from one-inch to accommodate the electroslag. The machine couldn’t maintain the continuous weld in the field. The men started welding the belly band’s two inch joints with ball bats; oversized rods used in manual welding. Hobart later abandoned electroslag welding completely.”

RE: excerpt from: *Men of Steel*

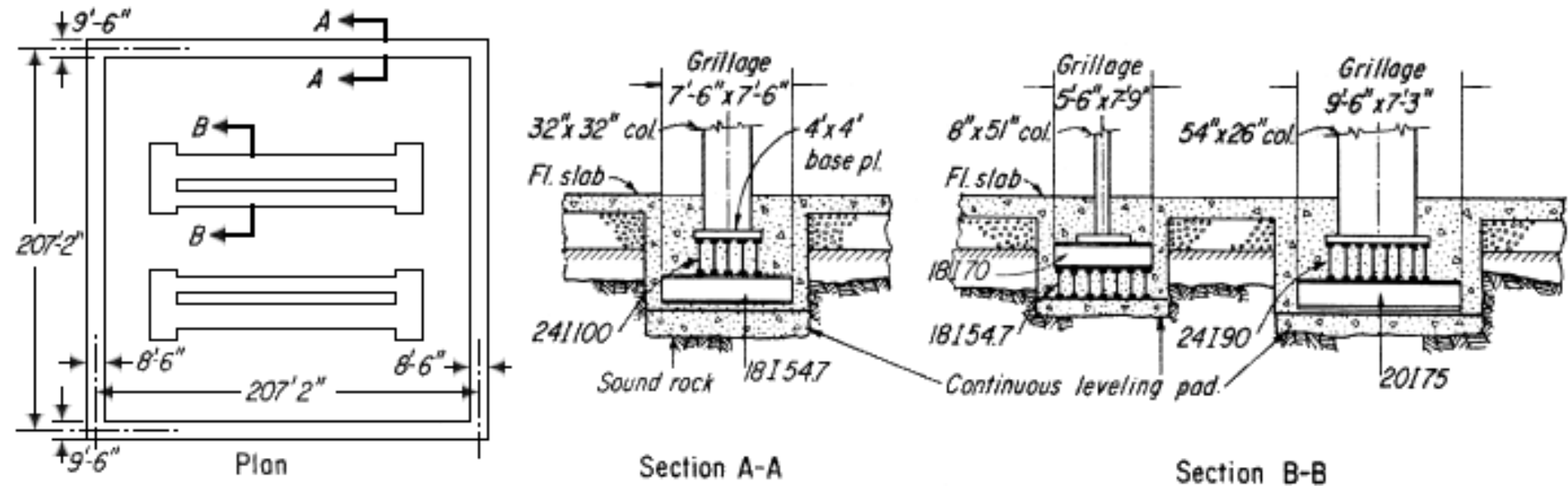
**“*What do you mean go to work?,*’ the welder asked
‘*There’s where the work is*’ the foreman said, pointing up
‘*Oh no, I want a job down here*’ stated the welder
‘*We’re not building down here, we’re building up there*’
responded the foreman
The welder looked up again, gave the foreman back the
safety harness and left, but most stuck it out.”
RE: excerpt from: *Men of Steel***



“The advantage of welding was that it reduced the cost of the steel you needed to buy. The saving was partly offset by higher onsite labor costs but on balance, it was less expensive than bolting. That was in a normal building. On a project with as much steel as the WTC, the savings could be huge. By 1964, welding technologies had improved tremendously and the PA started to talk seriously to the steel companies about welding. More a psychological barrier than a real one, the innovative PA called for welding the steel of the WTC. After the WTC, welding high-stress connections rather than bolting became the standard.”

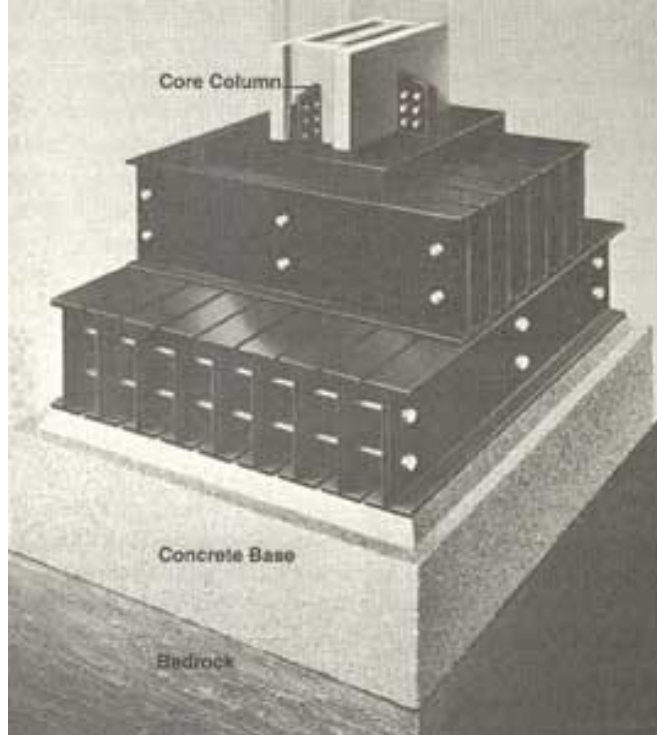
RE: excerpt from: *Men of Steel*

First Things First



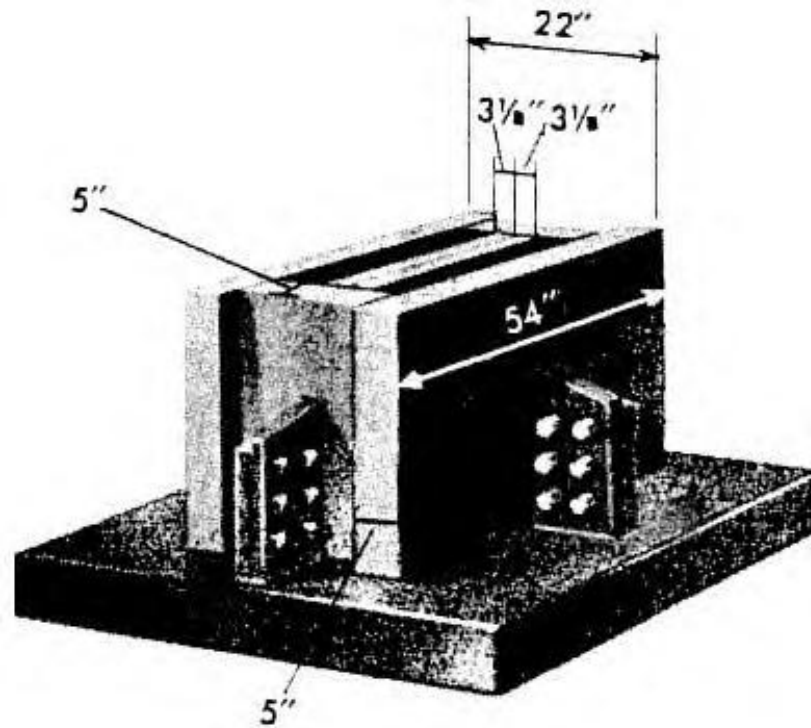
“Low-rise structures will be founded on bearing piles or caissons carried to rock about seventy-feet below grade. The skyscrapers and other buildings with deep basements will be supported on concrete piers resting on bedrock...A continuous footing will support the closely spaced exterior columns of each skyscraper. Continuous footings will also support the interior columns, the largest of which are 54 x 26 inch, plate box sections. All columns will have two-tiered grillages of heavy steel sections.”

RE: excerpt from: ENR



“The first piece of steel to be set; a 34-ton monster, was a grillage – a massive assembly of beams and plates that measured 8-feet x 10-feet. All grillages are formidable – they are used to hold columns that are too big to be secured by simple base plates. This one, and twenty-seven others were bigger and heavier than most because of the burden of weight they would bear. The prefabricated units would be the framework upon which the core of the entire building, a million tons, would ultimately rest.”

RE: excerpt from: *Men of Steel*



“That the exterior columns would be set in garden-variety base plates might seem paradoxical. It was the structural innovation of these buildings that the outer walls would be load-bearing and carry the heaviest steel, primarily to brace the towers against the whipping winds of Lower Manhattan. But because the exterior load would be distributed among many more columns than those in the core; eighty columns spaced ten-feet apart around the perimeter, each wasn’t as heavy so setting them in grillage would have been overkill.”

RE: excerpt from: *Men of Steel*

Cowboys of the Sky

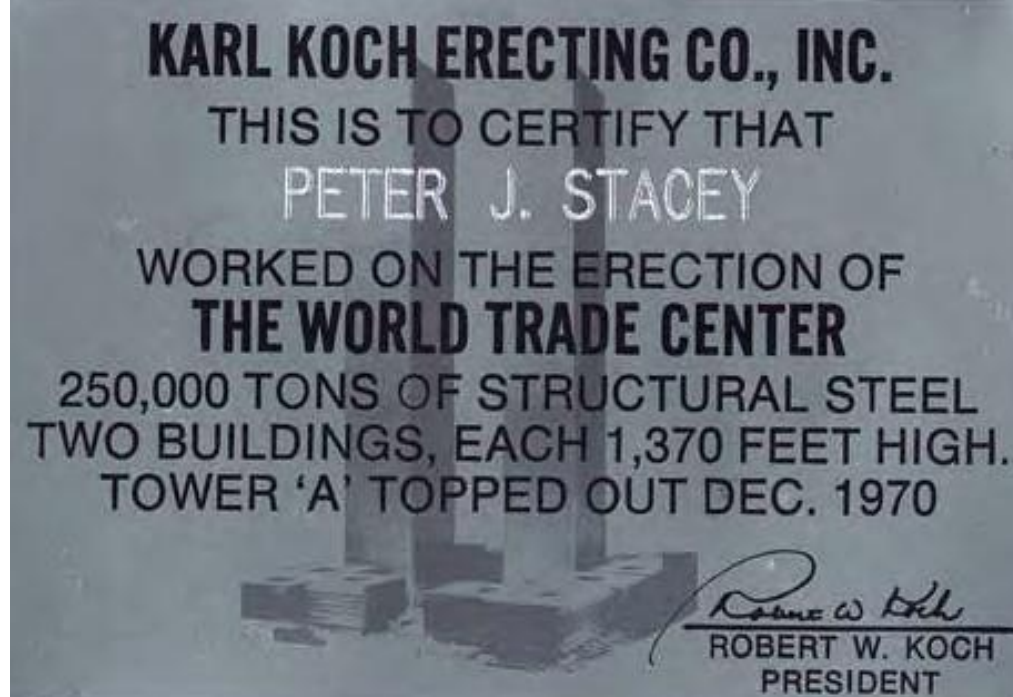


“The Mohawk ironworkers were long known for their inclination to go from job to job, leaving one for another on a whim lured by who-knew-what. The other thing they were known for, of course, was their fearless affinity for high steel.”

Karl Koch III

“Tobacco burning means that you’re communicating with the creator and giving thanks to the creator. You’re burning tobacco and it rises up and the creator knows that you’re speaking to him truthfully and honestly and you’re being thankful. So we always carry tobacco – it’s just a little bit of medicine to help you. We always have it close by.”

Brad Bonaparte – WTC Mohawk Ironworker



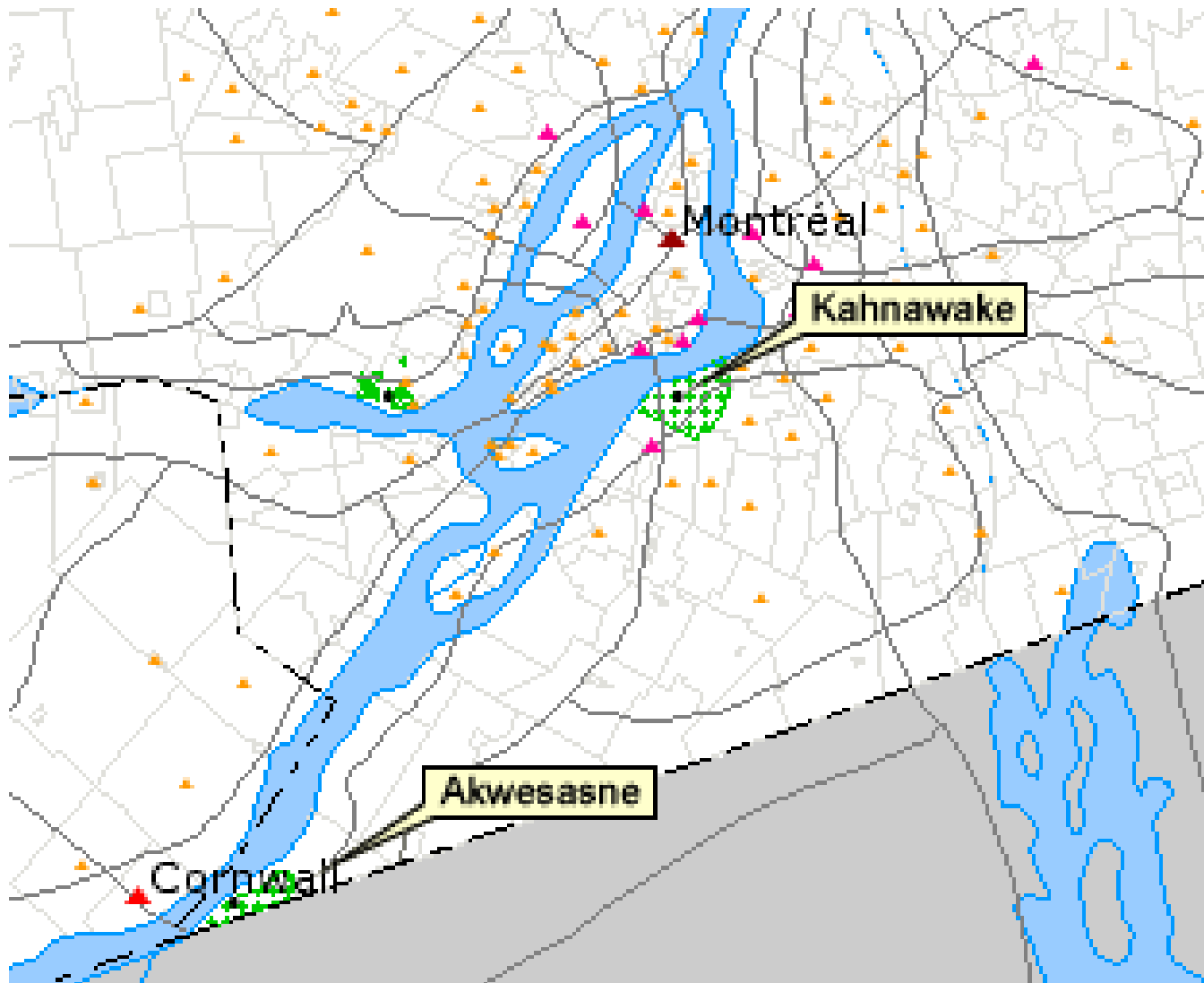
“I remember fog really socking that whole place in. We got up on the work floor, the Kangaroo cranes stood at least three floors above that. You couldn’t see it, couldn’t see anything. And then you’d hear ice crashing down on the floors below. So we went back down and we reported to the office that it was too dangerous to work. That was the last time I saw the Trade Center. But the 110th floor was up.”

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Peter Stacey – WTC Ironworker

“I was young at the time, the height didn’t bother me. Once they put me on the 45th floor. They tied a rope around me, and they just lowered me over the side, and I would shoot the bolts in from the outside so they could put the nuts and washers on from the inside. It was a little high over the side – forty-five floors just with a line, but I thought maybe that’s what they always do.”

Randy Horne – WTC Mohawk Ironworker



Mohawk Reservations
On the St. Lawrence River near Montreal, Canada

“The Fuji Bank, which would be occupying floors 79 through 82, wanted to install a 10,000 pound safe. It was too heavy to install without additional support so steel plates were welded onto both sides of core columns, all the way down to the Basement. Also, dampers designed by Leslie Robertson to reduce movement of the building in the wind were installed throughout the towers.”

RE: excerpt from: *Men of Steel*



“Sidewalk Superintendents”



“I used to sit there at lunchtime; I’d sit on the edge and unwrap my sandwich and I’d drop the paper out in the breeze and watch it float over the city as I’d eat my sandwich. And you get this feeling that you want to know what it feels like to just jump off the building, just like float, you know, like fly – just this urge. You’re comfortable with it, you’re not afraid of it anymore and you feel like you can. You have to watch yourself, a lot of guys have told me the same thing.”

**Steve DeSmidt, WTC
Ironworker**

“When the first tenants move into the 110-story north tower of New York City's World Trade Center near the end of next month, the building won't be finished. It will, however, be just about completely clothed in its permanent silver-toned aluminum sheath and most of its windows will be glazed. The wall panels have been raised to the 68th floor and they are going on and up at the rate of four to five floors a week. As in any well run job, rapid progress stems from many things including competent long-range planning, good management and coordination and cooperation among designers, suppliers, owners and contractors. For the Trade Center wall panels, the extensive use of specially built castings, jigs, templates and machines speeds up the job. One casting permits a four-man crew to set a wall panel accurately in minutes. Job and shop-built templates and jigs enable one and, at most, two-man crews to set and attach quickly and precisely every component in the wall system, with no one holding the pieces. There is one precision machine that drills a dozen 9/16-inch diameter holes through 1&3/8-inch high-tensile steel in 45 to 50 seconds. Another rapidly and safely sets exterior wall panels from inside the building.”



“...seem to go on endlessly in the upward dimension, as though being constructed by battalions of exuberantly unstoppable madmen, determined to keep building until the architect decides what kind of top he wants.”

Russell Baker – Columnist, *New York Times*



Strike!

“The tugboat captains were our truck drivers. If they didn’t work, we didn’t get our floor panels from our plant in Carteret, NJ to the job site. The reason they had the job in the first place was that barging the floor panels to the site seemed the only realistic way of doing it...It wasn’t very surprising when the tugboat union went on strike in March of 1970. Unions love it when a contract expires right before a major job; they’ll never be in a better bargaining position.”

Karl Koch III



“Ray Monti called on his Seabee ingenuity and came up with an idea; why not get the biggest, strongest helicopter and fly the floor panels across the bay one by one. Sikorsky’s S-64 Skycrane could lift ten tons and the PA could have it for just \$18,000/day...The pilot of the S-64 got her up and began flying upstream toward NY Harbor. He got past the Goethals alright, but as drivers halted on either side of the Bayonne Bridge and watched spellbound, the panel started to wobble and swing so wildly that there was a danger of losing control of the helicopter. He pushed the red button that drove an explosive charge to cut the cable. The floor panel crashed into the water just beyond the bridge and sank to the bottom of Arthur Kill.”

RE: excerpt from: *Men of Steel*

“The first thing I had to do was get an escort. I went down to the state troopers in Trenton and described what I wanted to do. They gave me one state trooper for each county, but I had to get the county or city escorts myself. So I set it all up. It was a lot easier than I thought it would be...

‘What do you mean what am I doing to you?’

‘We’re on strike!’

‘Well, God bless you, I’m not. But you know what? A handful of you guys usually bring these panels over here by barge. Do you know 2,000 guys are gonna be out-of-work if they don’t have these panels? I’m gonna haul them until you dummies go back to work.’

Tom Petrizzo, Trucker

“The panels we needed arrived at the WTC site at 3:00AM; five hours after starting out. Tom and his drivers left the flatbeds at the site and retrieved them the next day after our cranes unloaded them. In three weeks, he transported 660 panels; 10% of the entire project before the strike ended.”

Karl Koch III

“There were two other strikes during the three years of construction for the WTC. The teamsters went out, shutting down concrete deliveries, but only for a couple of days. A citywide strike by the International Union of Elevator Constructors, whose members operated the temporary hoists, was extremely disruptive but it didn’t shut down the job. The strike occurred as the 44th floor of the north tower was being set. The men had to walk up stairs to get to the floors under construction during the strike.”

RE: excerpt from: *Men of Steel*



“The 23rd of December 1970 came up cold, damp and gray. It was nearly two years and five months after that hot morning in August of 1968 when the first grillage for the north tower was set at the bottom of the bathtub. Now, there were 117 levels of steel sitting on it. Down on the street, the 100,000th piece of steel – the topping out piece, was about to be hoisted with an American flag on a pipe tied around it.”

RE: excerpt from: *Men of Steel*





“It was my family’s company, started by my grandfather and father in 1922, that found itself forty-five years later with the job of the century; 200,000 tons of structural steel, six million square feet of floor panels and a work force of 600...The WTC provided the foundation for a fatal betrayal of family trust that would be the defining saga of my life...For me, the WTC was the best and worst thing that ever happened to the Koch family...After buying us out in 1974, my uncles sold the company to Skanska, an enormous international construction conglomerate based in Sweden. In 1989, the company was renamed Koch-Skanska with annual sales of \$102 million and a net worth of \$52 million”

Karl Koch III

Part 9

Days of Infamy

February 26, 1993



“A time bomb-laden vehicle could be driven into the WTC and parked in the public parking area...At a predetermined time, the bomb could be exploded in the Basement...The Assistant Deputy Director of the FBI thinks this is a very likely scenario for the WTC and has described it graphically in conversations with OSP staff.”

**RE: PA anti-terrorist unit OSP (Office for Strategic Planning)
internal security report, 1985**



“Most experts agreed that while the towers could be hurt by a bomb, they could not be destroyed. The 1993 terrorists had driven 1,200 pounds of explosives into the basement. Even so, the base of the towers – the strongest part of the buildings, easily deflected the explosion.”

RE: excerpt from: *102 Minutes*





“Without elevators, sending companies to upper floors in large high-rise buildings is measured in hours, not minutes”

Donald Burns - FDNY commander at the 1993 WTC bombing

RE: it took a firefighter carrying +/-60 lbs. of equipment about one-hour to ascend twenty-five floors by stair

“The fire-warden program had been given fresh emphasis at the WTC after the 1993 bombing, although wardens had been required for most skyscrapers long before then. In effect, they were a human measure meant to make-up for what the FDNY saw as safety deficiencies in tall buildings like the WTC, erected under the 1968 building code. The 1968 code, championed by the real estate industry, had made it cheaper to build tall buildings and more profitable to own them. It had been enacted over numerous objections from FDNY, which complained that fire safety was being compromised. After fires in two new skyscrapers killed five people in 1970, the city required owners of private skyscrapers to operate a fire-warden program as part of Local Law 5 – a package of safety measures enacted at the request of fire commissioner John T. O’Hagan.”

“To maintain the WTC as a Class-A office space, the PA would have had to spend \$800 million rebuilding its electrical, electronic, communications and cooling systems. A repair bill of some \$700 million and hundreds of millions in lost revenue followed the February 1993 bombing. With an annual budget of \$2.6 billion and the ability to generate capital through bonds, tolls, fares and airport tariffs, the PA had the wherewithal to rebuild the WTC.”

RE: excerpt from: *102 Minutes*

September 11, 2001



“And they cast dust on their heads and cried, weeping and wailing, saying: ‘Alas, alas, that great city wherein were made rich all that had ships in the sea by reason of her costliness! For in one hour is she made desolate’”

Book of Revelations 18:19



Saturday, July 24th 1945





The Times Company

Y. JULY 29, 1948.

Printing Office
and News Editor

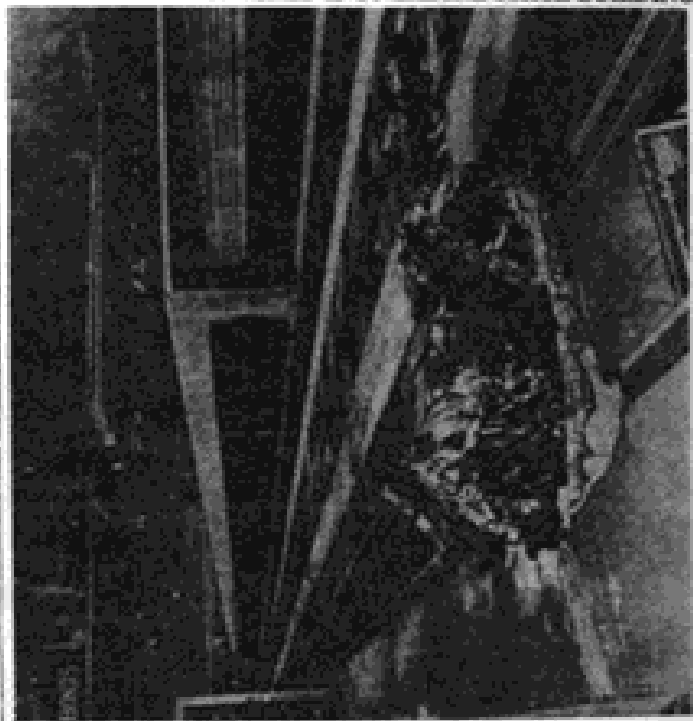
TELEPHONE

100 N. York St. and Broadway, 100 N. York St.

BOMBER HITS EMPIRE STATE BUILDING, SETTING IT AFIRE AT THE 79TH FLOOR; 13 DEAD, 26 HURT; WIDE AREA ROCKED

WHERE BOMBER CRASHED INTO EMPIRE STATE BUILDING

B-25 CRASHES IN FOG



Hole 18 by 20 Feet Torn
Through North Wall
by Terrific Impact

BLAZING 'GAS' SCATTERED

Flames Put Out in 40-Minute
Fight—2 Women Survive
Fall in Elevator

By FRANK ARAM

A two-engine B-25 army bomber, lost in a blinding fog, crashed into the Empire State Building at a point 18 feet above the street level at 7:58 a. m. yesterday. Thirteen persons, including the three occupants of the plane and six persons at work within the building, were killed in the catastrophe, and twenty-six were injured.

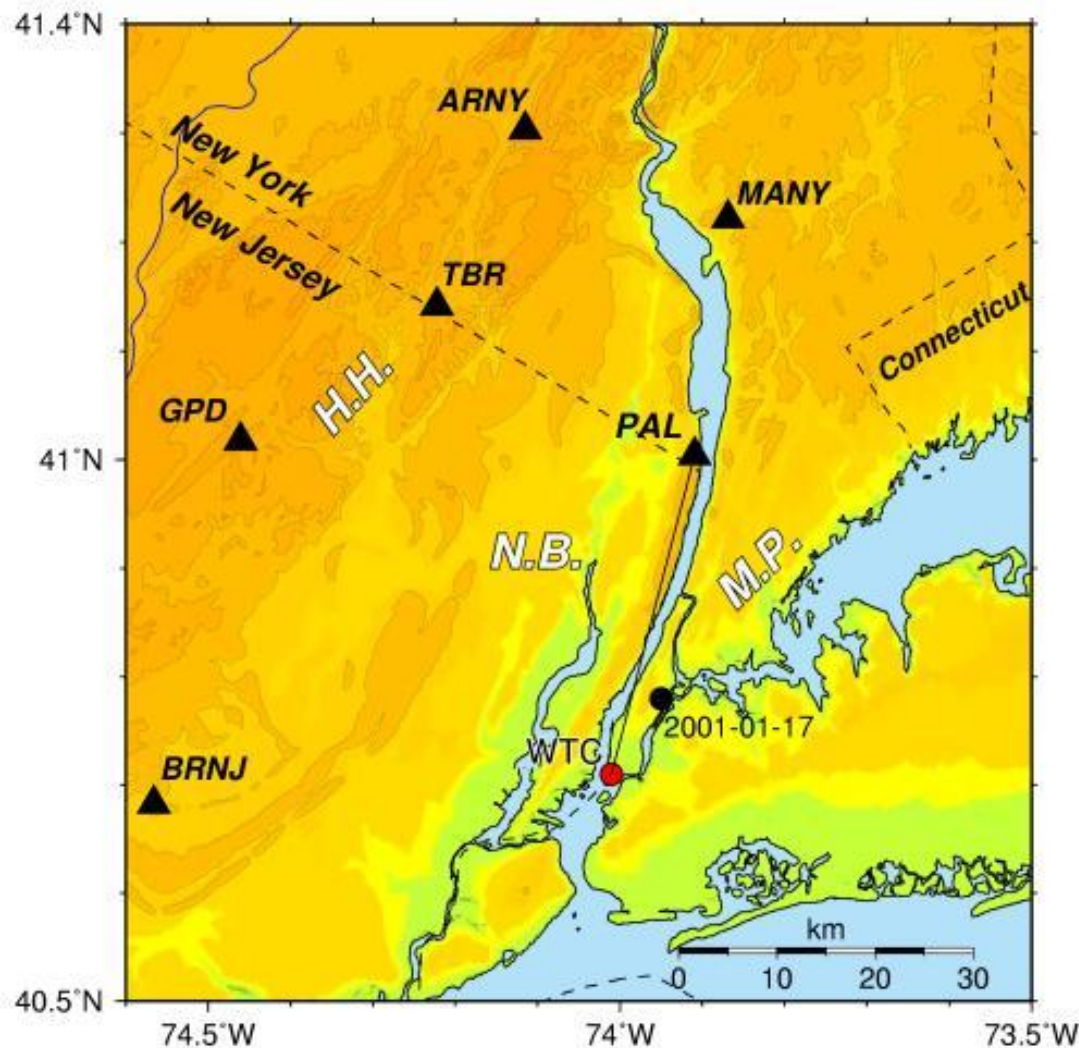
Although the crash and the fire that followed wrecked most of the seventy-eighth and seventyninth floors of the structure, causing damage estimated at \$200,000, Louis, Gen. Hugh A. Dixon, president of the Empire State, Inc., Corporation, said last night that no inspection by the city building department and by other engineers and architects showed that the structural members of the



“For hundreds of people on the upper floors of the north tower death had come in a thunderous instant. The remains of one man who worked for Marsh & McLennan, which occupied space on the 93rd to 100th floors, would later be found five blocks from the tower.”

RE: excerpt from: *102 Minutes*





When American Airlines Flight 11 hit One WTC at 450 mph, the impact registered on seismographic instruments in Columbia University's Lamont-Doherty Earth Observatory in Palisades, N.Y. – twenty-two miles to the north, generating signals for twelve seconds. Literally, the earth shook.

RE: excerpt from: *102 Minutes*

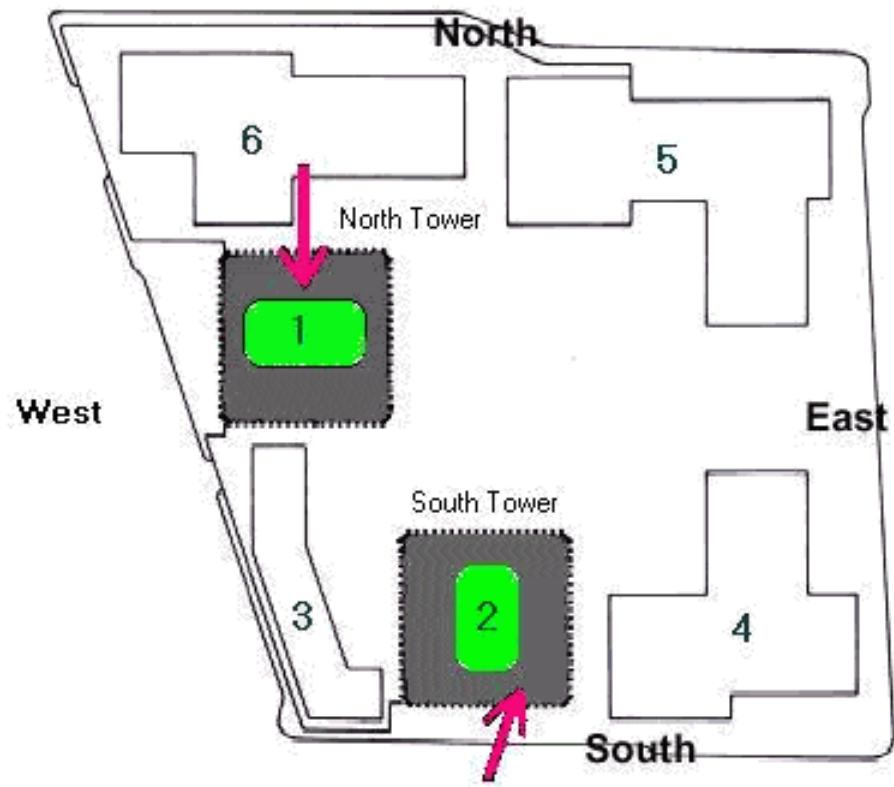
Seismographic Stations & Topography for the Greater NYC Area:

- * Red Dot: 9/11/01 seismic events
- * Black dot: epicenter of January 17, 2001 earthquake
- * Black Triangles: stations that recorded 9/11/01 seismic events
- * NB: Newark Basin / HH: Hudson Highlands / MP: Manhattan Prong













“The FDNY could fight a fire on one floor, maybe two. They could not handle what confronted them; at least five floors fully engulfed. Each fire hose expelled 250gpm, enough to dose a fire spread across 2,500 SF. With multiple hoses, they might be able to battle a fire that stretched across a single trade center floor of 40,000 SF, but not five floors and certainly not – as it turned out, without water.”

“One of the best-kept secrets of two towers of the WTC was that their structural steel had never been fireproofed to the satisfaction of the WTC’s engineers and/or architects. No one had ever tested the fireproofing of the steel in two of the tallest buildings in the world. In fact, it was literally crumbling off. Not long after the 1993 bombing, the PA began to replace the fireproofing. By September 11, 2001, the PA had completed only 30 of the 220 total floors in both the towers.”

RE: excerpt from: *102 Minutes*





Death of Father Judge – FDNY Chaplain
(first official 9/11 casualty)

Catastrophic Collapse

















Aftermath



BUILDING STATUS

- | | |
|---|---|
|  Not affected |  Major structural damage |
|  Needs Cleaning |  Destroyed |
|  Damaged but stable |  In danger of collapse |





Greek Orthodox Church

**The only structure
completely destroyed
on 9/11 other than
WTC 1 thru 7**















Fritz Koenig's Plaza Sculpture





























Rescue & Clean-up







“The fuselage of the plane, the motors and the wheels are back there. Those guys in the tent are all FBI, NYPD or ATF. They’re finding wallets, watches, all kinds of jewelry and personal belongings. That’s the coroner’s area. There was so much being found at the beginning they had refrigerator trailers.”

Tom Petrizzo, Trucker

RE: hired during the 1970 strike to haul the floor panels, Petrizzo was hired by NYC to bring the scrap of the WTC to the re-opened *Fresh Kills Landfill* on Staten Island





“It was about thirty-feet high. Now, most of it was gone, shipped out to Hugo NeuSchnitzer in Jersey City, the biggest scrap dealer in the country. By now a lot of it was on its way to China to be melted down and recycled.”

RE: excerpt from: *102 Minutes*



In Memoriam











**Fritz Koenig's
Plaza Sculpture
Recovered & relocated to
Battery Park as a permanent
memorial to 9/11**







TO HONOR AND REMEMBER THOSE WHO LOST THEIR
LIVES ON SEPTEMBER 11, 2001 AND AS A TRIBUTE TO THE
ENDURING SPIRIT OF FREEDOM

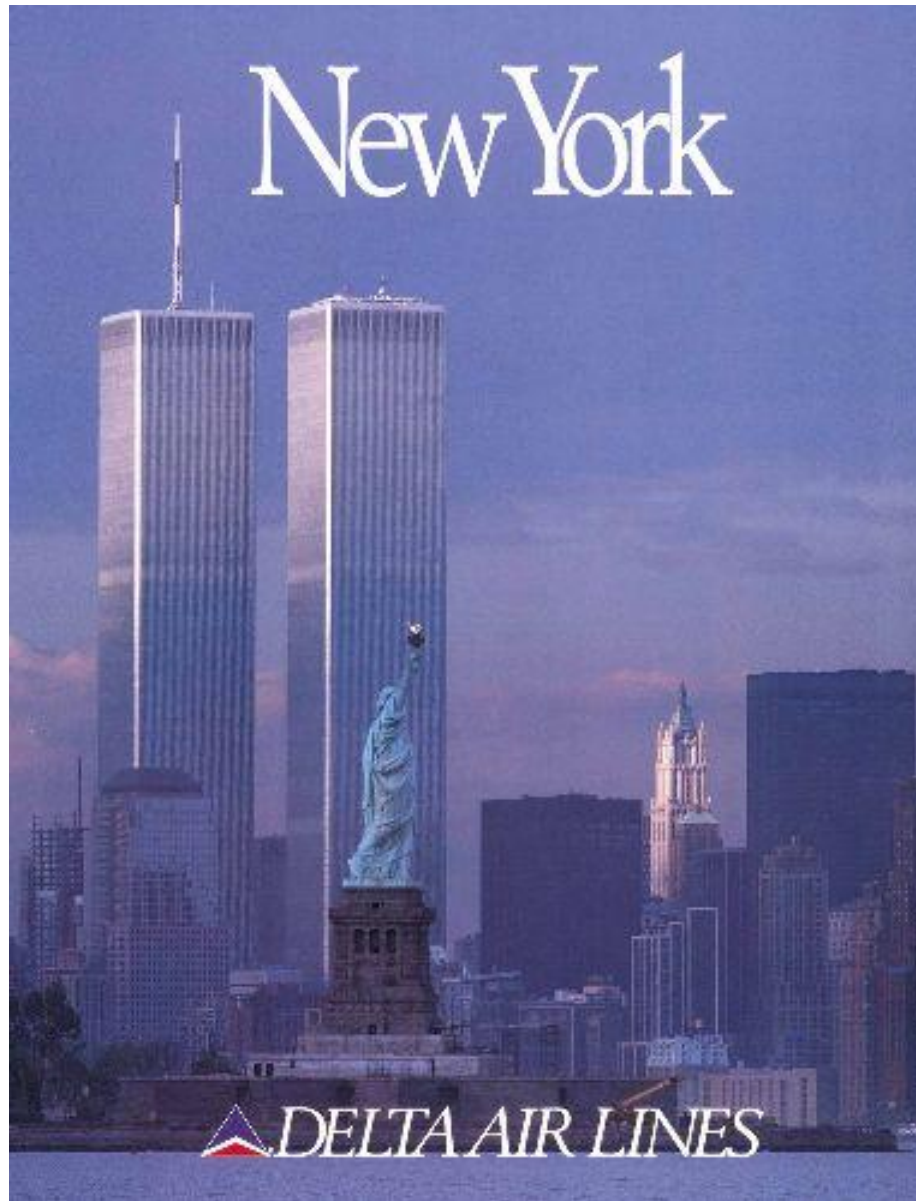
Part 10

Legacy



“It turned out that the Committee for a Reasonable WTC was right when it predicted that the PA could fill one but not two towers with companies engaged in world trade. The PA wound-up renting to anyone with a check and didn’t turn a profit on the buildings until 1981. Eventually, control of the WTC changed hands. In 1999, developer Larry Silverstein bought the 99-year lease for \$3.2 billion.”

RE: excerpt from: *102 Minutes*



New York

 DELTA AIR LINES

“I was competing against all the other people who were developing buildings around us in New York City. We’re going to have ten or twelve million square feet of space and I have to fill it, or I get fired.”

Guy Tozzoli, WTC Director



“In 1974, as the commodities exchange combined their operations under one roof. Silver and copper coins, packets of coffee and sugar, oranges, potatoes and wads of cotton were planted beneath the cornerstone of 4 WTC. The PA had secured the exchange as WTC tenants by offering them a rent subsidy that allowed them to pay \$3.00/SF – less than a third of what NYS taxpayers were spending to rent four million square feet of Tower Two.”

RE: excerpt from: *102 Minutes*



“The Port of New York Authority last week said its World Trade Center in New York City’s lower Manhattan will cost \$575 million, a jump of 9.5% from the \$525-million estimate announced in 1965. Four years ago the cost was pegged at \$270 million. The estimate subsequently went to \$350 million, and in 1965 rose again to \$525 million. The organized opposition to the center, the Committee for a Reasonable World Trade Center, says even the new estimate is too low. Lawrence A. Wien, committee chairman and head of the syndicate that owns the Empire State Building, says the center will cost a minimum of \$750 million. Others believe its cost could top \$1 billion.”

RE: excerpt from: ENR (January 1967)

“The WTC was dedicated on April 4, 1973, by which time its cost had reached \$700 million.”

RE: excerpt from: *102 Minutes*



“It was raining”

Austin Tobin

RE: reason given by the former PA director as to why he was not present at the WTC dedication on April 4, 1973



“For hours, a rapt crowd watched from the plaza as a ‘human fly’ used homemade climbing equipment to inch his way up Tower One’s façade to the summit. In 1972, a daredevil skydiver made a bull’s-eye landing atop Tower Two and an unemployed construction worker protesting the plight of the world’s poor, parachuted off Tower One landing safely in Austin Tobin Plaza.”

RE: excerpt from: *102 Minutes*



*“When I see three
oranges, I juggle; when I
see two towers, I walk”*

Philippe Petit

“To anyone gawking from a car window during those last few grimy miles through New Jersey to the Holland Tunnel, it appears that there is no skyline anymore, just those looming twin towers. Even in aerial views of Lower Manhattan these days, the towers look like the two tallest kids in a choose-up basketball game.”

Glen Collins – Writer, NY Times Magazine





“To his credit, Leslie Robertson has not run away from the scrutiny of his design. At a meeting of the National Council of Structural Engineers Association in New Hampshire on October 5, 2001, someone in the audience asked Robertson if there was anything he wished he had done differently in the structural design of the WTC; he broke down and wept at the podium. He held the position that it was impossible to design a terrorist-proof building. Instead, he said we should make sure we keep terrorists out of the cockpits of airplanes.”

RE: excerpt from: 102 Minutes



“Most of the tall buildings that we’ve designed recently, we share the load, we share the wind and earthquake forces between the core and exterior. In the WTC, the tube was so stiff they didn’t put any lateral load resistance in the core...I still think the weak link was the floor system...I think people will think twice before they use a long-span open-web joist-type design on a large, important building.”

Charles Thornton, Partner - Thornton-Tomasetti Engineers



**September 11th Memorial
(model)**



“We really wanted our design to be grounded in something that was very real, not just in sculptural sketches. We explored the infrastructural challenges because the proper solution would have to be compelling, not just beautiful. The design does have great sculptural implications, and we fully understand the iconic importance of the tower, but it also has to be a highly efficient building. The discourse about Freedom Tower has often been limited to the symbolic, formal and aesthetic aspects but we recognize that if this building doesn't function well, if people don't want to work and visit there, then we will have failed as architects.”

David Childs, Architect

RE: his design for *One WTC*

(a.k.a. *Freedom Tower*)

“All the men are working in conjunction to put this building up. They all know how important this is to the country – and to show the world what us Americans can do...”

George Collins - Deputy Foreman, *Freedom Tower*