Trailblazers with Walter Isaacson
Skyscrapers

It's October 23, 1929, the height of the Roaring Twenties in New York, and 900 feet above the streets of Manhattan, the Vertex is about to be unveiled to an unwitting public.

Very few people know about the Vertex, or even what a Vertex is.

A 125-foot-long metal spire, it's been constructed in total secrecy inside the walls of the then-under-construction Chrysler building.

An icon of the New York skyline today, the Chrysler building was at the time a participant in a furious race to the heavens.

Its competitor: the Bank of Manhattan Trust Building at 40 Wall Street.

The builders of each were determined that their skyscraper would be the tallest building in the world.

And what made the competition even more heated was that the two visionary architects behind the buildings, William Van Alen for the Chrysler Building and H. Craig Severance for the Manhattan Bank Building, were former partners turned bitter rivals.

All of New York seemed to be watching as the two men duked it out, altering their plans in mid-construction, each determined to triumph over the other by constructing a taller building.

Van Alen kept his secret weapon under wraps until the Bank of Manhattan Building's height, at 927 feet, was officially announced in the newspapers, along with the claim that his arch-enemy Severance had won the competition.

And then, on October 23, in a feet of incredible engineering and derring-do, his workers removed the pieces of the Vertex from inside the Chrysler building and assembled it in mid-air.

The Chrysler Building was now the tallest in the world.

But Van Allen's triumph would be bittersweet. As monumental as they were, the Bank of Manhattan Trust Building and the Chrysler building couldn't escape the fact that the very next day after the vertex raised, the stock market crashed.

The Great Depression had begun.

These monumental skyscrapers, soaring symbols of the Jazz Age, were about to nearly bankrupt their owners.

But the impression they left on the public would define cities for a century.

I'm Walter Isaacson, and you're listening to Trailblazers, an original podcast from Dell Technologies.

INTRO:

Skyscrapers have always brought together cutting-edge technology, incredible feats of engineering, huge amounts of money and, at times, even bigger egos.

Ever since the first buildings of 10 stories or higher were built in the 19th Century, they've captured the public's imagination and becoming icons of the cities whose skylines they dominate.

This century has seen them reach even higher, with the first 1-kilometer building scheduled to be completed next year.

And while they're still highly expensive trophies for cities like Dubai who want to show off their wealth to the world, the newest skyscrapers are more than just symbols.

They're at the cutting edge of innovation, leading the way for sustainable technologies in an era where our cities keep getting bigger.

Skyscrapers might just be our future.

ACT 1

And if you believe the story, it all began with a birdcage.

There was a fundamental problem if you wanted to build a structure more than four or five stories tall, and that was: walls.

Up until the late 19th Century, buildings were held up by their exterior masonry walls.

That meant the taller the building, the thicker the walls had to be to carry its weight.

When a Chicago architect by the name of William LeBaron Jenney was charged with designing the 10-storey Home Insurance Building in 1884, he was eager to find a new, lighter way of construction.

As the story has it, Jenney returned home from his labours one evening.

His wife stood up to welcome him, laying down the book she was reading on top of a birdcage in the family's salon.

Jenney was immediately struck by how this light structure could easily support a weighty hardcover tome, and cried out, "If this little cage can hold a heavy book, why can't an iron or steel cage be the framework for a whole building?"

The age of the steel frame skyscraper had begun.

Carol Willis: 09:18 *Steel allows buildings to have very small points on which they come down into the ground down into the foundations that stabilize them, so that that point support of a metal grid instead of a big thick bearing wall made of brick or stone.*

Carol Willis is an architectural historian and the founder, director and curator of the Skyscraper Museum in New York City.

Carol Willis: *It's the way that buildings become not just taller but more open in the space and creating the interior floor space. So without steel skeleton technology going higher than about 10 stories is, is really not feasible or economic, even though taller buildings than that existed. For example, in Chicago, the Monadnock building, which was about, um, 14, 15 stories tall, but at its base in 1891 had 12 foot thick masonry walls.*

The word "skyscraper," which was originally coined in the 18th Century to refer to particularly tall racehorses, starts being used to refer to this heighty, steel-framed buildings.

And although the first skyscrapers were built in Chicago, it's in another American city that they truly took root.

By the beginning of the 20th Century, New York City was a boomtown.

And, crucially, its most coveted land was in Manhattan, an island of very limited dimensions.

Carol Willis (~4:00) *So with technology going hand in hand with the process of urbanization, we think of New York at the, at the turn of the 20th century, of immigration with a gigantically expanding population. All of those kind of surging business interests express themselves in, the*

value of land and the capitalization of the value of that land in tall buildings.

To "make the land pay," as developers of the time said, they had to squeeze more office space out of relatively small footprints.

There's nowhere to grow but up.

By the 1920s, skyscrapers weren't just a way for developers to squeeze out some extra dollars.

In New York, they're representative of a whole, swinging, post-WWI attitude, and they start to go up in droves.

Neil Bascomb: 06:58 *Right about when the 1920s really came to fore, they exploded onto the scene.*

Neil Bascomb is the author of *Higher: A Historic Race to the Sky and the Making of a City*.

Neil Bascomb: *Prior to that you would have in New York at least, you know, a new building go up every 10 years, that would, ~~that would~~ raise the height level. But ~~it wasn't only,~~ it was only in the 1920s with America really coming into its own after World War One, this idea of American greatness, the stock market mania, real estate prices were shooting, uh, through the roof. There was all this mania ~~over,~~ over being faster and contests and gambits to, to go higher. And so in New York, that really became a focus. ~~And so~~ you have almost on a weekly basis~~, uh,~~ developers announcing buildings that are going 800 feet, a thousand feet, 1500 feet high, even though many of them were just dreams and illusions. But there was this kind of stir and momentum, uh, that came with the roaring twenties, ~~uh,~~ for New York in particular to put its mark on the world. And they were going to do that with skyscrapers.*

And while the motives were supposedly financial, there was always another element at play whenever someone set out to build the tallest building in the world.

Neil Bascomb 09:37 *The building of them, yes, is a financial decision. But for the developers, for the builders like Walter Chrysler who were putting ~~the names,~~ their names on these buildings, it was about a personal statement. It was about ego. It was about Hubris. It was about making the world know what a success they were. And so that's why you have the Chrysler building. […]*10:53 *Walter Chrysler said very early in the construction of his building is to his architect, William Van Allen, "I want to build a monument to me."*

Add to that the rivalry between Van Allen and H. Craig Severance, his former partner and architect of the *other* tallest building in the world, and you have the makings of a very personal battle being waged on Manhattan's streets.

A dispute over who deserved credit for their buildings had split up the successful team years earlier, and there was no shortage of bad blood between them.

Newspaper readers ate it up.

Neil Bascomb [~23:00] : *The public could not help but be aware of this race because almost on a daily basis they were tracking the progress of these buildings, uh, sudden announcements, um, from the architect saying that they were going to go higher. And ultimately, you know, at one point a in October naming the Bank of Manhattan building as the winner of this contest, ~~uh,~~ only to be surpassed by first the Chrysler building and then the empire state.*

Ultimately, the Chrysler building would only wear the crown of world's tallest for a little over a year, before the upstart Empire State Building came along and surpassed it with startling speed.

Ironically, while Van Allen's vertex spire edged it out over the Bank of Manhattan building, it was a very of-its-time zeppelin docking station erected on the top of the Empire State Building that caused it to surpass the Chrysler.

(The whole thing was as much of a stunt as the vertex, and no airship ever actually docked there, despite a widely-circulated fake photo.)

When the stock market crashed, it created a financial cataclysm that meant it would take decades for these buildings to make a profit.

Famously, the Bank of Manhattan Trust building, the bronze-medalist in the height wars, would be sold off for less than the cost of its high-speed elevators.

These days, it's known by the name of a developer who bought it in the mid-90s for, he claimed, only a million dollars. It's new name: The Trump Building.

Whether they were financial successes or not, the skyscrapers of the early 20th Century helped define, and still do, what a modern city looked and felt like.

Neil Bascomb 25:24 *The building of these skyscrapers are integral not only to our vision of what New York is, so you can't drive towards Manhattan without, um, seeing these, these, these tall needles and that's your image or idea of New York. But the skyscrapers were also integral in the development of the, of the culture of New York because they allowed for a density that had never been seen before~~, uh, in man.~~ So you have these buildings, you know, 68 stories high, 72 stories high, filled with workers. It changed the, the way that people worked, the density, it changed the vibrancy, uh, of the city. And so the skyscrapers are every bit of every bit as much a part of, of New York and, and what it is than, than anything else. ~~They are, I think it's, it's as~~*

~~old as time as a, as I said, uh, that people continue to try to, to build highest. Um, and you know, it's, it's lovely. It's exuberant. It's,~~ it's part of what makes these cities interesting and you see it in New York today where developers are going higher and higher and higher. ~~Um,~~ and people are still captivated by that.

ACT 2

The Art Deco skyscrapers of the 1920s and 1930s still define Manhattan as we know it, but it wasn't until after the second world war that the truly modern skyscraper came into being, as technological advances allowed for tremendous innovation in the way they were built and looked.

The exterior shell of a building, called curtain walls, long removed from the duty of holding up the structure, started to be built with steel and glass. Carol Willis:

Carol Willis: [~11:00] *The great advances came after World War Two when welded steel, which is much stronger in its joints, makes more rigid joints. was able to allow architects and engineers to make those steel frames lighter than they had been when they were riveted by, ~~uh,~~ crews of, of riveters who had red hot steel rivets, like, like bolts on that they drove into the holes, ~~the existing, uh, holes, uh,~~ of the, ~~of the, the um,~~ steel I-beams of, ~~uh,~~ the frame of the building.*

Speaker 1: 11:39 ~~Like the empire state building. So~~ *the advance of steel skeleton construction after World War Two made buildings that were lighter and stronger. And they also allowed for the advancing technology of glass and glass curtain walls, which changed dramatically the appearance of buildings from the kind of stone mountains that you see in the 1920s and early thirties in New York buildings like the Chrysler building or the empire state building. And then in the postwar period, these glass boxes where there's as we call it, ~~uh,~~ a curtain wall of glass, like a membrane that just~~, uh,~~ separates the*

inside and the outside so that the visual connection from the interior of the building is no longer through a fixed window.

Some of the more famous buildings from that era are the Headquarters of the United Nations and the Seagram Building in New York City.

Sixty years later, they still look remarkably modern.

Over the second half of the 20th Century, other prosperous cities began to follow New York's lead.

Hong Kong, an island city like Manhattan, underwent a building boom in the 1970s, leading to it having the world's largest concentration of skyscrapers, with over 8,000 high-rises in its greater urban area.

When Dallas was flushed with oil money in the 1980s, the glass and steel towers went up.

And now, it's the oil-rich metropolises of the Middle East that are fuelling a new skyscraper boom.

Bill Baker: 13:10 *When we were designing, uh, what was originally called the Burj Dubai, now called the Burj Khalifa, ~~uh, the,~~ the remit from the client was the world's tallest building.*

Bill Baker is a structural engineer at the Chicago firm Skidmore, Owings and Merrill.

He's best known for engineering the Burj Khalifa, which since its opening in 2010 has held the crown of the tallest skyscraper in the world.

When Baker and his team took their original 518-meter design into their test wind tunnel, the structure couldn't stand up to the high winds it would face in the desert.

Wind is perhaps the biggest challenge tall buildings face.

When high winds encounter tall buildings, the gusts create a swirling pattern called a vortex.

Which can be highly destabilizing.

Bill Baker: 06:31 *one of the things we'd like to do, which, uh, enables to do these very, very tall buildings is we like to do what we call "confuse the wind." So, uh, if you have a building that's of say a square, uh, plan that that's uniform from top to bottom, you can get fairly large vortex shedding forces. Yeah. Cause the vorticies will be organized from top to bottom. And the analogy I like to use is like a child on a swing. Uh, if you have a child on the swing and they kicked their feet and they kick it at the harmonics, uh, of the swing that go quite high, even all they're doing is moving their feet.*

Speaker 2: 07:17 *But if you confuse the wind by changing the, the shape of the building, either the, what it looks like in plan or the width of it, uh, or you put put holes to the building or many other things you can do, what you do is you confuse the wind. ~~And particularly if, let's say the size of the floor plates change as you go up every different zone, we'll have the vorticies happened at a different rate. Uh, the, uh, the smaller the floor plate, the faster the vorticies.~~ And so going back to the analogy of the child or the swing, it's like, instead of the child having two feet kicking at the same rate, the child has maybe a dozen feet and they're all kicking at different rates. And you can imagine the swing would go nowhere. ~~And so the, you know, that's the, uh, uh, so that's what the one thing is we'd like to do.~~ We call it confusing the wind.*

Baker and his team's innovation was a new type of structure they called the "buttressed core."

Over the decades, firms like Baker's had iterated on William LeBaron Jenney's birdcage-inspired steel skeleton.

Chicago's Willis Tower, formerly known as the Sears Tower, is what's known as a "bundled tube" skyscraper.

Like it sounds, it's built out of several enormous tubes, bundled together to resist wind and seismic forces.

To build the huge Burj Khalifa, Baker designed a new variation on the bundled tube, one that allowed him to build way higher than he had ever imagined.

Speaker 2: *14:57* *In the middle of the building where the three wings come together is where all the elevators and some of the stairs are. And a lot of the uh, utilities for the building are in that central area. We call that a core and it's in the Burj, it's a hexagonal shape […]*

Speaker 2: 15:41 *So we, uh, we had this, this core in the middle, but the core in the middle around the elevators and like was great for torsion. But it was too slender to go to great heights. So it needed to be stiffens. So what we ended up doing, we put walls down the corridors coming off of this, uh, core and on the three wings to buttress it, just like the buttresses on a Gothic Cathedral.*

In the end, thanks to this hyper-stable new structure, they were able to build the Burj Khalifa a whole 320 meters taller than the 518 originally planned.

That's approximately the size of one extra Eiffel Tower they were able to add on.

At 2,700 feet total, the Burj Khalifa was the tallest building in the world when it opened in 2010, and, amazingly, it still holds that title nearly 10 years later.

But that record is bound to be short lived, when the Jeddah Tower, a 1 kilometer skyscraper gets set to rise in Saudi Arabia next year.

But all of that will pale in the face of another project in development from Bill Baker's firm, SOM: the Burj Jumeira, which is anticipated to rise 1800 feet from the desert, from a man-made lake.

If Walter Chrysler saw the Chrysler building as a monument to himself, one can only imagine what he would think of that.

While technological advances have allowed buildings to grow taller, they're making an impact in other, perhaps more important ways as well. Software has completely re-shaped the way architects approach design.

In the early 1950s, the first computer-assisted drawing software came into being when an MIT scientist named Douglas T. Ross was inspired by the digital graphics on radar displays to create what became known as computer-aided design software, or CAD.

CAD first took off in the automotive industry, but it quickly became clear that it had a place in architect's offices. And while the early, simple software was useful for drawing up blueprints, it's allowed for increasingly sophisticated modeling, the kind that's essential for designing modern, high-tech skyscrapers.

Scott Johnson [~4:30] *Structural design was really one of the first things where we use computers to track changes in stresses and say a steel frame in a tall building. And, and in some cases, in our case, we applied computers to actually the formal development of architecture in aesthetics.*

Scott Johnson is a design partner and founder at the Los Angeles architectural firm Johnson Fein.

Scott Johnson: 05:37 *It was maybe three decades ago and the architect figured out what he or she wanted to do. And once we figured that out, we sent it around to the engineers and specialty consultants and they applied their overlay on it and we went back and forth till we had a completed design….Today from day one, when you begin to design a process, you share software, usually three dimensional software….It's algorithmic. So you can develop, in theory, formal languages for*

architecture in any way you want. A building does not have to be a rectangle. It doesn't have to have a flat skin. It can be anything that you choose.

But beyond just the rippling, wave-shaped walls of steel and glass that can be created with computer-assisted design, the software also allows the construction of far more energy-efficient and sustainable skyscrapers.

Johnson calls these new types of building "performative."

Scott Johnson: 07:18 ~~The moment that you're on a computer and you're designing with a computer, you can track all of your movements in real time. You can also measure everything. So~~ *you could be designing the skin of a tall building, and ~~one skin,~~ you could measure as you design it, how much solar radiation it would absorb, a lot or a little affecting how much energy would be required to air condition and expel the heat or not.*

Scott Johnson: 08:54 *Most major buildings are trying to achieve, uh, higher levels of performance in terms of reducing the amount of energy. Uh, reduce the amount of carbon they require. And uh, now you can, every little nuance in the design, you can now measure it as you're designing in real time to diminish the amount of energy consumption, which on the whole is about 50% of the entire energy we use in the United States is used in the performance of buildings. So if we can take a meaningful, uh, hit on that, we can significantly reduce our appetite for energy.*

Some engineers are actually using skyscrapers' impressive height to find novel ways to decrease its environmental impact.

Bill Baker:

Bill Baker [~26:40] *I remember going up on the outside of the Burj Khalifa during construction and, uh, it was like July. And so you're right*

on the Gulf, so it's pretty hot, pretty humid. Uh, and then, uh, going up and we go up on the outside on these man hoists and a round level 50 all sudden you start to notice. And then when we got up to level 160, it was like pleasant. ~~Uh, you, you had gone through such, uh, you know, the, uh,~~ the temperature had dropped quite a bit. Uh, the, uh, the humidity had dropped. The air was, had lost, uh, uh, dust in it. And it was really quite remarkable. And so, ~~uh, uh, our, uh,~~ sustainable engineers called it "sky-sourced sustainability" where they would actually try to pull in the, the fresher, cooler air from up high and use it, uh, for the, uh, for the operations of the buildings. And I think, uh, people will get more and more clever about that,

You know, as these, you know, these buildings have a lot of surface area. Can we use that to generate electricity? Certainly the operations, the internal energy use is going way down with better lighting systems and better heating and cooling systems. That's, there's huge efficiencies are starting to be realized there. And so can the outside of the building, uh, through its height by grabbing, um, perhaps, um, you've heard of geothermal, maybe this is sky thermal.

Ultimately, tall buildings' largest environmental impact may be in the way they draw people to live closer to each other and share resources. The closer we live together, the less fossil fuels we need to burn to get around, and the more efficient the systems that keep us comfortable can be.

Scott Johnson:

Speaker 1: 10:10 *Sustainability is a very complex, uh, phenomenon and it has to be, to be meaningful. It really has to be discussed in its complexity. Uh, the amount of what we call embedded energy in a tall, high rise building is probably greater than in a log cabin, meaning the amount of energy it takes to produce a highly specialized, very tall, let's call it very heavy building, is probably greater than a two story log cabin. However, having said that, if you were in a city with a lot of tall buildings, your occupancy density would*

be higher. There would be more people living within walkable distances to the things they need. And in terms of comprehensive understanding of sustainability, people would in theory be walking or taking public transit and the transit costs or transportation costs, use of energy would be significantly less. So, uh, you have to look at sustainability in three-dimensions really.

Carol Willis calls this phenomenon "vertical density," and she believes that properly managed, it's not only sustainable, but can increase a city-dweller's quality of life.

Carol Willis: 29:15 *It's a virtuous circle, so long as, as the necessary companions of open space, which is public and available to all and mass transit, which removes cars from the road and makes people's lives better and the environment better.*

In 2018, the United Nations released a study predicting that by 2050, nearly 70 percent of the world's population will live in urban areas, an increase from today's 55 percent.

While skyscrapers have long been symbols of wealth and ego, as we cluster together more tightly in cities, they may be our only option to survive the growth of big cities and the environmental impact of our growing global population.

Ever since the legend of the tower of Babel, humans have dreamed of reaching the heavens in man-made towers.

Now we may find that our future lies up there in the clouds.

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