Dear Colleagues

The long hot summer days are finally behind us, giving some respite to the many workers striving to bring the Capitol Crossing Project to fruition. In my last Construction Note, I described the steps that will be taken to move the historic Adas Israel Synagogue to a temporary site and then to a permanent site sometime later. By the way, although I have called it the Adas Israel Synagogue, its current name is the Lillian & Albert Small Jewish Museum; it is maintained by the Jewish Historical Society of Greater Washington. The Adas Israel Congregation continues to exist. Its synagogue stands at the corner of Connecticut Avenue and Porter Street, N.W.

If you have walked by the historic synagogue site, you will see that Wolff Movers have begun to mobilize in anticipation of the move. The trenches for the cribbing piles have been dug, the cupola at the back of the synagogue has been repaired and painted, and the windows are boarded or bricked up. The cribbing piles and the hydraulic jacks attached to dollies are now on the site, bricks have been removed to create holes for the steel support beams, and

the three main beams and all of the crossbeams have been set. Yellow metal supports have been placed at the four corners of the building and cables that surround the building will soon be tightened to compress the walls so that the bricks don't shift as the building is lifted from its foundation. The building will be lifted off its foundation on October 31. The move will take place around 10:00 a.m. on November 3.

A major project milestone was achieved in early October when the platform over I-395 between Massachusetts Avenue and E Street was completed. The Manitowoc crane, a mainstay of the project for many months, has been disassembled and removed from the site. I will miss this mighty mover of steel and concrete planks; but its departure signals great progress for Capitol Crossing. The platform completion also means that our Gewirz residents will once again have relatively quiet nights, at least after a section of the E Street Bridge has been demolished and reconnected to the platform. Fortunately, the demolition will be done primarily by saw-cut rather than hoe-ram. Thus the sound emanating from the corner of 2nd and E Streets will be at lower decibel levels than it could have been.

E Street Bridge Demolition

Garage Excavation at 3rd Street

Excavation for the garage on the west side of the project is underway and the old wall along the west side of the highway is being demolished. Pile driving and lagging continue at various points along the perimeter and tie-backs are being installed. (See CONSTRUCTION NOTES March 17, 2015, for a description of lagging and tie-backs. http://www.law.georgetown.edu/campus-services/facilities/construction-info/index.cfm) Concrete is being poured to form the

East Concourse Roof Construction from the North and South

walls and the part of the roof over the East Concourse, and masons are beginning to form the interior walls by laying CMU (concrete masonry units) blocks. They are usually referred to as cinder blocks. Concrete workers continue to pour the walls and roof sections of the new Massachusetts Avenue entrance to the highway. The surface of the F Street Bridge has been paved and contoured by the motorized screed. Columns and decks now rise up to the eighth

Mass. Ave. Portal Entrance

F Street Bridge

floor of the 200 Massachusetts Avenue building and the ninth floor pours will begin in two weeks. Workers have begun installing the plumbing rough-in and ductwork. Temporary plywood walls have been installed on several floors to protect the area as work continues in the building's interior.

Reshores, that is, the metal poles standing between the floor decks, have been removed from several floors of the building. As you may recall from previous CONSTRUCTION NOTES, concrete begins to cure when it is poured. The

Reshores on floors 3 and 4

curing process permits the concrete to attain its maximum compressive strength, generally around 4,000 to 5,000 pounds per square inch (psi). The compressive strength of the floor decks in 200 Massachusetts Avenue is 6,000 psi on the east side and 8,000 psi on the west side. The columns are designed to a compressive strength of 10,000 psi. Curing is dependent upon the moisture of the mixture and the temperature of the air. The core and outer temperatures of the concrete must be maintained within 35 degrees of each other during the curing process or the concrete may weaken or crack. The temperature during the last few weeks has been ideal for the curing process. This should continue for the next month but then the cold may become a factor since temperatures below 40 degrees slow the curing process. Because the building is not scheduled to top off until January, it might be necessary to bring in heating units or blankets to ensure proper curing.

Although the chemical reactions within the concrete continue for many years, workers can usually walk on concrete floors within three days. Nonetheless, the structure cannot support heavy weight loads from the floors and columns rising above for at least twenty-eight days. Consequently the scaffolds and the plywood and aluminum forms must remain in place to support the concrete floors. The forms and scaffolding can be removed after twenty-eight days, but reshores are set in place as the concrete continues to cure. When the reshores are removed, one can walk relatively unimpeded throughout the area and begin to get a sense of the dimensions and possible uses of the space. The

picture above shows the future lobby and retail spaces of the first floor looking west. You can read more about the curing process at http://www.cement.org/for-concrete-books-learning/concrete-technology/concrete-construction/curing-in-construction

Concrete seems to be everywhere, not just at the west edge of our campus but all over the city. The amount of new construction during the last ten years, primarily supported by concrete, is astounding. The fabric of our urban environment has been truly transformed. For longtime residents of Washington D.C., the transformation defies simple explanation. We have witnessed the city's sleepy southern feeling in the 1950s and early 1960s. We have lived through the destruction of many neighborhoods and commercial areas after the assassination of Martin Luther King in 1968. We rejoiced in the city's slow economic reemergence and then ached at its collapse in the 1980s. Finally we watched the resurgence of the city that began in 1992 and which continues today. We now live in a city with an architectural vernacular that is completely different from the past. The four-story Victorian and Italianate buildings that

The Healey Building, circa 1890
surrounded by the Mass. Court
Apartments, circa 2004
at 3rd Street and Mass. Avenue

adorned Washington's downtown and East End in the 19th and early 20th century have almost all given way to tall multi-purpose buildings. While the new urbanists and the preservationists may debate the value of this change, there is no doubt that the Washington cityscape has become increasingly vertical.

Modern urban architecture connotes tall buildings, with arms of steel reaching to the heavens. We recall the famous and fearless steel walkers of the early skyscraper era, often members of the Mohawk Nation, balancing precariously but precisely on steel girders high above the streets and sidewalks of New York and Chicago. Even those early skyscrapers are now dwarfed by their modern successors. The tallest buildings in the world now reach almost

unimaginable heights. Burj Khalifa in Dubai, currently the world's tallest building, is 2,717 feet tall; but it soon will be eclipsed by the Jeddah Tower in Saudi Arabia -- 3,307 feet tall – in 2020, and then the Azerbaijan Tower on the Kazahr Islands – 3,458 feet tall – also in 2020. The latter two are more than ½ mile tall!

But buildings like those have no place in Washington D.C. Washington, unlike those other cities, is a concrete town rather than a steel town. Even from its beginnings, Washington was destined to become a concrete town, although stone and timber were its earliest construction materials. When the Territory of Columbia was created and planned, both Thomas Jefferson and George Washington favored height limitations. Jefferson's experience in Paris convinced him that buildings should be "low and convenient, and the streets light and airy." Washington also wanted low residential and commercial buildings to preserve clear views of the heroic public buildings he planned to commission in the capital city. But Washington, as with most of his ideas, also had more practical concerns. He worried about structural and fire safety in addition to aesthetic delights. The concerns of both men easily found their way into Pierre L'Enfant's original "grand plan" for the city.

In architectural and construction parlance, American cities are considered either concrete towns or steel towns, depending on the building material typically used to create their skylines. Baltimore, for example, at least before its decline, was considered a steel town. So are Philadelphia, New York, the cities of New Jersey, and most other cities along the Northeast coast. Washington, on the other hand, and most of the cities along the Southeast seaboard, are concrete towns. As you might imagine, the cost and availability of material and the cost of local labor are the biggest drivers of the concrete/steel decision. Concrete, you may remember, is made from relatively inexpensive materials -- sand, cement, gravel, and water -- that are found almost everywhere. Steel, however, is expensive to fabricate relative to concrete and often has a volatile pricing structure. Concrete buildings need more workers than steel buildings. Workers bundle the reinforcing steel that sits within the floors and columns, build the scaffolding and the wood and aluminum forms for the pours, and guide the concrete pour for each element of the building. Steel requires fewer workers to rivet or weld the beams and steel structures take far less time to erect. Contractors and owners balance these variable costs in every development project

to determine which type of building will be more cost-effective and therefore, more profitable. The combination of low cost for concrete and the cheaper cost of labor, driven in the south by anti-labor tendencies, has pushed those markets in the direction of concrete. As a result, Atlanta, Dallas, Miami, and other southern cities, unlike those in the northeast, became predominantly concrete towns.

Other factors, however, make a solely cost calculation incomplete. Structural depth also plays a role. The height limitation imposed on buildings in the District of Columbia, rather than solely the cost, is a major reason why Washington is a concrete town. Although many people think that either the Washington Monument or the Capitol Dome is the reference point for D.C.'s height limitation, it is actually the Cairo Apartment Building, erected in 1894 at 1615 Q Street, NW, that caused the statutory limitation. The design of the Cairo is a mere architectural curiosity today, but it sparked an aesthetic outrage among architects and civic leaders at the turn of the century. Then, as now, it was the tallest apartment building in Washington, D.C., visibly taller if one takes the time to study it closely. Towering high above its neighboring churches and residences, the Cairo was viewed as "arrogant" by the citizens of that day. Its Egyptian Revival facade, derived from buildings at the 1890 Chicago Exposition, did nothing to lessen the anger of its critics. In response to this civic outrage, Congress passed legislation in 1899 that limited the height of buildings in Washington to 130 feet. The Act did not mention the Cairo, nor, as the website *Mythbusting: The Height Limit* and others erroneously report, did it concern the height of the Capitol. Congress enacted additional legislation in 1910 that forbade buildings to rise more than twenty feet higher than the width of the street they face. That legislation remains essentially intact today.

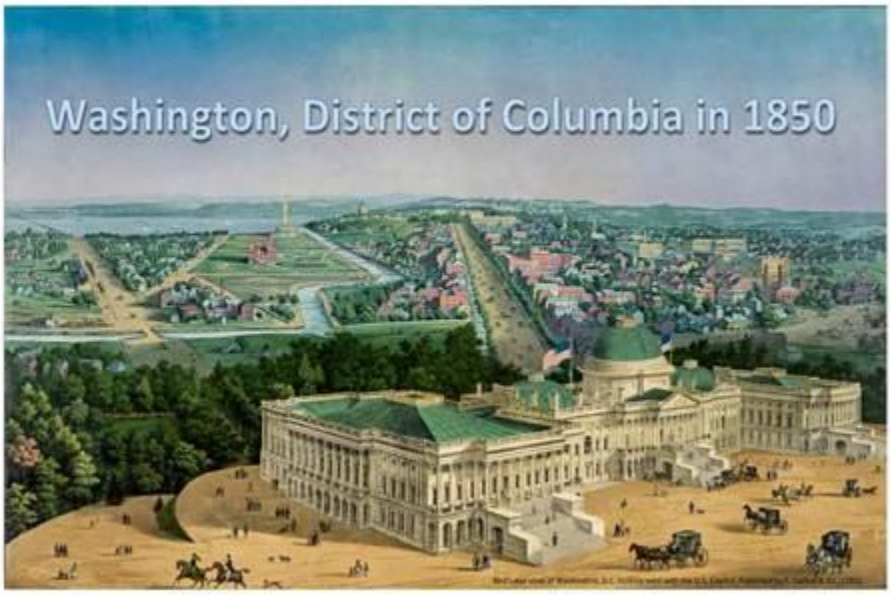
The Cairo became a hotel in 1900 attracting many famous and infamous patrons and remained a hotel until the 1960s. If you are interested in its history, you can read more at https://en.wikipedia.org/wiki/The_Cairo and http://ghostsofdc.org/tag/the-cairo/

The Cairo Apartments

The Basilica of the Shrine

Unlike the Cairo, most buildings in D.C. are limited to about thirteen stories; but there are exceptions. The Basilica of the National Shrine of the Immaculate Conception in Northeast D.C., completed in 1959, received an exemption from the law and is the tallest building in the city other than the Washington monument. It is also one of the ten largest churches in the world. Its height to the top of the cross is 329 feet. The Old Post Office Building, now the Trump International Hotel, was grandfathered in since it was completed in 1899, the same year that the height legislation was enacted. Prior to its repurposing as a hotel, it was the tallest federal building in the city with its clock tower reaching 315 feet above the ground.

Although the debate over the height limit continues today, the restriction continues to drive Washington into the ranks of concrete towns. Because concrete permits a significantly shallower depth between floors and ceilings than does steel, concrete buildings can have more stories and thus, more usable space than steel buildings of the same height. The additional usable space plus the lower cost of materials and labor tells engineers and developers that the return on the developers' investment and the project's profit will be greater using concrete rather than steel. Those equations result in the construction of concrete buildings in almost every development project in Washington.



For over one hundred years, this height limitation has preserved the horizontal nature of Washington that L'Enfant, Jefferson, and Washington originally envisioned. It is why the soaring skyscrapers of Chicago and New York are absent from our skyline and why, ultimately, D.C. remains a concrete town. As my long-time readers know, I am enamored of concrete. Its universality and versatility in the molding of the urban fabric continues to fascinate me. But despite its ubiquitous, it does not come without concerns. Water, gravel, cement, and sand, the essential elements of concrete, are seemingly inexhaustible and benign. But that is not the case. Construction booms in China, Indonesia, India, and the other emerging nations of Asia and Africa, and the extensive beach restoration projects caused by storms, rising oceans, and other aspects of global warming have created a global demand for sand that is almost unimaginable.

The silicon chips that power our computers and cell phones are also made from sand. Dubai and China are building artificial islands using sand, and stretches of Manhattan and much of Washington D.C. were created with dredge material. Louisiana has a fifty-year $50-billion project to rebuild its Gulf coast through barrier islands, all of which will be sand based. The emerging but controversial fracking operations also require sand, and the roads that connect these growing cities and their new business operations and neighborhoods require concrete and thus, sand.

The worldwide demand for water-based sand is literally stripping riverbed and beach sources bare. Sand deposits in mines throughout the world are being exhausted. Deep-ocean dredging off the coast of Florida, used mostly to replenish beaches, has completely depleted the offshore sand. The capture of water-based sand and sand from mines has also led to environmental imbalances, destroying coral reefs and altering marine and wildlife habitats throughout the world. The largest sand mine in the world is in China's largest freshwater lake; but that lake is also its most important migratory destination for winter birds. Although desert sand is plentiful, wind erosion leaves the grains in shapes unsuitable for making concrete. As a result, the need for other sources has increased. This demand has led to corruption and worse. Newspapers in India now refer to "sand mafias" that control a black market created by sand shortages. According to California journalist Vince Beiser, hundreds of people have been murdered in India over sand procurement.

Sand is not the only substance that causes concern. Five to ten percent of all greenhouse gas emissions in the earth's atmosphere come from manufacturing cement. Heating the limestone and other ingredients by burning fossil fuels to make cement is the third largest source of greenhouse gas emissions in the United States. Making one ton of cement emits one ton of CO_2. It is now beyond dispute that global warming is driven by greenhouse gases. Our progress, both here and abroad, has brought prosperity to many around the world and has decreased abject poverty dramatically. Yet there are costs.

Winston Churchill once said "you can always count on Americans to do the right thing, after they have tried everything else." New crises often spur new ideas. So it is with concrete. New processes created by two California Companies, Calera and Blue Planet, as well as by a few others, can capture the CO_2 emissions and either store them or turn them into useful products. These carbon negative cements, or "green cements" soak up more carbon than is emitted during the production. The U.S. used more than 82.8 million metric tons of Portland cement in 2015. China used 216 million tons. Calera claims its process captures the greenhouse gases as they are produced and then turns them into chalk. Using the resultant chalk rather than cement will cut carbon emissions by half. Other companies are experimenting with other methods that will reduce energy needs when making Portland cement. Blue Planet's technology sequesters the CO_2 and turns it into light-weight aggregates that replace the gravel in the concrete. The CarbonCure Company takes a different approach. Their process uses local gas suppliers to capture carbon dioxide from the emissions of industrial polluters. The gas companies supply purified and liquefied CO_2 stored in pressurized tanks to CarbonCure's producer partners. The producers then inject the recycled CO_2 into wet concrete while it's being mixed, where it is chemically converted into a solid mineral that is permanently captured within the concrete. The company believes the process reduces CO_2 emissions and helps to improve the compressive strength of

ready mixed concrete. The key, however, is to ensure that the specialty cements have the same structural properties and low cost of Portland cement. The D.C. Department of the Environment has comment favorably on the Blue Planet product and believes its green cement is commercially viable. Moreover, the Blue Planet product is white and not grey or black like Portland cement. That brings a higher capacity to reflect sunlight and a reduction in heat and energy costs.

Both 200 Massachusetts Avenue and 250 Massachusetts Avenue are slated to be LEED certified Platinum buildings. LEED Platinum is the highest environmental performance-rating a building can receive. If BBC and PGP can reduce their use of CO_2, the LEED rating becomes easier to attain. BBC and PGP are in discussions with several companies about the viability of using carbon negative cement to further reduce the environmental impact of the project. They have contracted for the CMU with Parkinson Masonry which will use carbon-cure CMU in both 200 and 250 Mass Ave. The design team reviewed the product data and is satisfied that it complies with building codes and strength. Using the new carbon-cure concrete, however, requires a more complex assessment. Currently, there are no local fabrication plants capable of producing the green concrete. If the concrete has to be transported from other regions, the greenhouse gases emitted during the transport eliminate the benefits of using it. There are plans to establish a local plant sometime next year. Unfortunately, that will be too late to produce carbon cure concrete for 200 Massachusetts Avenue. If the plant is built and operating in time, BBC and PGP will consider using it for 250 Massachusetts Avenue.

The third critical element of concrete is water. In developing and developed countries alike, water is becoming scarce. Agriculture is, of course, water intensive; but industrial demands for fresh water are causing groundwater resources to be compromised or depleted and surface water to be polluted. The result is a diminishing water table and the endangering of the ecosystem in our water supply. The effects of global warming add stress onto this already compromised water system. Industrial use is growing. Approximately three hundred and forty-three liters of water are needed to manufacture one ton of cement and one ton of concrete is produced for every human being in the world each year. There are 7.5 billion people on earth and the United Nations estimates the world's population will increase to 11.2 billion in the year 2100. When one does the math, the depredation of the world-wide fresh water supply becomes staggering. Two hundred and eighty-four liters of water are needed to produce one cubic meter of concrete. 200 Mass. Avenue will use about 18,500 cubic yards of concrete and 250 Mass. Avenue will use about 21,000 cubic yards. Those buildings will require more than 2.5 million gallons of water to produce its concrete.

So the question becomes: how do we maintain a safe and sustainable planet and continue the inexorable march to progress? There is no doubt that progress and urbanization spur our imagination, intensify creativity in the arts and sciences, bring new wealth, and reduce poverty. They also lift our spirit and permit us to renew our hopes and reimagine our very lives. Proof of my claim comes from recent United Nations studies showing that the number of people living in extreme poverty and the number of small children dying has tumbled by half in two decades. For the most part, those improvements have come about because of development and progress in developing nations. But we cannot assume all we do to advance progress can be undertaken without concern for our integrated human and environmental ecosystem. When musing about the transformative power of machines at the beginning of the 20th century, Rudyard Kipling wrote

these lyrical yet powerful lines, with optimism and hope for the integration of nature and progress:

Though our smoke may hide the Heavens from your eyes,
It will vanish and the stars will shine again

But Aldo Leopold, writing in SAND COUNTY ALMANAC, saw the flaws in humanity's obsession with progress. Writing sixty years later than Kipling in that same century, a century where progress seemed to have no limits, Leopold reminded us that "We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

It may be that the steel towns and concrete towns of the American Century brought progress, minimized poverty, and lifted our spirits. It may be that the developing steel towns and concrete towns of emerging nations will bring the same benefits to others that they brought to us. But the optimism of Kipling must be tempered with the cautionary message of Leopold. The environmental mess we have today is a child of our progress. It may get worse with the emerging progress of the millions of people in the world who seek the benefits that we in the western world take for granted. But perhaps Churchill was correct. And perhaps companies like Blue Planet and Carbon Cure signal that we have exhausted all the wrong things and are on a small but significant path to doing the right thing; heeding the message of Leopold and Rachel Carson and the new heroes of the environmental movement and heralding a new era of optimism and hope, where developers use the land and its abundance with love and respect and where progress emerges compatibly with environmental necessity.

Wally Mlyniec

SOURCES

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The Basilica of the National Shrine of the Immaculate Conception, http://www.nationalshrine.com/site/c.osJRKVPBJnH/b.4764147/k.9FF6/Architecture.htm

David Biello, *Cement from CO_2: A Concrete Cure for Global Warming*, SCIENTIFIC AMERICAN, August 7, 2008. https://www.scientificamerican.com/article/cement-from-carbon-dioxide/

Blue Planet, *Products*, http://www.blueplanet-ltd.com/#products

CarbonCure, *Technology* http://carboncure.com/technology/

Department of English, Gymnasium Steglitz Berlin, *Two essays on Rudyard Kipling´s "The Secret of the Machines*, http://www.gs.cidsnet.de/englisch-online/klasse11/kipling_machines.htm

Ghosts of D.C., http://ghostsofdc.org/tag/the-cairo/

Rudyard Kipling, *The Secret of Machine*, first published in A SCHOOL HISTORY OF ENGLAND (1911)

Aldo Leopold, SAND COUNTY ALMANAC AND SKETCHES HERE AND THERE, Oxford Press (1949)

Wallace Mlyniec, CONSTRUCTION NOTES, TRANSFORMING A CAMPUS IN WASHINGTON D.C., (2006)

Diane Rehm Show, *The Increasing Global Demand for Sand*, August 8, 2016 http://thedianerehmshow.org/shows/2016-08-08/the-global-demand-for-sand

John Stowell, *Analysis on Carbon Negative Cement*, D.C. Department of Environment, Elsevier (2015)

Nicholas Kristof, The Best News You Don't Know, NEW YORK TIMES (September 22, 2016) http://www.nytimes.com/2016/09/22/opinion/the-best-news-you-dont-know.html

P. Van den Heede & N. De Belie, Environmental Impact and Life Cycle Assessment of Traditional and Green Concretes: Literature and Theoretical Calculations, Elsevier (2011)

Various contributors, *What is the minimum curing time for cement concrete?* QUORA, https://www.quora.com/What-is-the-minimum-curing-time-for-cement-concrete

Wikipedia, *The Cairo*, https://en.wikipedia.org/wiki/The_Cairo

Wikipedia, *The List of Future Tallest Buildings*, https://en.wikipedia.org/wiki/List_of_future_tallest_buildings

We Love D.C., Your Life Beyond the Capitol, *D.C. Mythbusting: The Height Limit*, http://www.welovedc.com/2009/05/19/dc-mythbusting-the-height-limit/

Wikipedia, *Height of Buildings Act of 1919*, https://en.wikipedia.org/wiki/Height_of_Buildings_Act_of_1910

Jerzy Z. Zemajtis, *Role of Concrete Curing*, PCA, http://www.cement.org/for-concrete-books-learning/concrete-technology/concrete-construction/curing-in-construction