Engineering That Inspires

Richard C. Benson

Introduction

Now at the end of a long career as an engineering educator and university administrator, I've given thought as to why my professional life evolved the way it did. In particular, why engineering, as opposed to some other worthy walk-of-life? I realize now that, as far back to my days as a toddler (I am 75 years old now) I was exposed to engineering marvels that inspired me to be like their creators … an engineer.

On December 5, 2025, the Jonsson School of Engineering and Computer Science at UT Dallas put on the "Artfully Engineered Exposition," showcasing the artistic talents of several dozen ECS faculty and staff members. Dean Stephanie Adams asked me to curate the exposition, which became a true labor of love.

Throughout the exposition, we were treated to impressive displays by our colleagues who have extraordinary talent as painters, sculptors, photographers, quilters, cross-stitchers, woodworkers, singers, dancers, musicians, composers, lyricists, and comedians. Even a latte artist displayed her talent, the results quickly consumed. I do hope that the exposition becomes an annual event for the Jonsson School.

A highlight for me was to play my trumpet in a newly formed 7-piece ensemble that we called the "Capstones." (Did you spot the pun? Not Cap·stones but Caps·tones.) It was the first time in nearly 50 years of marriage that my wife, Leslie, and I played music together. Leslie is an accomplished bassist.

For the occasion, I gave a lecture titled, "Artfully Engineered: Where Left Brain Meets Right Brain."[1] But there was one major difference between the exposition and the lecture. The exposition had its focus on the artistry of our ECS colleagues when, by and large, they were not doing their work as engineering educators or staffers. In other words, the artistry that they exhibited was outside their "day job." I expect that more than a few visitors to the exhibition were pleasantly surprised to discover that those "Left Brain" engineers had a smidgen of "Right Brain" artistic talent.

The essence of the "Artfully Engineered" lecture, however, was to present engineering as inherently beautiful, not something apart. Such is also the motivation of this article. Because of space constraints, instead of the more than 50 examples that I used in my December 5th lecture, I will present eight broadly selected examples of engineering marvels that have inspired me across the seven-going-on-eight decades of my life.

1 The lecture is published on YouTube by the UTD Geoscience Studio: "Artfully Engineered: where left brain meets right brain," March 13, 2026, www.youtube.com/watch?v=NuvYSfcLLyY. More details are in the UTD Geoscience Studio podcast, "An Accomplished Life: Dr. Richard Benson," Jan. 16, 2026, www.youtube.com/watch?v=EDvEeod8opc.

The 1950s: The Steam Engines of Blacksburg, Virginia.

My journey of inspiration begins in Blacksburg, Virginia. As a very young boy in the 1950s, we would visit my grandparents who lived there. This was fifty years or so before I would return to Blacksburg to work at Virginia Tech. Across the street from my grandparents' house was a train station, into which would come some of the last steam engines in regular use. They brought coal, which would then be dropped through a trestle into dump trucks and carried to houses and businesses of the town. Virginia Tech still operates a coal-fired power plant.

Those engines were big, they smelled, and they were loud. They assaulted the senses, but in the most glorious way. My grandfather told me that if I approached the train and made a downward-pulling motion with my arm, the engineer would toot back. And he would! I have said on many occasions that the mind-blowing imprint of that steam engine led me to become an engineer.

The steam engines that so mesmerized me were built for the Norfolk and Western Railway by the Baldwin Locomotive Works in the very early 1900s. They were class M 4-8-0, meaning they had four leading wheels, eight drive wheels, and no wheels under the cab. The M 4-8-0 engines were sometime nicknamed "Mastodons," which seems entirely appropriate for a huge "creature" that huffs and puffs, lumbers about, and seems thoroughly alive.

Norfolk and Western Engine 475 was retired from service in 1959, but then found new life in 1991 when it was restored by the Strasburg Rail Road. It currently makes runs on four miles of track in the heart of Amish Country in Lancaster, Pennsylvania. The photograph I have chosen for illustration shows the restored 475 at the East Strasburg Station (Figure 1).

In another inspiring example of engineered objects finding new life and new use, the railroad upon which those steam engines ran was converted to a very popular hiking and biking trail: the Huckleberry Trail. [2] That idyllic 6-mile path between Christiansburg and Blacksburg, Virginia, was one of my favorite places to go for a walk and collect my thoughts during my time at Virginia Tech.

2 For those familiar with Blacksburg, Virginia, my grandparents' house was on Clay Street, where the Blacksburg Police Station now is located. Across the street was the train station, where the Blacksburg Library now is located. Adjacent to the library is the terminus of the Huckleberry Trail, formerly the Huckleberry Line.

The 1960s: The Race to the Moon

Throughout my teenage years, the great race to the Moon was a compelling adventure. We all watched with awe as first the Mercury missions with one astronaut aboard, and then the Gemini missions with two astronauts aboard, and then finally the Apollo missions with three astronauts aboard, developed the capabilities needed for a successful journey to the Moon ... and return!

The nation's resolve was captured in an electrifying speech delivered by President John F. Kennedy at Rice University on September 2, 1962, in which he said:



Figure 1. Norfolk and Western Engine 475 at the East Strasburg Station in Strasburg, Pennsylvania, June 2, 2014. Photo: O484 on Wikimedia / Creative Commons.

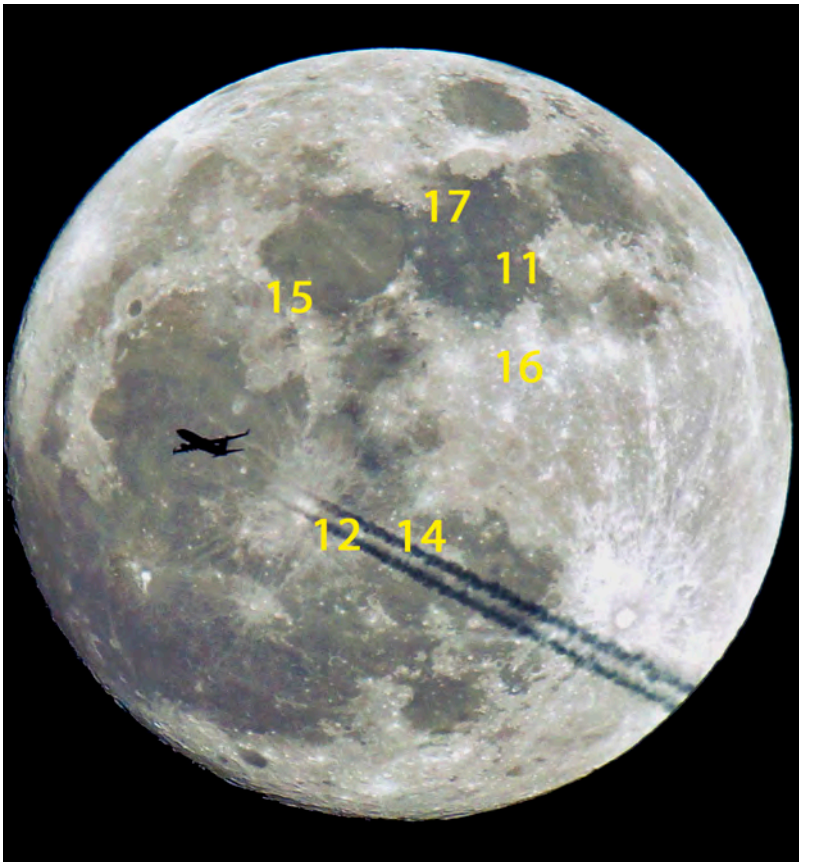


Figure 2. The six Apollo landing sites (11, 12, 14, 15, 16, 17) and the three fly-bys (8, 10, 13) marked on the full cold moon (the last full moon of the year) with a jet passing in front, December 21, 2018. Photo: Richard C. Benson

> We shall send to the moon 240,000 miles away, a giant rocket, more than 300 feet tall on an untried mission to an unknown celestial body, and then return it safely to Earth. … We choose to go to the moon in this decade and do the other things not because they are easy, but because they are hard.

And the nation made good on President Kennedy's promise with the Apollo 11 landing on the Sea of Tranquility on July 20, 1969—ever after known as "Moon Day." Throughout the decade there were many moments of triumph, and some of failure, the most heartbreaking being the capsule fire that took the lives of the Apollo 1 crew.

A particular moment of inspiration came with Apollo 8, the first mission to orbit the Moon, which thus became the first time that humans saw and photographed the far side of the Moon. On December 24, 1968—Christmas Eve—the three Apollo 8 crew members, Jim Lovell, Bill Anders, and Frank Borman, read from the Book of Genesis: "*In the beginning God created the heaven and the earth … .*"

Six more Moon landing missions took place, the last being over half a century ago, Apollo 17 in September 1972. Of course, Apollo 13—the "Houston, we have a problem" mission—became a fly-by instead of Moon landing. A "slingshot" around the Moon became the only means of bringing the crippled spacecraft back to the Earth.

I have marked the six Apollo landing sites and the three fly-bys on a picture of the "Full Cold Moon" of December 2018 (Figure 2). This image of the full moon—they all look rather alike—is distinguished by the fact that I captured a Boeing 767 jet passing in front just as I clicked the camera shutter.

I should note that there was a wonderful epilog to these early space missions. Christopher C. Kraft, Jr. was the head—and indeed the creator—of the Mission Control Center during the early Mercury and Gemini missions. He was sometimes referred to as the "eighth Mercury astronaut" as he became the face of the missions on many television broadcasts. Years later, when I became the dean of engineering at Virginia Tech, I was thrilled to discover that Chris Kraft was a VT graduate. He was the first alumnus that I made a point of travelling to meet (in Houston), and I found him to be an absolutely delightful man. In 2006, Kraft became the first recipient of NASA's Ambassador of Exploration Award. The accompanying trophy contained a small, encased piece of the Moon, about the size of a marble. Kraft, in turn, presented that trophy to Virginia Tech, where it is prominently displayed in the Engineering Dean's Office.

The 1970s: Stunning Advance in Computing Power

The 1970s were the years of my college education. I entered Princeton in the fall of 1969, spent a year at the University of Virginia for my master's degree in 1974, and completed my Ph.D. at Berkeley in the fall of 1977.

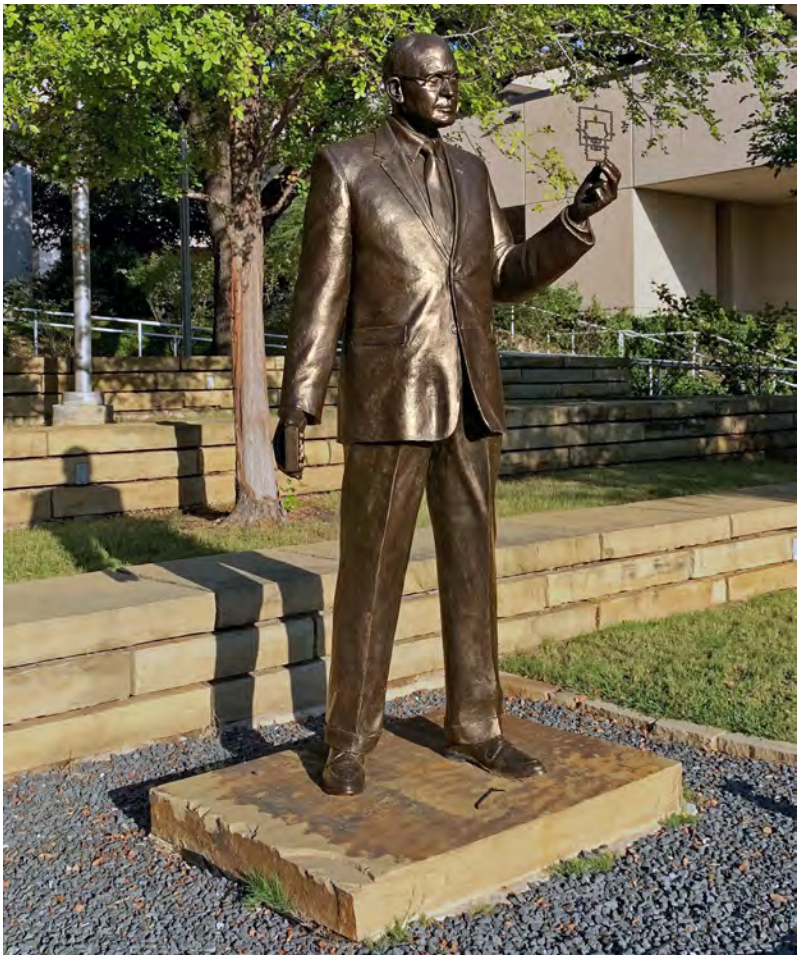


Figure 3. Statue of Jack Kilby on the UT Dallas campus, September 29, 2022. In the sculpture by Zenos Frudakis, Kilby holds the first, Nobel Prize-winning integrated circuit in his left hand, and the first Texas Instruments calculator in his right hand. Photo: Richard C. Benson

It was an exhilarating time to be at such wonderful universities and surrounded by so many brilliant individuals, including my fellow students. I loved hearing them think, even if—*especially if*—they were in fields far removed from my mechanical engineering major. It also didn't hurt that Princeton, with its classic Gothic architecture, and Virginia, with its Thomas Jefferson-designed grounds, were two of the most beautiful campuses in the world.

But this is an essay about amazing engineering, and here I take note that there was no greater decade than the 1970s for the advancement of computing. In the late 1960s I had summer jobs at an R&D lab at Picatinny Arsenal in New Jersey, where one of my assignments was to perform rather tedious calculations for the engineers of the lab. This I did on a Monroe Calculator. This was a device, resembling a large typewriter, that added and divided—*all mechanically*.

When I decamped for Princeton in 1969, my father, forever the best engineer in the Benson Family, gave me his slide rule. *It was a beauty!* A Keuffel & Esser Log Log Duplex Decitrig model. I used it throughout all my undergraduate studies. I still have it.

Then, at the start of my master's studies at the University of Virginia in 1973, I saw my first scientific calculator. It was a Texas Instruments SR-50. *It was a marvel!* About the size of a paperback book, it could calculate sines, cosines, natural logs, fractional powers, and much, much more. Wow! It is little surprise that K&E made its last slide rule on July 11, 1976, which it then donated to the Smithsonian.

Another leap forward came in 1974 at UC-Berkeley when I saw my first programmable calculator, a Hewlett Packard HP 65. *It was awesome!* I used a successor model, the HP 11C, through most of my research active years. I still have an HP 11C, of sorts. It is an app on my iPhone. In every way, the app mimics the original HP 11C, except it is now much faster.

A most interesting epilog to this story plays out at UT Dallas around 2021. A great friend of the university, Harlan Crow, offered to commission a statue of an inspirational figure for the campus. But Mr. Crow had two conditions: first, the stature must be lifelike, and second, it must be of a person who inspires through their brilliance. It didn't take long to settle on Jack Kilby, the TI engineer extraordinaire and Nobel laureate who invented the first integrated circuit. In the campus statue Kilby holds a copy of that first integrated circuit in his left hand, and in his right hand, he holds the very first handheld calculator, the TI "Cal-Tech" (Figure 3).

The 1980s: In the Shadow of the Erie Canal

There is a special category of engineering marvels that predate the invention of great earth-moving equipment powered by steam, gasoline, electricity, and other sources of energy. I think of them as being built by hand and hoof, i.e. human and animal labor, with perhaps a bit of hydropower achieved by tapping a nearby river.

Among such marvels that I have photographed are the Great Pyramid of Giza, built around 2570 BC, and the tallest structure in the world for an astonishing 3,792 years; the Badaling Section of the Great Wall of China, built over millennia from as early as the 8th century BC with substantial additions in the Ming Dynasty of the 16th century; and the Caesarea Aqueduct, built by the Romans in the time of Herod the Great, 22 to 10 BC, in what was then the Kingdom of Judea.

The example that I would like to focus upon is more recent and closer to home—quite literally so. In the 1980s and early 1990s, while working for the University of Rochester, my family and I lived in Pittsford, New York, just east of Rochester. In particular, we lived in an area known as Bushnell's Basin along the Erie Canal.

The Canal had been built between 1817 and 1825, connecting Lake Erie in the west to the Hudson River in the east. It was an astonishing

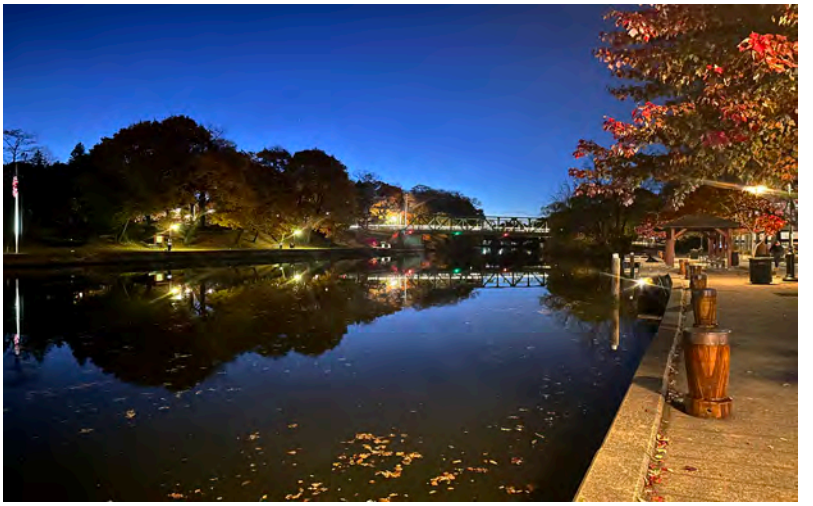


Figure 4: Autumn evening on the Erie Canal at Schoen Place in Pittsford, New York, October 24, 2024. Photo: Richard C. Benson

engineering feat to build a 363-mile waterway, with no greater tools than pickaxes and shovels, and maybe some black powder for blasting.

A particular challenge was to get the canal to cross Bushnell's Basin, which was a rather deep cut in the land formed by Irondequoit Creek. In the space of a mile, the canal would have to be locked down about 70 feet, only to have to raise it right back up again. Further complicating the construction was the lack of a water supply of a high enough elevation to refill the potential locks on the west side of Bushnell's Basin.

To solve this problem, engineer James Geddes designed a "Great Embankment" to go directly across the basin. A team of mostly Irish immigrants built up the new land bridge with rock and soil brought in from surrounding areas. Nine-hundred 20-foot pilings were used to stabilize the land. A culvert was built underneath to allow the Irondequoit Creek to continue on its natural path. Shortly after completion, the Marquis de Lafayette traveled the Erie Canal and is quoted at having expressed amazement that in places, the canal "pursued an aerial route."

Indeed, the Erie Canal at Bushnell's Basin is amazing, and I got to call it home. At the edge of my yard was Irondequoit Creek, and beyond that was the rise of the Great Embankment. And every now and then, I would look up to see a boat passing by. In essence, I lived adjacent to a beautiful 363-mile waterfront park, along which I could hike, bike, or ski throughout the year.

The photo I have used for illustration shows a lovely stopping-point along the canal, Schoen Place (Figure 4). It is on the western edge of the Great Embankment. And, yes, Schoen Place was named for a German immigrant, John Schoen, whose last name was anglicized from Schön, the German word for beautiful. How appropriate!

The 1990s: A Bridge is a Thing of Beauty

In this section devoted to beautiful bridges, I will allow myself a bit of license in noting that not *every* bridge described was seen and traversed by me in the 1990s. Rather, it is a convenient place to take stock of these engineering marvels that have fascinated me throughout my life.

A beautifully designed bridge has the perhaps unexpected attribute that it often enhances the beauty of its surrounding environment. Think of the Bixby Bridge or the Golden Gate Bridge, both on California State Route 1.

The late 1800s saw major advances in bridge design because of advances in understanding how to build structures that were both strong and relatively lightweight. Great examples are the iron truss bridges of Gustaf Eiffel and contemporaries. (Eiffel's skill in ironwork is, of course, most famously exhibited in his design of the Eiffel Tower in Paris.) A particularly beautiful display of his skill is the Maria Pia Railroad Bridge, which spans the Douro River, connecting Porto and Vila Nova de Gaia, Portugal. Built in 1877, it was the longest single-arch span in the world at the time. Nine years later and one kilometer up the Douro River, a protégé of Eiffel's, Théophile Seyrig, took the title with the beautiful Dom Luis I Bridge.

Special mention must be made of the Brooklyn Bridge. Designed by the great German engineer, John Roebling (who died before construction began) the bridge was made possible by Roebling's then-novel mastery of cable suspension. This was used to lift the roadway *from above* and then transfer the load to massive towers on opposite ends of the bridge. Building those towers took a terrible toll in human life. Many workers suffered from so-called "caisson's disease," which we now know as the bends. This resulted from working in highly pressurized containers, i.e. caissons, at the bottom of the East River, and then rising too quickly to the surface. Such was the fate of chief engineer, Washington Roebling, son of John. After Washington's incapacitation, his wife, Emily Warren Roebling, took over the chief engineer's role, in all but title, and completed the project in 1883.

Two other stupendously long bridges have fascinated me since childhood. I remember reading about Henry Flagler's railroad bridge of 1912 in a *Weekly Reader*. The bridge ran for 113 miles, connecting 40 Florida Keys, from Key Largo to Key West. Today, the rebuilt bridge is now a part of U.S. Route 1. I am also awestruck by the Chesapeake Bay Bridge-Tunnel, which connects Virginia's Tidewater Region and Eastern Shore. It is 17.8 miles long, has two high-span bridges, two mile-long underwater tunnels, and four artificial islands.

I'll close this section with a look at the Bridge over the New River Gorge in West Virginia (Figure 5). Every third Saturday in October is declared to be "Bridge Day" when pedestrians can stroll the bridge, the third tallest in the U.S., and watch hang-gliders, bungee jumpers, rappelers, and more. The image of the bridge was chosen for the reverse of the West Virginia quarter.



Figure 5. The New River Gorge Bridge near Fayetteville, West Virginia, May 10, 2015. Inset: West Virginia state quarter. Photo: Richard C. Benson



Figure 6. The Little Black Church, Búðir, Iceland, September 8, 2024. Photo: Richard C. Benson

The 2000s: Places of Worship are Awesome

As in the previous section, I will take some license and make observations on places of worship that I have seen and photographed, but not all of them will be from the decade of the 2000s. I start by noting that churches, cathedrals, temples, mosques, etc. are most purposefully designed to put the congregant or visitor in awe.

Consider some of the great cathedrals of the 12th and 13th centuries. Construction began on the Notre Dame Cathedral in Paris in 1163, Saint Patrick's Cathedral in Dublin in 1191, and the Cologne Cathedral in Köln in 1248. These enormously tall buildings are in many ways more impressive from the *inside* than the outside. By mastering the use of arches, buttresses, shells (doubly-curved, in contrast to an arch) the ceiling could be placed *many* stories above the floor. Natural light would come through stained-glass windows, themselves works of art.

Other senses can be brought into play. Outside of the Sensoji Buddhist Temple in the Asakusa District of Tokyo is an incense burner called a Jokoro. The purpose is for the visitor to waft the smoke over their heads in order to clear their minds. At the Byodo-In Buddhist Temple in Oahu, Hawaii, there is a bell that visitors can ring. As with the Jokoro, the purpose of the bell is to use the lingering reverberations to clear one's mind and bring peace.

In so many of these places of worship, an organ and/or a carillon plays a central role. The Catedral de Murcia in Murcia, Spain has a 4,000-pipe organ, and a campanile with 25 bells, each one named. The acoustically lively interior of the Murcia Cathedral creates a fabulous environment for the organ but makes it difficult to follow what a speaker is saying. Most, I expect, would find that an acceptable tradeoff.

In many places of worship, people are honored. At the Saint Louis Cathedral in New Orleans, King Louis IX of France is depicted in a stained-glass window. Similarly, the Cathedral of Saint Francis of Assisi in Santa Fe depicts its namesake in a stained-glass window. Statues in Dublin's Saint Patrick's Cathedral include holy figures, like Saint Patrick, but also citizens of the city, including the author Jonathan Swift and the brewer, Benjamin Lee Guiness.

By contrast, Islamic mosques—I have visited three in Cairo and others elsewhere—do *not* depict the human form, the purpose being to discourage idolatry. Rather, beautiful, intricate designs are created through geometric patterns, floral images and calligraphy.

To finish this section, I will mention the exquisitely simple Little Black Church in Budir, Iceland (Figure 6). No carillon, no flying buttresses, but nevertheless a mesmerizing sight. The church is painted with pitch, similar to the coatings used on the hulls of ships, which helps protect from the harsh seaside elements. The church is literally pitch-black.

The 2010s: Signature Engineering at Virginia Tech

The Virginia Tech campus is a beautiful place. As with my prior employer, Penn State, Virginia Tech is a land grant university. The "A&Ms," with their historical focus on "Agriculture and Mechanics," tend to do an especially good job with landscape architecture. Thus, we find one of the most extensive and beautiful groves of elm trees at Penn State, and a campus at Virginia Tech that *Condé Nast Traveler* described in 2025 as one of the most beautiful in the United States. Further, Virginia Tech, in the heart of the Blue Ridge Mountains, has a setting that I have heard described by more than one national reporter as "achingly beautiful."

The architecture of Virginia Tech is also striking. By resolution of the Board of Visitors, every major building must be in a collegiate Gothic style and clad in "Hokie Stone," which is a limestone quarried nearby in Southwest Virginia. This is illustrated here by Goodwin Hall, which opened in 2014 (Figure 7). As an interesting side note, our UT Dallas colleague Calvin Jamison was a member of the BOV when the "Hokie Stone" resolution was passed in 2010. Securing funding for the "Signature Engineering Building"—which was the working title for Goodwin Hall before its naming—was a major focus of my eleven years as dean of the Virginia Tech College of Engineering. It required a coordinated, team effort of college personnel working with the Virginia Legislature, prospective donors, and other university personnel to make a reality.

More important than the funding for the building was its design. It would be home to three of the college's departments: Chemical Engineering, Mechanical Engineering, and Engineering Education. UT Dallas' dean of engineering, Stephanie Adams, once had her office in Goodwin Hall, when she served as the head of the Department of Engineering Education.

I also wanted the Signature Engineering Building to be a "living laboratory." By that, I don't mean a place where laboratories were located—you'll find that everywhere—but rather a place where the building *itself* was instrumented for measurement and analysis. I had been inspired by a visit to the University of Colorado, Boulder, where I toured the Integrated Teaching and Learning Laboratory (ITLL). There I saw utility lines, wiring, etc., deliberately exposed so that CU engineering students could use the building for experimentation.

We gave Goodwin Hall easily accessed instrumentation, similar to the ITLL, but with one marvelous new twist. Two mechanical engineering faculty members, Pablo Tarazaga and Mary Kasarda, had the brilliant idea to embed 241 accelerometers throughout the building so that it would have exceptional sensitivity to all structural dynamics. If someone walked softly down the third-floor corridor on the south side of Goodwin Hall, the building knew. If a minor temblor passed through the New River Valley, the building knew. If the cannon went off at Lane Stadium after a Virginia Tech touchdown, the building knew. And, thus, by design and extension, Virginia Tech students knew. I'd call that beautiful engineering.



Figure 7. Goodwin Hall at Virginia Tech, Blacksburg, Virginia.
May 16, 2016. Photo: Richard C. Benson



Figure 8. The Edith and Peter O'Donnell Jr. Athenaeum, UT Dallas,
June 11, 2026. Photo: Richard C. Benson

The 2020s: The Beautiful UT Dallas Campus

I come, at last, to my final act as a university administrator. It was my privilege to serve as president of The University of Texas at Dallas from 2016 to 2025. As members of the campus community know, UT Dallas has a history unlike any other major American university. Founded in 1961 by leaders of Texas Instruments, the small, private Graduate Research Center of the Southwest, eventually was made a part of The University of Texas System in 1969. Thus was born The University of Texas at Dallas.

Explosive growth followed, with undergraduate programs added in 1975, the first freshmen arriving in 1990, and the first residence halls built in 2008. Throughout, the university made its reputation through the excellence of its STEM programs—Science, Technology, Engineering, Math and Management. (We have two Ms at UT Dallas.) Alas, UT Dallas also made its reputation as a rather stark campus, with concrete everywhere and hardly a tree to be seen.

This all started to change dramatically in 2008 when led by President David Daniel and Vice President Calvin Jamison, and with generous funding from Margaret McDermott, ground was broken on the Campus Landscape Enhancement Project. The world's most renowned landscape architect, Peter Walker, did the design. The beautiful magnolia trees and pools along the Margaret McDermott Mall are now the defining elements of UT Dallas' transformation into one of the nation's most beautiful campuses.

In my 2016 inauguration address, I declared that we would put the A for Arts into STEM to make UT Dallas a STEAM university … and we did! In addition to the programmatic elements, such as the founding of the Bass School of Arts, Humanities, and Technology, we have developed a new arts and performance district. Known collectively as the Edith and Peter O'Donnell Jr. Athenaeum, the district follows from the vision of several giants in UT Dallas history, most notably Rick Brettell, founding director of the Edith O'Donnell Institute for Art History, and Hobson Wildenthal, UT Dallas' long-serving provost. Through their efforts, the university acquired the exquisite Crow Museum of Asian Art, which is the centerpiece of the first building of the Athenaeum (Figure 8). Phase I opened in 2024. The Dallas Museum of Art also maintains a presence in Phase I.

Phase II of the Athenaeum will be devoted to the performing arts. It is under construction now, and, when opened in 2027, will feature a 680-seat concert hall. Phase III is in preliminary design and will, like Phase I, be devoted to displaying UT Dallas' growing collection of art objects.

In my last year as UT Dallas president, I was often asked what I thought my legacy would be. While I am proud of the many UTD advancements on my "watch," the most enduring legacy will be UT Dallas' rise to prominence in the arts.

Final Thought

From steam engines to a great STEAM university, I have lived a life surrounded by great beauty. Beauty in the natural world, of course—and another one of my photographic interests—but also a beauty born of the creativity of engineers. To all those designers of bridges, canals, aqueducts, trains, rockets, computers, art galleries, concert halls, musical instruments, and places of worship, thank you! I have not finished visiting your inspirational works of art. A