The Geometry of Architecture and Sailing.
A work hard....play harder way to approach life.

If you live, play, learn or work in buildings, you are likely to spend two thirds of your life inside them. The buildings that you are in need to be safe, comfortable and function well. Beyond these basic responsibilities, Architects can be allowed to create and innovate when given the freedom. For buildings to be safe, the geometry of structural components have to be arranged to resist the forces of gravity, and the overpowering effects of Earth, Wind and Fire (the adults will get this pun). Ninety percent of buildings are a result of the business of supply and demand. On time, on budget and meet the basic needs of the occupants to be viable products in the real estate marketplace........................................but then there is the other ten percent.

Look at the building blocks for these shapes. There are the basic geometric forms like triangles, squares, rectangles and circles. Then there are forms from nature. Open this link and have a look.

https://www.google.com/search?q=structural+geometry+in+buildings&client=safari&hl=en-us&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwijavvqvvTZAhhVeHGMKHeNuBTqAQI_kw&biw=1366&bih=637
Geometry has been described mathematically for centuries. The great pyramids of Egypt are made up of four triangles sitting on a square and are around 45 stories tall.

https://ancientegpythistorykingdom.weebly.com/pyramids.html

Then, the famous Architect I.M. Pei used this same form to expand the Louvre Museum in Paris, France. The museum is underground and connects to the French Renaissance Architecture from the days of Napoleon.

http://www.architectmagazine.com/awards/aia-honor-awards/louvre-pyramid-the-folly-that-became-a-triumph_o
Forms from nature were usually scaled up from the plant or animal that they were emulated from. Spanish Architect Antoni Gaudi used forms in nature to create a cathedral started in the late 1800’s in Barcelona called La Sagrada Familia. 
https://www.biography.com/people/antoni-gaudi%C3%AD-40695

He was run over by a horse drawn trolley car and his vision is still being carried out today mostly from donations in attempts to finish the structure. It will be the largest Cathedral in Europe when completed. A team of 33 architects and engineers has been assembled to finish the vision.
Here is a video animation of how the cathedral will be completed. The materials that you see, touch and feel will be the same but the structure will be modern steel post tension systems hidden away to insure that the structure does not fail.

https://www.youtube.com/watch?v=69COC7UhbwY
https://i.pinimg.com/originals/c8/cd/7f/c8cd7f5c3566b1231abcf02be67b74b4.jpg
https://www.youtube.com/watch?v=AWQje34khog

In the legal parameters of current times, buildings have to be described in greater detail in order to be built. Our limitations to convey that level of detail in the past without powerful computer software lead us to create buildings that were easier to describe with the geometry of basic building blocks. Now, non-building block shapes can be conveyed with powerful software and are becoming more mainstream in architecture. An architect that is known for this progressive approach is Frank Gehry.
Buildings have to be safe from the overpowering effects of Earth, Wind and Fire. Earthquakes and wind impose similar forces on the geometry of a building. To test structural configurations, scale models on shaker tables and computer simulations are used to define the natural frequency of a building and the nodes they present. Buildings need to ductile and allowed to move to absorb shock and vibration much like a fly fishing pole when you shake it. It will bend, but not break and eventually settle down to become still and straight again. In buildings, all of the parts have to be allowed to move and absorb the forces. The utilities to the building have to be able rigid buildings, like those made of masonry are usually the ones that fail.

https://en.wikiversity.org/wiki/Tectonic_hazards/Seismic_fitness

[Image of building components with labels for longitudinal and transverse directions]

Here is some scary footage of a 9.0 Earthquake in Japan with buildings swaying like they are designed to.
https://m.youtube.com/watch?v=g0cz-oDfUg0

The structural geometry of building components are surpassing the many other constraints that humans present. If a building sways on a daily basis in the prevailing winds, then people get seasick. Pools and aquariums and even your beverages slosh back and forth. We are at the limits now and counterbalance systems will be the next to be refined.
https://m.youtube.com/watch?v=e7ho6z3yyo
https://m.youtube.com/watch?v=hSwjkg3nv1c
Now take the modern computer software abilities to describe these wild and organic shapes and apply it to sailing. Sailing is one of the “play harder” sides of my life. I have sailed half way around the world and spent thirty years racing on yachts. We are in an exciting time. Sailboats had made design gains each year that were small compared to now.....we are in the “age of foiling”. I raced with Scott Graham over a 20 year period. He is a fluid dynamics engineer that worked on the Americas Cup racing yachts. While designing the New Zealand boat as a catamaran, he convinced them, that he could make it fly over the water by using foils. AND it complied with the rules! Now every other syndicate had to play catch up. We went to watch his creation in the San Francisco America’s Cup in 2013. Boats that had normally competed at 10 to 18 knots of boat speed are now doing 45 to 50 knots on the same or less wind. Here is a long video that you can watch if you are interested. It is an incredible comeback story for the Americans to win over the New Zealanders. Here are some pictures.
The boats were downsized to become affordable and refined further for the 2017 Americas Cup held in Bermuda. It was won by New Zealand. The geometry is not just in the boats, it is in the course that they sail. Sailboats can’t sail directly into the wind. The changing wind angles and course markers form triangles. Watch this video and the computer graphics to see the geometry.

https://m.youtube.com/watch?v=Fli1nhG1Agk
https://www.youtube.com/watch?v=mlM2tQOzkY0

Since New Zealand won the Cup, then they get to dictate the rules for the next America’s Cup Boat. It is back to a monohulls, but with foils! The “Around The World Non-stop Solo Race” called “Vendee Globe” will be the first big race that monohulls with foils are to be tested in extreme conditions. Records should fall again. The current trimaran record is 42 days around the world. It used to take three times as long 10 years ago.