Contemporary Architecture, Design, and Sustainability

What is Architecture? Architecture in broad terms is all about the built environment. It provides shelter and integrates the surrounding landscape, open areas, communities, and aesthetics. Design in contemporary architecture has become a lot more exploratory in recent years, not only in terms of how design issues are tackled, but also in terms of ecological solutions being implemented.

Architecture is an exciting field because architects seek to push the boundaries of what can be built. With current technology, they seek to design buildings that not only serve as residences or offices, but are self-sustainable and sit naturally in their environment. Architects impart their creative ideas into structures that fit into an environment and endure for many years, existing harmoniously with the environment.

Sustainability is a key factor in architecture today. Architects look for ways to reduce the use of energy and other natural resources, and then harvest and re-use those resources. Sustainability is essentially the ability to maintain a building without causing damage to the environment.

These ideas are widely implemented in the home, the workplace and public spaces. Humans take natural resources for granted. By reducing energy usage in everyday life and in the way we build, our natural resources and energy will go much farther. Architects are exploring how to harness nature and use sustainable materials to make our built environment a better place to coexist with nature.

Part of this exploration of sustainability has contemporary architects experimenting with more sculptural design ideas and 3D software, and the advancements in digital design tools have helped make this possible. These tools enable architects to visualize a building in real time in order to work out important design essentials and aesthetics. 3D software is a key tool in developing 3D models that can then be used for a variety of purposes. For example:

- Physics Simulations: Testing outside forces and stresses on the building.
- Wind and Turbulence Testing: Testing the turbulence patterns around the building.
- Lighting: Testing lighting of the building to find optimum solutions for natural lighting.

The use of 3D has also helped architects enhance their visualization techniques, so they are able to present clients with more realistic images of what an intended building will look like.

Two great examples of contemporary architecture are London’s Millennium Bridge and City Hall building. Bridges have always been important in history, but in recent years some have become incredible works of art and architecture. Bridges connect us; they have changed history by enabling people to access areas
that might otherwise be unreachable, and they can also be beautiful and exciting designs. They enable people to cross impossible boundaries, and act as key elements in both pedestrian and motoring infrastructure. The Millennium Bridge in London is a very shallow suspension bridge that pushes the boundaries of technology.

Image_01 (Image Copyright Andrew Tanousis)

The City Hall in London is another key landmark. The building was designed in such a way that the floors overlap each other. Each floor in the building shades the floor below in summer, saving on air conditioning and unnecessary energy usage. Elements in nature have definitely influenced the design of this structure.

Cues for the Millennium Bridge were taken from the structure and organization of shells.

Image_02
Many contemporary architects are creating work with a focus on sustainability and organic design. Through the use of design and 3D software, Frank Gehry has revolutionized the way we see architecture, creating buildings that could only be imagined a century ago. He has become internationally recognized for his sculpturally composed buildings and curvilinear forms.

His work starts with very rough sketches, breaking from the repetition and formula of traditional building. Similar sketches show the flowing and organic lines, and how they could evolve into a structure. The sketches eventually become 3D models, demonstrating how the structures work, function as spaces, and fit into the environment. Going back and forth between sketch and model enables an architect to make sure the design conforms to specifications.
The Walt Disney Concert Hall in Los Angeles, California, http://www.laphil.com/, consists of extremely complex and organic shapes that could be a metaphor for a sail with the wind behind it or a school of swimming fish. It is a unique architectural achievement that could not have been realized without the use of 3D in the design process. Evident in the designs, is the inspiration Gehry drew from the movement and texture of fish. The Vila Olímpica in Barcelona is another striking example of this singular type of architecture.


Forms of moving fish inspired the building of the Walt Disney Concert Hall. Fish are curvilinear in nature, which makes them very streamlined and elegant in design.
The Walt Disney Concert Hall evokes a sense of motion. It is made up of fast flowing and beautiful geometric forms, curving at different angles. This space is an amazing accomplishment not only in terms of design, but in the way it sits beautifully in the environment, juxtaposed against a variety of other building styles. The building is composed of asymmetrical shapes that flow together to create a very harmonic whole. Although it looks complex in structure, if we start to deconstruct the shapes and look at them individually, we can start to see how the overall design is achieved.
Breaking down the shapes of the building and sketching them, results in shapes similar to these. Looking at a complex design as a whole sometimes makes it difficult to understand the basic forms or shapes. Whereas studying the individual shapes makes it easier to understand how they were constructed in the first place. The Walt Disney Concert Hall is made up of very complex forms. Sketching the forms and understanding the shapes we want to achieve makes it easier to construct these design elements in 3D. All of the objects below start by taking a primitive shape and manipulating control points or vertices. You can create similar complex geometric forms out of primitive objects. The exciting thing about 3D is that you are limited only by your imagination.

These shapes look quite complex, but in fact they were generated using a box primitive. It was converted to an editable poly with the vertices pulled into the desired shape.
Image_09 shows an exploded view of the shapes. Looking at a design in an exploded view enables you to better visualize the overall whole.

These are the completed shapes. The surfaces look complex, but knowing they were generated from a simple box object makes them easier to understand.

After breaking down all the shapes as sketches and integrating them into 3D, we can start to visualize how to reconstruct a final model.
Many of today’s contemporary architects are inspired by nature. In the designs of Santiago Calatrava, you can see his inspiration comes from objects as diverse as birds and skeletal structures. Many of the shapes Calatrava uses can be broken down into much simpler forms. A good way to understand how an architect thinks about design is to analyze the shapes.

The Sundial Footbridge that suspends the Sacramento River in Redding, California displays beautiful lines and geometric shapes. http://www.turtlebay.org/att_sundialBridge.php
Images_11-13 are a series of sketches showing the initial idea and shapes of the Sundial Bridge. Sketching from different angles and views is important because it communicates your ideas to others, develops ideas that meet the criteria of your brief, and provides a better description of the object’s form.
In Santiago Calatrava's designs, the structure of the building is often visible in the design. One of his most interesting buildings is the Turning Torso Tower in Malmo, Sweden. [http://www.turningtorso.com/](http://www.turningtorso.com/)

The sketches illustrate how he based this idea on the turning of a human torso. Calatrava also incorporates sustainable solutions into his designs. Turning Torso Tower has many sustainable features including a system for recycling organic waste into Biogas, which in turn powers the buses of the city of Malmo.

The Turning Torso Tower in Malmo, Sweden was inspired by a drawing of a twisted human torso.

The geometry that makes up the Turning Torso Tower is very simple. Each floor is rotated a certain number of degrees to the floor below, giving the building its twisted effect. Once the structural elements are added and the geometry starts to twist, the building starts to develop a sense of complexity.
Image 17 shows some of the close up detail and geometry of the Turning Torso Tower.

During the process of designing, it is always important to think about shapes in their most basic element. This will enable you to figure out how structures fit together.

Acclaimed British architect, Sir Norman Foster, is known for the efficiency in his designs. His architectural style is exciting as he brings an awareness of the environment into his projects. Sustainability and beauty are key issues in his current designs.

Foster harnesses a synergy between the building and the environment through the use of natural ventilation and light. This enables people to feel comfortable because they can relate to the outside world. The Swiss Re building and City Hall in London are two examples of how he is inspired by abstract shapes.

The geometry in these buildings can be broken down into primitive shapes. Although both have a curved appearance, the Swiss Re building has only one curved piece of glass in its entire structure, which completes the dome at the top of the building. The curved effect is achieved by placing flat quadrilaterals onto a curved structure. The more planes that are used the better the illusion of curvature.

Small squares placed along a curve make it smooth; the bigger the quadrilaterals the less the curvature. Foster’s use of glass quadrilaterals is a running theme in his designs.
The Swiss Re building is not only a beautiful design, but also an energy-saving structure. The building has its own microclimate, which has eliminated the use of air-conditioning. Each floor is rotated by 5 degrees from the floor below, enabling the incorporation of a ventilation system. Light and ventilation are huge issues in design and sustainability.

http://www.fosterandpartners.com/

Image_18 (Image Copyright Andrew Tanousis)

Image_18 shows some of the details in the base of the Swiss Re building. The area at the bottom of the building has been converted into a public space.
This image shows basic geometry in the windows.

Image_19 and Image_20 examine the detail of the Swiss Re building. When the geometry is broken down to its basic parts, the building does not seem as complex.
Image_21 demonstrates how the details of the Swiss Re building can be deconstructed into a component of parts. Each of those parts serves a purpose and a function in making the building sustainable and green.

Image_22 is a 3D model of the Swiss Re building. Once the 3D asset has been produced, it can be used to aid a range of design processes. It can establish how the building can be built most efficiently, and what its optimum shape should be, based on the current design criteria.
The render above is a close up detail in the 3D model. 3D modeling enables us to build an overall shape, and then continually make adjustments to achieve an optimal design. 3D software is a very exciting medium. It enables the visualization of a design in real-time to see if it works at all stages of a design cycle.

Image 24 is a deconstruction of the geometry that makes up the Swiss Re building. It is now easier to understand it as an overall shape.
Rem Koolhaas is a renowned Dutch architect and Professor in Practice at Harvard University. 


At first, his style may seem disharmonious, his buildings abstract and unrelated forms, yet he draws inspiration from light, color and translucency. Like Sir Norman Foster, he uses glass as one of his main design features, although his style is more angular and asymmetrical. Deconstructing the elements of his designs illustrates the basic primitive shapes, and how he thinks about construction. The Seattle Public Library is an example of functional and aesthetically beautiful forms. 3D visualization was used in developing the design of the building, and the use of glass and natural light reduces energy costs.

Look at Image_25. Deconstructionist architecture? Or simply functional forms that collectively work together as a space, moving away from what architecture is deemed to be. Koolhaas does not follow any guidelines; this is visible in his designs. The shapes he uses are very simple.
Image_26 is a breakdown of Koolhass' structure into very basic and primitive geometry. Essentially, it is sketching cubes. These cubes can then be further visualized in 3D, and from there made into a 3D model.

Image_27 is the exploded parts that make up the building. Once all the pieces are aligned, they can be put together. If a design does not work as expected, the 3D model can be refined to accommodate changes. 3D allows a very rapid design development cycle.
Image_28 shows the final 3D model. Constructed from primitive objects, the shapes are the same, but vary in size and proportion. It is always a good idea to start the design process by sketching. 3D then enables us to take that sketch and visualize the designs.

Introducing 3D software into the architectural design process has allowed contemporary architects to explore new depths and push design boundaries. Models can be created in 3D, and manufactured directly from the 3D data. 3D data can be used in a variety of ways. For example, XYZ coordinates can be used to produce a physical model from the 3D model. The use of 3D is a very important process, shaping the way architects address important sustainability issues. A designer can draw up the floor plans for a building in AutoCAD, and then export the data into a 3D application like Revit or Inventor to start the modeling process.

Since ancient times, civilizations have been able to harvest natural resources to help them survive and adapt to their environment. Structures were erected to shelter them from the elements. Fire was the only way to keep warm. Now we harness technology to use the sun to heat water for buildings, reducing energy costs.

A classic example of sustainability can be seen in the 14th century Moorish Alhambra, in Granada, Spain. [http://www.greatbuildings.com/buildings/The_Alhambra.html](http://www.greatbuildings.com/buildings/The_Alhambra.html)

The use of fountains and ponds is prominent throughout the Alhambra. This water was used for both cooling and watering. This may seem like a great waste, but Granada is surrounded by mountains, which are always covered in snow in the winter. The water that was collected at the bottom of these mountains was directed to fountains and in turn to ponds.

Sustainable building is re-shaping the way architects approach their designs. Light and ventilation solutions are being integrated, and this can ultimately guide the design cues of the building. We have the ability to air-condition buildings, but there are more ecological solutions such as incorporating natural ventilation systems. Solutions have been introduced into the building of office and public space, and these same solutions are being applied to homes. These concepts are helping to reduce the need for energy and other resources. Reducing energy usage helps sustain the environment.
Sustainability is not an issue limited to just commercial property and public spaces. Image_29 illustrates how sustainable solutions can be incorporated into the household. Rainwater is collected, re-distributed, and used to flush the toilet, wash clothes, or water the garden.

Eventually, many of our natural resources will be depleted. What if we ran out of resources that are essential to everyday life?

- What would you do to design a building to make sure this didn’t happen?
- How would you incorporate an ecological design solution into a building?

By incorporating sustainability into the design process, architects are revolutionizing the way they build and the way people live. Sir Norman Foster envisioned a city within a city as inspiration for his Swiss Re building. Its gardens create a microclimate, and through clever engineering, a ventilation system serves the whole building. Contemporary architects are raising the bar by incorporating sustainable solutions into architectural design. This has been due, in part, to advancements in technology, particularly digital software that allows for real time evaluation of a design at every stage of the design process.
Image_30 shows more sustainability solutions in the household. The Solar panels on the roof of the house are used to heat water in a tank. The water can then be distributed around the house without the need to use fresh water.

Design plays a very important role in architecture, not just aesthetically, but technically. As technology evolves and software becomes more powerful, it enables architects to explore new possibilities. Architects visualize their designs throughout the process, and explore the shapes that make the structures, determining changes that need to be made. The ability to visualize 3D shapes enables architects and designers to understand the form a building will take and the space that it will occupy. Looking to the future, incorporating sustainable features will play a leading role in defining how buildings are designed and unifying them with their environments.

You can take a closer look at some of the architects mentioned here by looking at the following links.

www.fosterandpartners.com
www.foga.com
www.greatbuildings.com
www.calatrava.com/main.htm
www.oma.nl
www.ace.mmu.ac.uk/eae/Sustainability/sustainability.html