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Why Concrete? Four Case Studies of Concrete Architecture

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Background

With the progress of science and technology, taller buildings exist in our society, enabling more people to live, work, and study in cities. In the past, people were likely to use wood to construct their house because wood was easy to find and process. However, most architects claim that wooden houses are prone to fire, which means taking concrete as a main material while workers construct a building is a better choice.

Tea House, Shanghai
Photo was taken by me

Concrete becomes the main building material

In last 60 years, people have been likely to take advantage of concrete to build pavement in society because concrete has strong features, which are better durability and low costs[1]. Therefore, as the diagram in Figure 1 demonstrates, using concrete to build pavement is economical because there is no need to pay for any reinforcing steel in the slabs or for labor to place the steel[2]. Nowadays, architects discuss whether concrete can be used to shape the building space, bring ing a different experience than wood and metal to people. They believe that there are three advantages, which are saving more budget, producing low consumption, and shaping different forms of concrete to become building material. Thus, architects prefer to use concrete at first when they are considering w hich building material to choose.

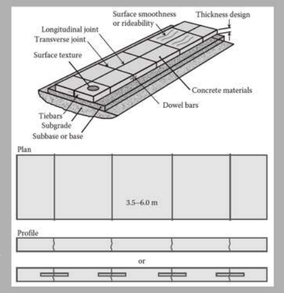

Figure 1 Concrete pavement. (Reprinted by permission of ACPA, Skokie, IL.)
https://www-taylorfrancis-com.libezproxy2.syr.edu/chapters/mono/10.1201/b17043-6/types-concrete-pavements-norbert-delatte?context=ubx&refId=c02769c0-51db-4512-aa79-5871e763c72dhttps:%2F%2Fhome.firefoxchina.cn

Concrete technology and the Development of Architecture

In the past, Le Corbusier, one of the pioneers of modern architecture, preferred to take advantage of characteristics of concrete to design a building. He was apt at shaping a free space by using concrete. With respect to both space and technique, Le Corbusier's contribution seems to establish the five points of a new architecture, pilotis (exposed lower-story columns), free facades, open floor plan, ribbon windows, and roof gardens, as the diagram in Figure 2 demonstrates[3]. Concrete granted Le Corbusier the ability to show his early design concepts, which is the necessity of connecting the machine age with classical architecture. During the postwar era, Le Corbusier turned his attention to the tactile expressiveness of concrete, which could stimulate both a primitive purity and enable buildings to be built on a bigger scale than before[4]. Consideration of the concept of the architect as "poetic engineer," Le Corbusier's explorations are realized in buildings like the Chapel at Ronchamp. Chapelle Notre-Dame-du-Haut, situated in Ronchamp, France, is likely to relate to water. According to Deborah Gans, in keeping with basic belief of the architect in the structural parallels between man-made technologies and nature, Le Corbusier also prefered the roof to be designed a form of seashell found on a Long Island beach[5]. As the section of chapel in Figure 3 shows , in the dim chapel, the roof swells up, the floor dips down, and the western wall rippled like a wave, which means space shaped by concrete may provide a clue to people, rethinking the significance of space spirits , which is that space brings different feelings to people in same place.

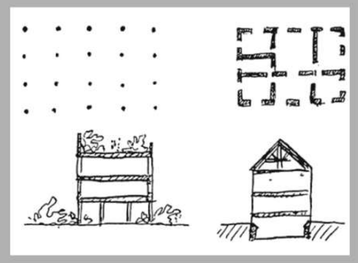

Figure 2 Five Points of a New Architecture
https://www-sciencedirect-com.libezproxy2.syr.edu/science/article/pii/B9780851391557500060

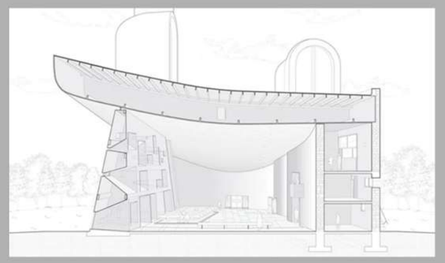

Figure 3 The Section of Ronchamp
https://www.inexhibit.com/mymuseum/notre-dame-du-haut-le-corbusier-ronchamp-chapel/

At present, most architects prefer to shape different space and emotion by using concrete enhanced by advanced technology. Architects from Tongji University enjoy creating emotion for people because architecture has different definitions. Church of The Light, built by Tadao Ando, enables visitor to feel more solemn. The Church is totally different with other church es because the architect combined light with concrete, producing a silent and holy atmosphere in interior space. According to Jin Baek, just as Ando's concrete wall was to reveal its actual performance by releasing it from an architect's enthusiasm for design[6].

Besides, Tea House, designed by Archi-Union Architects from China, is constructed from the salvaged parts of the original warehouse's collapsed roof. The volume is a three-dimensional irregular shape which is impossible to be understood through plans. The twisting shape was designed by scripting in Grasshopper an algorithmic plug-in for Rhino, which is a modeling software[7]. Concrete casting after the reinforced bar was completed by manual labor and the final physical effect was achieved. As the interior area of Tea House in Figure 4 shows, the traces of the timber formwork remained imprinted on the poured concrete after construction. Consequently, although there are errors in the formwork, planning and manual casting the combination of digital design and low-tech manual construction provided a great opportunity to study the possibilities of digital architecture, which means concrete may holds different shapes in architecture like no other material.

Architects want to push the progress of architecture and will try lots of methods to take experiment in architecture. A few years ago, people used 3D printing technology to create their favorite tools, such as spoon, fork, bowl, and knife. However, nowadays, people use the technology to design structures and taking advantage of algorithm creates new forms in architecture, as Figure 5 demonstrates. Although the technology may still seem incipient, one of the world's most famous firms, Zaha Hadid Architects, has fully embraced it. They argue that in the next two to three years, there will be significant activities about concrete printing[8].

Figure 4 Interior Area of Tea House
https://www.gooood.cn/tea-house-j-office-by-archi-union-architects.htm

Figure 5 Concrete Printing
https://news.psu.edu/story/583678/2019/08/13/research/research-team-receives-grant-commercialize-3d-printed-concrete

Conclusion

From what has been discussed above, we can safely draw a conclusion that concrete is no longer a fresh word to people and shape s different possibilities of space as technology advances. People could not imagine that concrete would bring lots of chances for architecture and has driven the development of the whole industry in last few years. There is a saying, "The group of modern architects, as the flying corps trying to establish new records or exploring to discover unknown regions, all belong together[9]," mentioned by Le Corbusier. It means that the responsibility of architects is to explore possibilities of architecture and change people's lives.

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