The relevance of kinetic architecture for the future set out through one project: Adaptive Space


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In the western society, there are numerous examples of how motion can be applied in buildings. These examples can be seen in films, commercials and music videos. Although these movements are technically impossible, they do have a reason why they are shown. There lies a sort of beauty in them, a beauty which is difficult to grasp. It looks mysterious and sometimes impossible, because people are not familiar with motion in buildings. The motion looks very complex, but actually, it consist of very simple movements. Combined it looks complex, and beauty will arise from it.

This study offers a glimpse of how we can incorporate movement into buildings, so that it will become present in our everyday life. For this to become true, the ideas of utilizing motion seen in motion pictures have to be translated into constructive concepts and be implemented into actual buildings. If kinetic architecture is going to be a major field within architecture, systems will have to be developed which are widely applicable. Most of the systems build today, are project based which hold back the further development of such systems.

Kinetic architecture
The motions shown in the examples all have their own reasons why they were applied. In contemporary architecture, there are just tree main reasons for applying motion in buildings. The first one is for visual means. Applying them for architectural reasons: for the beauty of the motion [Tzonis 1999] or to express some input, like weather or emotions [Oosterhuis 2002]. The second reason is to control or influence the climate inside buildings. This can be done by creating openings (visual or physical) or by adjusting volumes to control the amount of light, air or water entering the building. The last reason is to improve the spatial functionality, where scenarios are created to modify spatial relations [Price 1984]. This can be done through altering volumes or moving objects.

Adaptive space
This project aims on the spatial functionality. If successful concepts can be found, they could have a great impact on architecture in the near future. The objective is to utilize space more efficiently. Buildings are mostly used as efficiently as possible, due to the high cost of a building. But if you see the actual used space through time, you’ll see that most of the time the rooms are empty. They are serving as a storage space and are waiting for a person to use the room. But what a large storage. The relevance of kinetic architecture for the future set out through one project: Adaptive Space

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space, filled with mostly empty space. Normally storage space is packed very densely with objects, because of this the space can’t be used very functional for activities other than loading or unloading goods. This study tries to create an environment in which rooms act as storage space, when they are not being used, and act as fully functional room, when they are being used. To achieve this, the rooms will have to contract and expand. Therefore, some building elements must move.

First, the study looked on where motion could be applied usefully. Moving (parts of) the exterior shell of a building will not help the spatial functionality of the building. We build because we want a space that differs from the surrounding space. Creating a motion where the size of the building will increase and decrease doesn’t add much value. It will be easier to create a static building that is as large as de building with motion expanded. Thus, only the elements inside a building qualify for the motion: floors and the partition walls. Although moving the floors can add great value, it has its disadvantages.

By moving the walls you can increase the surface of the floor and because they are mostly not structural elements, it is easier (and cheaper) to move the partition walls instead of the floors.

**Sensors, rules and events**

The goal is to create an environment in which the space can be used more efficiently. For this to happen there will have to be a scenario of some kind describing various events that can take place. By setting a few rules, a scenario can be created, so that the goal can be achieved. To trigger the events, data-input is needed in order for the walls to react. This data-input is gathered via sensors that will monitor the users.

There are two types of sensors needed to operate the adaptive spaces. The first ones are sensors to locate persons in the rooms. The second type of sensors is attached to the kinetic walls and is able to scan the space in front of that wall. These sensors are mainly used for safety and operate very similar to the ones used in the doors of an elevator. Therefore, if anything comes within half a meter of the wall, the wall will stop moving. There is no physical interface, the sensors detect persons and locate them in the room and therefore space itself becomes the interface.

The walls will move on specific events. When a person enters a room, the walls of this room will move outward until they reach an object and stop. If a person leaves the room, it will contract and the next room will expand. If both rooms on either site of the wall are not occupied, the walls move to his base position. The same will happen when both rooms are occupied. The base position is a predefined point and can be in the middle of the two rooms or a point at which both rooms can still be utilized. It can be adjusted by the users by changing some variable in the software.

Because of the rules, the configuration of the room will adjust itself to any influence the users give it. The rooms can be modified just by placing or removing objects in front of the kinetic walls. So if a person moves all the furniture from one room into the next, the empty room will get very small and the full room very large. This will give him the ability, within some limitations, to influence his own floor plan. The user gets the control over the proportions of the rooms and distances will become variable.

**Example**

Adaptive space can be applied in almost every building. Examples are: housing, offices (flexible working spaces), hotels, clubs, museum, pavilions, storage space, etc. The most interesting are urban sites with a high building density and ground price.

In the next example, a five-storey building with small apartments, you can see what adaptive spaces can do for a building.

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Figure 1. Example: a five-storey building with small apartments

The building was designed on a site in Amsterdam, with a surface area of 7.6 m wide en 13 m deep. The building consists of 10 small apartments stacked onto each other and are 6.6 x 6 m. The target group exist of students, newcomers, singles or as a second home. The apartments are quite small, but they do offer privacy. The floor plan consists of an entrance hall, living, bathroom and bedroom, which contains a folding bed. If a person walks through the apartment, the rooms will automatically adjust themselves. In the figures below you can see that the room the person stands in is expanded, taking the space from the other rooms. This room is now fully functional, while the other rooms resemble more like a storage space.

Figure 2. As a person walks through the various rooms, he will experience only the expanded rooms.

When a person enters a room, it will expand. This way the person will only experience the expanded rooms and the entire building will look larger than it really is. However, it is not just the perception of the space, in fact it is actual space that has become larger, providing extra space for walking or to play in. Therefore we can say that the entire building has become larger. The extra space gained can be seen in figure below. In this example the persons will experience the building 40% larger. Because of this it will become possible to reduce the size of the entire building. The extra space will definitely compensate the costs of moving the walls.

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Figure 3. A person will experience the building up to 40% larger than the original.

To realise adaptive spaces a system has been developed to provide movement to the dividing walls. This technique can be applied to all sorts of spaces that contain partition walls. The system that will provide the motion works independently and every type of wall with a rigid structure can be attached to it.

Experience

When walking through an empty building, the rooms will expand and contract, making the whole building a dynamic landscape. The wandering person will detect when a room is occupied, because the walls that make up the room will only move to their base position. The presence of movements of the building will indicate that other persons are nearby. In this way buildings are starting to act as individuals that react on the users. And people should take into account that buildings can move. This will definitely intensify the relationship between the users and the building. It will have great implications on the human psyche. We don’t know how the people will react, living in an environment which constantly moves. Will we adapt to it easily or will it become annoying in the long run? The only way to find it out is to actually live inside a building with adaptive spaces.

Conclusion

This project shows that kinetic systems can have benefits that exceed static concepts. They can solve problems that otherwise could not be solved. If kinetic systems become more widely applicable it can have a great impact and expand the field of architecture. The first steps toward building actual kinetic structures are being taken. This research has given just one example of kinetic architecture and the developments of such systems are still in its infancy. Imagine what could happen with architecture if more kinetic concepts are conceived. Combined together and you will get an environment that reacts on every move you make. The possibilities are endless and the only limiting factor are we ourselves.

References