HUMANS: ART IN MOTION

AN ASBTRACT JOURNEY THROUGH PERCEPTUAL KNOWLEDGE

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Abstract

Through this project, an attempt is made to look into human existence in an abstract manner where human motion and movement is the means of medium. The project is at the boundary between computer science, dance, performance art, animation, medical research, and other uses of motion capture technology.

Acknowledgements

I would first and foremost like to thank the Almighty Allah for giving me the strength, patience, courage and will power to complete my 5 years of my education in the field of architecture. Next i would like to thank my parents for always being there as my support system.

The people who have guided me and been mentors to me in the design process of this project are my teachers Abul Fazal Mahmudun Nobi, Habib Reza and Shakil Ahmed Shimul, without whom this project would not have been possible.

Third I would like to thank two of my closest friends Amlin Iqbal Eshita and Mushda Ali for constantly supporting me in my distress, encouraging me, listening to me whine, and also scolding me when i needed it, this project would not have been possible without the mental stability and support they provided me.

Lastly I would like to thank Teesha, Trisha and Naymun who came to me like angels to help me when I was in dire need of assistance to wrap up my work.

CHAPTER 1- PROJECT BACKGROUND

1.1 Project Brief

Project name:

Humans: Art in Motion

An Abstract Journey Through Perceptual Knowledge

Project type: Multidisciplinary edutainment center

Site: The project is a self proposed project, so it has no specific site proposed by the government, therefore the site was chosen in such a manner that is a central location of the capital city, with proper road connections, which can attract mass volume of people with the site acting as a center that connects various functional groups.

Area: 7.5 acres approx.

1.2 Project Introduction

Interest in human motion goes back very far in human history, and is motivated by curiosity, needs or methods available at a time. For example, a biomechanical perspective is characterized by the "need for new information on the characteristics of normal and pathological human movement". It is also possible to outline disciplines of science (e.g., mathematics) or arts (e.g., paintings, sculptures), relevant to human motion, just to indicate briefly the complexity of the subject. Obviously, different disciplines are interested in different aspects of the subject; biomechanics is, for example, focusing on human locomotion, with less interest in muscle models, and when correcting motion (e.g., of disabled children) by surgery, it will be exactly the opposite.

Through our movements we get "in touch" with our world, taking its human measure. Attention to bodily movement is thus one of the keys to understanding how things and experiences become meaningful to organisms like us. Movement is one of the conditions for our sense of what our world is like and who we are; a great deal of our perceptual knowledge comes from movement, both our bodily motions and our interactions with moving objects. It is originally through movement that we come to inhabit a world that makes sense to us- that is, a world that has meaning for us. Movement thus gives us knowledge of our world and, at the same time, reveals important insights about our own nature, capacities and limitations. What is it that we experience through our movements?—qualities of things, spaces, and forceful exertions. We start communicating with the world, from right after we are born, with our bodily movements and motions, one form being through imitation.

1.3 Aims and Objectives of the Project

Aims of the project

- Understanding self existance from the standpoints of art and physiology through an abstract window.
- Open new windows in terms of research and realizations regarding human locomotion.

Objectives of the project

- Uniting art and science to understand perception in everyday experiences.
- Creating a new experimental space for physiologists, philosophers, neuroscientists and artists to work together.
- Sharing knowledge through seminars, workshops, conferences, exhibitions and installations.
- Collaborating with partners in the arts, in industry and in the medical and educational sectors.
- Blurring the artificial line between art and science.

1.4 Given program

- Gathering hall
- Exhibition space
- Auditorium
- Multipurpose hall
- Museum
- Lecture halls
- Workshops
- Library
- Administrative office

- Cafeteria and restaurant
- Souvenir shops

CHAPTER 02: SITE APPRAISAL

2.1 Site Location

2.2 Site Analysis

2.2.1 Existing Site

2.2.2 Geographic heart of the Capital

2.2.3 Importance of Hatirjheel Project to Reinforce New Life in the Capital

2.2.4 Analyzing the Surrounding Areas

2.3 Environmental Considerations

2.4 SWOT Analysis

Site Appraisal

Since the project is a self proposed project, there is no particular site set for the project so various options were contemplated and then the current site was chosen due to meeting various criteria for needed for a site due to this particular kind of project, one major one being it made sense to be in the capital city.

2.1 Site Location

One of the key concerns for the site was an area that was very well connected to the city, so that it could attract a large number of people. Also another consideration was to locate the project adjacent to a zone that experiences thoroughfare of local, foreign and foreign visiting traffic for various reasons throughout the year. The site required a location that does not belong to any specific residential neighborhood, surrounded by mixed use development and public spaces of different scales.

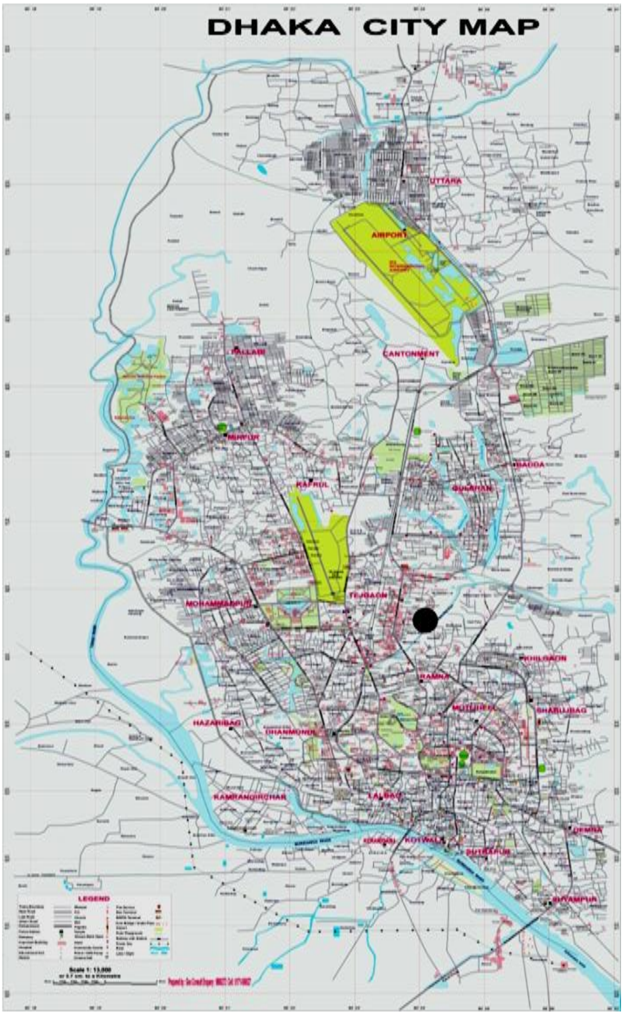


Fig. 2.1 : Site location, Source modified by author from Dhaka city map from RAJUK website

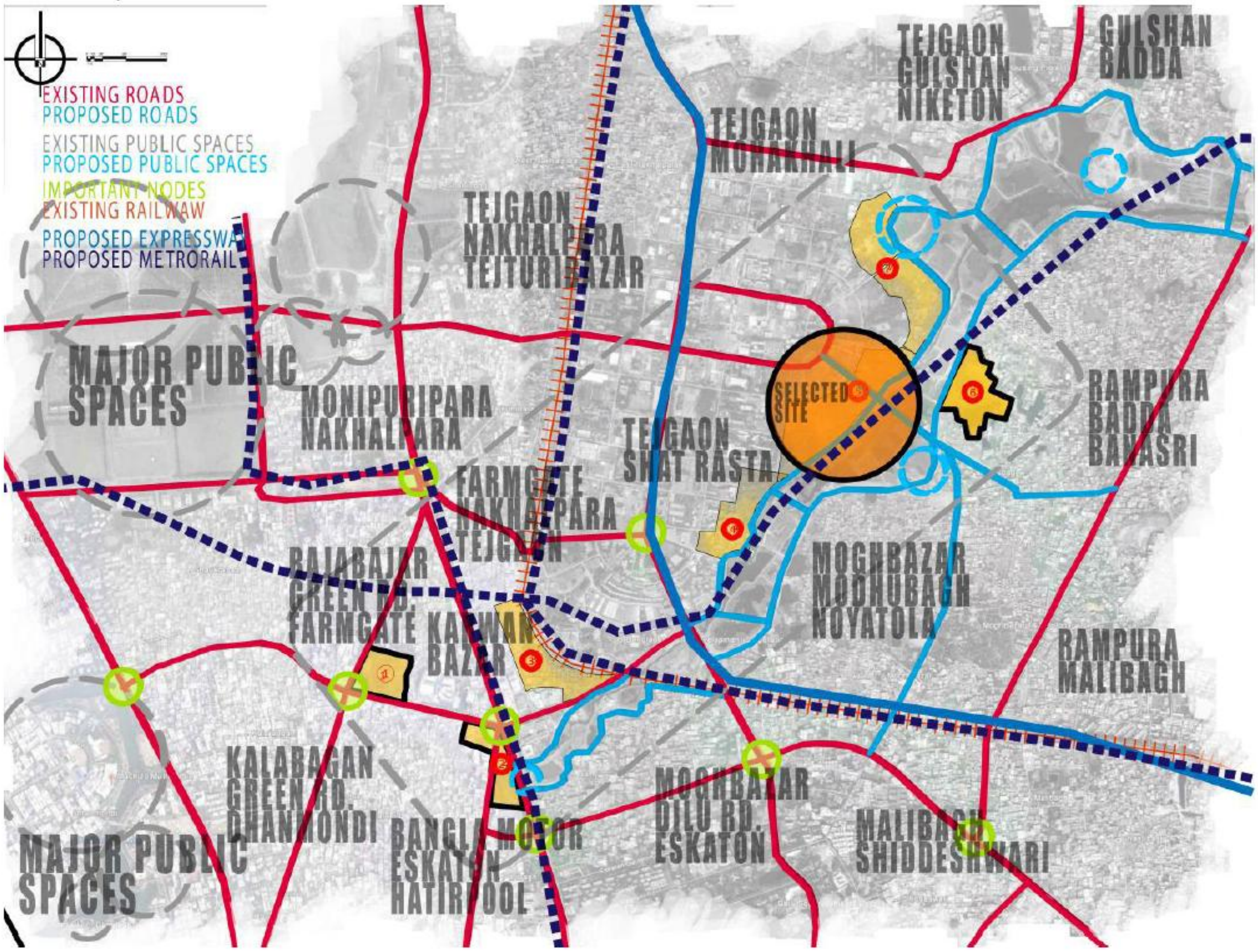


Fig. 2.2 Analyzing site connectivity, Source: Farzana Shahrin Rahman

The issues that influenced the selection of the site are; connectivity, access, functional zoning, surrounding development category, vista and relation with other public spaces, spatial hierarchy of surrounding structures, existing proposals, etc.

Taking the under construction infrastructure and waterfront redevelopment project of *'Hatirjheel'* into consideration and predicting the major future public space of the city, the site was chosen on the Northern bank of the lake, in Kunipara, Tejgaon.

2.2 Site Analysis

2.2.1 Existing site

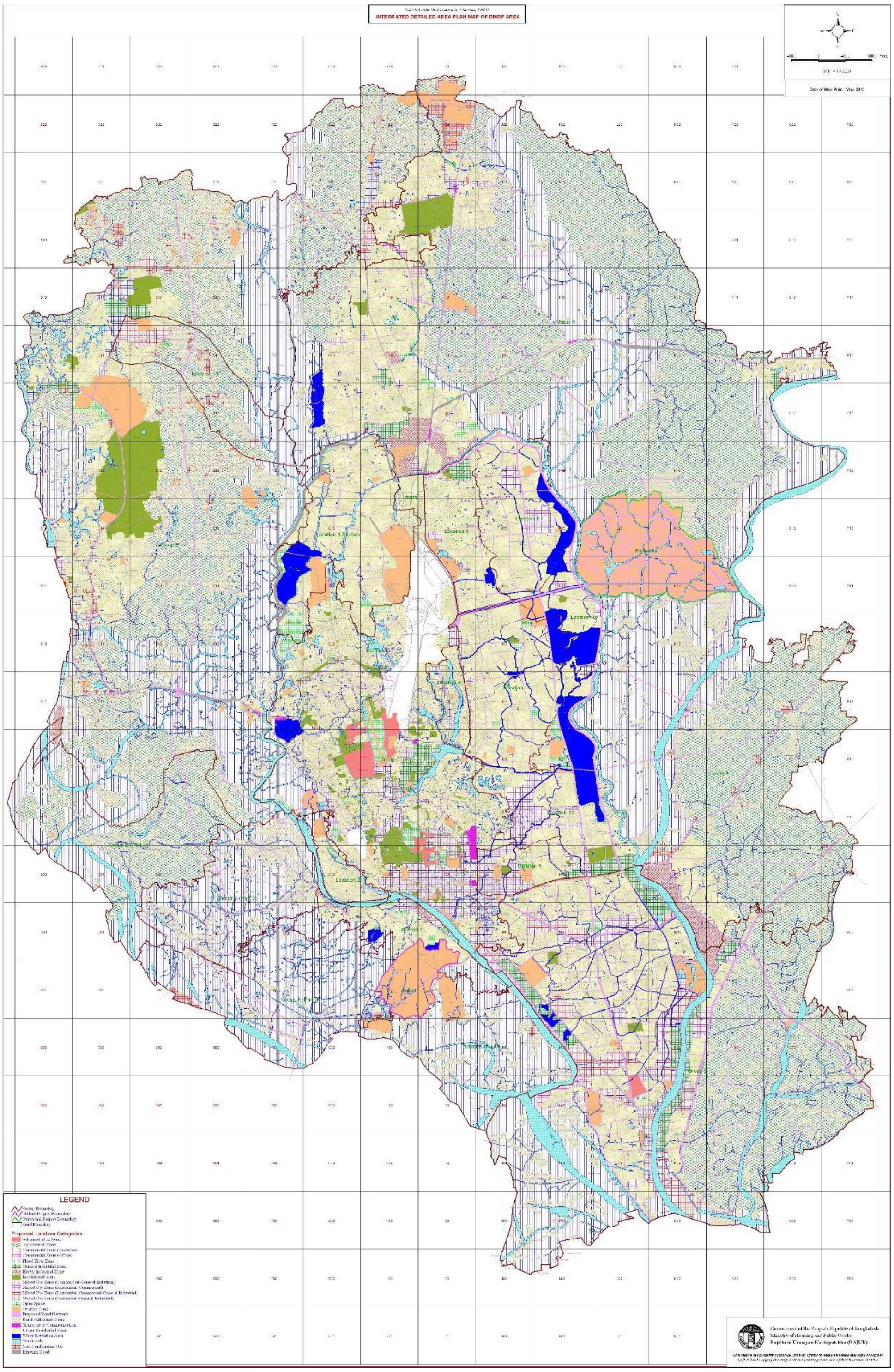


Fig. 2.3 Dhaka city total area plan, Source : RAJUK website

2.2.2 Geaographical Heart of the Capital

Predominantly industrial, the entire Tejgaon region is now growing into the extended Central Business District, initiated from the Karwan Bazar-Farmgate area. Most major arteries of the city connect or pass through this region. The upcoming infrastructure projects of the city also integrate with the region. This area brings in a lot of people from different socio-economic brackets from all over the city every day for various reasons. In terms of community and locality, the region belongs to the whole city rather than to any particular neighborhood; but simultaneously houses a distinct flavor of its own.

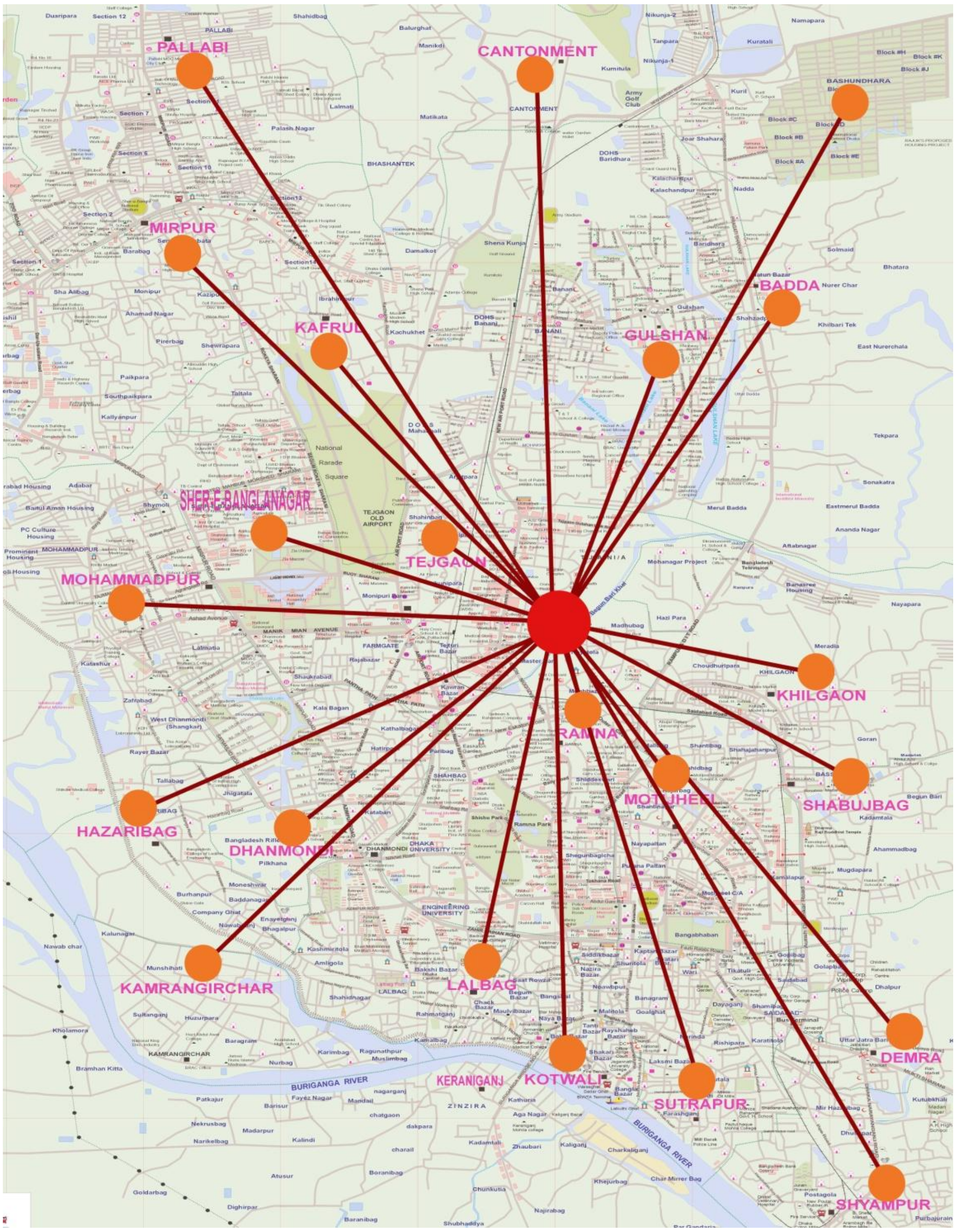


Fig. 2.4 : Geographical proximity to other areas of the city, Source modified by author from Dhaka city map, RAJUK website

2.2.3 Importance of Hatirjheel Project to Reinforce New Life in the Capital

The Hatirjheel infrastructure and waterfront project can be predicted to become the largest public retreat and waterfront recreational space. The project comprises of different sort of public spaces, smaller and larger scale gathering spaces, parks, event spaces, etc. But most importantly the project creates opportunities for a rapid mixed development catering the visitor public. It also bridges the long gap in the thoroughfares of the city.

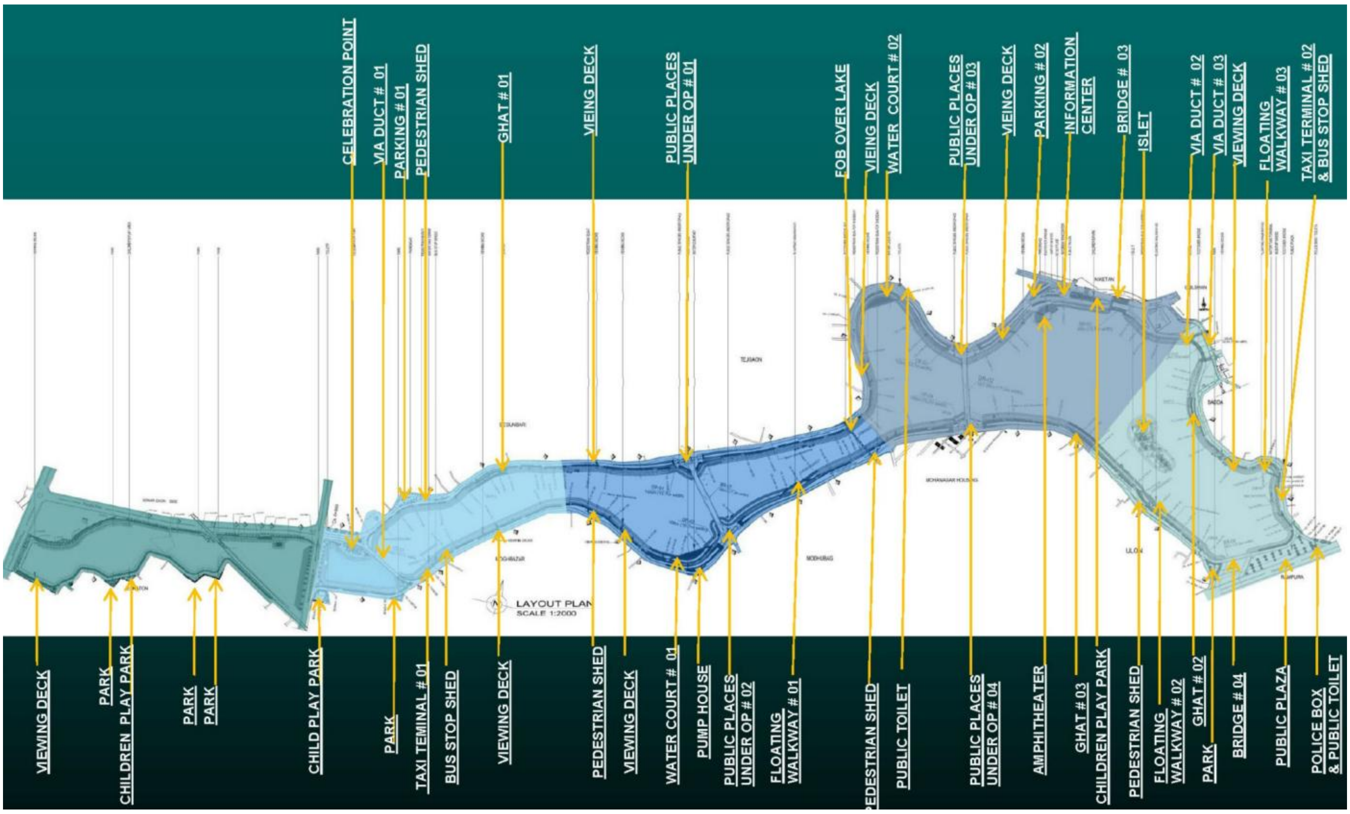
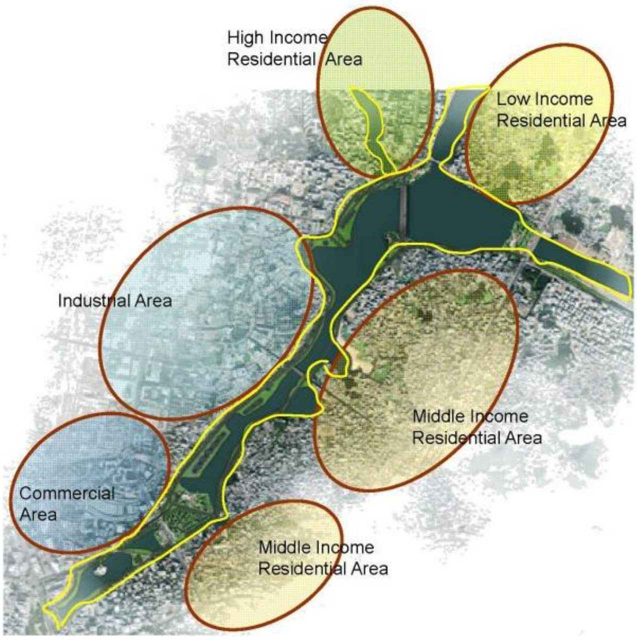


Fig. 2.4 : Development plan for the Hatirjheel Project, Source VITTI Sthapati Brindo Ltd.

2.2.4 Analyzing the Surrounding areas

Fig. 2.5 : Surrounding areas and selected plot, Source modified by authour from masterplan of Hatirjheel project by VITTI Sthapati Brindo Ltd.

Currently the site falls under the 300m future development zone of Hatirjheel- Begunbari development project. The surrounding developments are mostly industrial factories and tin-shade companies like KOhinoor, Nabisco, Polar ice-cream and so on. Among the commercial uses, the commercial banks are mention worthy. Significant banks like Pubali bank Ltd, Shonali Banks Ltd have their age-old brunches in this area for quite a long time. Also there are some institutions like - Bangladesh Textile Engineering College, Ceramics institute, Polytechnic institute, etc. in the area around. Along the main road (Shahid Tajuddin Ahmed Shoroni), there are two fuel pumps and one at the Shat Rasta node. Basic utilities like gas, water & electricity are available. The site is surrounded by the residential zones of the Moghbazar and Modhubag housing as well. The site is a potential and strategic zone for creating a project like this, since it can attract all kinds of audience from all over Dhaka city. Since the target audience was mainly city dwellers, who can't take a break from their normal life and relax. Thus the site was chosen to provide a convenient access and the existing water body of Hatirjheel will add to the design.



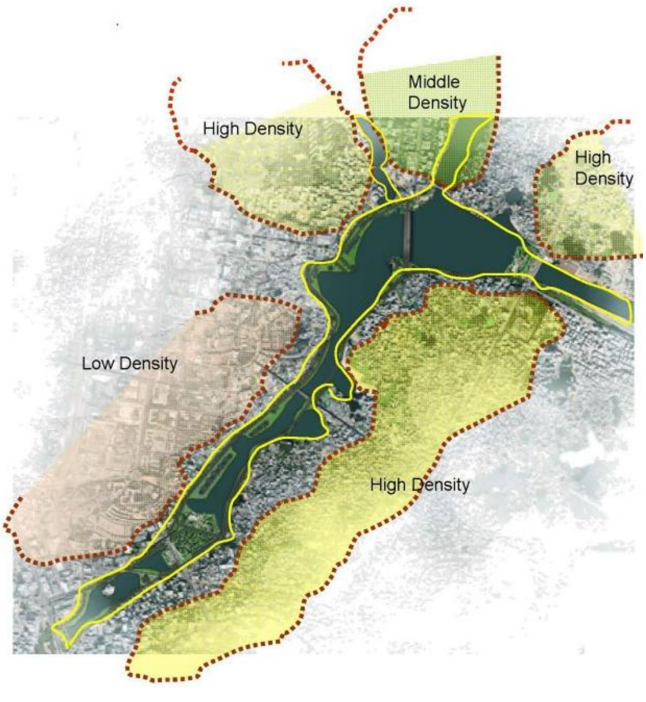


Fig. 2.7: Density mapping of surrounding, Source VITTI Sthapati Brindo Ltd.

Fig. 2.6: Income mapping of surrounding, Source VITTI Sthapati Brindo Ltd.

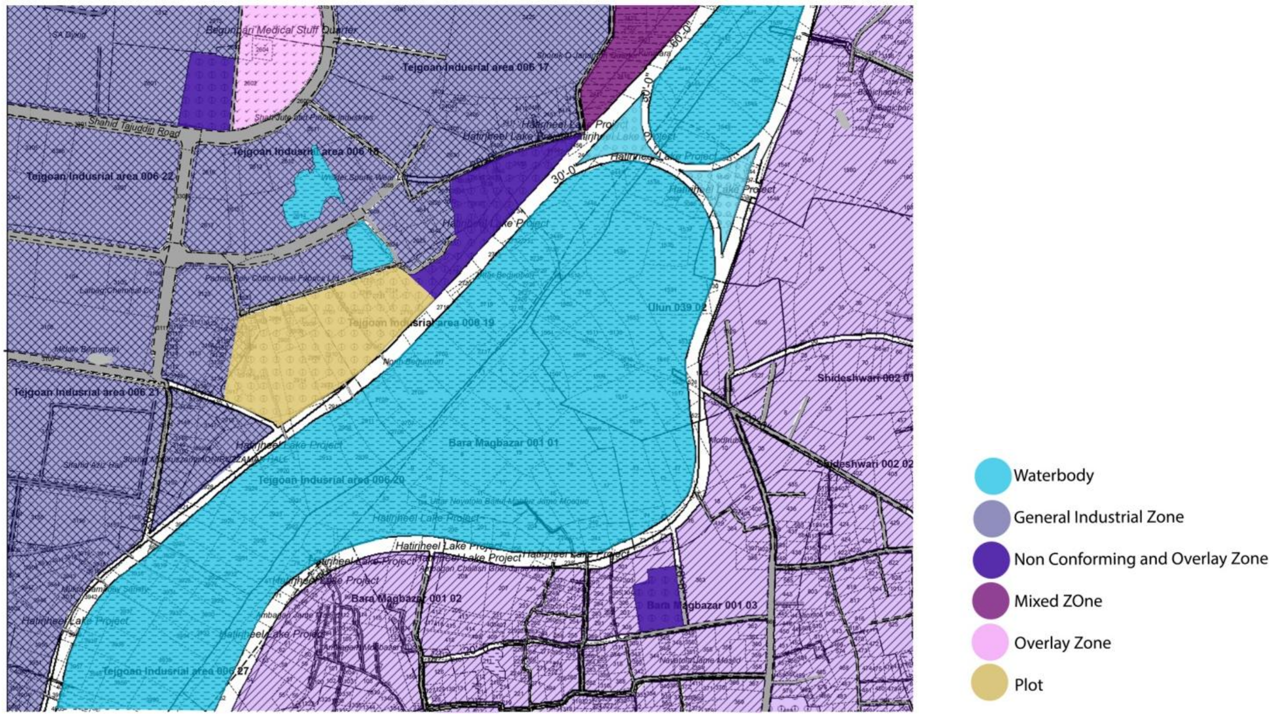


Fig. 2.8, Land use pattern, Source modified by author from DMDP

Fig. 2.9: Figure ground map

Fig. 2.10: Vegetation

Fig. 2.11 : Solid- void relationship

2.3Environmental Considerations

In many research studies the Tejgaon area is significantly mentioned as the most polluted area of Dhaka city in terms of sound, air and soil pollution; as it is a dense industrial zone. But the gradual development of the city is making this area a mix of commercial and industrial use. Many industries are being moved from this area to the out skirts of Dhaka city for reducing the environmental damage caused by them.

As a fabric of mixed use contents, the temperature of Tejgaon is slightly different from the rest of Dhaka. The air is more carbonated and hotter. But due to the waterfront location of the site, and being surrounded by dormitory areas, there are large open and green spaces around the site. The average temperature of the entire area is given below.

Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Temperature °C (°F)	28 (82)	28 (82)	32 (90)	34 (93)	33 (91)	32 (90)	31 (88)	31 (88)	31 (88)	31 (88)	29 (84)	26 (79)	31 (87)
Average Temperature °C (°F)	22 (72)	21 (70)	26 (79)	28 (82)	29 (84)	29 (84)	29 (84)	29 (84)	29 (84)	27 (81)	24 (75)	20 (68)	26 (79)
Average Min Temperature °C (°F)	16 (61)	15 (59)	20 (68)	23 (73)	24 (75)	26 (79)	26 (79)	26 (79)	26 (79)	24 (75)	19 (66)	14 (57)	22 (71)
Average Precipitation mm (in)	8 (0)	32 (1)	61 (2)	137 (5)	245 (10)	315 (12)	329 (13)	337 (13)	248 (10)	134 (5)	24 (1)	5 (0)	1875 (74)
Number of Wet Days (probability of rain on a day)	2 (6%)	3 (11%)	5 (16%)	9 (30%)	15 (48%)	21 (70%)	26 (84%)	25 (81%)	19 (63%)	8 (26%)	2 (7%)	1 (3%)	136 (37%)
Average Daylight Hours & Minutes/ Day	10h 50'	11h 19'	11h 58'	12h 40'	13h 15'	13h 33'	13h 25'	12h 55'	12h 15'	11h 33'	10h 58'	10h 41'	12h 00'
Sun altitude at solar noon on the 21st day (°).	46.4	55.7	66.5	78.2	86.5	89.6	86.5	78.5	67.1	55.5	46.4	43	66.6

2.4 SWOT Analysis

Strength

- Wide roads
- Connecting bridge from Modhubagh to Kunipara
- Landscaping and civic amenities along the road
- Pedestrian on both sides of road running along the waterfront
- Various universities around which will attract a large number of students
- Media and newspaper offices in close proximity
- Waterfront has the possibilities to become the breathing space of the city. This is to influence the environmental impacts of the surrounding neighborhood

Weakness

- Internal roads encroached with vendors and temporary shops
- Pedestrians blocked and encroached by vendors and shops
- Possibilities of crimes
- Influx of traffic during the office opening and closing hours.
- Distinct distinction between industrial and institutional zones.
- Due to prevailing industrial development, the area is exposed to industrial exhausts, resulting in slightly hotter average temperature and polluted air.

Opportunities

- Connecting the two shores of the lake and, localities
- Become very popular and vibrant street.
- Create recreational spaces, eventful waterfront.
- Preserve eco system, home of other animals, birds.
- Plantation can help to make the area fresh, cooler, etc.

Threats

- Rapid development of infrastructure may lead to unplanned growth.
- Increase in land value.
- Poor maintenance can lead to public suffering.
- Unplanned development can create adverse environmental impacts and hamper the waterfront public experience.

CHAPTER 03: LITERATURE REVIEW

3.1 The Need for this Project

3.2 Understanding Human Motion: A Historic Review

3.2.1 Classical Antiquity

3.2.2 Renaissance

3.2.3 Baroque

3.2.4 Age of Enlightenment

3.2.5 Chronophotography

3.2.6 Human Motion Studies in Biomechanics

3.2.7 Human Motion Studies in Computer Graphics

3.2.8 Human Motion Studies in Computer Vision

3.3 Interpreting Human Motion Through Art

3.3.1 Kinetic Art

3.3.2 Interactive Art

Literature Review

This project makes as attempt to tie together various fields of studies that try to explain the existence of human beings, and this project makes an attempt to reconcile all those strings of thought together to create a clear image of the veracity of humans.

3.1 The Need for this Project

Bangladesh is a country where we constantly see family members trying to push children into graduating in the field of science, usually engineering or medicine, however what many forget to put emphasis is on is the field of liberal arts. In a time when everyone's trying to be competitive in the field of technology, science, enginnering, what people are forgetting is the power and importance of imagination and the liberal arts.

Off course no one is denying the weight of being competitive in the sciences, however if our next generation is to lead the world of innovation, then their education cannot be divorced from the liberal arts. There exists an artificial line between science and arts, however when we look into the works of innovators like Leonardo Da Vinci or Steve Jobs, we realize that they actually realized the importance of both. Another example from our very own nation who cannot be ignored is Muhammad Zafar Iqbal. So the question that comes to mind is what makes these people more unique than others, what makes them stand out, and the answer to that is, they were/are better equipped to face the world better, because they have all the different weapons of knowledge in their arsenal. The ability to aplly cross-disciplinary thinking into an incredibly complex world is something we need more of, to view the world differently, to think differently and to actually come up with solutions which are not typical, but rather out of the box.

The kind of exhibits in this particular museum will do exactly that, try to exhibit and understand human beings from diverse viewpoints. Therefore, a project like this will address all of it together, and inspire people to embrace the importance of philosophy, science, technology, engineering, arts, and help the audience to address the field of education differently, while at the same time understanding the abilities in oneself better.

3.2 Understanding Human Motion: A Historic Review

3.2.1 Classical Antiquity

The ancient Greek philosopher Aristotle(−383to−321)published, besides much other fundamental work, also a (short) text ΠΕΡΙ ΠΟΡΕΙΑΣ ΖΩΙΩΝ on the gait of animals. He defined locomotion as "the parts which are useful to animals for movement in place". The text is very readable, certainly also due to an excellent translation, and it contains discussions of interesting questions (e.g., "why are man and birds bipeds, but fish footless; and why do man and bird, though both bipeds, have an opposite curvature of the legs"), links to basic knowledge in geometry (e.g., "when ... one leg is advanced it becomes the hypotenuse of a right-angled triangle. Its square then is equal to the square on the other side together with the square on the base. As the legs then are equal, the one at rest must bend ... at the knee ..."), or experiments (e.g., "If a man were to walk parallel to a wall in sunshine, the line described (by the shadow of his head) would be not straight but zigzag..."). This text is the first known document on biomechanics. It already contains, for example, very detailed observations about the motion patterns of humans when involved in some particular activity. Sculptures, reliefs, or other art work of classical antiquity demonstrate the advanced level of understanding of human or animal motion, or body poses (often in a historic context). Classical antiquity already used mathematics for describing human poses or motion, demonstrated in art works that we have to consider individual poses as well as collective poses (e.g., in Roman arts, a married couple was indicated by showing eye contact between woman and man, possibly enhanced by a pictured handshake), and showed in general that motion and poses need to be understood in context. Motion was only presented by means of static artwork; the first dynamic presentation of motion was by means of moving pictures, and this came nearly 2000 years later, at the end of the 19th century. A charioteer with horses four-in-hand traditionally had the horses gallop in a race, where gallop is defined as a certain step-sequence by the horses, also including a period of suspension with no hoof touching the ground. However, until the invention of moving pictures, it was an open question whether such a period of suspension does occur. In classical antiquity, motion patterns of humans were usually studied in close relation to motion patterns of animals. Indeed, those comparative studies have continued to be useful: see Figure 3.1 illustrating evolutionary relations between joints of humans and horses.

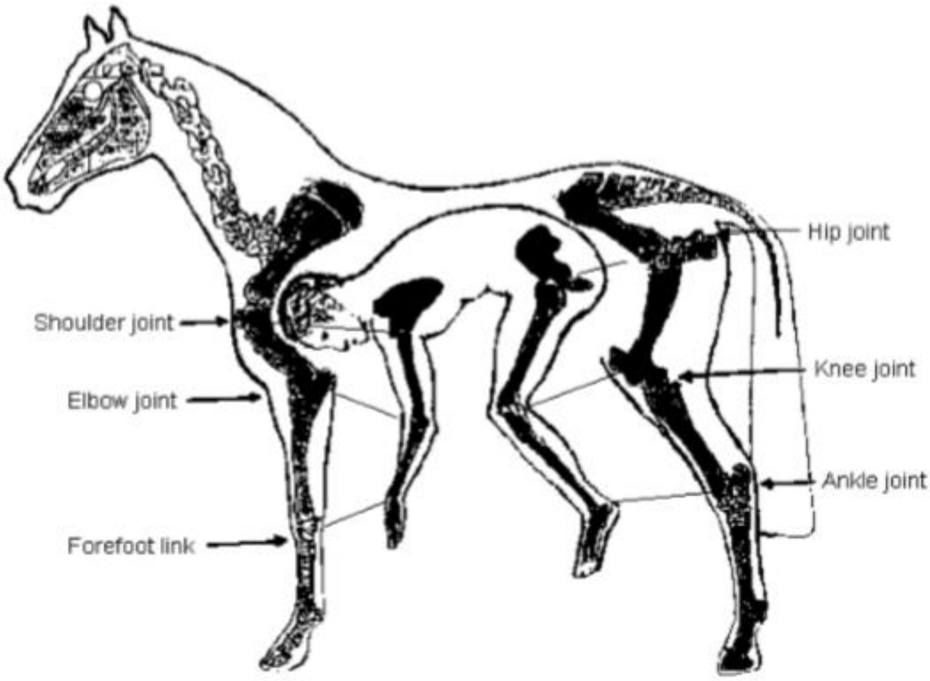


Fig. 3.1: A modification of a drawing published by W. F. Bartels

3.2.2 Rennaisance

Leonardo da Vinci (1452–1519) stated in his sketchbooks, that “it is indispensable for a painter, to become totally familiar with the anatomy of nerves, bones, muscles, and sinews, such that he understands for their various motions and stresses, which sinews or which muscle causes a particular motion” of a human. For an example of his modeling of the human anatomy, see Figure 3.2 on the left and in the middle. In his mirror writing he wrote that “m c measures 1/3 of n m, measured from the outer angle of the eye lid to letter c” and “b s corresponds to the width of the nostril”. However, a few pages later he showed “funny faces” in his sketchbook (for a few, see right of Figure 3.2), illustrating that a match between model and reality was not always given.

Fig. 3.2: Fragments from Da Vinci's sketchbooks (human faces)

Besides very detailed models of the human anatomy, also characterizing special appearances such as parameters of "a beautiful face" (e.g., in his opinion, in such a face the width of the mouth equals the distance between the middle line of the mouth to the bottom of the chin), da Vinci's sketchbooks also contain quite detailed studies about kinematic trees of human motion. For a man going upstairs (see left of Figure 3.3), he writes: "The center of mass of a human who is lifting one foot, is always on top of the center of the sole of foot [on which he is standing]. A human going upstairs shifts weight forward and to the upper foot, creating a counter weight against the lower leg, such that the workout of the lower leg is reduced to moving itself. When going upstairs, a human starts with relieving body weight from that foot which he is going to lift. Furthermore, he dislocates the remaining body mass onto the opposite leg, including the [weight of the] other leg.

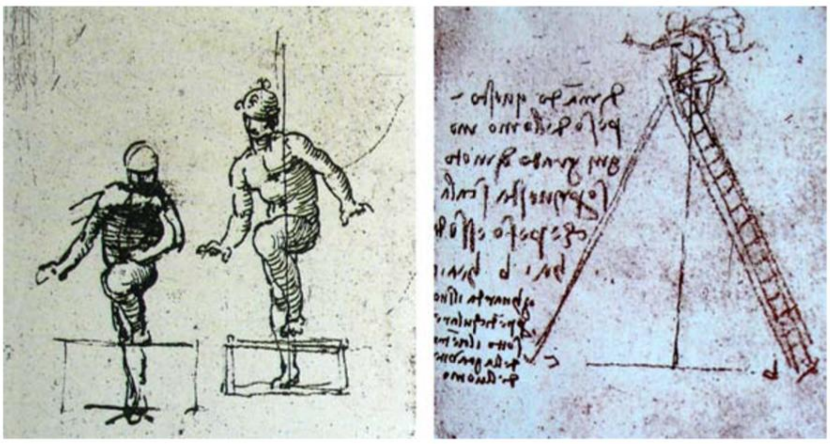


Fig. 3.3: Drawing in Da Vinci's sketchbook

Then he lifts this other leg and places the foot on the step, which he likes to climb on. Next he dislocates the whole body weight, including that of this leg, onto the upper foot, puts his hand onto his thigh, slides his head forward, and moves towards the tip of the upper foot, quickly lifting the heel of the lower foot. With this push he lifts himself upward, simultaneously he straightens the arm which was resting on the knee. This stretching of the arm pushes body and head upward, and thus also straightens the back which was bended before."

Next to the drawing, shown on the right of Figure 3.3, da Vinci wrote the following: "I ask for the weight [pressure] of this man for every segment of motion when climbing those stairs, and for the weight he places on b and on c. Note the vertical line below the center of mass of this man." It is certainly impressive to see the level of detail in modeling human shape or motion, given by da Vinci centuries ago. This was illustrated above just by examples, and a comprehensive biomechanical study about his contributions would be a sensible project.

3.2.3 Baroque

The scientist Giovanni Alfonso Borelli (1608–1679) contributed to various disciplines. In his "On the Movement of Animals" (published posthumously in two parts in 1680 and 1681) he applied to biology the analytical and geometrical methods, developed by Galileo Galilei (1564–1642) in the field of mechanics. For this reason he is also often called "the father of biomechanics", or (one of) the founder(s) of the Iatrophysic School (also called iatromathematic, iatromechanic, or physiatric). A result of basic importance for establishing this school is that the circulation of the blood is comparable to a hydraulic system. This school vanished after some years, but some of the work of Borelli is still worth noting today. He "was the first to understand that the levers of the musculoskeletal system magnify motion rather than force, so that muscles must produce much larger forces than those resisting the motion". Bones serve as levers and muscles function according to mathematical principles; this became a basic principle for modeling human motion.

Figure 3.4 shows an example of a drawing from. The physiological studies in this text (including muscle analysis and a mathematical discussion of movements, such as running or jumping) are based on solid mechanical principles. The change from visual (qualitative) observation to quantitative measurements was crucial for the emergence of biomechanics. Borelli also attempted to clarify the reason for muscle fatigue and to explain organ secretion, and he considered the concept of pain.

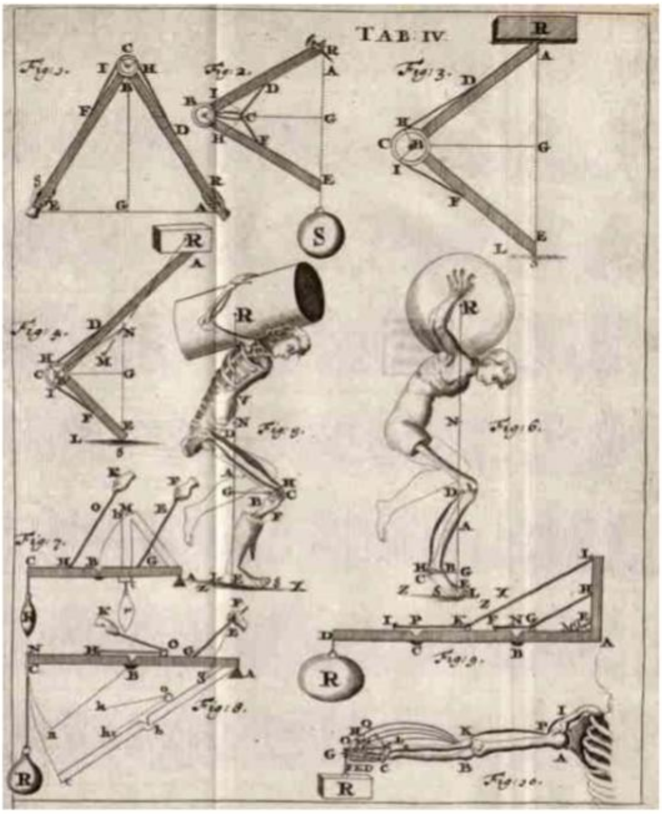


Fig 3.4: Studies done by Borelli

3.2.4 Age of Enlightenment

There seem to be not many important contributions to the study of human motion, between the times of Borelli and the latter half of the 19th century, when chronophotography provided a new tool for understanding motion. Besides studies on human or animal motion in a narrow sense, the foundation of modern dynamics by Isaac Newton (1642–1727), including his three laws of motion, was also a very crucial contribution to the understanding of human motion (these laws are formulated here for this case, slightly modified from :

Newton's Law of Inertia. A human in motion will continue moving in the same direction at the same speed unless some external force (like gravity or friction) acts to change the motion characteristics. (This law was already formulated by Galileo Galilei.)

Newton's Law of Acceleration. $F = ma$. A force F acting on a human motion will cause an acceleration a in the direction of the force and proportional to the strength of the force (m is the mass of the human).

Newton's Law of Action-Reaction.Ahuman'smotionagainstamedium(such as another body) is matched with a reaction force of equal magnitude but opposite direction.

All three laws had been discussed already in some sense by Aristotle when considering the motions of a boat. According to Aristotle, "every movement needs a mover", and his (incorrect !) concept can be expressed as $F = mv$, where v is the velocity. Between the 17th and 19th centuries numerous famous scientists, starting with Ren´e Descartes (1596–1650), basically established modern mathematics, including geometrical volumes, analytical geometry, and geometrical algebra. Today's human motion studies benefit from those developments.

In the 19thcentury,a variety of toys were made which produced moving pictures. In the 1830s, several inventors developed the Phenakistoscope, a disk with several radial slots and successive pictures painted between the slots. When the disk was spun with the pictures on the side facing a mirror, a viewer looking towards the mirror from the blank side of the disk would get momentary views (through the slots) of the pictures in cyclic motion. In the 1860s, several inventors improved that to develop the Zoetrope, a rotating drum with slits parallel to the axis. A strip of paper could be fitted inside the cylinder, with slits in the paper fitted to the slits in the cylinder, and with successive pictures printed on the paper between the slits.

A major contribution was the work by brothers Ernst Heinrich Weber (1795– 1878), Wilhelm Eduard Weber (1804–1891), and Eduard Friedrich Weber (1806– 1871); all three collaborated in their research on physics, human anatomy and locomotion.

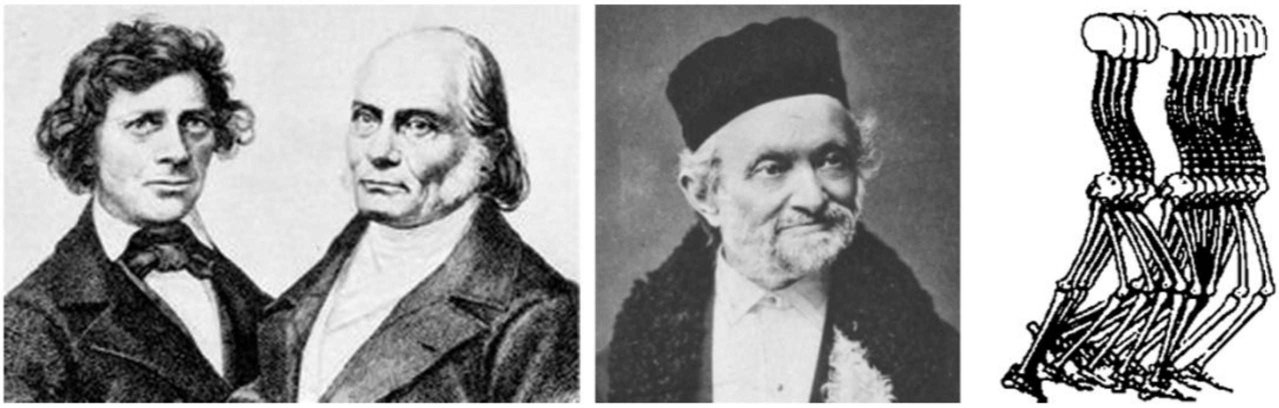


Fig.3.5. From left to right: Eduard Friedrich Weber, Ernst Heinrich Weber, and Wilhelm Eduard Weber. Right: calculated picture of human locomotion.

3.2.5 Chronophotography

The French astronomer Pierre Janssen (1824–1907) used on 8 December 1874 a multi-exposure camera (of his own invention) for recording the transit of Venus across the Sun. His "clockwork 'revolver' took forty-eight exposures in seventy two seconds on a daguerreotype disc. Janssen's work in turn greatly influenced the chronophotographic experiments" of the French scientist Etienne-Jules Marey (1830–1904); see left of Figure 6 for a photo of himself. He was interested in locomotion of animals or humans. In his book he reported about motion studies, where data had been collected by various instruments; see Figure 3.7.

Fig. 3.6: left E J Marey; right an 1882 photo by Marey

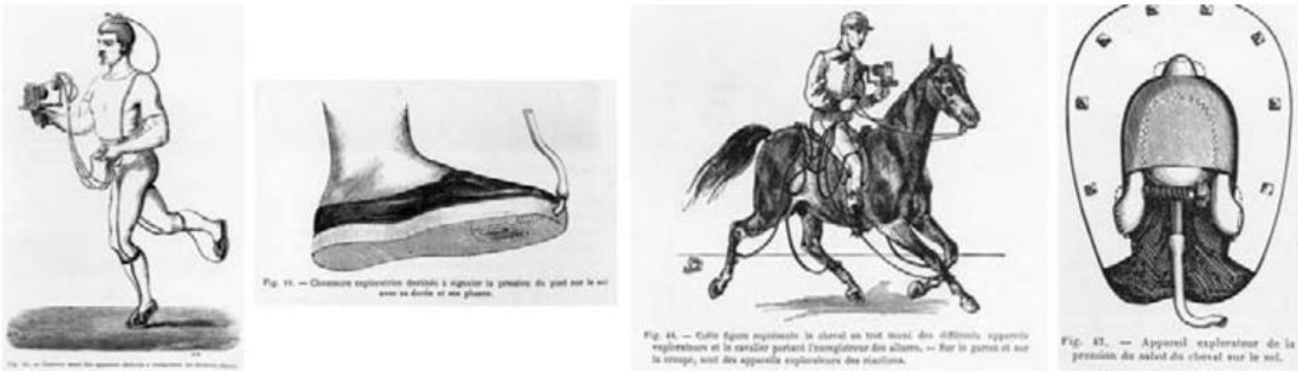


Fig.3.7. Left: a runner with instruments to record his movements, including a shoe to record duration and phases of ground contact. Right: a trotting horse with instruments to record the horse's leg locomotion, including an instrument for measuring the ground pressure of a hoof.

His interests in locomotion studies led him later to the design of special cameras allowing a recording of several phases of motion in the same photo. Figure 3.6, right, shows a flying pelican recorded by him around 1882. Marey reported in a 1890 book about locomotion of birds, also using his photographs for illustration and analysis. Later he also used movies (with up to 60 pps in good quality), which was influential pioneering work for the emerging field of cinematography. Figure 3.8 illustrates his work reported in the book.

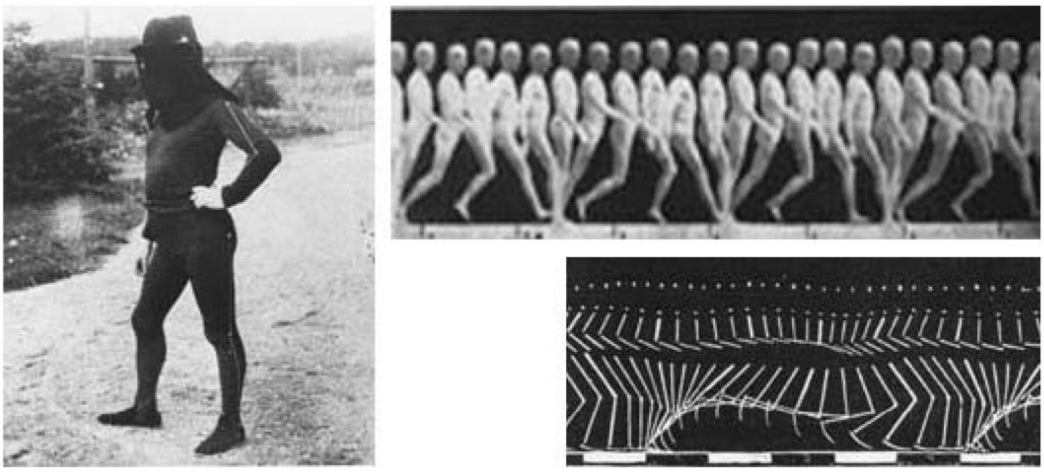


Fig.3.8. Left: a man in a black dress; limbs are marked by white lines. Right, top: a chronophotograph of a striding man dressed partially in white, and partially in black. Right, bottom: white lines in a chronophotograph of a runner

The British-born Eadweard Muybridge (1830–1904) became a renowned photographer after he emigrated to the USA. Inspired by Marey's recording of motion, and by a disputed claim that a galloping horse may have all four hooves off the ground, in 1878 he set up a series of 12 cameras for recording fast motion alongside a barn, sited on what is now the Stanford University campus. His rapid sequence of photographs of a galloping horse did show all four hooves off the ground for part of the time. He invented a machine for displaying the recorded series of images, pioneering motion pictures this way. He applied his technique to movement studies. The human subjects were typically photographed nude or nearly nude, for different categories of locomotion; see Figure 3.9.

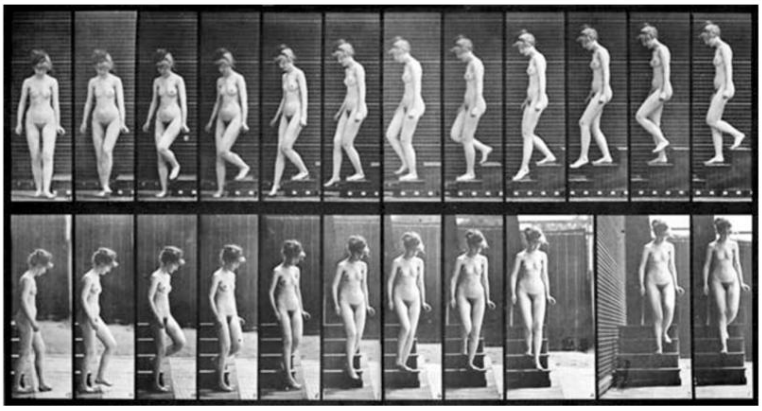


Fig.3.9. Woman walking downstairs (Muybridge, late 19th century).

Muybridge's motion studies, based on multiple images, included walking downstairs, boxing, walking of children, and so forth. They are often cited in the context of the beginning of biomechanics, and they were definitely very influential for the beginning of cinematography at the end of the 19th century. Movies were shot in several countries, shortly after his successful demonstrations of "moving pictures".

3.2.6 Human Motion Studies in Biomechanics

In the latter half of the 19th century, Christian Wilhelm Braune (1831–1892) and Otto Fischer (1861–1917) started with experimental studies of human gait (e.g., for determining the center of mass), which resulted in the development of prosthesis. Less known, Gheorghe Marinescu (1863–1938) produced in 1898 (with the help of operator Constantin M. Popescu) the first scientific movie "Walking disorders in organic hemiphlegia".

In the 20th century, biomechanics developed into a discipline of science, establishing its own research programs. The French reformer (and 'work physiologist') Jules Amar (1879–1935) published in 1914 the very influential book, which soon after defined the standards for human engineering in Europe and the United States. The technology of cinematographic analysis of sprint running allowed a new quality in research (note: the flicker-fusion rate of the human eye is only about 12 Hz); see, for example, papers by Wallace O. Fenn (1893 – 1971), who became the president of the American Physiological Association. Graduate programs in biomechanics developed in the United States in the 1940s. Starting with the 1950s, biomechanics became a worldwide discipline for physical educators, especially in the context of sports. Helmholtz's myograph was developed into the electronic electromyograph, for measuring the electric activity of muscles.

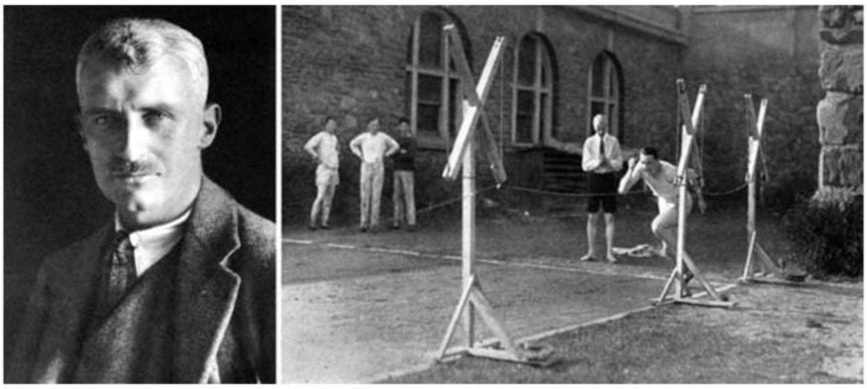


Fig.3.10. Left: A. V. Hill. Right: Testing the acceleration of sprinters by Hill at Cornell University, Ithaca, NY. "The large coils of wire were used to detect a magnet worn by the runner as he sprinted past them. Velocity and acceleration were calculated by knowing the distance between the wire coils.

The book by Nicholas Bernstein (1896–1966) pioneered the areas of motor control and coordination. He studied the spatial conception of the degrees-offreedom problem in the human motor system for walking, running or jumping. Archibald Vivian Hill (1886–1977) was convinced by F. G. Hopkins (Nobel Prize in Physiology or Medicine, 1929) to "pursue advanced studies in physiology rather than mathematics". Hill investigated the efficiency and energy cost in human movement. Based on his solid background in mathematics, he developed mathematic "models describing heat production in muscle, and applied kinetic analysis to explain the time course of oxygen uptake during both exercise and recovery". His research initiated biophysics. Hill shared the 1922 Nobel Prize in Physiology or Medicine with the German chemist Otto Meyerhof. Hill was honored for his discoveries about the chemical and mechanical events in muscle contraction. Research in computerized gait analysis is today widely supported by markerbased pose tracking systems (see Figure 3.11), which have their origins in the work by G. Johannsson. Basically, the camera systems used are fast (e.g., 300 Hz or more), but recorded images are normally restricted to binary information, showing positions of markers only. Computer vision already helped to create 3D body models for gait analysis (e.g., by using whole–body scanners, based on the principle of structured lighting, or by applying photometric stereo). The increasing availability of high–speed cameras supports the development of marker–less motion tracking systems , overcoming the apparent restrictions of marker–based systems. For a review on past and more recent work in biomechanics, see. Recent textbooks are, for example, or other book publications by Human Kinetics.

Fig.3.11. Gait laboratory of The University of Auckland (in 2000). Left: walking subject with markers. Middle: walking area (top) and one of the fast cameras (bottom). Right: generated animated 3D stick figure (to) and camera calibration unit (bottom).

3.2.7 Human Motion Studies in Computer Graphics

Computer animation of human walking is a major area of interest in computer graphics. Compared to biomechanics, the discipline emerged “recently”, namely about 50 years ago with the advent of the computer. Basically, a computer graphics process starts with defining the models used. Figure 3.12 illustrates three options. Tracking markers (see previous section) allows to generate a stick figure, which may be based on general assumptions into a volumetric model (e.g., defined by cylindric parts, or a generic body model of a human). Then the ways are specified how to present those models, for example rendered with respect to given surface textures and light sources in form of an animation, within a synthesized scene, or just against a monochromatic background.

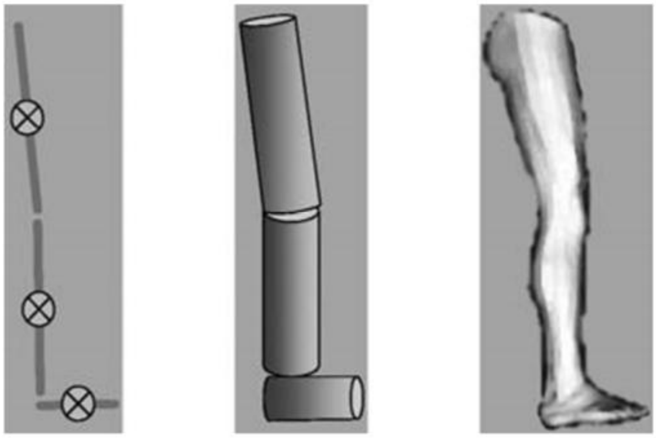


Fig.12. Three options for modeling a leg: stick figure (left), simple geometrical parts (middle), or a (generic) model of the shape of a human leg.

Static model of moving humans, or dynamic 3D poses, are generated by applying various means. For static whole–body modeling, this can be achieved, efficiently and accurately, by structured lighting or encoded light (e.g., Gray codes) for static bodies. LEDs, marker–based multi–camera systems (see Figure 3.11), or silhouette–based generic 3D model tracking are options for capturing data about movements of a human.

3.2.8 Human Motion Studies in Computer Vision

Computer vision exists for about the same time as computer graphics. Instead of only capturing image sequences, to be analyzed by a human observer, now those sequences are digitized, and computer programs are used for an automated analysis of the sequence. As illustrated by Figure 3.8, Marey already used simplifications such as white skeletal curves on a moving human. Braune and Fischer attached light rods to an actor's limbs, which then became known as Moving Light Displays (LEDs). Gunnar Johannsson pioneered studies on the use of image sequences for a programmed human motion analysis, using LEDs as input. These very limited inputs of information allow an interesting analysis, for example with respect of identifying a particular person. Motion analysis in computer vision has to solve two main tasks, detecting correspondences between subsequent images, and tracking of an object within a sequence of images. This can be based on different methodologies, such as tracking 2D features at a local (e.g., corners) or global level (e.g., silhouettes, after a "proper" segmentation of images), or tracking based on projecting a generic 3D model (of a human) into the scene (see Figure 3.14).

Fig.3.13. A sequence of 15 LED frames, extracted from an animation

Fig.3.14. Human poses are tracked using a generic 3D model of the upper human body; the figure shows the backprojection of the recorded 3D motion into the original 4camera image sequence, also demonstrating model movements of occluded body parts

3.3 Interpreting Human Motion Through Art

There are two ways to interpret human motion through art

-kinetic art

-interactive art

3.3.1 Kinetic Art

Kinetic art is art from any medium that contains movement perceivable by the viewer or depends on motion for its effect. Canvas paintings that extend the viewer's perspective of the artwork and incorporate multidimensional movement are the earliest examples of kinetic art. More pertinently speaking, kinetic art is a term that today most often refers to three-dimensional sculptures and figures such as mobiles that move naturally or are machine operated. The moving parts are generally powered by wind, a motor or the observer. Kinetic art encompasses a wide variety of overlapping techniques and styles.

There is also a portion of kinetic art that includes virtual movement, or rather movement perceived from only certain angles or sections of the work. This term also clashes frequently with the term "apparent movement", which many people use when referring to an artwork whose movement is created by motors, machines, or electrically powered systems. Both apparent and virtual movements are styles of kinetic art that only recently have been argued as styles of op art. The amount of overlap between kinetic and op art is not significant enough for artists and art historians to consider merging the two styles under one umbrella term, but there are distinctions that have yet to be made.

Origins and Early Development

The strides made by artists to "lift the figures and scenery off the page and prove undeniably that art is not rigid" (Calder, 1954) took significant innovations and changes in compositional style. Édouard Manet, Edgar Degas, and Claude Monet were the three artists of the 1800s that initiated those changes in the Impressionist movement. Even though they each took unique approaches to incorporating movement in their works, they did so with the intention of being a realist. In the same period, Auguste Rodin was an artist whose early works spoke in support of the developing kinetic movement in art. However, Auguste Rodin's later criticisms of the movement indirectly challenged the abilities of Manet, Degas, and Monet, claiming that it is impossible to exactly capture a moment in time and give it the vitality that is seen in real life.

It is almost impossible to ascribe Edouard Manet's work to any one era or style of art. One of his works that is truly on the brink of a new style is Le Ballet Espagnol (1862). The figures' contours coincide with their gestures as a way to suggest depth in relation to one another and in relation to the setting. Manet also accentuates the lack of equilibrium in this work to project to the viewer that he or she is on the edge of a moment that is seconds away from passing. The blurred, hazy sense of color and shadow in this work similarly place the viewer in a fleeting moment

.

Fig. 3.15: Édouard Manet, Le Ballet Espagnol, (1862).

Edgar Degas is believed to be the intellectual extension of Manet, but more radical for the impressionist community. Degas' subjects are the epitome of the impressionist era; he finds great inspiration in images of ballet dancers and horse races. His "modern subjects" never obscured his objective of creating moving art. In his 1860 piece Feunes Spartiates S'exercant a la Lute, he capitalizes on the classic impressionist nudes but expands on the overall concept. He places them in a flat landscape and gives them dramatic gestures, and for him this pointed to a new theme of "youth in movement".

It wasn’t until 1884 with Chevaux de Course that his attempt at creating dynamic art came to fruition. This work is part of a series of horse races and polo matches wherein the figures are well integrated into the landscape. The horses and their owners are depicted as if caught in a moment of intense deliberation, and then trotting away casually in other frames. The impressionist and overall artistic community were very impressed with this series, but were also shocked when they realized he based this series on actual photographs. Degas’ was not fazed by the criticisms of his integration of photography, and it actually inspired Monet to rely on similar technology.

Degas and Monet's style was very similar in one way: both of them based their artistic interpretation on a direct "retinal impression" to create the feeling of variation and movement in their art. The subjects or images that were the foundation of their paintings came from an objective view of the world. As with Degas, many art historians consider that to be the subconscious effect photography had in that period of time. His 1860s works reflected many of the signs of movement that are visible in Degas' and Manet's work.

Auguste Rodin at first was very impressed by Monet's 'vibrating works' and Degas' unique understanding of spatial relationships. As an artist and an author of art reviews, Rodin published multiple works supporting this style. He claimed that Monet and Degas' work created the illusion "that art captures life through good modeling and movement". In 1881, when Rodin first sculpted and produced his own works of art, he rejected his earlier notions. Sculpting put Rodin into a predicament that he felt no philosopher nor anyone could ever solve; how can artists impart movement and dramatic motions from works so solid as sculptures? After this conundrum occurred to him, he published new articles that didn't attack men such as Manet, Monet, and Degas intentionally, but propagated his own theories that Impressionism is not about communicating movement but presenting it in static form.

20th Century Surrealism and Early Kinetic Art

The surrealist style of the 1900s created an easy transition into the style of kinetic art. All artists now explored subject matter that would not have been socially acceptable to depict artistically. Artists went beyond solely painting landscapes or historical events, and felt the need to delve into the mundane and the extreme to interpret new styles. With the support of artists such as Albert Gleizes, other avant-garde artists such as Jackson Pollock and Max Bill felt as if they had found new inspiration to discover oddities that became the focus of kinetic art.

Gleizes was considered the ideal philosopher of the late 1800s and early 1900s arts in Europe, and more specifically France. His theories and treatises from 1912 on cubism gave him a renowned reputation in any artistic discussion. This reputation is what allowed him to act with considerable influence when supporting the plastic style or the rhythmic movement of art in the 1910s and 1920s. Gleizes published a theory on movement, which further articulated his theories on the psychological, artistic uses of movement in conjunction with the mentality that arises when considering movement. Gleizes asserted repeatedly in his publications that human creation implies the total renunciation of external sensation.That to him is what made art mobile when to many, including Rodin, it was rigidly and unflinchingly immobile.

Gleizes first stressed the necessity for rhythm in art. To him, rhythm meant the visually pleasant coinciding of figures in a two-dimensional or three-dimensional space. Figures should be spaced mathematically or systematically so that they appeared to interact with one another. Figures should also not have features that are too definite. They need to have shapes and compositions that are almost unclear, and from there the viewer can believe that the figures themselves are moving in that confined space. He wanted paintings, sculptures, and even the flat works of mid-19th-century artists to show how figures could impart on the viewer that there was great movement contained in a certain space. As a philosopher, Gleizes also studied the concept of artistic movement and how that appealed to the viewer. Gleizes updated his studies and publications through the 1930s, just as kinetic art was becoming popular.

When Jackson Pollock created many of his famous works, the United States was already at the forefront of the kinetic art movement. The novel styles and methods he used to create his most famous pieces earned him the spot in the 1950s as the unchallenged leader of kinetic painters, his work was associated with Action painting coined by art critic Harold Rosenberg in the 1950s. Pollock had an unfettered desire to animate every aspect of his paintings.[citation needed] Pollock repeatedly said to himself, "I am in every painting". He used tools that most painters would never use, such as sticks, trowels, and knives. The shapes he created were what he thought was "beautiful, erratic objects".

Fig. 3.16: Blue Poles No.11, Jackson Pollock, 1952

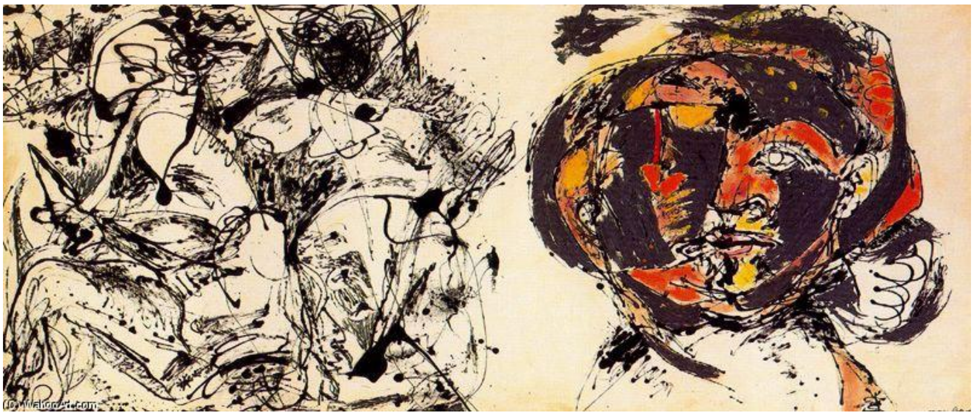


Fig. 3.17: Portrait and a Dream, Jackson Pollock, 1953

This style evolved into his drip technique. Pollock repeatedly took buckets of paint and paintbrushes and flicked them around until the canvas was covered with squiggly lines and jagged strokes. In the next phase of his work, Pollock tested his style with uncommon materials. He painted his first work with aluminum paint in 1947, titled Cathedral and from there he tried his first "splashes" to destroy the unity of the material itself. He believed wholeheartedly that he was liberating the materials and structure of art from their forced confinements, and that is how he arrived at the moving or kinetic art that always existed.

Max Bill became an almost complete disciple of the kinetic movement in the 1930s. He believed that kinetic art should be executed from a purely mathematical perspective. To him, using mathematics principles and understandings were one of the few ways that you could create objective movement. This theory applied to every artwork he created and how he created it. Bronze, marble, copper, and brass were four of the materials he used in his sculptures. He also enjoyed tricking the viewer's eye when he or she first approached one of his sculptures. In his Construction with Suspended Cube (1935-1936) he created a mobile sculpture that generally appears to have perfect symmetry, but once the viewer glances at it from a different angle, there are aspects of asymmetry.

Mobiles and Sculpture

Max Bill's sculptures were only the beginning of the style of movement that kinetic explored. Tatlin, Rodchenko, and Calder especially took the stationary sculptures of the early 20th century and gave them the slightest freedom of motion. These three artists began with testing unpredictable movement, and from there tried to control the movement of their figures with technological enhancements. The term "mobile" comes from the ability to modify how gravity and other atmospheric conditions affect the artist's work.

Although there is very little distinction between the styles of mobiles in kinetic art, there is one distinction that can be made. Mobiles are no longer considered mobiles when the spectator has control over their movement. This is one of the features of virtual movement. When the piece only moves under certain circumstances that are not natural, or when the spectator controls the movement even slightly, the figure operates under virtual movement.

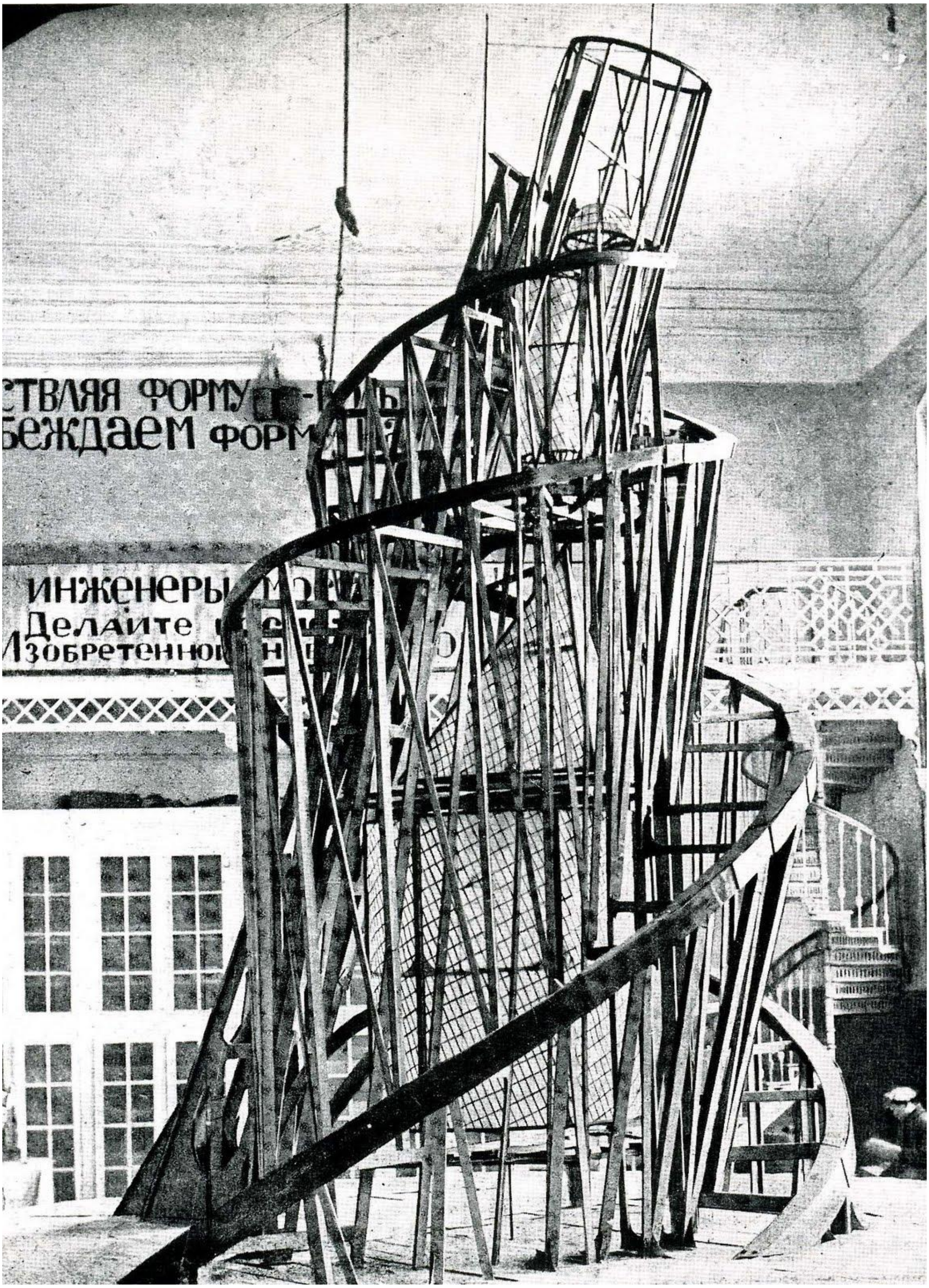


Fig. 3.18: Model for the Monument to the Third International, Vladimir Tatlin, 1919-20

Fig. 3.19: Dance, An Objectless Composition, Alexander Rodchenko, 1915

Alexander Calder is an artist who many believe to have defined firmly and exactly the style of mobiles in kinetic art. Over years of studying his works, many critics allege that Calder was influenced by a wide variety of sources. Calder's style of mobiles created two types that are now referred to as the standard in kinetic art. There are object-mobiles and suspended mobiles. Object mobiles on supports come in a wide range of shapes and sizes, and can move in any way. Suspended mobiles were first made with colored glass and small wooden objects that hung on long threads. Object mobiles were a part of Calder's emerging style of mobiles that were originally stationary sculptures.

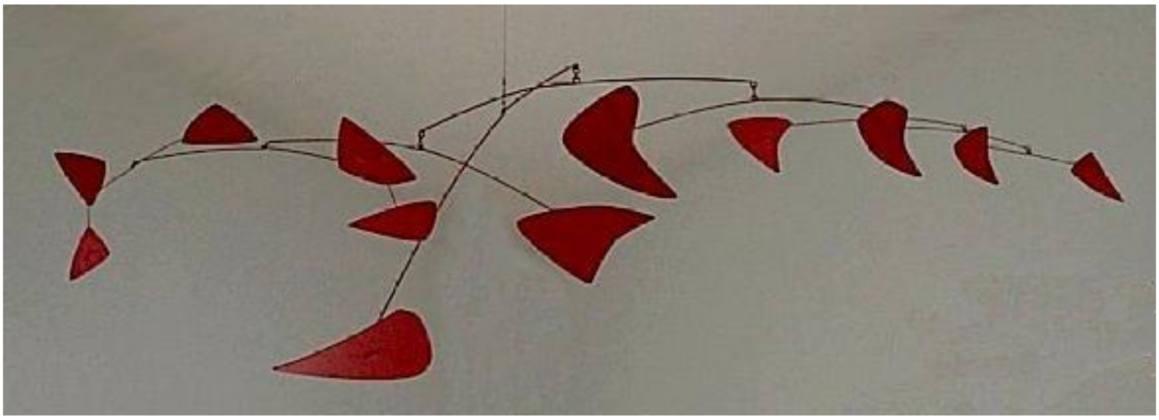


Fig. 3.20: Red Mobile, Alexander Calder, 1956

Contemporary Work

In recent years with the marriage between art and technology, the scope for kinetic art has expanded greatly.

Fig. 3.21: Ialu, John Douglas Powers, 2013

Fig. 3.22: Haliades, John Douglas Powers, 2013

Fig. 3.23: The Twister Star Huge, Lyman Whitaker

- Dancers in Motion:

Creative photo series by Japanese artist Shinichi Maruyama showcases the movement and the beauty of the human body. More than 10,000 photographs of nude dancers were combined to form beautiful images that show uninterrupted movements of each person.

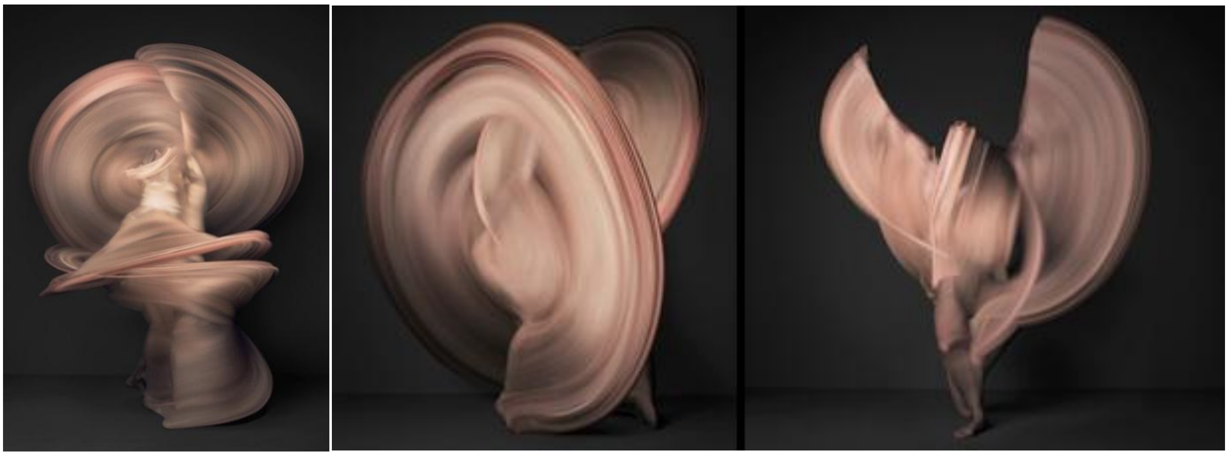


Fig. 3.24: Shinichi Maruyama Photography

- Sculptures in Motion

Peter Jansen, a student of physics and philosophy, the Dutch artist captures sequences of human movements within a single frame of space and time. The result is quite stunning.

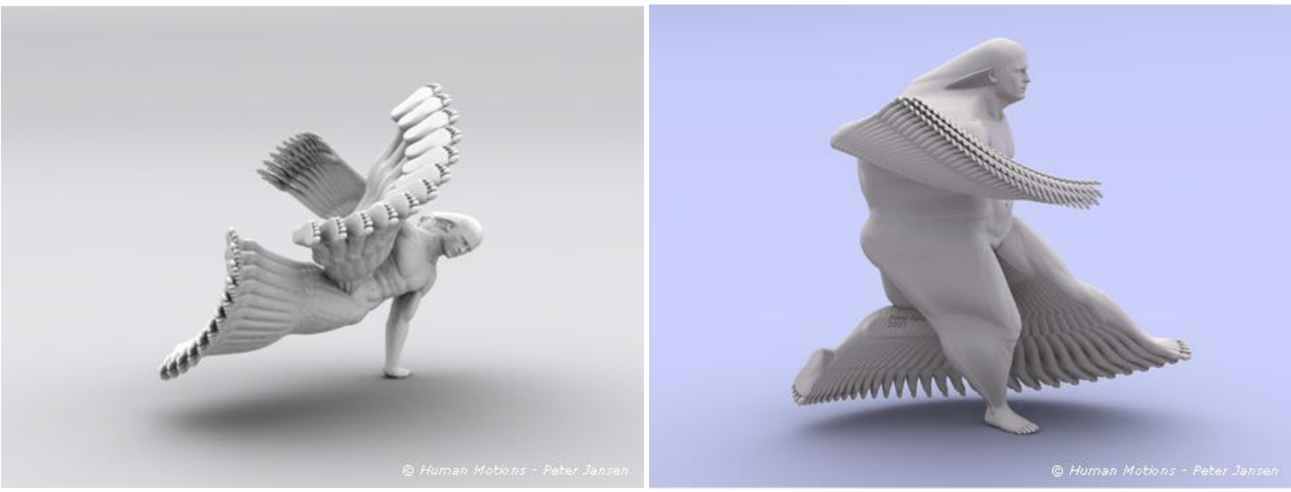


Fig. 3.25: Peter Jansen sculptures

- Made by Humans by Universal Everything

UK studio Universal Everything motion-captured a dancer to make an animation, which is projected onto the world's highest-resolution screen (+ movie).

"We choreographed a contemporary dancer in a motion capture studio," Universal Everything founder Matt Pyke told Dezeen. "We then transformed the motion capture data into a digital sculpture, formed from the trails of human movement." The hundreds of white light points that form the dancing figure become strands that glow yellow, then red, before solidifying into blue as the dancer moves across the screen.Universal Everything produced animations at a highly detailed 16K resolution for the 25-metre-wide by four-metre-high screen in the Hyundai Vision Hall, located at the South Korean motor group's Seoul campus.

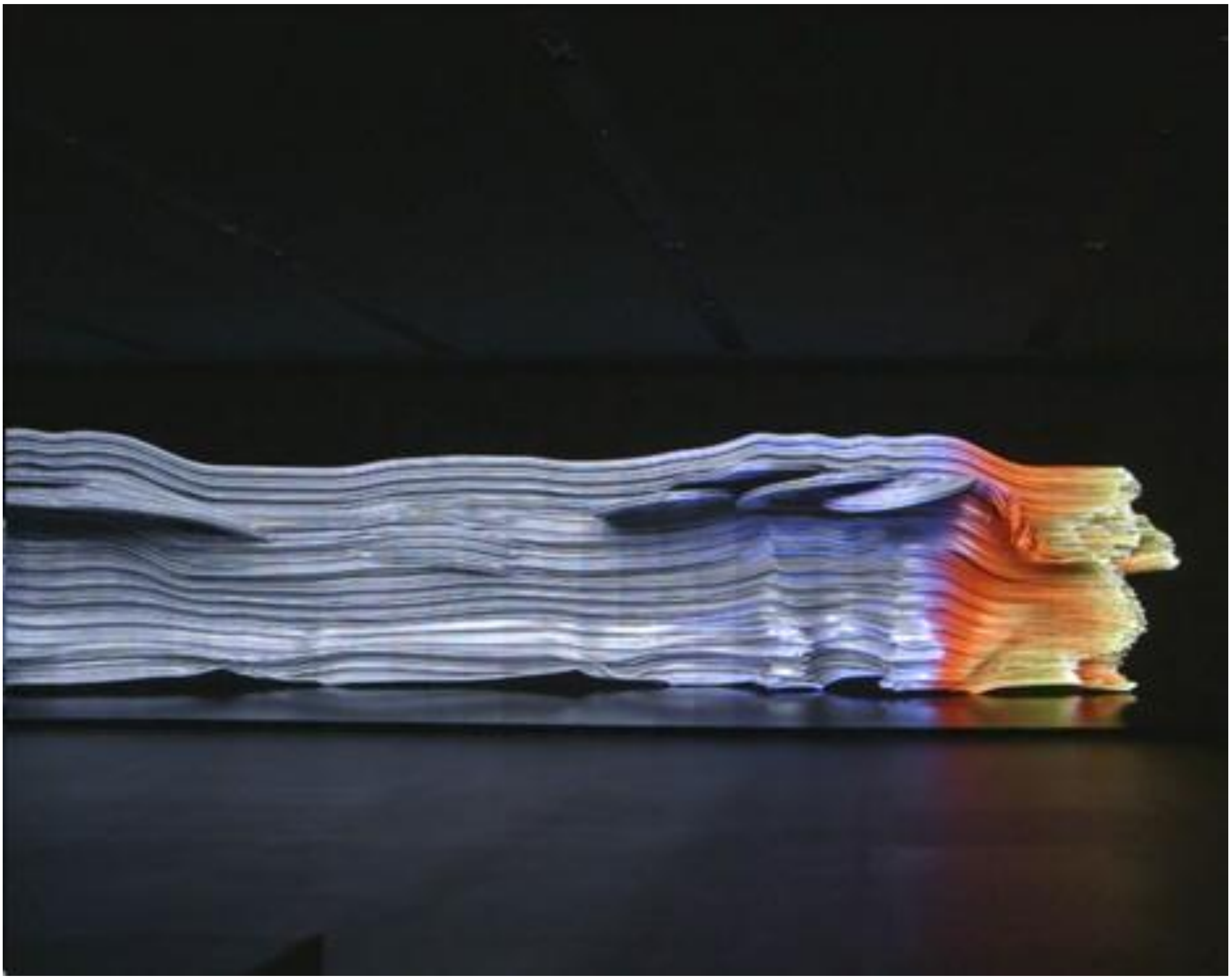


Fig. 3.25: Made By Humans

3.3.2 Interactive Art

Interactive art is a form of art that involves the spectator in a way that allows the art to achieve its purpose. Some interactive art installations achieve this by letting the observer or visitor "walk" in, on, and around them; some others ask the artist to become part of the artwork.

Works of this kind of art frequently feature computers and sensors to respond to motion, heat, meteorological changes or other types of input their makers programmed them to respond to. Most examples of virtual Internet art and electronic art are highly interactive. Sometimes, visitors are able to navigate through a hypertext environment; some works accept textual or visual input from outside; sometimes an audience can influence the course of a performance or can even participate in it.

Though some of the earliest examples of interactive art have been dated back to the 1920s, most digital art didn't make its official entry into the world of art until the late 1990s. Since this debut, countless museums and venues have been increasingly accommodating digital and interactive art into their productions. This budding genre of art is continuing to grow and evolve in a somewhat rapid manner through internet social sub-culture, as well as through large scale urban installations. Unlike traditional art forms wherein the interaction of the spectator is merely a mental event, interactivity allows for various types of navigation, assembly, and/or contribution to an artwork, which goes far beyond purely psychological activity. Interactivity as a medium produces meaning.

Interactive art installations are generally computer-based and frequently rely on sensors, which gauge things such as temperature, motion, proximity, and other meteorological phenomena that the maker has programmed in order to elicit responses based on participant action. In interactive artworks, both the audience and the machine work together in dialogue in order to produce a completely unique artwork for each audience to observe. However, not all observers visualize the same picture. Because it is interactive art, each observer makes their own interpretation of the artwork and it may be completely different than another observer's views.

Some of the earliest examples of interactive art were created as early as the 1920s. An example is Marcel Duchamp's piece named Rotary Glass Plates. The artwork required the viewer to turn on the machine and stand at a distance of one meter in order to see an optical illusion.

The present idea of interactive art began to flourish more in the 1960s for partly political reasons. At the time, many people found it inappropriate for artists to carry the only creative power within their works. Those artists who held this view wanted to give the audience their own part of this creative process. An early example is found in the early 1960s "change-paintings" of Roy Ascott, about whom Frank Popper has written: "Ascott was among the first artists to launch an appeal for total spectator participation". Aside from the "political" view, it was also current wisdom that interaction and engagement had a positive part to play within the creative process.

In the 1970s artists began to use new technology such as video and satellites to experiment with live performances and interactions through the direct broadcast of video and audio.

Interactive art became a large phenomenon due to the advent of computer based interactivity in the 1990s. Along with this came a new kind of art-experience. Audience and machine were now able to more easily work together in dialogue in order to produce a unique artwork for each audience. In the late 1990s, museums and galleries began increasingly incorporating the art form in their shows, some even dedicating entire exhibitions to it. This continues today and is only expanding due to increased communications through digital media.

A hybrid emerging discipline drawing on the combined interests of specific artists and architects has been created in the last 10–15 years. Disciplinary boundaries have blurred, and significant number of architects and interactive designers have joined electronic artists in the creation of new, customdesigned interfaces and evolutions in techniques for obtaining user input (such as dog vision, alternative sensors, voice analysis, etc.); forms and tools for information display (such as video projection, lasers, robotic and mechatronic actuators, led lighting etc.); modes for human-human and human-machine communication (through the Internet and other telecommunications networks); and to the development of social contexts for interactive systems (such as utilitarian tools, formal experiments, games and entertainment, social critique, and political liberation).

Osmosis Interactive Arena by Arik Levy

In Osmosis Interactive Arena, visitors enter a darkened room with a screen at one end. By stretching an arm or hopping to one side, for example, they can mutate the crystals on screen in unpredictable ways. This installation creates a new bridge between the body movement, the eye, the sense of space and the impact that of all of these have over the geometric and structural mineral body.This emotional interface transforms the object into a symphony of movement and colors, texture and density. We live on our planet not without impact, we engineer and progress not without transition... all of this generates unexpected results that one cannot create with conventional tools or intellectualised creativity.

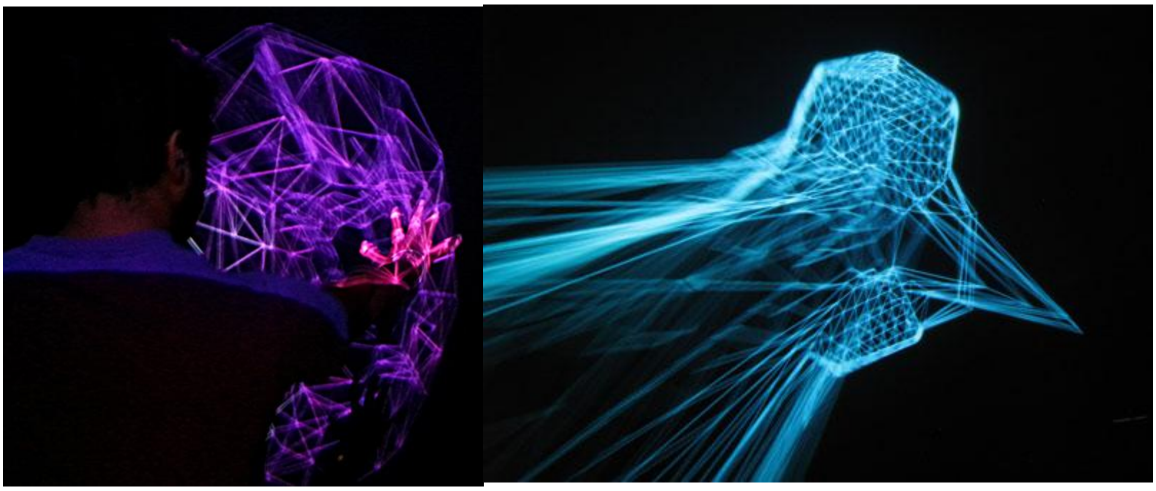


Fig. 3.26: Osmosis Interactive Arena

Footfalls

Footfalls (2006, by Tmema [Golan Levin & Zachary Lieberman]) is an interactive audiovisual installation in which the stomping of the visitors' feet creates cascading avalanches of bouncy virtual forms.

Footfalls was commissioned in July 2006 by the NTT InterCommunicationsCenter (ICC), Tokyo, for their solo exhibition of Tmema projects. The project developed as an outgrowth of the "Bubbles" module from our Messa di Voce installation. In Footfalls, stepping and stomping sounds produced by the visitors' feet are detected by microphones under the floor, and used to govern the size and number of virtual objects that fall from a six-meter high projection. The harder the visitors stomp, the more items fall. Using their silhouettes, visitors can then "catch" and "throw" these projected objects around.

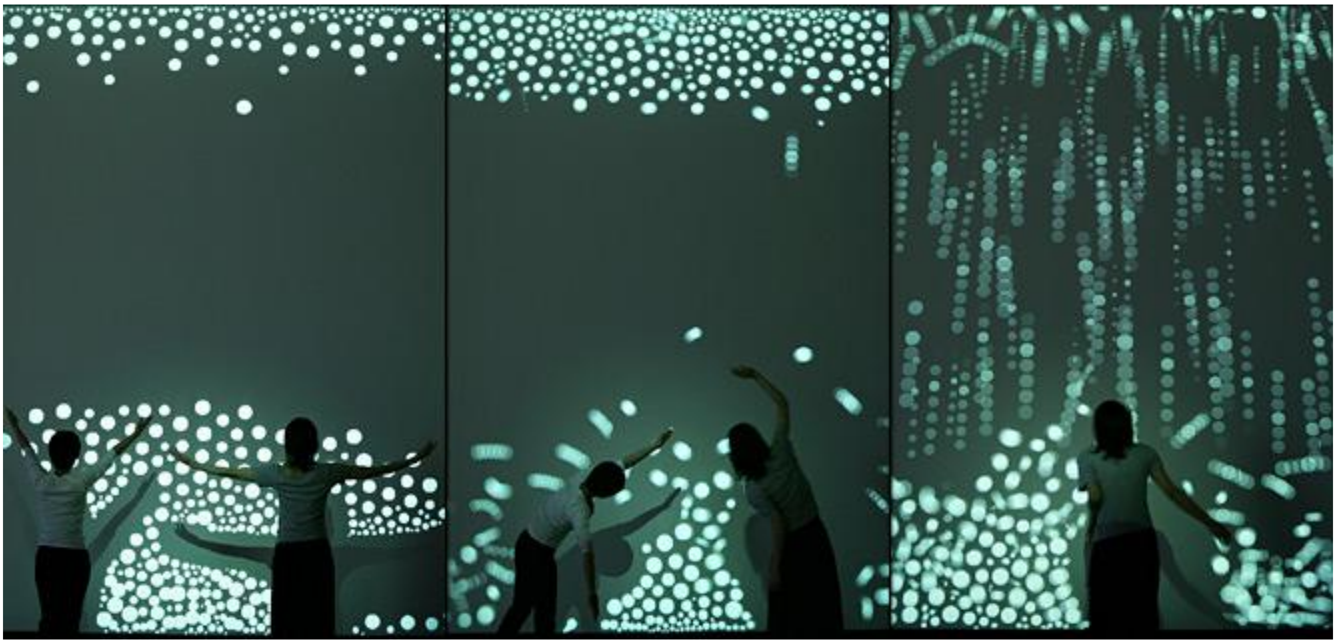


Fig. 3.27: Footfalls

Interstitial Fragment Processor

The Interstitial Fragment Processor is an interactive system which gives objecthood to the otherwise imaginary spaces that are continually formed around and between our bodies.The installation recovers, collects and drops the contours formed as enclosed holes in the shadows of its participants. As these empty holes become elastic, positive masses, they release inner sounds and plummet toward the floor, where their accumulations reveal histories of performance and play.

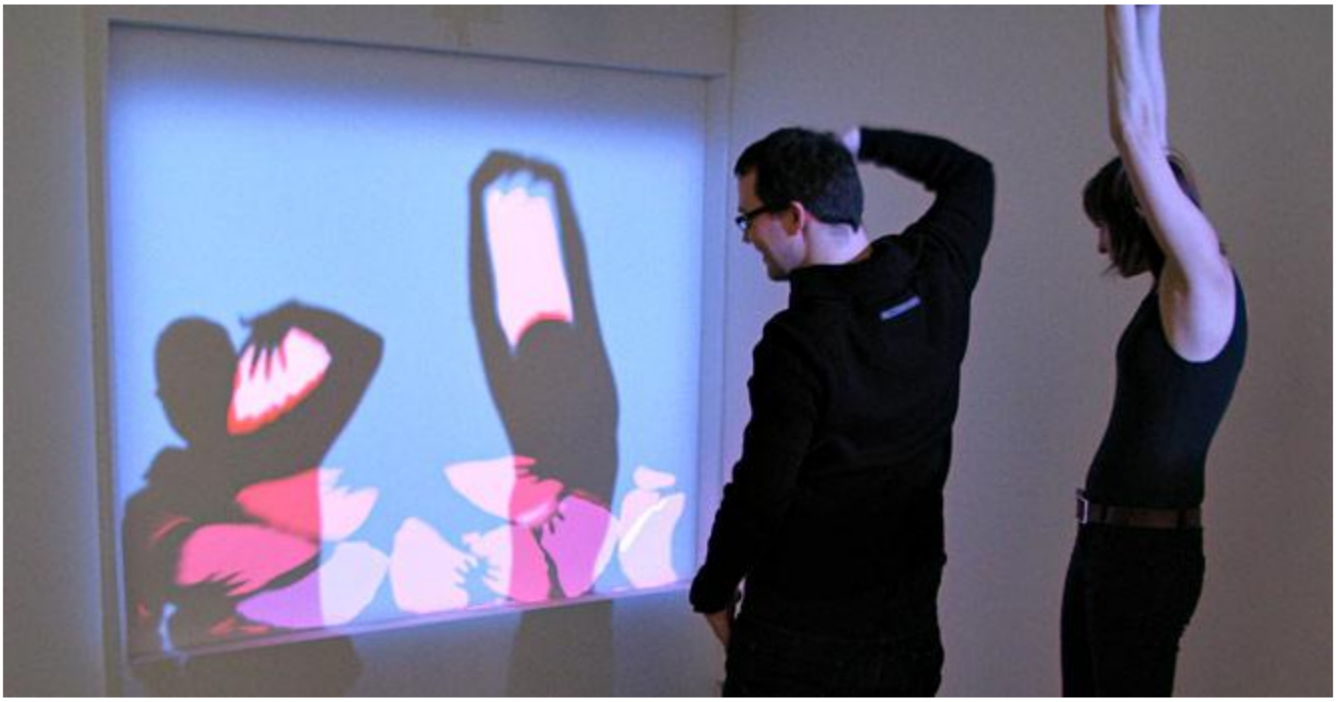


Fig. 3.27: Interstitial Fragment Processor

Multiple Shadow House

Olafur Eliasson, Multiple shadow house, 2010. When a body enters the space and begins to interact with the light installation, beautiful and subtle overlaid visions of their shadow fan across the screens – as they move around forward and backward the image is thus altered and can be manipulated. In this way the project is a creative collaboration between the artist, viewer, space and technology. Essentially the artwork is redundant without the presence of the figure.

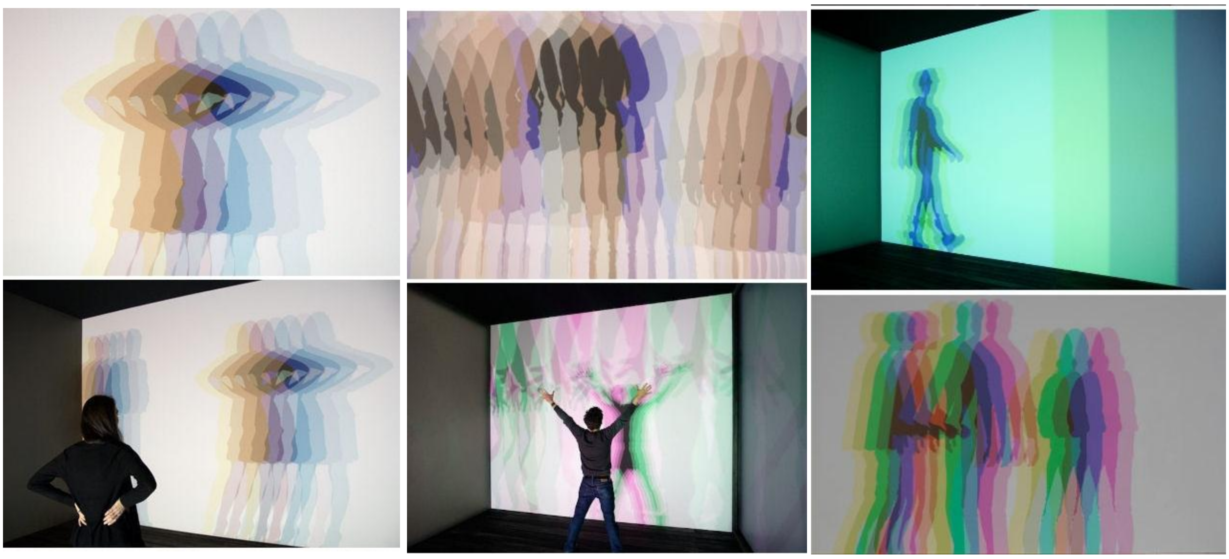


Fig. 3.28: Multiple Shadow House

CHAPTER 04: CASE STUDIES

4.3 Introduction

4.4 Cases

4.4.1 Museum of human abilities: student competition project

4.4.2 Synaesthetic museum

4.4.3 Black Swan

4.4.4 Rock Gym for Polur

4.1 Introduction

Since this project is a self proposed project and there isn't exactly any other projects similar to this project, in this section, various different projects are studied and analyzed.

4.2 Cases

4.2.1 Museum of Human Abilities: Student competition project

This two person project was an entry in a student project competition dedicated to developing public spaces in the center of Moscow. An attemot to organize a large part of the city Kremlin, which is the heart of Moscow, where currently there is a lack of pedestrian access, with high traffic. The site has rich historical value, which once housed a crowded market. The site had two squares and the Polytechnic Museum between them. The concept of the design was arranging the site with several pedestrian paths, special routes each having different views, materials, etc.

The project made an attempt to have a triad of museum on the site, since the polytechnic museum was already present, so the two students each proposed two new museums on the site, one being a time museum, the other, which is the subject of this case study, is a human museum, with specific attention to human abilities and achievements.

The geometry of the museum is a combination of a modified cube and a tube. The project tried to exhibit the intellectual and physically driven achievements of the human race. The project attempted to show a human being as a combination of a direct, solid, logical as a nature itself cube (which is a symbol for physical) and a curved, adjustable, sophisticated circle as a human's mind (which is a symbol for mental). So the cube could house different kinds of information about physical human abilities: about Olympic winners, sport records, mountain discoverers, some anatomic information.

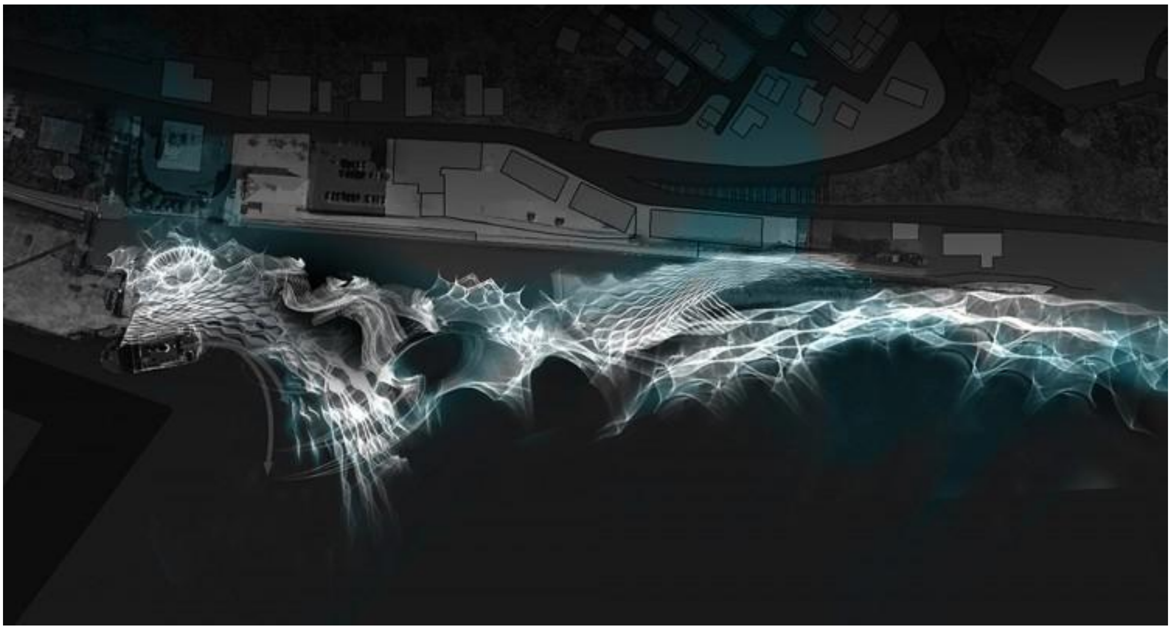
In another part of the museum would be placed everything dedicated to mental: information about Nobel prize winners, inventors, prominent scientists and artists, maybe some art masterpieces, showing an ability to create beauty and harmony.

There is also a lobby with a cloakroom at the ground floor, a library and an auditorium on the first floor and a café at the highest point of the museum where a panoramic view of the center of Moscow could be seen.

Findings

This is a nice example of a project backed up with strong concept while architecturally speaking it takes a strong play on the form of the building, and at the same time it comes up with innovative ways to address civic spaces which encourage public activities.

4.2.2 Synaesthetic Museum



Location: Quebec City, Canada

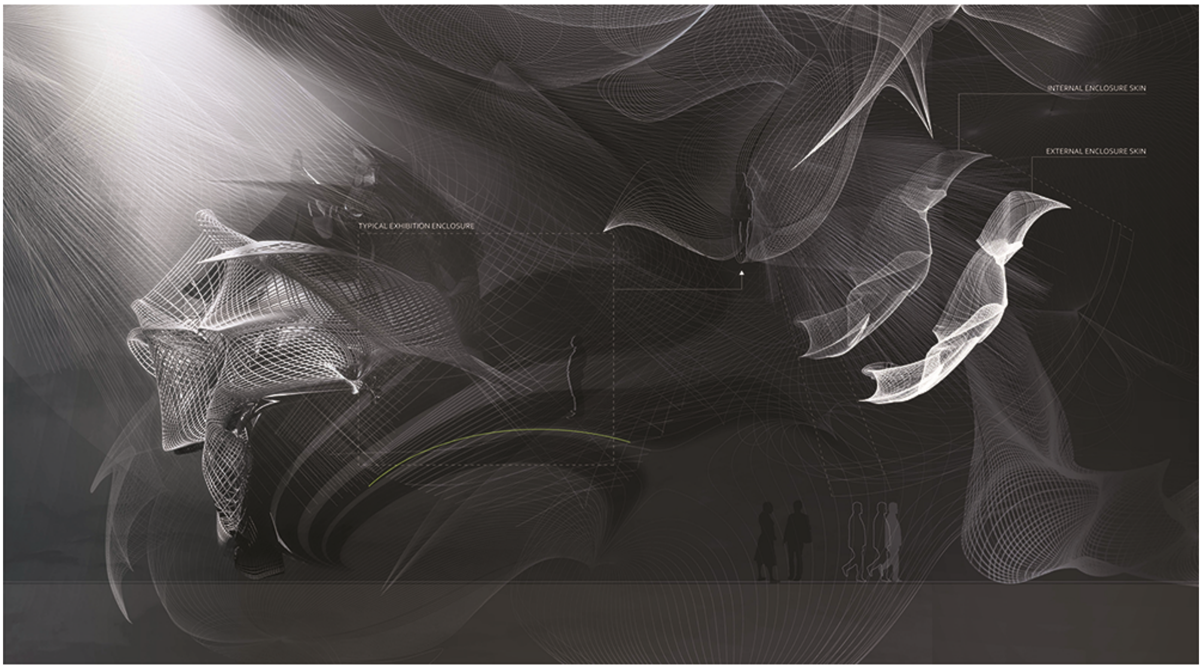
Design: Francois Mangion

Collaboration: Shuchi Agarwal

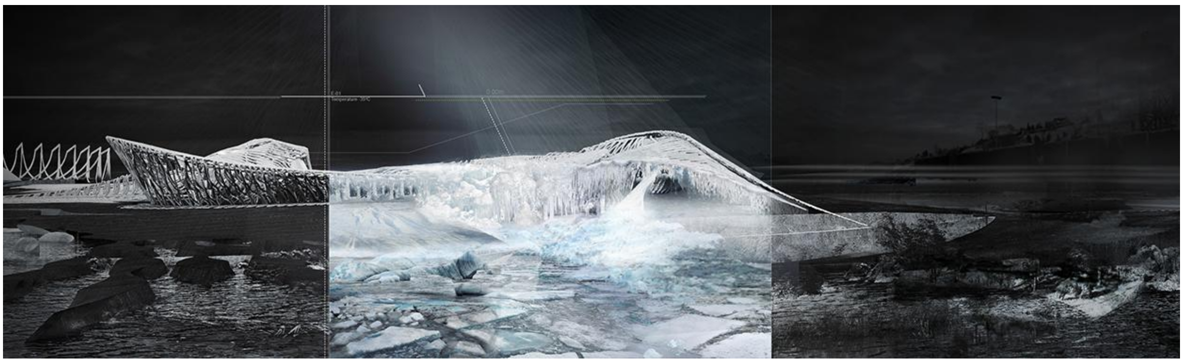
Research: Bartlett School of Architecture, UCL, B-Pro Graduate Architectural Design

This project seeks to find a harmony between the visual and aural perception in architecture. Using light as the architectural generative tool to create form, the Synaesthetic Museum exemplifies the relationship between the actual form itself and the aural qualities it can create. Merging together the individual field of research within light caustics (Francois Mangion) and phonetics of space (Shuchi Agarwal), the museum heightens ones awareness of the essential role the human senses play in the built environment.

Located on the opposite side of the historical French-Canadian city of Quebec in Canada, across river St. Lawrence, this project represents an initial step towards interpreting the intelligent proportions of the harmonic instruments to design an architecture performance through sound into expressions of formal proportion in architecture. A harmonic layer of string arrangement, designed through the synthesis of harmonic proportions, forms an Aeolian pavilion that uses wind energy to generate pleasant synaesthetic sound. The spatial and functional implications of the Synaesthetic Museum become key requirements for it to function both as a museum and an Aeolian building. Structured round several prototypes and investigations, the design explores various tectonic analysis related to both the architectural language, generated through caustics, and the inclusion of fully functional harmonic strings. The goal of this project is to be able to translate and re-interpret a combination of sound and light through form; to better understand how to create atmosphere and compose a one unique performative experience.



The trend of movement and transition of light caustic patterns were studied through meticulous data mapping of the interaction between the initial surface pattern and its projected caustic pattern. The relation between the light source, the initial pattern and its protected pattern onto a designed recording surface was investigated through a fully functional physical generative model. Multiple light sources were computed individually providing arrayed projected curves generating form. Combining the human scale, structural possibility and the relationship with the environment, the projected arrays of the caustic pattern were further refined and optimised.



Findings

The approach of this design is such that it looks into how light evolves in to habitable spaces; the museum redefines how people occupy the built environment also through sound hence experiencing a homogeneous correlation between the volumetric qualities of light and sound. The Synaesthetic Museum engages the users in an optical and harmonic experience, which gives new meaning to experiential architecture.

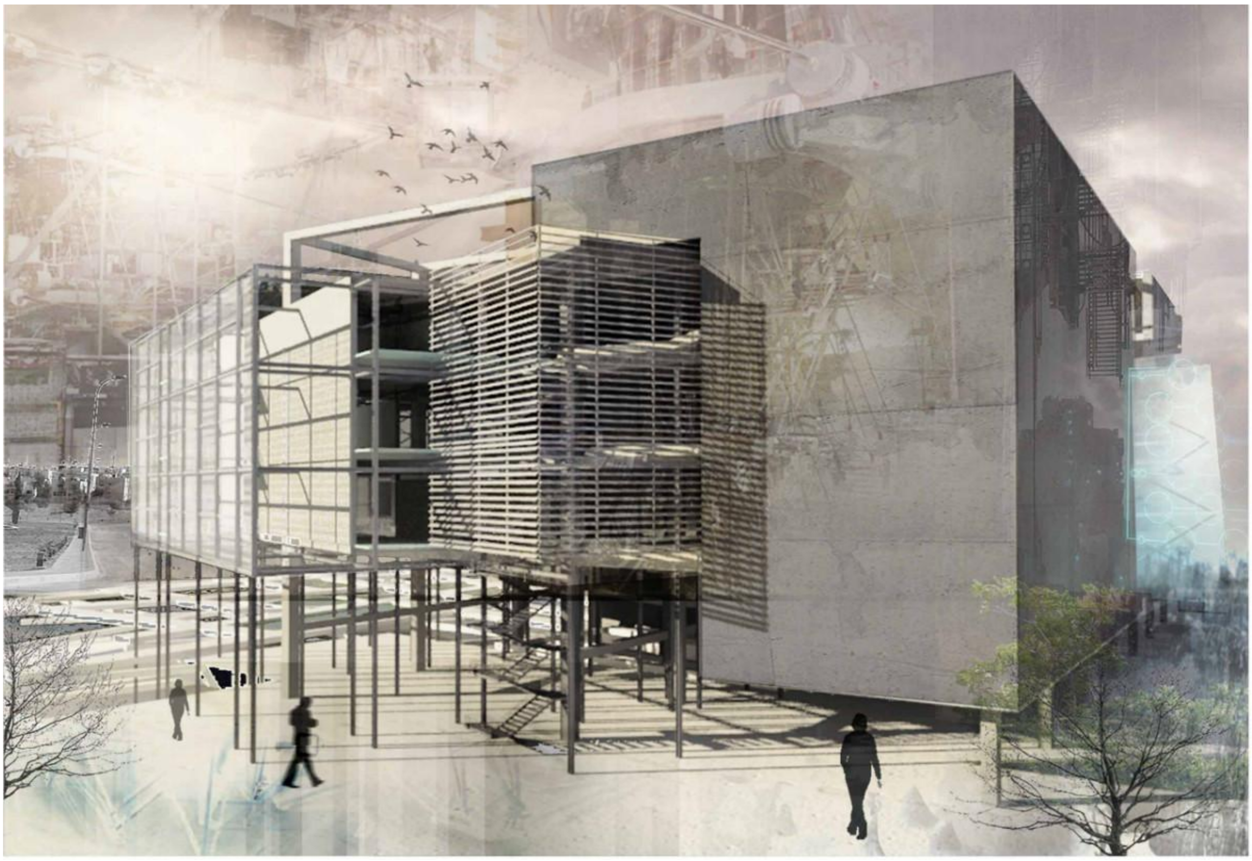
4.2.3 Black Swan

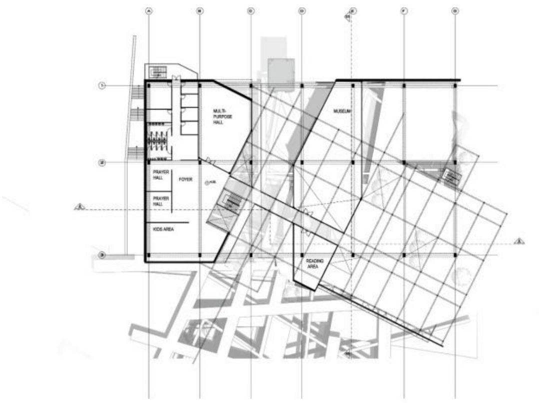
Project Name: Black Swan
Students: Basma Khlaif ,Reham Adi,Dareen Alloun.
School: University Of Jordan, Faculty Of Engineering, Department Of Architectural Engineering.
Technology and innovation center: graduation project.

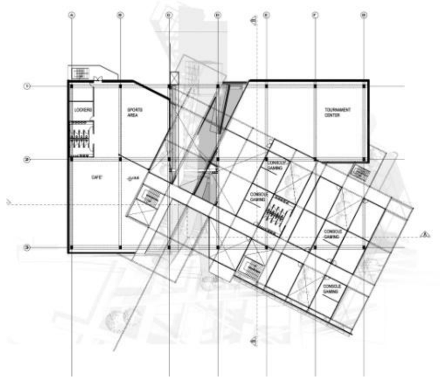
It is hard-to-predict the rare events that are beyond the realm of normal expectations. The rise of the Internet, the personal computer and World War as examples of black swan events.

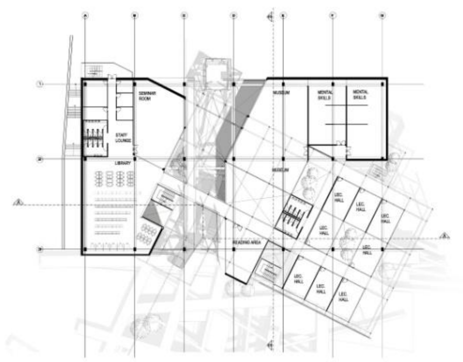
According to the large magnitude and consequence and their dominant role in formulating the users' identity, our mission is “Identity Reformulation”.

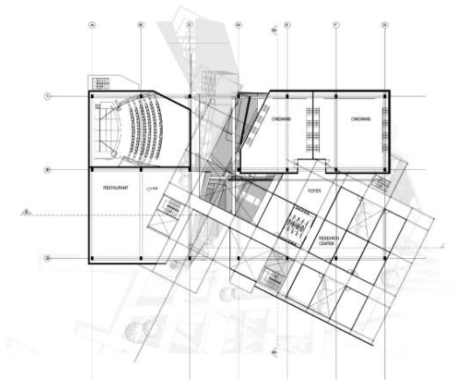
This project combines the concepts of purgatory, architecture theory of constructivism versus deconstructivism theory and Bernard Tschumi's concept of space violating bodies.



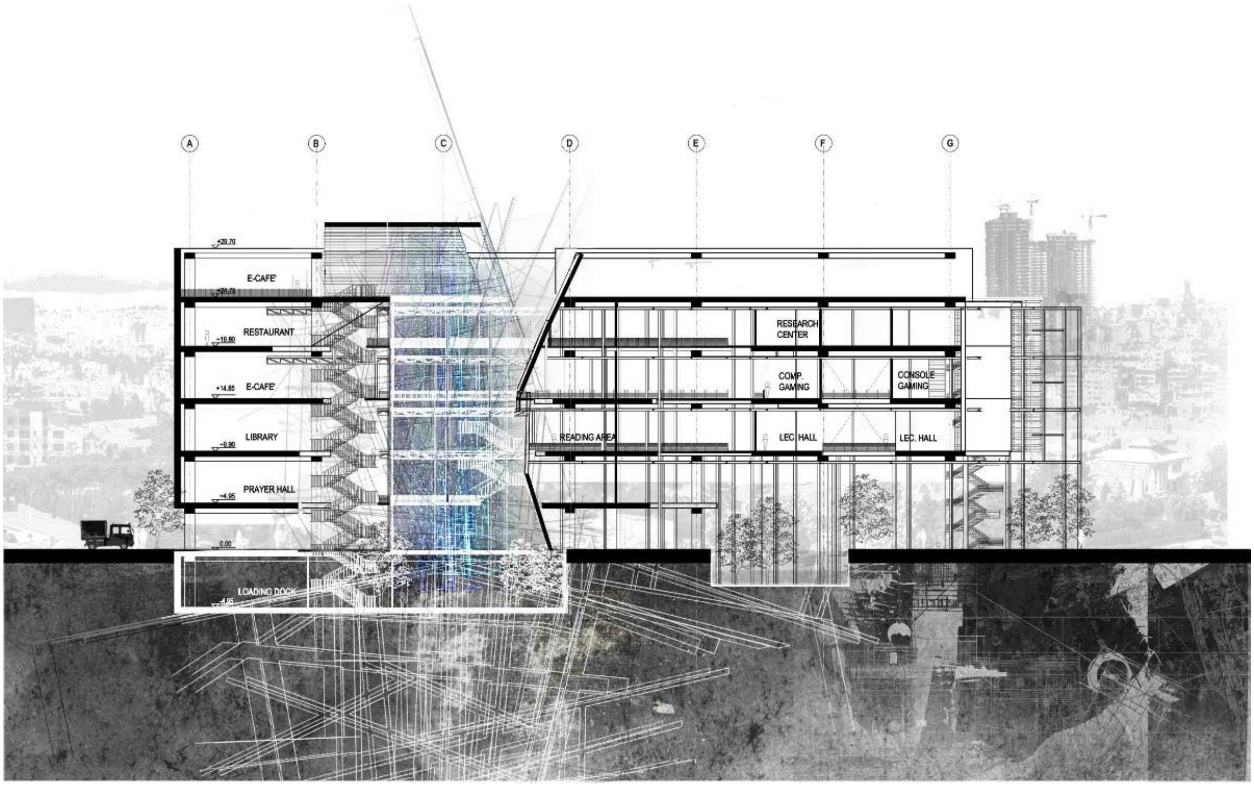








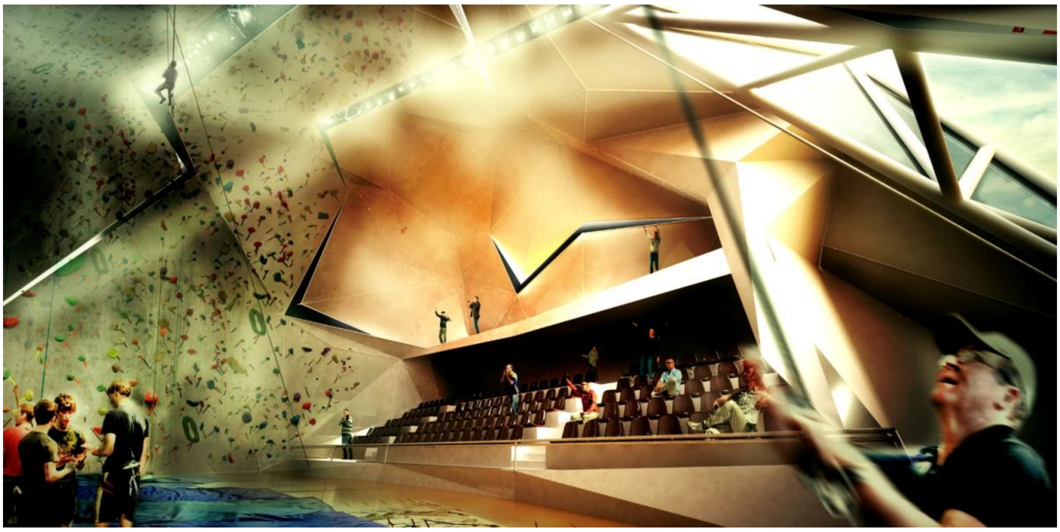
The approach of the design process was to give half the story, to allow the audience to find themselves in it as directed by their own senses and abilities. A paradox was created where one can visualize the unseen reality, take trace of their own identity, heal themselves and form their own identity while eventually entering catharsis and then start again in the physical world.



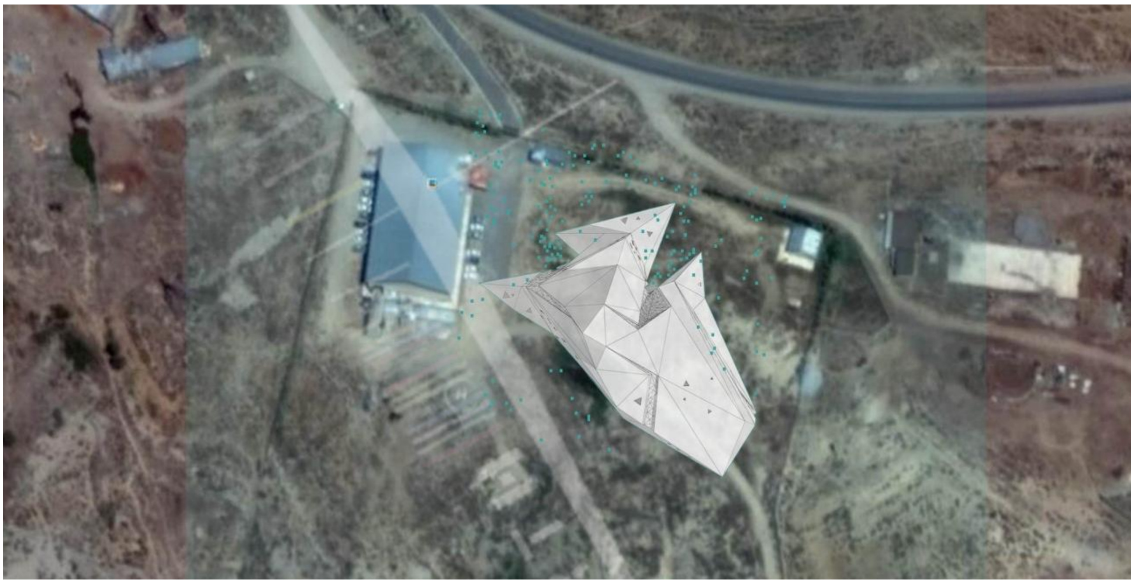
4.2.4 Rock Gym for Polur

In response to the climbing potential of Polur, Iran, New Wave Architecture has designed a new rock climbing hall within the rocky lands of Mazandaran. Overlooking the country's highest peak, the “fragmented mass” invites nature and landscape to “visually creep into the building” to offer daylight and establish a strong connection between climbers and the surrounding landscape.

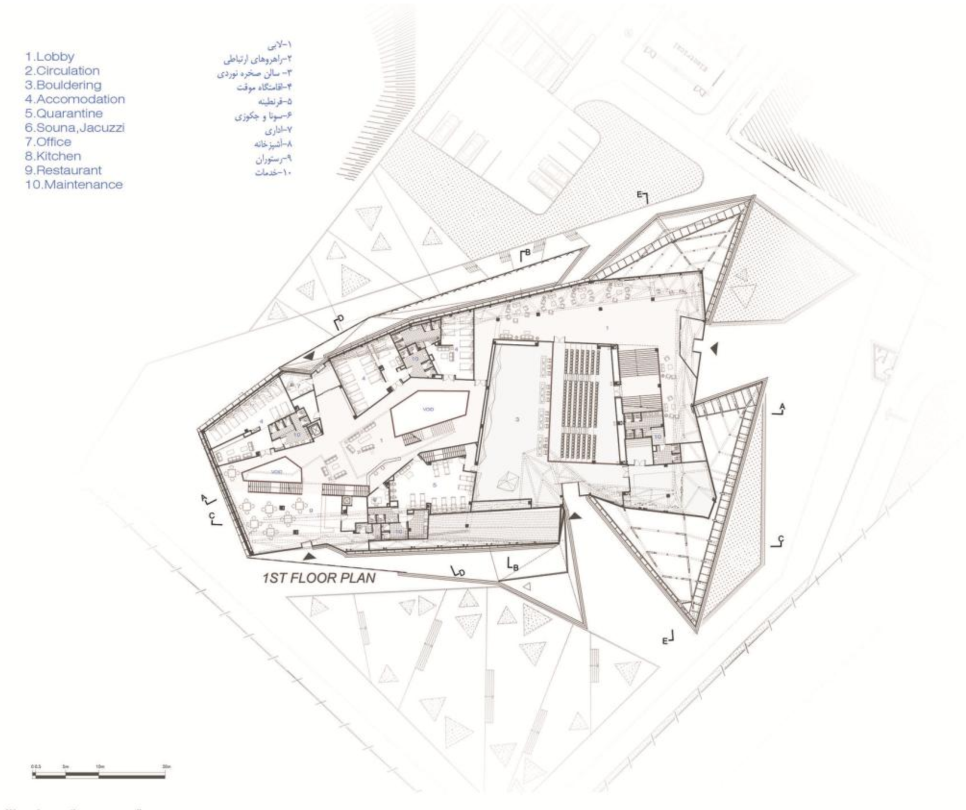
Within the “boulder-like walls,” which were inspired by the geological process of the large-scale movements of the earth‘s crust and its tectonic forces, programs include a dynamic climbing hall, temporary accommodation zone, fitness gym and maintenance areas.



The exterior is clad in white fiber cement panels, which simultaneously allows the building to blend into its snowy context while offering climbers outdoor routes. Steel moment resisting frames are used as the main structural system; while tubular trusses transmit the floor loads to vertical elements due to project long spans.




1.Lobby
2.Circulation
3.Bouldering
4.Accomodation
5.Quarantine
6.Souna,Jacuzzi
7.Office
8.Kitchen
9.Restaurant
10.Maintenance
۱-لابی
۲-راهروهای ارتباطی
۳- سالن صخره نوردی
۴-اقامتگاه موقت
۵-قرنطینه
۶-سونا و جکوزی
۷-اداری
۸-آشپزخانه
۹-رستوران
۱۰-خدمات
GROUND FLOOR PLAN


1.Lobby
2.Circulation
3.Bouldering
4.Accomodation
5.Quarantine
6.Souna,Jacuzzi
7.Office
8.Kitchen
9.Restaurant
10.Maintenance
۱-لابی
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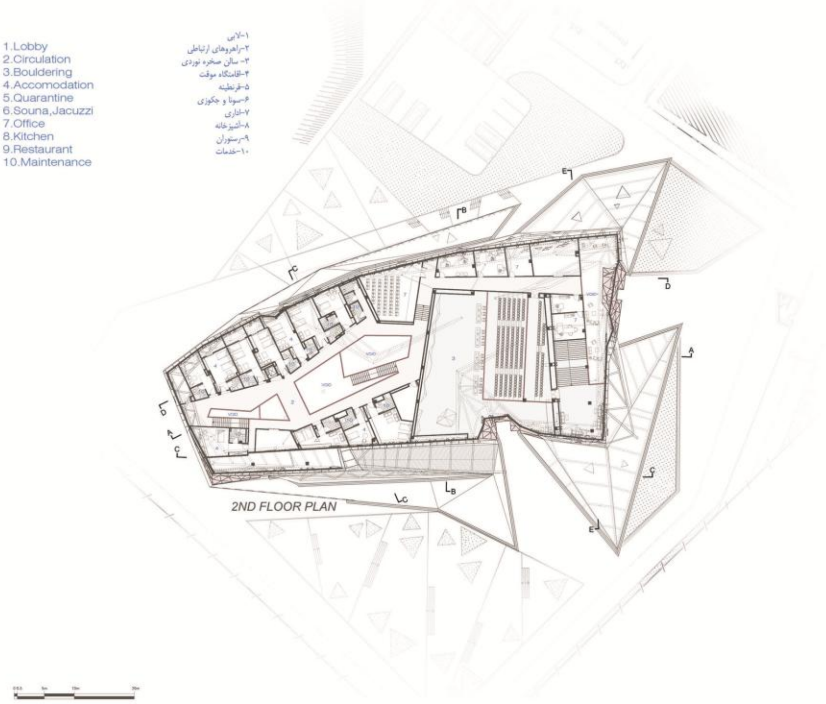
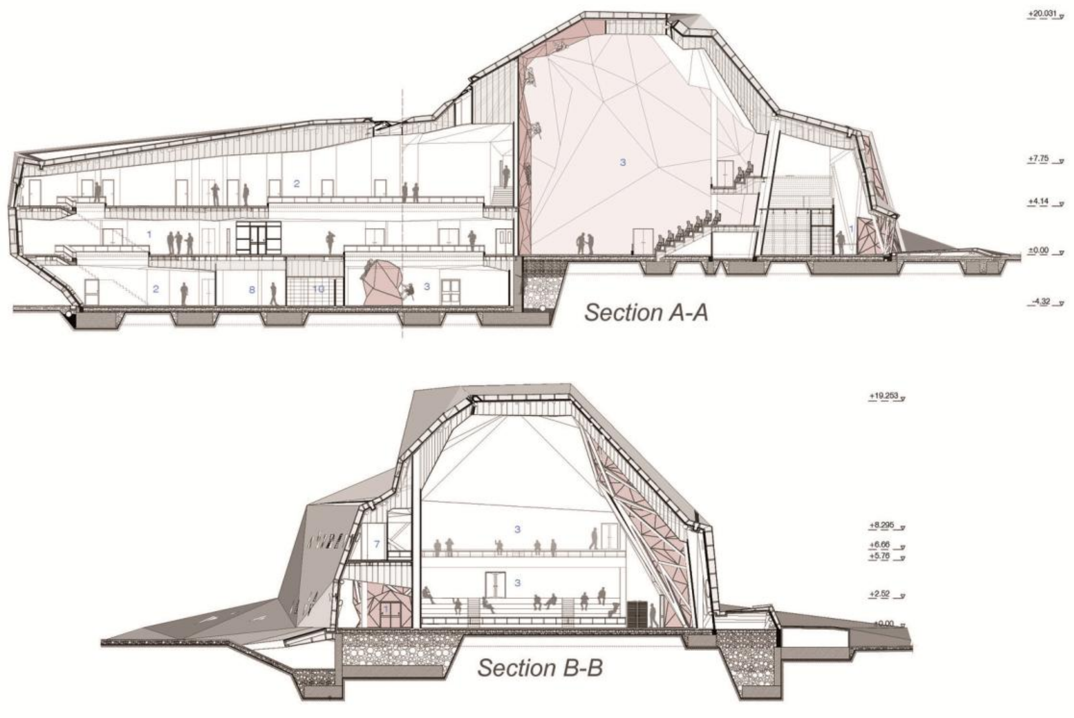
۴-اقامتگاه موقت
۵-قرنطینه
۶-سونا و جکوزی
۷-اداری
۸-آشپزخانه
۹-رستوران
۱۰-خدمات
1ST FLOOR PLAN

1.Lobby
2.Circulation
3.Bouldering
4.Accomodation
5.Quarantine
6.Souna,Jacuzzi
7.Office
8.Kitchen
9.Restaurant
10.Maintenance

۱-لابی
۲-راهروهای ارتباطی
۳- سالن صخره نوردی
۴-اقامتگاه موقت
۵-قرنطینه
۶-سونا و جکوزی
۷-اداری
۸-آشپزخانه
۹-رستوران
۱۰-خدمات





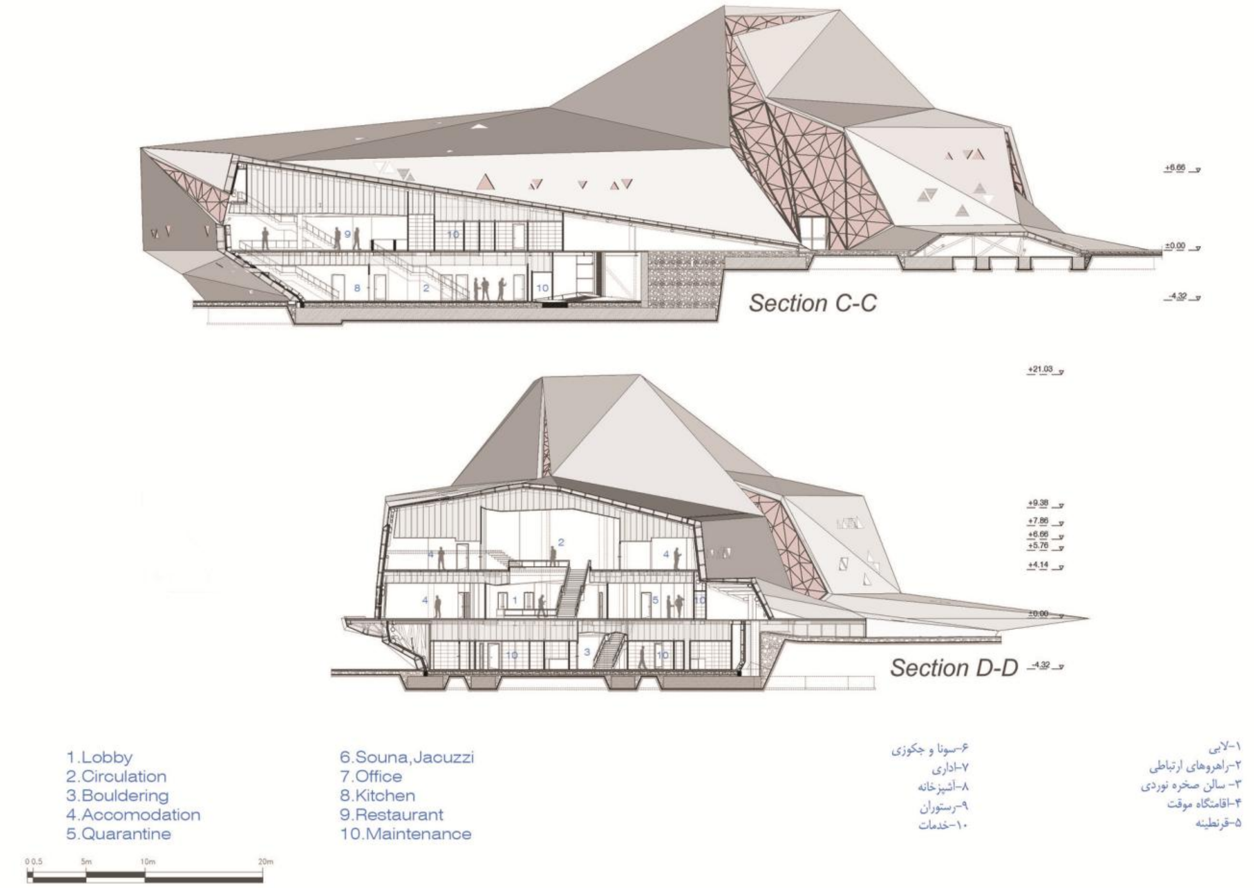
1.Lobby
2.Circulation
3.Bouldering
4.Accomodation
5.Quarantine

6.Souna,Jacuzzi
7.Office
8.Kitchen
9.Restaurant
10.Maintenance

۶-سونا و جکوزی
۷-اداری
۸-آشپزخانه
۹-رستوران
۱۰-خدمات

۱-لابی
۲-راهروهای ارتباطی
۳- سالن صخره نوردی
۴-اقامتگاه موقت
۵-قرنطینه

0 0.5 5m 10m 20m



Findings

Even though the concept and function of the Rock Gym is different from the proposed project that this particular paper is discussing, the kinds of form being dealt with in both the projects are similar. The Rock Gym project helped in understanding how to manipulate the plans, landscape and façade of the proposed project.

CHAPTER 05: PROGRAM DEVELOPMENT

5.1 Museum

5.2 Research Center

5.3 Recreational/ Common Area

5.4 Grand Total

5.1 Museum

SPACE	SPACE REQUIRED PER PERSON (SQ-FT)	NO. OF USERS	SPACE REQUIRED PER ROOM (SQ-FT)	NO. OF ROOMS	AREA REQUIRED (SQ-FT)
LOBBY (reception+ information desk)	6.5	600			4000
PERMANENT EXHIBITION SPACE					55,000
TEMPORARY EXHIBITION SPACE					79,300
EXHIBIT PRESERVATION/ PREPARATION AREA	184	15		2	2,760
STORAGE				5	3,600
WORKSHOP				1	9,000
RETAIL AREA					3000
WASHROOMS			160	2	320
SUBTOTAL					156,980
Circulation (30%)					47,094
TOTAL					204,074

Administration

SPACE	SPACE REQUIRED PER PERSON (SQ-FT)	NO. OF USERS	SPACE REQUIRED PER ROOM (SQ-FT)	NO. OF ROOMS	AREA REQUIRED (SQ-FT)
DIRECTOR			600	1	600
STAFF (with waiting area)	100	25		1	12,000
CONFERENCE ROOM	20	25			500
STORAGE				1	200
WASHROOMS			160	2	320
SUBTOTAL					13,620
Circulation (30%)					4,086
TOTAL					17,706

5.2 Research Center

Administration

SPACE	SPACE REQUIRED PER PERSON (SQ-FT)	NO. OF USERS	SPACE REQUIRED PER ROOM (SQ-FT)	NO. OF ROOMS	AREA REQUIRED (SQ-FT)
DIRECTOR			600	1	600
STAFF	80	8	540	1	640
CONFERENCE ROOM	20	35	700	1	700
AREA FOR REPROGRAPHY					100
WASHROOMS			160	2	320
SUBTOTAL					2,360
Circulation (30%)					708
TOTAL					3,068

Library

SPACE	SPACE REQUIRED PER PERSON (SQ-FT)	NO. OF USERS	SPACE REQUIRED PER ROOM (SQ-FT)	NO. OF ROOMS	AREA REQUIRED (SQ-FT)
LOBBY					200
CHECK AREA AND LOCKER					200
READING AREA	10	150		1	1,500
BOOK STACK	0.1/book	50,000 books		1	5,000
AUDIO VISUAL	30	20			600
SUBTOTAL					7,500
Circulation (30%)					2,250
TOTAL					9,750

Archive

SPACE	SPACE REQUIRED PER PERSON (SQ-FT)	NO. OF USERS	SPACE REQUIRED PER ROOM (SQ-FT)	NO. OF ROOMS	AREA REQUIRED (SQ-FT)
LOBBY					200
CHECK AREA AND LOCKER					200
STACK AREA				1	4,000
AUDIO VISUAL	30	16			480
SUBTOTAL					4,880
Circulation (30%)					1,464
TOTAL					6,344

Research Facilities

SPACE	SPACE REQUIRED PER PERSON (SQ-FT)	NO. OF USERS	SPACE REQUIRED PER ROOM (SQ-FT)	NO. OF ROOMS	AREA REQUIRED (SQ-FT)
COMPUTER LABS	50	30		1	1,500
MOCAP LAB				1	6,200
SEMINAR HALL	10	270		1	2,700
SUBTOTAL					10,400
Circulation (30%)					3,120
TOTAL					13,520

5.3 Recreational/ Common Area

SPACE	SPACE REQUIRED PER PERSON (SQ-FT)	NO. OF USERS	SPACE REQUIRED PER ROOM (SQ-FT)	NO. OF ROOMS	AREA REQUIRED (SQ-FT)
MULTIPURPOSE HALL	10	400	4,000	1	4,000
LOUNGE			2,200 | 10,000	2	12,200
RESTAURANT	20	200		1	4,000
KITCHEN					1,500
WASHROOMS			35	2	70
SUBTOTAL					21,770
Circulation (30%)					6,531
TOTAL					28,301

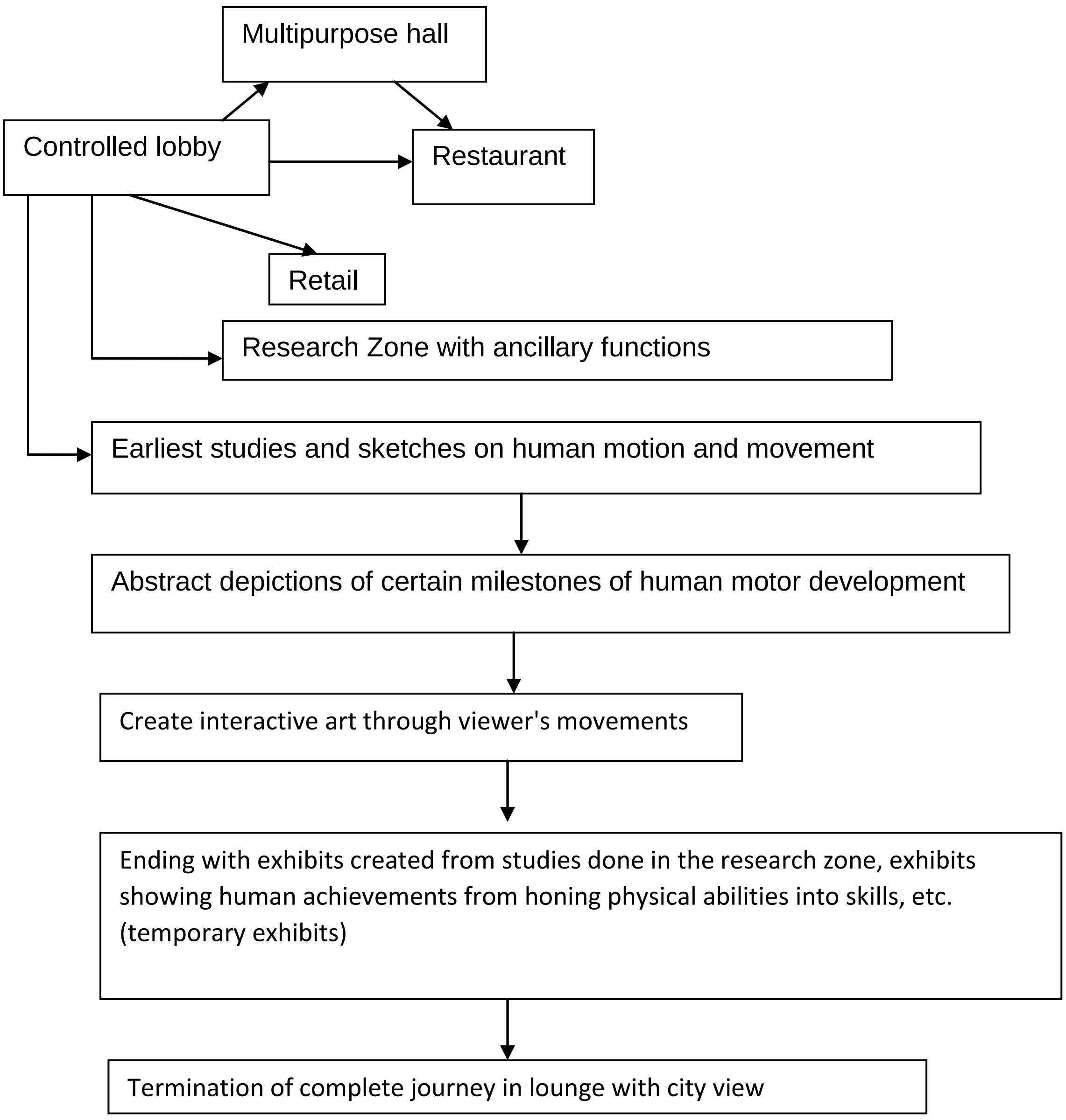
5.4 Grand Total

SPACE	AREA REQUIRED
MUSEUM	204,074
MUSEUM ADMINISTRATION	17,706
RESEARCH CENTER ADMINISTRATION	3,068
LIBRARY	9,750
ARCHIVE	6,344
RESEARCH FACILITIES	13,520
RECREATIONAL/COMMON AREA	28,301
GRAND TOTAL	282,763

CHAPTER 06 - CONCEPTUAL STAGE AND DESIGN DEVELOPMENT

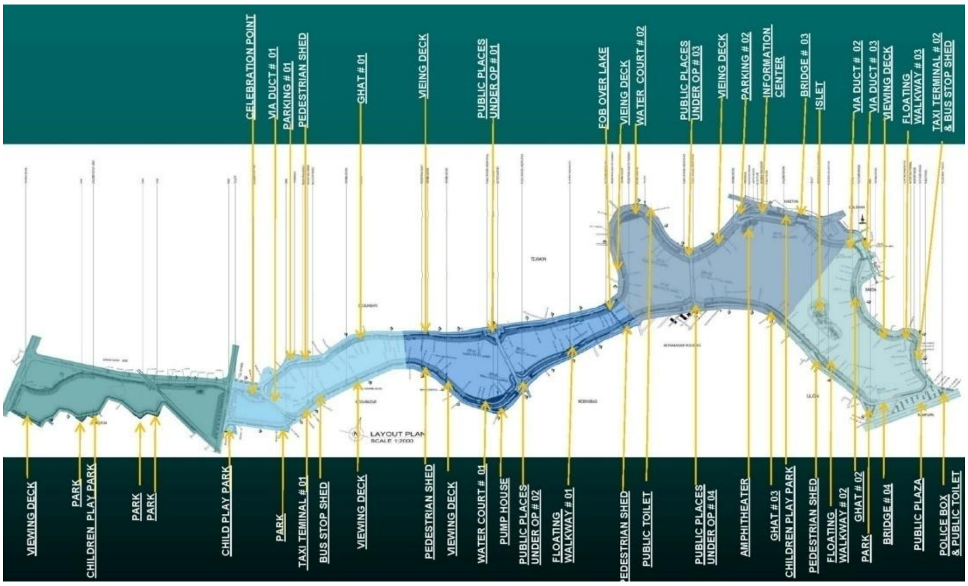
6.1 Introduction

Upon developing the idea of the project, since the whole idea was showing people that science and art can integrate together to create a new medium of communication with the mass people, using technology as the catalyst, that showcased humans in terms of their bodily motion, since it is a method of making meaningful experiences, thus functions were developed in a manner that dealt with human movement. Then came the site and zoning of these sectors within the site.



6.2 Concept Development

The initial idea of the project was to choose a certain location for the project where public imflux is high so that the project can be successful to pull in audiences. Hatirjheel is the perfect location for such a project since major public functions are being developed along the belt of Tejgaon, along with the fact that the surrounding areas of the chosen site is very diverse, therefore pulling in a diverse audience to the museum.



The concept of the design is mainly based on one of the earliest geometric studies done on human motion. As discussed earlier, one of the first methods of analyzing and understanding human movement and its geometry, with the aid of technology was chronophotography so an image showing successive positions of the limbs in an elastic jump upon the ball of the foot was chosen as geometry upon which to base the geometry of the form.

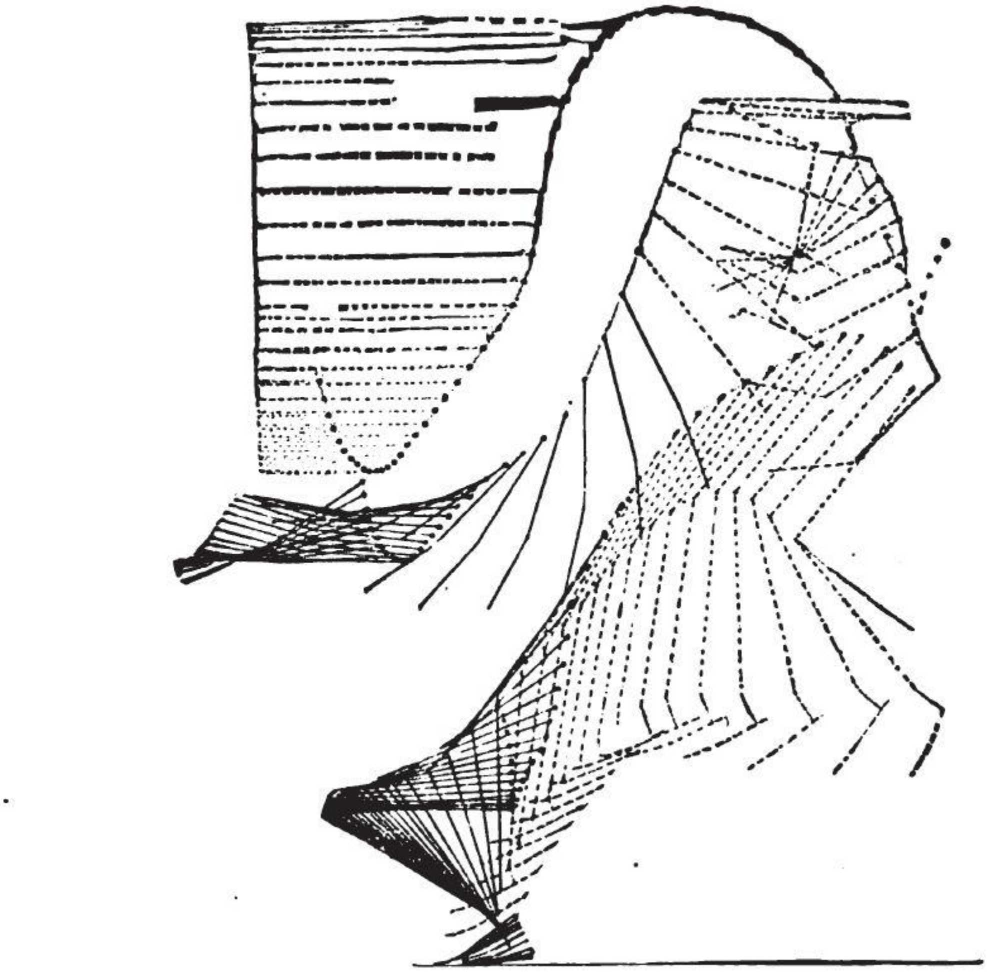
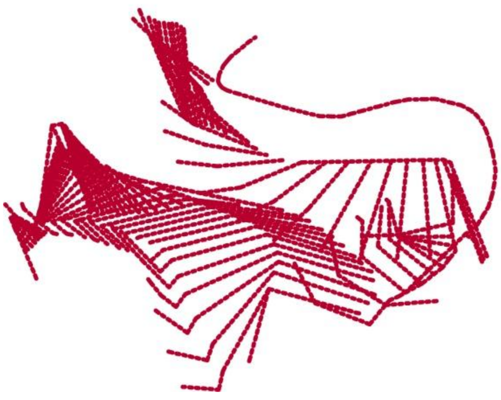
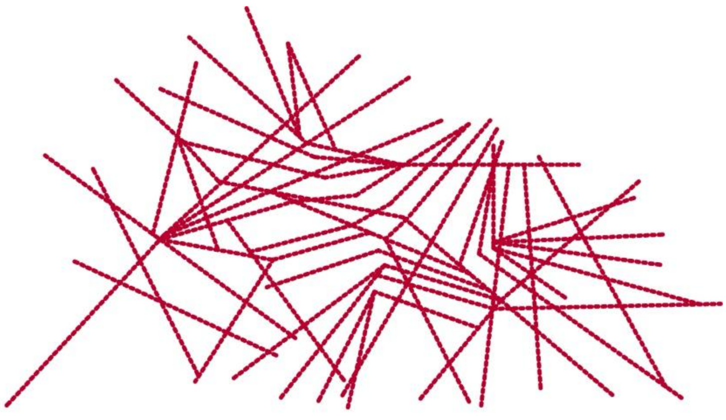


FIG. 14.—SUCCESSIVE POSITIONS OF THE LIMBS IN AN ELASTIC JUMP UPON THE BALL OF THE FOOT.

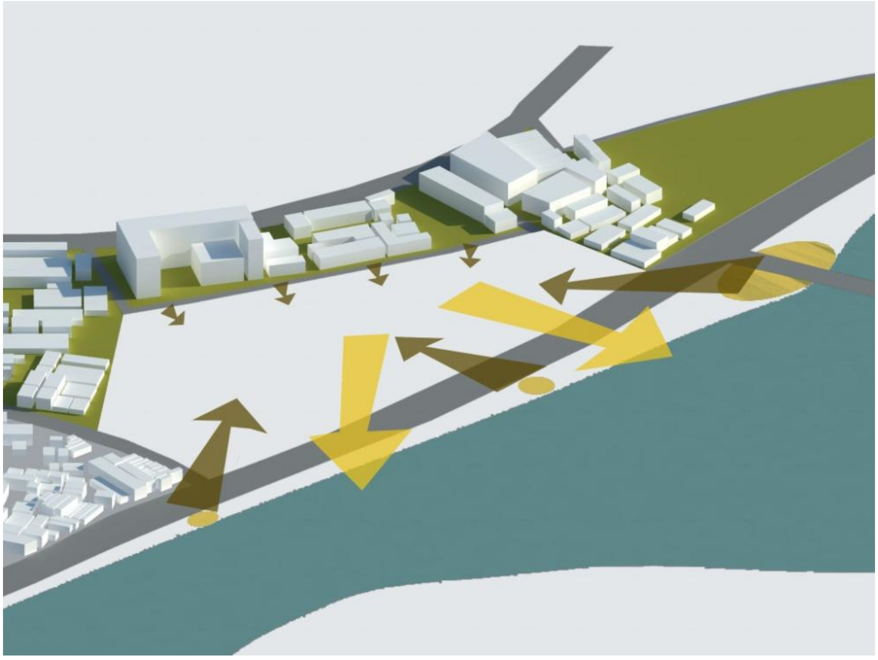
The geometry was then deconstructed to introduce new reference lines and directionalities, to generate a dynamic form that does justice to the form play to the typology of museums which concurs with the idea of the project.



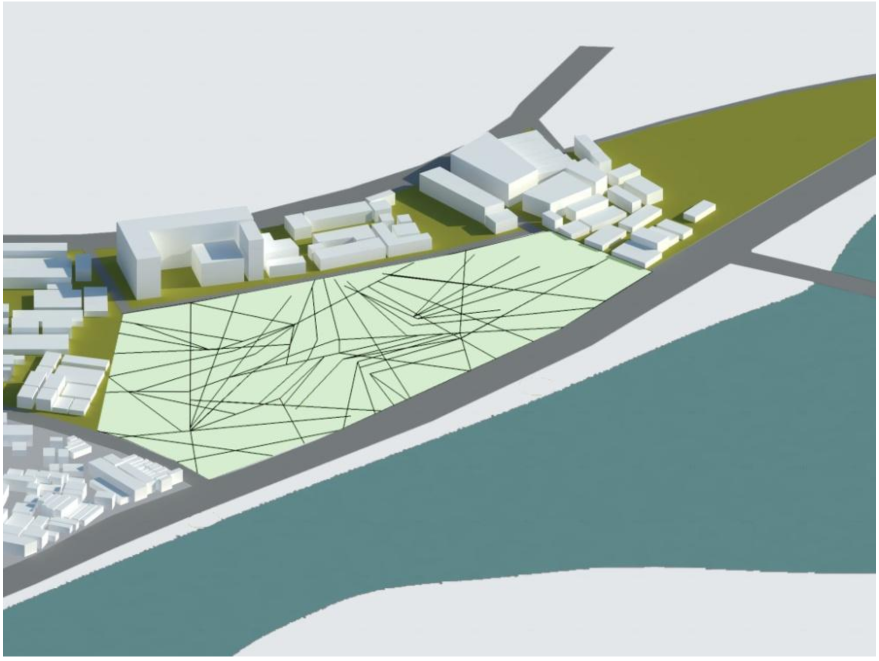


6.3 Form Development and Programmatic Layout

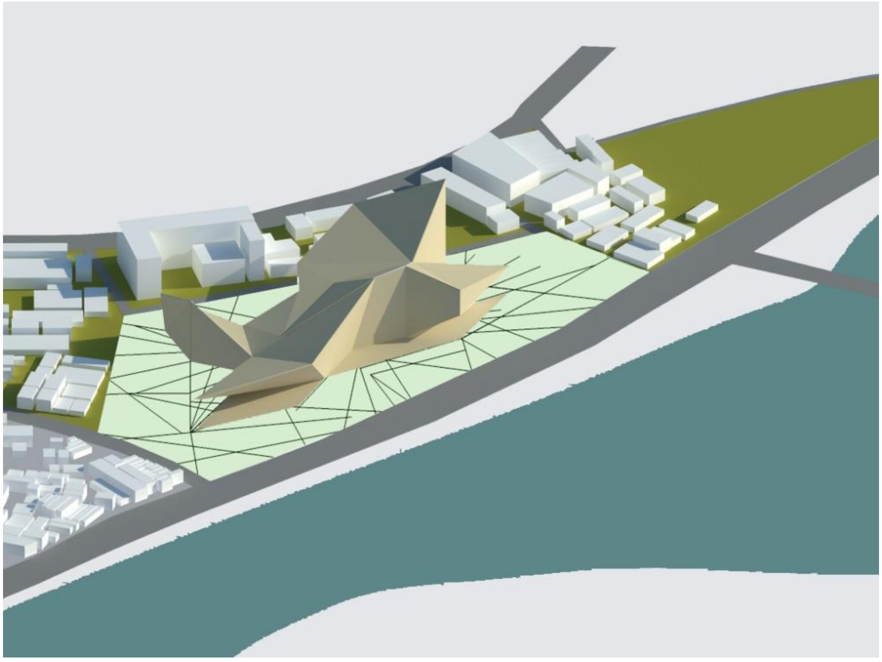
The first thing to do was understand the site and its surrounding through identification of the nearest public amenities to be developed on the Hatirjheel belt, nearest to the site, which are shown by yellow circles in the image below. The brown arrows show the direction of crowd generation nearest to the site while the yellow arrows show optimum view from site.



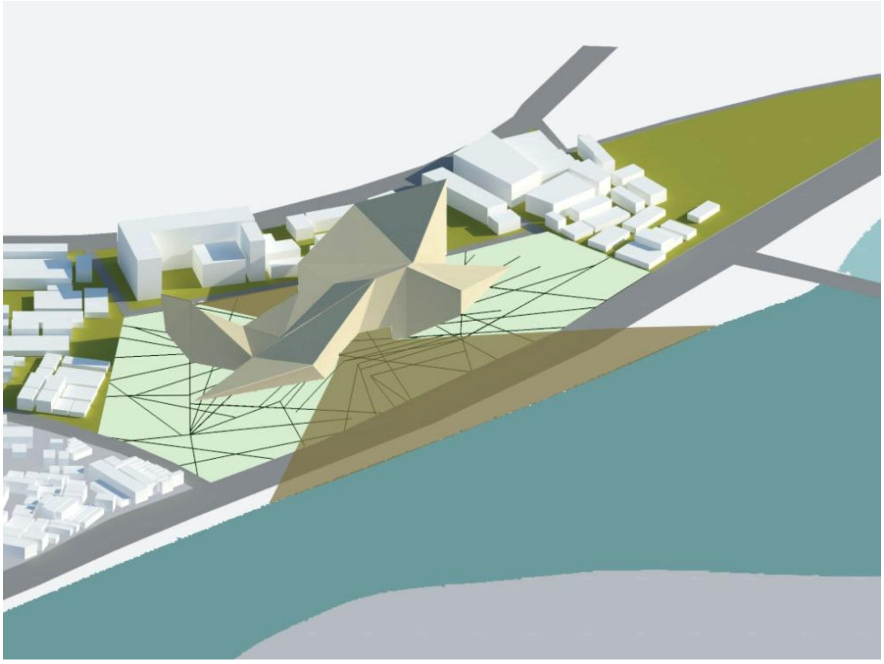
The deconstructed geometry was placed upon the site to act as a guiding grid for form generation.



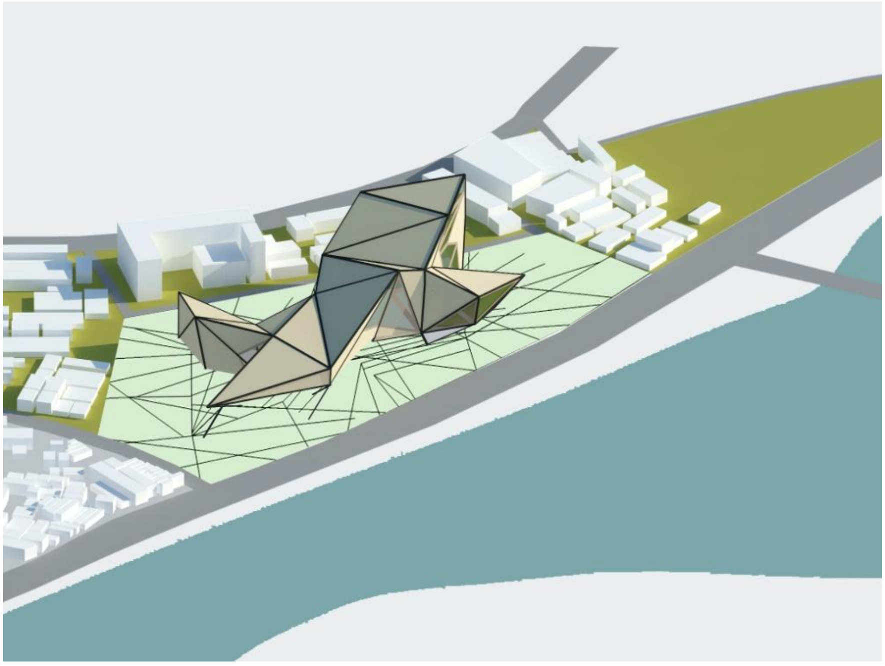
A form was generated.



A thoroughfare was introduced to connect the front and the back of the site through pedestrian movement.

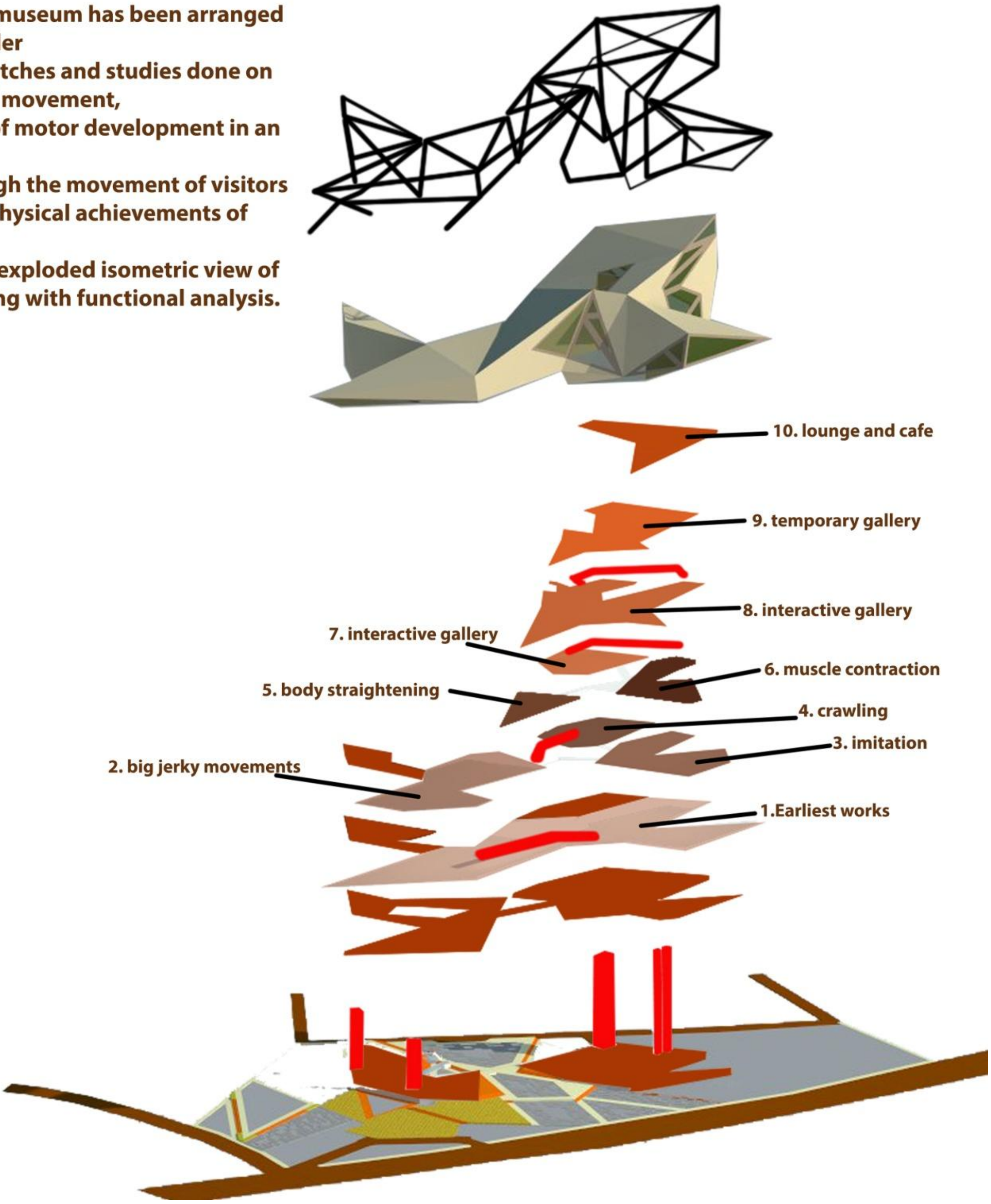


The final form with the structure.



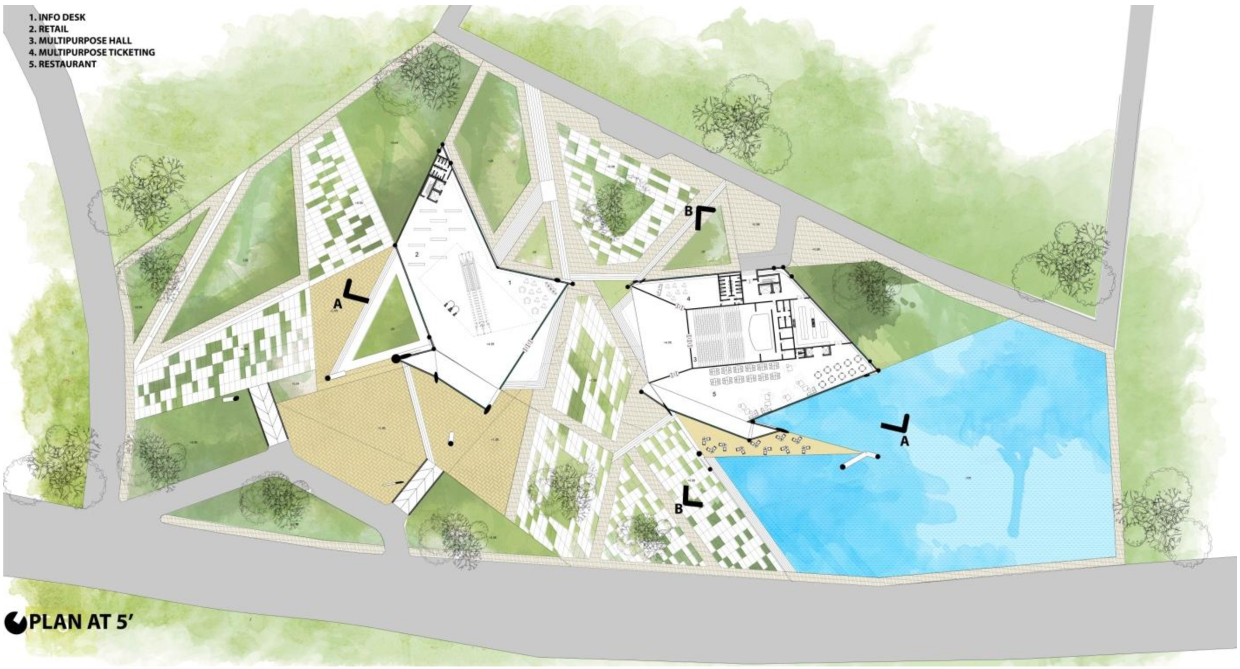
Introducing the Landscape and plaza.

The journey of the museum has been arranged in the following order
- earliest works, sketches and studies done on human motion and movement,
- the major stages of motor development in an early age
- creating art through the movement of visitors
- exhibition finest physical achievements of mankind
Below is shown an exploded isometric view of the whole form along with functional analysis.

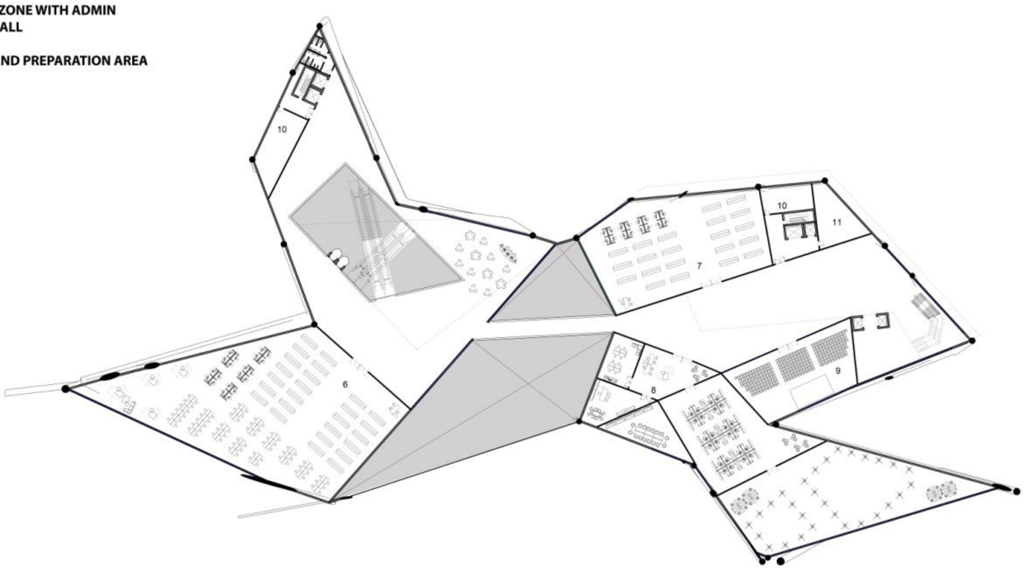


6.4 Final Design Drawings

SITE PLAN



6. LIBRARY
7. ARCHIVE
8. RESEARCH ZONE WITH ADMIN
9. SEMINAR HALL
10. STORE
11. SERVICE AND PREPARATION AREA

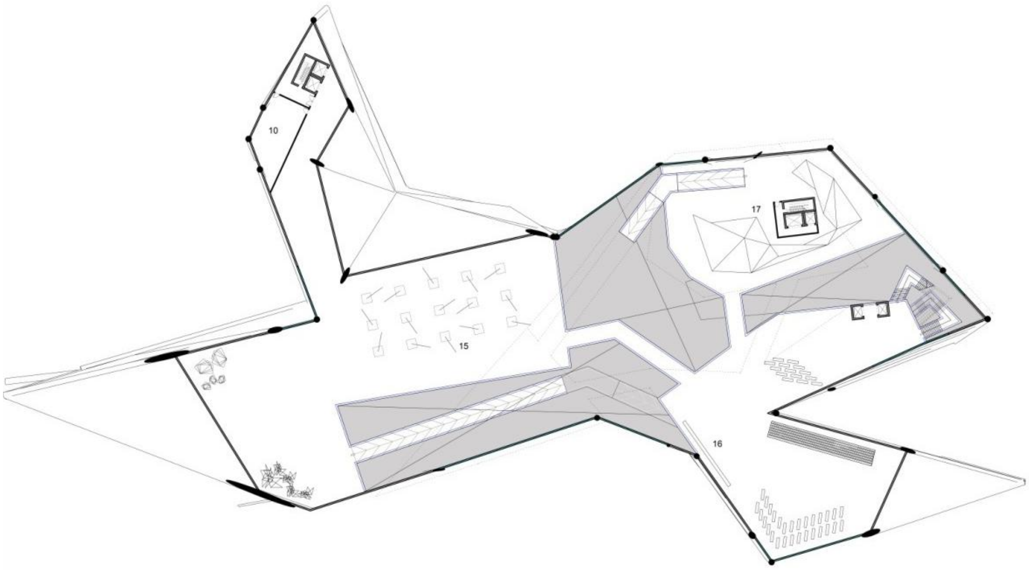


PLAN AT 37’

10. STORE
11. SERVICE AND PREPARATION AREA
12. LOUNGE
13. GALLERY OF EARLIEST WORK ON HUMAN MOTION AND MOVEMENT
14. MUSEUM ADMIN
24. WORKSHOP

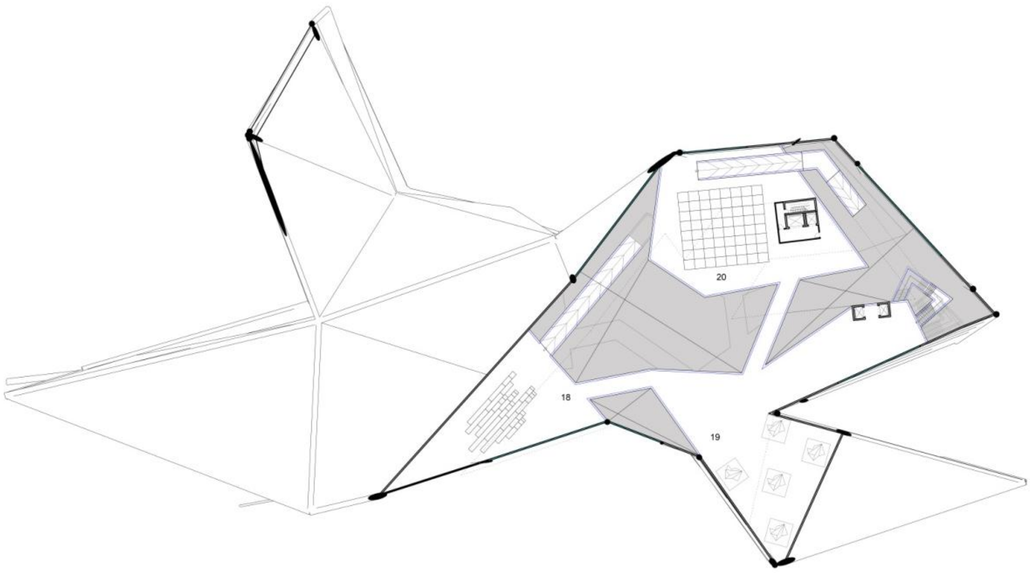
PLAN AT 53’

10. STORE
15. GALLERY OF BIG JERKY MOVEMENTS
16. GALLERY OF IMITATIVE BEHAVIOR
17. GALLERY SHOWING PHASE OF CRAWLING



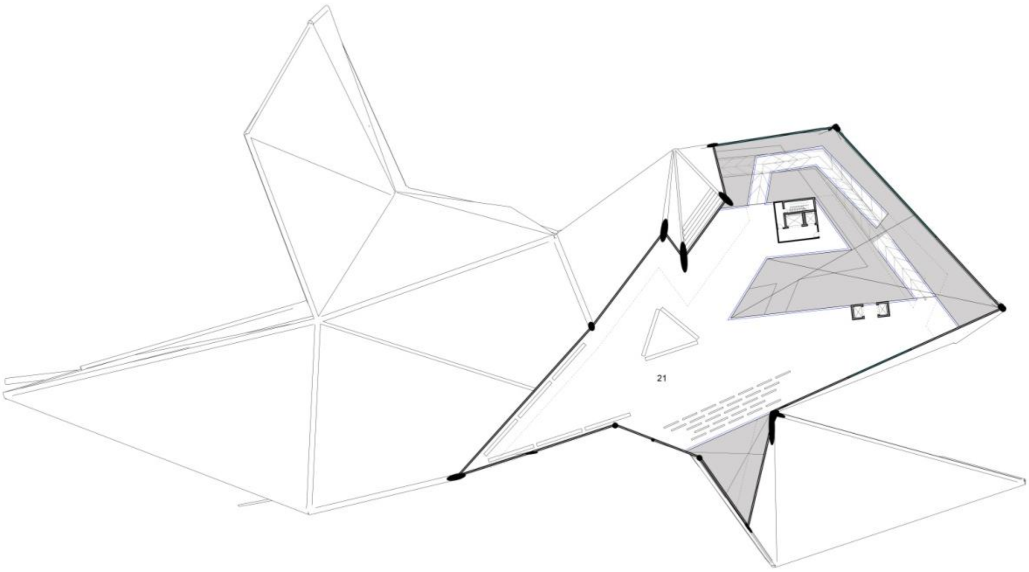
PLAN AT 69'

18. GALLEY OF BODY STRAIGHTENING
19. GALLERY OF MUSCLE CONTRACTING
20. INTERACTIVE GALLERY



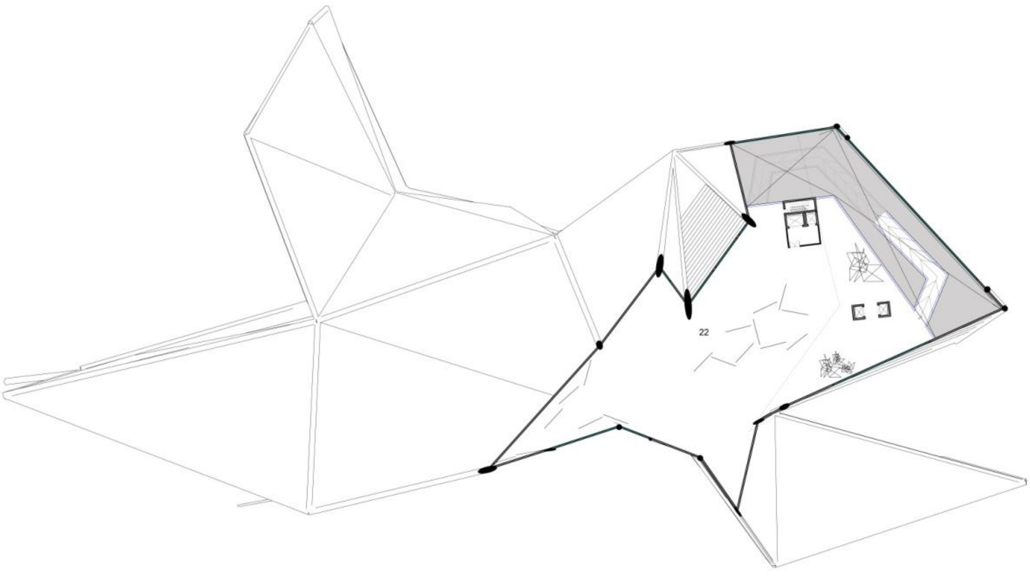
PLAN AT 85'

21. INTERACTIVE GALLERY



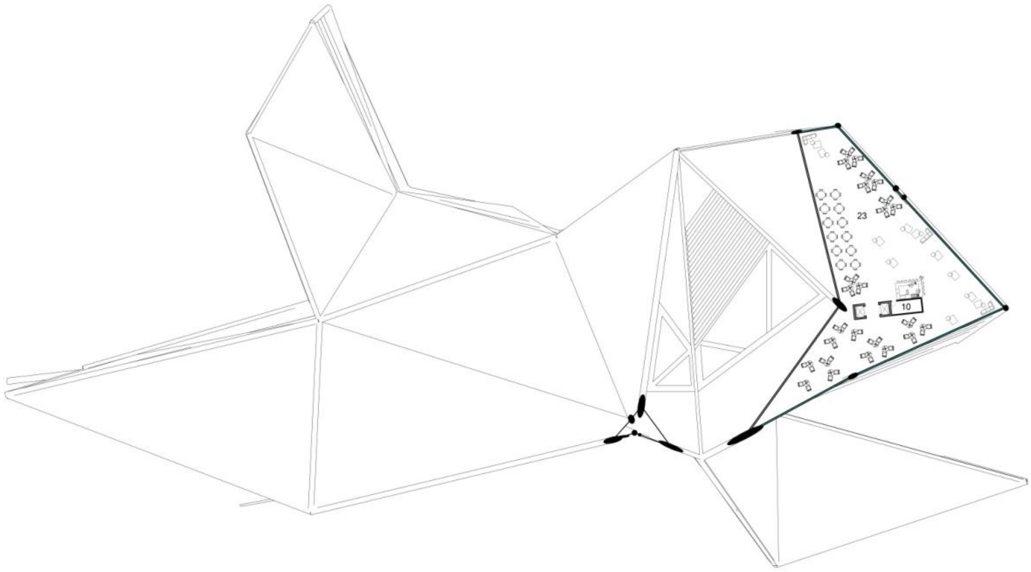
PLAN AT 101’

22. TEMPORARY GALLERY



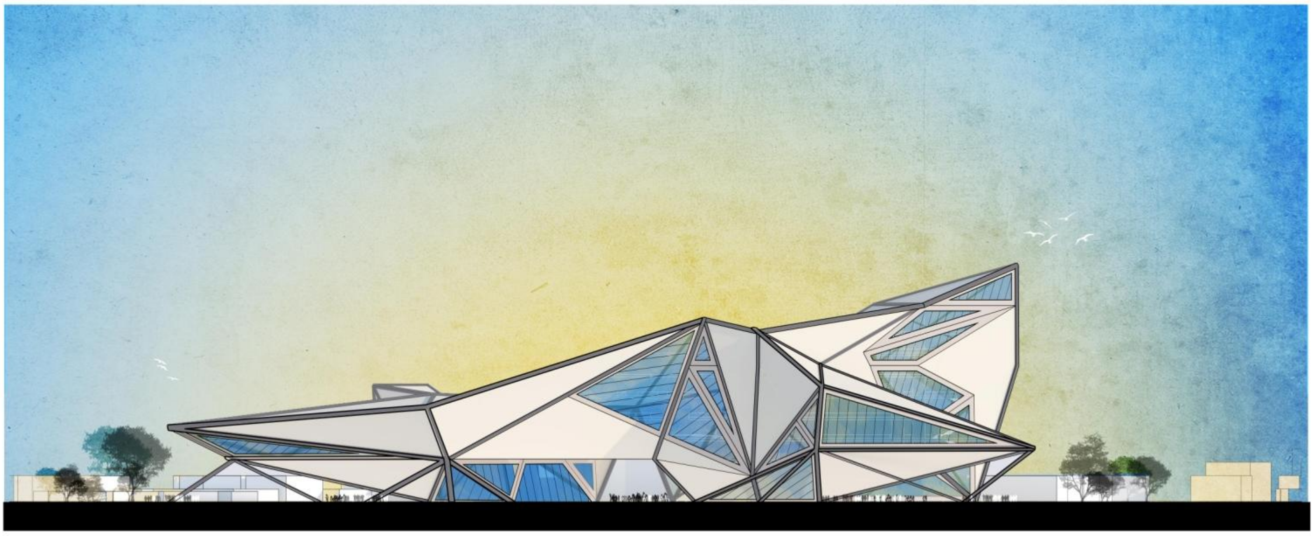
PLAN AT 117’

23. LOUNGE AND CAFE
10. STORE

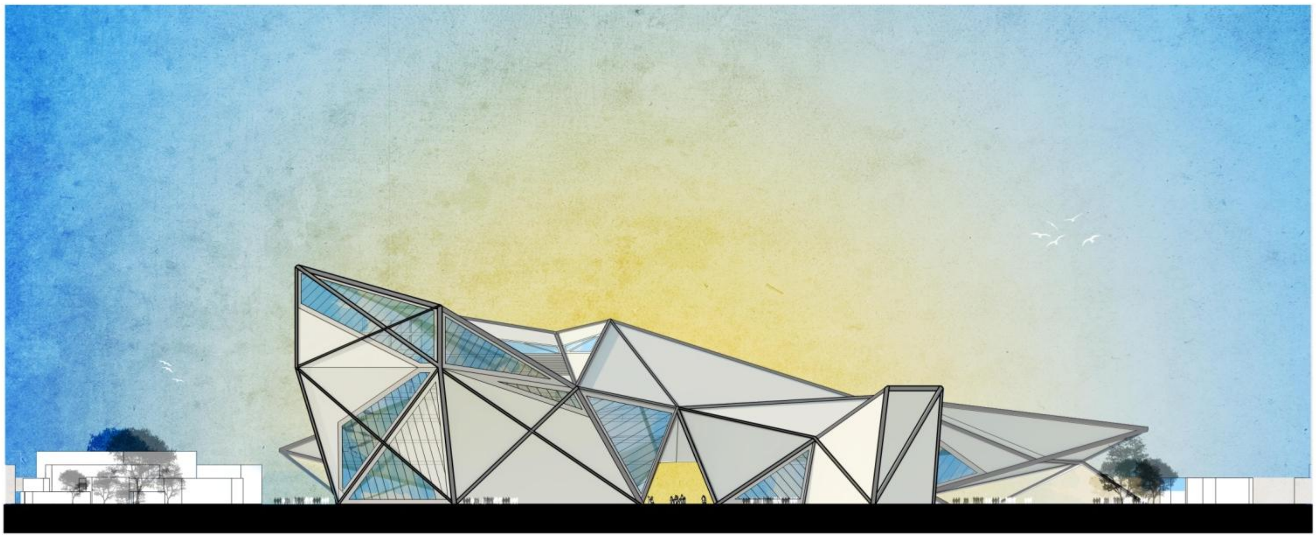


PLAN AT 140’

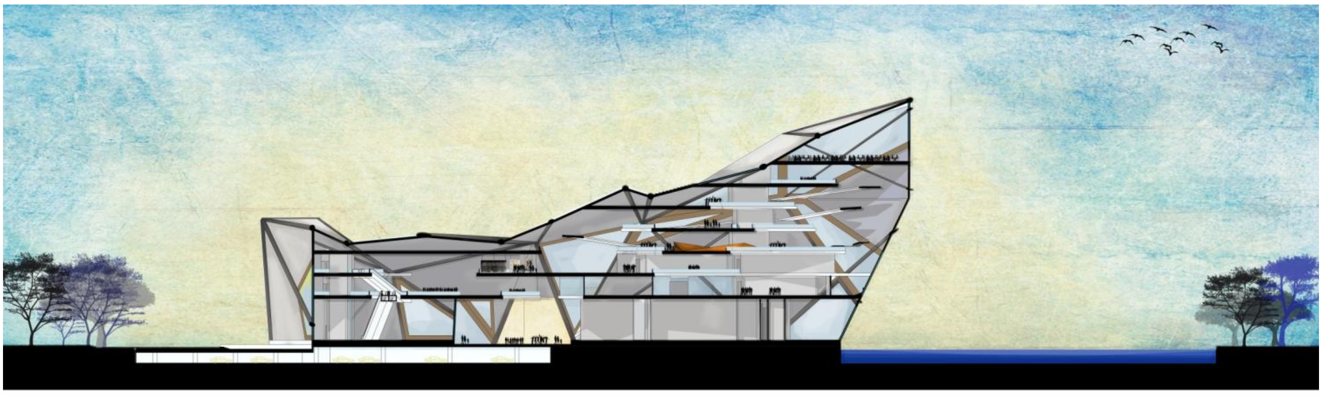
BASEMENT PLAN



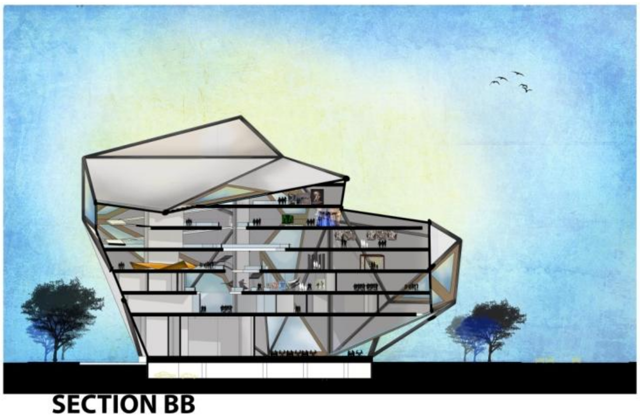
SOUTHEAST ELEVATION



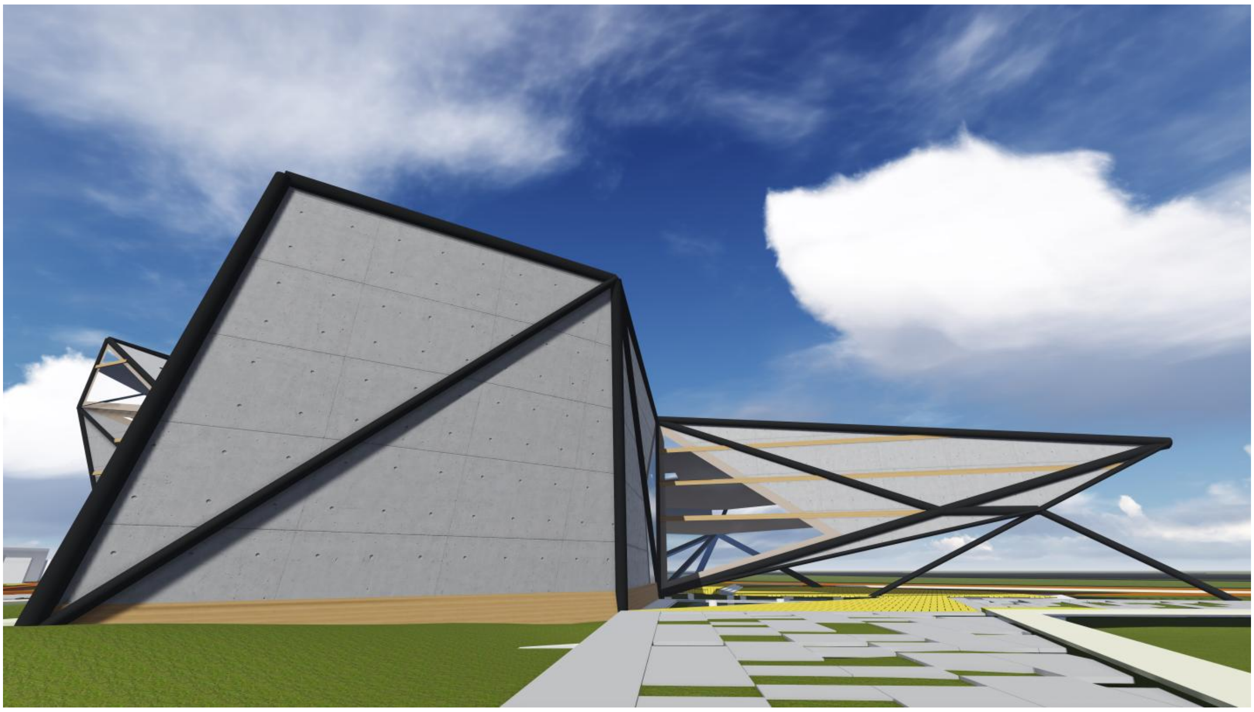
NORTHWEST ELEVATION

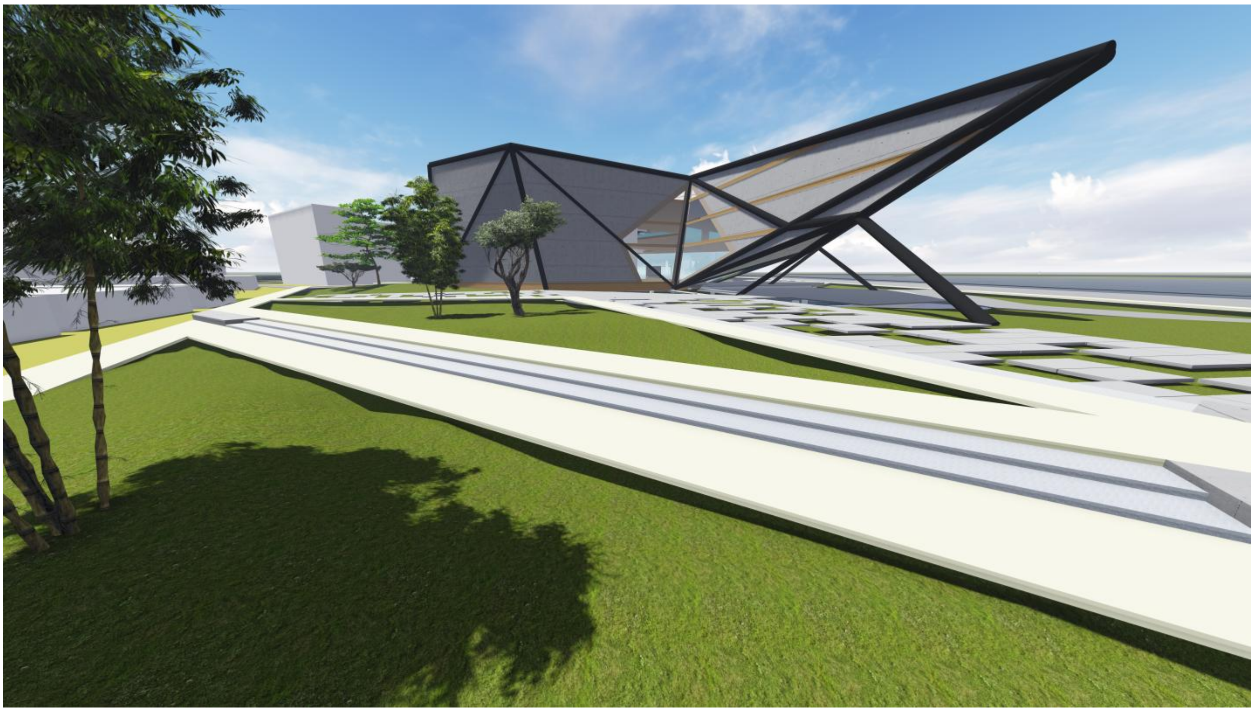


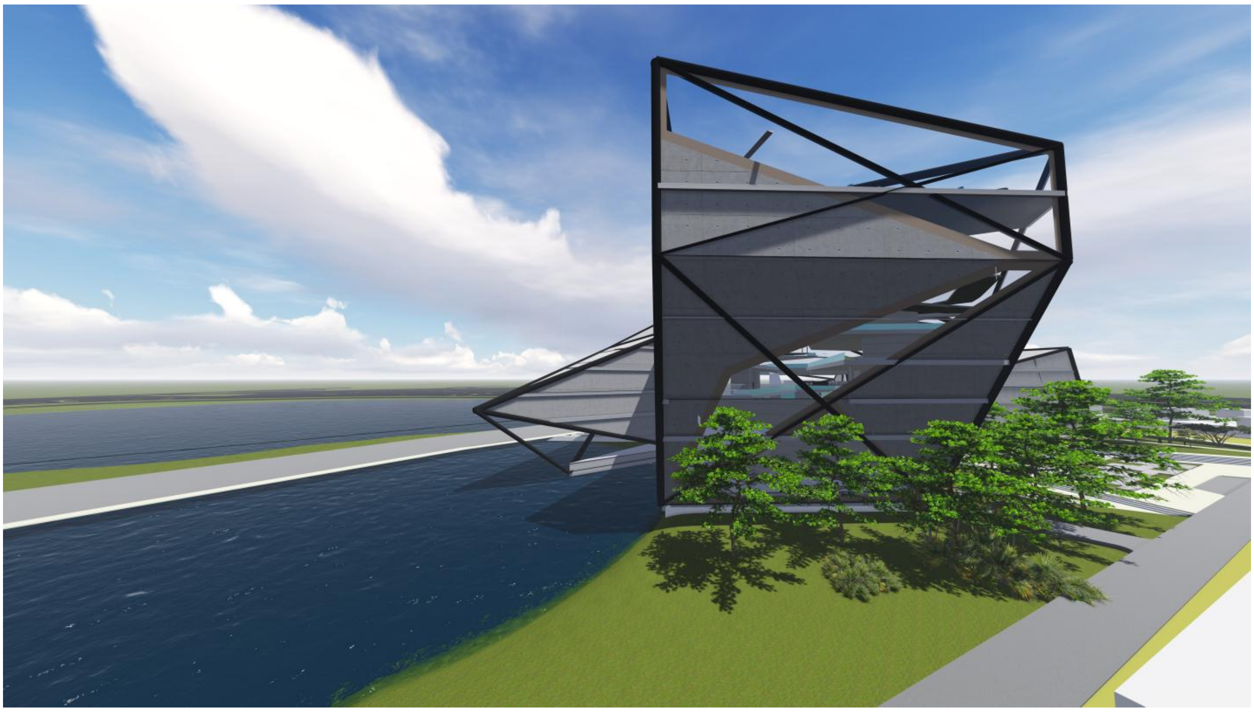
SECTION AA

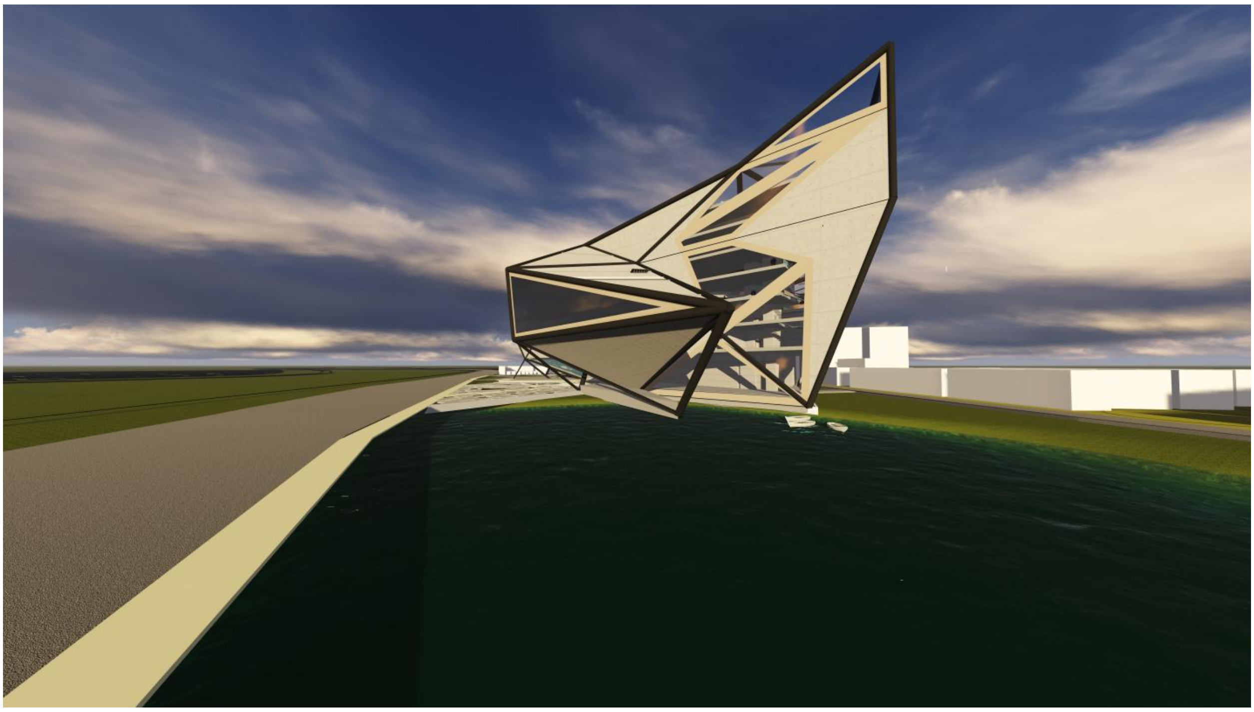


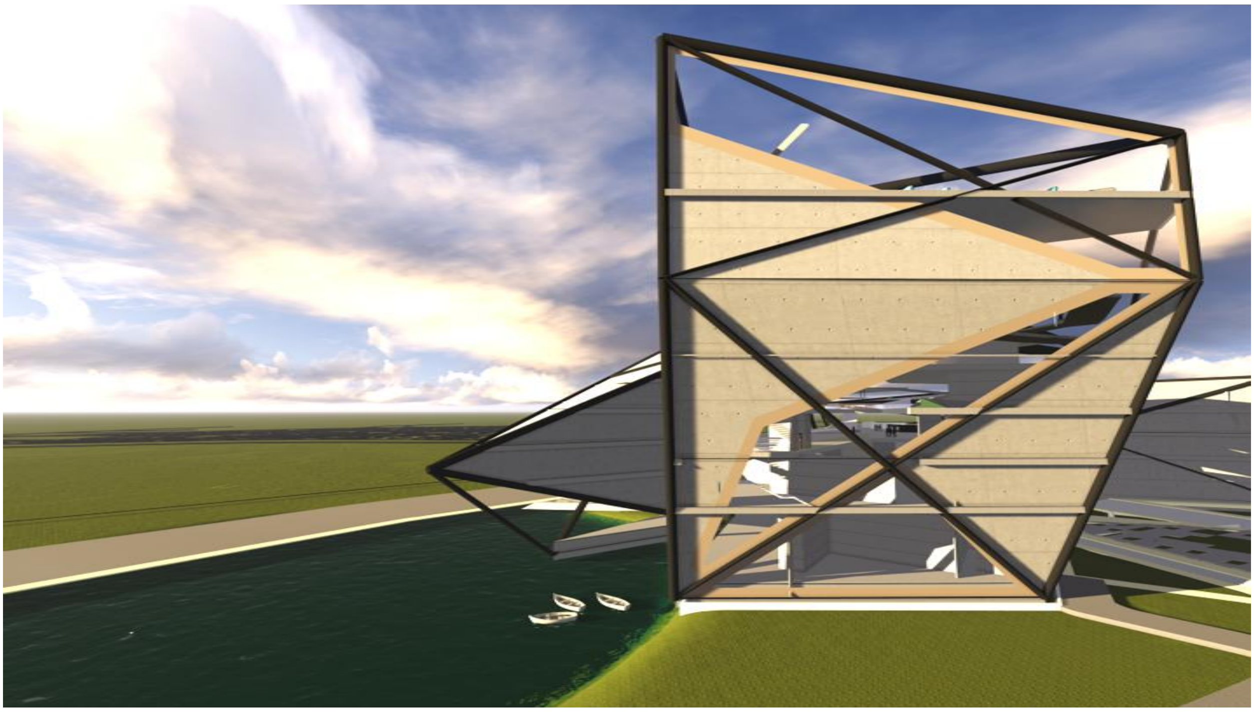
SECTION BB

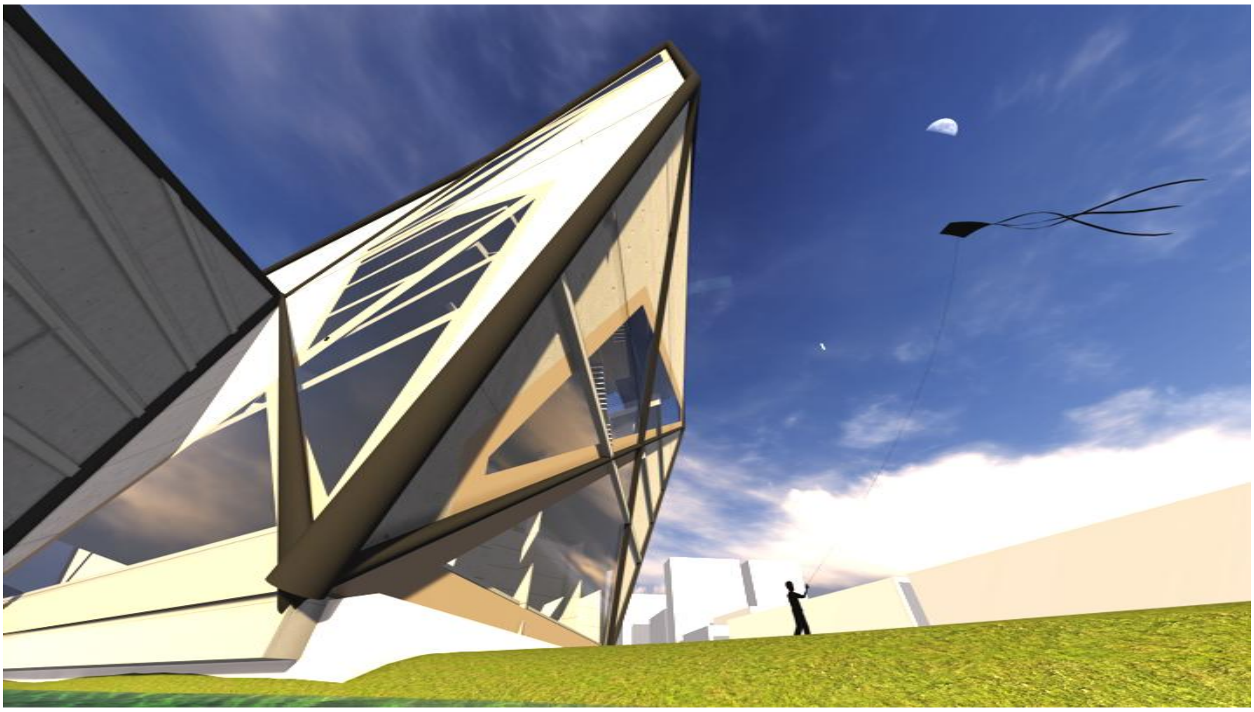


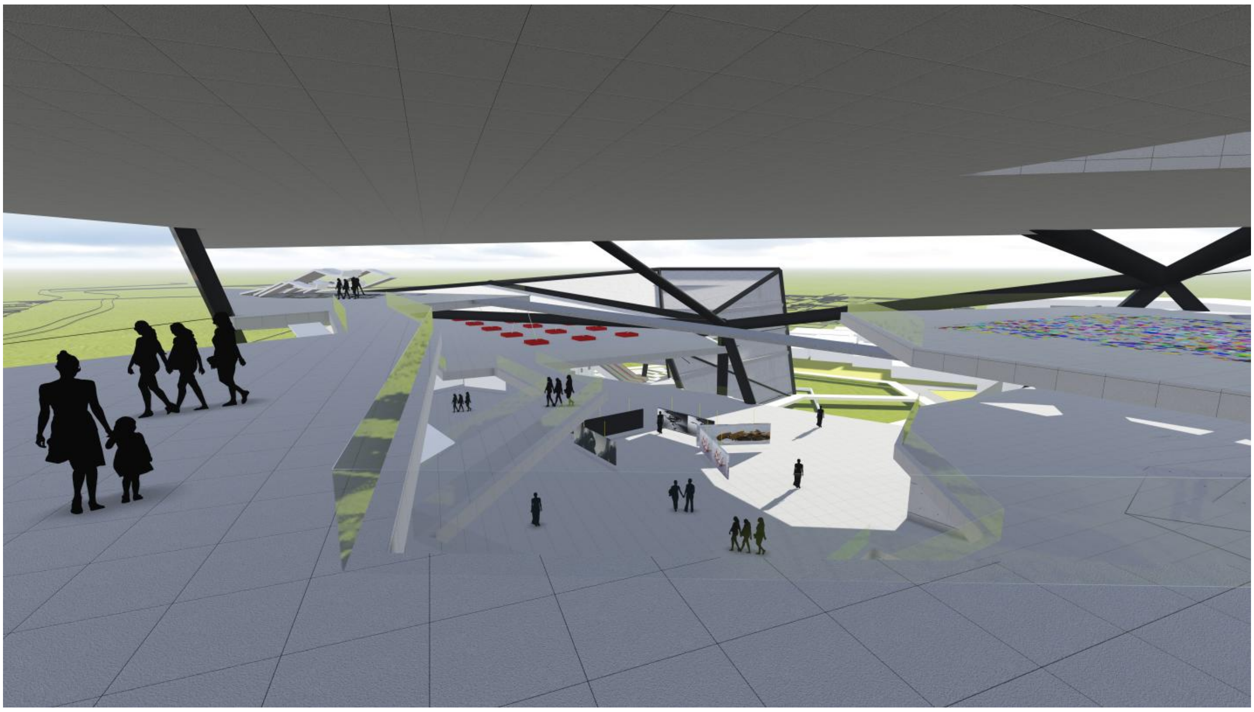


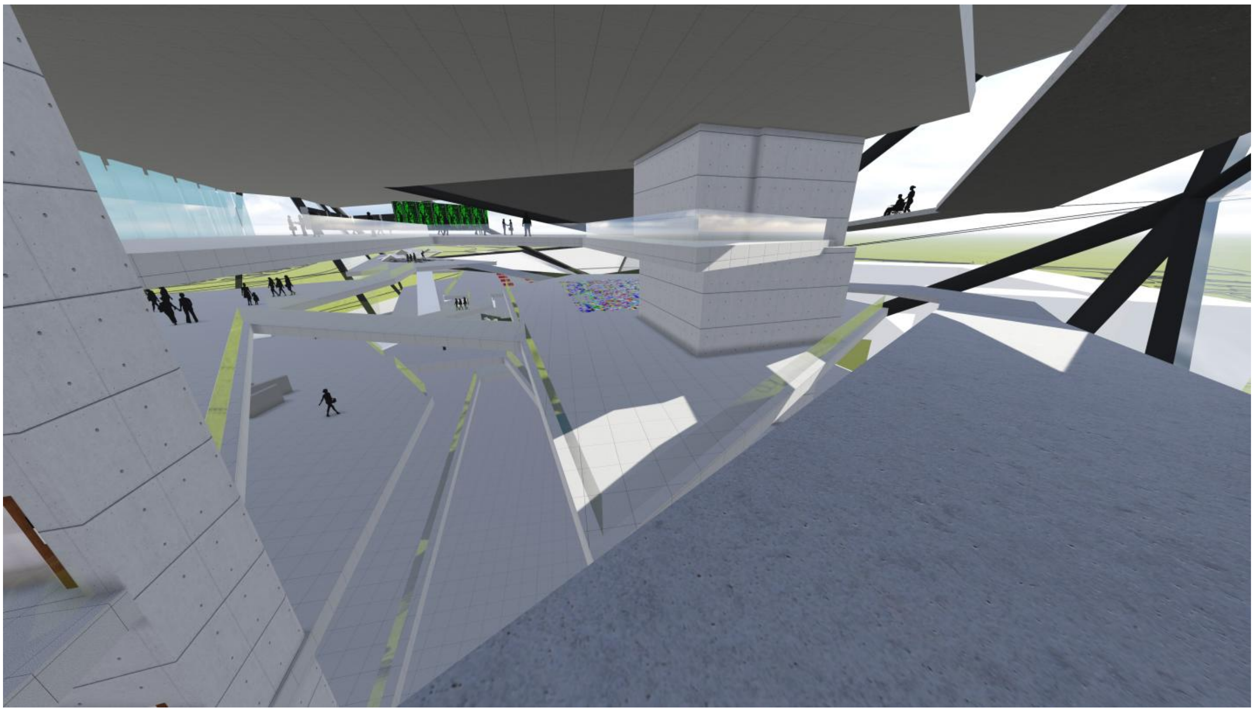


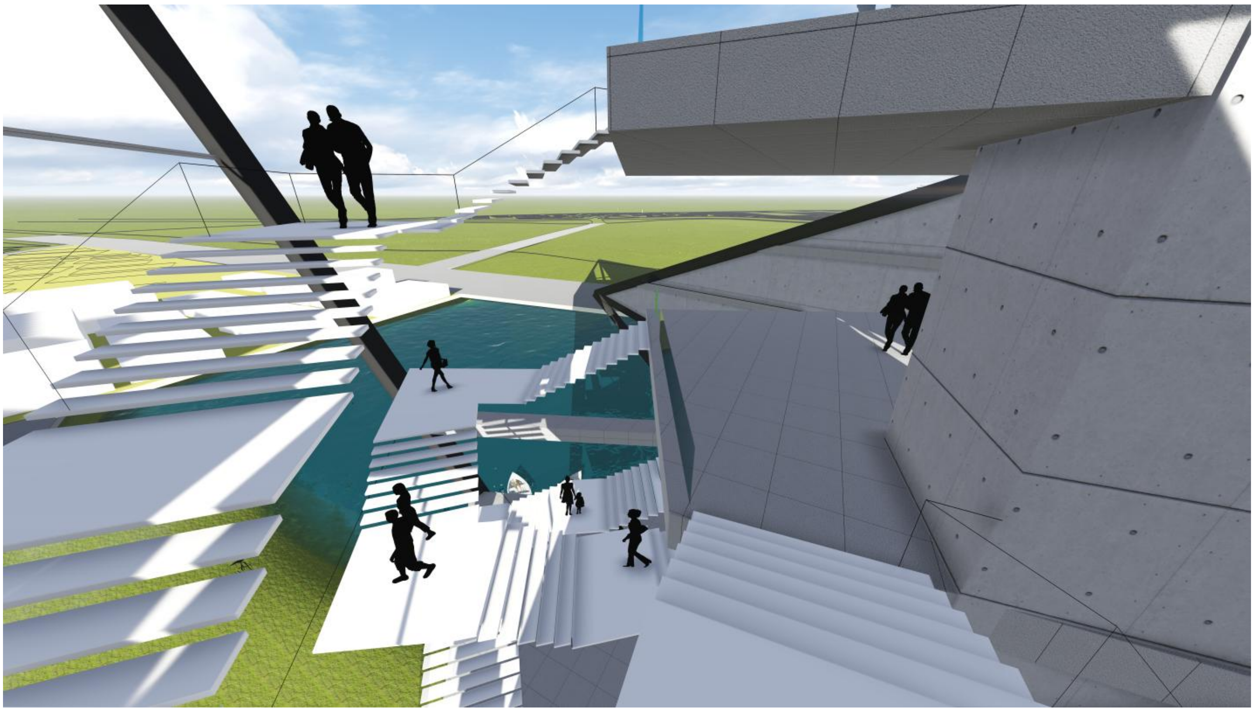


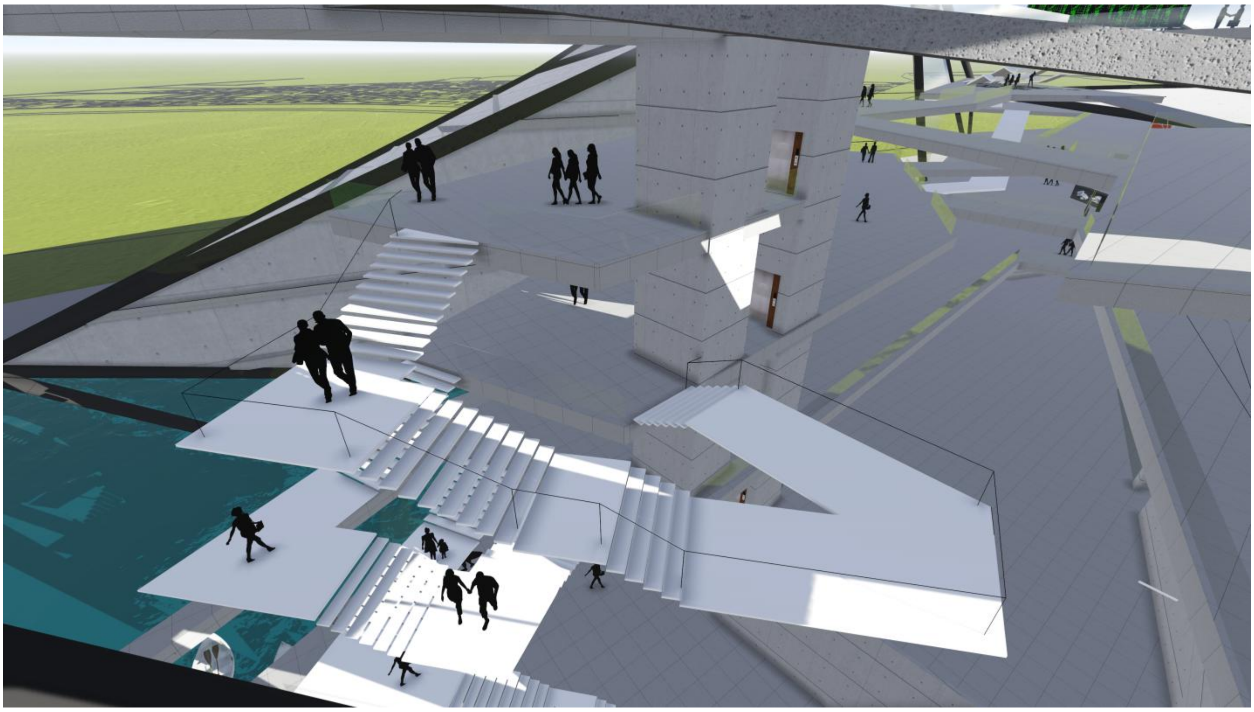




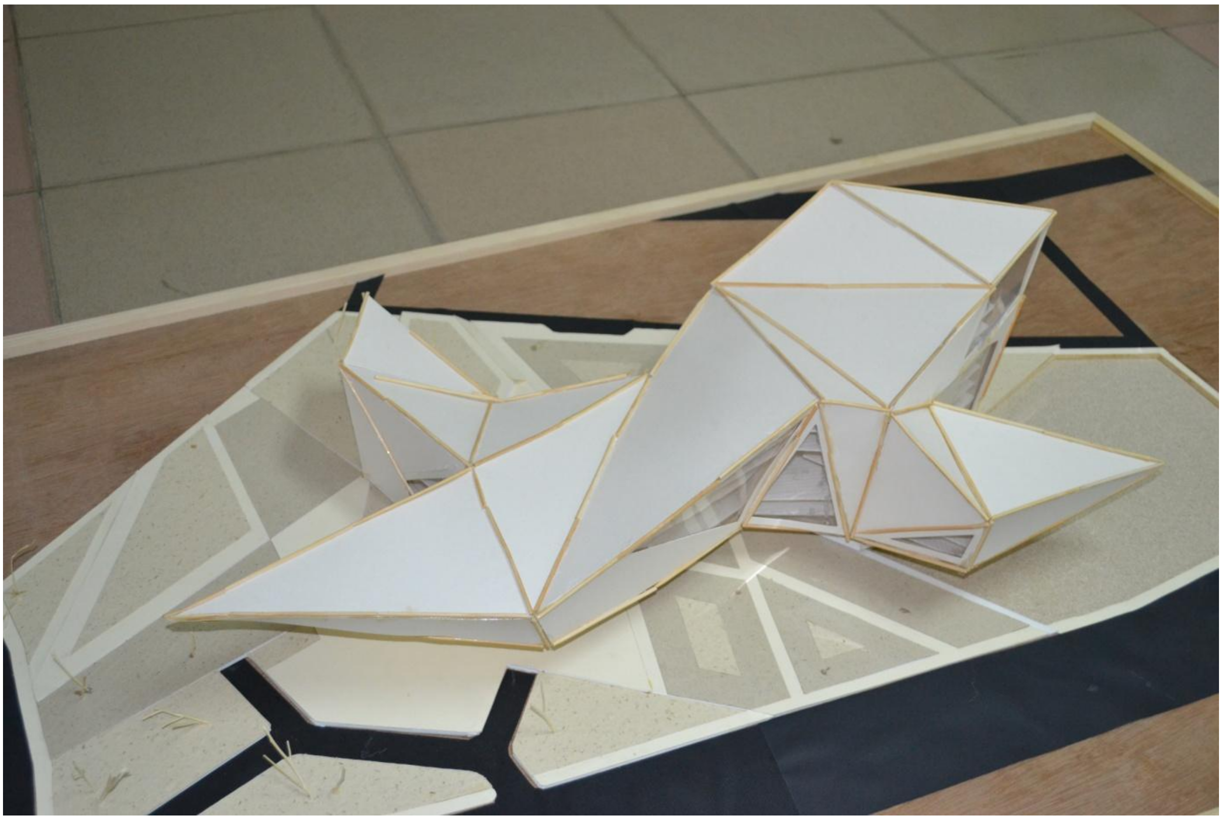


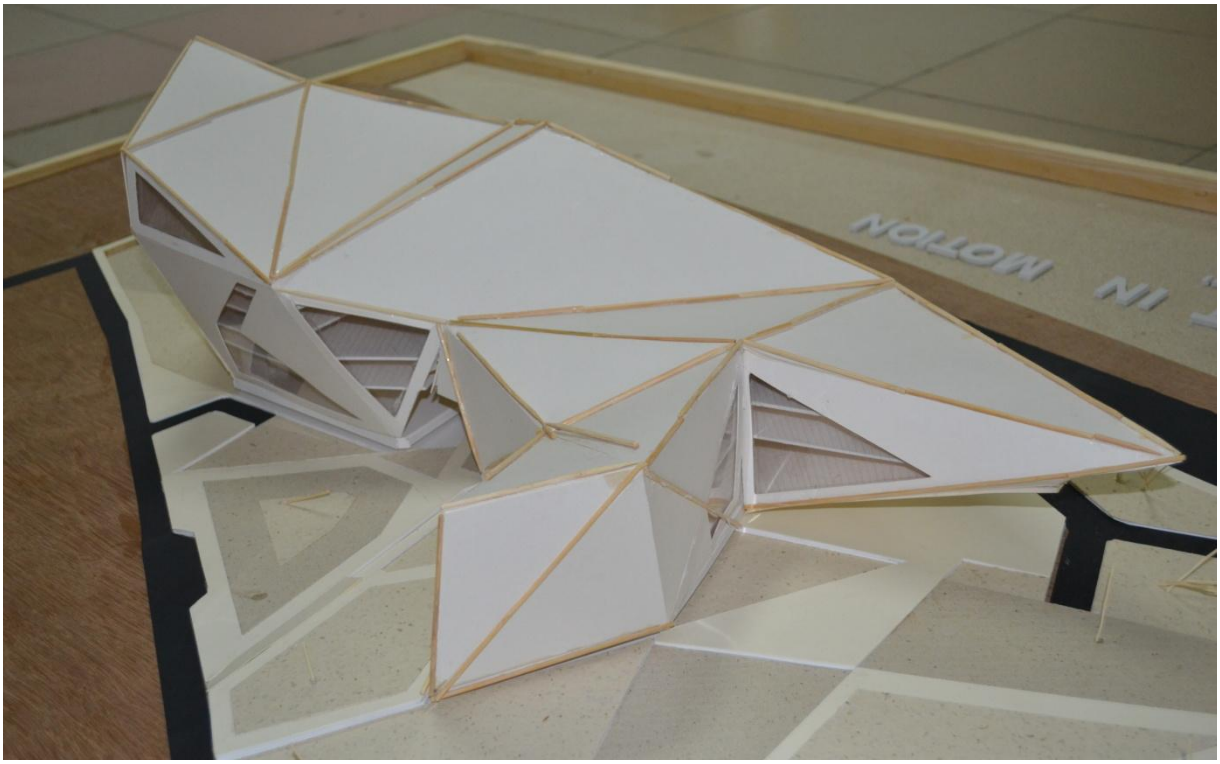


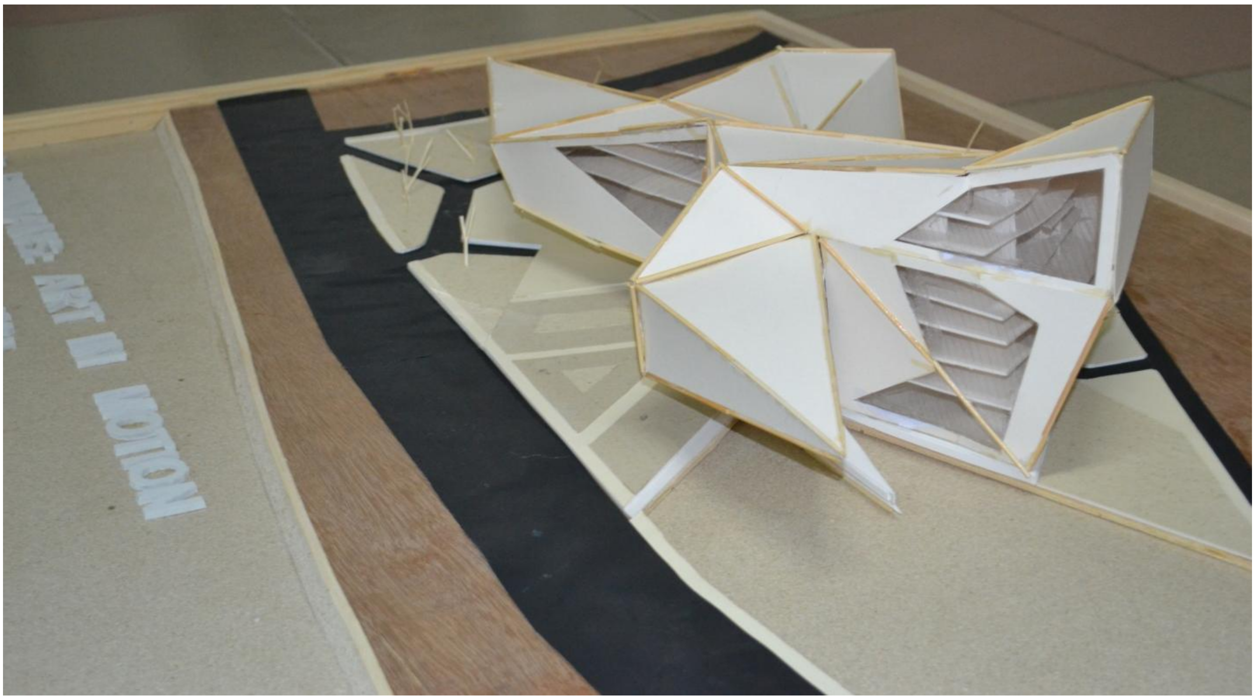


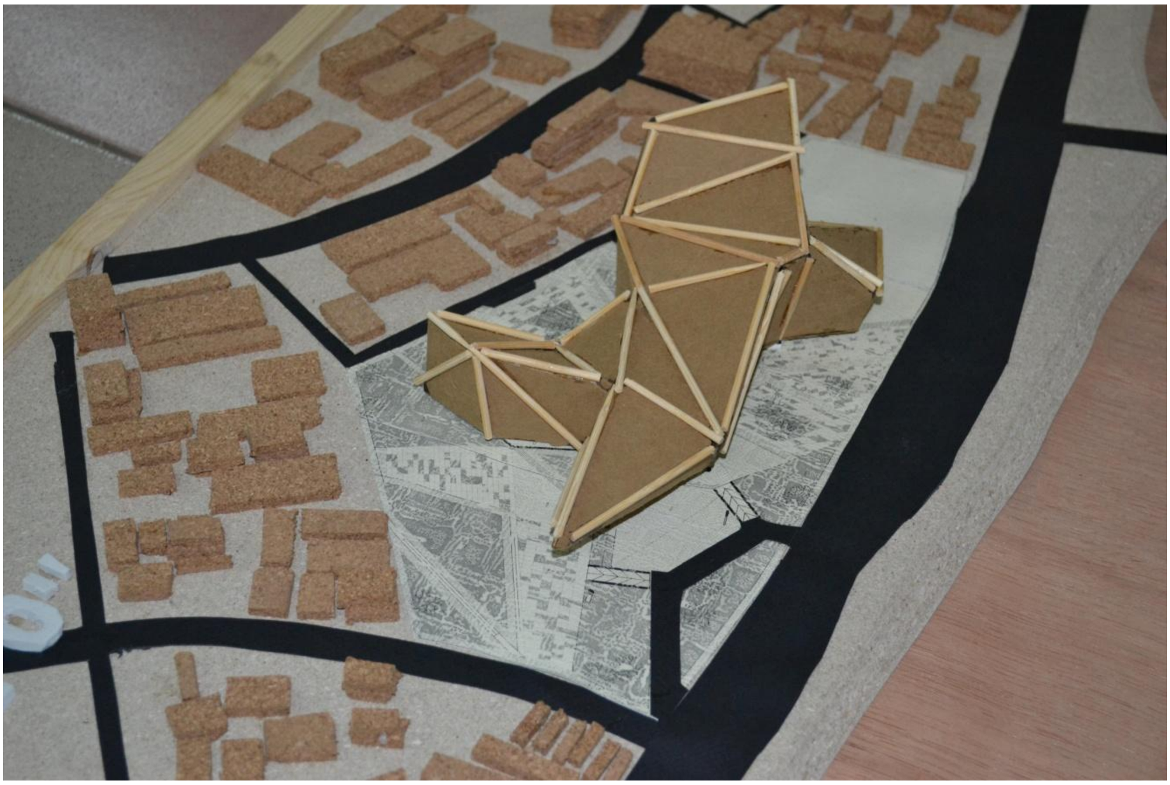


6.5 Final Design Model






ART IN MOTION



CONCLUSIONS

This review certainly proves that studies on human motion were and are interdisciplinary (from the beginning, which was about 2000 years ago). This project aims at contributing to deeper interactions between biomechanics, computer graphics, and computer vision (already existing at advanced levels in some institutes. Basic concepts for biomechanical studies of human motion were already developed by 1687, when Isaac Newton published his three laws of motion. Basic mathematic tools for human motion studies were already provided in mathematics by the end of the 19th century. The start of photography in the 19th century led to the documentation of human motion, starting at the end of the 19th century. The advent of the computer, and of digital technology in general in the latter half of the 20th century finally provided the tools for analyzing human motion based on digitized image sequences, and for animating or studying human motion using extensive calculations and detailed models of human locomotion.

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