Structure and Architecture
Lecture 9

Works of Richard Buckminster Fuller

Richard Buckminster Fuller, also known as Bucky was born in 1895 and lived 88 long years, died in 1983. He was an American architect and systems theorist, an author, a designer, an inventor and what not. He has published more than 30 books in his career. He is famous for coining and popularizing many terms such as; Spaceship Earth, Ephemeralization, Synergistic, etc. He was the reason behind the popularization of the Geodesic dome, the one we see as a desic Domes today was once popularized by Richard Buckminster Fuller and the Carbon Molecules were known as 'fullerenes' were later named by scientists for their structural and mathematical resemblance to geodesic domes. They had renamed carbon molecules as Fullerenes, giving credit to Fuller because he popularized the Geodesic dome and the substance had a striking resemblance in terms of structural and mathematical ways of Buckminster Geodesic domes. Fuller was the second world President of Mensa from the year 1974 to 1983. He attended the Harvard University where in his early career, he was expelled from the city twice. Let's have a look at his early life and career. Fuller was born on July 12, 1895 and Milton, Massachusetts, the son of Richard Buckminster Fuller senior and Caroline Wolcott Andrew. Initially at school, he had trouble with geometry, he was unable to understand the abstraction necessary to imagine that a chalk dot on the blackboard represented a point or that a simple straight line with a pointed arrow at the end, extended to infinity. He was not able to understand basic simple yet complex things like these. Later he went on to familiarize Geodesic domes as he was the pioneer of having Geodesic domes. Fuller taught at black mountain college in north Carolina during the summers of 1948 and 1949. There with a support of a group of professors and students, he began reinventing a project that would make him famous, the Geodesic dome. Although the geodesic dome had been created about 30 years ago by Dr. Walther Bauersfeld. Fuller was awarded the United States Patent for the geodesic domes. He is credited for popularizing this type of structure. If you have been wondering how does a geodesic door look like or how do I even know how differentiate between a geodesic one and a normal one? This is how a geodesic dome looks like. You see these complex triangular shaped patterns that recur and create this entire structure? It's a dome that is created of triangular, straight lines, hexagons, this is how a geodesic dome looks. One of his very early models was first constructed in 1945 at Bennington College in Vermont, that is a place where he frequently lectured. In 1949, he erected his first geodesic dome building that could sustain its own weight with no practical limits. It was 4.3 meters (14 feet) in diameter and was constructed of aluminium aircraft tubing and a vinyl-plastic skin, in the form of an icosahedron. To prove his designs work, Fuller suspended from structure's framework and several students helped him build it. He actually hung/ suspended from the structure's framework, he suspended himself from the structure's

framework which a lot of people helped him build. He suspended himself so that he'd actually prove that structure's firmness. Look at how confident a person has to be in order to suspend himself from the structure's framework. The U.S. government immediately recognized the importance of his work and employed his firm Geodesics Inc. in Raleigh, North Carolina to make small domes for the Marines. Within a few years there were thousands of these domes around the world. Fuller's first 'continuous tension - discontinuous compression' geodesic dome, it is called continuous tension - discontinuous compression domes since this dome is a particular structure where the tension element was always there in the structure. Wherever you look, there's always tension. Compressions are present in limited areas, it occurs only in certain areas. There is no continuous compression here but the tension is continuous in this entire structure, it is called continuous tension and discontinuous compression structures. We also saw another kind of assembled structures, Tensegrity structures. We looked into how tensegrity structures were named tensegrity by Richard, the pioneer who invented this type of structure. It's called continuous tension and discontinuous compression because the tension element is always there and the compression element is very minimal and reduced only to certain points.

Buckminster Fuller repeatedly worked with tension elements in such a way that everything he worked on had a strong connotation with tension. These continuous tension - discontinuous compression structures featured as single force compression members which has no flexure or bending whatsoever, did not touch each other and were 'suspended' by the tensional members.

Geodesic dome, this is how a Geodesic dome looks. Fuller was most famous for his lattice shell structures. Geodesic domes have been used as a part of military radar stations, civic buildings, environmental protest camps and exhibition attractions. Their construction is based on extending some basic principles to build simple 'tensegrity' structures like tetrahedron, octahedron, and the closest packing of spheres. Making them extremely lightweight and enormously stable. The Fuller Dome is referenced in the Hugo Award winning novel called 'Stand on Zanzibar' by John Brunner, in which a geodesic dome is said to cover the entire island of Manhattan. It actually floats in the air due to its light weight trait and covers the entire city of Manhattan. This entire thing is floating because of the hot air flowing inside, it creates a hot air balloon effect and the large air mass which is immediately under the dome. This kind of a feature is there in this novel, this Hugo award winning novel, the novel is titled 'Stand on Zanzibar', written by John Brunner.

We need to understand another important building called Buckminster Fuller, called the Montreal Biosphere. This is how the building looks, this is the building and this is the place outside the building. This a huge latticed framework, Geodesic dome. This is the building and

look at how big this building is. Fuller was lecturing at NC State University in Raleigh in 1949, where he met James Fitzgibbon who later became a close friend and colleague. He began working with the architect Shoji Sadao in 1954, and in 1964, they cofounded the architectural firm 'Fuller & Sadao Inc' whose first project was to design the large geodesic dome for the U.S Pavilion at Expo 67 in Montreal. This building is now the 'Montreal Biosphere'. A list of awards and recognitions which Fuller had received. Fuller was awarded 28 United States Patents and many honorary doctorates. In 1960, he was awarded the Frank P.Brown Medal from the Franklin institute. Fuller was elected as an honorary member of Phi Beta Kappa in 1967, on the occasion of the 50th year reunion of his Harvard class of 1917. In 1968, he was elected into the National Academy of Design as an Associate member, and became a full Academician in 1970.

Dymaxion Car

Fuller did not just work in the principle of Structure, he was an inventor, he worked on a variety of areas including transportation. He was the designer of the Dymaxion car. The Dymaxion car was a vehicle designed by Fuller, featured prominently at Chicago's 1933- 1934 Century of Progress World's Fair. During the great depression, Fuller formed the Dymaxion Corporation and built three prototypes with noted naval architect Starling Burgess and a team of 27 workmen. With this team of naval architects and a few workmen, he designed three prototypes of Dymaxion card. The Dymaxion car was truly not an automobile per se, but rather the ground taxiing mode of a vehicle that might one day be designed to fly, land and drive an 'Omni-Medium Transport' for air, land and water. Fuller focused on the landing and taxing qualities, and noted severe limitations in its handling. The team made constant improvements and refinements to the platform. There was an account where once Buckminster Fuller was actually accused of creating the Dymaxion car with imperfections because there was an accident on the streets where there was another car that was driven by a local politician. After a lot of cases and investigation, it was proved that the Dymaxion car was not at fault, still there was an accusation. Later on, when Buckminster Fuller was driving the Dymaxion car along with his daughter, he also crashed once with this car. That doesn't mean that the car is not of the right design or something but the idea of a Dymaxion car which a normal medium transport can fly or sail through waters and still go on land at the same time is a brilliant idea. We need to look at the word Dymaxion itself because Buckminster Fuller constantly associated the word Dymaxion with most of his work. This word is a portmanteau of the words dynamic, maximum and tension to sum up the goal of this study, "maximum gain of advantage from minimal energy input". He took the dy from dynamic, max from maximum and ion from tension, thereby coining the word 'dymaxium'. This word has been associated with a lot of projects, a lot of ideas that Buckminster Fuller brought into this world. Maximum gain of advantage from minimal input of energy was the entire concept of his life's work.

Not only did he work on transportation, he also worked on housing. He calls it 'Dymaxion house'. Fuller's energy-efficient and inexpensive Dymaxion house garnered much interest, but only two prototypes were ever produced. This prototype is a round structure, not a dome, shaped like a flattened 'bell' of certain jellyfish. It has several innovative features including revolving dresser drawers, and a fine-mist shower that reduces water consumption. According to Fuller's biographer Steve Crooks, the house was designed to be delivered into two cylindrical packages, with interior color panels available at local dealers. A central circular structure was designed to rotate around a central mast to use natural winds for cooling and air circulation. This is how the building looks like, the dymaxion house with the central dome and windows all around. This is how the building looks. Such a pity that only two prototypes were structured. Another picture of the other dymaxion house that was constructed. Look at the way he uses a cover which allows air to escape from the top, way he used visuals, the way he integrates the inside of the building with the outside. Let's look at another interesting thing that Buckminster Fuller worked on, called the Dymaxion Map.

Fuller designed an alternative projection map called the Dymaxion map, this was designed to show the Earth's continent with minimum distortion when projected or printed on a flat surface. There was a constant need to print the world map on a piece of paper, with the current projection where we use a rectangular piece of paper to print all the world's continents, there is always a great amount of distortion created amongst the continents. To minimize the distortion Buckminster Fuller imagined that the world is a geodesic dome and he divided the sphere into a large number of triangles, he juxtaposed the triangles of the geodesic dome with the globe and he transferred all the mapping things from the globe to his triangle system. The map looks something like this. The relative position of the continents, the north America with respect to South America with reference to Antarctica here, the distance between North America and Greenland, the distance between North America and Russia over here and all the way till China and India and with Europe, Gulf and Africa here and Asia extending to Australia in the far end here. The actual reference of one continent with reference to another continent or with respect to other environments are all perfectly right because this longitude actually gets connected. All these places belong to the same longitude which means that all these places are along the same piece of paper, which means when you are taking a print of this picture, the distortion level that is produced is very very minimal and here, if you take a print of this and if you fold along these triangular edges, you will still be able to create a complete sphere out of these triangles, forming a geodesic dome in itself.

Recently, there was a competition which was announced worldwide to create newer versions of dymaxion maps itself. People came up with a lot of options and this dymaxion map made of wood won the competition. It is the same map which Mr. Buckminster Fuller designed, it uses

the same idea, the same idea of splitting into triangles but its just that it is made of wood rather than paper. In 1960s, Fuller developed a game called the World Game. It is a collaborative simulation game played on a 70-by-35-foot Dymaxion map, in which players attempt to solve world problems. Apparently there is a very big map which is 70 feet by 35 feet in height and on this map, there are people who play the game, they attempt to save the world by solving problems of the world. Each place has some problems and these people have to solve the problems. The ultimate goal of Mr.Buckminster Fuller was to create a world of no problems. He always belonged to the entire world, he always calls the universe as his home, he always has large goals like creating world peace with the power of the mind. This is one game that he developed wherein he attempted to solve the world's problems by developing a game.

Another interesting concept which we need to understand while we are studying Mr. Buckminster Fuller is the Fly eye dome. This is how the dome looks like. It is called a Fly eye because of enormously large bulging eyes that look very similar to that of a house fly's eyes. Fuller designed the dome as his idea of the affordable, portable home of the future. If you say affordable, it is made out of one simple piece because this is the only piece which you need to buy and this piece when it can be multiplied is the same piece as this. When this piece can be multiplied into any number of components, the whole dome is produced. It is made up of one single component which is this unit, that creates the entire thing. Similarly, this is the unit, this single unit produces the entire dome. Here, in this picture you can see the Dymaxion car. This is how the Dymaxion car looks like and you see the Fly eye dome in the background. Look at the comparisons of the two. look at how big his dreams are. He calls it the affordable, portable home of the future with windows and openings in the dome to hold solar panels and systems for water collection, thus allowing the dome to be self sufficient. He imagines that these holes will hold solar panels and systems for water collection, water transportation, water movement, materials to make the whole dome, self sufficient structure itself. There are only three prototypes which were built into the Fly eye dome, one was 24 ft in diameter, one was 12 ft diameter, third one is much bigger than that. The bigger dome is owned by an art gallery and the mid sized dome, 24 ft dome is owned by a Miami based real estate developer and the smallest of the Fly Eye dome is owned by none other than Norman Foster and Partners.

Buckminster Fuller was quirky in nature, following his global prominence from 1960 onwards, Fuller became a frequent flyer, often crossing different time zones to lecture in International cities. In the 60s and 70s, he wore three watches simultaneously. One for the time zone of his office in Carbondale. one for the time zone of the location he would visit next, one for the time zone he is currently in.