# Project design constraints

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Heart valves are normally very vulnerable and prone to malfunction and disease, as a result of these, mechanical heart valves (prosthetic heart valves) are made to replace heart valves that no longer function. There are two main varieties of prosthetic heart valves, they are the bio prosthetic, and the mechanical heart valves. Mechanical valves are excellent when it comes to durability, however, they tend to coagulate blood flowing in them. On the other hand, the bio prosthetic valves are not as durable as the mechanical valves. They, therefore, have to be replaced on a regular basis.

When making or designing these hearts, a lot has to be put into consideration: for instance, that the body is a hostile environment, especially to foreign bodies. Prosthetic heart valves are no exception either, they have to be made using the right material or else they will be faulty as soon as they are “ installed” into the human body. The best solution to the design problems associated with the prosthetic heart valves is to come up with a design that uses mechanical properties.

When designing prosthetic heart valves, care has to be taken to ensure that the different biomaterials used to design them, fit the peculiar blood flow requirements of the human body. Blood clots have to be reduced, and the blood flow produced should be more central. The different biomaterials mostly used in designing of these valves are carbon, titanium, alumina, polyurethane, and polyester. The materials must be able to respond to the forces of tension, twisting, and bending forces.

Given the design requirements of flow chambers of the heart, the material chosen for the design of the heart flow chambers has to meet a load of requirements. For instance, alumina as a biomaterial, has to sustain high

fluid resistance. Additionally, it has to be economical, and avoid stiffening. The material also has to have good thermal conductivity.

The fact that the human body happens to be one of the greatest corrosive surroundings for foreign materials means that the material used to make the flow chambers have to be able to sustain the corrosion from the active enzymes, at the human body temperature. Additionally, caution has to be reserved to guarantee that the material used is not poisonous to the human body. A composite design is proposed; in which the porous synthetic grafts are improved in terms of biocompatibility. Polyester textile can be coated using cross-linked protein. Studies of different kinds of proteins such as collagen, gelatin, elastin, and albumin have been conducted.

There is no ideal material yet, to use in making of prosthetic heart valves. This is because the different available materials like titanium, or stainless steel, polyester, alumina, or pyrolitic carbon have faults in one way or another. When each one of them is used by itself, the patient has to go through long anticoagulant therapy.

An example of a design that can be used is the asymmetric design of the natural human heart coined by Gianni Pedrizetti and Vukicevic of Trieste University. The model is made of aluminum, and has a similar size to the natural human heart. A mock ventricle used is made of silicon.