Aspect Of Mechanical Engineering in the development of Artificial Implant: Provision of Biomechanics and Material Engineering

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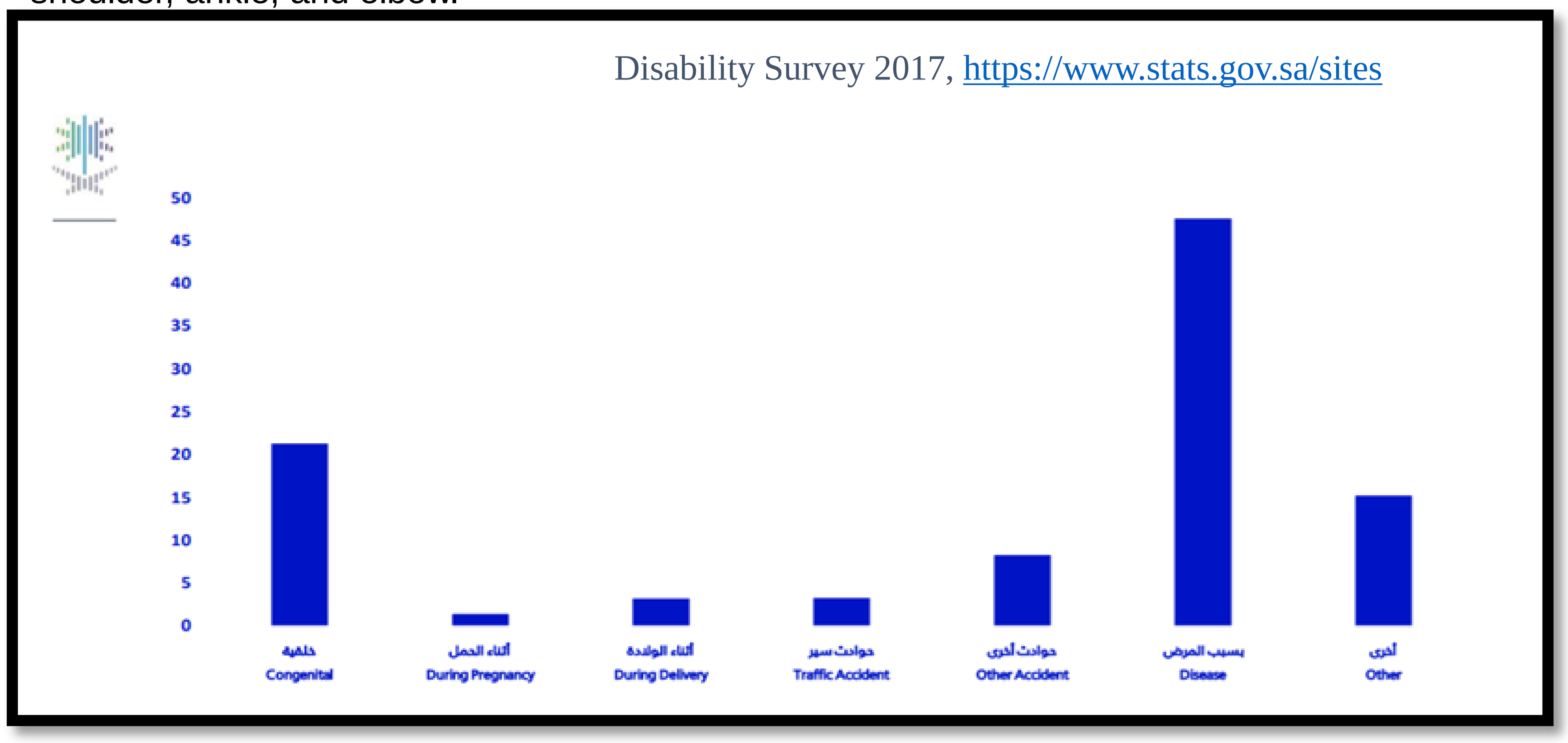
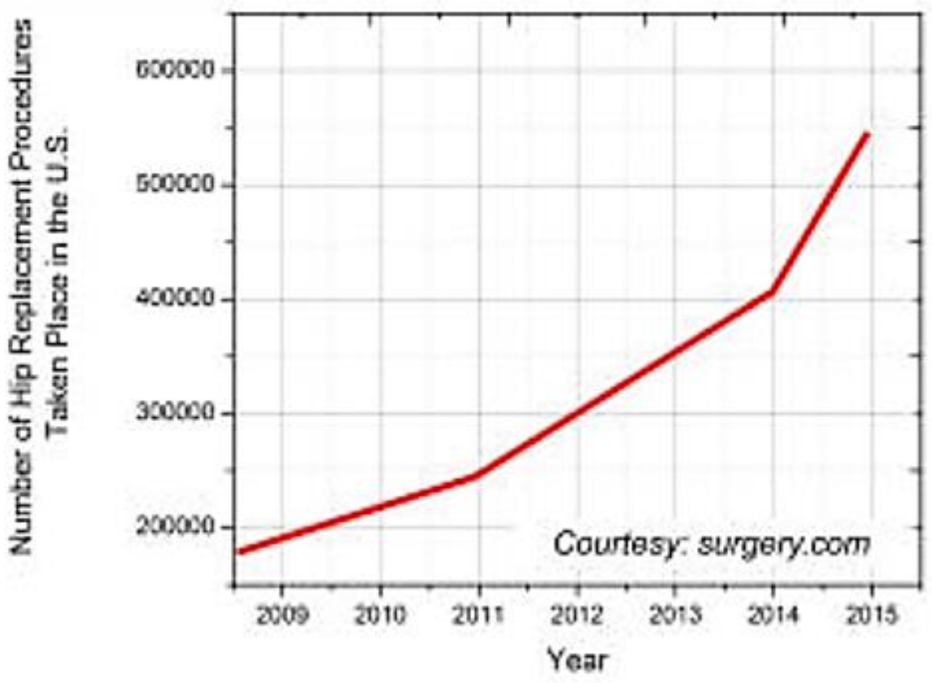
Research Background and Objectives:

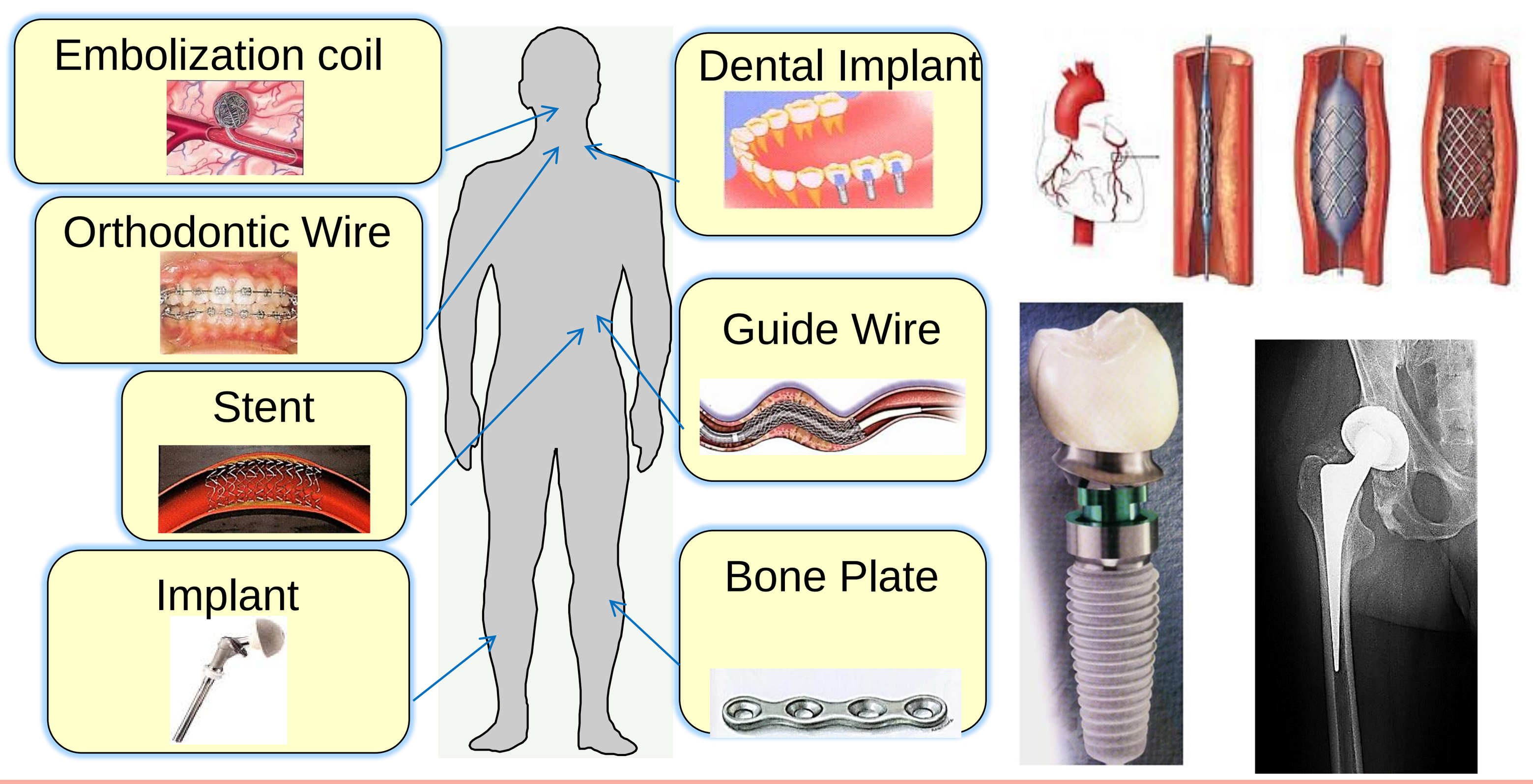
Disability is a complex multidimensional challenge and it can substantially limit major life activities of person. For instance, it is estimated that in KSA, 3.73% of the population has functional disabilities, which limit their independence. One of the most prominent application areas for biomaterials is for orthopedic implant devices. Both osteoarthritis and rheumatoid arthritis affect the structure of freely movable (synovial) joints, such as the hip, knee, shoulder, ankle, and elbow.





The loss of body part is possible from the beginning of the ages for humans, and this happens for several reasons including diseases, accidents and wars, and the cost of artificial implant is very high at the moment for some members of the community. Patients around the world are now requiring implants that can last longer and provide less discomfort while decreasing cost.

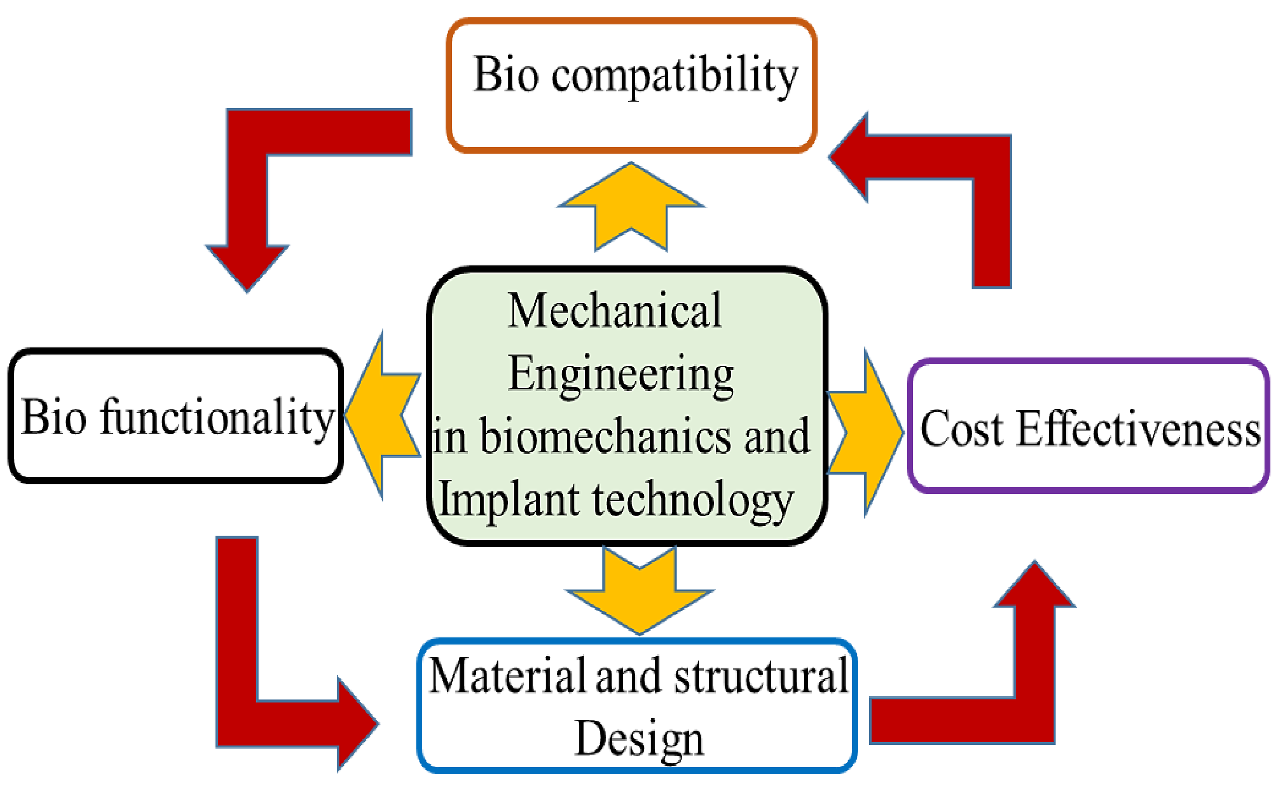
Outlook of Biomaterials in Implant Technology:



Basic Science of successful Implantation

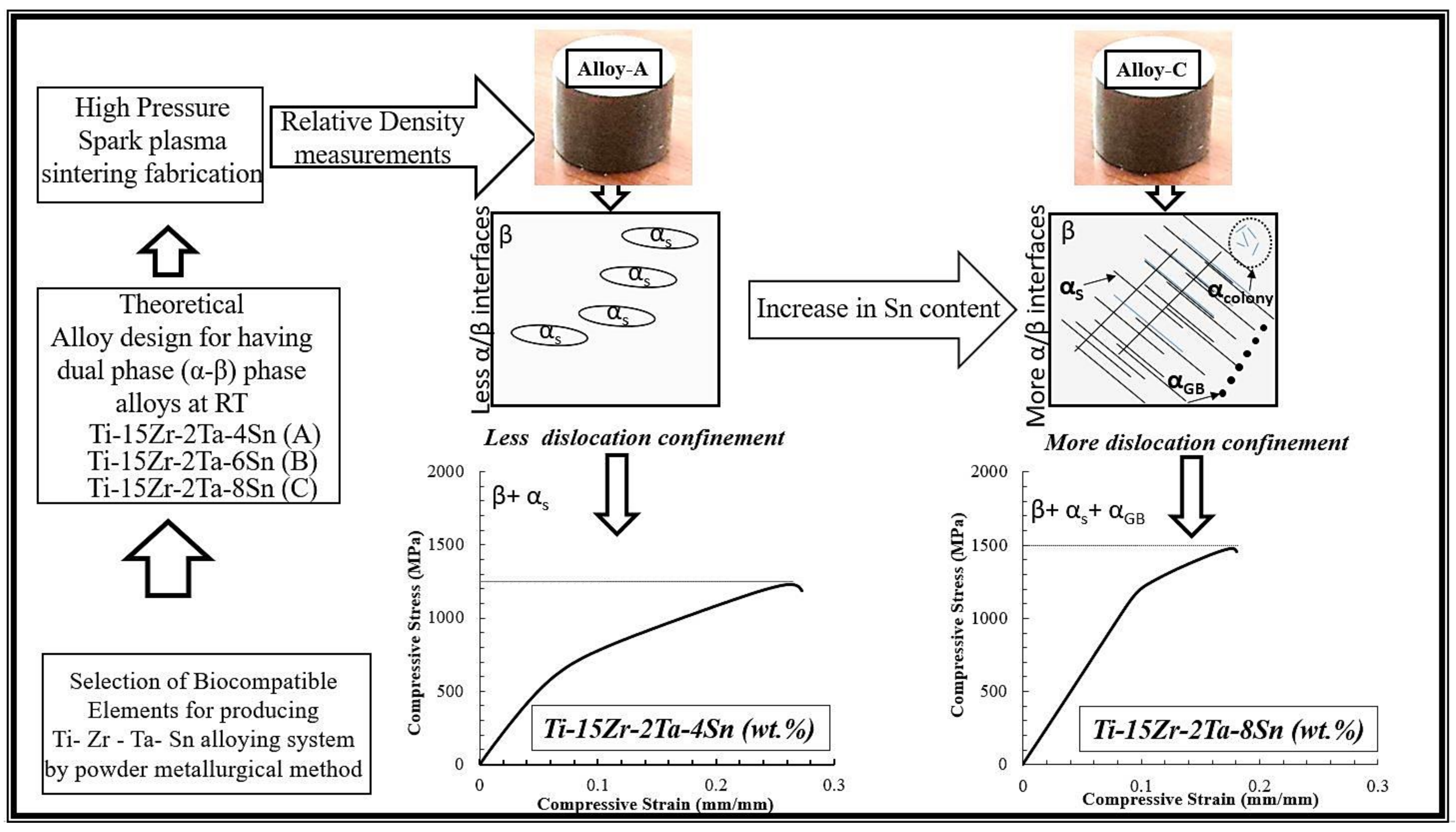
Very often, pure Ti and (α + β) Ti-6Al-4V alloys have been used commercially for implant applications, but ensuring their chemical, mechanical, and biological biocompatibility is always a serious concern for sustaining the long-term efficacy of implants. Therefore, there has always been a great quest to explore new biomedical alloying systems that can offer substantial beneficial effects in tailoring a balance between the mechanical properties and biocompatibility of implantable medical devices. Secondly from viewpoint of Implant design it must be adequate so that it should not affect the magnitude or type of forces applied to the bone–implant interface

Research Methodology:



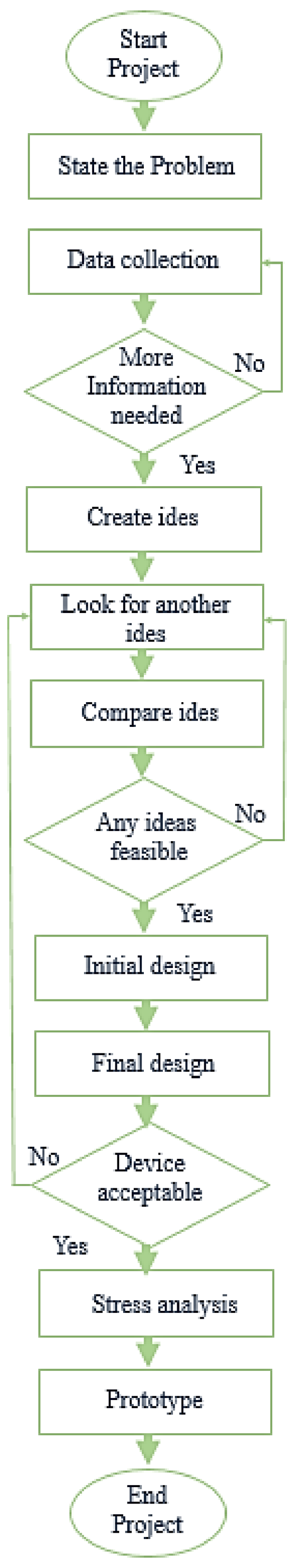
Our research and development activities in department of mechanical engineering adapts a synergistic approach that integrates the basic science and engineering approach for developing new material, designing and fabrication of cost effective bio implants and medical devices.

Development of Biomedical Alloys:



Design strategy and Fabrication of a Lower Artificial Limb

By following the principle of engineering design methodology i.e., weight and rate comparative analysis we selected single axis with spring design and material selection by design have been decided by using Ashby plots and material index, then we did theoretical analysis and calculations for knee joint and rod to make sure it is safe, and we prove that using bath ANSYS analysis and SOLIDWORK simulation, and manufacture our final design using CNC machines which is cost us less than 1200 SR which is less than our constraint cost.



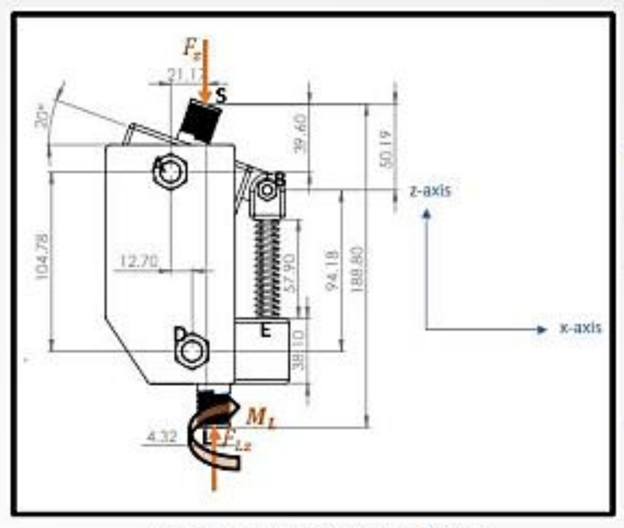


Figure 1: FBD Knee joint

Type of load	Forces					Moments	
UNIT	Newton					Newton-meter	
Name	F_z	F_{LZ}	F_{plateX}	F_{platez}	$F_{Springz}$	M_L	M_{plate}
Value for one side	1785.5	1785.5	0	1444	341.4	7.713	18.34
Total Value	3571	3571	0	1444	682.8	15.426	18.34

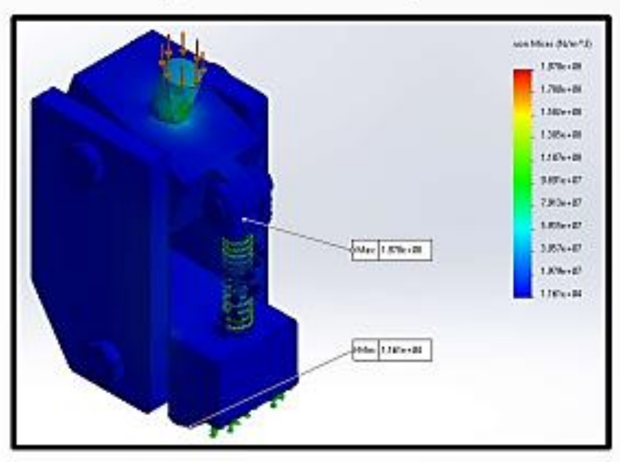


Figure 2: SW Knee Von Mises stress results

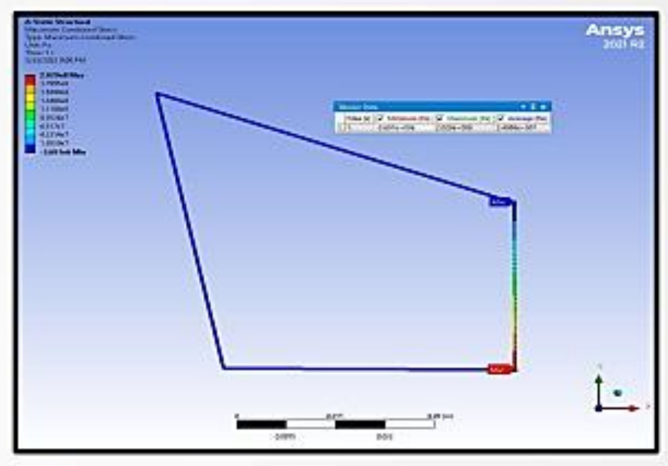


Figure 3: Ansys simplified Knee Maximum combined stress results

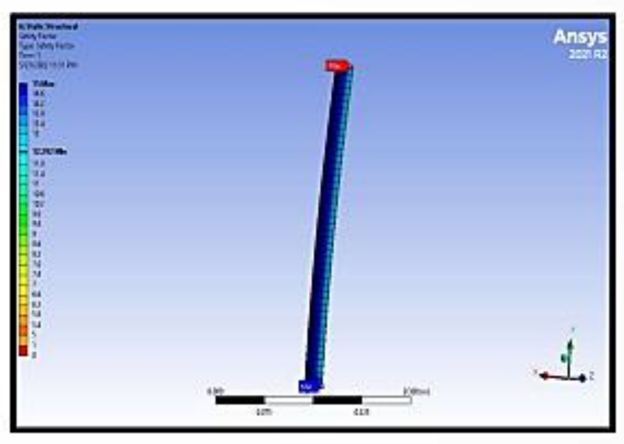
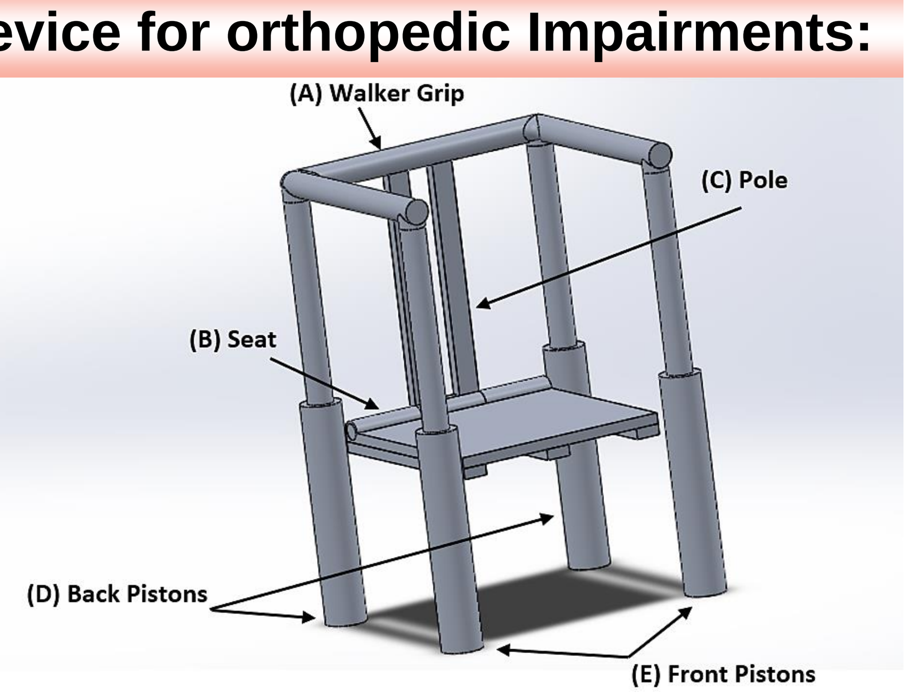


Figure 4: Ansys Rod Minimum Factor of safety results

Figure 5: Full leg prototype

Design of After Fall Assistive Device for orthopedic Impairments:

This study focused on designing a device to support individuals after fall withstanding their weight. A 3D CAD design was modelled according to the standard dimensions of a conventional walker aid. FEA was done which showed that the design can lift an overweight individual with a weight of 142 kg and still being able to withstand heavier weight. The results of FEA could be the reference in any future improvement of the design.



Fully assembled device parts. (A) is the walker hand grip. (B) is the seat which is supported by pole (C). (D & E) are back and front pistons which perform the lifting mechanisms

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