From: Team B2 (Eisa Almutairi, Zaid Almutairi, Yousef Alazmi, Dhari Alshammari)

To : Dr.Oman

Date: 10/14/2017

Subject: Technical analysis outline

Zaid (strength of material)

Strength of the materials will be focus of this technical analysis. This will include the stress, strain and the tensile strength of the materials. There will be several materialsthat will be used for this analysis. They include the steel, iron, aluminum and copper metal. The strength of each of them will be evaluated to find the material that has strength of more than 210 MPa, strain strength of more than 180 Mpa, and stress of more than 200 Mpa. The material that will have the above combinations will be the one that will be chosen. The above deduction will also be accompanied by measures of the thickness, as we do not want to use very thick sheets of metal that will make the design to be cumbersome to the person that is using it.

Yousef (Range of motion)

Motion for any human body is the way of walk, moving from one place to another place and if we talk in terms of hands, range of motion is to carry any item from one place at a maximum distance of hand and place it to the other location by moving the hand. There are many disabilities present in human body which relate to limb. Human body has two limbs one is upper limb which is known as arm from fingers till shoulder. And second is lower limb which is legs from feet till hips. Different type physical disabilities have found in limbs such

If the person has half arm he has limited range of motion. He can carry some object with the help of both arms but the range of carrying the object will be less.

$$Normal\ Arm\ length = 1\ meter$$

$$Half\ Arm\ length = \frac{1}{2} meter$$

$$Half\ arm\ length = 0.5\ meter$$

So the half arm cut person can only carry any object placed around 0.5 meters away from him. That's his final range of motion.

- Person with half leg cut cannot move directly and that's why there range of motion is almost zero. They can move only with the help of sticks.
- Full arm cut person cannot move anything with the help of hands as they don't have any hands that's why there is zero range of motion for those persons.
- Person with full leg cut cannot move as well without any help of wheel chair or sticks or artificial leg so there is no zero range of motion for such person.
- A person whose elbow is not working correctly that person cannot move the hands in the specific direction and his range of motion also reduce to half because he can move his half hand.
- Person whose legs cannot carry the weight cannot stand on its own but he can move just the legs all around so the range of such motion is only around the body by where his leg can touch. For example if a leg is of 2 meter then his range of motion is also 2 meters.
- Person whose legs are not moving cannot move their body so such people don't have any range of motion.
- Those arms which cannot up stand those arms cannot move in all around and don't have any motion so there is zero range of motion for such limbs

With all such disabilities the design for this project can make such an artificial limb with the working module which can make possible to remove the restriction for the range of motion for example a person with no leg or half cut leg can move properly like a normal human. Design of the project much consider the range of motion for limb to be unrestricted.

Eisa (Speed Related to Forece)

.Normal human can move around fast like when running around and but people who are physically disable have some restrictions in their motion like they can walk only, they can just move their hands only to limited height etc. So such disabilities which cause restriction in speed of motion are as

- A person whose elbow doesn't work cannot move the hand quickly around so his motion speed restricts.
- A person with faulty knee can cannot walk fast, he can move the knee slowly so the speed of motion resctricts because of knee.
- If a disable person has disjoint leg he cannot move using the leg and he need sticks for walking around. So there is no motion for such person.
- Disjoint arm of person cannot move so the motion of such body restricts to zero with the hand.

In this project the design must consider the speed of motion to be unrestricted and after wearing the product, person will have to move with the same speed as a normal person. Whereas if the hand elbow cover uses then it must give the same speed of motion for the hand as a normal has.

Dhari (Life expectancy)

Life expectancy of material varies for different materials. Material fatigue can calculate using the following formula

Stress Amplitude

$$\sigma_m = \frac{1}{2}(\sigma_{max} - \sigma_{min})$$

Mean Stress

$$\sigma_m = \frac{1}{2}(\sigma_{max} + \sigma_{min})$$

Where

$$\sigma_{max} = \sigma_m + \sigma_a$$

$$\sigma_{min} = \sigma_m - \sigma_a$$

Number of cycles before the fatigue point appears.

$$N = -\frac{t}{\tau} = \frac{\omega t}{2\pi}$$

- Steel has the fatigue limit of 0.5 when the value of 290 MPa. And number of cycles for the steel is 10^6 before it breaks

  - Aluminum has the fatigue limit of 0.4 when the value of stress is around 290 MPA and Number of cycles for the Aluminum is $5 * 10^6$

    - It has the fatigue limit of 0.5 for the same pressure 290 MPA

    And number of cycles are 5 x 10^6

❖ Fatigue limit is 0.38 for the stress of 290 MPA

Number of cycles are 10^6

✓ Fatigue limit is 0.34 for the stress of 290 MPA

Number of cycles are 10^8