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Design and Fabrication of Revolving Doors for Production of Electricity and Compressed Air.

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***Abstract*— The purpose of this paper is to meet energy demand; renewable energy and some unconventional source of energy can provide the necessary amount of clean energy for climate stabilization and reduce the consumption of fossil fuel. In this paper, prospect and feasibility of power generation by using revolving door has been investigated. The objectives of this paper are to design and fabricated of a prototype revolving door which can generate energy by amplifying the initial RPM of door shaft. Gear, pinion and motor mechanism are used as an energy generation part of the proposed revolving door**

A human pushing on a door in order to open or close it increases its rotational kinetic energy. This energy is a result of the inertia of the door and its angular velocity. The kinetic energy of the rotating door is calculated 130.20 Joules and the mass of the door used in the test were approximately 32 kg and the lateral dimensions Height and weight were 120 cm and 55 cm respectively. During the door opening testing, the average door speed of 4 rpm resulted in the door's kinetic energy. While sizing of the generator found that about 2kg-cm of torque was required to turn the generator, nominal electrical load connected. Generator, single generator arrangement generates 3.6W and four generator arrangement is made radial to the gear, power generated 14.4W for one revolution. Total power generation for one day is 54.75W.

***Keywords*— CATIA V5, Revolving Door, Green Energy**

I. INTRODUCTION

Energy is vital for the progress of a nation and it has to be conserved in a most proficient manner. Not only the technologies should be developed to produce energy in a most environment-friendly manner but we have to obtain from all varieties of fuels and also utmost importance should be given to conserve the energy resources in the most efficient way. Energy is the ultimate factor responsible for both industrial and agricultural development. The renewable energy technology to meet the energy demands have been steadily increasing for the past few years, however, the important drawbacks associated with renewable. Energy systems are their inability to guarantee reliability and their lean nature. In today's world meeting means for producing energy by conventional methods are declining day by day.

To contribute for this ever increasing demand in production of energy, this paper deals with power generation by means of revolving doors, the model on CATIA V5 gave an accurate design of what might the revolving door look like, and what load it can withstand, based on the chosen material. Diameters, axial force, torque transmitted and the gear ratio. Accordingly, a material can be chosen on CATIA V5 to portray what the deformation may look like.

II. METHODOLOGY

A. THEORETICAL APPROACH

Steps and Equations:

Step 1: Total mass of gate (m) = mass of plates + mass of shaft …… (1)

Total mass of plate = no of plate x mass of each plate

= 7 Kg

Step 2: Reaction at the support (R) = μ x m x g…. (2)

Reaction force developed at the support is 20.601 N.

Step 3 Minimum torque T_{min} = R x r ….(3)

a. Minimum torque required to rotate the gate = 0.1545 N-m

b. F_{min}= minimum torque/width of gate from center (4)

c. $p = 2\pi nTact/60$ ……(5)

= 3.141 W

Step 4: Gear Design

a. Lewis form factor for 20° stub, y = 0.17 – (0.95/Z)…(6)

b. $F_{t1} = (9550\ X\ P\ X\ Cs)/N2\ r_2$ ……(7)

c. $F_t = \sigma_o$ b y p $C_v = \sigma_o$ b y p K_v ……(8)

d. $K_v = 3/(3+V_m)$ …….(9)

e. b= 11m …….(10)

μ = co-efficient of friction
m = Module
V_m= Mean pitch line velocity
T_{act} = Actual torque
K_v= Linear velocity factor

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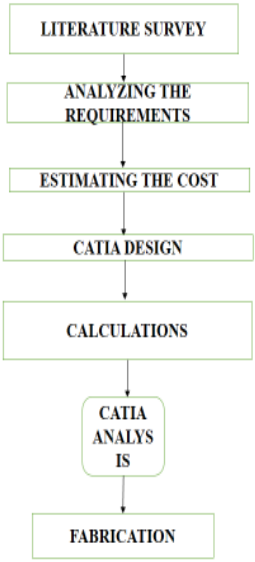
B. FLOWCHART



III. RESULTS

After having analyzed revolving door on CATIA V5 and obtaining a result on both analytical and numerical approaches, these were the summarized results.

A. ANALYTICAL APPROACH

After completing the design of revolving door the in CATIA, the following analysis was carried out in order to view the deformation plot and view the Von-Mises stresses.

1. Material :Steel, considering D=15 mm, F = 70N(point load)

Total stress developed = 6.24×10^5

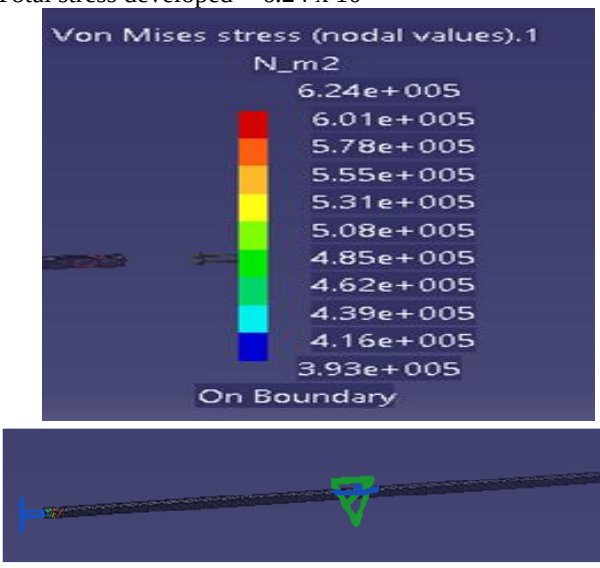
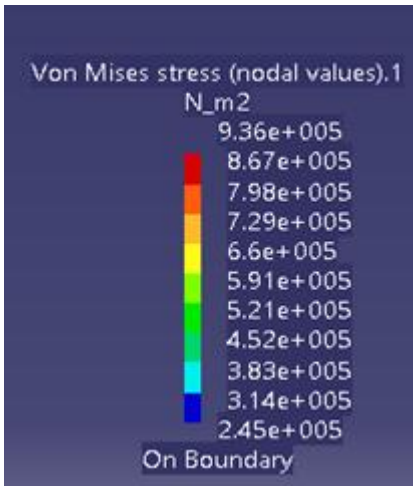


Fig 1. Deformation plot of shaft under point loaded

2. Material: steel When applied torque to shaft (Since the obtained stress of the shaft is less than the maximum allowable stress of mild steel. i.e, 2.154MPa < 240MPa)



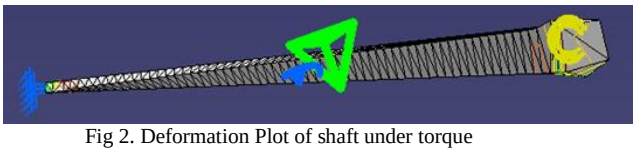


Fig 2. Deformation Plot of shaft under torque

3. Material: steel , considering a plate, on which a person applies force of 20N

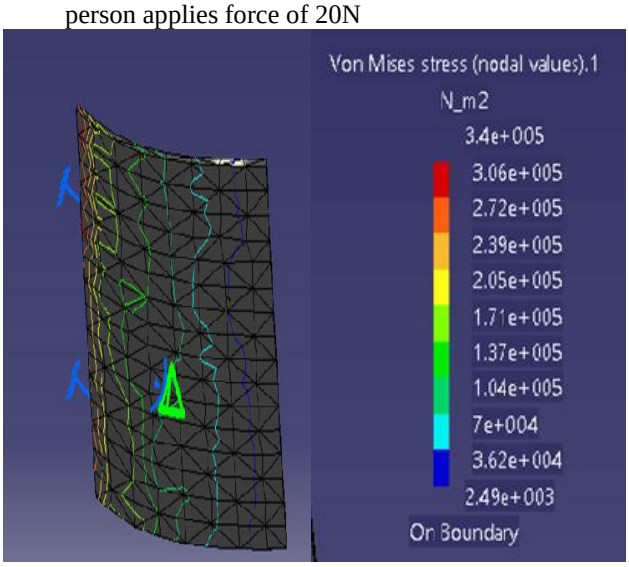


Fig 3. Deformation Plot of plate under force

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Table 1: Gear Specifications

Tooth characteristic	Full depth 20° involute system	GEAR 1	GEAR 2
Pressure angle (α)	20°	20°	20°
Addendum, mm	1m	1.5	1.5
Minimum dedendum, mm	1.25 m	1.8755	1.875
Pitch diameter, mm	Zm	64 X 1.5 = 96	16 X 1.5 = 24
Outside diameter, mm	(Z+2)m	66 X 1.5 = 99	18 X 1.5 = 27
Tooth thickness, mm	∏/2 X m	2.356	2.356
Face width, mm	11m	17	17

IV. CONCLUSION

This Project demonstrates to us how different materials can be analyzed on CATIA V5 in order to view their deformations and their Von Mises stresses. Stepper motor is used to generate electric power. The gate can produce electric power when turned both in clockwise or anticlockwise. The output of the generator obtained ranges from 4volt to 11volt. This output voltage is limited by force applied on the gate and gear ratio.

The output voltage can be increased by

i) Using larger gate which would require large force to rotate it.

ii) Using higher gear ratio which would give higher no. of rotations for the generator.

When diode is connected to output with 100Ω resistance in series the output voltage was 9volts and hence the power developed is given

Power (P) = $V^2/ R = 9^2/100$

= 0.81 Watt.

Pneumatic power is developed in the form of compressed air. For a force of 20 N applied on gate, for one stroke of pump it generates 1.1 bar of pressure which is stored in the tank. The pressure keeps on increasing as air is pumped by foot pump and is stored in the tank.

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