Design of a Gravity Wheel for Mineral Transport and Power Generation

Premalal DADTR, Karunanayake WAPC, Kodikara NE, Razmy SAM and * Dissanayake DMDOK
Department of Earth Resources Engineering, University of Moratuwa
*Corresponding Author Email – kithsiridissanayake@yahoo.com

Abstract: The energy needs of the world Mining Industry show an exponentially increasing trend owing to greater demand. The best available reports speculate that our present oil reserves will last for 40 years at most; therefore, efforts worldwide are directed towards identifying and utilizing new energy sources. Renewable energy development receives high priority among them. However, investing in new technology developments for renewable energy is time and money consuming.
The main objective of the study was to adopt the Gravity Wheel concept based on the parameters given in the BuzzSaw Gravity Wheel Design of 1909, in order to develop a working model for mineral transport and power generation. The SolidWorks CAD software was used for motion study. Mathematical modelling was in favour of the continuous motion of the Gravity Wheel design. The design promises to have significant economical benefits for the mining industry. Additional benefits are also apparent for the off-grid power generation industry as well.

Keywords: Conservation of Energy, Energy Consumption, Free Energy, Gravity, Leonardo Da Vinci, Perpetual Motion

1. Introduction

World energy consumption is increasing rapidly, surpassing the hither to made estimate and supply from traditional sources. With this increasing demand, energy sources of the earth are depleting with a threatening rate. Gravity Wheel was a concept of Leonardo Da Vinci. Later, there had been many attempts to develop this concept into reality.

This research was carried out with the intention of inventing a renewable free energy source. The vision was to be realized by following the Gravity Wheel concept of Leonardo Da Vinci. Renewable energy is often the ideal solution for the enormous energy requirement in the Mining and Mineral Processing Industry.

Figure 1 – First Conceptual Designs by Da Vinci. http://www.veljkomilkovic.com

2. Methodology

During the literature survey, through the extensive studies on various Gravity

Dr. D.M.D.O.K Dissanayake, B.Sc Eng. (Hons)(Moratuwa), Ph.D.(Seoul), C.Eng., M I E (S L.) Senior Lecturer in Department of Earth Resources Engineering, University of Moratuwa
Mr. D.A.D.T.R. Premalal, Mr. W.A.P.C. Karunanayake, Ms. N.E. Kodikara, Mr. S.A.M. Razmy,
Final-year undergraduate students of University of Moratuwa.

Wheel designs, it was concluded that the research should be focused on the BuzzSaw Design. Informal evidence present shows that this design was successful. Few specifications of this particular design were available and rest of the hidden areas had to be investigated.

Determination of the design parameters and the development of the CAD model were followed by the simulation and the motion study. Simultaneously, the mathematical model of the design was also developed.

2.1 CAD Modelling

For the modelling and simulation of the gravity wheel design, SolidWorks software was used. This is a well known Mechanical CAD software used by over 130,000 recognized companies in the world.

After designing all the parts of the model, they were assembled in the software using relevant assembly criteria.

The assembled model was then tested using the simulation functionality of the SolidWorks software. In this simulation, only the combination of Inner Wheel, Outer Wheel and Weights was used. Also, the model was simulated using imposed velocities on them, with a ratio of 1:2 on Inner Wheel to Outer Wheel.

2.2 Motion Study

Next step was to conduct a motion study of the design. For this purpose, only the Inner and Outer wheel assembly was used. The motion study was carried out using known constant velocities of the two wheels. The positions of the weights at half-second time lapse were determined manually by taking the snapshots of the instantaneous locations of the two wheels and their notches for a period of twenty seconds.

3 Results

The Gravity Wheel design was modelled in the software for simulation and motion study.

Figure 2 – Inner and Outer wheels of the Design

Figure 3 – A Weight of the Design

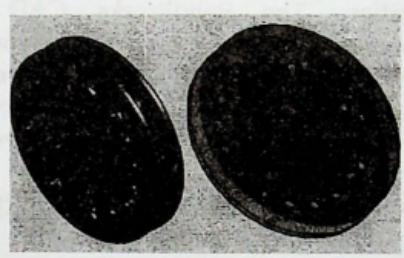

Figure 4 – Assembly of the Parts

3.1 Optimum Angular Velocity

When the wheels are in rotary motion, the centrifugal forces acting on the weights prevent them from shifting from the outer wheel to the inner wheel. In order to determine the optimum angular velocity of the wheels, a mathematical modelling was carried out. For this the ratio between the velocities of the outer wheel and Inner wheel 2:1, was considered.

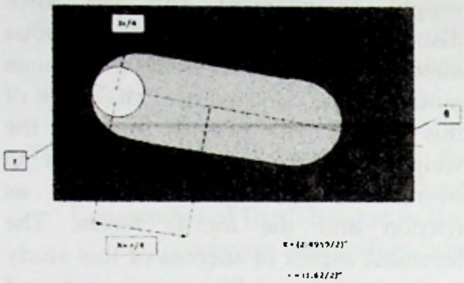

Figure 5 – Motion along the Gutter

Along the gullet:

$S = ut + \frac{1}{2}at^2$

$(x + \frac{1}{4}r) = 0 \times t_1 + \frac{1}{2}at_1^2$

$$(x + \frac{1}{4}r) = \frac{1}{2}at_1^2 \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

For this calculation, the friction between the weight and the gullet was assumed to be negligible.

Along the gullet: F=ma (As per Newton)

$$mg\sin\theta - \frac{mV^2\cos(\theta_1 - \theta)}{R} = ma$$

$$a = g\sin\theta - \frac{V^2\cos(\theta_1 - \theta)}{R} \ldots\ldots(2)$$

From (1) & (2):

$$(x + \frac{1}{4}r) = \frac{1}{2}\left[g\sin\theta - \frac{V^2\cos(\theta_1 - \theta)}{R}\right]t_1^2$$

$$t_1^2 = \frac{2(x + \frac{1}{4}r)}{g\sin\theta - \frac{V^2\cos(\theta_1 - \theta)}{R}}$$

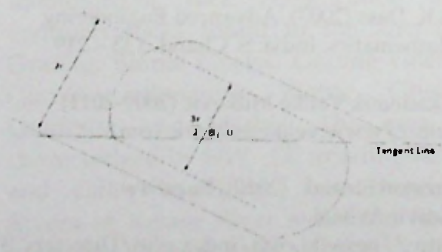

Figure 6 – Motion of the notches

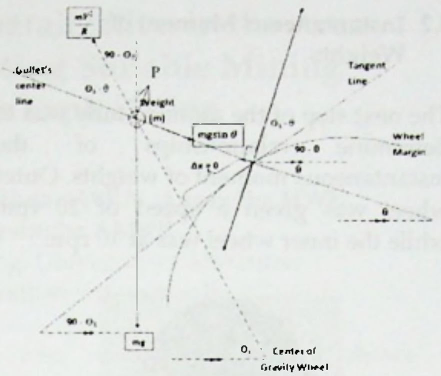

Figure 7 – Motion of the Weight in the Wheel

Along the Tangent: S = ut

$$(2r - \frac{3r}{2})\cos(\theta_1 - \theta) = Vt_2$$

$$t_2 = \frac{(2r - \frac{3r}{2})\cos(\theta_1 - \theta)}{V}$$

$$t_2 = \frac{r}{2V\cos(\theta_1 - \theta)}$$

$t_1 = t_2$:

$$\sqrt{\frac{2(x + \frac{1}{4}r)}{g\sin\theta - \frac{V^2\cos(\theta_1 - \theta)}{R}}} = \frac{r}{2V\cos(\theta_1 - \theta)}$$

Above relationship was derived to determine the optimum velocity of the two wheels.

Where:

X – Linear length of gullet/2 (m), r – Radius of the gullet's curvature (m), t_1 – Time taken by weight to travel to the centre of the gullet from start (s), a – Acceleration of weight (ms^{-2}), m – Mass of the weight (Kg), g - Gravitational acceleration (ms^{-2}), θ – Gullet's instantaneous inclination, θ_1 – Inclination of the weight with respect to the centre, R – Distance to the weight from the centre (m), V – Tangential velocity of the Inner Wheel (ms^{-1}), t_2 – Time taken by the notches to reduce their gap to critical position.

3.2 Instantaneous Moment of Weights

The next step of the motion study was to determine relationships of the instantaneous moment of weights. Outer wheel was given a speed of 20 rpm while the inner wheel was at 10 rpm.

Figure 8 – Instantaneous position at t=0s

$M \curvearrowright$

$= mgr_1 \cos 10.32° - FR_1 + mgr_1 \cos 33.1° - FR_1 + mgr_1 \cos 55.88° - FR_1 + mgr_1 \cos 78.66° - FR_1 + mgr_1 \cos 11.9° - FR_1 + mgr_1 \cos 34.12° - FR_1 + mgr_1 \cos 56.9° - FR_1 + mgr_1 \cos 79.68° - FR_1$

$= \underline{5.1107\ mgr_1 - 8FR_1}$

$M \curvearrowleft$

$= FR_1 + mgr_2 \cos 33.96° + FR_1 + mgr_2 \cos 79.39° + FR_1 + mgr_2 \cos 44.47° + FR_1 + mgr_2 \cos 55.76° - FR_1$

$= \underline{2.5562\ mgr_2 + 4FR_1}$

Where:

r_1 – (Inner wheel radius – radius of weight), r_2 – (Inner wheel radius + radius of weight), R_1 - Inner wheel radius, m - Mass of a weight, g - Gravitational Acceleration, F - Friction force

Moment determination was carried out for the entire time span of twenty seconds.

4 Discussion

In accordance with the motion study and the mathematical calculation it is obvious that the Buzzsaw's gravity wheel is a possible task to accomplish. SolidWorks modelling and the simulation shows that the instantaneous weight arrangement and the force distribution favour the continuous movement of the wheel. The continuous motion is the controversial challenge of this design. The gravity force of the weights generates sufficient power to overcome opposing forces such as friction and the inertia forces. The foremost aspect of success of this study is the initial weight arrangement and hence every position of the wheel generating a considerable imbalance force.

5 Conclusions

The results of the motion study show positive results including the conservation of favourable moment distribution throughout the motion. With these findings, the next step of this research will be to develop the physical model.

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