Design And Fabrication Of Irrigation Canal Renovator

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Abstract: Technology development is the foremost seed for our luxurious and ease lifestyle. Every work and process of human beings is handed over in the hands of machines in the name of automation. Agriculture is the known backbone of India and other economies but automation in this field is in infant stage in India. Canal plays vital role in irrigation and water supply, based on which the farmers cultivate. Kaveri delta canals are the oldest and longest one in Tamil Nadu which irrigates about 5.15 lakh hectares of land in Thanjavur and Trichy districts. The major issue is the growth of weed in these canals, so water does not reach to all agricultural fields intended. In agricultural usage small irrigation canals from the river streams plays a vital role in irrigation. But they are not maintained properly until farmers need it which is water management crisis. So, during this period unwanted deposits cover the irrigation canal. At time of water supply, the canals are dug and cleaned manually. The objective of project work is to design and fabricate a product named "irrigation canal renovator" which automate the process of cleaning the canal. A product named irrigation canal renovator is drove manually in the canal. Product consists of main frame in the trapezoidal shape which replicates the shape of canal. Three blades of size 500mm in diameter is placed in lower part of the frame and two blades of same size is placed in the side frames. Blade drive power from motor shaft, which is in turn powered by a battery. Clearance is provided for easy maneuvering of the machine. The blade rotates at speed of 600rpm, which cuts the grass and other plants.

Index Terms: Agriculture, water management, irrigation canal, mower blades, trapezoidal shaped chassis.

1. INTRODUCTION

Technology development is the foremost seed for our luxurious and ease lifestyle. Industries of current world is being adopted under the automation which leads the industry to incremented advantages. Every work and process of human beings is handed over in the hands of machines. Agriculture is the known backbone of any regions' development. Many countries have a farm-dependent economy – either in a small or large way. From employment generation to contribution to National Income, agriculture is important, but automation in agriculture is in infant stage in India. It is a growing trend across multiple industries to replace human labor with automation, and agriculture is no exception. Most aspects of farming are unexceptionally labor-intensive, with much of that labor comprised of repetitive and standardized tasks. The automation is being developed for almost all the processes of agriculture from seeding to harvesting and even for packing the agricultural products. On the other hand, Water is the elixir of life, a precious gift of nature to mankind and millions of other species living on the earth. Tamil Nadu is 4% of India's land area and is populated by 6% of India's population, but has only 2.5% of India's water resources. Major water uses include human / animal use, irrigation and industrial use. Tamil Nadu's demand for water is growing at a rapid rate due to both population growth and increased per capita needs caused by economic growth.

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LITERATURE REVIEW

Charlle (1971) designed and fabricated Rotary mechanical ditch cleaner.Rotary mechanical ditch cleaner invention relates to ditch-clearing devices, and more particularly to a ditch cleaner of the type having a rotary digging element. A main object of the invention is to provide a novel and improved implement particularly adapted for use in cleaning irrigation ditches of grass, weed, silt, or other undesirable foreign material, the device being so arranged that it does not plug the outlets of a system in which it is employed. A further object of the invention is to provide an improved irrigation ditch-cleaning device which is relatively inexpensive to fabricate which is sturdy in construction, which is accurately adjustable to provide the desired depth of cleaning action, and which is so arranged that material removed from a ditch by apparatus will be thrown clear off the ditch so that said material will not return. A still further object of the invention is to provide an improved ditch cleaning implement attached to a conventional tractor and to be energized therefore from, the device providing efficient clearing action and being usable to clean a ditch whether the ditch contains water, or is in a dry condition, being so arranged that it will clean a ditch without making it deeper or wider, and and being likewise arranged so that it will not leave a plug in the ditch when it is elevated therefrom. A still further object of the invention is to provide an improved ditch cleaning implement which is compact in size,which is relatively light in weight, which is easy to adjust for desired depth of action, which does not damage a ditch in which it is employed, and which does not break the seal in ditches having a special lining material therein for sealing action. Baria et al (2018), made a review paper on the automatic cleaning system for drainage. Water is a necessary need for human beings and all living beings. There's plenty of water on earth, but it's not good for human use. When used for some reason, clean water is more essential. Impurities can cause hazardous & disease in water. As long as the drainage system is considered to be the function of the main drainage system is to collect, transport and dispose of the water via an outlet. Impurities in drainage water can only be like empty bottles, polythene bags, papers and so on. Such impurities in drainage water can cause blockage and drainage system to be washed manually from time to time. This project

automatically cleans the water in the drainage system when any waste occurs and this method and effective and simple way to clean the drainage system and avoid blockage After reviewing many literature reviews we conclude that many similar empirical studies have been conducted and categories such as automatic drainage system and auto cleaning system have been conducted. We focus more on the drainage of the system. Waste water management by the pump, screw conveyer and sprocket, lifter, and collection in the wastewater treatment system to achieve automated municipal waste water treatment control. Reflect more on the drainage of the system. Waste water management by the pump, screw conveyer and sprocket, lifter, and collection in the wastewater treatment system to achieve automated municipal waste water treatment control. To capture the floating waste, the machine must travel in the drain to reduce human labor. During the heavy rains, which had more amount of running water with garbage and high speed, the cleaner worked effectively to drive.

METHODOLOGY AND MATERIAL

METHODOLOGY

Cleaning of canal is done manual in Tamil Nadu. Farmers goes down the canal and the remove the weeds manually. This job requires lot of labors and time. As there is only limited time the clean the canal partially which results in wastage in water resource. The difficulties in developing a machine which automate this process are that, the canal in the trapezoidal shape, soil is muddy to travel which requires specially designed wheels, angels of sides of trapezoid is different, length of the sides may vary, there no. of turns and ups & downs in the canal. The first step of identification of problem is done. The next step is to select the material for all the components followed by designing. Then the design parts are assembled in software and fix tolerance values. Fabricate the designed models using suitable methodology. Then assemble the parts in the main frame or chassis. The final step is to test the project and get the results and analysis the result. Make modification according to the result analysis.

COMPONENTS & MATERIAL

Irrigation canal renovator is manufactured from differing kinds of metal & materials. Frame or chassis is made up of mild steel due its high availability, enough strength, lower cost. Pillow bock is made up cast steel which is standard. 2A pulley and 3 A pulley is used which is of cast iron. Blade is made up of stainless steel which is of 500mm in length. AC motor is used to power the blades for rotation. V Belt of required size is used to transfer power from motor to blade which is made of rubber. Hinge joint is used to provide angle adjustment in chassis which is of mid steel. All components are connected to the chassis using nuts and bolts of required dimensions.

FABRICATION PROCEDURE

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Initially, frame is made with help of square bars. The square hollow bars are welded in the shape of trapezoidal shape along the mechanism to adjust the angles. Then pillow blocks are welded to it to support shaft of the motors and blades. Housing for motors are made and welded to the chassis. Shaft is machined to transfer power from motor to blade. Pulleys of required size is coupled to motor shaft and blade shaft. Motor is bolted to the motor housing. V belts of suitable size are used to connect the blades and motor.

IRRIGATION CANAL RENOVATOR WORKING

The irrigation canal renovator is driven manually in the canal. It consists of main frame in the trapezoidal shape which replicates the shape of canal. Three blades of size 500mm in diameter is placed in lower part of the frame and 2 blades of same size is placed in the side frames. Motor is connected to the blades for rotation. Motors and blades are connected through pulleys. 3-A pulley is used for motor at the center and 1-A pulley is used for other motors and blades. Motors are connected in parallel connection for power supply. Belt drive is used to transmit power. Machine is driven inside the canal. Machine is switched on. Power supply drives the motor. Pulley and belt drive transmit power to the blades. The blades rotate at the rpm based on ratio of pulleys which produces corresponding cutting force. The blade cuts the grass (weed) in the canal. Hence it is cleaned. The number of blades in each member varies based on the length of each side of the canal. Size of each blades varies with the type of weed to be cut and size of each member. Adjustment of angle of side members is provided with help of hinge joint arrangement. Hence angle can be varied according to the canal.

DESIGN CALCULATION

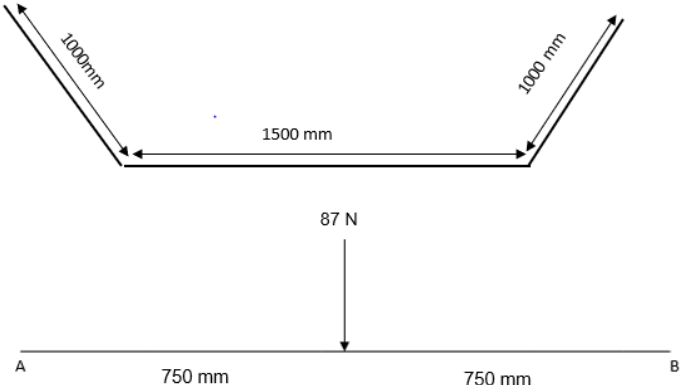
FRAME STRENGTH CALCULATION

Horizontal member has three motors, hence higher amount of load is acting in that member than that of others. Calculating the required strength of that member is enough.

Available Data

Force due to motor = 87 N

No. of motors = 1



Frame strength is calculated by following procedure,
Total force acting upwards = Total force acting downward

$R_a + R_b$ = forces due to motor ……(1)

= 87 N

$R_a + R_b$ = 87 N

M_a = 0

0 = (29*250) + (29*750) + (29*1250) – (1500*R_b)

R_b = 43.5 N

R_a = 43.5 N (from equation 1)

Where,

R_a - Reaction force at point A

R_b – Reaction force at point B

M_a – Moment about A

Bending stress = (y*M)/I ……..(2)

Where,

y - Deflection

M - Maximum moment

I – Moment of Inertia

Deflection, $y = \frac{P*a*(3*L^2-4a^2)}{24*E*I}$ ……(3)

(From strength of Materials book by Er. R.K. Rajput)

Where,

P – load at the points = 43.5 N

a – distance from the point to the load = 750 mm

L – length of the member = 1500 mm

E – young's modulus of the material

- young's modulus of mild steel = 210 N/mm^2 (ref: AMESweb.info)

I – Moment of Inertia

I = (S^4-s^4)/12

= (38.1^4-36.1^4) / 12

= 505454.549 mm^4

From equation (3),

$y = \frac{43.5*750*(3*1500^2 - 4*250^2)}{24*210*505454.549}$

y = 9.4 mm

Maximum moment = $wL^2/8$ ……..(4)

Where,

w = P/a

= 43.5 / 750

= 0.058 N /mm

From equation (4),

M_{max} = 0.058*1500^2/8

M_{max} =11062.5 Nmm

From equation (2),

Bending stress = (9.4 * 11062.5) / 505454.549

= 20.57 N/mm^2

Allowable bending stress = 205 N/mm^2 (ref : aw

FOS = 4 (assume)

Maximum bending stress = bending stress * FOS

= 82.87 N/mm^2

Maximum bending stress within the allowable bending stress

MOTOR POWER CALCULATION

Available Data

Height of bade from ground = 50 mm ……[2]

Diameter of the blade = 500 mm

Weight of the blade = 1.2 kg (actual measurement)

Cutting force of grass = 20N ……[2]

Motor power is calculated by following procedure,

Torque = force * perpendicular Distance

= 20 * 250 mm

= 5 Nm

$Power = \frac{2\pi NT}{60}$

Where,

N - speed of the motor = 660 rpm ……[4]

T - torque of the motor

$Power = \frac{2*\pi*660*5}{60}$

= 314.15 W

Therefore, standard motor at 350 W @ 660 rpm is chosen.

PULLEY RATIO CALCULATION

Available Data

Input speed (N_1) = 1440 rpm

Output speed (N_2) = 660 rpm ……[4]

Smaller pulley (d) = 200 mm

Motor power = 350 w

Pulley ratio calculation is done by following procedure,

$\frac{N1}{N2} = \frac{D}{d}$

D = diameter of larger pulley

$\frac{1440}{660} = \frac{D}{200}$

D = 436 mm

Output Torque $= \frac{Power \times 60}{2\pi N}$

Output Torque $= \frac{350 \times 60}{2 \times \pi \times 660}$

Output Toque = 5.066 Nm

RESULTS AND DISCUSSION

When the irrigational canal's motors are switched on the blade rotates and cuts the weed in the canal. The machine can be driven manually through the canal and weeds are removed. During trail run number of small hinderances are faced. Some of them are, clearance of blades to the ground, wheels used does move in the muddy land. These hindrances had overcame by adjusting clearance accordingly and replacing the wheel suitable for muddy land. Thus, irrigational canal renovator achieves the main aim of cleaning irrigational canal.

CONCLUSION

The main motive of the project is to clean the irrigational canal when it is not in use for long period of time (4-6 months). This project serves the need as expected. By application of simple engineering technology, we learned in our engineering life we have assembled such a machine which is cost effective compared to other techniques. The low budget project is very useful for the society and being cost effective and energy efficient can play a vital role in water management and agriculture of India.

FUTURE ENHANCEMENTS

Machine can be made totally operator less thereby making it work with no human effort by locomotive mechanism powered

by either motor or engine .Vertical movement of blades so that, it can dodge from the obstacles in the canal likely stones, etc. Developing mechanism to remove the weeds after they have been cut.Renewable energy source use for operating the motor.

REFERENCES

[1] Charlie.M.Rogermancs (1971) “rotary mechanica ditch cleaner” ,united states patent, appl no.803,308

[2] Ibe, Godwin Anwara, Department of Mechanical Engineering Technology ,(2017), International Journal of Engineering Research, Vol 6, Issue No.3,pp : 116-119.

[3] Ishan Izzudheen, Job Varghese ,JomyTomy, Mohammed Rizwan, Lokesh K.S. , (2016) “Fabrication of semi-automatic feeding mechanism for small scale poultry farm” ,NCAMES,ISSN : 2231-5381.

[4] Jigar Rajendrakumar Shah, (2017), lecturer in Mechanical Department,SB polytechnic, KJ Campus,Savli,” Design and anlysis of grass cutting Manchine” , IJARIIE(O)-2395-4396,Vol-3 Issue-6.

[5] Harshvardhan Baria, Mackwan Akash, Nirav Makwana, Raj Parmar, Sharad Chhantabar,(2018) a review paper on “automated drainage cleaning system” , 2nd international conference on current research trends in engineering and technology , volume 4 issue 5.

[6] H.kolvusalo , E. Ahti, A. Lauren, T. Kokkonen , T. Karvonen ,R, Nevelainen , and L.finer ,(2008) ,”Impact of cleaning on hydrological process in drained peatland forest”, Hydrol. Earth Syst. Sci., 12, 1211-1227.