Design and Fabrication of Multi-Terrain Motorized Mountain Board

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Abstract— Our project, a multi-terrain mountain board, is inspired by new-age design with an introduction of engine on a skateboard. What sets it apart from a skateboard is that the engine, used for acceleration, is mounted upon the board. The mountain board includes a chassis on which a deck is supported, a sprocket-chain combination is connected to the rear axle of the chassis, which is connected to the engine. The sprocket is fixed to a wheel which helps to drive the entire board. On the either wheel of the rear axle, a mechanical disc brake is mounted which provides deceleration and stopping the forward motion of the board. High tensile springs are fixed underneath the board which helps in dual suspension and turning of the board. The chassis is inclined to a certain angle from the front axle. This inclination makes the board to turn in any side. More the inclination, easier will be the steering movement.

Key words: Multi-Terrain Mountain Board

I. INTRODUCTION

A multi-terrain mountain board mainly denotes a board that can travel on almost any surfaces, e.g. concrete, mud, grass, etc. With a 69.9 cc engine mounted on it, it has very easy acceleration and is convenient to use. The average speeds can go up to 40-50 kmph and can pass on through slopes very easily. In the latest popularity, engines or motors are being mounted on such skateboards but these skateboards cannot be used in rough or uneven surfaces, due to their small wheels, less ground clearance, and lack of steering in rough surfaces. These motorized mountain boards are very convenient in use but major drawback is that due to engine mounting, there remains less space to place feet on board and can also cause injuries to the rider if not driven safely.

II. DETAILED DESIGN

For safe riding of the board, each and every minute parts needs to be designed neatly to reject any defects.

A. Rear axle shaft

Material: C45 Carbon steel (psg 1.9)
Yield stress: σ_{yt}= 360 Mpa
FOS=2
$\sigma_t = \frac{\sigma yt}{FOS}$ = 180 MPa ... Allowable tensile stress
$\tau = 0.5\sigma_t$=90 MPa... Allowable shear stress
Consider bending
By flexurer formula for bending

$$\frac{\sigma b}{y} = \frac{M}{I}$$

$\sigma_b = 1.2\sigma_t$ = Direct stress=1.2×180=216MPa
$y = \frac{d}{2}$
Equivalent bending moment,
$M_e = 0.5 * \{K_b M + [(KbM)^2 + (KtT)^2]^{0.5}\}$
From psg 7.21
Revolving shaft
Heavy shock loads,
Kb=2
Kt=2
M=Maximum bending moment=38787Nmm
T= torque=19.32Nm=19.32×10^{3}Nmm
M_e=0.5 * {2×38787+[(2×38787)^2+(2×19.32×10^3)^2]$^{0.5}$}
M_e=82119.369Nmm
M_e=82.119KNmm... Equivalent bending moment
$\frac{216}{\frac{d}{2}} = \frac{82.119\times10^3}{\frac{\pi}{4}\times d^4}$
d=15.70mm
We select standard diameter of 20mm
d=20mm
Now, Consider shear (torsion)

$$\frac{\tau}{r} = \frac{T}{J}$$

Equivalent twisting moment,
T= {(KbM)^2+(KtT)^2}$^{0.5}$
T={(2×38787)^2+(2×19.32×10^3)^2}$^{0.5}$
T=8664.727Nmm
T=86.64KNmm
$\frac{90}{\frac{d}{2}}$=86.64×10^3/π/32×d^4
d=16.989mm < 20mm
We have taken standard solid shaft of diameter 20mm
.: Design is safe for bending and torsion (twisting also)

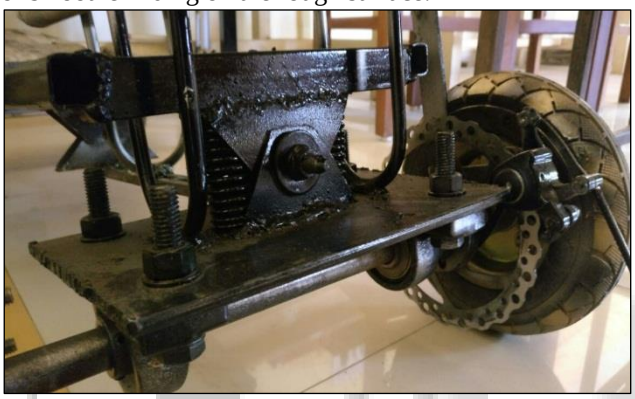
B. Bearings

We designed the bearing to select the standard bearing.
Considering by applied loads on the application,
Radial load on the bearing=Fr=35.5kg (348.255N)
Axial load=Fa=17.75kg (174.127N)
So we select the bearing,
TIMKEN UCP 204 Pillow block bearing (Deep groove ball bearing), which is safe for the design with 19mm inner diameter.
The bearing life calculated was 3years (approx. 3521.839 million revolutions)

C. Springs

We have used the stainless steel springs with high stiffness. These springs helps for the tilting motion of the deck, so mountain board will take turn to the left as we tilt towards the left side of the board and vice versa.

Also springs provides the suspension for the board for smoother riding on the rough surface.



D. Plywood and mild steel plates

Plywood, mild steel plates have designed from Roark's formula for stress and strain book for rectangular plates design.

Fig. : Actual model

III. Applications

The board has nearly same specifications as other vehicles due to the fact that it uses less fuel and power than the latter ones, which will make it useful for travelling.

Due to its compact size and less weight, the board can be easily transported and can be carried along with the rider.

Since the mountain board is similar to a skateboard, it can act as a sports competition too.

IV. Future Scope

The motorized mountain board can be used in many ways. It can act as an adventure sports along with a free body environmental ride. The main motive of the board is to minimize the cost of production while generating almost similar riding efficiency as other vehicles. The drive length of such boards can be up to 20-25 km with a maximum speed of 50kmph. Since the board can withstand almost every terrain (Concrete, Mud, Uneven road), the board will manage to give the rider a better experience.

The engine used in this board is convenient but is more powerful, hence special type of engine can be manufactured considering the specifications required. Small and light weight engines can be used. Also, battery operated motor can be more efficient but will increase the cost of the board.

Some modifications can be done by providing a handle on the board which will help to accelerate and brake the board easily. For this, the twisting moment due to feet will be removed and the board won't be inclined from the front axle too.

V. Conclusions

Hence, we can conclude that a similar mode of transport can be manufactured using minimum parts. With similar working as compared to other vehicles, it also has low cost, cheap and highly affordable. With every part being replaceable, the maintenance is very low and can compete with other vehicles easily.

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