Calculation, Design and Manufacturing of Mobigym

[1]AshishTripathi, [2]GauravOchani, [3]ChiragKarnawat, [4]KrunalGonnade
Dep. Mechanical Engineering, S.B.J.I.T.M.R, Nagpur, India.

Abstract:-*Bicycles was invented in 1817, first means of transport for public ease & bicycle also provides numerous health benefits by rigorous body & as well environmental healthy i.e. pollution free excess to road. Gymnasium, a place where people do heavy workout and gain fitness with proper muscular body.Mobigym, a concoction of bicycle and gym put's both of them together. Mobigym is a bicycle designed for exercise purpose and can be used as means of transport.*

Same in traditional bicycles the rear chain drive mechanism is carried out by foot pedals connects the rear wheel of cycle and another chain drive mechanics introduced carried by the handle connects the front wheel of the bicycle. Simultaneous action burns lots of calories and also bicycle cum mobigym is increased.Key factor of this mobigym is that it is being comfortably being designed for both men and women. Mobigym might be the need for fitness freak.

I. INTRODUCTION

In today's scenario, the life of people is becoming fast and growing in a very sensible manner where people do not get time for their personal body work out and hence they grow in a very unhealthy environment. Hence, we provided a very low cost and affordable equipment for a particular persons whole body workout in a only one equipment that we named mobigym.

Mobigym the name itself tells about all that we provided as a solution for whole body exercises .In this kind of equipment a person cannot even ride the bicycle through pedaling by legs but can also ride by using hand motion i.e the motion can provide the exercise to the arms, chest, back and also to the shoulder of a particular human riding the bicycle .

Using this equipment for a body workout people have a freedom to workout according to their free time and According to science, body of a particular human being grows in a better way doing a workout in an open environment rather t1han closed room and shifting from machine to machine.

II.PROBLEMS IDENDITIED

Working out at same place may be problematic for some people.

- Due to busy work schedule people are not able to workout efficiently.
- Indoor exercises are not much fruitful as green environment exercises.
- Only one person can use gym on a single membership card.
- You have to wait for your turn in gym for working out on a particular equipment.
- Today's reality is that people want a good physique but they don't have sufficient time to give to gym.

V. SOLUTION FOR PROBLEMS IDENTIFIED

- Mobigym allows the person to workout in healthy environment.
- Occupies less space as compared to gym eqipments.
- Provides good physique to a person & travelling medium as well.
- It also provide enviournment friendly travelling medium.
- No trainer is required i.e simple to drive
- Unlike gym no membership is required anybody can use it whenever one is willing.
- While driving both the mechanism simultaneously arm, thighs, back and shoulder exercise are being carried out
- Economical and one time investment

VI. PROPOSED DESIGN

A. Introduction

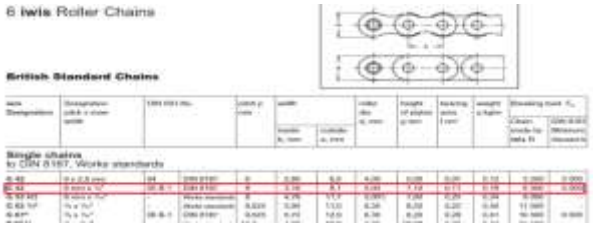
The mobigym is not just a bicycle but it is a complete kit for fitness of a particular person providing not only the exercise to the body but can also help the person to reach from source to destination. Mobigym allows many types of freedom to the people like if a person joins a gym for their fitness they need to take membership and they need to listen to the trainer as well, after that they are getting used to with the gymingequipments and for that at some time the need to wait till other person complete his exercise. In mobigym there is no kind of restriction, any person of the family can use it and at any time whichever they think is suitable for them.

Mobigym is also a bicycle which helps to develop various muscles of the body at a time and only in just one equipment. It can be used by pedalling not only through legs but also using the arms as well.

B. Calculations of the Model:

Chains:

Fig 4



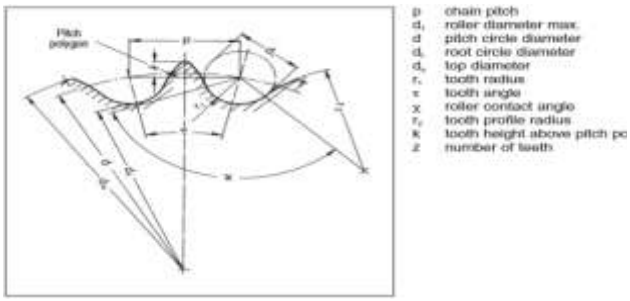


Fig 5

- Design calculation for pinion
- Speed of pinion(Ng) = 100rpm
- Velocity ratio =2
- Mass of rider (m)= 60kg
- Length of pedal lever(L) =190mm
- Assume british standard chain G52 iwis designation : pitch(P)-8mm, width(b1) =3
- Step1) Maximum torque applied on bicycle =(Mass of rider x g)x length of the pedal lever
  =60x9.81x0.1=58.86 N-m.
- Step2)Calculate rated power PR= 2πNT/60
  =2πx100x58.86/60

= 0.616KW.

- Step3) Design Power Pd= PRxKL
  Where, load Factor KL =1.25

  Pd =0.616x1.25
  =0.77KW.
- Step4) Tangential ortooth load
  Ft= Pd/Vp.
  Where, Vp= (πx DpxNP/60000)
  = (πx 16m x 200/60000)
  = 0.617 x m
  Therefore, Ft= (0.77 x103)/ (0.167x m)
  t= (4.61 x 103)/(m).

- Design of Chain And Sprocket
  d=5mm
- Pitch circle diameter
  dp= P/sin(180/T)
  P= 8mm,T=42,
  PCD=107.051mm
- Root Circle Diameter
  df=d-d1
  = 107.051-5
  = 102.05mm
- Top Diameter
  $(d_a)_{max}=d+1.2P-d_1$
  =107.051+(1.25*8)-5
  =112.05mm
  $(d_a)_{min}=d+(1-1.6/T)P-d_1$
  =107.051+(1-1.6/30)8-5
  =101.891mm
- Tooth Height
  $K_{max}=0.625P-0.5d_1+((0.8/T)P)$

Fig 9:Isentropic View

=2.625mm

$K_{min}=0.5(P-d_1)$
=0.5(8-5)

=1.5mm

- Tooth Space
  $R_{min}=0.505d_1+0.064*\sqrt{d_1}$
  =2.63mm
- Roller Contact
  $X_{min}=120^o-(90^o/42)$
  $=117.85^o$
  $X_{max}=140^o-(90^o/42)$
  $=137.85^o$
- Tooth Profile Radius
  $R_{2max}=0.008d_1(T^2+180)$
  =77.76mm
- Tooth Width
  $=0.93b_1$
  =2.938mm
- Beam Strength
  $F_B=S_o*CV*Y*b*m(1-b/L)$
  Where, S_o=105Mpa
  CV=0.5
  Y = Lewis Factor For pinion,
  Yp = 0.45- (2.87 / (tf)p)
  = 0.45- (2.87 / 18)
  Yp = 0.29
  For Gear:

$Y_g=0.45-(2.87/(t_f)_g)$
=0.45-(2.87/72)
=0.4451

B=phase width of gear =7 x m

Now for pinion,

Sop =$(So \times Y)_p$
=105 x 0.3255 = 34.17

For Gear,

Sog = $(S_o \times Y)_g$
=105 x 0.4451 = 46.73

F_B =34.17 x 0.5 x7m x m x (1-7m/ 17.88m)
= 72.53 x m^2

By limiting condition $F_B = F_t$
$72.56m^2 = (4.61 \times 103)/m$
m = 1.87
Tangential load F_t= (4.61 x 103)/ m
= 253 N

- Pitch Velocity V_p= 0.167 x m
  =0.167 x 1.87
  = 0.312 m/s.
- Diameter of pinion D_p=16 x m
  =16 X 1.87
  =29.92mm
- Diameter of Gear D_g=32 x m
  =32 x 1.87
  =59.84mm

- **Design Of Bearing:**
  Equivalent load coming on bearing,
  T xiii-xiv (B.D.Shiwalkar Data Book)
  $F_e= (xF_r +yF_a)k_{\square} \times k_0 \times k_p \times k_f$
  F_r=Radial load
  F_a=Axial load
  F_r=253.63N
  F_a=253N
  From T-xiii-14,

F_a/F_r=0.99>e
e=0.25(For deep grooved ball bearing)
X=0.56 & Y=1.6
From T-xiii-15
Service Factor=2.5(heavy shaft load ball bearing)

F_e=((0.56x253.63)+(1.6x253))x2.5x1x1x1x1
=1367.082N

- **Life of Bearing:**
  From T-xiii-17
  L=4000-8000hrs(domestic machines)
  L=8000hrs

$L=(c/F_e)^n*k_{ret}$

n=3 …… (For ball bearing)

k_{ret}= reliability factor (T-xiii-15)
For 90% reliability, k_{ret}=1

c=specific dynamic for ball bearing

$8000=(c/1367.082)^3*1$

C=27341.64

From T-xiii-21

C=27500

Hence, selecting bearing 0210.

C. Design of Mobigym .

Fig 6: Front view

Fig 7: Top View

Fig : Side View

- ***Analysis Of Mobigym***

Fig10: Analysis OfMobigym

Impulse Momentum=$(M*(V_1-V_2)/T)$

Where, M=mass of Bicycle and rider =100kg

V_1=Initial Speed of bicycle = 40Kmph.

V_2=Final Speed of bicycle = 0Kmph

T =Impact time = 1second

Therefore,

Impulse Momentum= (100*(40-0)/1)

= 4000N

- ***Original View of Mobigym:***

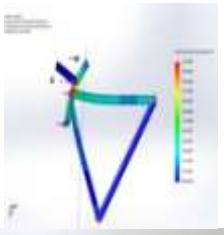


Fig 11: Original Product

D. Ergonomis*:*

Ergonomics of a bicycle refers to a pain-free &comfortable ride. Cycling right is just a matter of adjustments. On a bicycle the whole body is in action, many muscles are involved & each muscle has its counterpart. All the forces need to balance out before you begin to experience the true riding comfort.

PROBLEMS:

HANDS

hurt because : The arms are straightened.

The torso & arms are at an unfavorable angle. The handle bar and grip are not optimally shaped.

BUTTOCKS

hurts because : The saddle is positioned too high above the crank.Distance between the saddle and the crank is not right.

Saddle is at wrong angle.

KNEES & FEETS

hurts because : The saddle is too low.

The foot is wrongly positioned on the pedal.

The shoe is uncomfortable ot tightly laced.The selected gears are too heavy for that particular terrain.

VIII. CONCLUSION

From the research work done we came to conclusion which are as follows:-

1. Chain drive are less in weight as compared to shaft drive bicycle.
2. Safety of the human is more important espect in man machine relationship.
3. Anyone can drive mobigym.
4. Mobigym can go anywhere, anytime and it can be use of any age.

IX. REFERENCES

1. AmolH.Parihar, Pravin P. Huzare, SwapnilS .Kulkarni. Performance analysis of a handle bar using finite element method to enhance the strength.
2. Vijayan .S.N,Pravin K.B, Venkatasubramanian . D, Ponmadasamy .M, Sakthivel. M. Performance analysis of bicycle driven by gear and shaft transmission system
3. Ergotec: The guide to cycling ergonomics.
4. Asso.Porf. PradeepM.Ingole, Dr. Ajay U. Awate, MukundManas. Ergonomis Bicycle for ladies.
5. David Weldon. Mountain Bike Rear Suspension design optimizationhttp://www.cs.bath.ac.uk/~mdv/courses/CM30082/projects.bho/2005-6/weldon_dm_dissertation_2005-06.pdf
6. J. P. Meijaard, Jim M. Papadopoulos, Andy Ruina and A. L. Schwab. Linearized dynamics equations for the balance and steer of a bicycle.
7. Zebediah Tracy Claudio X. Salazar. Design of Urban Transit Rowing Bike (UTRB).
   A Major Qualifying Project Report Submitted to the Faculty of the WORCESTER POLYTECHNIC INSTITUTE. Issued on august 2010.
8. Lynn Weigand. The Economic Benefits of Bicycling. June 2008 CUS-CTS-08-03.
   https://www.pdx.edu/ibpi/sites/www.pdx.edu.ibpi/files/Economic%20Benefits%20of%20Bicycling.pdf
9. M. ReddiSankar, T. Pushpaveni, V. BhanuPrakash Reddy. Design and Development of Solar Assisted Bicycle.International Journal of Scientific and Research Publications, Volume 3, Issue 3, March 2013 SSN 2250-3153
10. V. Lohit, A. Imran Mohideen. Pneumatic Bike: A Step to FutureInternational Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Impact Factor (2012): 3.358