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Bike Brake Lever Optimization

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Abstract:
It has always been the subject of interest and research work to find out most efficient method to minimize the frictional and stress loss of any surface and any mechanism. For this research work the design modification is start and still going on to optimize the design of mating surface so loss will be minimum. In this project a research has been done on the design of lever surface. Brake lever is a very important part of automobile fields. By modify the design of lever surface & optimize its parameter so that its performance can be improved.

Keywords- *Design Analogy; Finite Element Analysis Technique; Optimization.*

I. INTRODUCTION

The basic function of brake lever is to activate the brake mechanism which allows people to slow down or stop while they are riding a bike. There are two types of mechanism mechanic brake or hydraulic, and both functioning and effectiveness are really different. If we talk about a mechanic brake lever, first of all we need to push it. This action stretches a metallic sane that permits the two brake pads put pressure on one of the two wheel rims. This type of brake is used on many types of vehicles such as car motorcycle etc. Their main advantages over other type of brake are their ability to perform well in dry and wet condition an under prolonged braking periods.

Fig. 1 Bike brake lever

Main problem creation of brake lever is:

A. Brake lever which are very high stress concentration during the force acting or release of clutch. Due to these high stresses and friction between nut and bolts contact point there is a higher possibility of fatigue failure. There is possibility to design of lever by including some stress relief features, stress relief features are providing flexibility and also useful in reduction the point of stress concentration

B. A study is done for brake lever with increasing thickness for effects of stress relief feature, and fillet surface as stress reduction to improve the fatigue life. To select the best suitable design of Brake Lever to reduce the stress on lever surface and improve its performance.

II. DESIGN ANALOGY

An optimum design can be achieved based on predetermined criteria of lever system using computational technique. It is also possible to determine where and how many changes should be made, if the intended use of the new product were to change, because all conditions for optimization are known and applied. This helps address the cases and designs may continue to be use to save the time, cost, and of trying to perform a better design. These initial designs are compared and analysis by using simple models, from which the best solution designs, is chosen. The best design is also improve upon iteratively. These components are in essence cycles of trial and error that can often require many automobiles, each of which can be costly and time consuming mechanism.

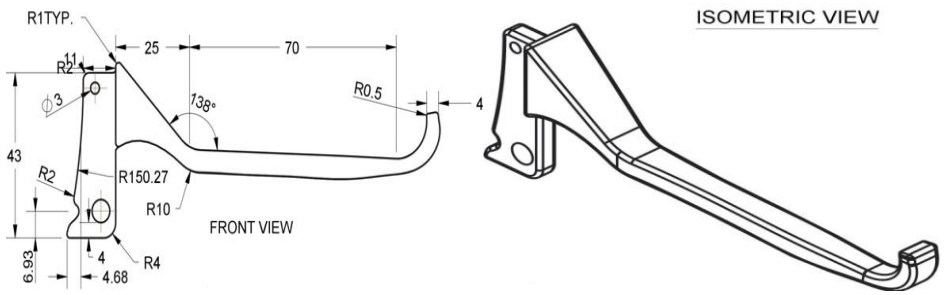

Fig. 2 Schematic view of brake lever

III. ANALYTICAL CALCULATION

The hand grip strength is the highest value recorded for the applied hand force. In this process the ages of males are 25-29 and its right hand force applied to the hand grip, if the brake lever will be yield or break under maximum force this value are shown in table 1.

Table 1 Hand grip strength [1]

Consolidated grip strength reference values for males

Age range (years)	Source references	Total subjects (*n*)	Left (lb) mean (95% CI)	Left (kg) mean (95% CI)	Right (lb) mean (95% CI)
20–24	[5,7–9,11,16]	134	104.6 (85.5–123.6)	47.4 (38.8–56.1)	117.6 (99.6–135.6)
25–29	[5,7,10,16]	149	110.2 (90.5–129.9)	50.0 (41.1–58.9)	119.0 (97.7–140.3)
30–34	[5,7,10,16]	120	108.4 (89.1–127.6)	49.2 (40.4–57.9)	116.4 (97.2–135.6)
35–39	[5,7,10,16]	117	113.7 (97.1–130.8)	51.6 (44.0–59.3)	117.6 (97.0–138.1)
40–44	[5,7,10,16]	111	109.7 (93.7–125.8)	49.8 (42.5–57.1)	119.4 (103.9–135.0)
45–49	[5,7,10,16]	110	107.4 (88.9–126.0)	48.7 (40.3–57.2)	111.1 (93.7–128.5)
50–54	[5,7,10,16]	100	99.7 (86.8–112.7)	45.2 (39.4–51.1)	111.4 (97.4–125.4)
55–59	[5,7,10,16]	100	90.4 (74.3–106.6)	41.0 (33.7–48.4)	97.2 (80.9–113.4)
60–64	[5,7,8,10,16]	120	85.4 (73.7–97.1)	38.7 (33.4–44.0)	92.0 (81.1–103.0)
65–69	[5,7,8,16]	82	84.3 (70.6–97.9)	38.2 (32.0–44.4)	91.9 (78.1–105.7)
70–74	[5,7–9,11,16]	120	79.9 (66.9–92.9)	36.2 (30.3–42.1)	84.3 (70.5–98.0)
75+	[5,7–9,11,15,16]	217	65.6 (54.7–76.4)	29.8 (24.8–34.7)	61.7 (55.2–68.4)

Now the brake lever has consider the hand force (F_H) and the frictional force (F_P) between nut & bolts contact point as shown in Fig.1. For this region the failure moments and force are calculated as

M= Maximum bending moment = $F \times D$,
$\sum M$ = Total bending moment,
F = Force acting at the lever surface,
l = Length of the lever,
D_1 = Distance between wire holes to the lever surface,
D_2 = Distance between wire holes to nut & bolts contact point,
F_1 = Hand force acting to the lever surface,
F_2 = Force acting at the contact region,
Moment at the hand force applied area $M_1 = F_1 \times D_1$
Moment at the contact point $M_2 = F_2 \times D_2$
We know that,
Stress (σ) = Load/Area or Stress (σ) = F/A where F = applied load & A = actual area.
Stress (σ) = Applied Load to the Lever Surface/Actual Area
$\sigma = 624.335/0.000086$ Or
Stress (σ) = 7255929.12 P_a or 7.259MP_a
Stress developed to the lever surface are $\underline{\sigma = 7.259 \times 10^6 MP_a.}$

IV. FINITE ELEMENT ANALYSIS TECHNIQUE

When the studies of actual brake lever the situation of the failure stresses is one of the most significant problems to be measured. The finite element analysis is used to analyze the stress developed to the lever mechanism. There are various published researches which have estimate the stress distribution of this mechanism. In this paper the various calculation techniques are used to analyze the failure problems have been presented. With all the pre-processing steps the model is now set for the static structure analysis, where the initial results of the static structure analysis are shown in figure.

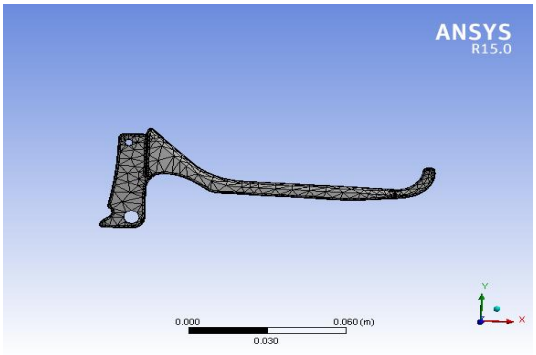

Fig.3 brake lever meshing

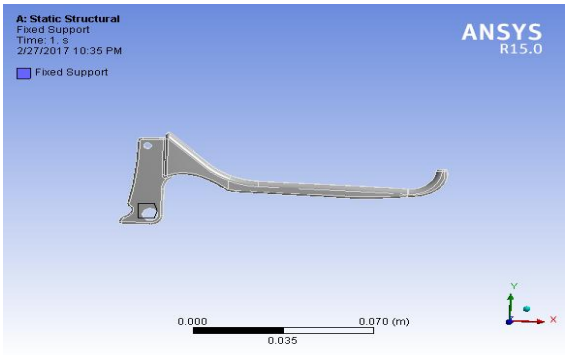

Fig. 4 Boundary condition of brake lever

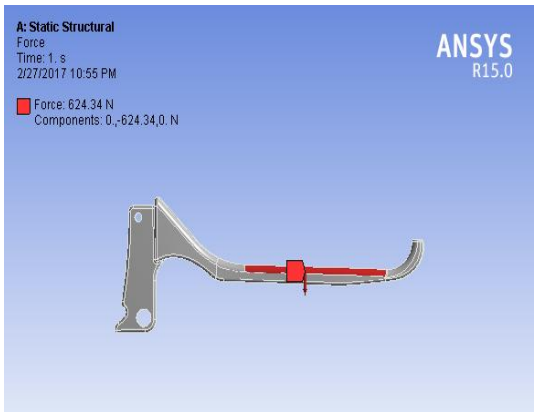

Fig.5 Force condition of brake lever

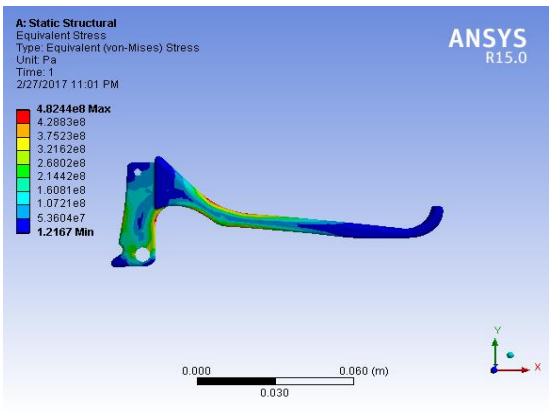

Fig.6 Stress value of brake lever

V. OPTIMIZATION TECHNIQUE

Studied the working condition of brake lever and give a various techniques for distributing the instantaneous pressure along the entire face width of the brake lever. Performed optimization for the given lever mechanism by varying the given suitable lever parameters, thus reducing the stresses and increasing the strength.

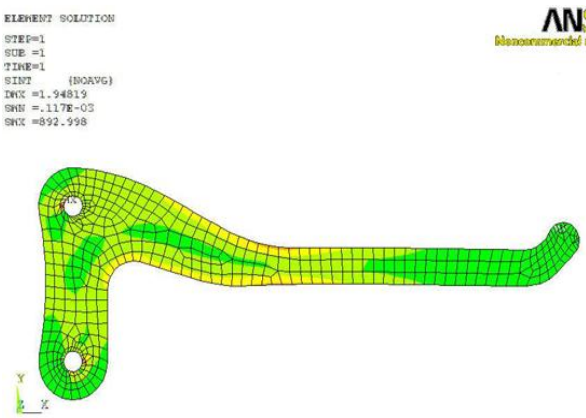

Fig.7 Static condition of brake lever

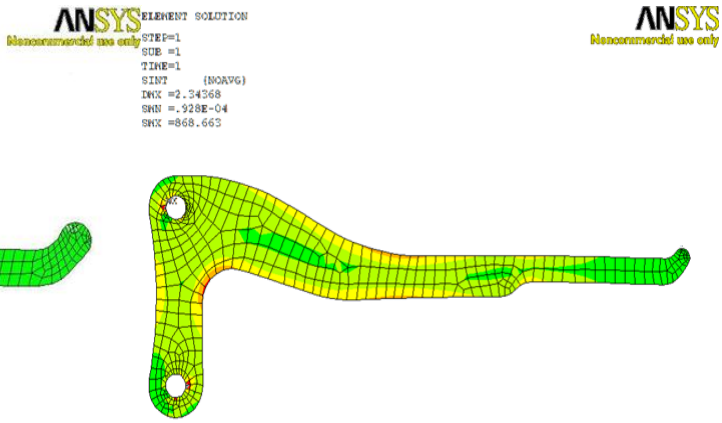

Fig.8 Remove material of brake lever

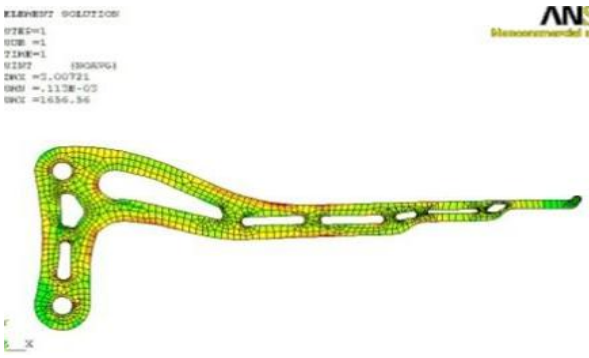

Fig.9 Stress intensity of brake lever

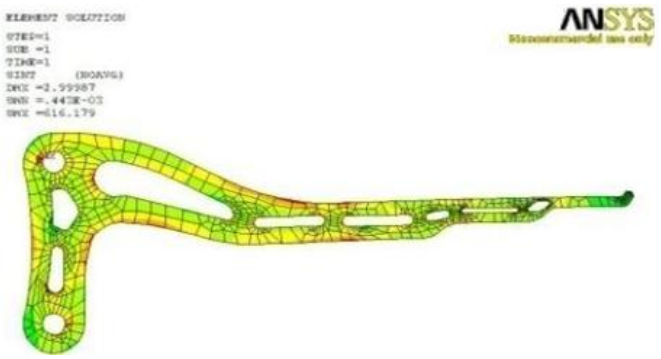

Fig.10 Stress intensity of brake lever

VI. RESULT AND DISCUSSION

The result of this research work is presents the comprehensive process for the design and optimization of brake lever failure stresses and related fatigue failure life. For using stress relief features and stress concentration factor we can reduce failure stress and increase the fatigue failure life of brake lever, but about this work I discussed about the shape optimization and failure stress to be reduced with respect to the parameters and surface design of brake lever. For this result leads to the failure stress reduced approximately, to reduce the failure stresses by using some design features and modification of brake lever that to be analyzed by the FEM methods and to finding out the minimum stress value.

VII. CONCLUSION

This work presents the results obtained by applying analytical method for brake lever to calculate the failure stress and the same by FEA analyses, which shows a good result in comparison. The stress analysis of a lever shows that the fillet which has tensile stresses has higher stress levels than the inner part of lever which has compressive stresses, and the pivot region point left side surface are tensile stress and the right side surface are compressive stress will be occurred. It is concluded from the stress relief study of keeping the fillet along the lever surface and providing consecutive holes to the pivot region than after increasing the area of lever fixture point so those results only for done by increase lever life and its shape to be optimized.

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