ISSN: 2394-7659
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International Journal of Engineering Researches and Management Studies

STUDY OF SHATTERING OF GLASS

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ABSTRACT

There are many uses of glass in day to day life and its applications are continuously increasing .some basic glass breakage is done by dropping weights from different heights and many variable were introduced like height, offset from centre of the glass, weight etc. Results and conclusion are introduced here from basic breakage of glass and how much information one can get from breaking the glass without any setup and by image processing of glass.

How glass break and what are the factors affecting its strength? What are the different trend and information one can get by breaking the glass?

Keywods:- *Glass, Shattering of Glass etc.*

I. INTRODUCTION

We all know the uses and application of glass in our life like in our car, cell phones, houses, lens, lights, interior design and many more. Engineers and physicist developed many such glasses, which are helpful for us like tampered glass used in our cell phone and laminated glass used in windshield of car, window glasses so that they are not easy to break and hold these tiny particle as they stick to layer of Polyvinyl butyral(PVB) and prevent from harmful consequences.

Small pieces coming out or blow out during breakage of glass is harmful and causes problem. So one should have information of glass breakage to avoid it. Some times before they were not present and causes so many problems for human life, breakage of windshield causes wounds on human body, sometimes leads to loss of eye by tiny particles blow out from breakage. Breakage of windshield leads to cracks, uses tampered glass and these cracks are given different names as shown in fig 1.1

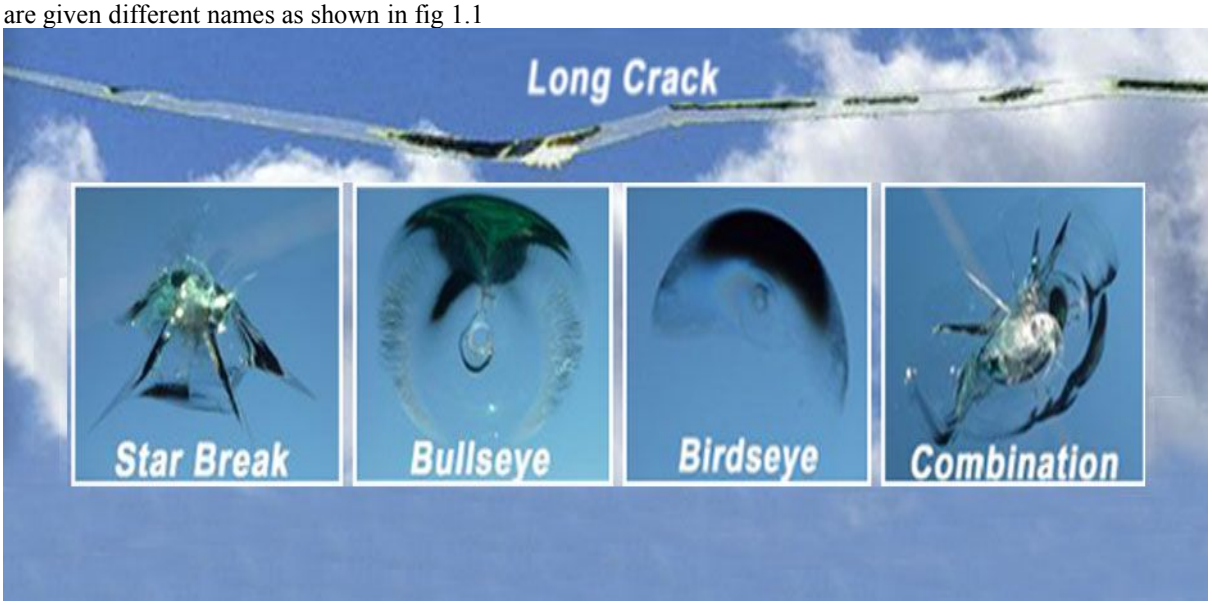

Image by fasbreakautoglassservice.com

Fig 2.1 (different types of crack in windshield)

As they are categorized by their shape in fig 2.1

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These are some glass crack categorized by some auto glass service company.

II. OBJECTIVES

Variation in breakage pattern, by changing offset from the centre of the glass slab?
How crack length vary by changing the variable introduced earlier?
How many pieces comes out from the glass, after dropping weight on varying offset from centre?
What trends followed by the number of pieces and crack length by changing variables?

III. EXPERIMENTAL PLAN

Weights on the glass were dropped, and see the pattern and extract information from it.
Variable here are weight, height from which weight dropped and offset or distance from the centre of the glass slab and these variable can be controlled.
Glass sheet taken was of same thickness and approx. same dimension.so this was not the variable for the setup
Setup should have the proper plane area on which glass slab was placed to avoid the variation due to surface finish.

Velocity = - eq 4.1
Velocity is the velocity at the time when weight collides with the glass
h = height from which weight was dropped.
g = gravity constant (9.8m/sec^2)
And
Momentum p= - eq 4.2
m = mass of weight
v= velocity at time of collision

IV. SETUP AND APPARATUS

For setup, glass slabs of dimension 15cm*15cm*4mm were taken and placed on flat wooden table as shown in figure below

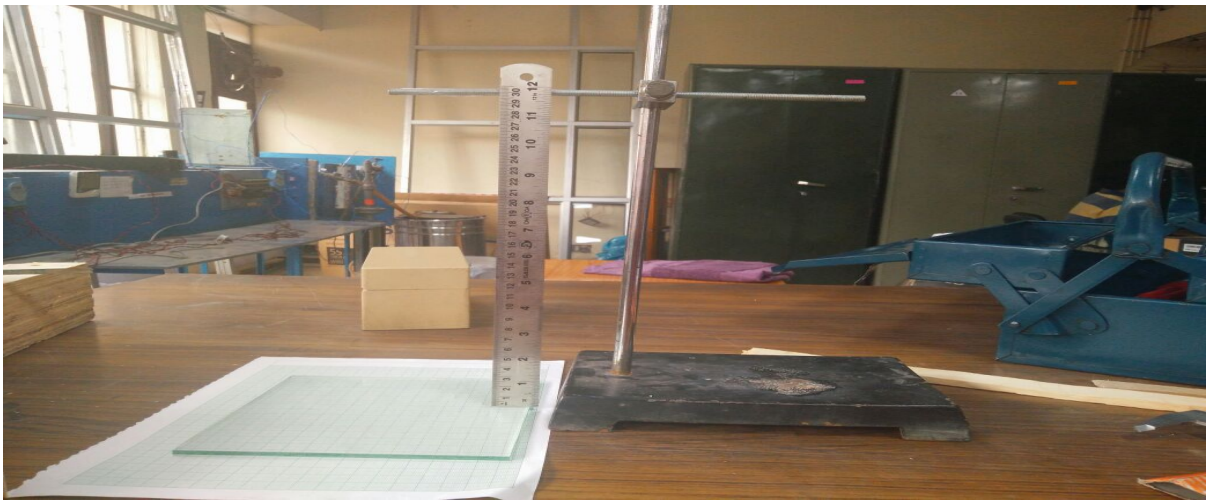

Fig 5.1 Experimental setup

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Fig 5.1 shows a slab placed on wooden table followed by a paper and a tower was made to calculate the height by which weight was thrown, scale was placed near tower to calculate the height.
And after estimating the height, as shown in figure 2.1 weight was dropped from the tower.

Fig 5.2 experimental setup with weight.

Number of attempt was made to break the glass with different variable and measurement was made with scale and Vernier calliper was used to measure the thickness of the glass slab.

V. EXPERIMENTAL PROCEDURE

First the slab was taken and placed on the setup, height was marked on the tower as shown in fig 5.1, and after that the weight was dropped from that height.
After breaking the glass, the image was taken of the glass and crack length, number of the pieces and distance from the centre of impact or collision was recorded and conclusion and results was made on the basis of these observation.

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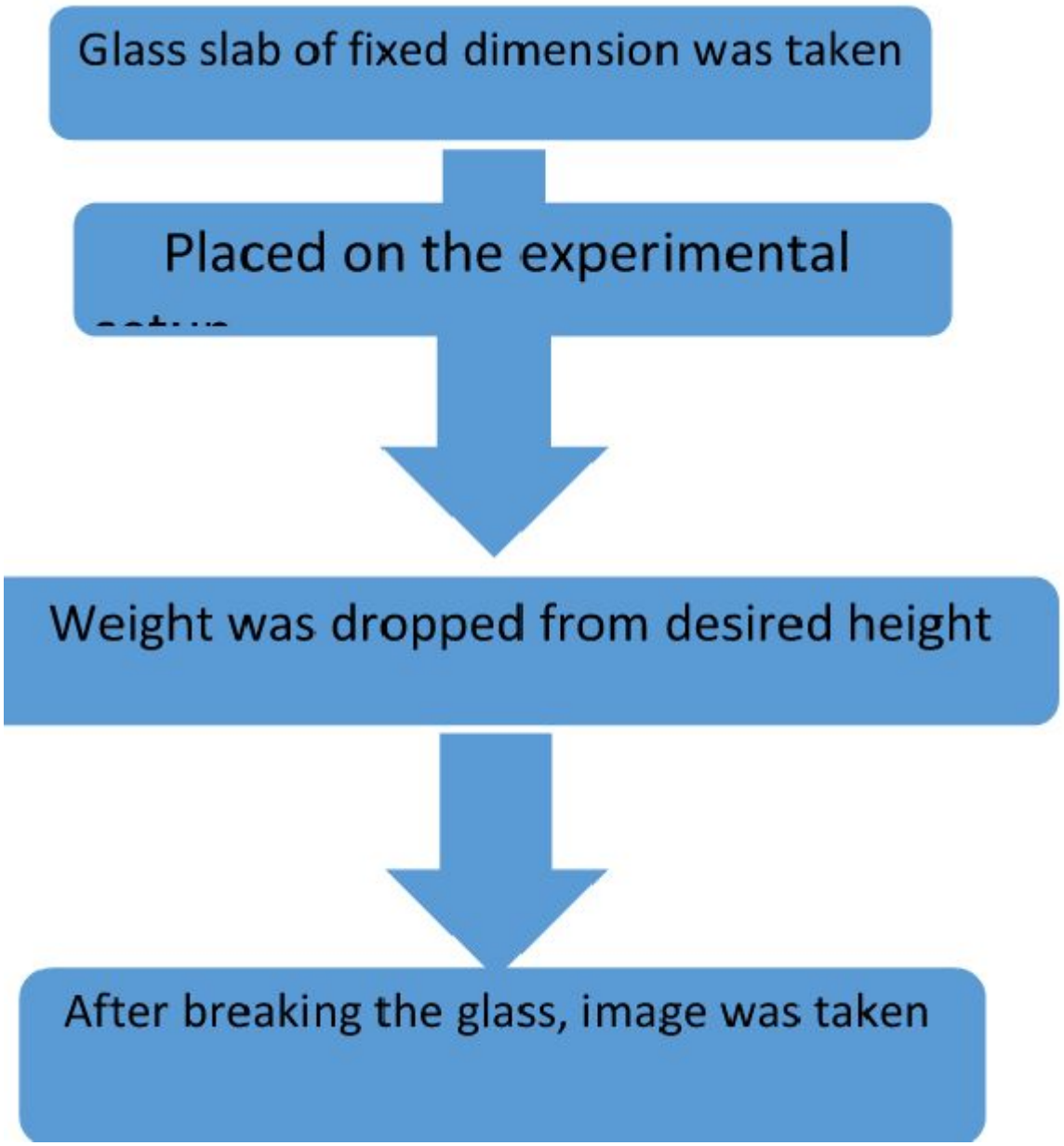

After that conclusion and results was made on the basis of observation.
2 times the experiment was performed for the same variable.

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VI. OBSERVATIONS

Experiment was performed many times and listed below with their images.
Once again variable has been introduced
H = height from which weight was dropped as shown in scale in fig 5.2
P = momentum of weight at the time of the collision.
W = mass of the weight dropped on the slab.
B = distance from the centre of the slab.

Constant variable are

W= 200g
H = 30cm
P = 0.484 kgm/sec
And H = 30cm

1ST Attempt (fig 7.1)

B = 0cm (no offset from centre)

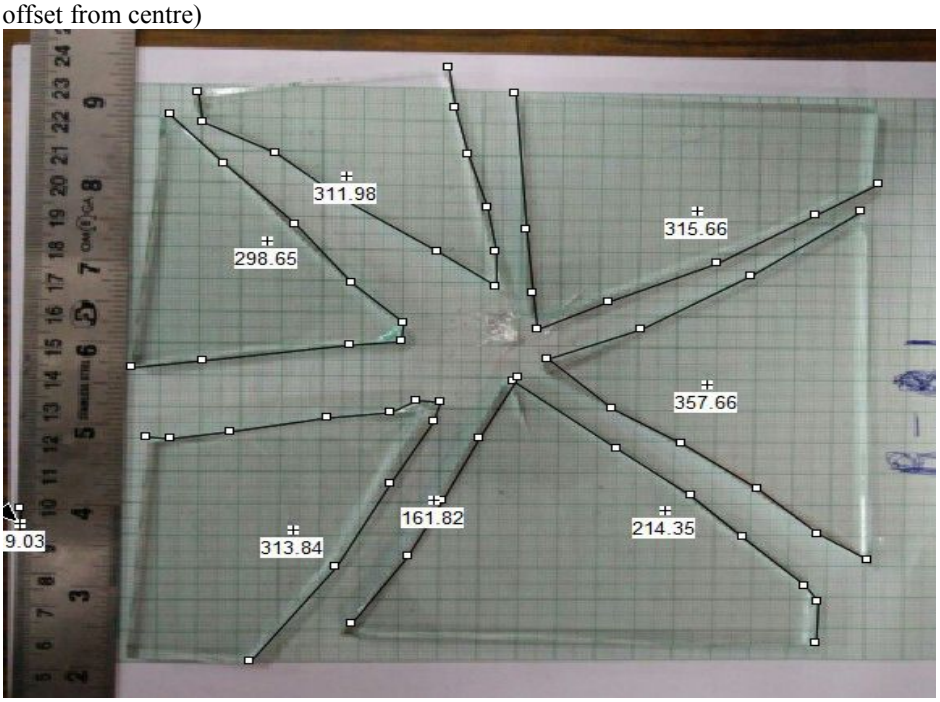

Fig 7.1

It shows by image processing the following data
Number of pieces (N) = 6
Average crack length (A) = 17.288 cm, crack length per piece
Total crack length (T) = 103.72cm

2nd Attempt (fig 7.2)

B = 2cm
A =16.24cm
T = 146.233 cm, N= 9

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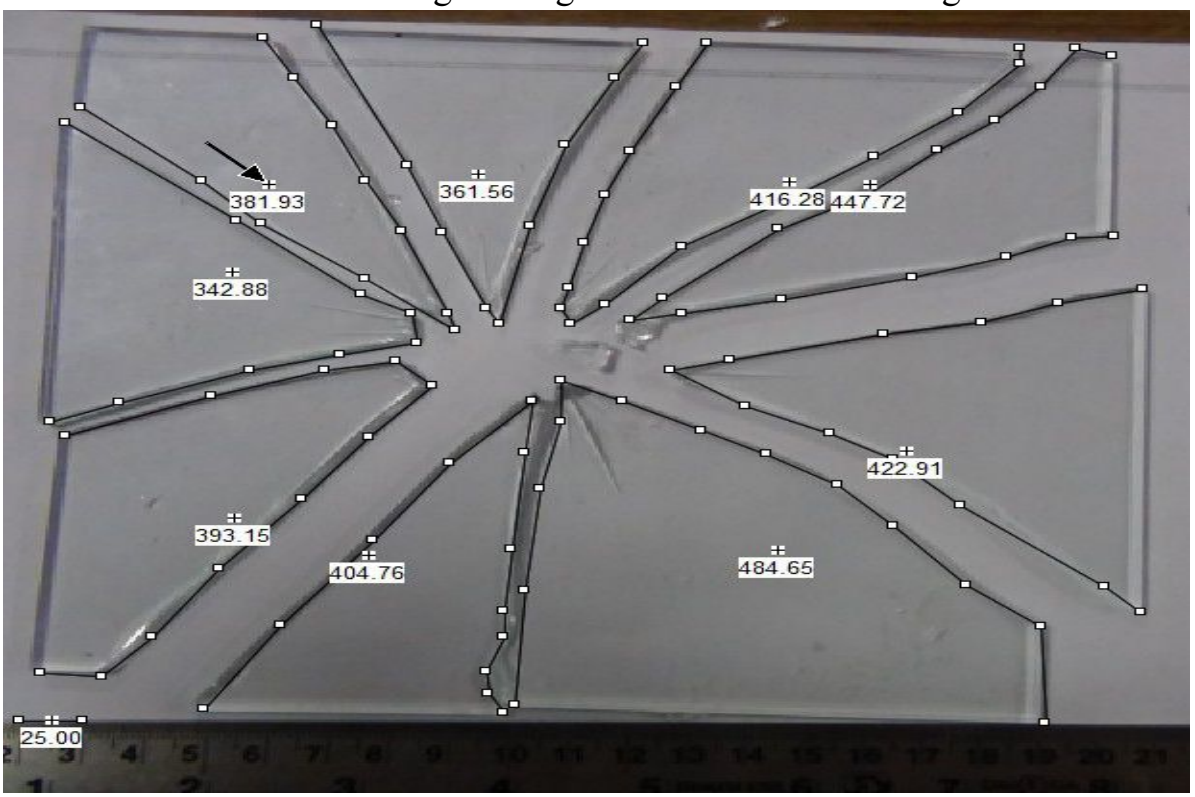

Fig 7.2

3rd Attempt (fig 7.3)
B= 4cm (offset)
N= 10
A= 17.26cm
T= 172.6 cm

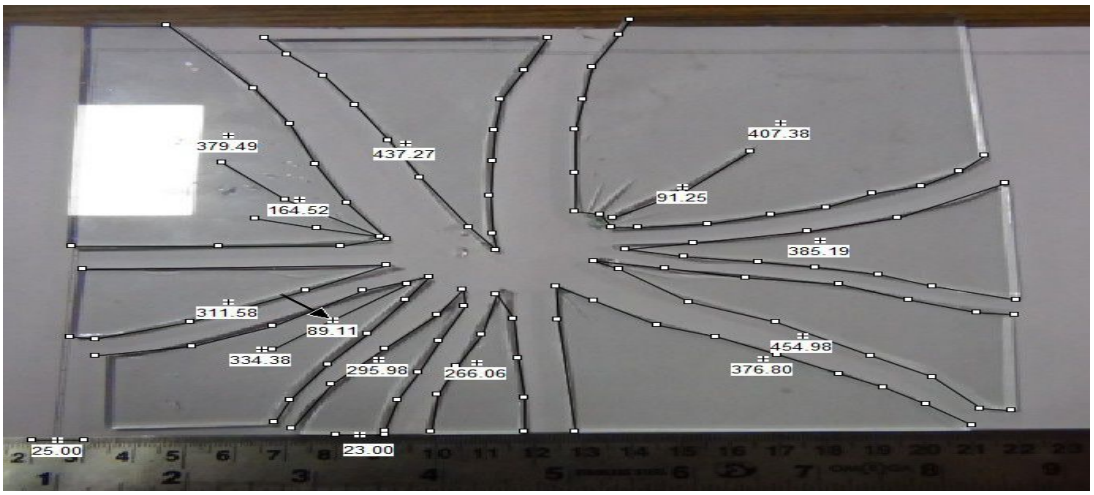

Fig 7.3

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4th Attempt(fig 7.4)
B= 5cm
N= 12
T = 179.87 cm
A= 14.98cm

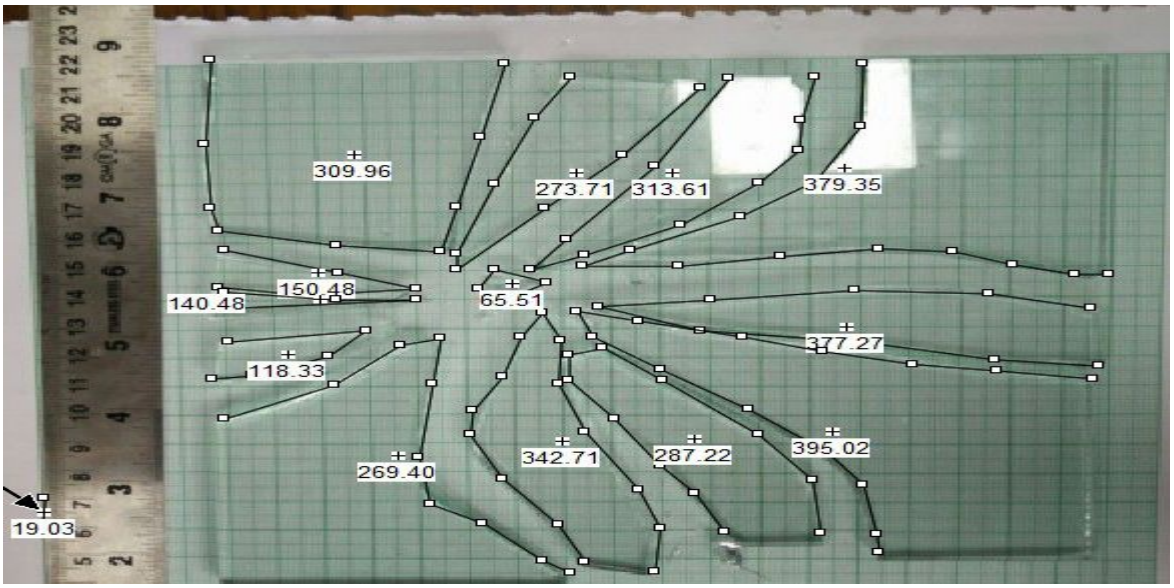

Fig 7.4

5th Attempt(fig 7.5)

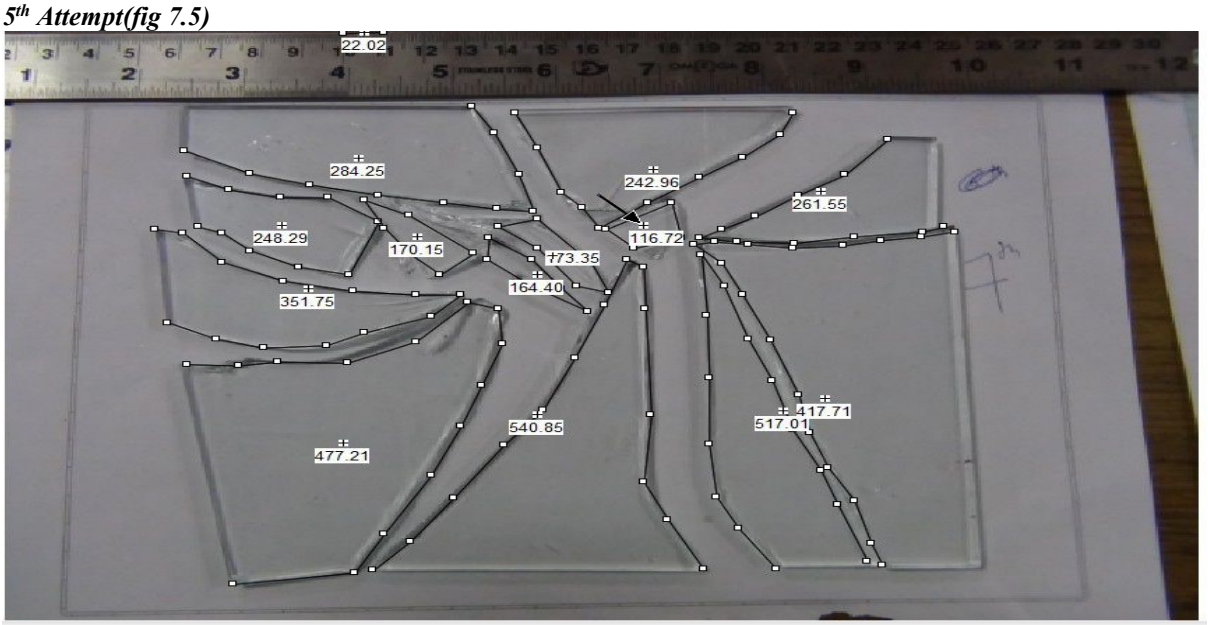

Fig 7.5

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B= 6cm
N= 13, T= 180.72cm , A= 13.84cm

Observation table:-

Sr.no	*B, Offset from centre (cm)*	*N,Number of pieces*	*T, Total crack length (cm)*	*A, Average crack length (cm)*
1	***0***	***6***	***103.72***	***13.84***
2	***2***	***9***	***146.233***	***16.24***
3	***4***	***10***	***172.60***	***17.26***
4	***5***	***12***	***179.87***	***14.98***
5	***6***	***13***	***180.11***	***13.84***

Table no 7.1

These are the trends followed by the variable introduced in previous section 7.1 that total crack length, average crack length and number of pieces vary according to the distance from the centre of glass slab.
And the glass dust come out during the breakage of the glass, these tiny pieces were neglected during above calculations.

VII. DISCUSSION AND CONCLUSION

The above plots more wisely followed the trends in light of theory, as we know that whenever you drop some weight on a glass, it contains kinetic energy at the time of collision and this whole energy will comes out in forms of surface energy gained by the broken glass,

As surface area of broken glass is more than that of initially taken glass, the whole kinetic energy of weight was used to break the glass and to propagate the crack through the surface of the glass.

There always crack presents in any solid, can be seen by microscope and energy required to propagate was given by weight containing kinetic energy at the time of Collison.

When sometimes there was not enough energy to propagate crack than unpropagated cracks were also present as can be seen in Fig 8.1

Sometimes, it's difficult to calculate the whole crack length, because of presence of glass dust, very tiny particle blown out during the breaking of the glass as can be seen in Fig 8.2

Some conclusion was made after the observations were recorded, and some trends were obtained during the breakage of the glass slab and these conclusion were made with the changing the point of collision or offset from the centre of the glass, where the weight was dropped (B).

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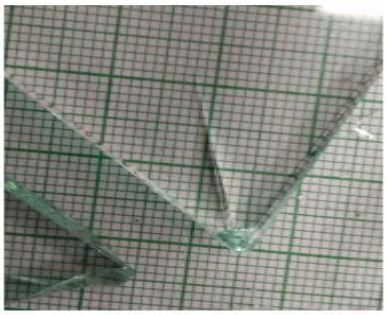

Fig 8.1 Not full propagation of cracks

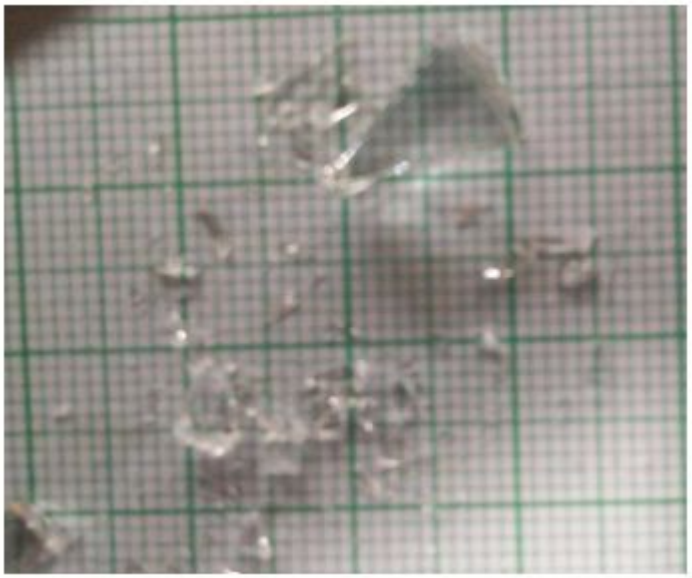

Fig. 8.2 Glass Dust

Now we concluded the following points from the observations.

7.1 Plots Of Different Characteristics of the Broken Glass

7.1.1 N ,Number of pieces v/s B,Offset from centre

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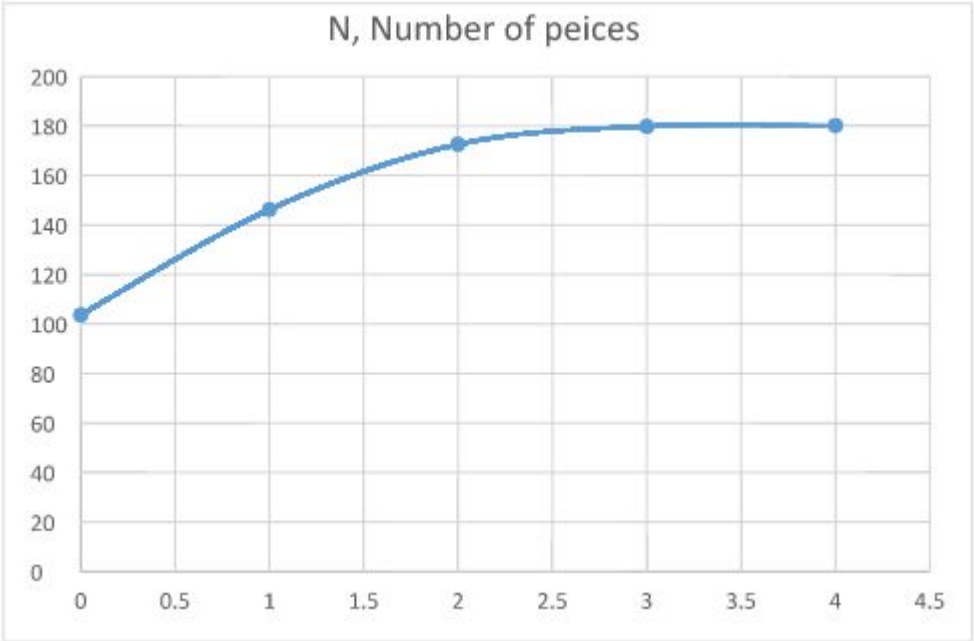

Fig 7.1.1

7.1.2 T, total crack length v/s B,Offset from centre

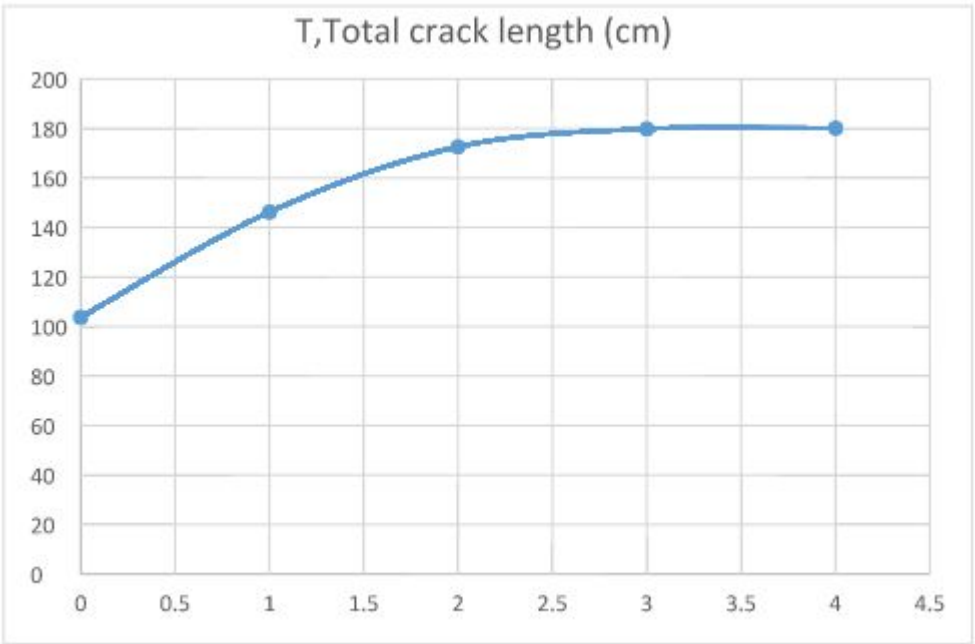

Fig 7.1.2

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7.1.1 A, average crack length v/s B,Offset from centre

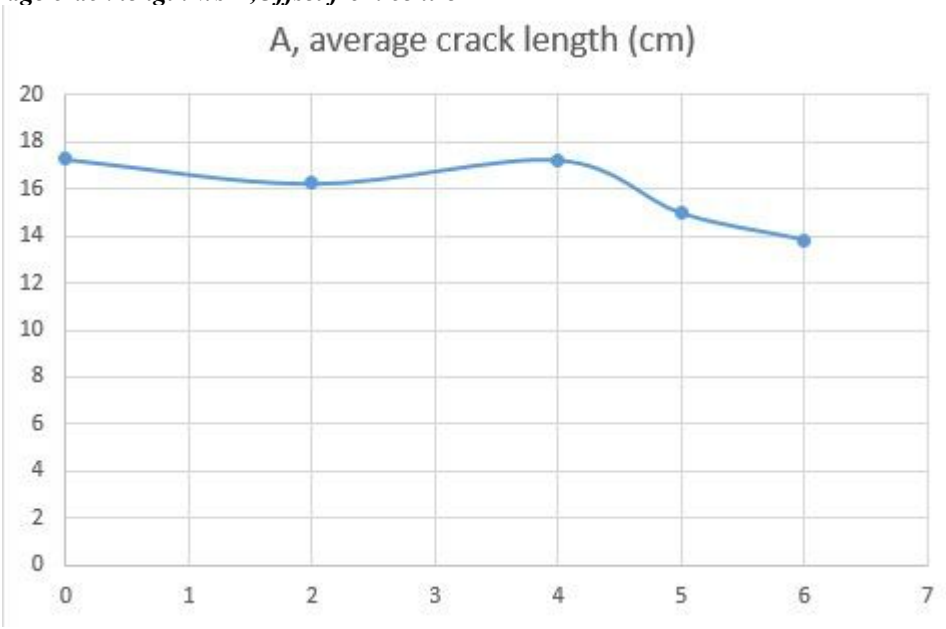

Fig 8.1.3

As seen in above following conclusion was made-
As we move away from centre of the glass (point of collision), then variation in the size of the parts broken also increases as can be seen in fig 7.1 to fig 7.5
The total crack length and number of pieces coming out (excluding dust) also increases as, the impact made away from the centre or by increasing the offset (B) as seen in Fig 8.1.1 and Fig 8.1.2 respectively.
Fig 8.1.3 shows that the average crack length or total crack length divided by number of pieces remains almost constant or vary low deviation

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