

# Design Optimizations of the Bracket Pattern of Folding Flexible Screen

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## Abstract

The bracket is on the back of folding flexible screen, which can support and protect the screen. The bracket is usually made of stainless steel, titanium alloy, carbon fiber composite, etc. As the component of folding flexible screen, the bracket must be foldable. So the bracket should be patterned with through-holes. In this work, the design and optimization of the bracket pattern are presented.

## Author Keywords

Folding Flexible Screen; bracket; pattern; design; optimization.

## 1. Introduction

In order to support and protect the folding flexible screen, the bracket is usually made of the materials with high mechanical properties such as stainless steel, titanium alloy, carbon fiber composite, etc. But at the same time, the bracket needs to be foldable, which is contradictory to the high strength of the materials. It should be to decrease the stiffness and increase the flexibility of the bending area of the bracket. The current method is to pattern the bending area of the bracket with through-holes, and make it easier to bend.

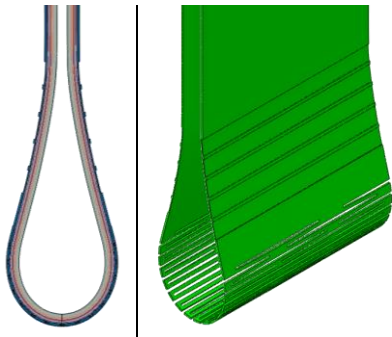


Figure 1. The sketches of the folding flexible screen and the bracket pattern.

## 2. The failure of the bracket

As the bracket is bent repeatedly, fatigue fracture of the bracket will occur and the bracket will be cracked finally.



Figure 2. The crack of the bracket in experiment.

It can be seen in the experiment and simulation that the crack of the bracket will occur in the stress concentration area (Figure 2 and Figure 3). In this work, the failure risk is represented by the maximum stress of the bracket.

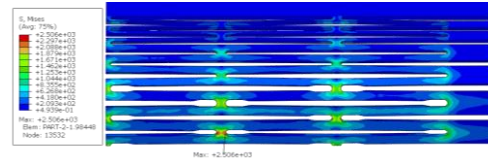


Figure 3. The point of maximum crack risk of the bracket in simulation.

## 3. The parameters of the bracket pattern

The bending area of the bracket is patterned with through-holes. The single hole is elongated and all the holes are arranged with a staggered arrangement, which is shown in Figure 4 and Figure 5. Where  $L$  is the length of a single hole;  $W$  is the width of the single hole;  $X$  is the interval between adjacent holes in lengthwise direction of the holes;  $Y$  is the interval between adjacent holes in width direction.

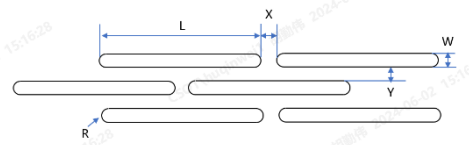


Figure 4. The parameters of the bracket pattern.

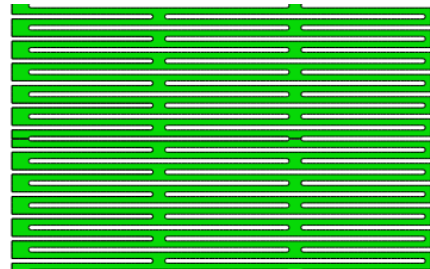


Figure 5. The sketch of the bracket pattern.

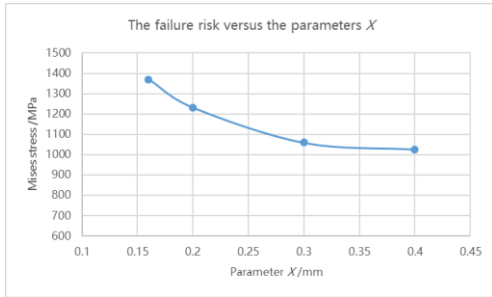
## 4. The failure risk versus the bracket parameters

The parameter  $W$  of the bracket pattern is usually set to a smaller value for the smoothness of the Screen, and the minimum value of  $W$  depends on the processing limit. The parameter  $W$  of the bracket pattern is usually set to 0.15mm.

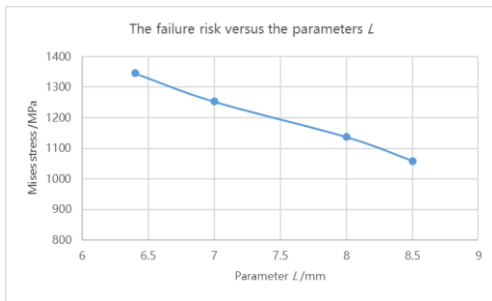
The mechanical properties of the bracket are simulated by FEA (Finite Element Analysis) software. It can be seen in Figure that the failure risk increases with the increase of the parameter  $Y$ . But meanwhile increase of the parameter  $Y$  can improve the support for the screen. So the parameter  $Y$  is set to a higher value (0.2mm).

From the simulation results, it can be seen that the failure risk of the bracket decreases with the increase of the parameters  $L$  and  $X$  (Figures 6 and 7). Among them, the value of the parameters  $X$  can't be too high, as the benefits are small  $X$  exceeding 0.3mm. A higher  $X$  will even affect the smoothness of the bent screen. So

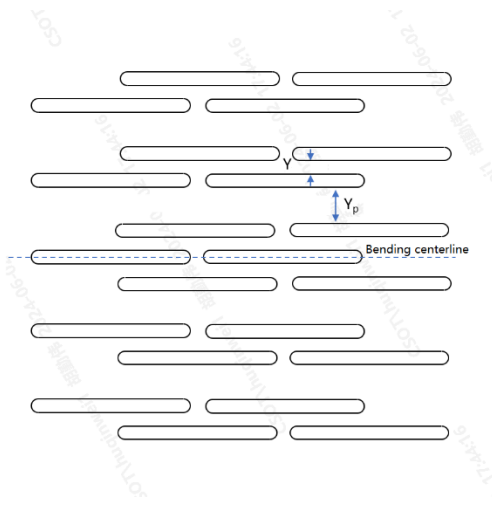
the parameter  $X$  is set to a moderate value (0.3mm). Increasing of the parameter  $L$  is an effective method to decrease the failure risk of the bracket. The value of parameter  $L$  can be adjusted according to the crack risk of the simulation.



**Figure 6.** The failure risk versus the parameters  $X$  ( $W=0.15\text{mm}$ ,  $Y=0.2\text{mm}$ ,  $L=8.5\text{mm}$ ).

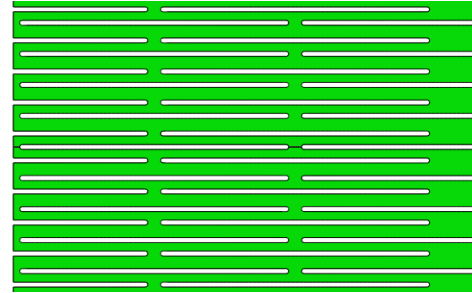


**Figure 7.** The failure risk versus the parameters  $L$  ( $W=0.15\text{mm}$ ,  $Y=0.2\text{mm}$ ,  $X=0.3\text{mm}$ ).



**Figure 8.** The sketch of the non-uniform arrangement of holes.

In addition, the holes can be arranged with a non-uniform method. As shown in Figure 8 and 9,  $Y$  and  $Y_p$  ( $Y < Y_p$ ) have an alternating arrangement. The wider bars ( $Y_p$ ) can provide better protection and support for the flexible screen; and the narrower bars ( $Y$ ) are more flexible for bending.



**Figure 9.** The pattern with the non-uniform arrangement of holes.

## 5. Conclusion

In this work, the design parameters of the bracket pattern are investigated. The effect of the parameters ( $W$ ,  $Y$ ,  $X$ ,  $L$ ) on the bracket failure risk is gotten by mechanical simulation.

- The parameter  $W$  of the bracket pattern can affect the smoothness of the Screen, and the minimum value of  $W$  depends on the processing limit. The parameter  $W$  of the bracket pattern is usually set to 0.15mm.
- The failure risk increases with the increase of the parameter  $Y$ . But the parameter  $Y$  is usually set to a higher value (0.2mm) to improve the support for the Screen.
- The failure risk of the bracket decreases with the increase of parameter  $X$ . Meanwhile the smoothness of the bent screen will also decrease. So the parameter  $X$  is set to a moderate value (0.3mm)
- Increasing of the parameter  $L$  is an effective method to decrease the failure risk of the bracket. The value of parameter  $L$  can be adjusted according to the crack risk of the simulation.

## 6. Impact of Your Research

This research presents the failure risk versus the pattern parameters of the bracket pattern. It is helpful for the design of the bracket of folding flexible screen.