

Good Use of Cracks

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Introduction

In many engineering constructions, crack is considered in serviceability limit state. However, serious cracks can also cause the failure of structures for cracks may lead to rupture. In daily life, sometimes we do need crack and rupture to help us to deal with some problems.

What's going on in life

It is hard for us to break off the egg without breaking the shell. However, only if there are small cracks on the surface of the shell, it becomes easy to break off the egg from these cracks.



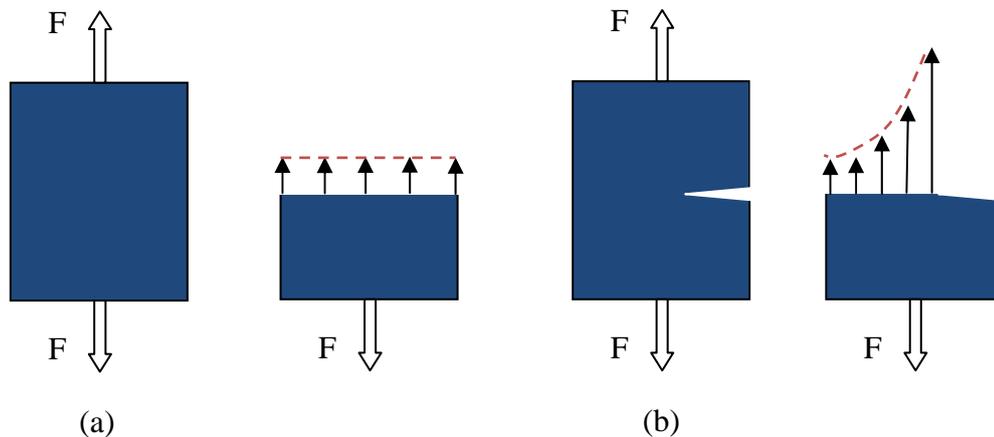
The nicks around the ring-pull of the can have the same effect like the cracks. Without these nicks we can hardly open the can.



Principle

The phenomenon above can be explained by stress concentration principle. For the existing of cracks gives rise to the increase of the stress at the end of the cracks.

As figures shown below, we can easily find that Figure (b) is easier to rupture. That is because the changing of cross-section leads to the increasing of stress around the gap. Also, according to the equation $\sigma = \frac{F}{A}$ (where A is the cross-section area), it can be proved that the reduction of A will give rise to the increasing of σ .

One more experiment

People in China like eating Sparerib Soup, while the ribs are difficult to cut off and snap (see above). A common method to deal with this problem is to use knife to make a crack on the bone. It can be found that just a small bending moment can break the bone into two pieces. Obviously, the crack gives rise to the stress concentration (the stress is higher near the crack than that in other parts of the bone), so it is easy to break the bone.

Conclusion

1. Cracks are always considered as having no good points. This study refutes this view and in fact in our everyday life, people make use of the cracks consciously or unconsciously, as shown in the experiments by myself.
2. The reason why cracks cause rapture is related to the concept of concentration principle. There is always higher stress around the cracks than other places. However, further analysis of rapture requires the knowledge of rapture mechanics, which is not mature and complex.

Reference

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