



A Study for Unbreakable Snack

MP21

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Motive & Goal



Collision
each s



of snack

**We will design
unbreakable snack
for snack company!**



Outline

Manufacture

Make Existing Snacks
- oven

Make Mold of Our Solution
- CNC milling machine

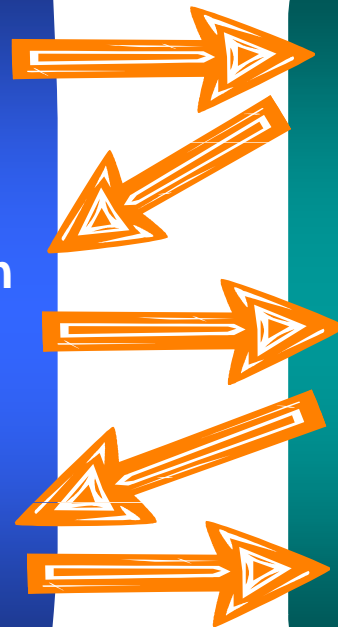
Make Our Solution
- mold, oven

Analysis

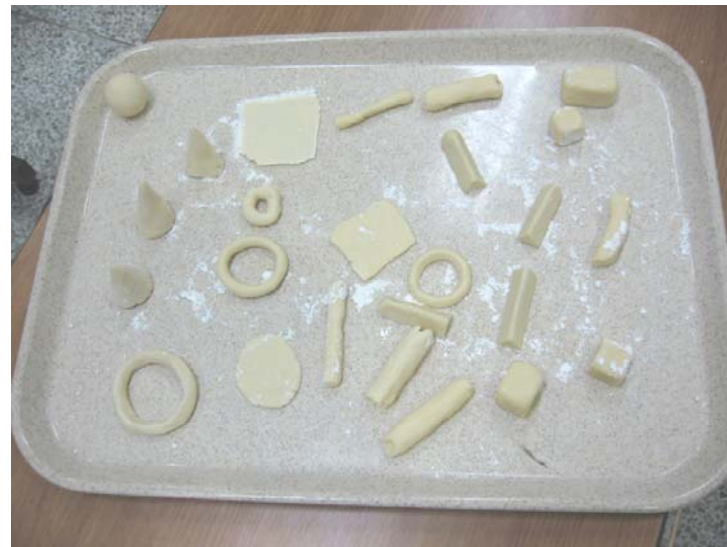
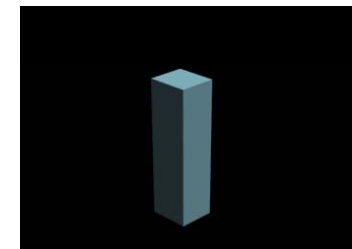
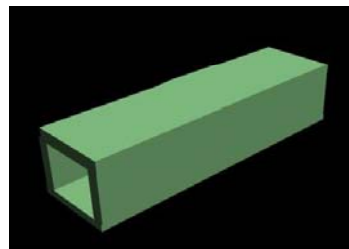
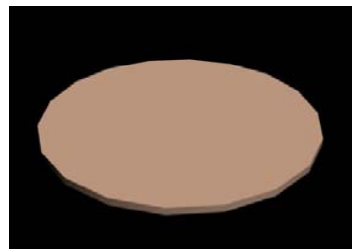
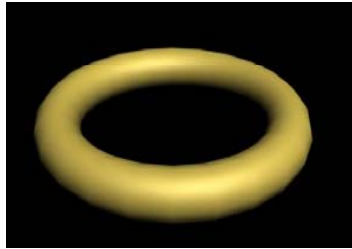
Analysis Existing Snacks
- property, finite element

Design Our Solution
- mold modeling

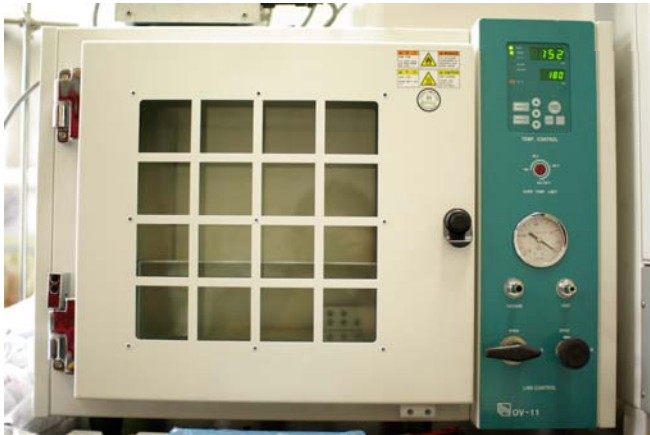
Analysis Our Solution
- Finite element



Existing Snacks



Existing Snacks



Existing Snacks

- ❖ We measured compressive stress and bending moment at failure.

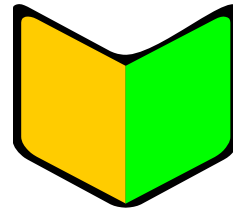


Theoretical Analysis

The condition of snack

–Volume have to look bigger

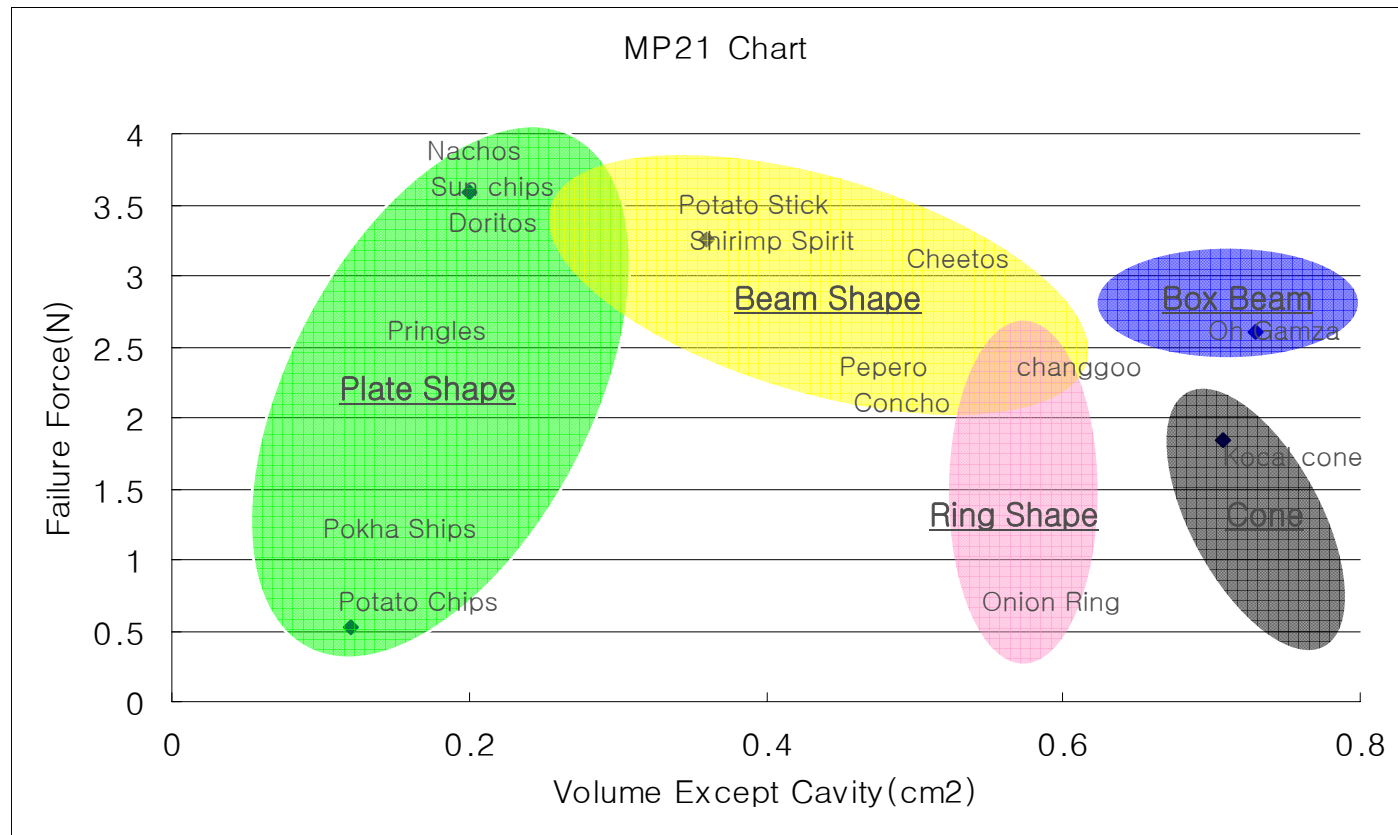
–Failure Stress And Bending per unit mass have to High



$$\frac{V_a F}{m} = \text{Max} \quad F = \frac{(F_{xx} + F_{yy} + F_{zz} + M)_{\text{max}}}{4}$$

Theoretical Analysis

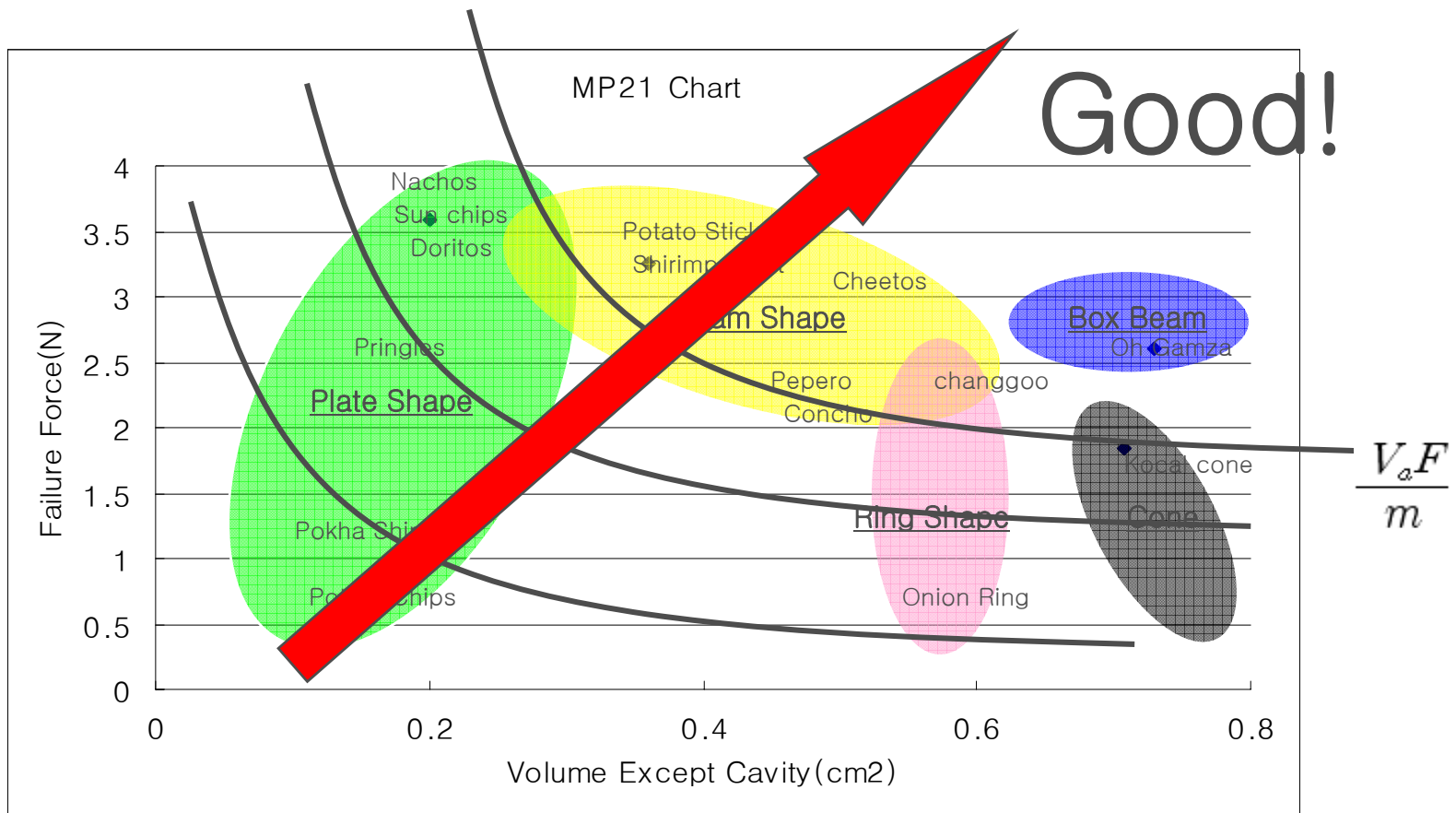
❖ MP21 CHART



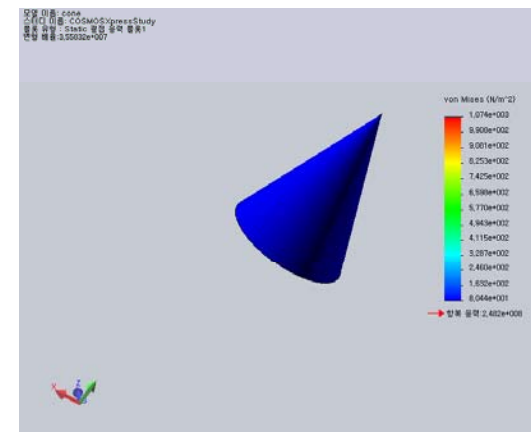
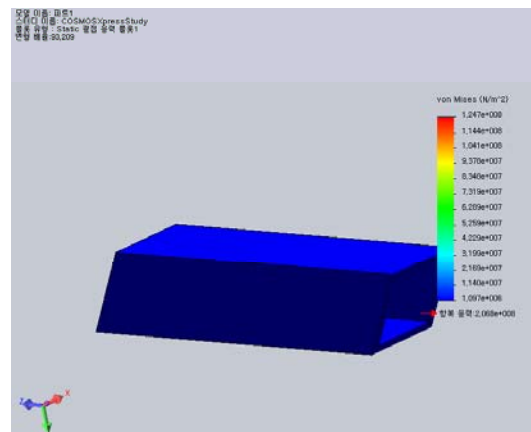
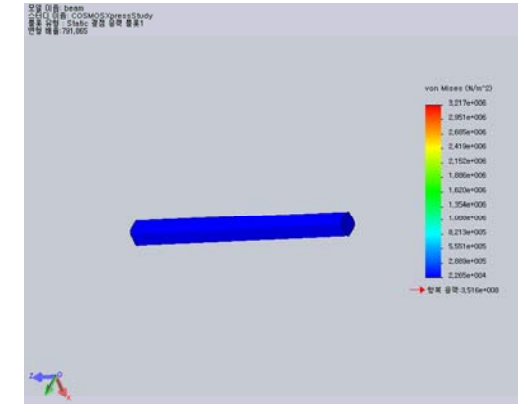
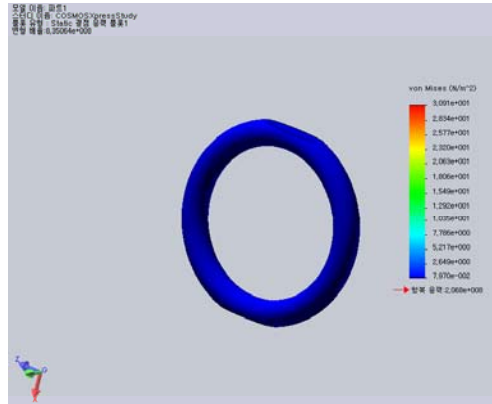
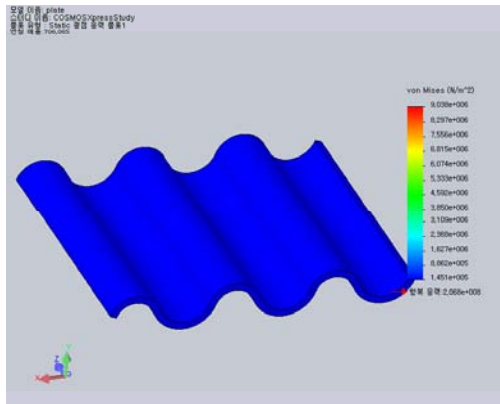
Theoretical Analysis

$$\frac{V_a F}{m} = \text{Max}$$

$$F = \frac{(F_{xx} + F_{yy} + F_{zz} + M)_{\text{max}}}{4}$$



Modeling & Analysis





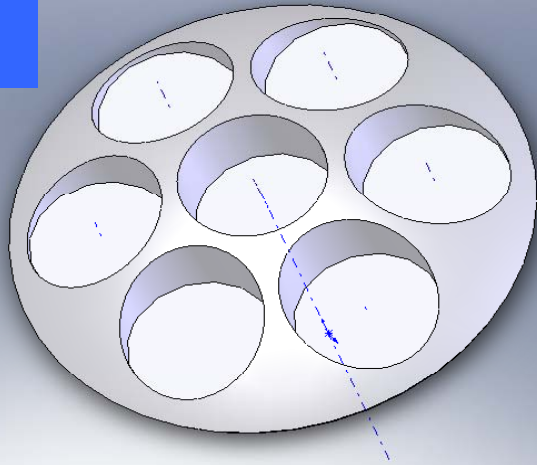
Design Consideration

1. avoid corners or edges
2. shell shape is weak to compression
3. must have large seemingly volume per mass
4. highly resistant to bending

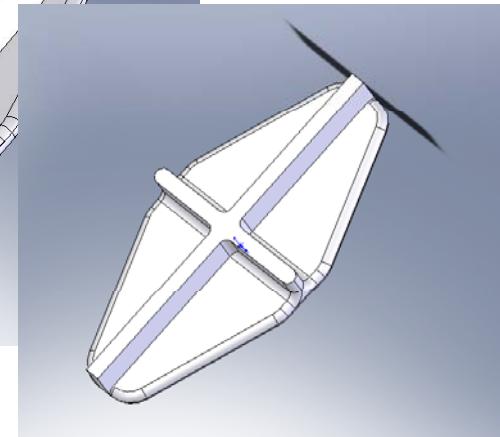
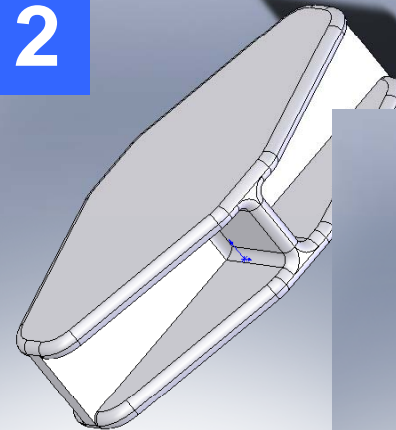


Proposals for Unbreakable Snack

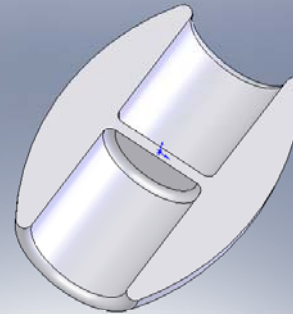
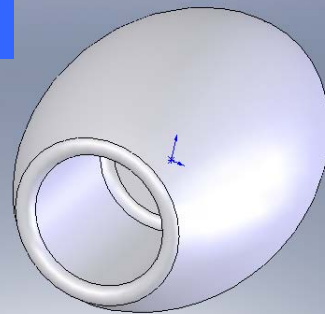
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2



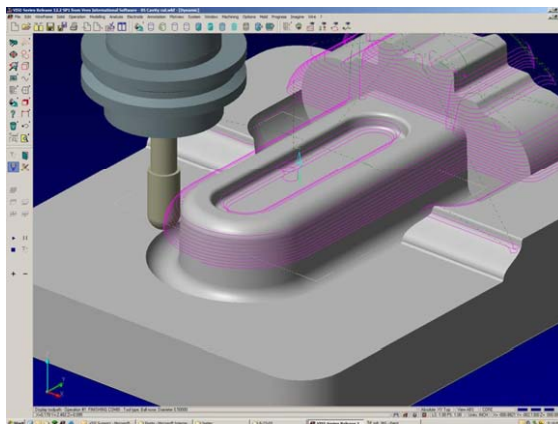
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Proposals for Unbreakable Snack

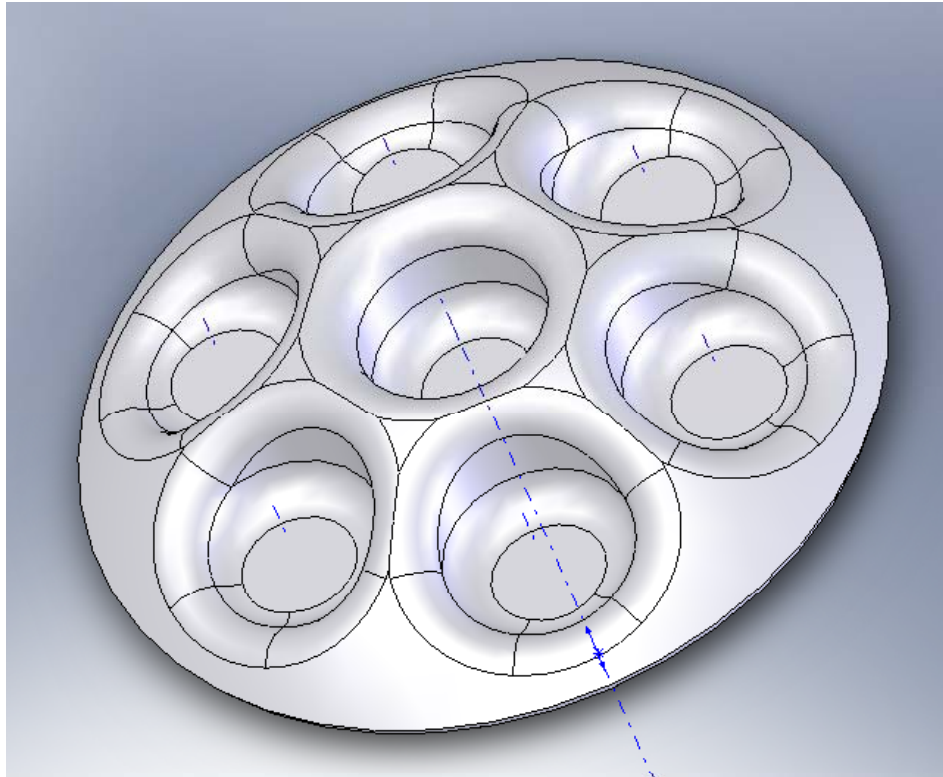
❖ Constraints for CNC Milling Machine and Mold

1. Whole Thickness $< 30\text{mm}$
2. Shell Thickness $> 6\text{mm}$
3. Corner Radius $> 3\text{mm}$
4. Draft Angle



Proposals for Unbreakable Snack

❖ Final Shape



- Honeycomb structure
- Strong to compressive stress, bending moment
- High apparent volume per mass
- Easy to make using mold




Proposals for Unbreakable Snack



❖ Optimization of Shape Parameters

$$\min_h U(h)$$
$$U(h) = \frac{P(h)^2 \times h}{2 \times E \times A(h)} \quad P(h) = K \frac{\pi^2 \times E \times I(h)}{h^2}$$



We determined the thickness of the snack using energy at buckling fracture

Proposals for Unbreakable Snack

❖ Mold for Final Snack Shape



Proposals for Unbreakable Snack

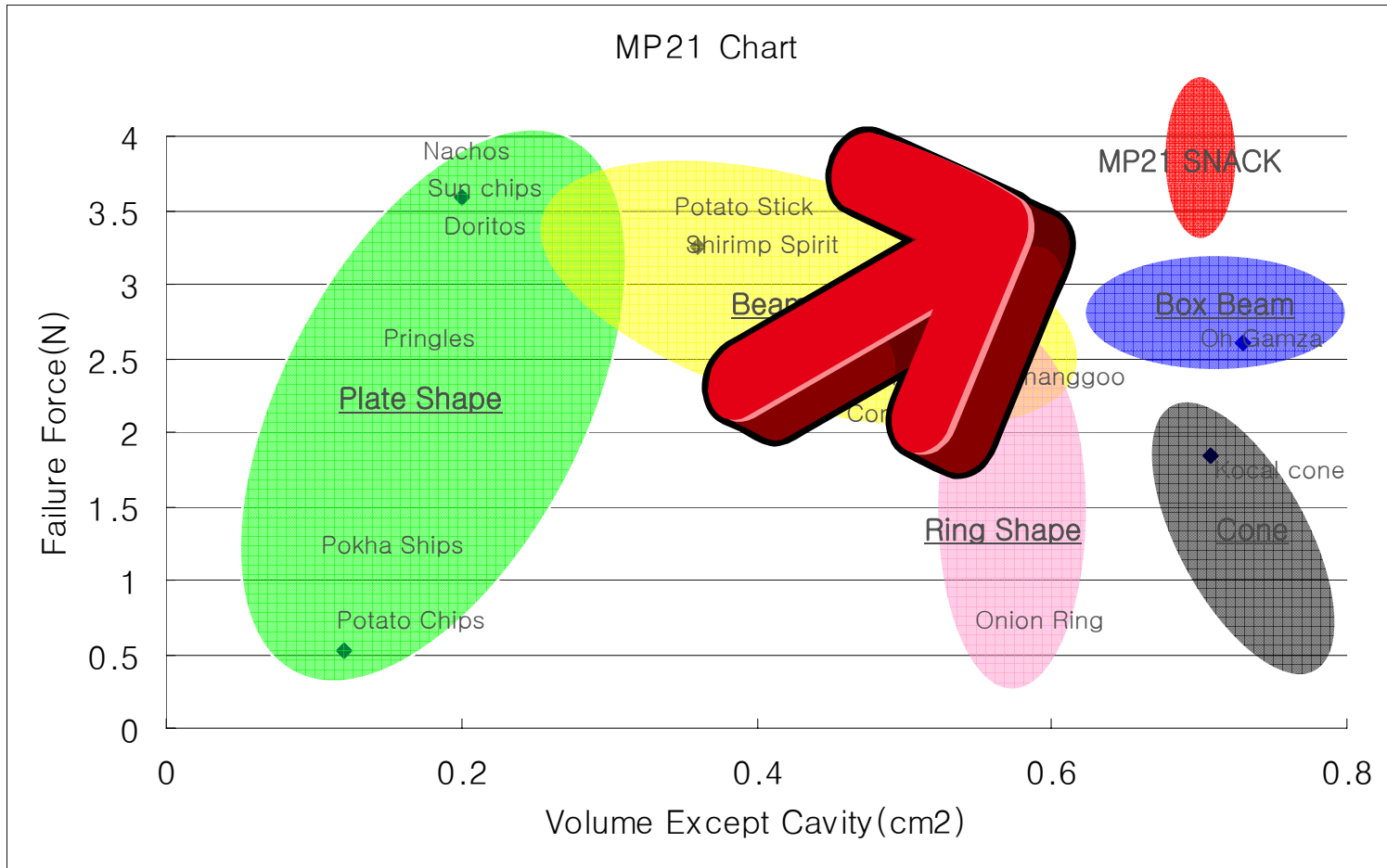


Proposals for Unbreakable Snack

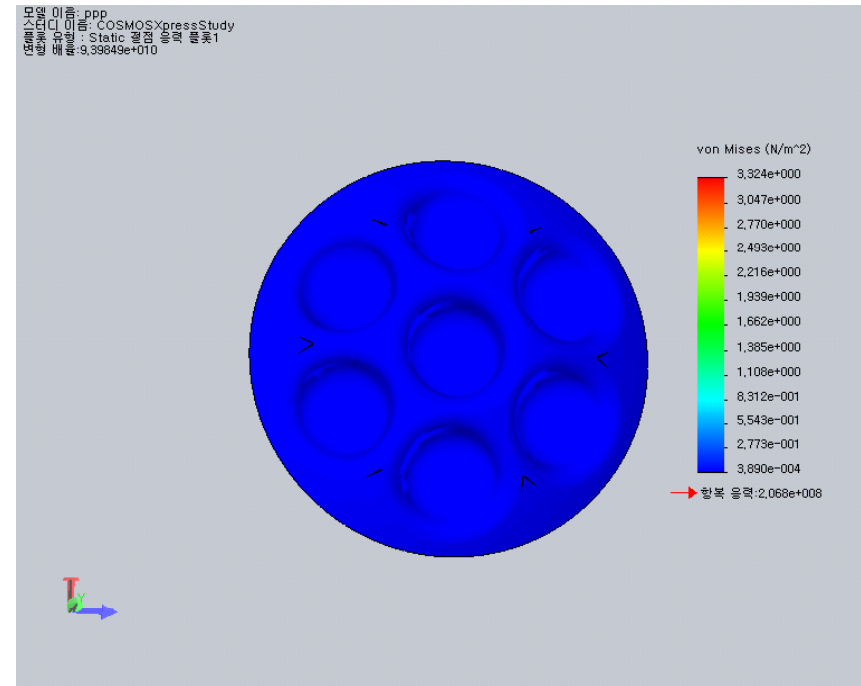
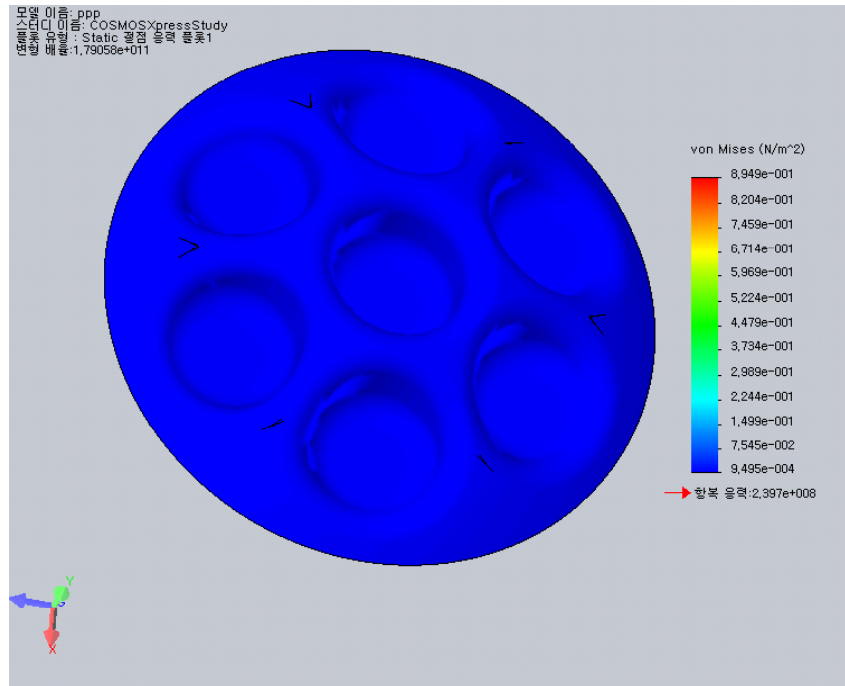
❖ Final Snack



Analysis



How to Eat



**It is strong but
easy to eat!**

Conclusion

Consumer can eat perfect snack from market!



Companies can maximize their profit, and lower manufacturing cost!



Thank You!

