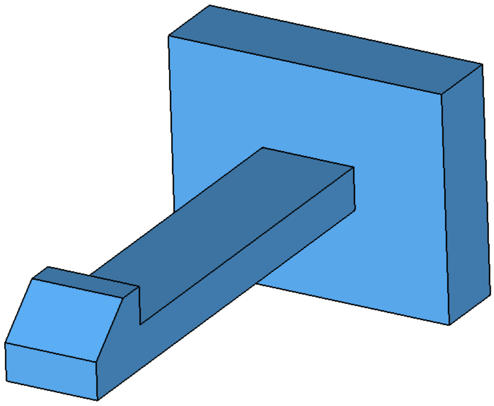
Snap-Fit Design

R&D Center

KOREA ENGINEERING PLASTICS CO.,LTD.

1. Snap-Fit Fastening



[Figure 1] Snap-Fit

(1) The Snap-Fit fastening method can simply fasten two components without additional component or a fastening instrument. Fastening force is generated by interaction between a latch and a groove.

(2) Features of the Snap-Fit fastening method:

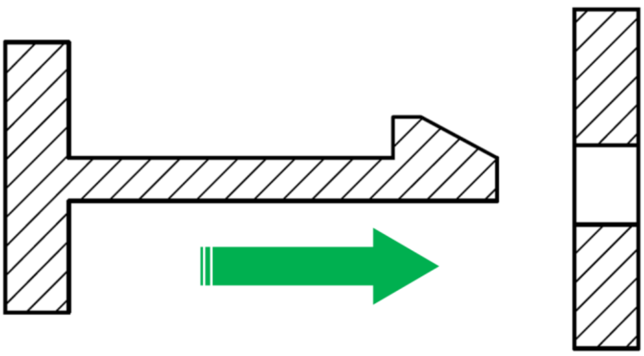
1) Depending on the form of the latch at the joint, it can be designed to be disassembled or fixed permanently.

2) If the materials of two components are completely different, such as different plastics or metals, this method can be applied.

3) It can save cost as there is no additional component cost and the fastening time is relatively quick compared to that of other fastening methods.

2. Snap-Fit Fastening Method

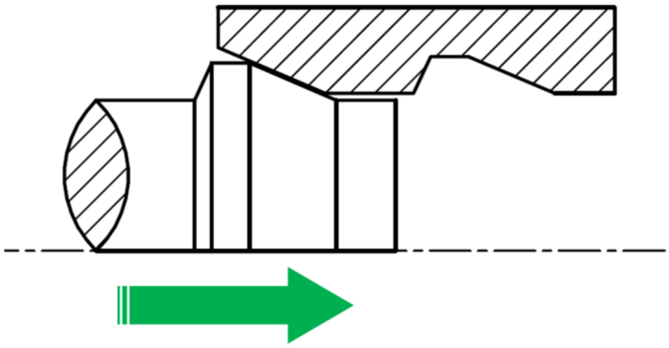
(1) Cantilever Snap-Fit



[Figure 2] Cantilever Snap-Fit

A Snap-Fit type with a cantilever form and most widely used

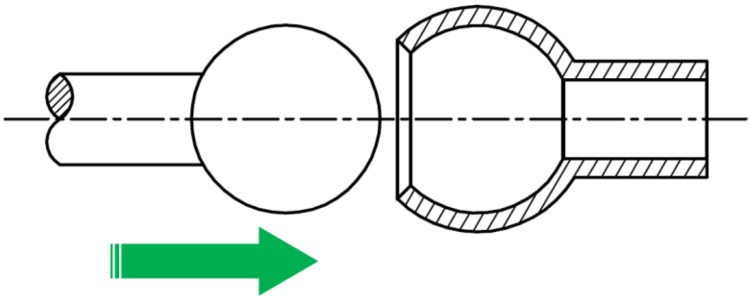
(2) Annular Snap-Fit



[Figure 3] Annular Snap-Fit

Used in products in which fastening and separation frequently occur, like a bottle and a bottle cap

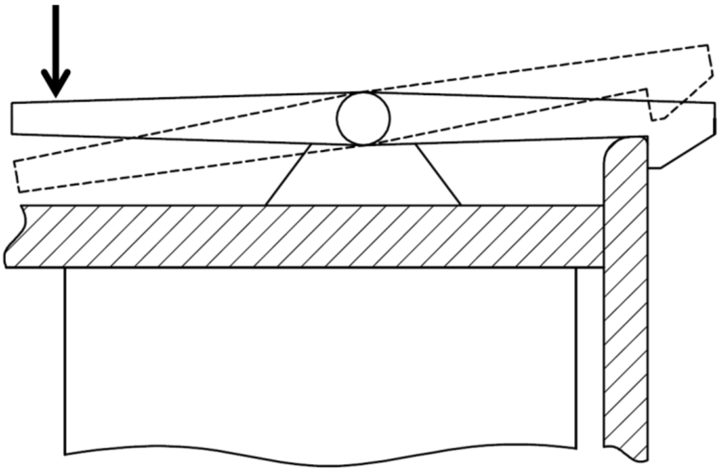
(3) Ball and Socket Snap-Fit



[Picture 4] Ball and Socket Snap-Fit

A way to fasten a ball and a socket and mainly used in parts serving a ball joint role

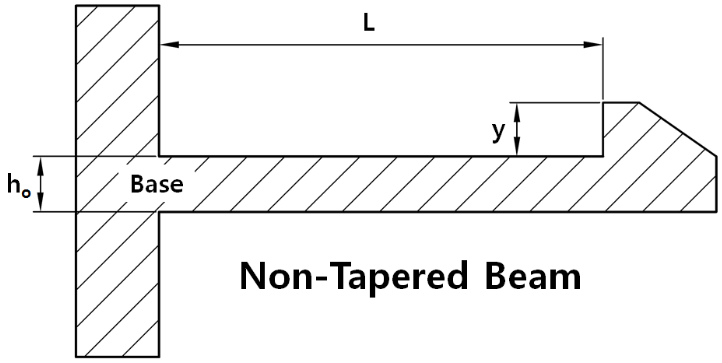
(4) Torsional Snap-Fit



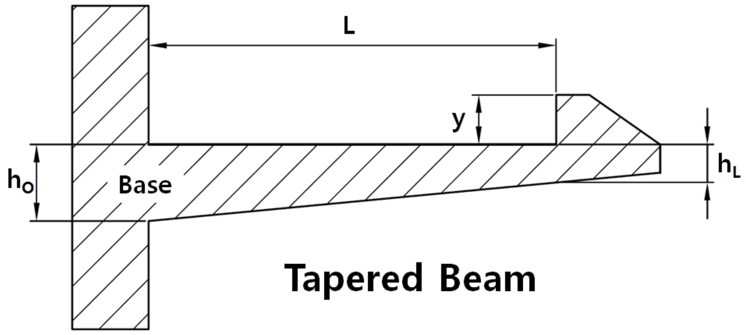
[Figure 5] Torsional Snap-Fit

When combined, torque is applied on the axial of the torsion bar which has a torsional spring effect

3. Snap-fit Design(with respect to Cantilever Snap-Fit)



[Figure 6] Straight Beam



[Figure 7] Sloped Beam

(1) Essentially, a Cantilever Snap-Fit is designed to be fastened with another component at the end of the protrusion which extends from the base of a component and is processed to form of a hook or a bead.

(2) Snap-fits should not be considered in components intended to be disassembled regularly. (Cantilever Snap-fits exhibit easy assembly, so disassembly is possible but rather difficult. In addition, as a snap-fit is designed on the basis of the deformation caused by assembly, plastic deformation or plastic failure may result from the disassembly causing relatively larger deformation.)

(3) Design conditions that must be considered

1) Generally, the strain of parts made of unfilled materials is allowed up to 5% and that of reinforced materials is allowed up to 1~2 %. (This strain is slightly higher than the generally recommended strain. However, strain only partially occurs at the surface and in addition a supporting wall is not completely fixed, unlike the assumption of mechanics theory, and has some flexibility. Therefore the above-mentioned strain is available since the real value can be decreased more effectively than the theoretical value.)

∴ Strain by deformation of straight beams (A) and slope beams (B)

Strain beam: $\varepsilon = \dfrac{3hY}{2L^2}$

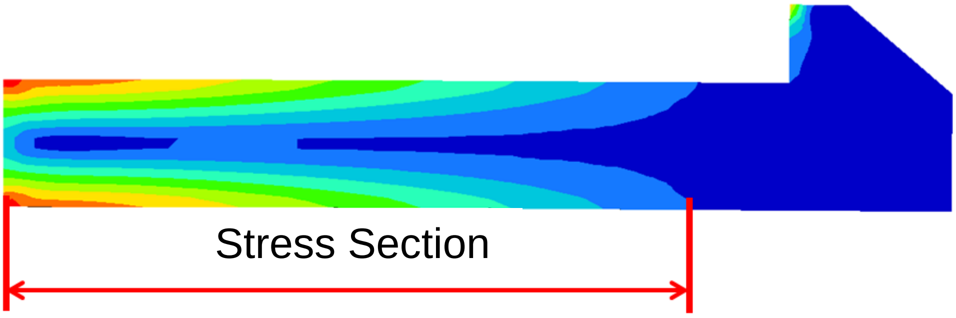
Slope beam: $\varepsilon = \dfrac{3hY}{2L^2K}$ (Geometrical factor from $K : \dfrac{h_L}{h_O}$)

2) As for permanent assembly, there is just one deformation, so the strain cannot exceed the above-mentioned strain.

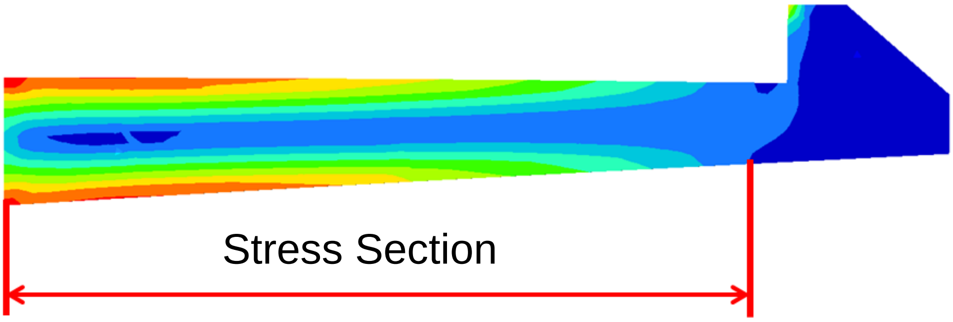
3) In the case of using a sloped beam, stress is reduced as it is widely distributed

throughout the cantilever. Therefore, stress concentration and fastening force is relatively reduced. (An added note: the ratio of h_O and h_L is recommended to be 2:1.)

The pictures below illustrate the aforementioned concept.



[Figure 8] Stress distribution of straight beams



[Figure 9] Stress distribution of sloped beams

4) In order to reduce the stress concentration, add a round form(R) to the edge of the bottom of a beam.

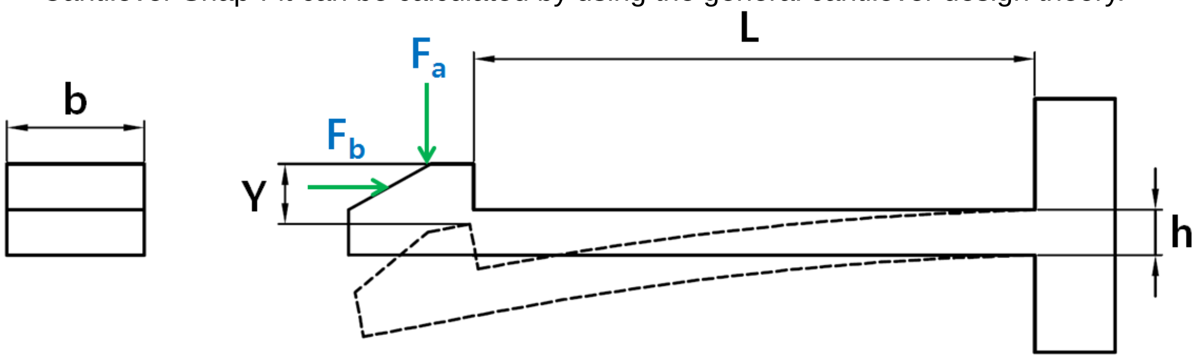
5) The location of assembly should be considered with flexibility of the wall of the product. This helps to reduce external stress.

6) To avoid shrinkage marks, it should be less than 60% of thickness of the basic wall.

4. Cantilever Snap-Fit Design Theory

(1) Cantilever design theory

Cantilever Snap-Fit can be calculated by using the general cantilever design theory.



[Figure 10] Cantilever Snap-Fit

Secondary moment of cross section $I = \frac{bh^3}{12}$

Cross-section coefficient $Z = \frac{I}{c} = \frac{bh^2}{6}$ ($c = \frac{h}{2}$)

Maximum flexural stress $\sigma = \frac{M}{Z} = \frac{PL}{Z} = \frac{PL}{\frac{bh^2}{6}} = \frac{6PL}{bh^2}$ (M : 모멘트, P : 하중)

Maximum deformation $Y = \frac{PL^3}{3EI}$

Loading $\therefore$ $P = \frac{3EIY}{L^3} = \frac{Ebh^3Y}{4L^3}$

Rearrange the equation of maximum flexural stress inserting the loading, P,

Maximum flexural stress $\therefore$ $\sigma = \frac{3EhY}{2L^2}$

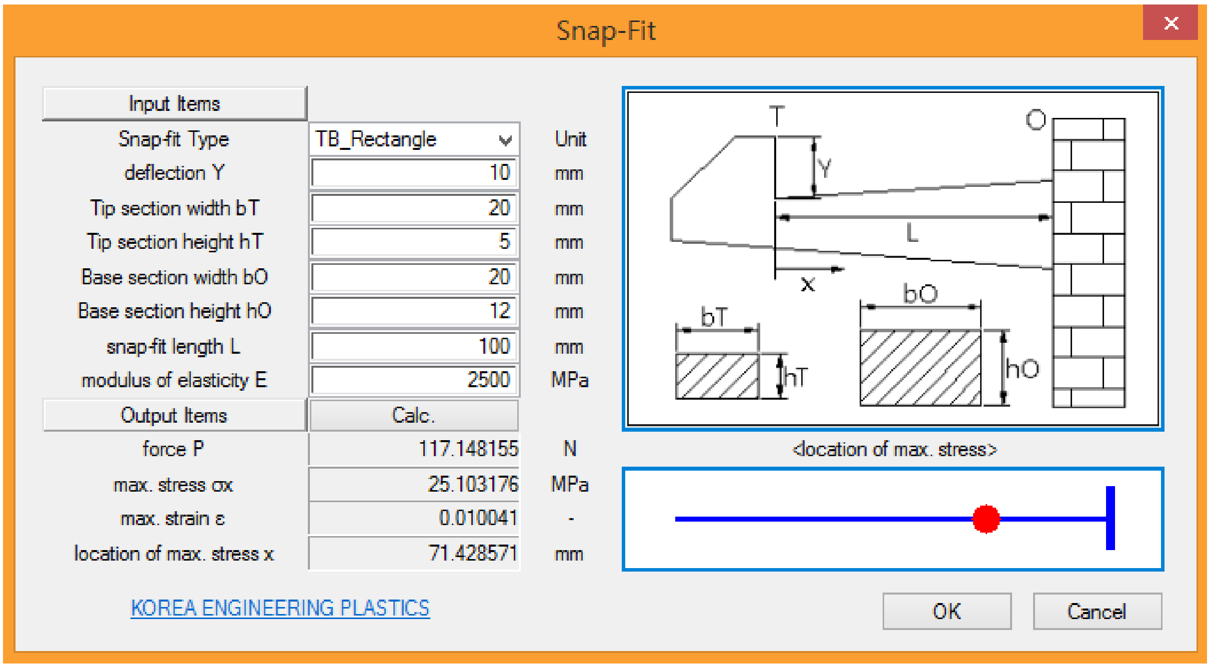
$\because$ $\sigma = E\varepsilon$

Rate of maximum deformation $\therefore$ $\varepsilon = \frac{\sigma}{E} = \frac{3hY}{2L^2}$

Transverse force, F_b, is obtained by this equation

$\therefore$ $F_b = F_a \frac{\mu + \tan\alpha}{1 - \mu\tan\alpha}$ (μ : friction coefficient, α : contact angle of slope)

5. Snap-Fit Calculation Tool – Ksoft



[Figure 11] Snap-Fit module of Ksoft

(1) By using the Snap-Fit module of independently developed Ksoft, the strength of cantilever Snap-Fits with various cross-section can be calculated.

(2) The following various cross-sections and types of Snap-Fit can be calculated.

Shape of cross-section	Whether change in Cross-section	Note
Rectangular	Straight beam	
Circular		
Triangular		
Trapezoidal		
Semicircular		
Randomly shaped		Use cross-section coefficient
Rectangular	Sloped beam	
Circular		

(3) Features of Snap-Fit module of Ksoft
1) Generally, when calculating the sloped beam, the ratio of sectional height is used. But Calculation of Ksoft uses precisely determined mathematical solution.
2) In the case of sloped beams, the site where maximum stress takes effect can be obtained and checked easily with Ksoft.

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