

Generative Shape Design

Computational Design Laboratory
Department of Automotive Engineering
Hanyang University, Seoul, Korea



한양대학교
HANYANG UNIVERSITY



CDL

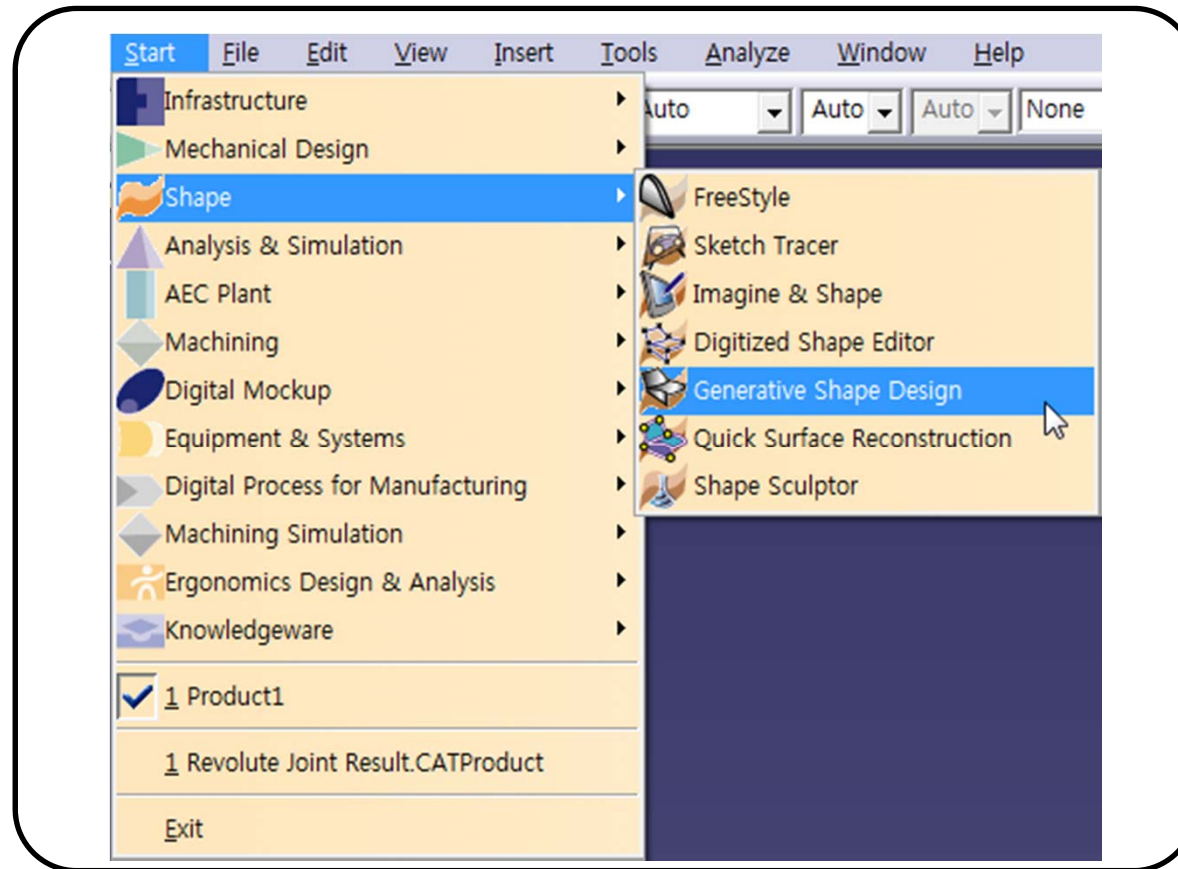
Computational
Design
Lab

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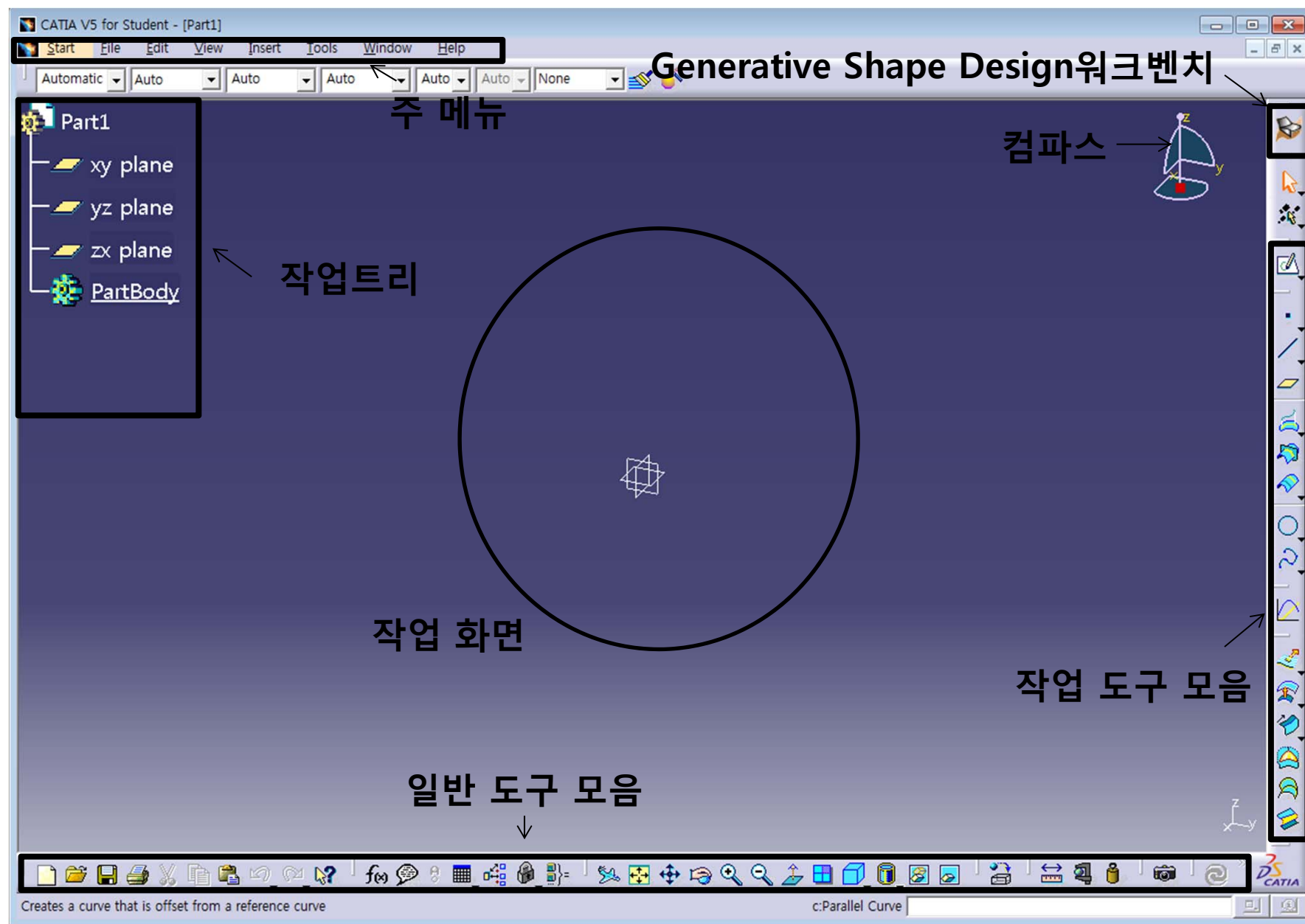
- ✓ 시작하기
- ✓ Wireframe
- ✓ Surfaces
- ✓ Operation
- ✓ Advanced tools

GENERATIVE SHAPE DESIGN 시작하기

Start 메뉴에서 Shape → Generative Shape Design 선택



GENERATIVE SHAPE DESIGN 작업화면

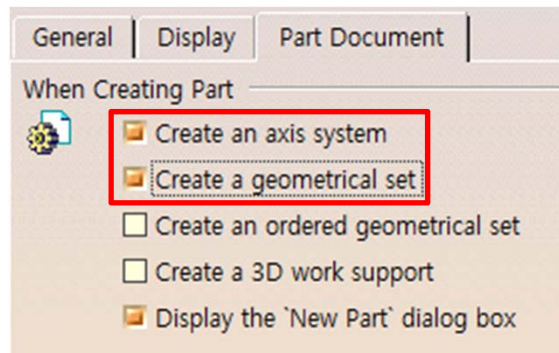


GENERATIVE SHAPE DESIGN 기본설정

기본 설정

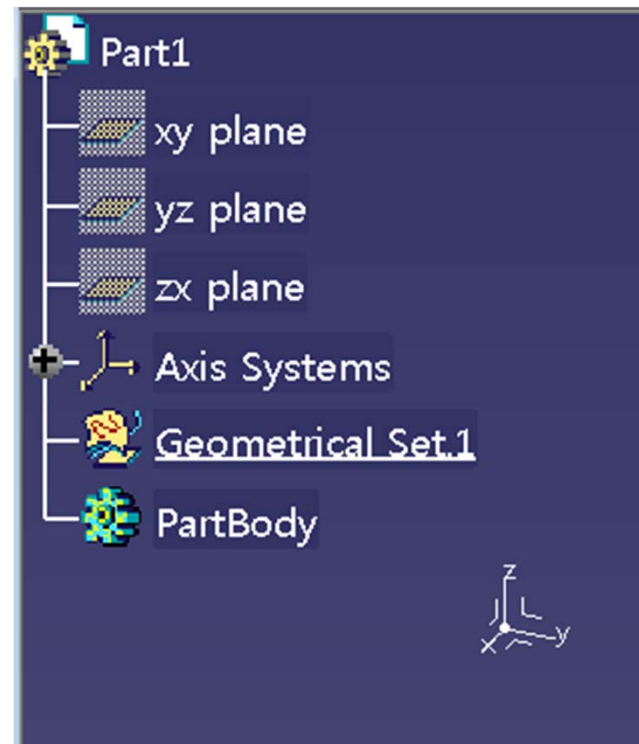
GSD 작업에 앞서 Geometrical set  과 Axis system  Option 설정을 해두면 작업이 수월해짐

· Tools → Options → Infrastructure → Part Infrastructure



Geometrical set:

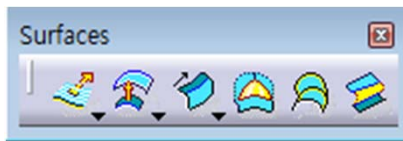
Wireframe 및 Surface 형상 요소에 대해 정렬 및
구분을 짓기 위한 세트



GENERATIVE SHAPE DESIGN 툴바 종류



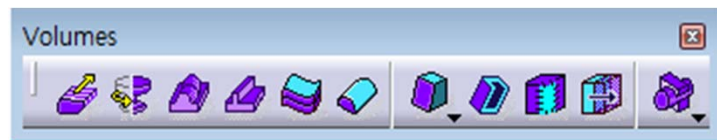
Reference Element와 Wireframe을 생성



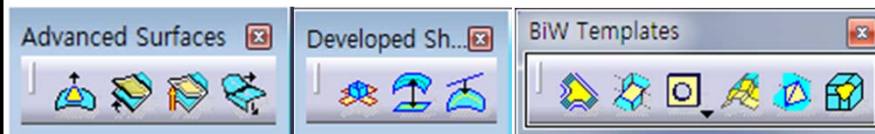
Wireframe or Sketch 로부터 Surface 생성



생성한 Surface를 조립, 분할, 연결 등을 하는 기능



Surface에 Volume을 부여하는 기능



좀 더 전문적인 Shape Design을 위한 기능

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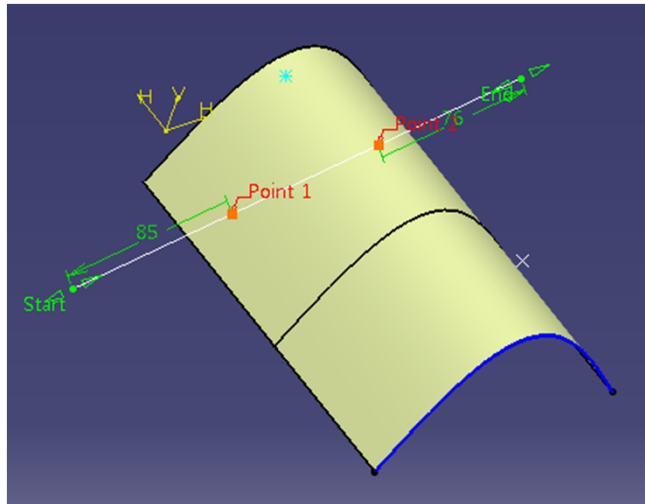
- ✓ 시작하기
- ✓ **Wireframe**
- ✓ Surfaces
- ✓ Operation
- ✓ Advanced tools

GENERATIVE SHAPE DESIGN TOOL

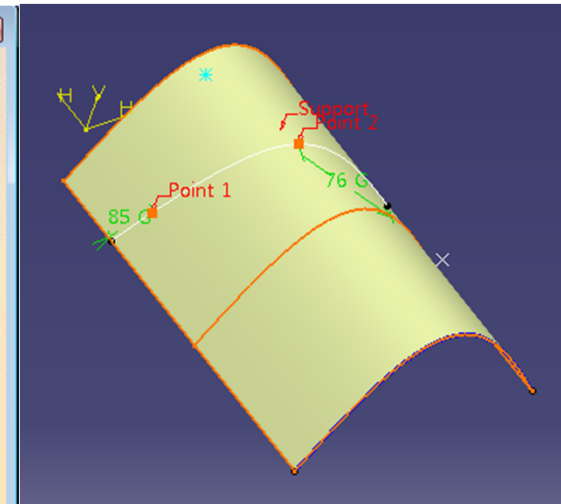
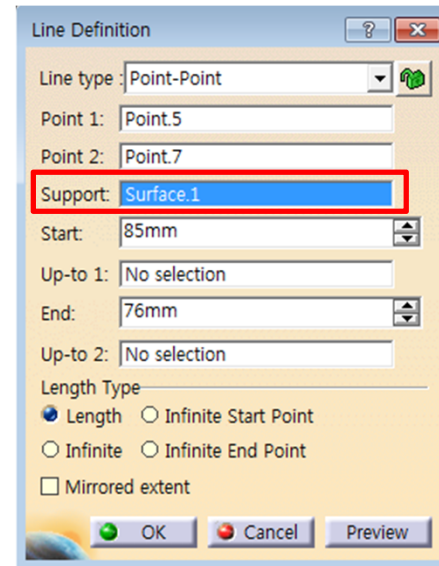
Wireframe

Line 

기존의 Line 생성 결과

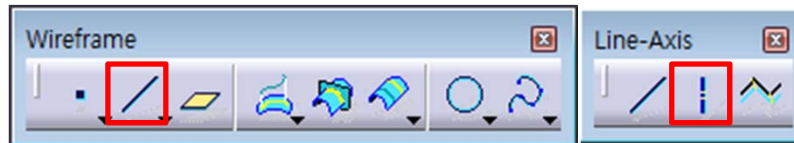


Surface를 Support로 선택 후 Line을 생성한 결과



GENERATIVE SHAPE DESIGN TOOL

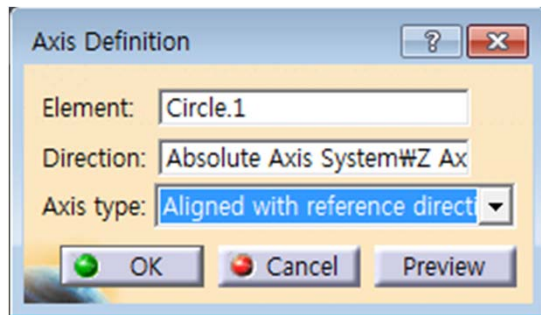
Wireframe



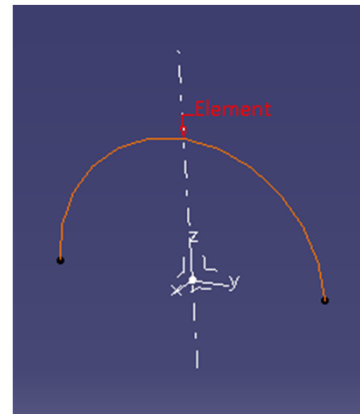
Axis



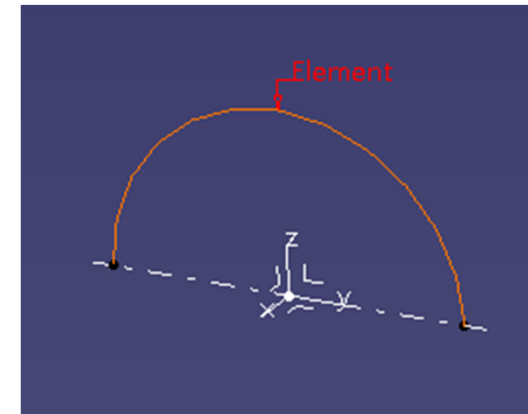
- 3차원 상에서 Axis를 생성



Aligned direction



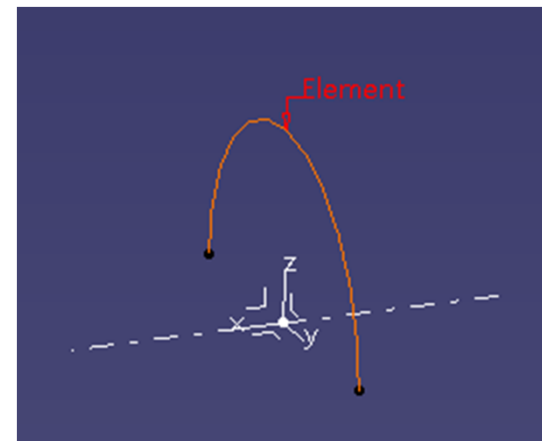
Normal to direction



Axis type :

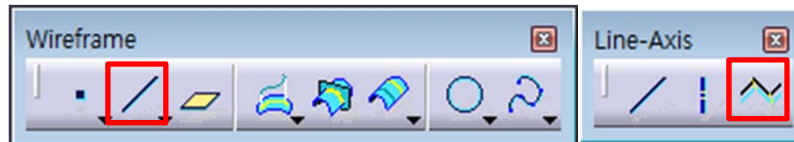
- Aligned with reference direction
- Normal to reference direction
- Normal to 'Element Type'

Normal to circle



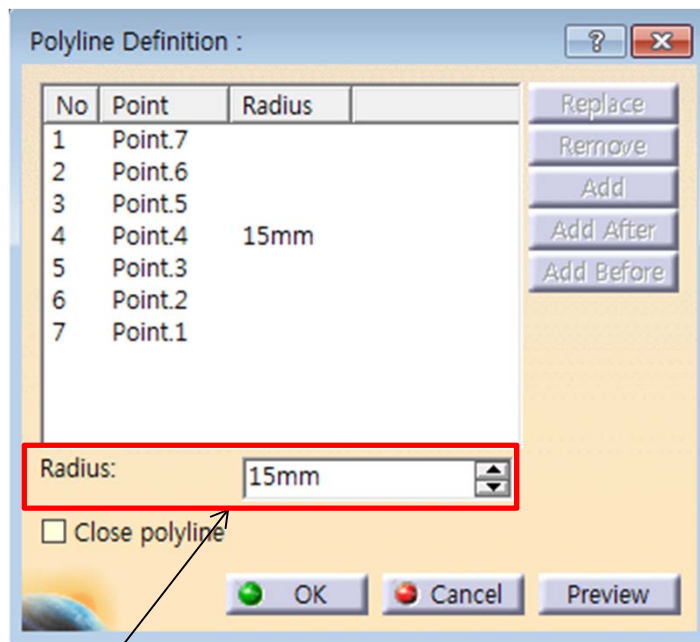
GENERATIVE SHAPE DESIGN TOOL

Wireframe

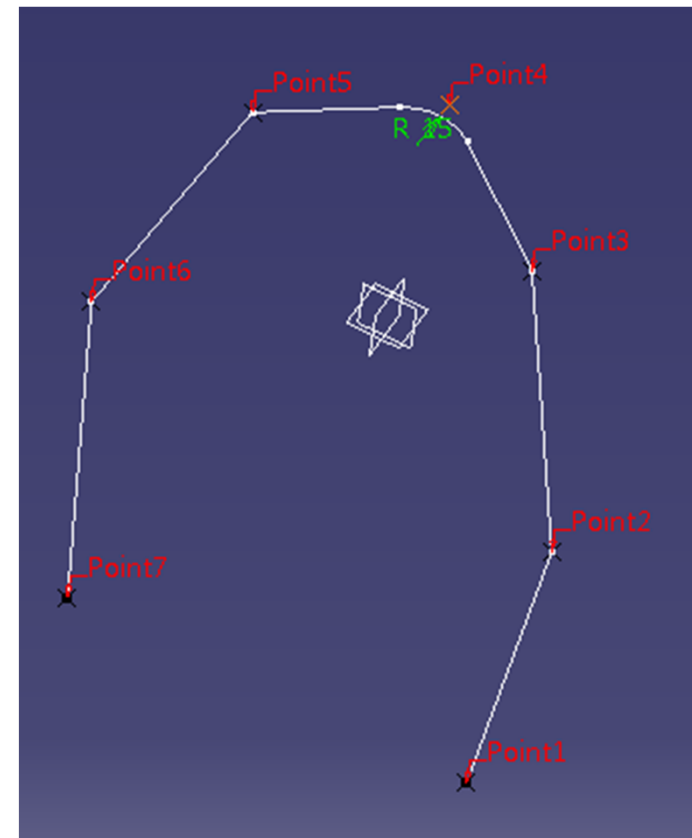


Polyline 

- 3차원 상의 points를 연결하여 직선을 만드는 기능.



포인트 위치의 radius를 조절하여 반경 부여 가능



GENERATIVE SHAPE DESIGN TOOL

Wireframe

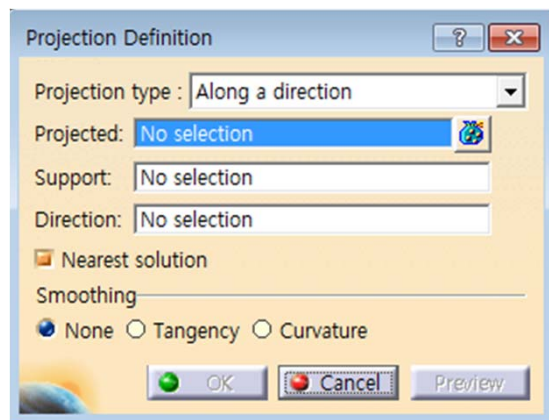
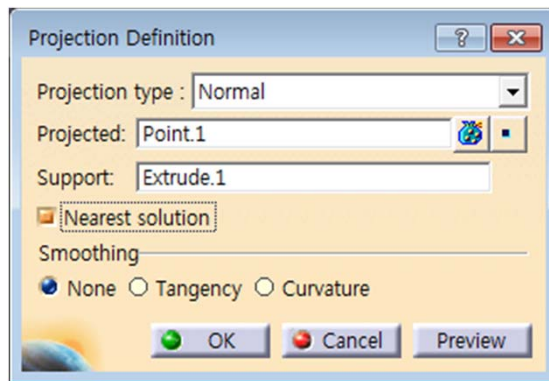


Projection

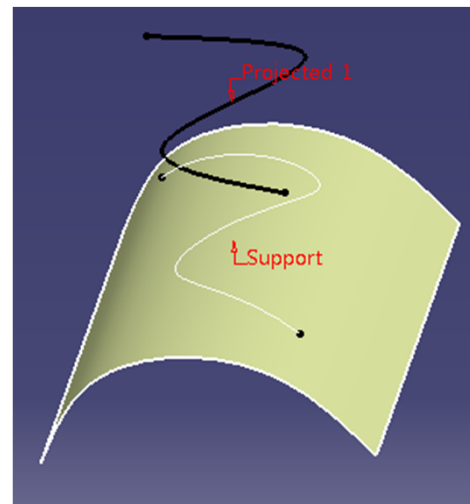


- 3차원 상의 points를 연결하여 직선을 만드는 기능.

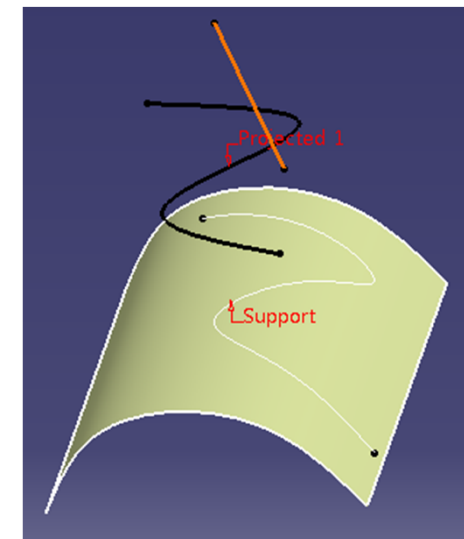
Surface의 곡률을 따라 투영



Z-direction

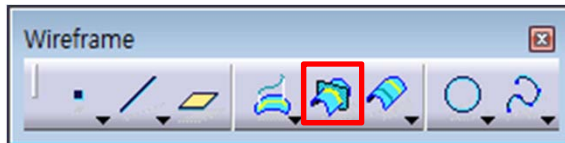


Line-direction



GENERATIVE SHAPE DESIGN TOOL

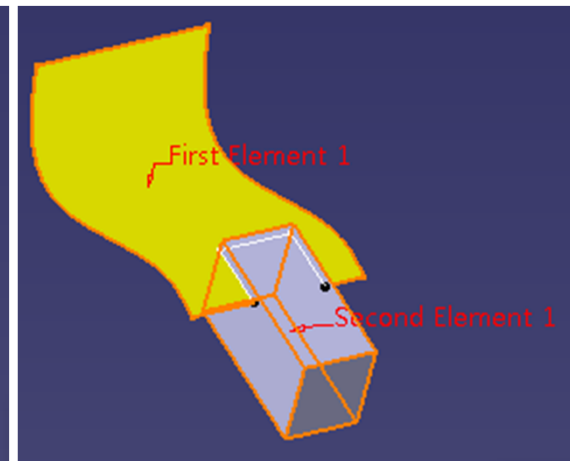
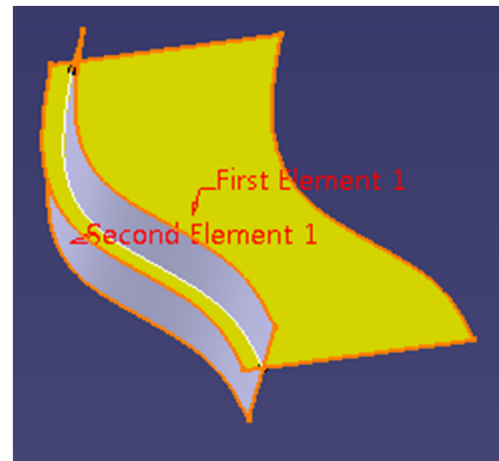
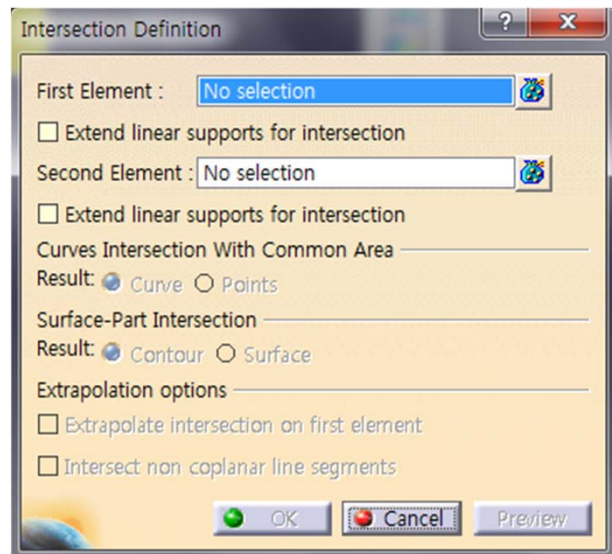
Wireframe



Intersection

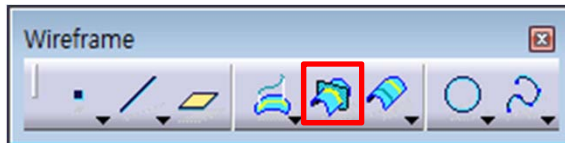


- 형상과 형상 사이를 교차하는 요소를 생성



GENERATIVE SHAPE DESIGN TOOL

Wireframe

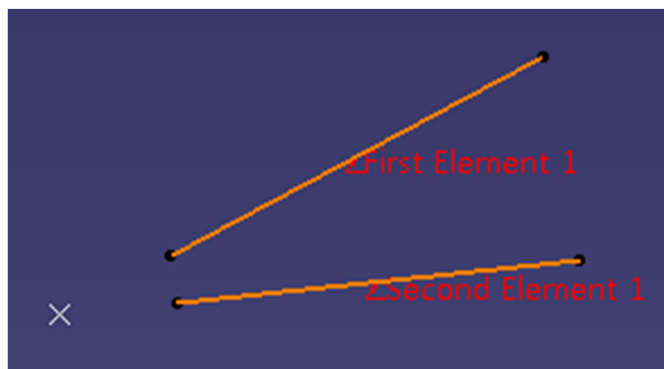
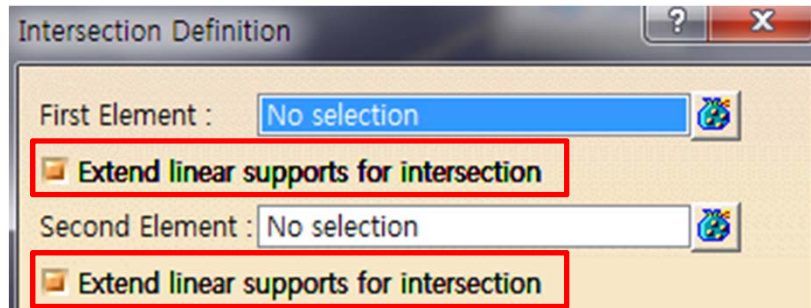


Intersection

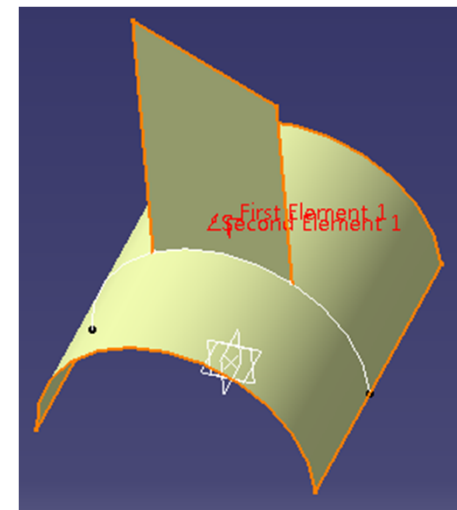
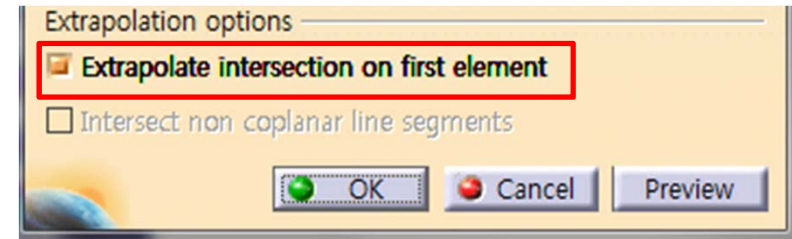


- 형상과 형상 사이를 교차하는 요소를 생성

Extend linear supports for intersection

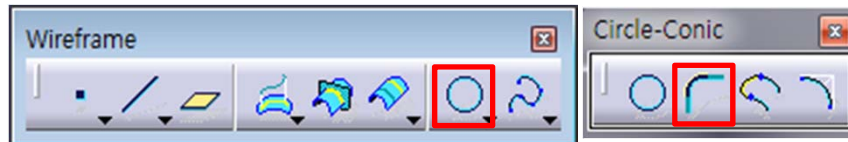


Extrapolate intersection on first element



GENERATIVE SHAPE DESIGN TOOL

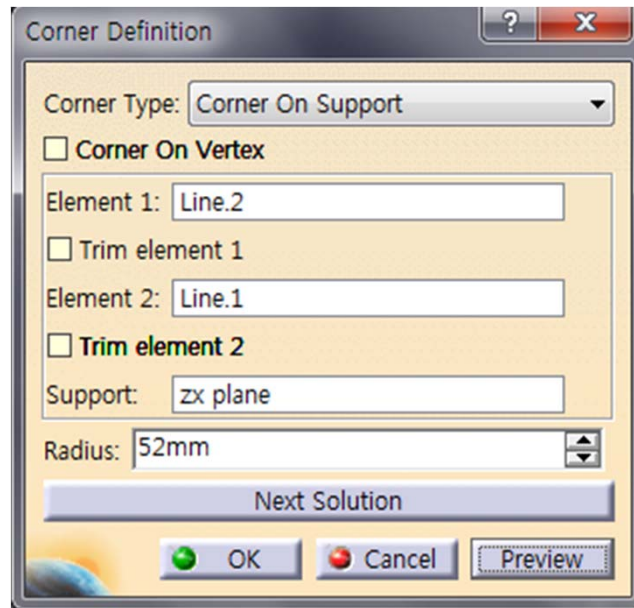
Wireframe



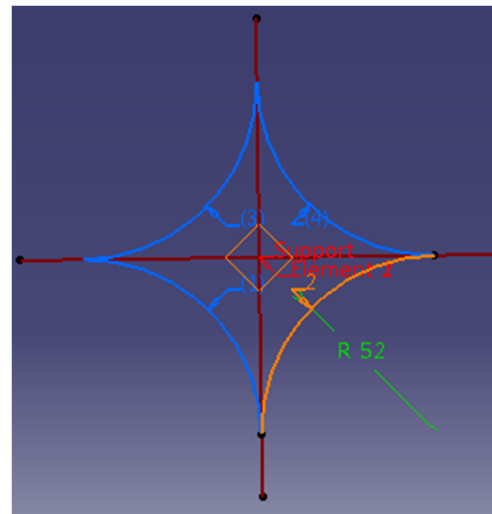
Corner



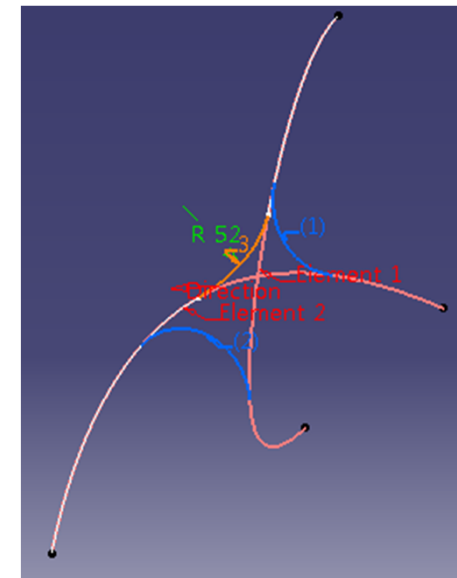
- 3차원상에 Corner를 생성



Corner On Support



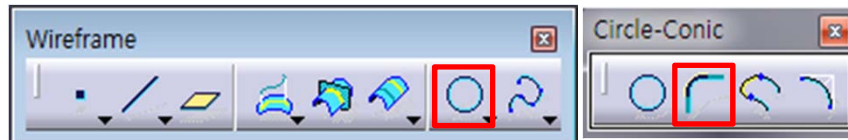
3D Corner



Corner Type의 3D Corner의 경우 element가 같은 평면상에 있지 않은 경우에 사용된다.

GENERATIVE SHAPE DESIGN TOOL

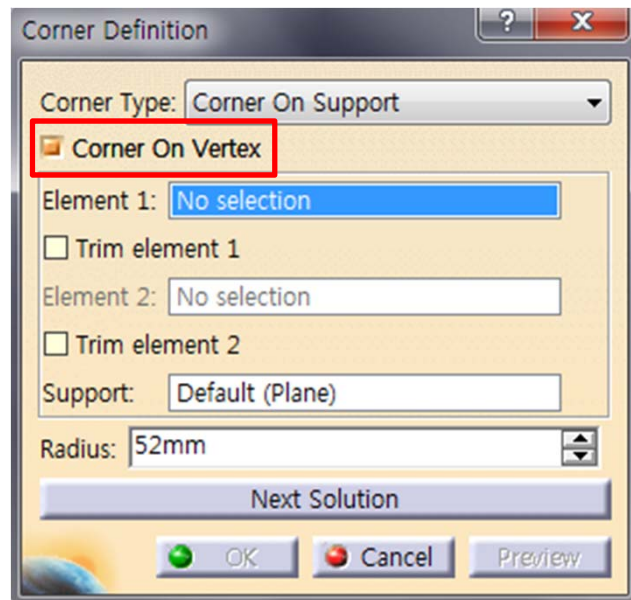
Wireframe



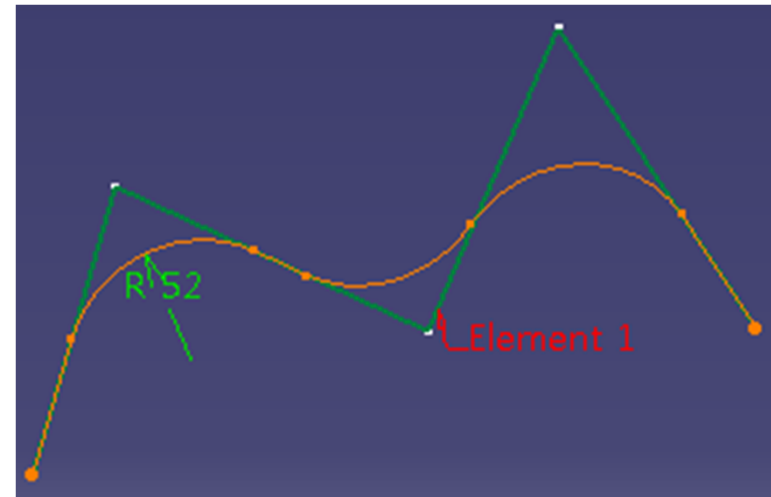
Corner



- 3차원상에 Corner를 생성

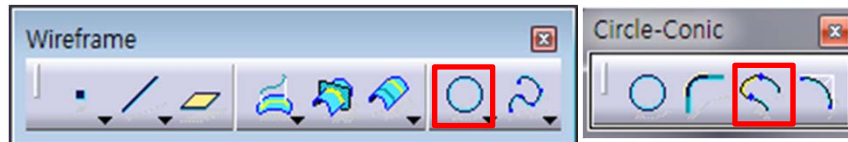


Corner On Vertex



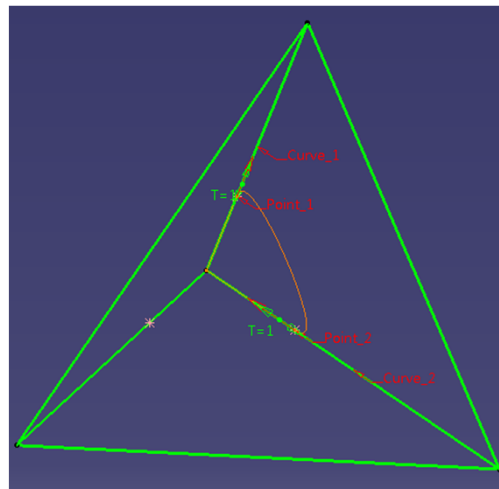
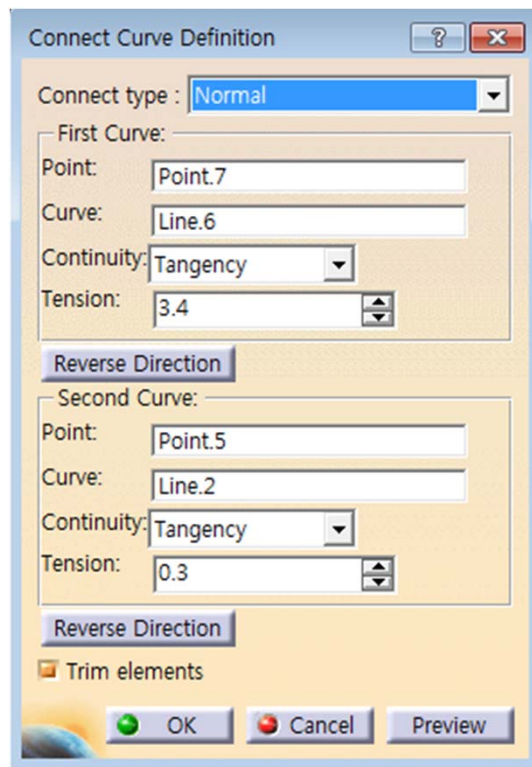
GENERATIVE SHAPE DESIGN TOOL

Wireframe

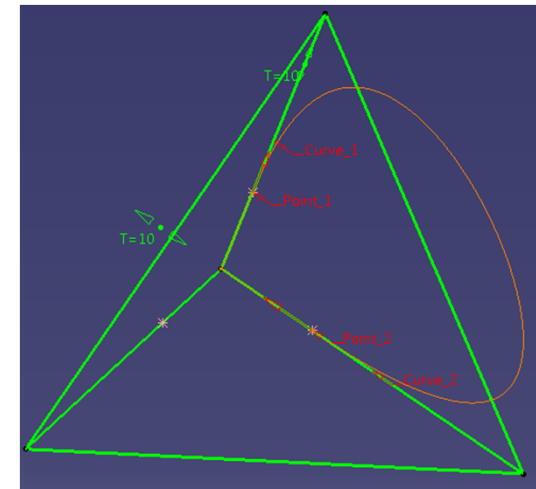


Connect Curve 

- 3차원상의 Curve와 Curve를 연결



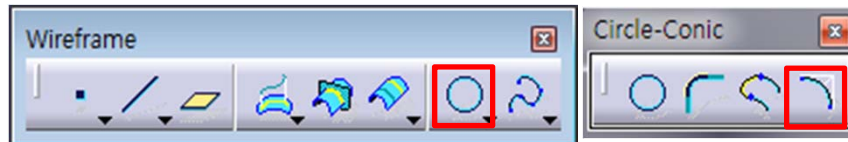
Tension이 1인 경우



Tension이 10인 경우

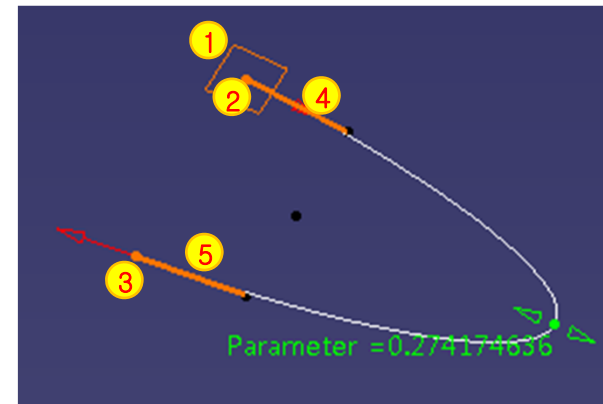
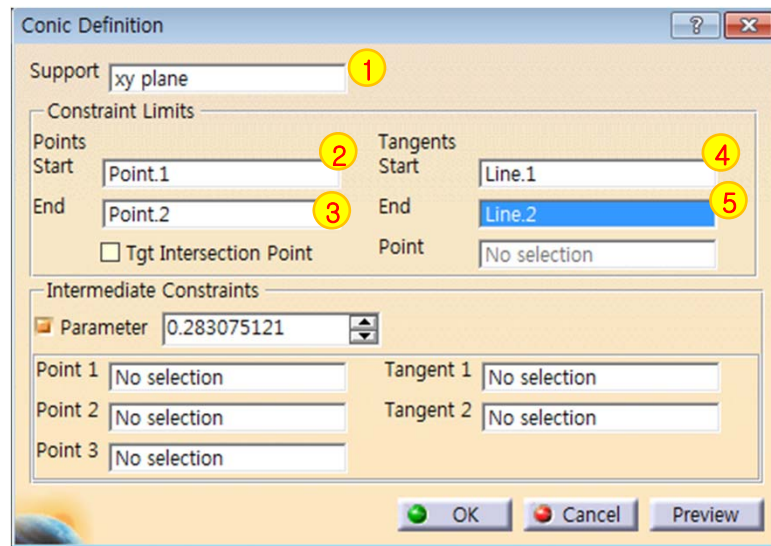
GENERATIVE SHAPE DESIGN TOOL

Wireframe

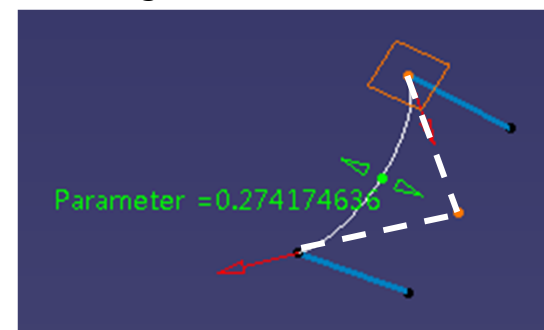


Conic 

- 3차원상에 Conic 생성

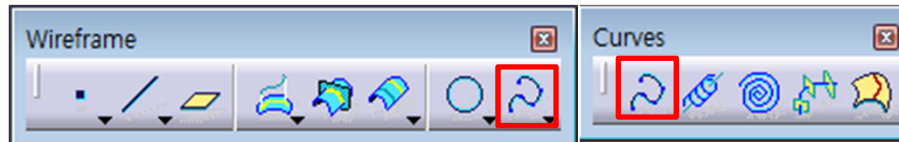


Tgt Intersection Point



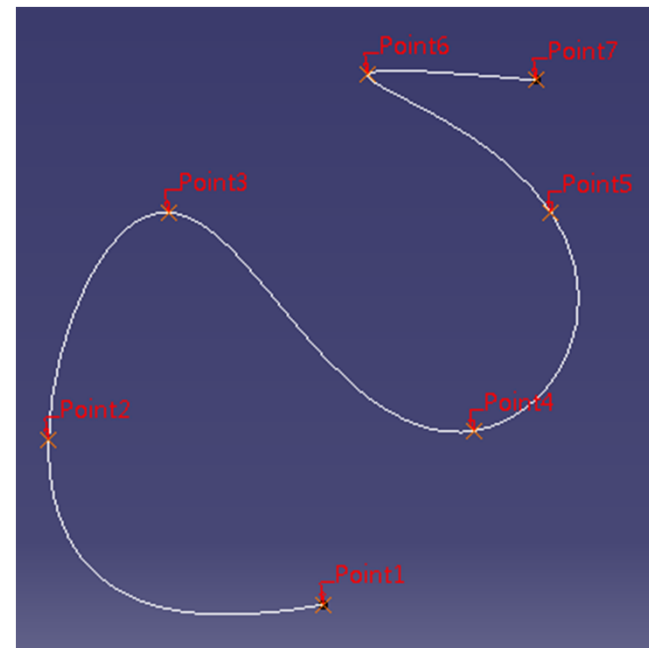
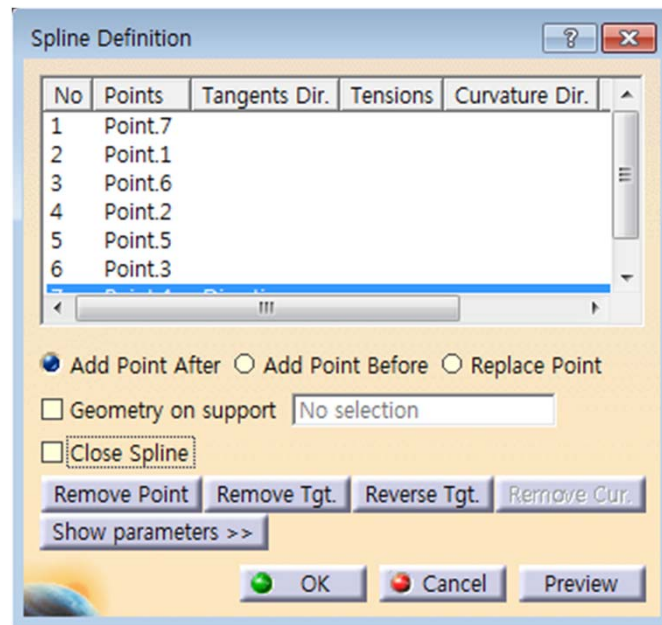
GENERATIVE SHAPE DESIGN TOOL

Wireframe



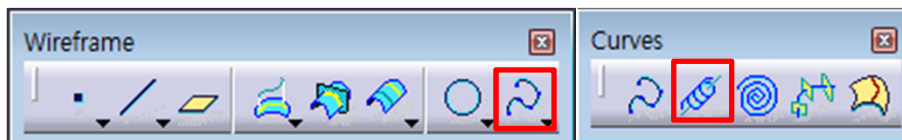
Spline 

- 3차원상의 Points를 이용하여 Spline Curve 생성



GENERATIVE SHAPE DESIGN TOOL

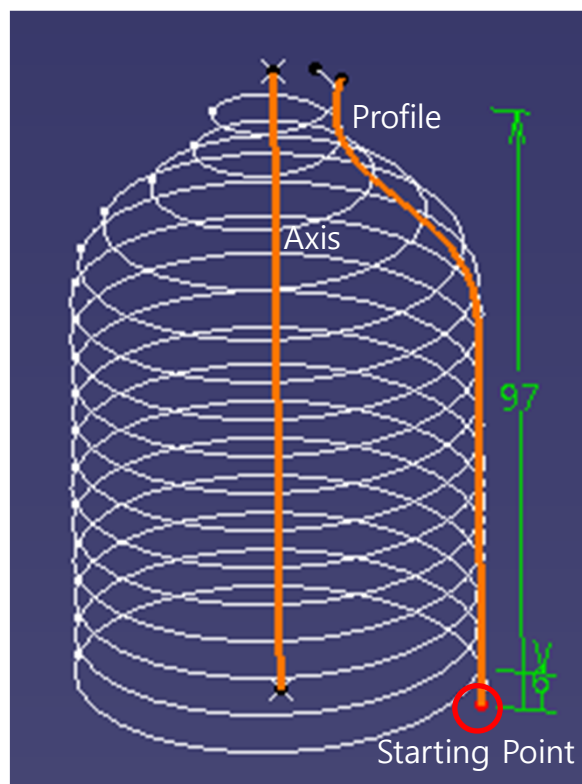
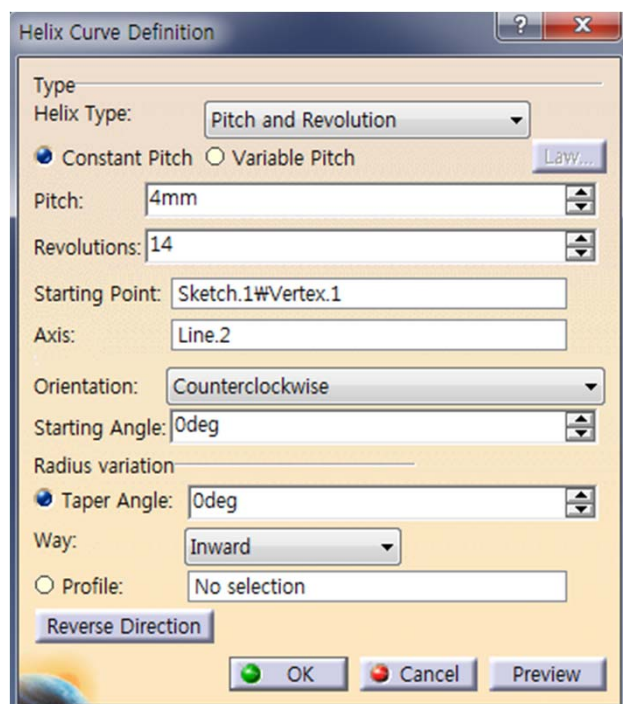
Wireframe



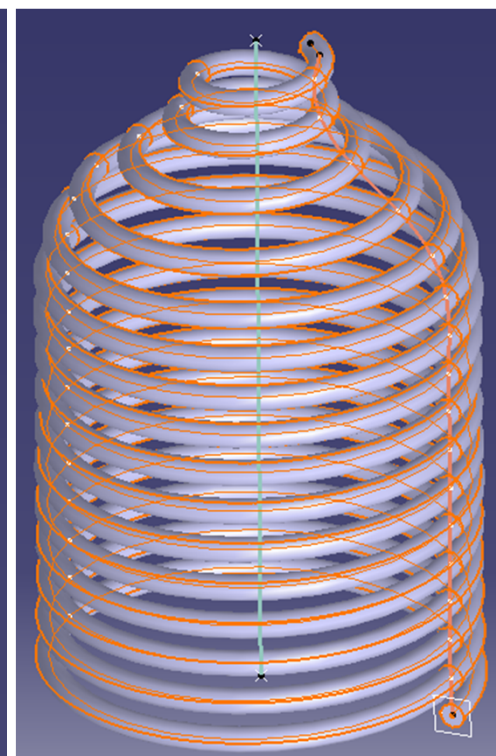
Helix



- 스프링 같은 형상 생성

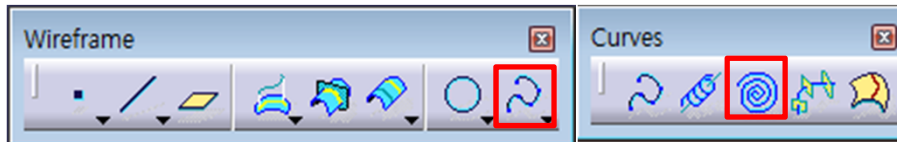


Part Design의 Rib 적용



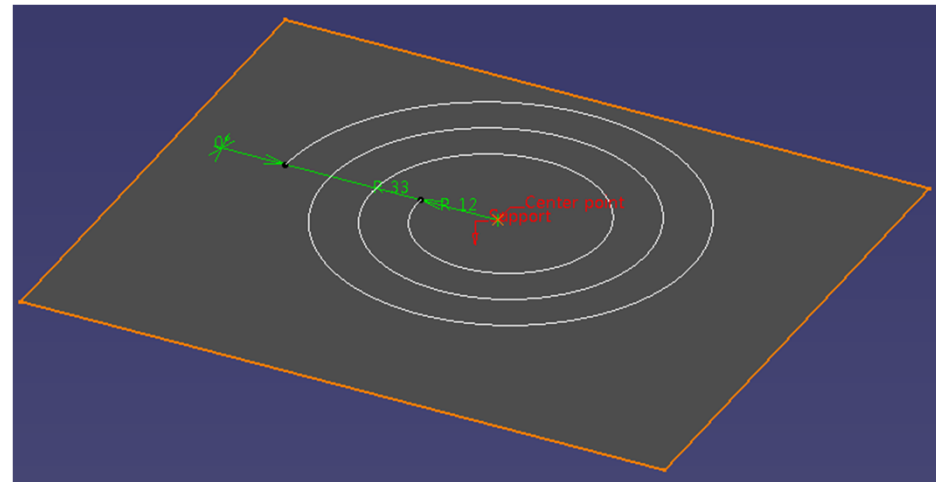
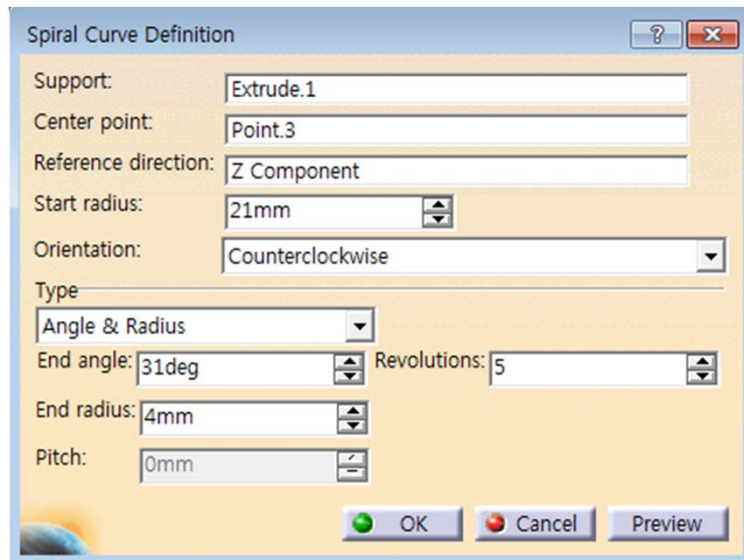
GENERATIVE SHAPE DESIGN TOOL

Wireframe



Spiral 

- 기준점으로 부터 나선 형태의 Curve 생성

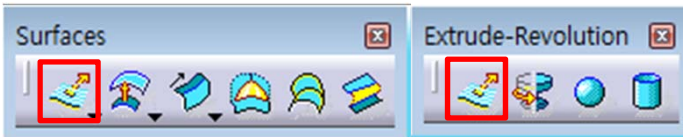


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- ✓ **Surfaces**
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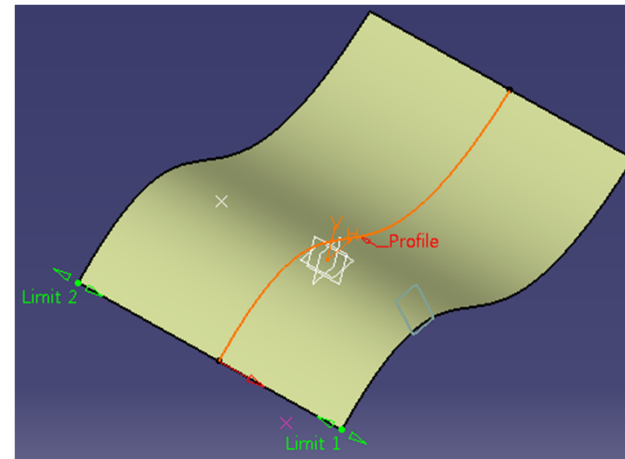
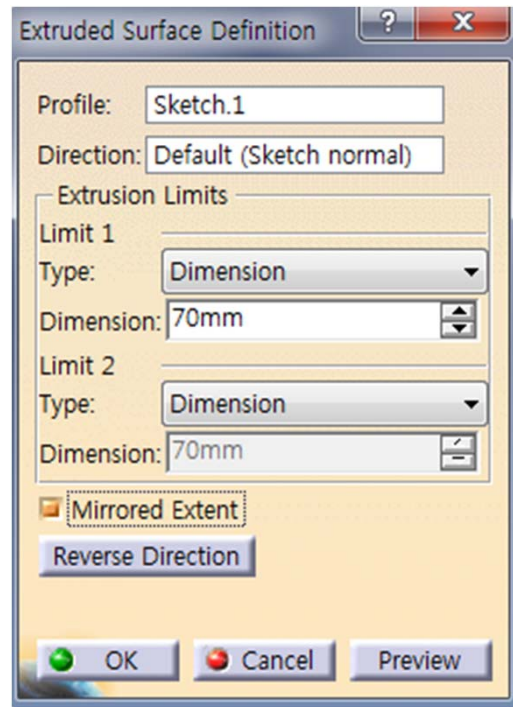
Surfaces



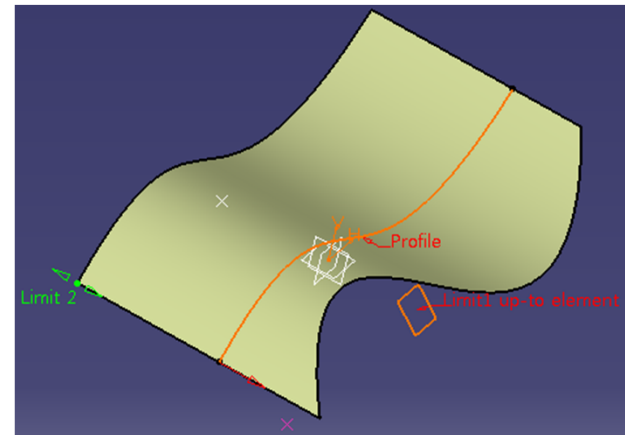
Extrude



- Wireframe/Sketch를 길이방향으로 늘려 Surface 생성

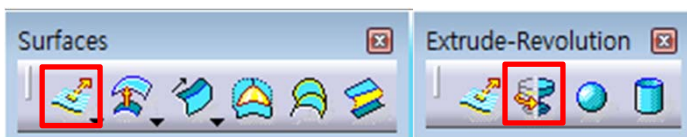


Plane을 이용한 Limit 설정 (Up-to element)



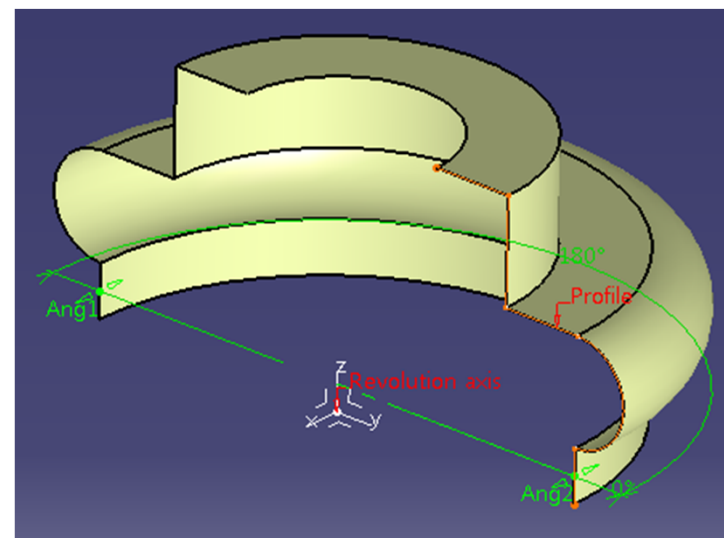
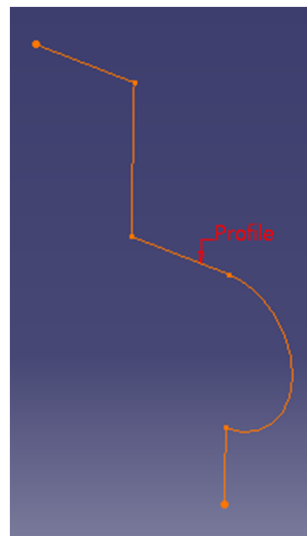
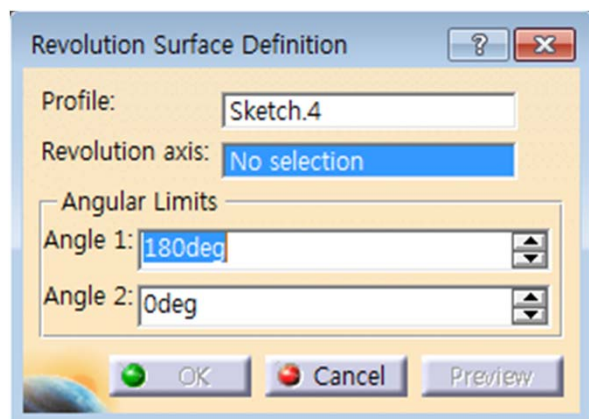
GENERATIVE SHAPE DESIGN TOOL

Surfaces



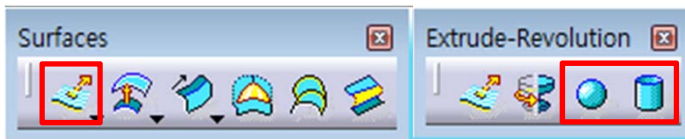
Revolute 

- Wireframe/Sketch를 회전시켜 Surface 생성



GENERATIVE SHAPE DESIGN TOOL

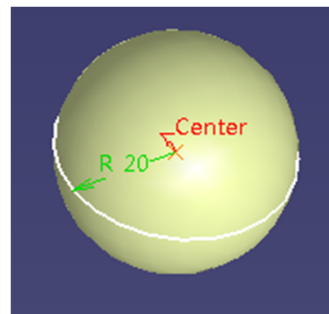
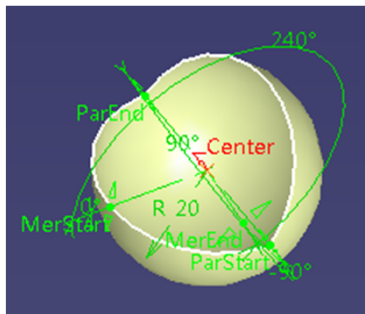
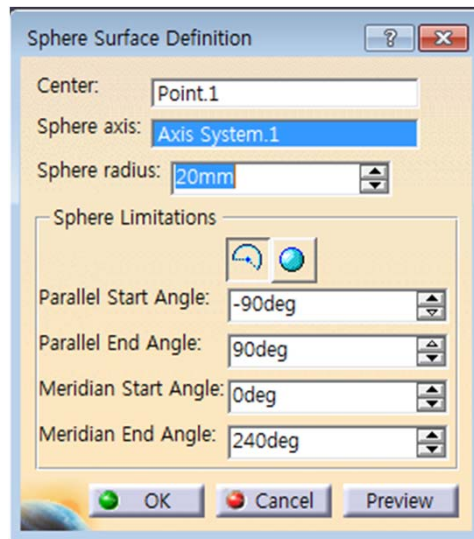
Surfaces



Sphere



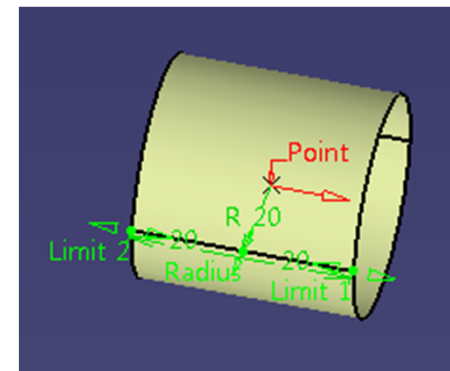
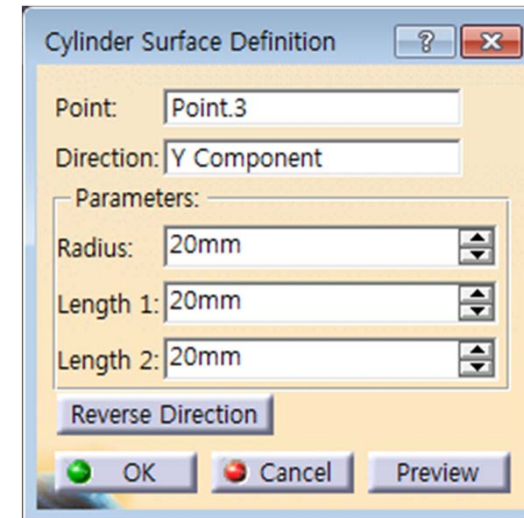
- Center를 기준으로 구 형태의 Surface 생성



Cylinder

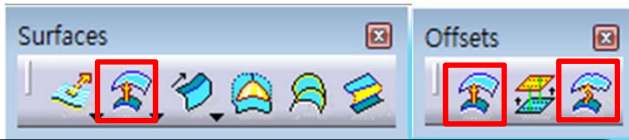


- Center를 기준으로 실린더 형태의 Surface 생성



GENERATIVE SHAPE DESIGN TOOL

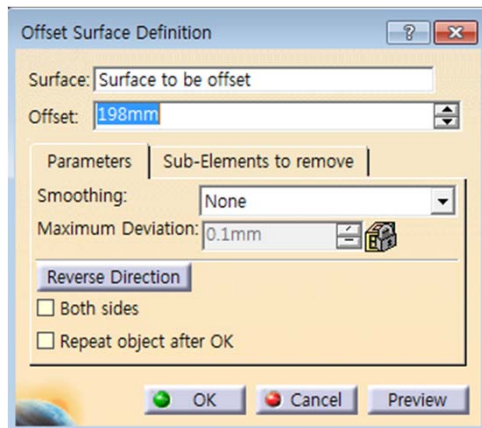
Surfaces



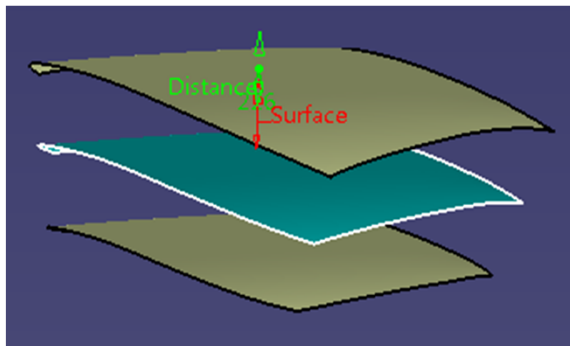
Offset



- Surface의 Offset 생성



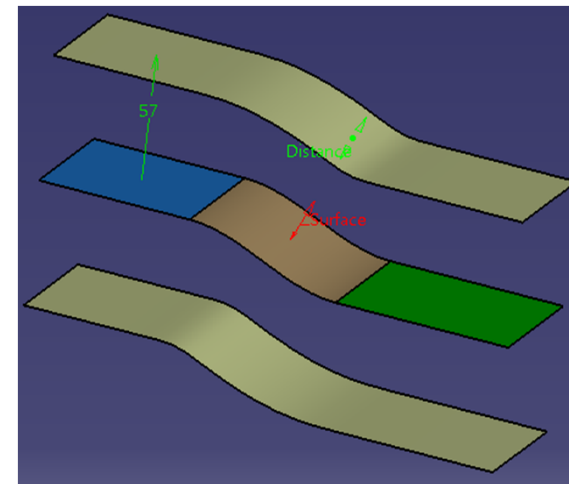
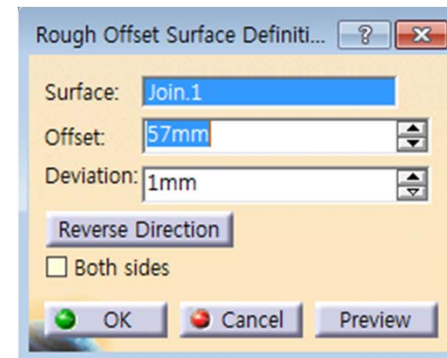
Both sides Offset



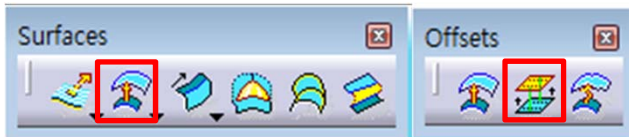
Rough Offset



- 근사적인 Surface Offset 생성

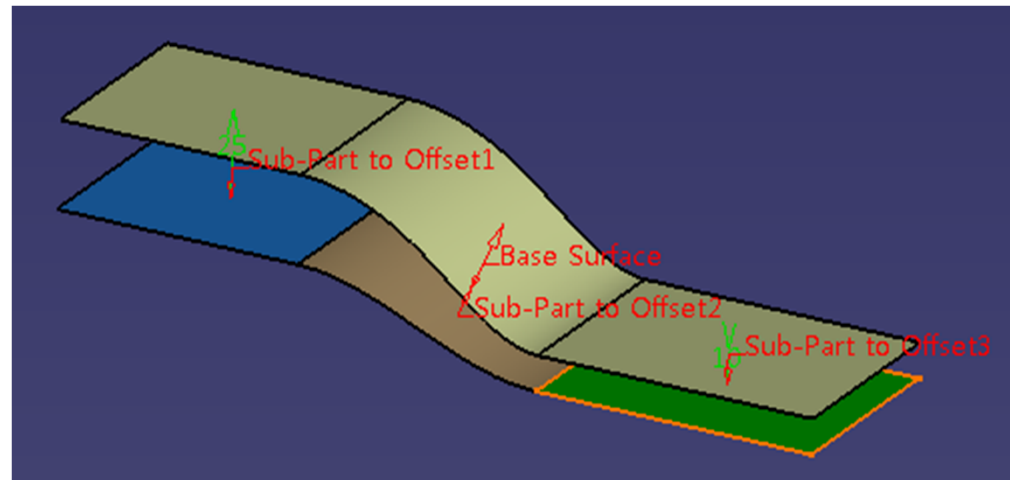
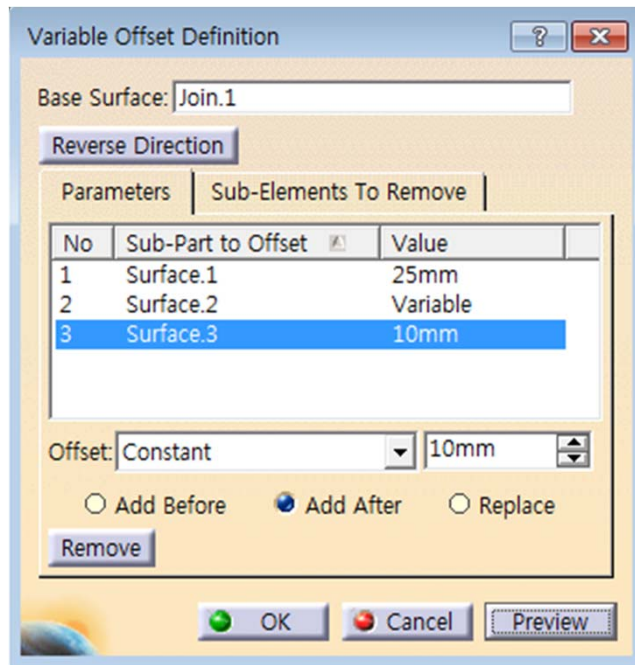


Surfaces



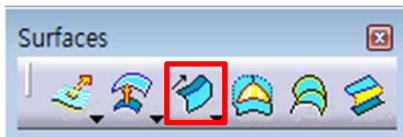
Variable Offset 

- 서로 다른 값을 가지는 Surface Offset 생성



GENERATIVE SHAPE DESIGN TOOL

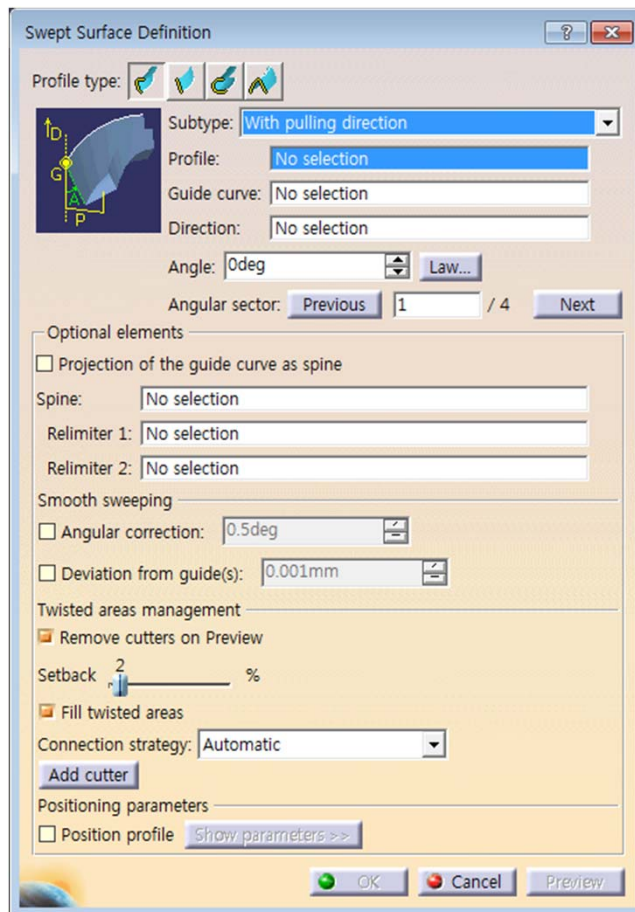
Surfaces



Sweeps



- 여러 elements를 이용한 Surface 생성



Explicit : Profile과 Guideline을 이용하여 Surface 생성

With reference surface
With two guide curves
With pulling direction



Line : Profile을 따로 사용하지 않고 Guideline등을 이용하여 Surface 생성

Two limits
Limit and middle
With reference surface
With reference curve
With tangency surface
With draft direction
With two tangency surfaces



Circle : Profile의 형상이 원형이 되도록 Surface 생성

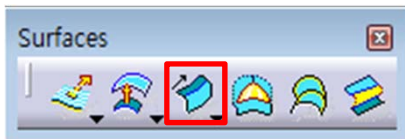
Three guides
Two guides and radius
Center and two angles
Center and radius
Two guides and tangency surface
One guide and tangency surface
Limit curve and tangency surface



Conic : Profile의 형상이 원뿔 모양이 되도록 Surface 생성

Two guide curves
Three guide curves
Four guide curves
Five guide curves

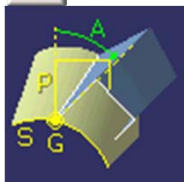
Surfaces



Sweeps



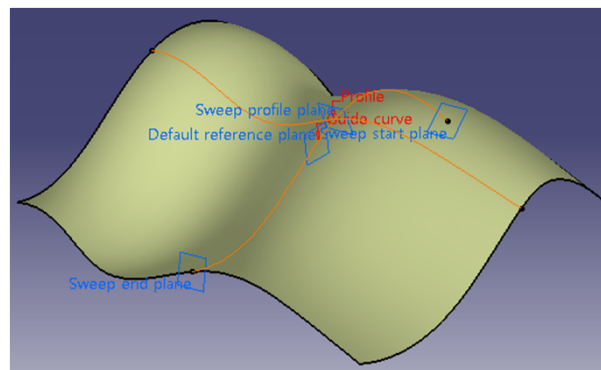
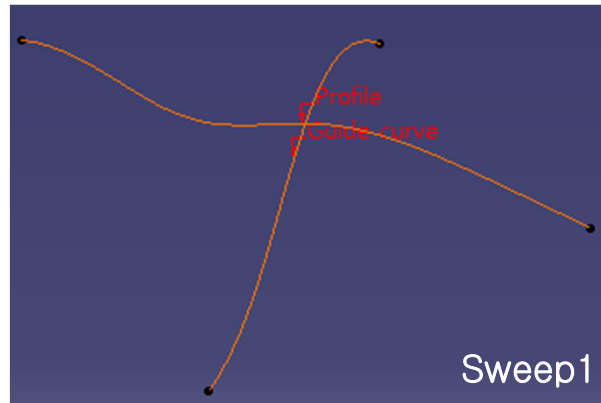
Explicit



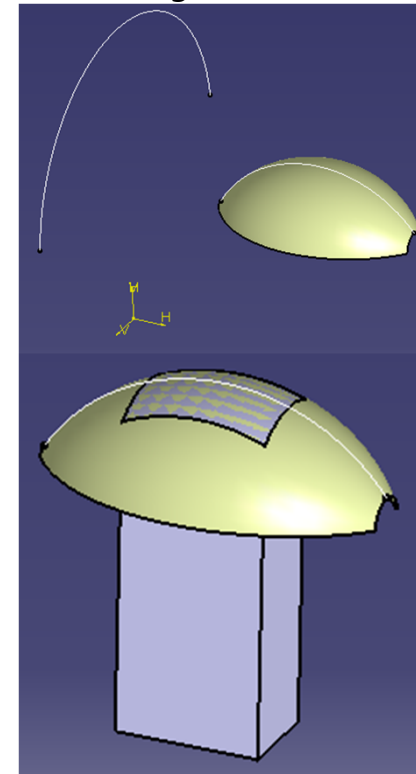
With reference surface
With two guide curves
With pulling direction

With reference surface

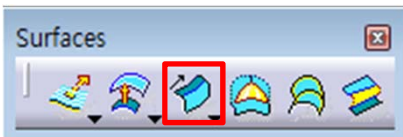
- Profile과 하나의 Guide curve를 이용하여 Guide를 따라가는 Surface 생성



Part Design의 Pad에 적용



Surfaces

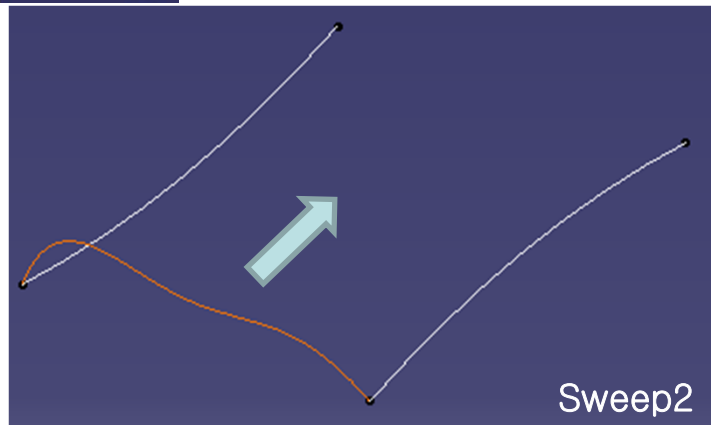
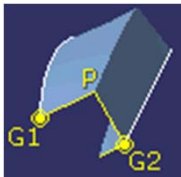


Sweeps



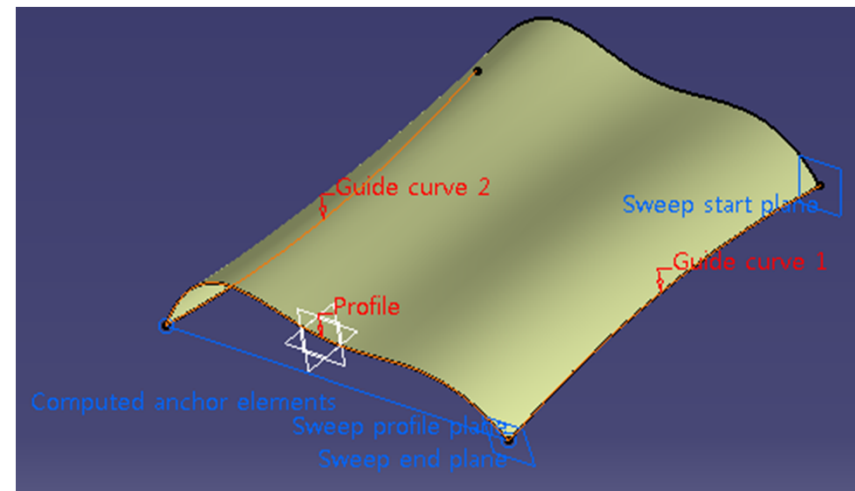
Explicit

With reference surface
With two guide curves
With pulling direction



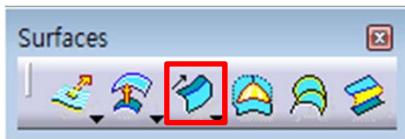
With two guide curves

- Profile과 두 개의 Guide curve를 이용하여 Surface 생성



GENERATIVE SHAPE DESIGN TOOL

Surfaces

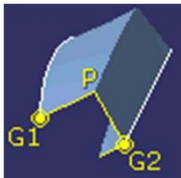


Sweeps



Explicit

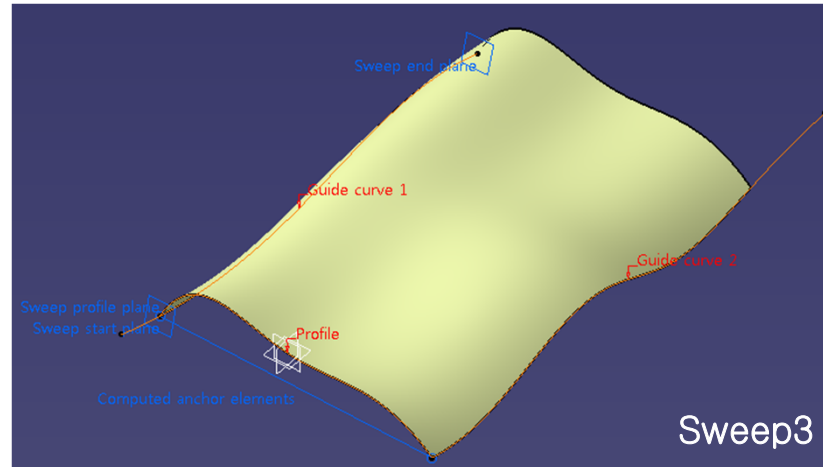
With reference surface
With two guide curves
With pulling direction



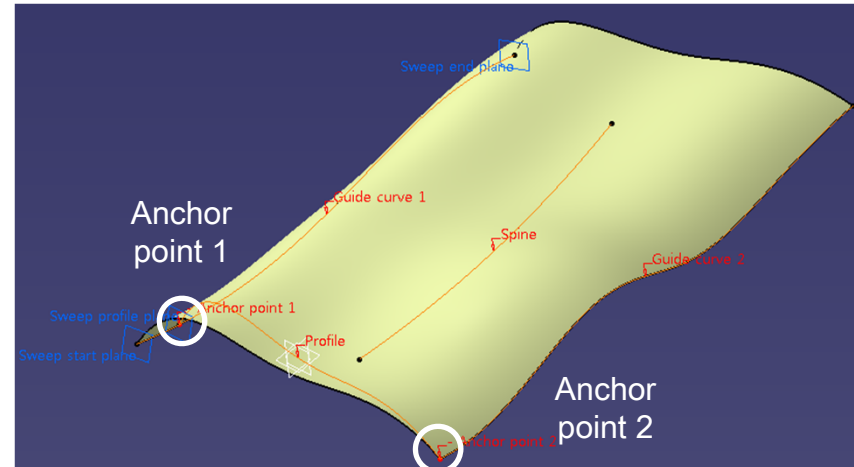
With two guide curves

- Profile과 두 개의 Guide curve를 이용하여 Surface 생성

Guide curve의 길이가 다른 경우

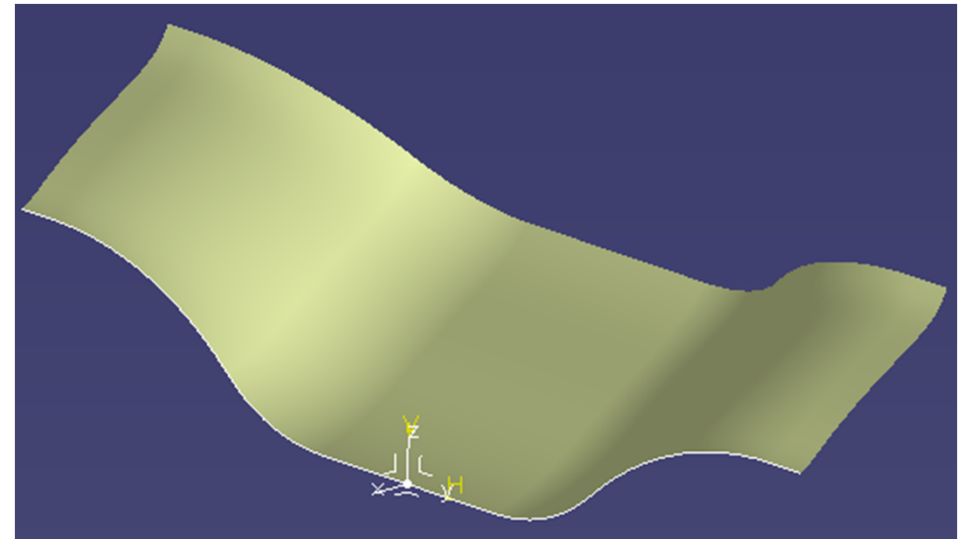
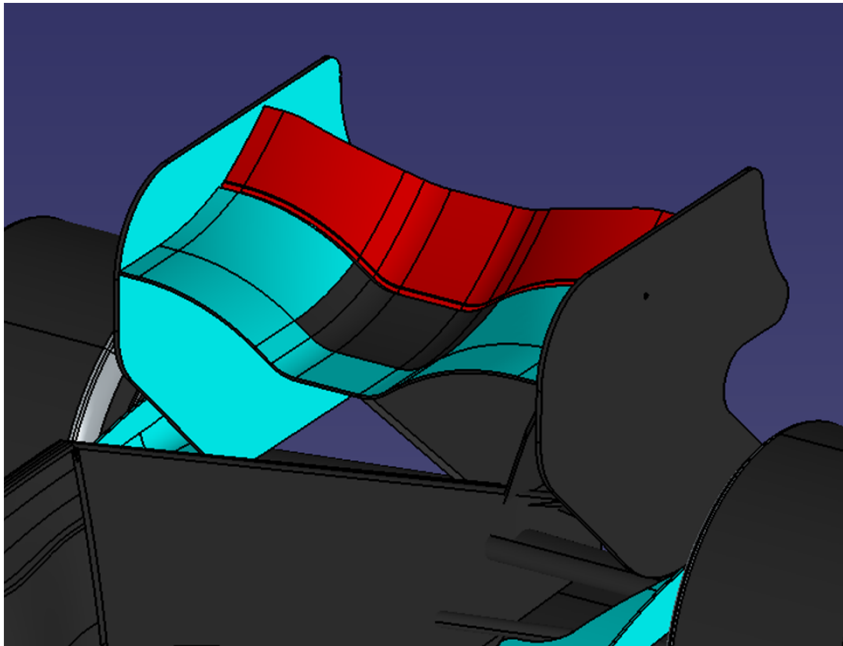


Spine 생성: Spine → Create Spine → Guide 선택



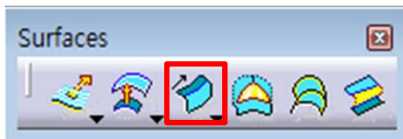
실습 예제

Sweep 기능을 이용하여 아래 그림과 유사하도록 surface 생성



GENERATIVE SHAPE DESIGN TOOL

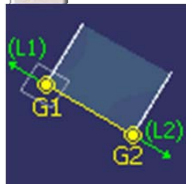
Surfaces



Sweeps



Line

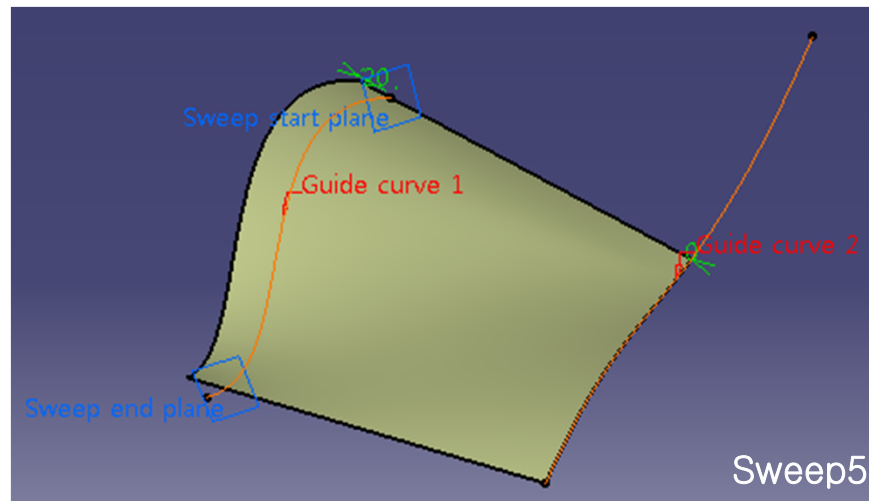


Two limits

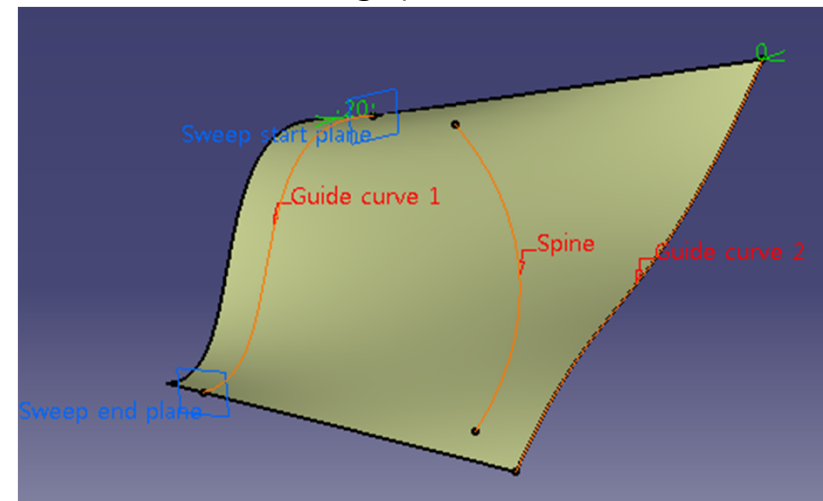
Limit and middle
With reference surface
With reference curve
With tangency surface
With draft direction
With two tangency surfaces

Two limits

- 두 개의 Guide Curve를 사용하여 Surface 생성

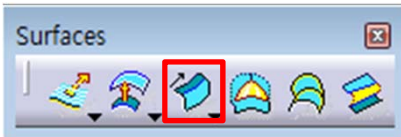


Using spine curve

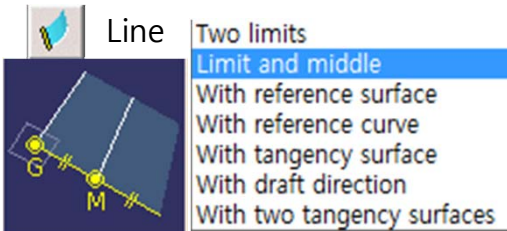


GENERATIVE SHAPE DESIGN TOOL

Surfaces

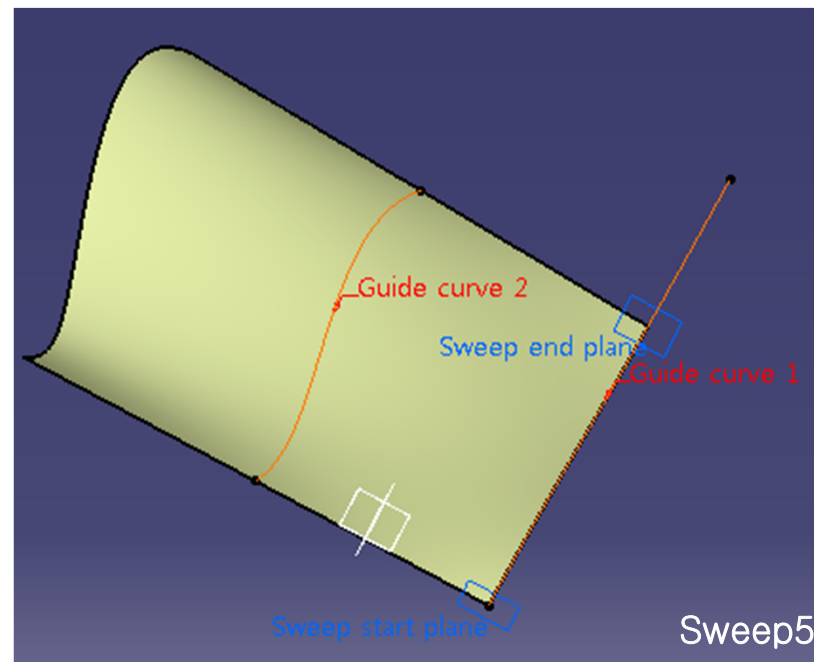


Sweeps

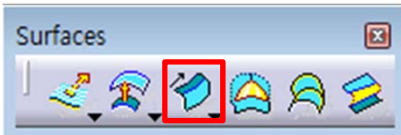


Limit and middle

- 하나의 Guide Curve 1는 경계선, 나머지 하나는 Surface의 중간에 위치하도록 설정



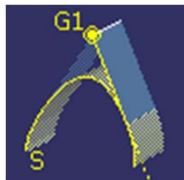
Surfaces



Sweeps



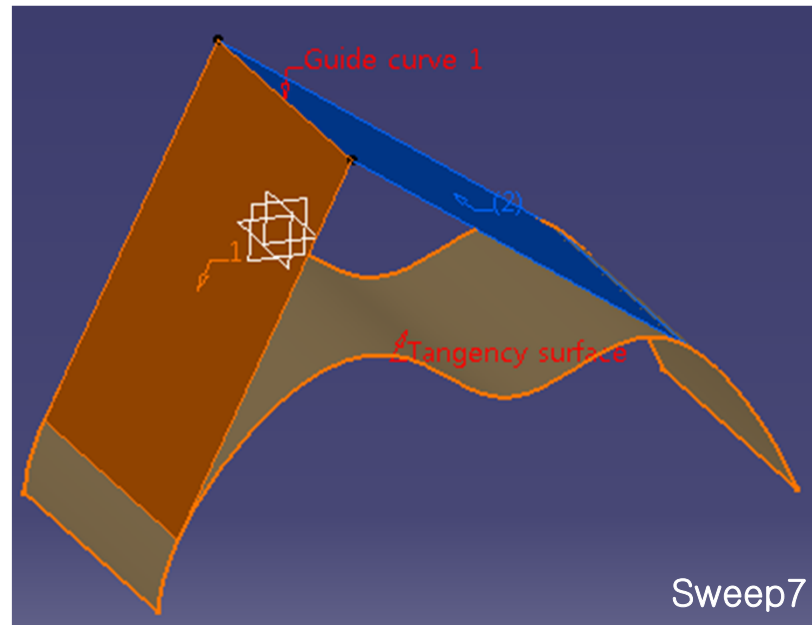
Line



- Two limits
- Limit and middle
- With reference surface
- With reference curve
- With tangency surface
- With draft direction
- With two tangency surfaces

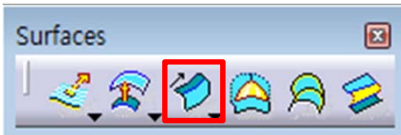
With tangency surface

- Guide Curve에서 특정 Surface에 접하는 surface를 생성



GENERATIVE SHAPE DESIGN TOOL

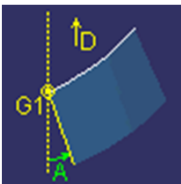
Surfaces



Sweeps



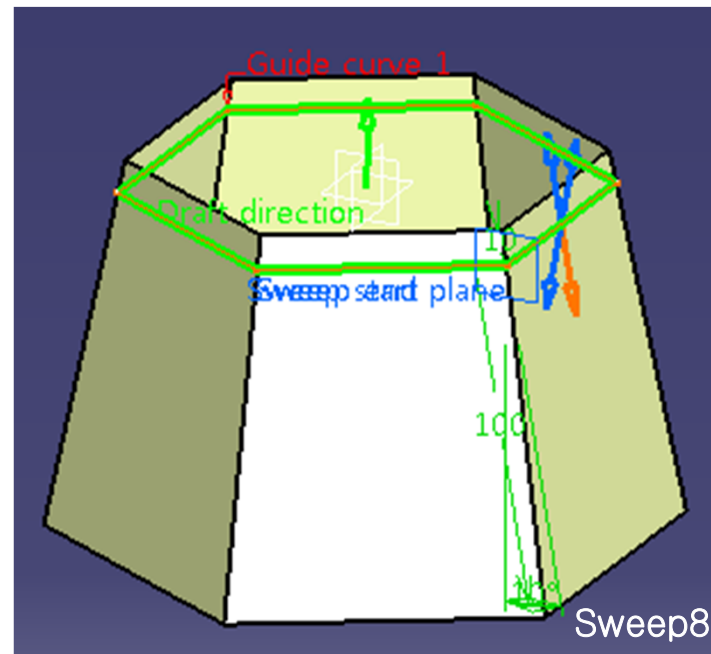
Line



Two limits
Limit and middle
With reference surface
With reference curve
With tangency surface
With draft direction
With two tangency surfaces

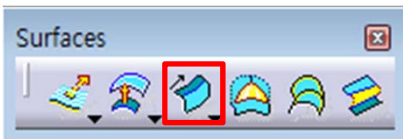
With draft direction

- Guide Curve를 선택한 Pulling direction 기준으로 각도를 부여하여 surface 생성



GENERATIVE SHAPE DESIGN TOOL

Surfaces



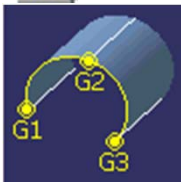
Sweeps



Circle

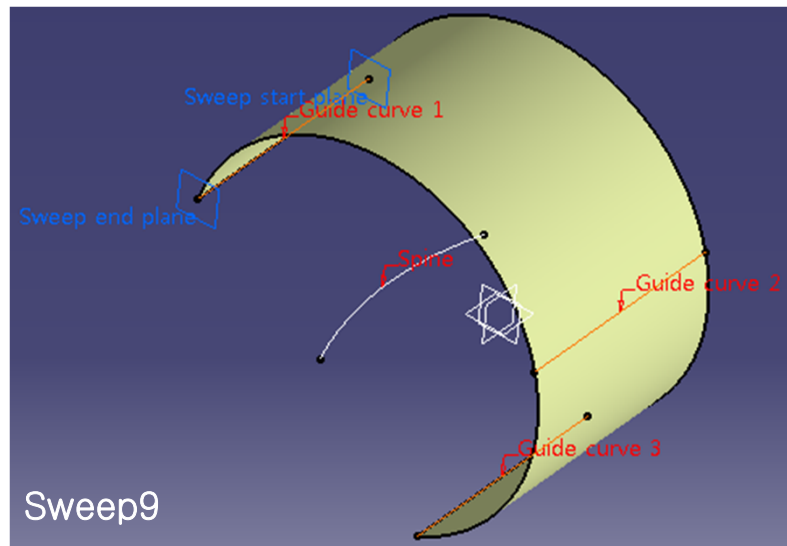
Three guides

Two guides and radius
Center and two angles
Center and radius
Two guides and tangency surface
One guide and tangency surface
Limit curve and tangency surface

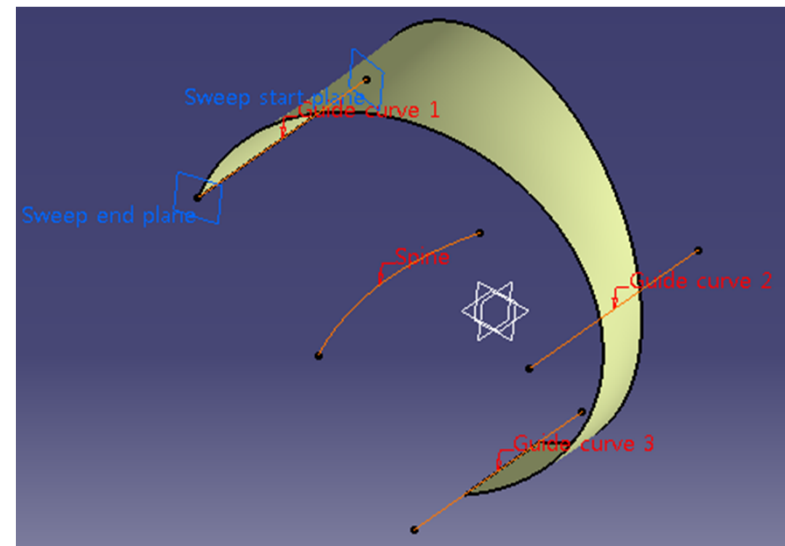


Three guides

- 3개의 Guide line을 이용해 생성

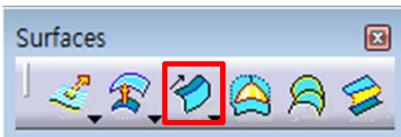


Spine 이용 (이 경우 Guides와는 별도)



GENERATIVE SHAPE DESIGN TOOL

Surfaces



Sweeps



Circle

Three guides

Two guides and radius

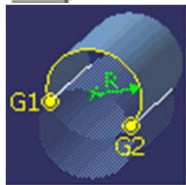
Center and two angles

Center and radius

Two guides and tangency surface

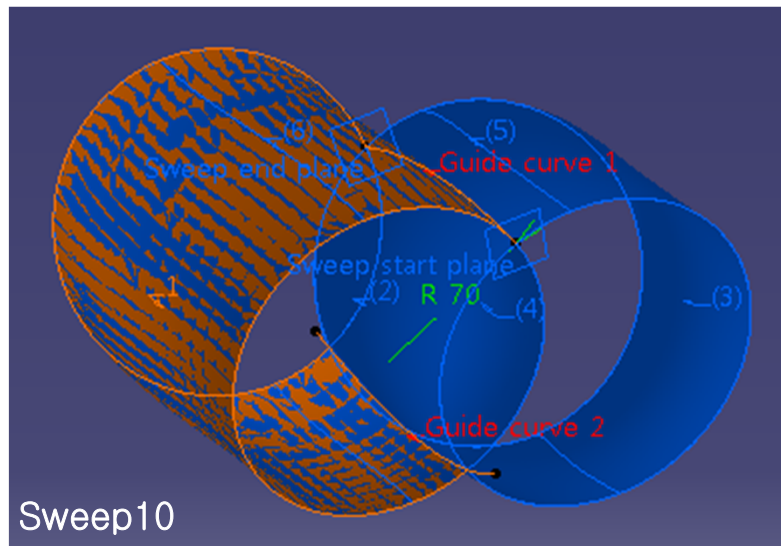
One guide and tangency surface

Limit curve and tangency surface

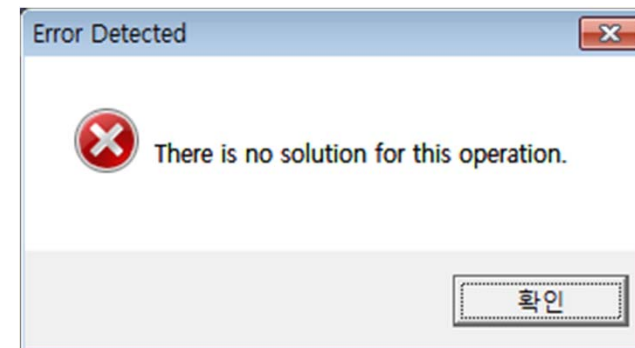


Two guides and radius

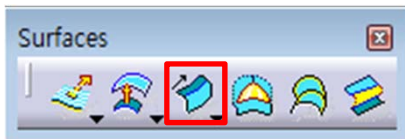
- 2개의 Guide line과 반경 값(radius)을 이용해 생성



입력한 반경에 맞는 형상이 없을 경우



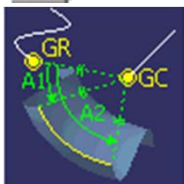
Surfaces



Sweeps



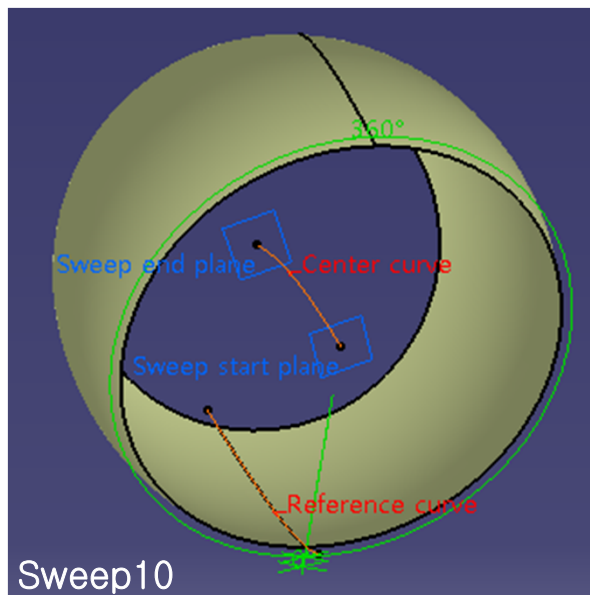
Circle



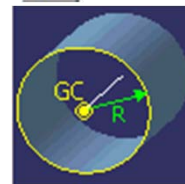
Three guides
Two guides and radius
Center and two angles
Center and radius
Two guides and tangency surface
One guide and tangency surface
Limit curve and tangency surface

Center and two angles

- 원의 중심을 지나는 Curve와 반경을 지나는 Curve를 이용



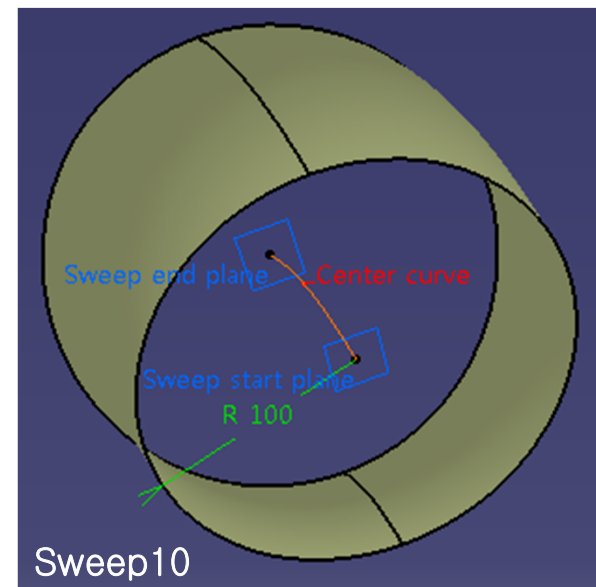
Circle



Three guides
Two guides and radius
Center and two angles
Center and radius
Two guides and tangency surface
One guide and tangency surface
Limit curve and tangency surface

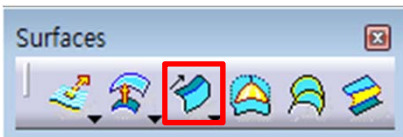
Center and radius

- 원의 중심을 지나는 Curve와 반경 값(radius) 사용



GENERATIVE SHAPE DESIGN TOOL

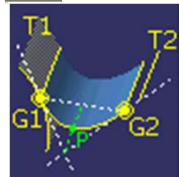
Surfaces



Sweeps



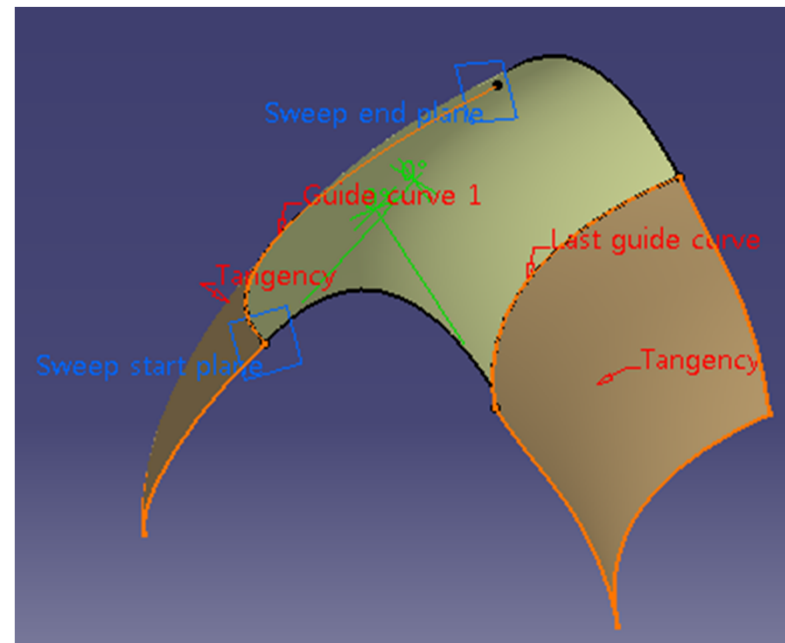
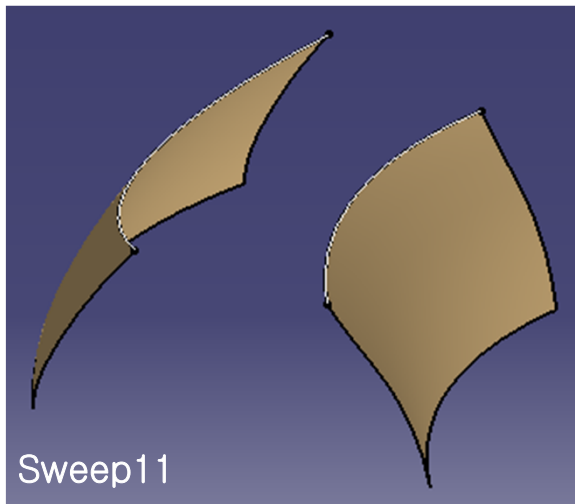
Conic



Two guide curves
Three guide curves
Four guide curves
Five guide curves

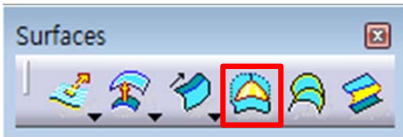
Two guide curves

- 두 개의 Guide Curve와 Surface를 이용하여 생성



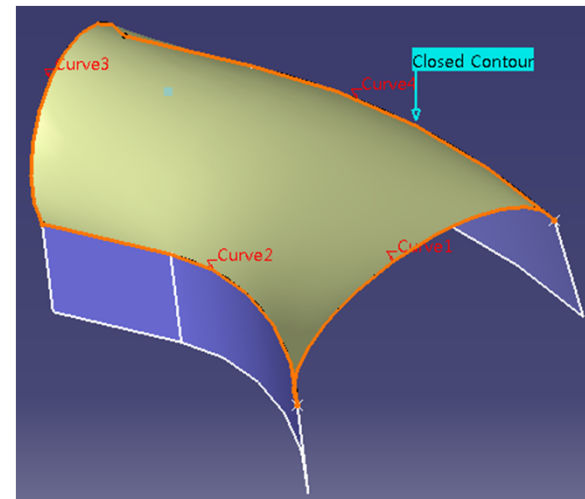
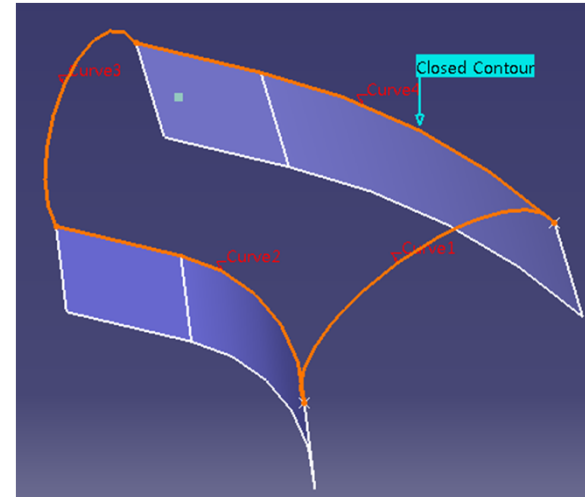
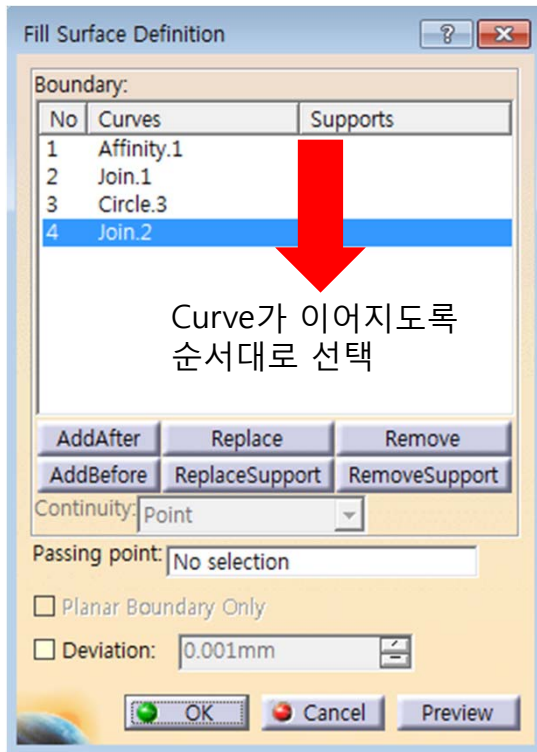
GENERATIVE SHAPE DESIGN TOOL

Surfaces



Fill

- Curve로 이루어진 닫힌 형상을 Surface로 채워줌



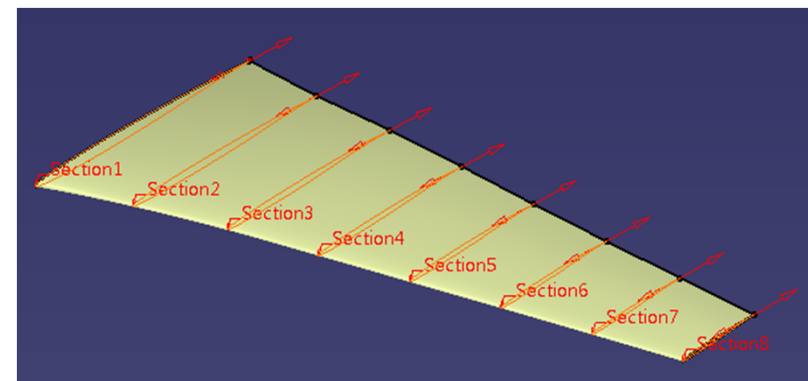
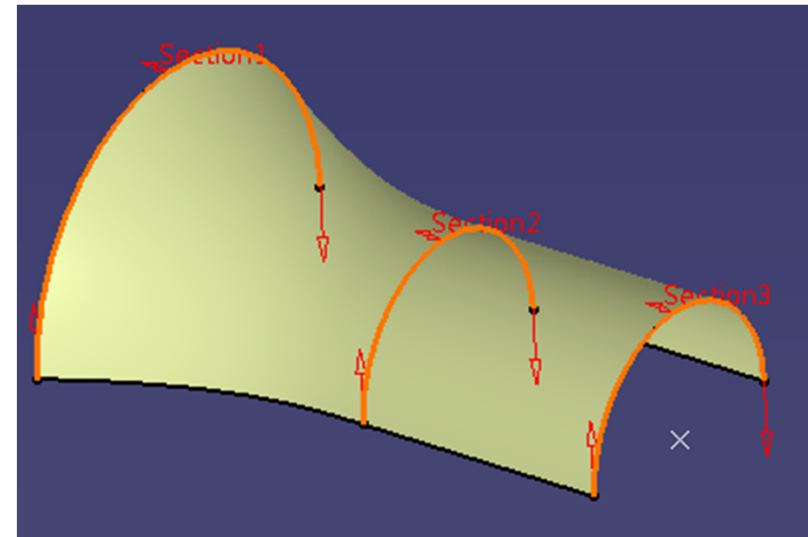
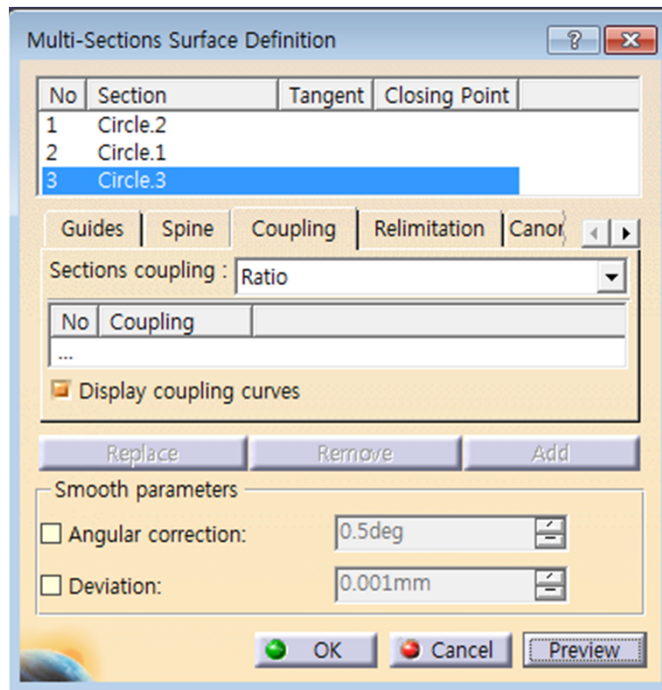
Surfaces



Multi-Sections Surface



- 여러 개의 단면 profile을 연결한 surface 생성



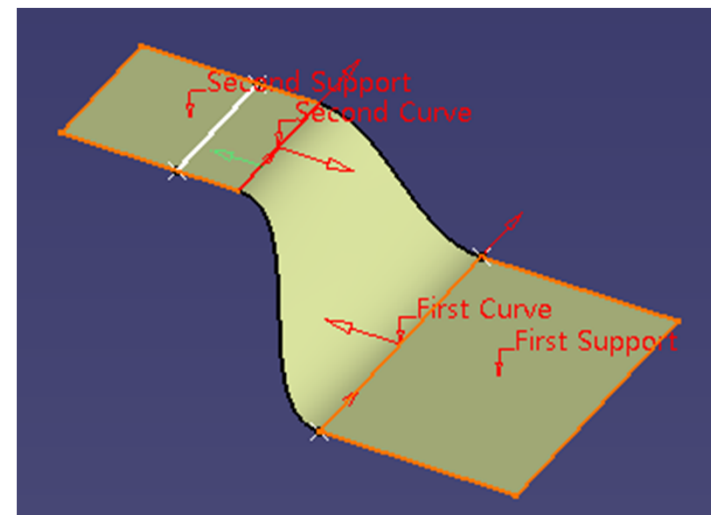
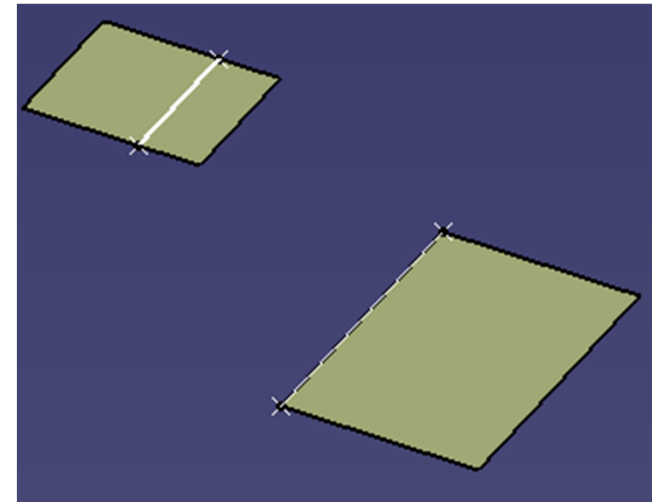
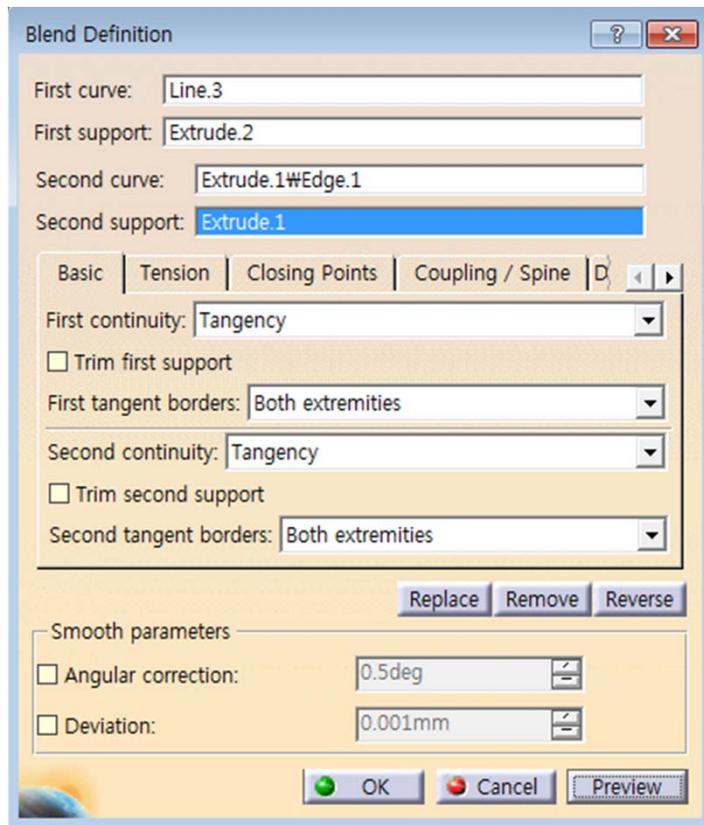
Surfaces



Blends

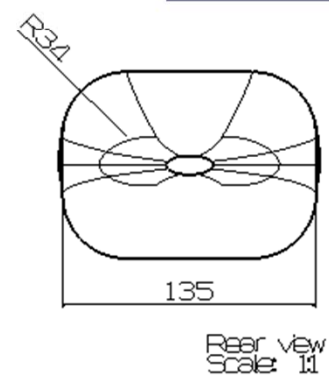
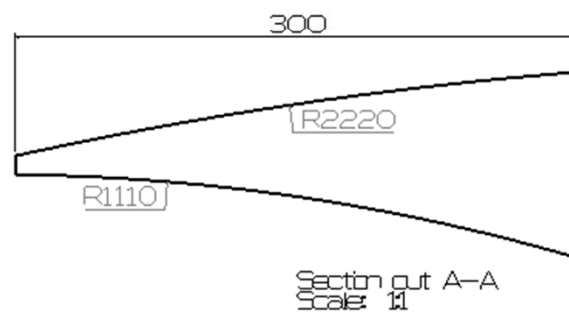
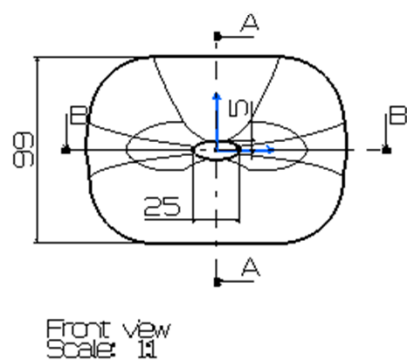
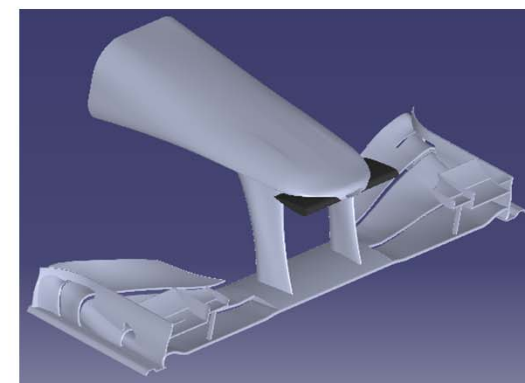
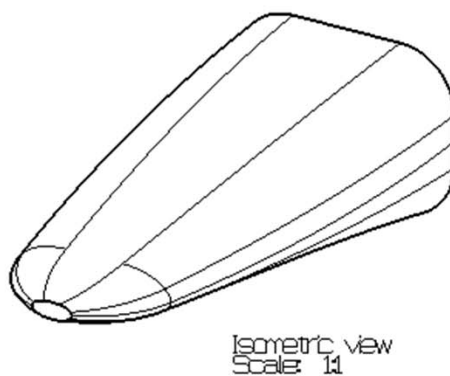
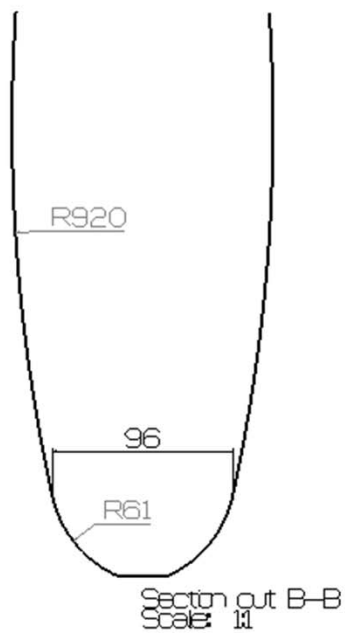


- Curve와 Curve의 사이를 연결하는 Surface 생성



실습 예제

- Multi-sections surface 기능 사용



CONTENTS

- ✓ 시작하기
- ✓ Wireframe
- ✓ Surfaces
- ✓ **Operation**
- ✓ Advanced tools

GENERATIVE SHAPE DESIGN TOOL

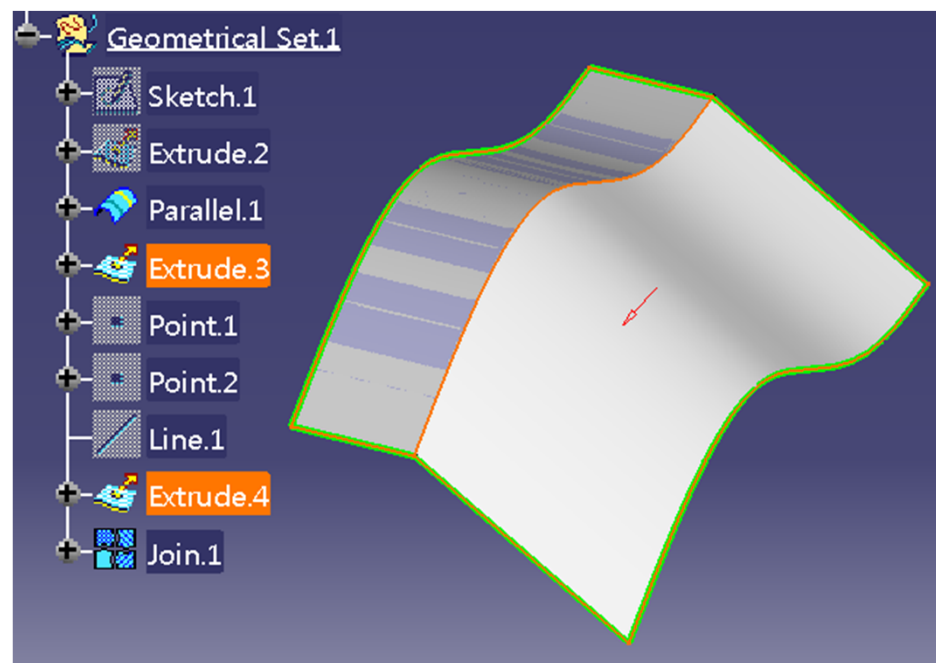
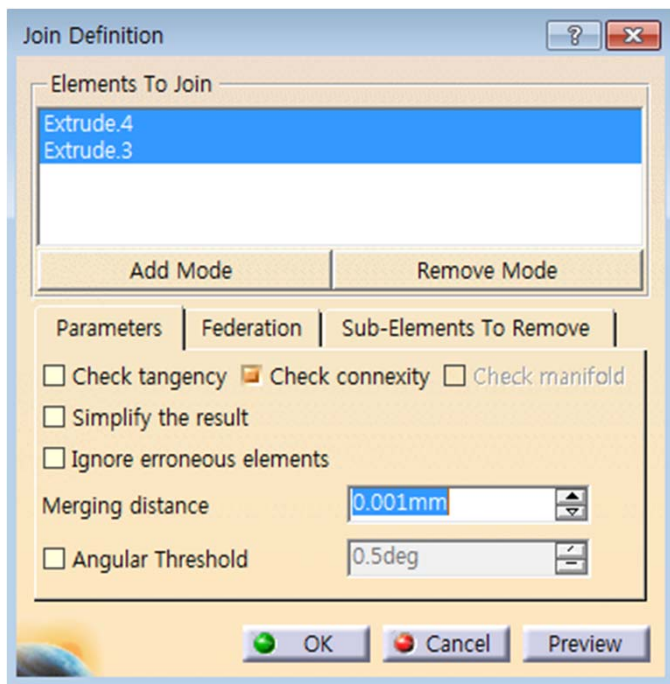
Operations



Join



- 여러 개의 Surface/Curve들을 하나로 묶는 기능



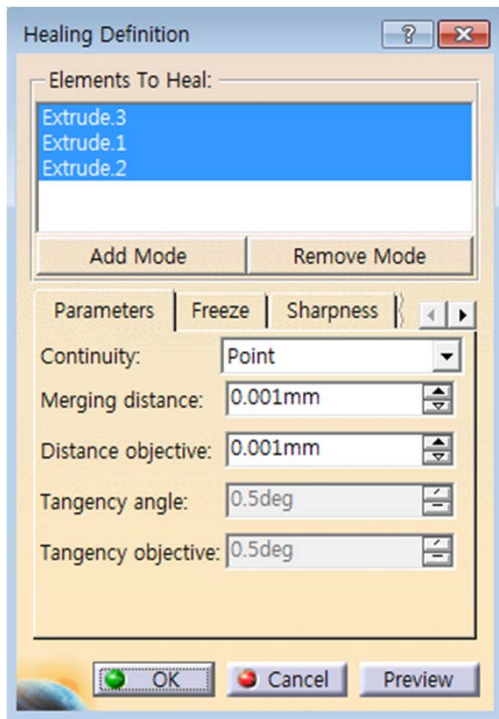
GENERATIVE SHAPE DESIGN TOOL

Operations

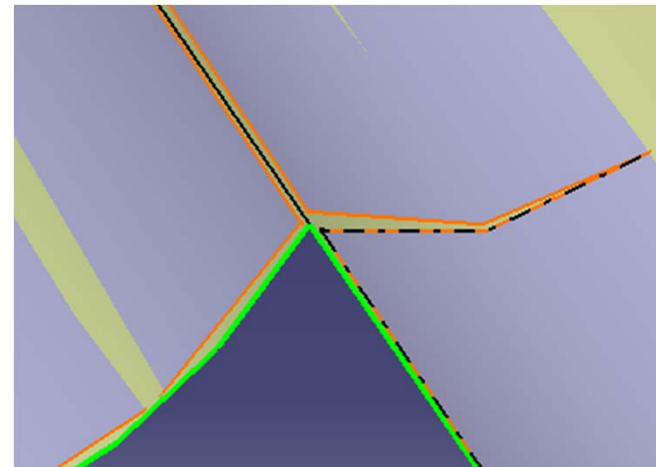
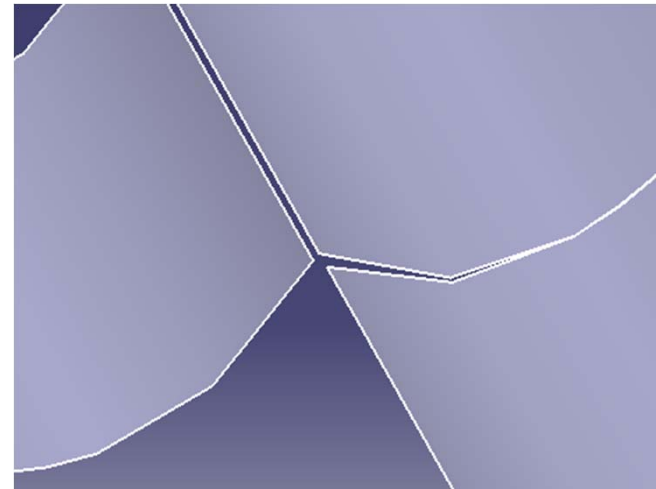


Healing 

- 여러 개의 Surface를 하나로 묶고
큰 공차를 가진 부분을 연결함



Distance objective : Merging distance의 허용오차



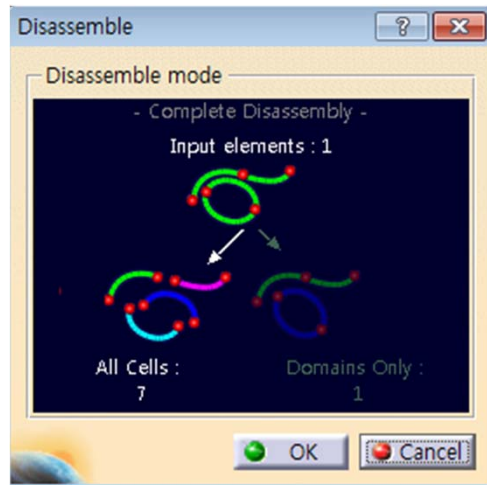
GENERATIVE SHAPE DESIGN TOOL

Operations

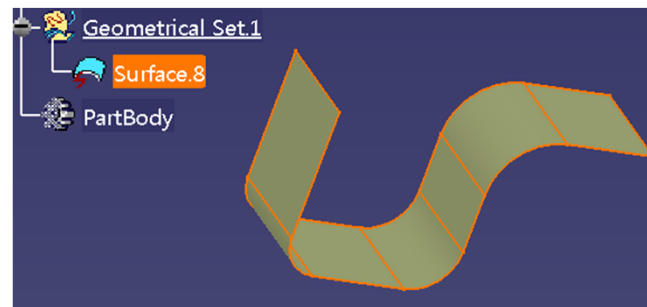


Disassemble 

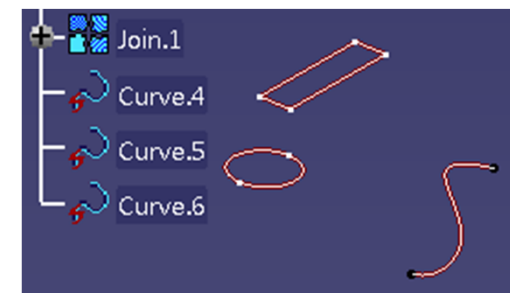
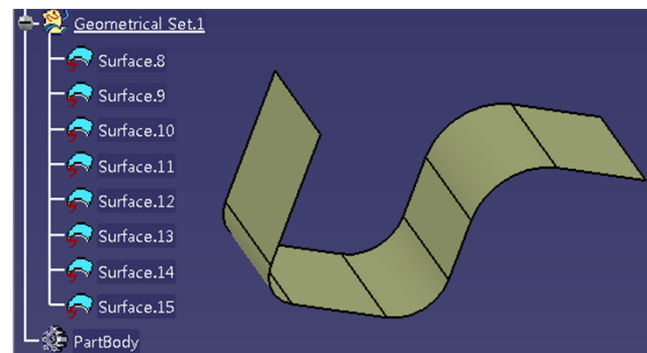
- 여러 개의 sub element로 이루어진 Surface나 Curve를 분해함



Surface



Wireframe



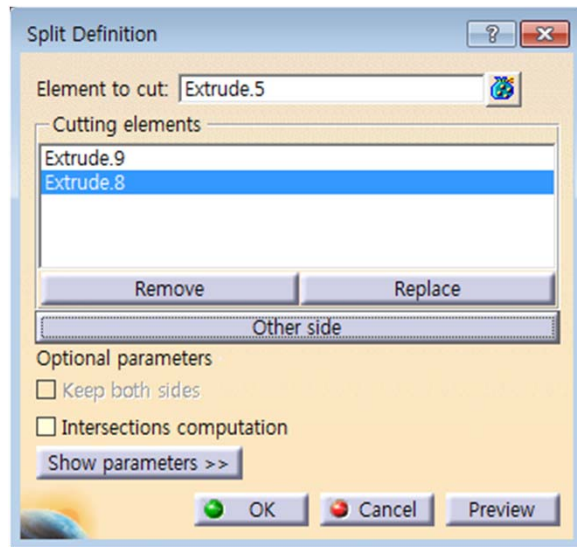
GENERATIVE SHAPE DESIGN TOOL

Operations

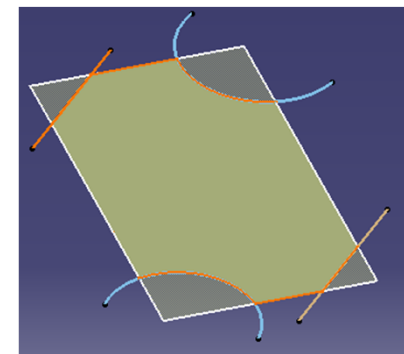
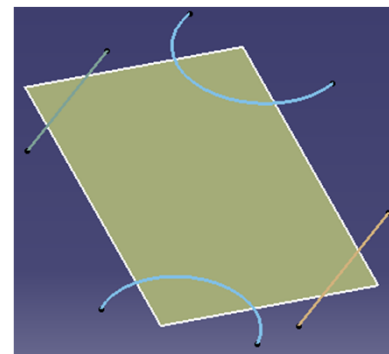
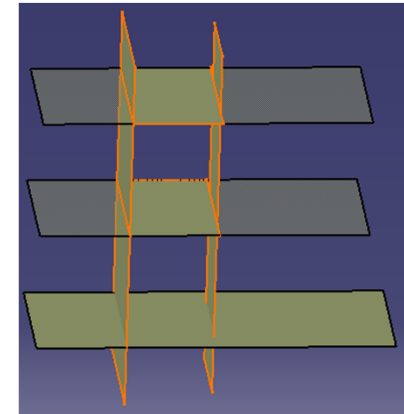
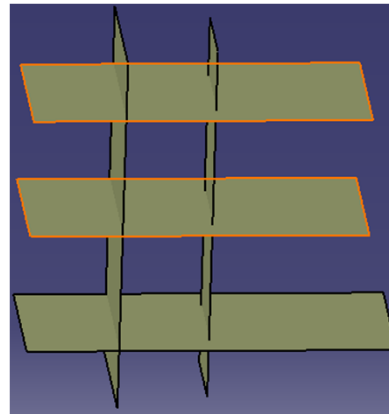


Split 

- Surface/Curve 형상을 임의의 요소를 기준으로 절단함



Keep both sides: Split으로 제거되는 요소도 남김



GENERATIVE SHAPE DESIGN TOOL

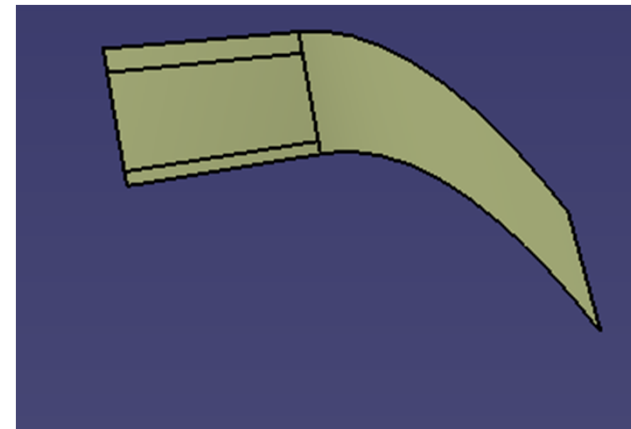
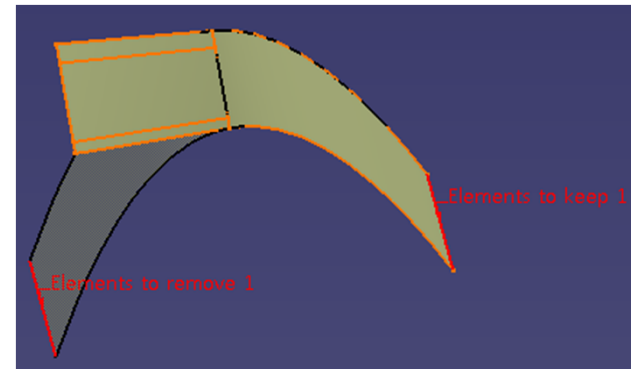
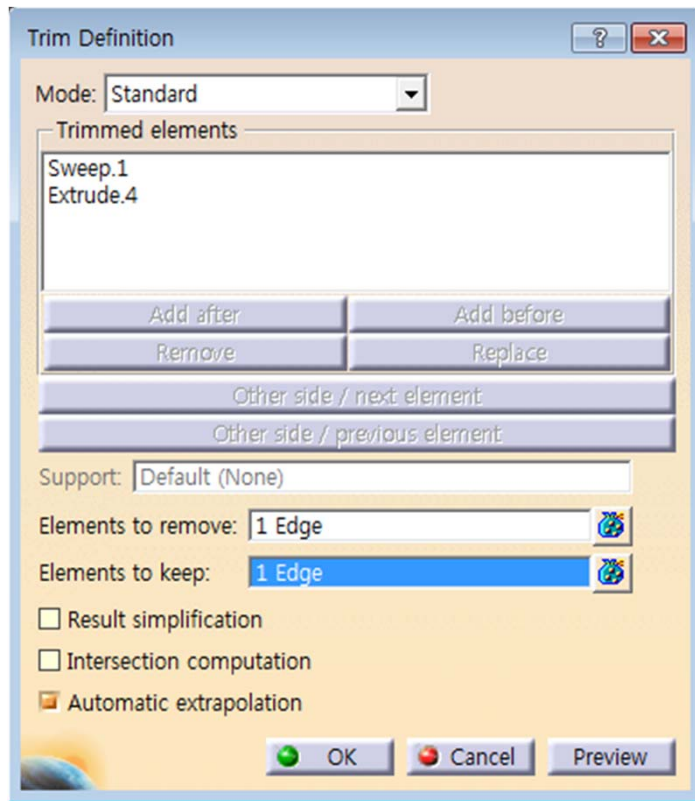
Operations



Trim



- Surface/Curve 형상을 임의의 요소를 기준으로 Trim을 진행함



GENERATIVE SHAPE DESIGN TOOL

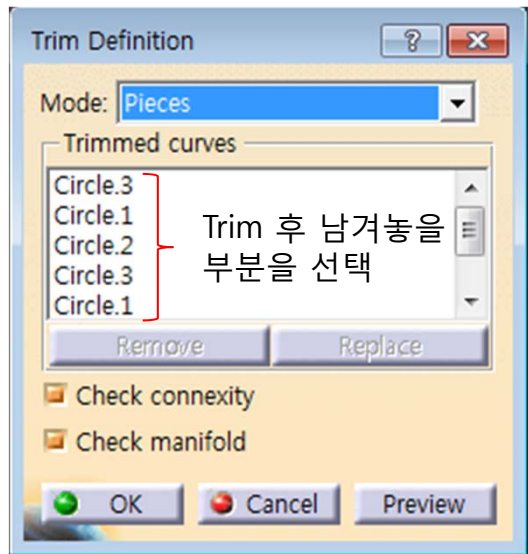
Operations



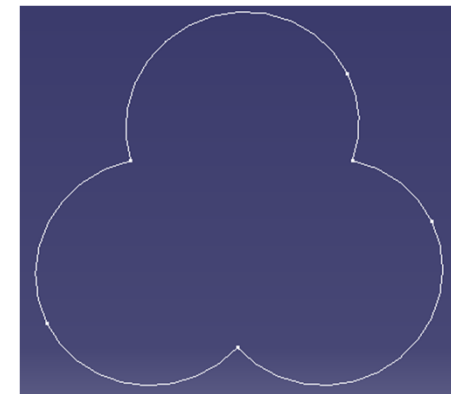
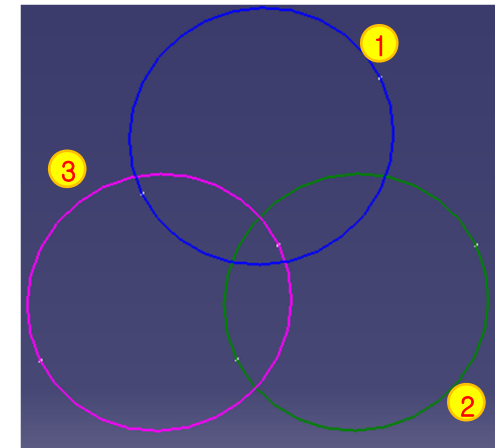
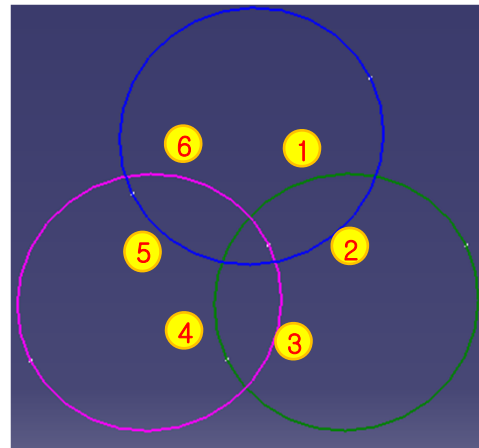
Trim



- Surface/Curve 형상을 임의의 요소를 기준으로 Trim을 진행함

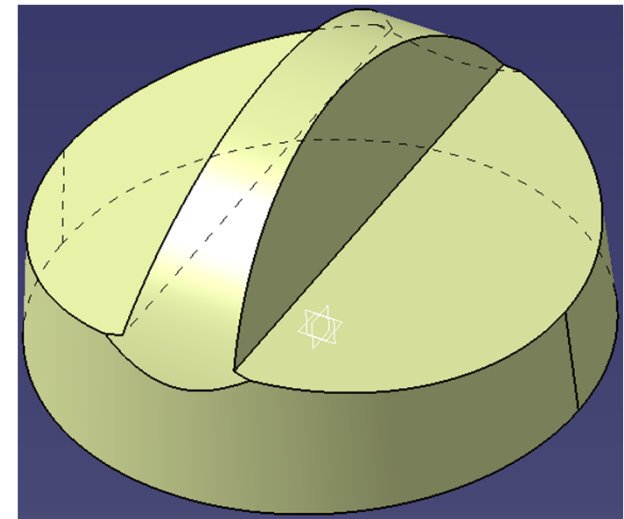
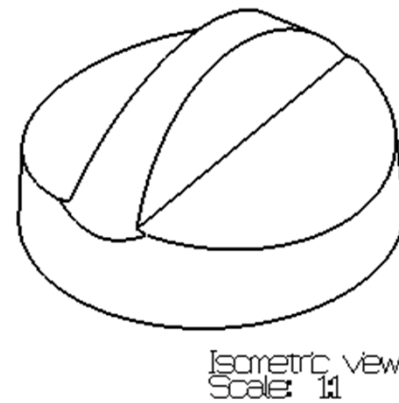
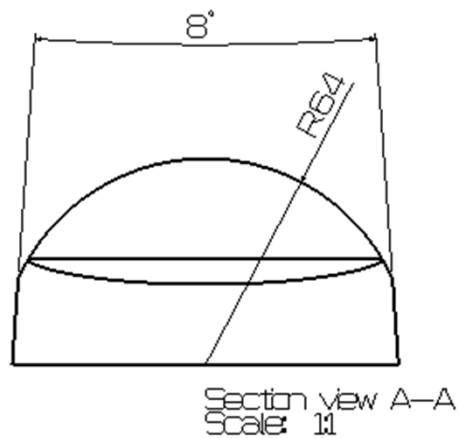
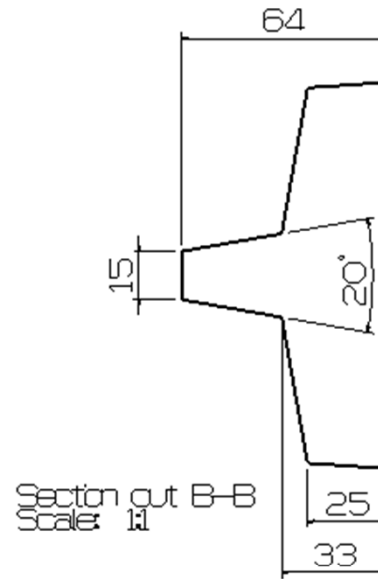
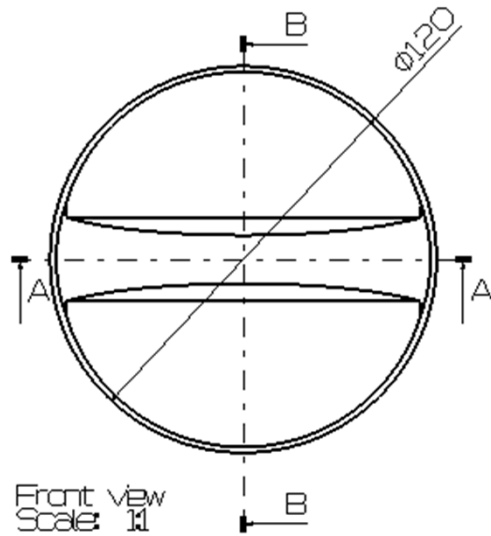


Pieces Mode : Curve 요소에만 적용 가능



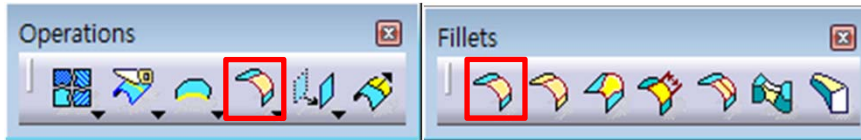
실습 예제

Generative Shape Design을 이용하여 모델링



GENERATIVE SHAPE DESIGN TOOL

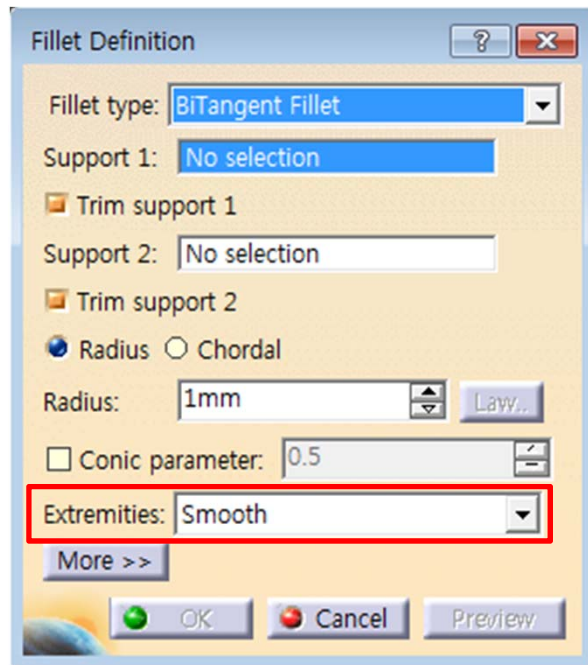
Operations



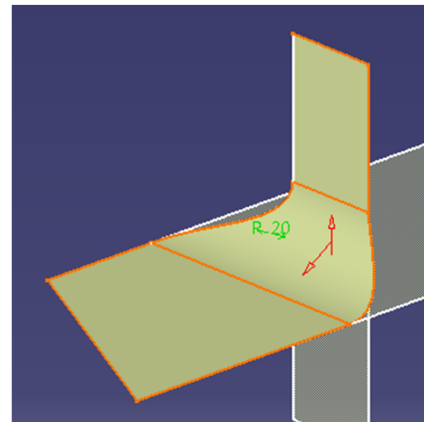
Shape Fillet 

- Surface 사이에 Fillet을 부여함

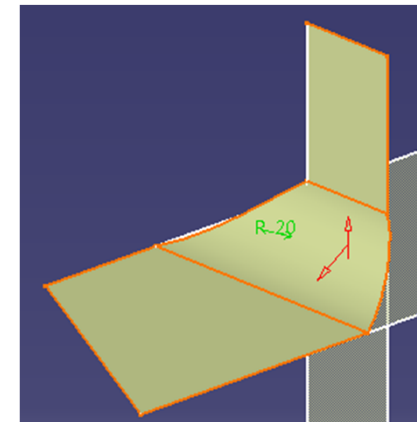
<BiTangent Fillet>



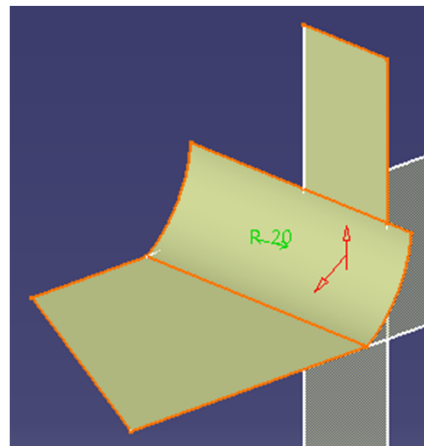
Smooth



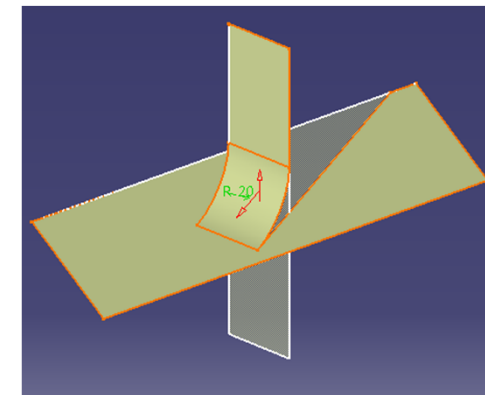
Straight



Maximum

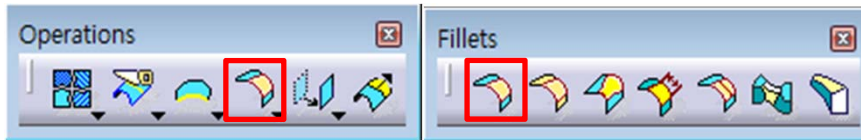


Minimum



GENERATIVE SHAPE DESIGN TOOL

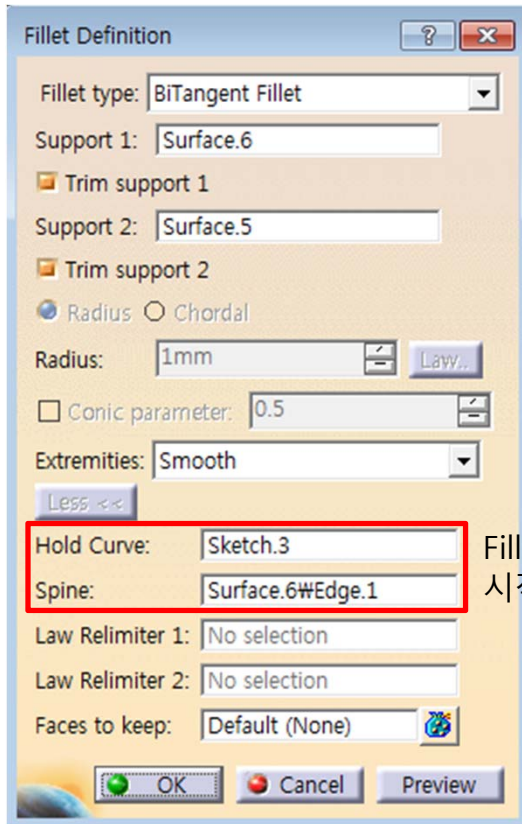
Operations



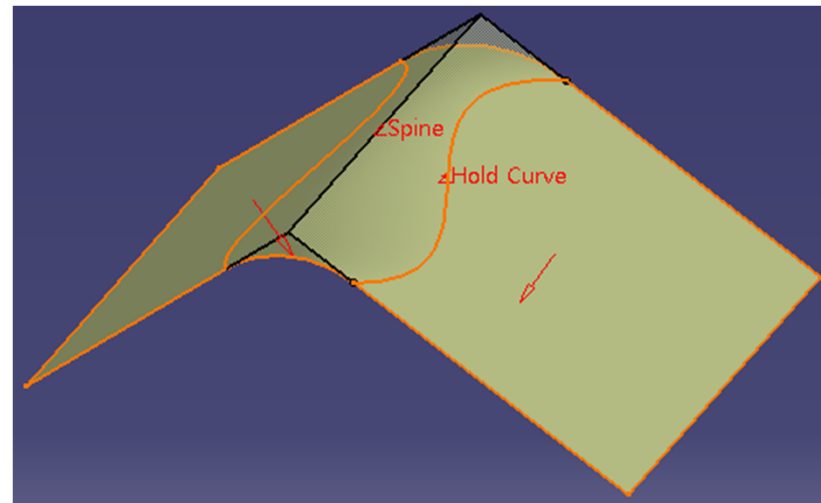
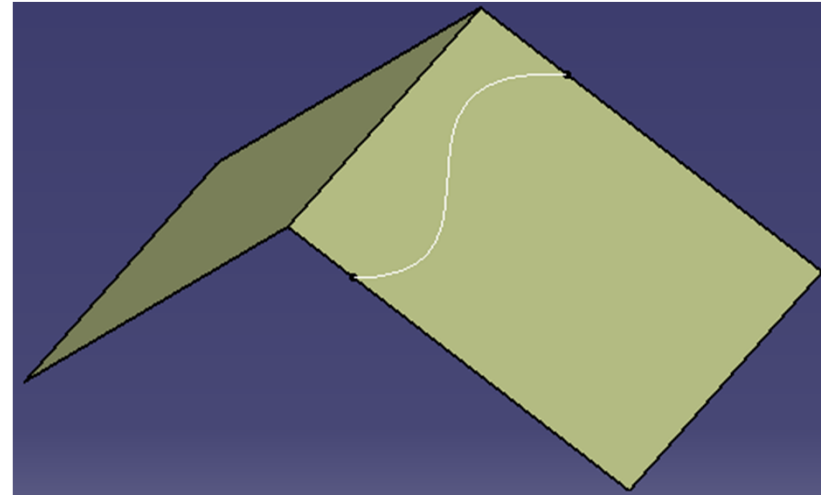
Shape Fillet 

- Surface 사이에 Fillet을 부여함

<BiTangent Fillet>

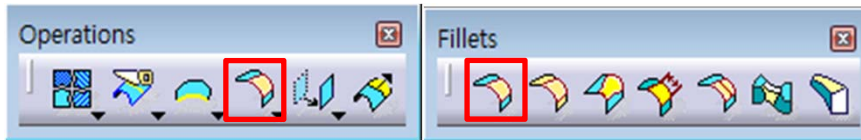


Fillet이 적용되는
시작부분을 정의



GENERATIVE SHAPE DESIGN TOOL

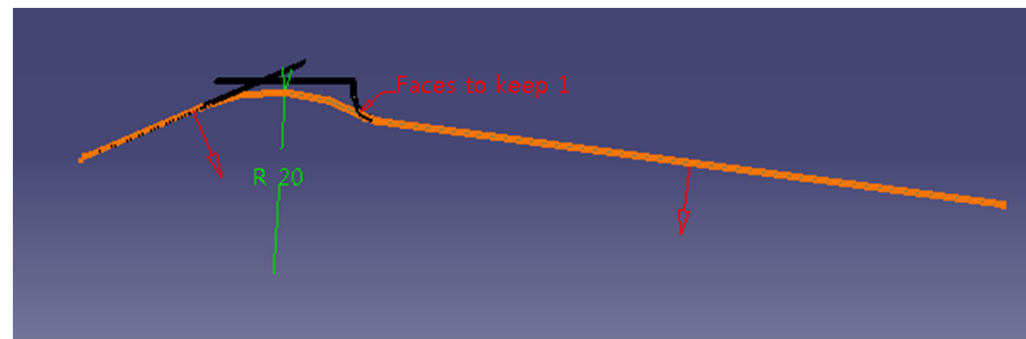
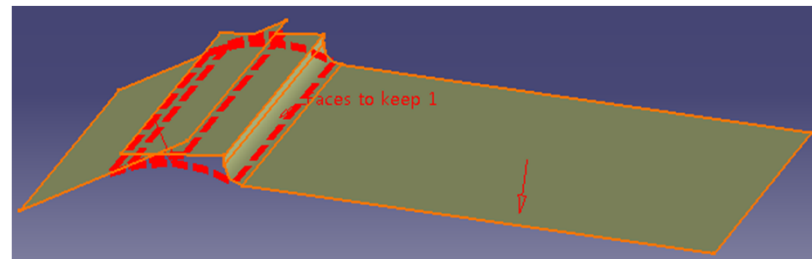
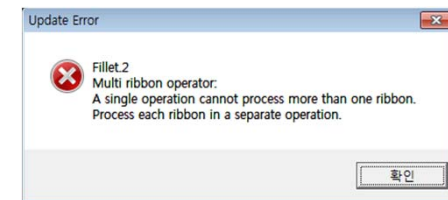
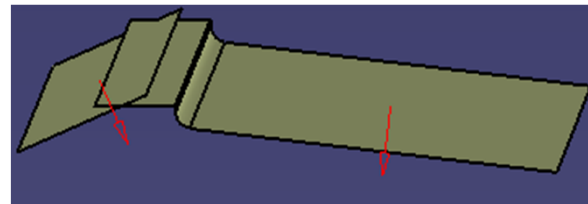
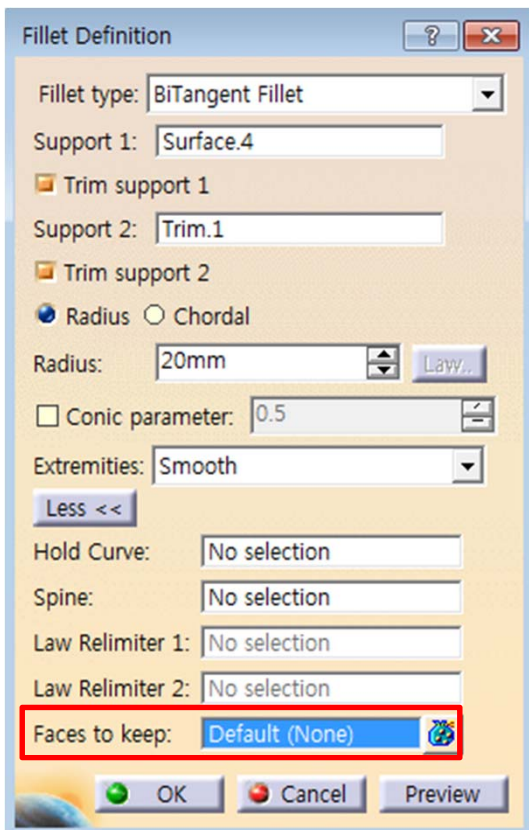
Operations



Shape Fillet 

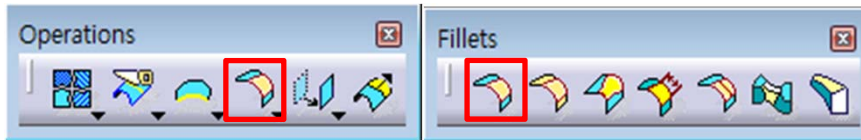
- Surface 사이에 Fillet을 부여함

<BiTangent Fillet>



GENERATIVE SHAPE DESIGN TOOL

Operations

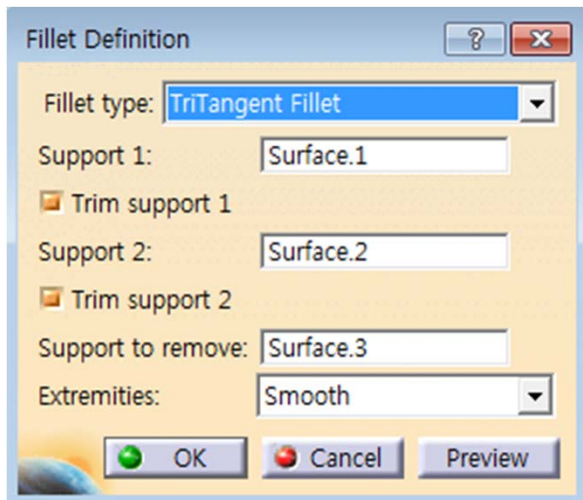


Shape Fillet

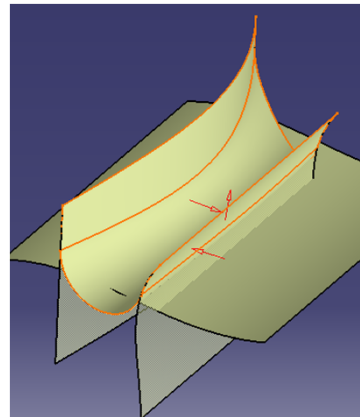


- Surface 사이에 Fillet을 부여함

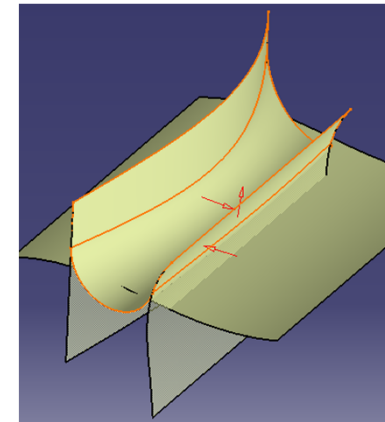
<TriTangent Fillet>



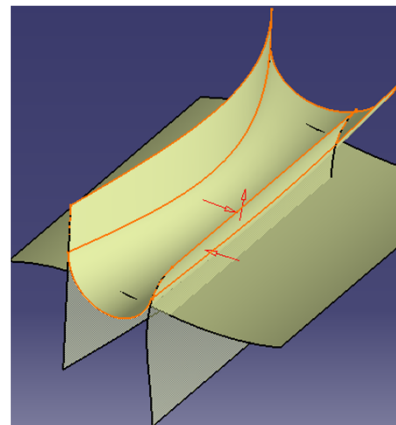
Smooth



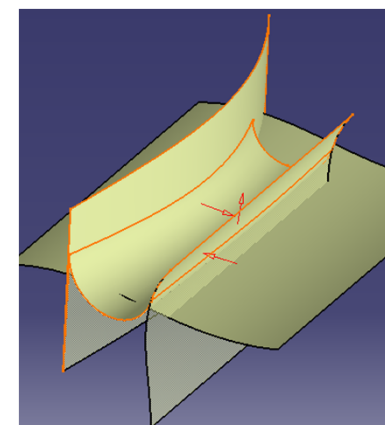
Straight



Maximum

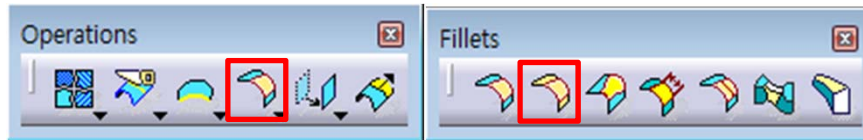


Minimum



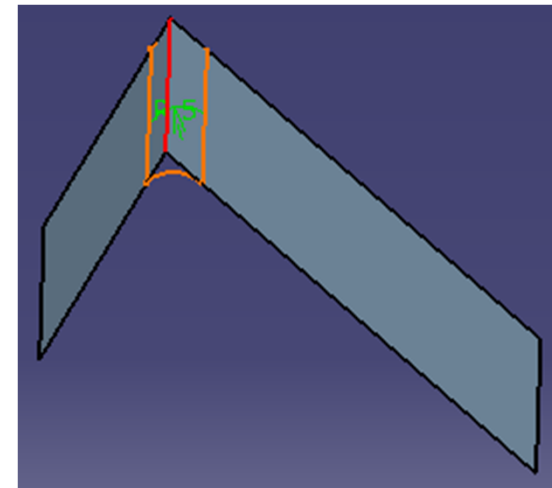
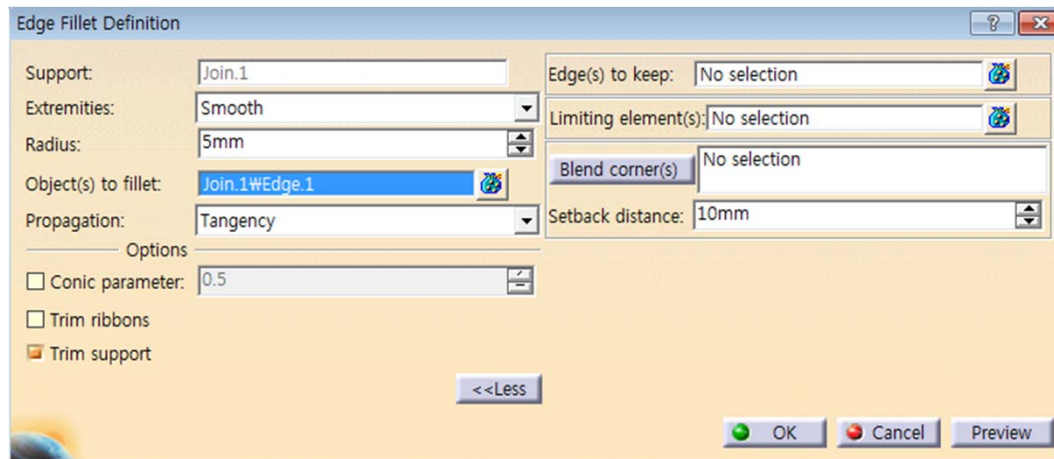
GENERATIVE SHAPE DESIGN TOOL

Operations



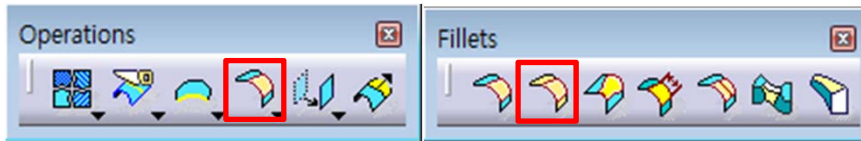
Edge Fillet 

- Join된 Surface와 같이 하나의 Surface 상의 모서리에 Fillet을 부여함



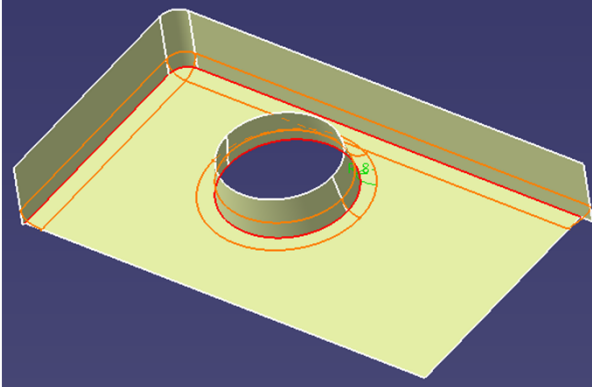
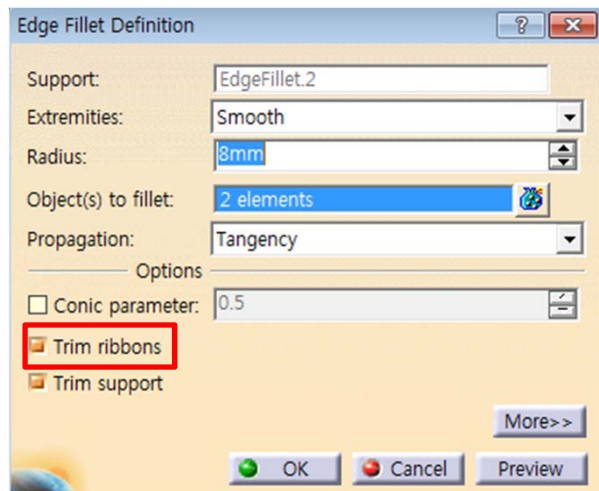
GENERATIVE SHAPE DESIGN TOOL

Operations

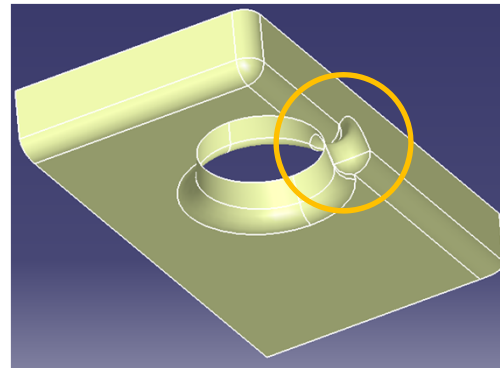


Edge Fillet 

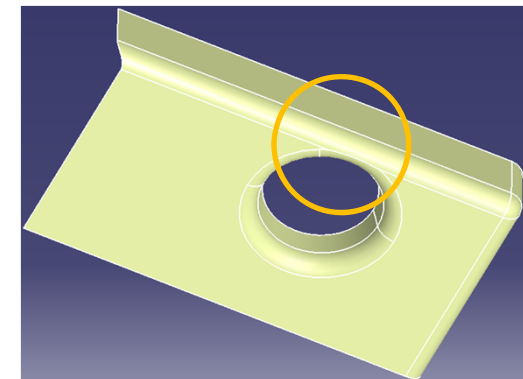
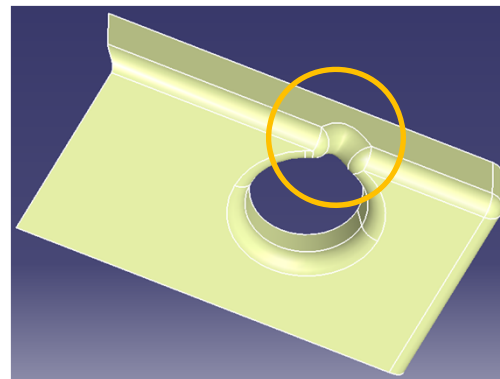
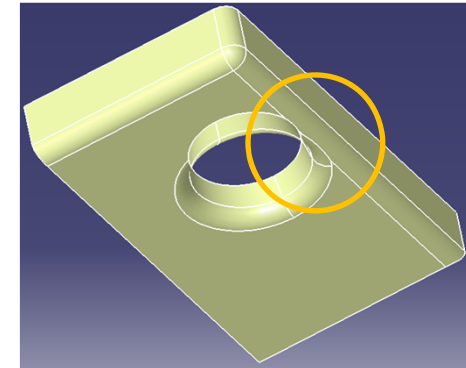
- Trim ribbons: Fillet이 겹치는 부분의 꼬임 형상을 방지



No Trim ribbons

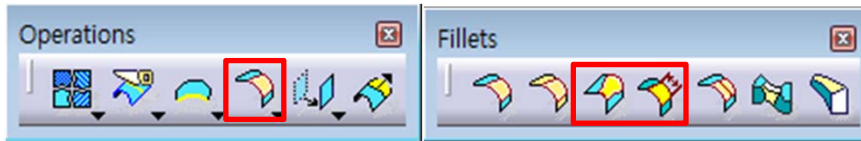


Trim ribbons



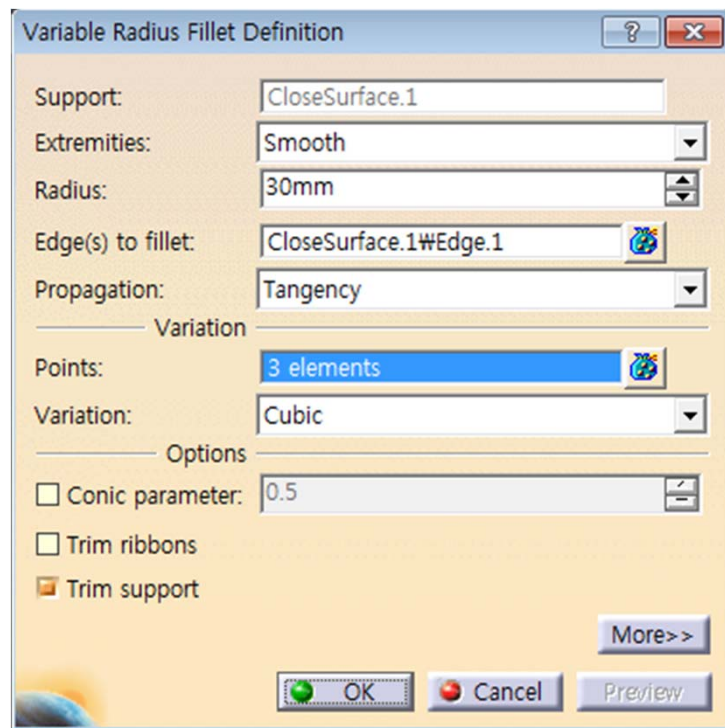
GENERATIVE SHAPE DESIGN TOOL

Operations

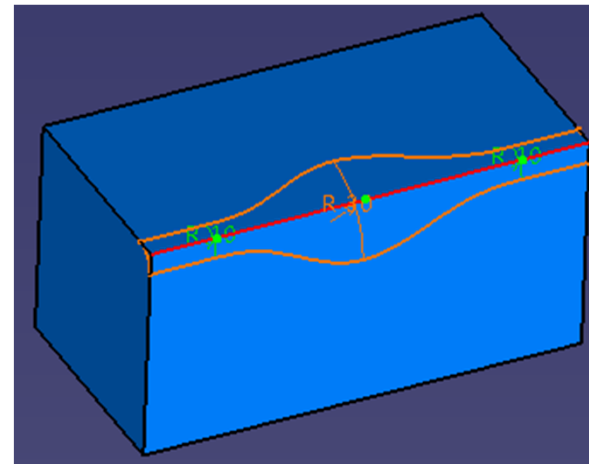


Variable Fillet  / Chordal Fillet 

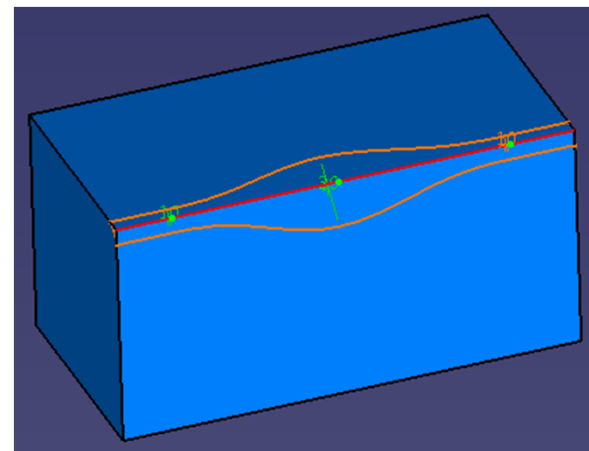
- 여러 개의 곡률/길이 값을 이용하여 Fillet 생성



Variable Fillet

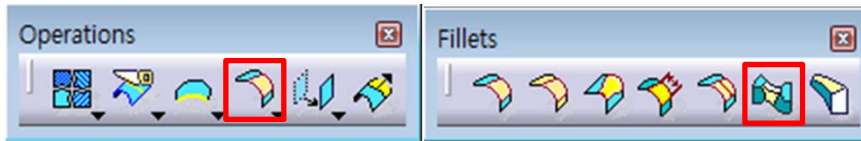


Chordal Fillet



GENERATIVE SHAPE DESIGN TOOL

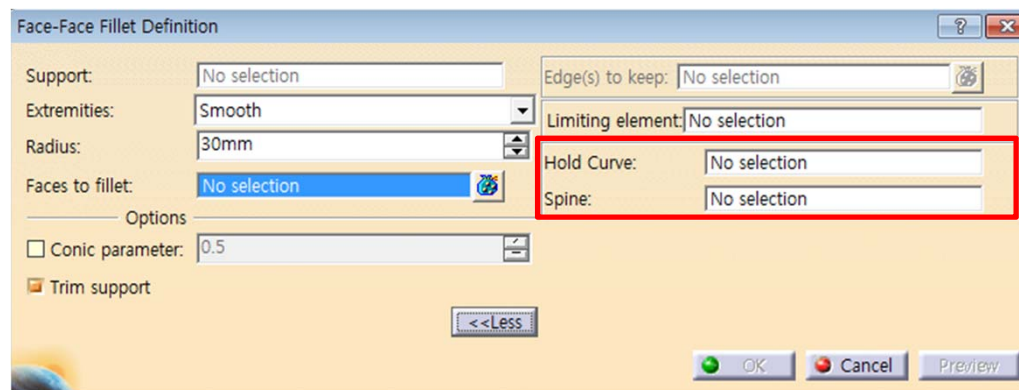
Operations



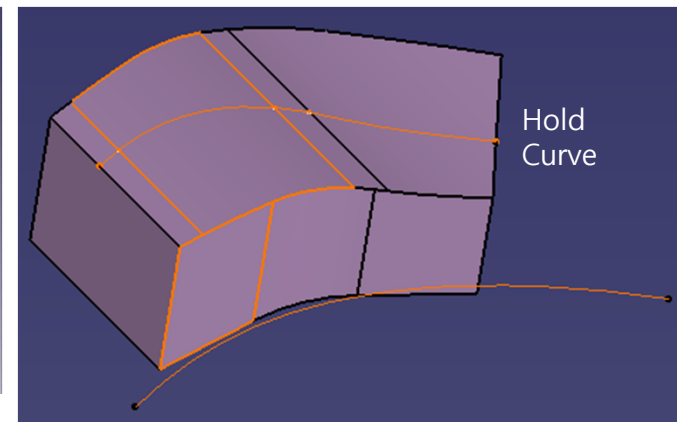
Face-Face Fillet



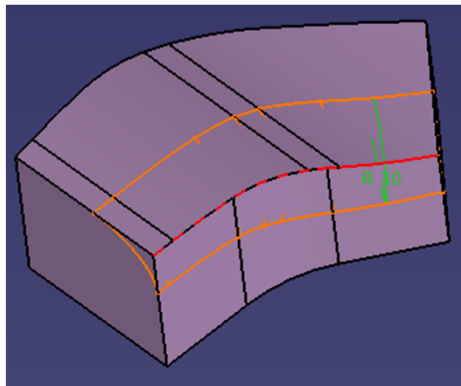
- 두 개의 Surface면과 Tangent하게 Fillet을 생성



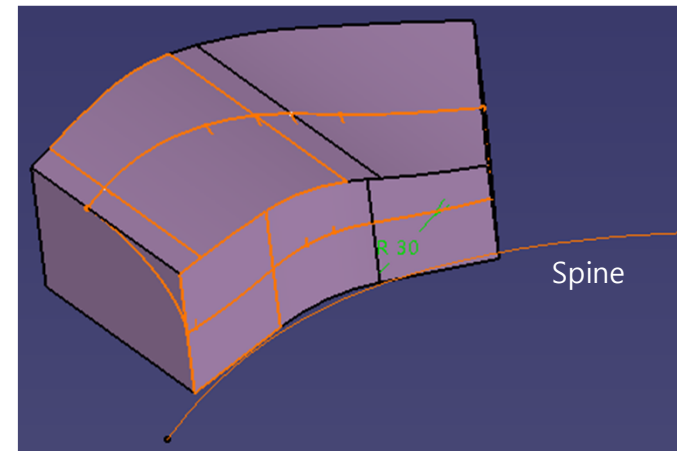
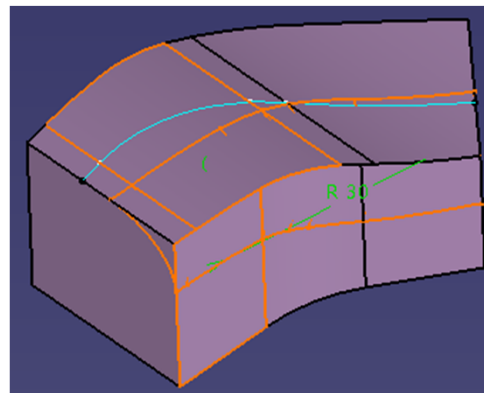
Hold Curve/Spine을 사용할 경우



이전의 Edge Fillet을 사용할 경우

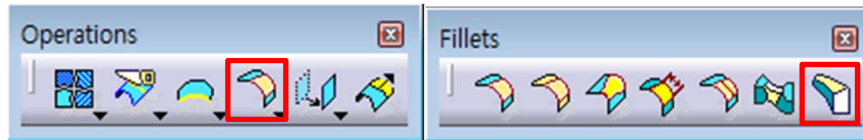


Face만 선택할 경우



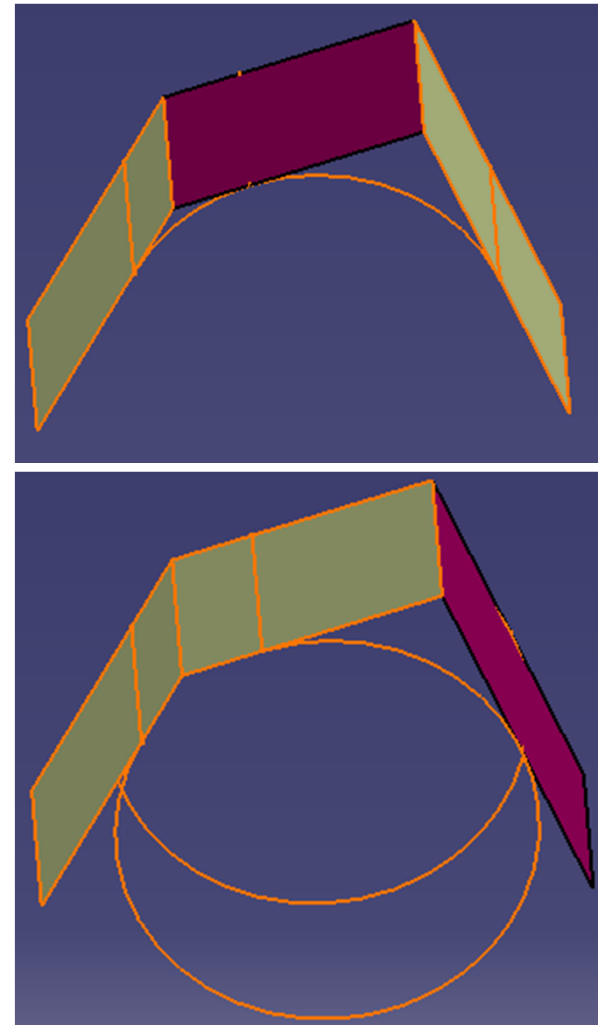
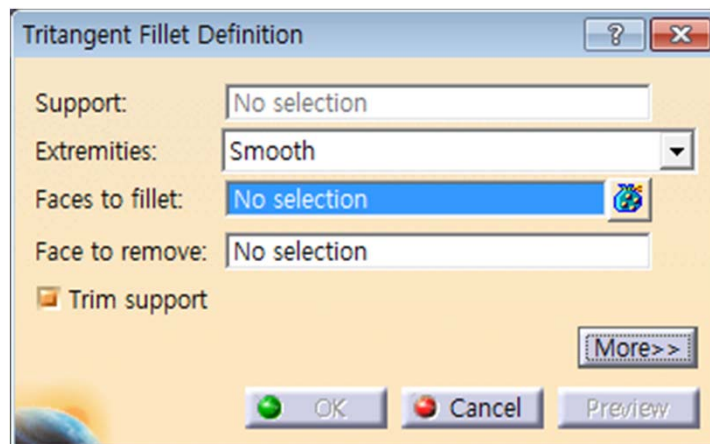
GENERATIVE SHAPE DESIGN TOOL

Operations



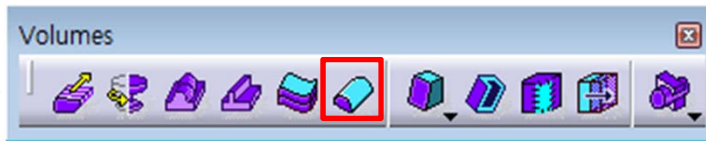
Tritangent Fillet

- 세 개의 Surface면과 Tangent하게 Fillet을 생성
(세 개의 surface과 하나로 인식되는 경우에만 사용 가능.
독립적으로 떨어진 surface 간에는 사용 불가.)



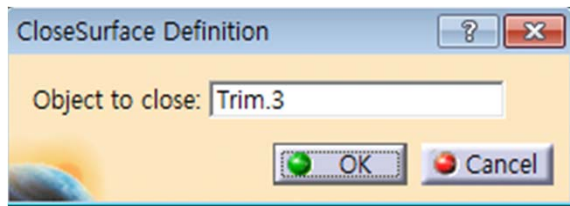
GENERATIVE SHAPE DESIGN TOOL

Volumes

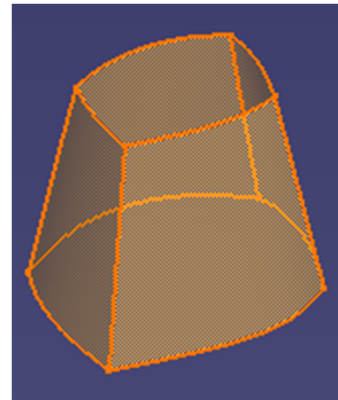


Close Surface 

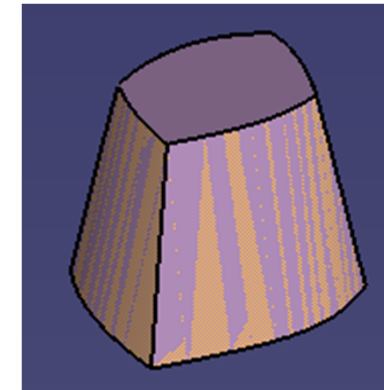
- 닫혀있는 구조의 Surface를 이용해 Volume을 생성



Open Surface

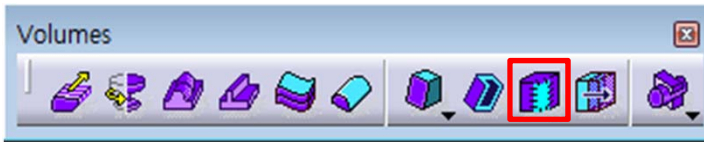


Volume



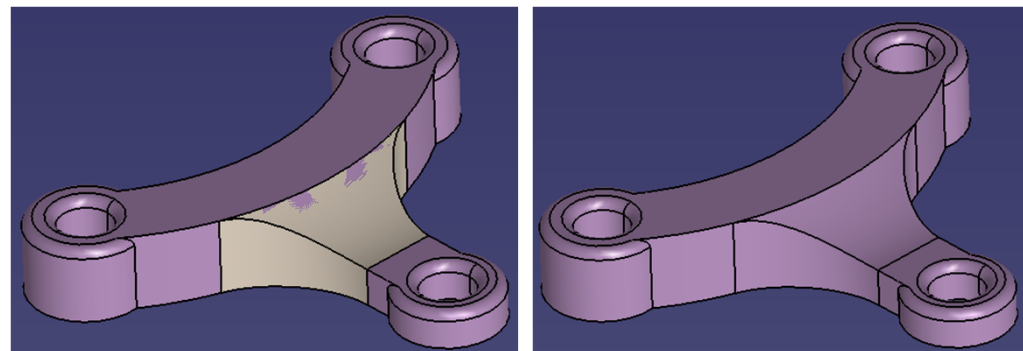
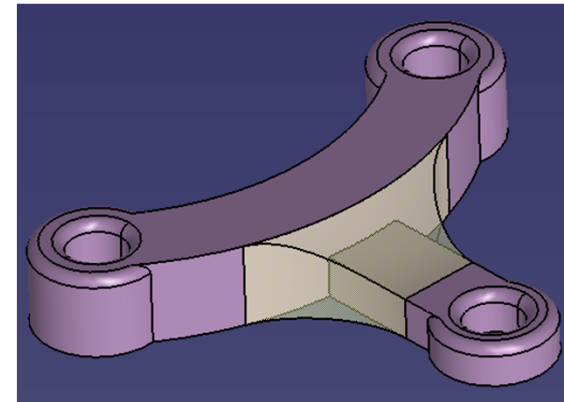
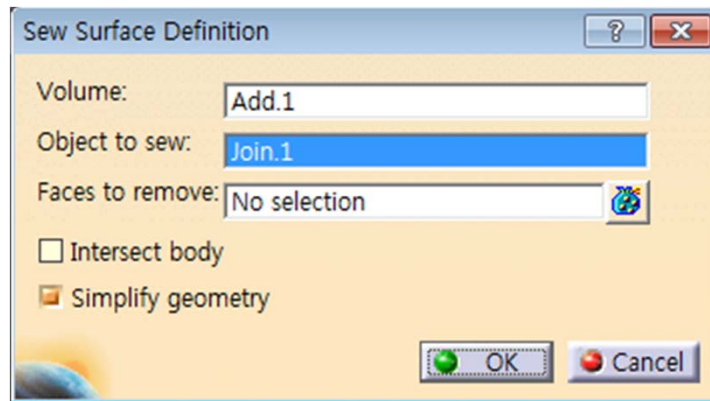
GENERATIVE SHAPE DESIGN TOOL

Volumes



Sew Surface 

- Volume과 연결된 닫힌 형태의 Surface 내부에 Volume을 생성



GENERATIVE SHAPE DESIGN TOOL

Replication

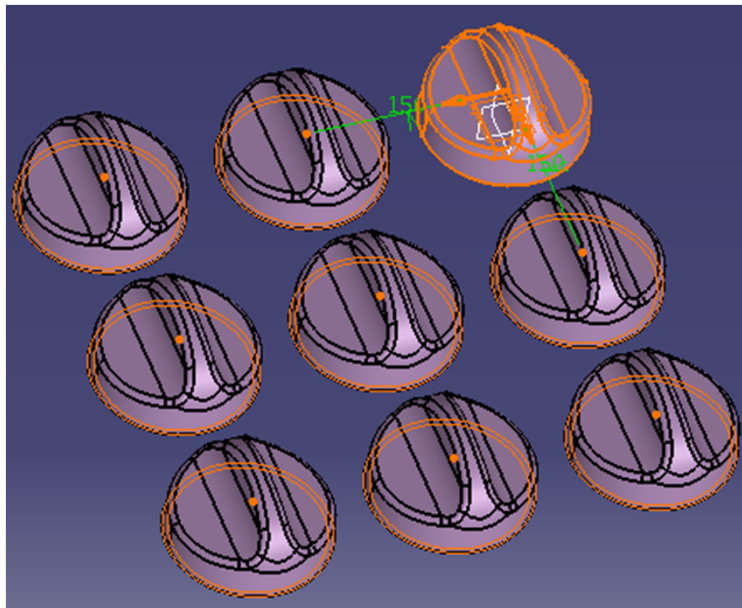


Patterns

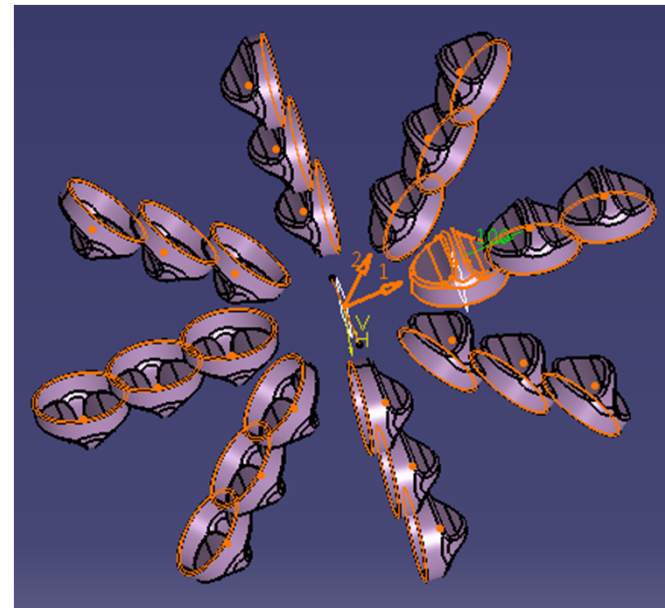
- Part Design에서와 마찬가지로 반복되는 형상 생성을 도와줌



Rectangular Pattern

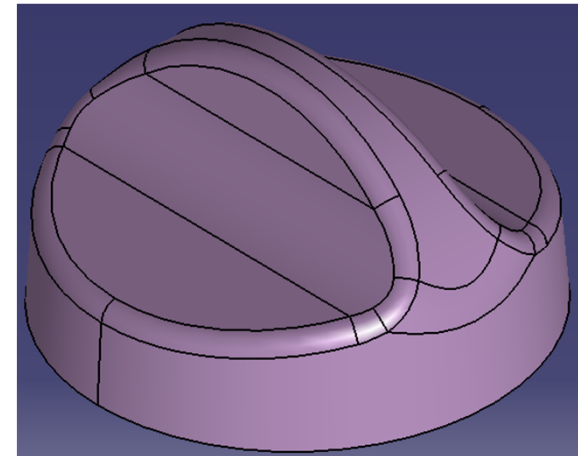
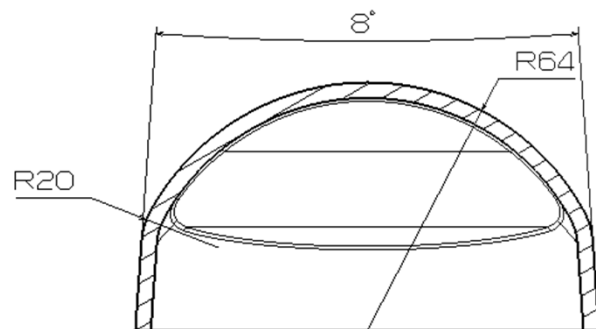
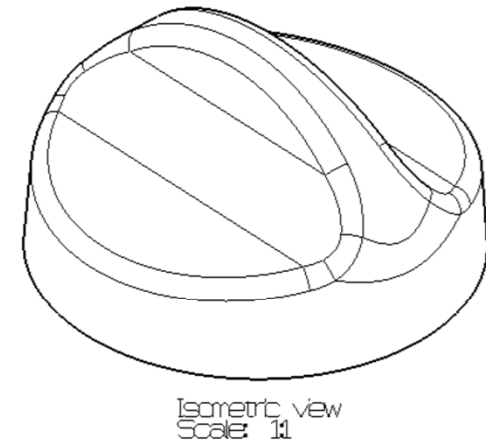
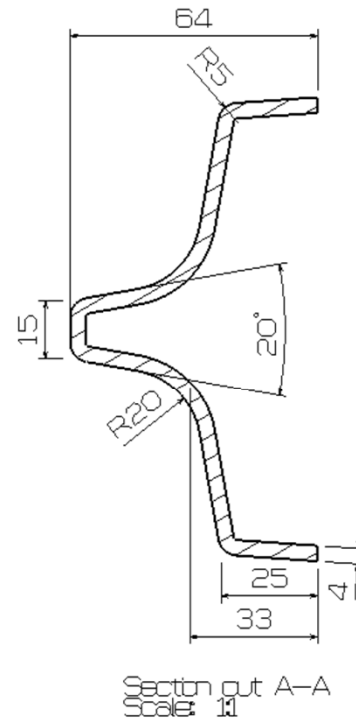
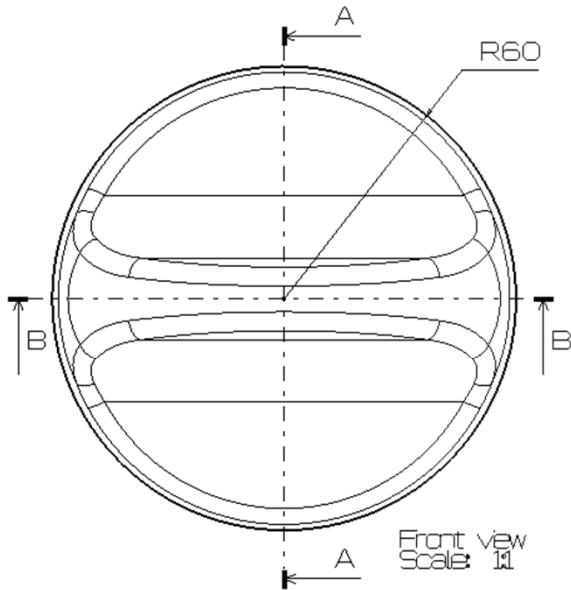


Circular Pattern



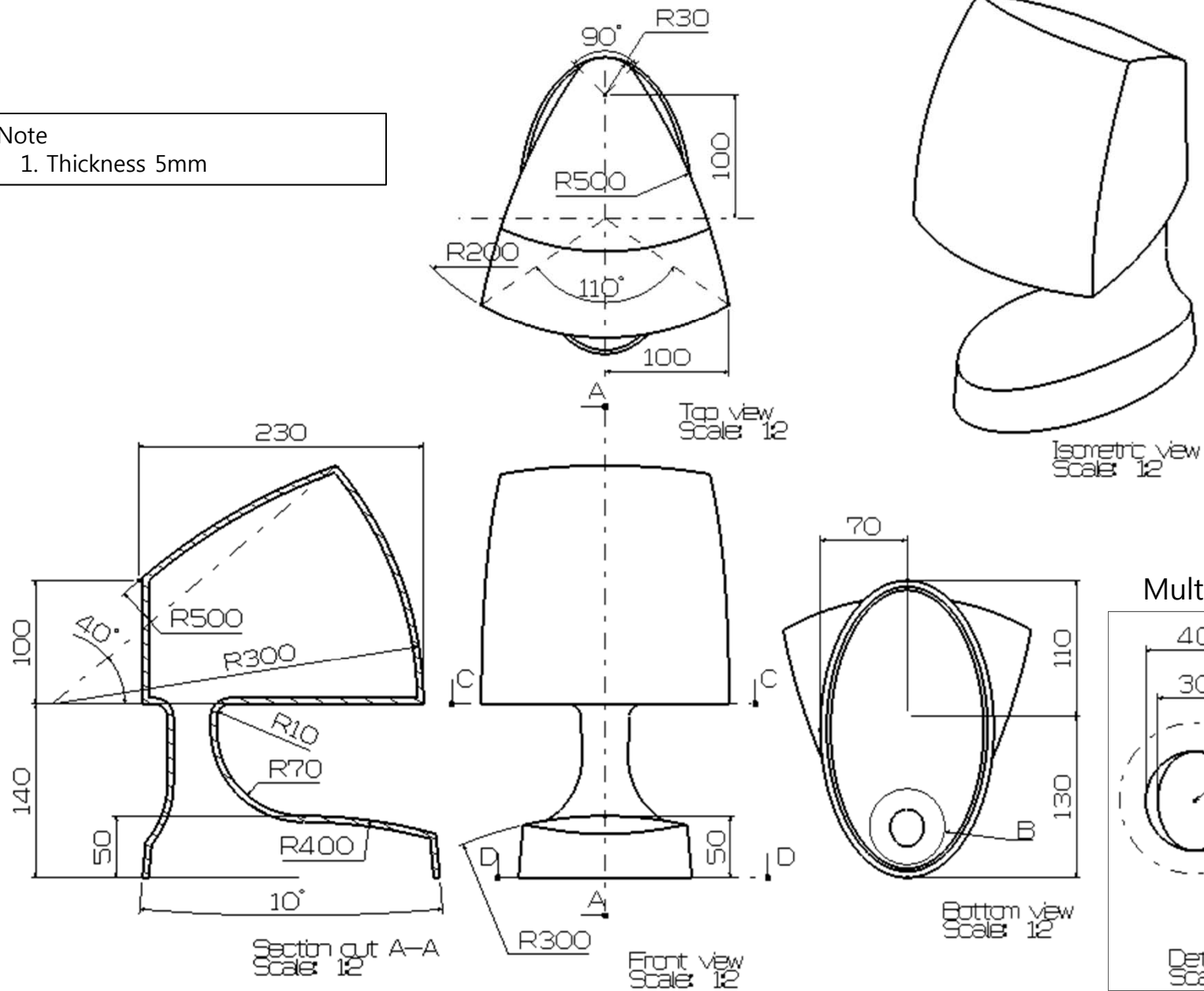
실습 예제

Generative Shape Design을 이용하여 모델링 (Volume툴은 Thick Surface  만 이용)



실습 과제

Note
1. Thickness 5mm

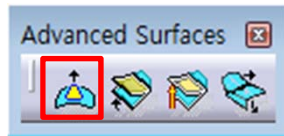


CONTENTS

- ✓ 시작하기
- ✓ Wireframe
- ✓ Surfaces
- ✓ Operation
- ✓ **Advanced tools**

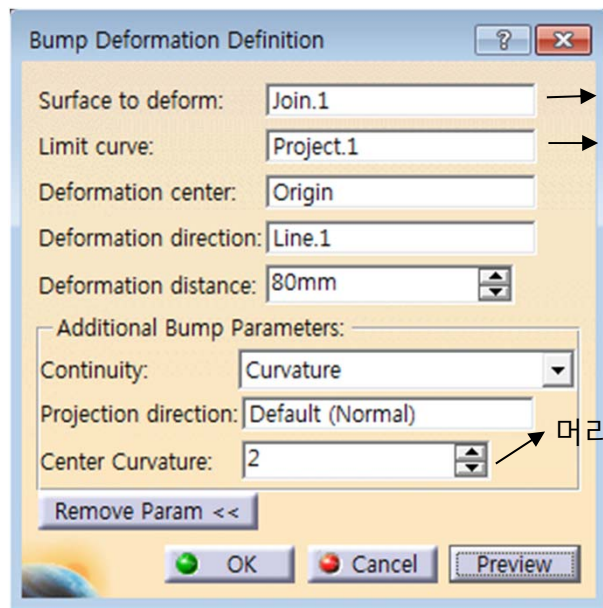
GENERATIVE SHAPE DESIGN TOOL

Advanced Surfaces



Bump

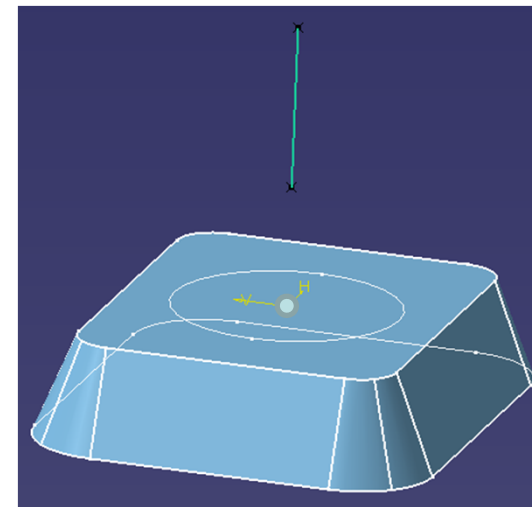
- 특정 위치에 돌출된 형상을 생성함



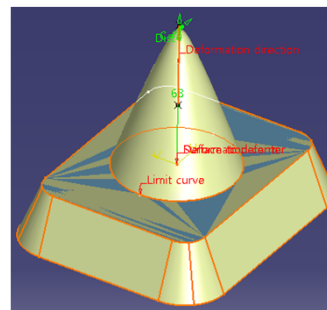
→ 변형시킬 Surface

→ 변형 범위를 제한

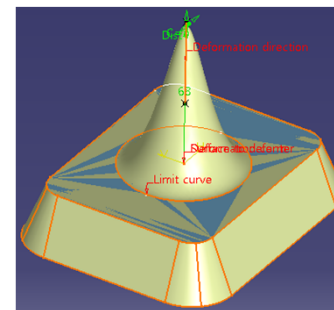
→ 머리 부분의 곡률 조정



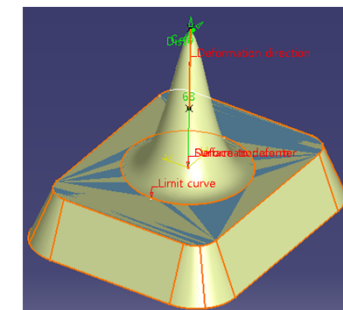
Point



Tangent

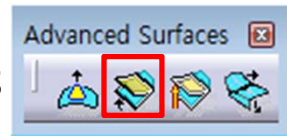


Curvature



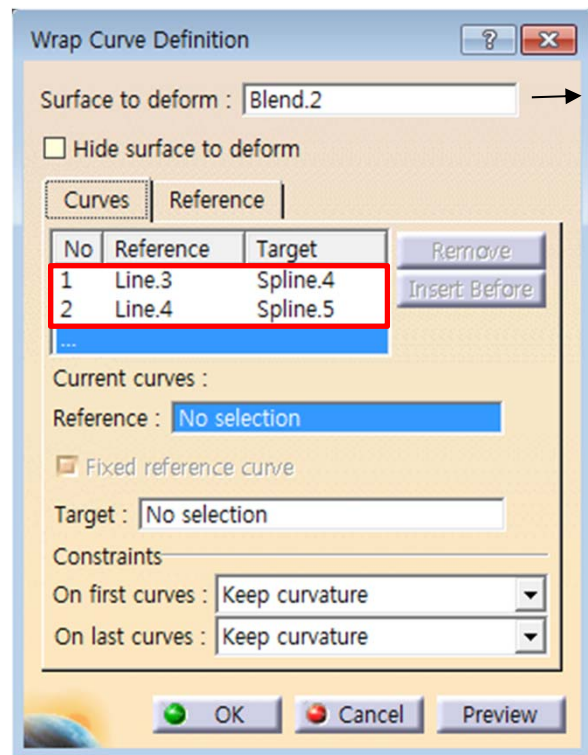
GENERATIVE SHAPE DESIGN TOOL

Advanced Surfaces

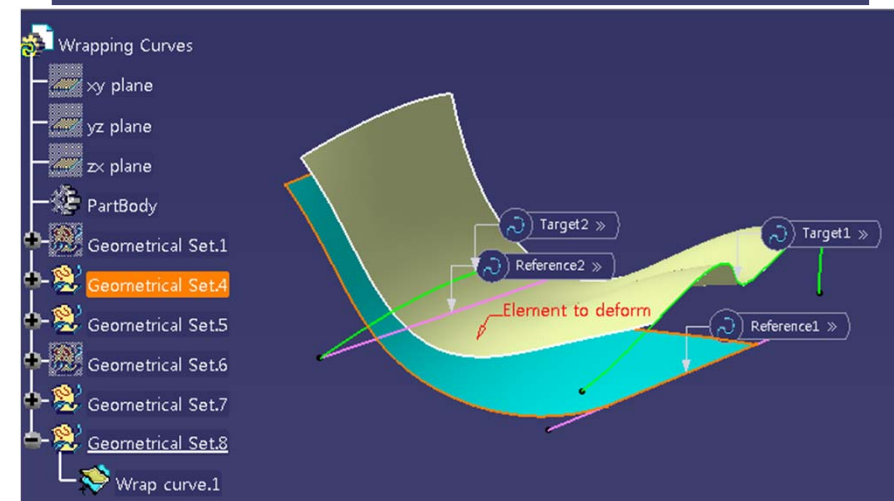
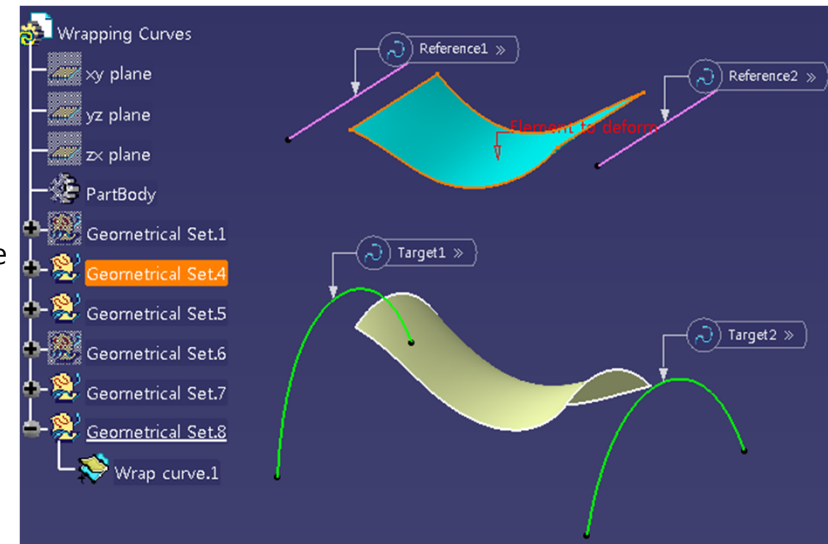


Wrap Curve

- Surface 형상을 특정 Curve를 이용하여 구부리는 기능

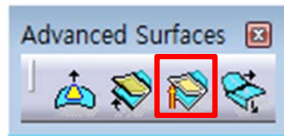


→ 변형시킬 Surface



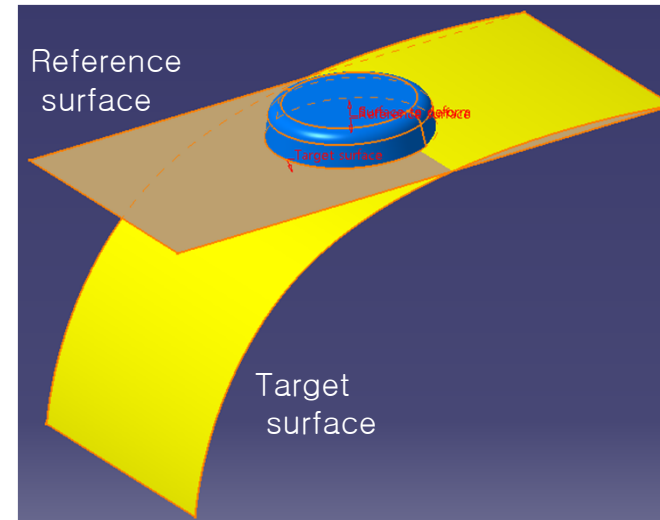
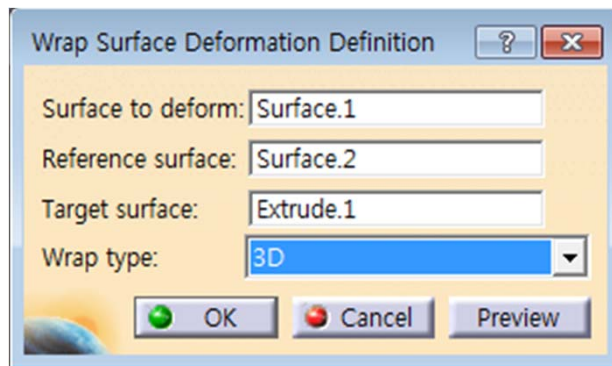
GENERATIVE SHAPE DESIGN TOOL

Advanced Surfaces

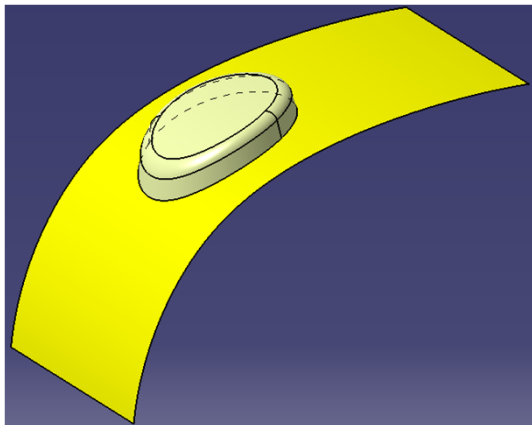


Warp Surface

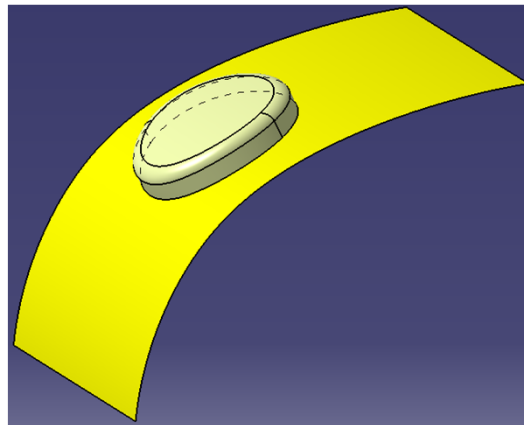
- Surface 형상을 특정 Surface를 이용하여 구부리는 기능



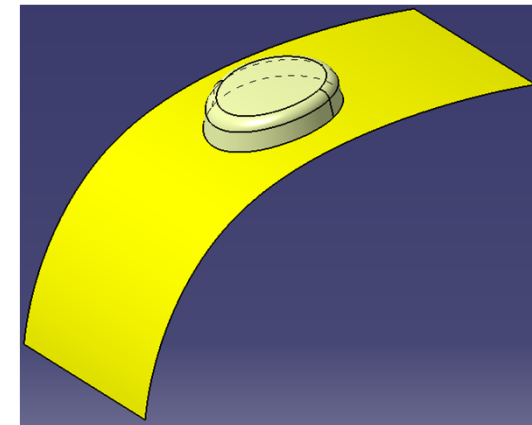
3D Type



Normal Type

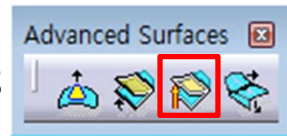


With direction Type (z direction)



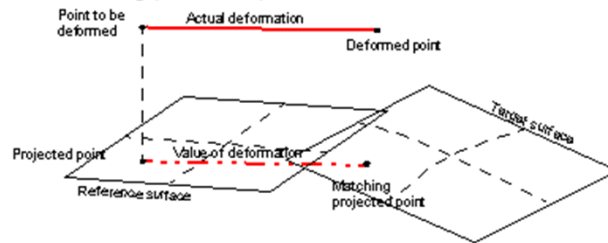
GENERATIVE SHAPE DESIGN TOOL

Advanced Surfaces



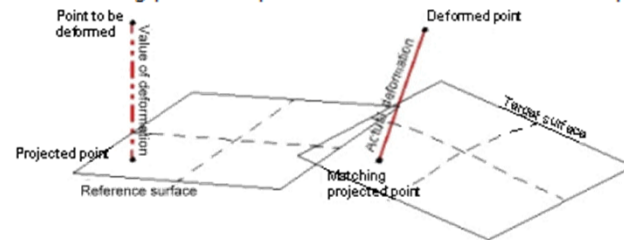
3D Wrap

The following picture explains how the deformation is computed in relation to the entered data, i.e. reference/target surfaces:



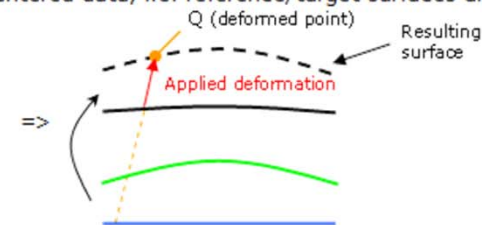
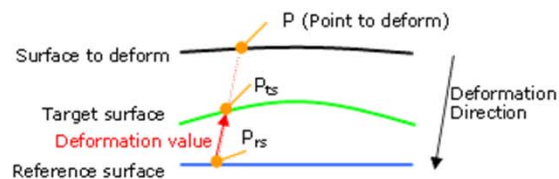
Normal Wrap

The following picture explains how the deformation is computed in relation to the entered data, i.e. reference/target surfaces:



With Direction

The following pictures explain how the deformation is computed in relation to the entered data, i.e. reference/target surfaces and deformation direction:



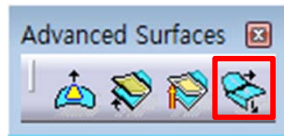
The deformed point is computed as follows: $Q = P + (P_{ts} - P_{rs})$

You need to select a deformation direction (here Plane.1):

Wrap type:	With direction
Direction:	Plane.1

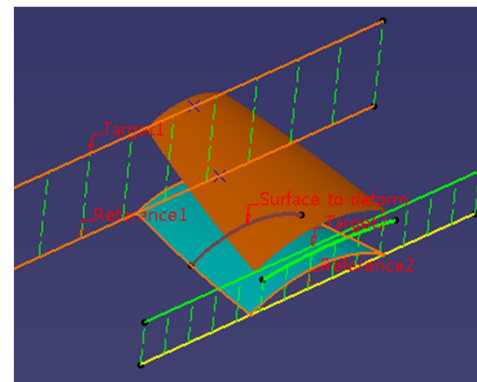
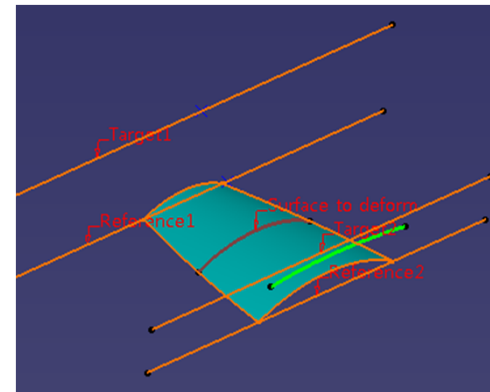
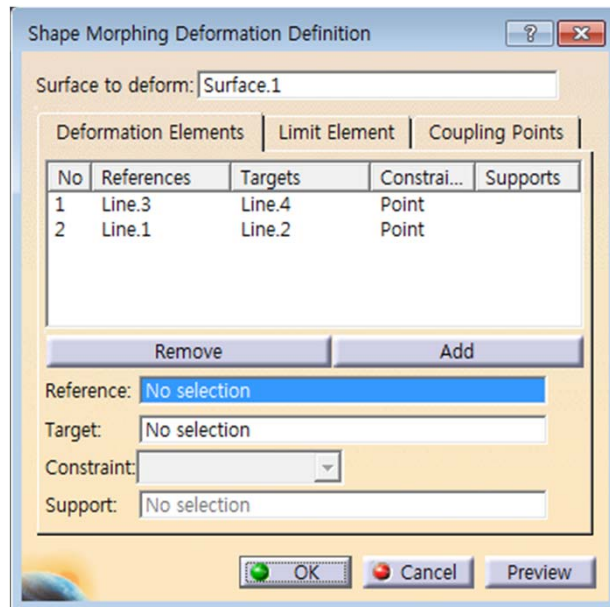
GENERATIVE SHAPE DESIGN TOOL

Advanced Surfaces

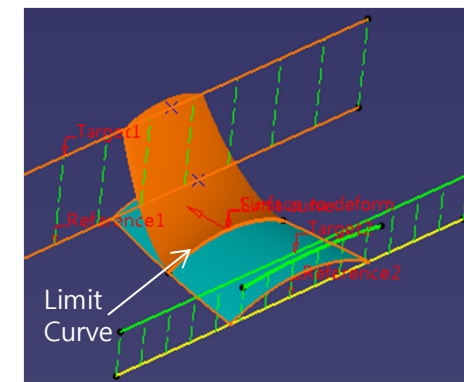


Shape Morphing

- Warp Curve와 유사하며 표현 범위가 좀 더 넓은

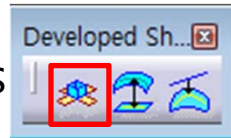


Limit Element



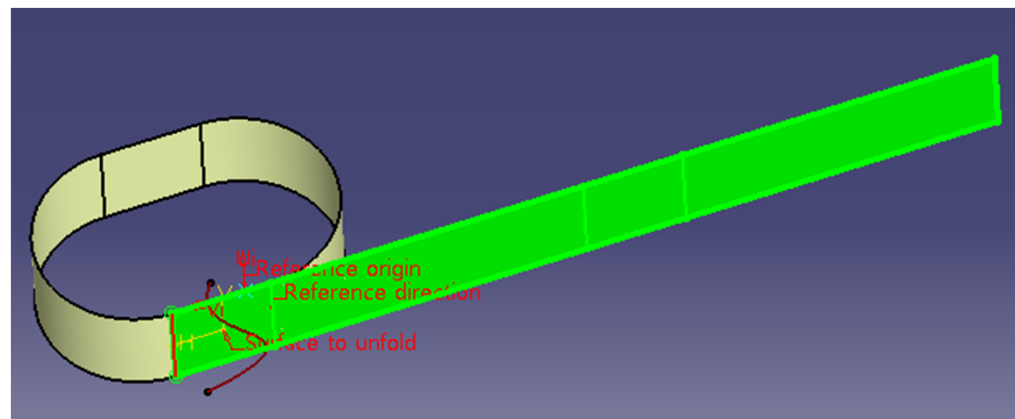
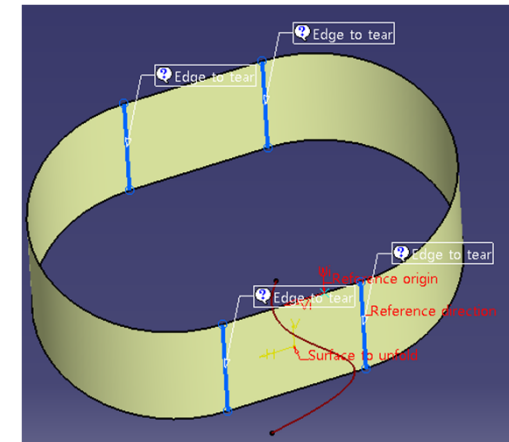
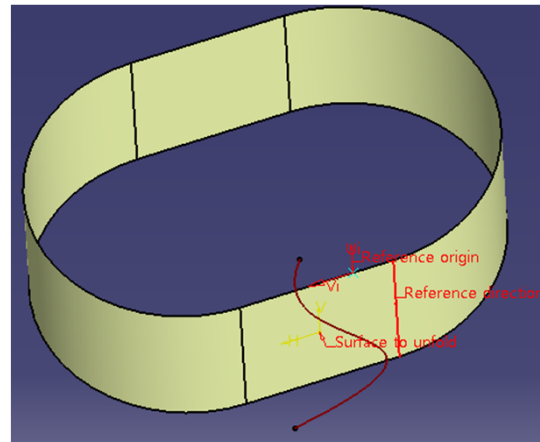
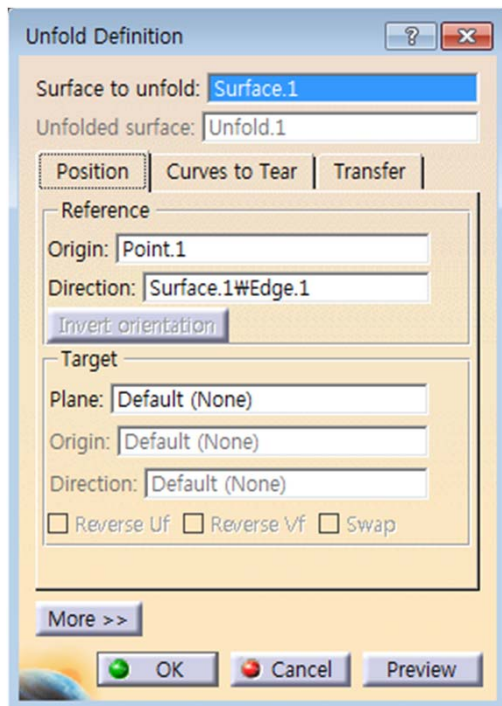
GENERATIVE SHAPE DESIGN TOOL

Developed Shapes



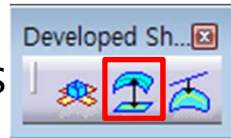
Unfold 

- 구부러진 Surface 형상을 하나의 기준 평면에 펼침



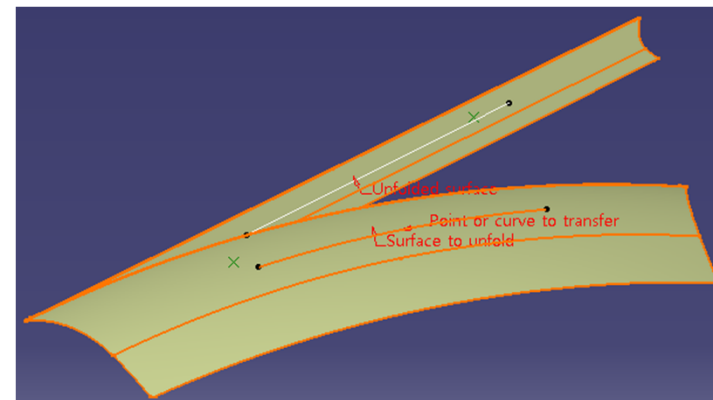
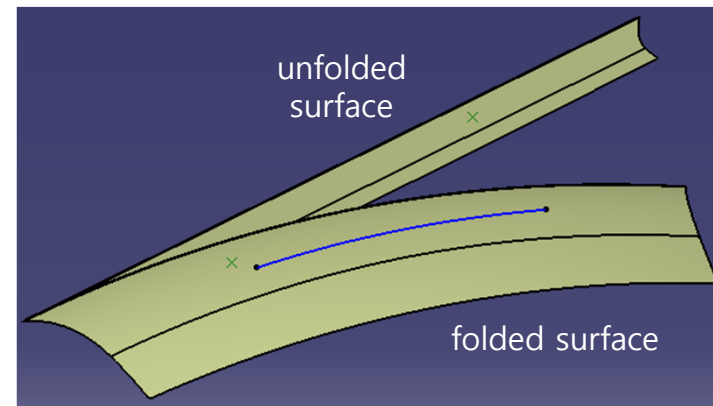
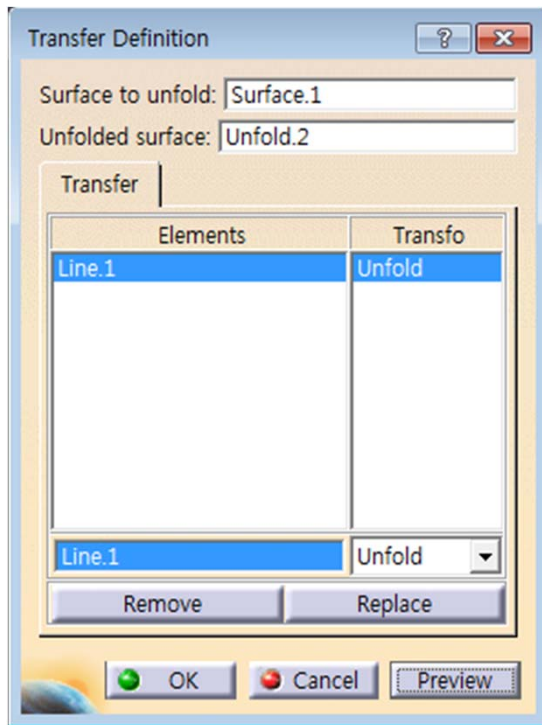
GENERATIVE SHAPE DESIGN TOOL

Developed Shapes



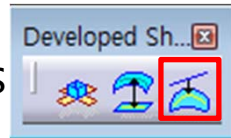
Transfer 

- Unfold 형상을 기준으로 생성된 Wireframe을 Unfold 후 형상에 맞게 변형시킴



GENERATIVE SHAPE DESIGN TOOL

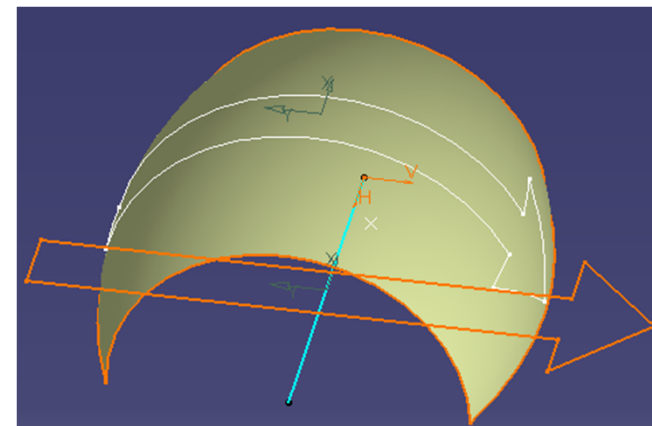
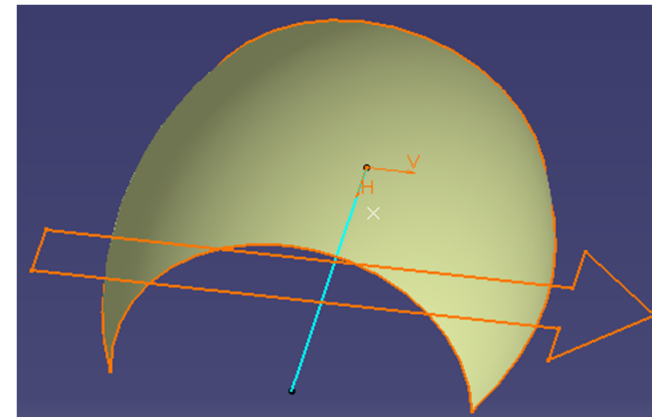
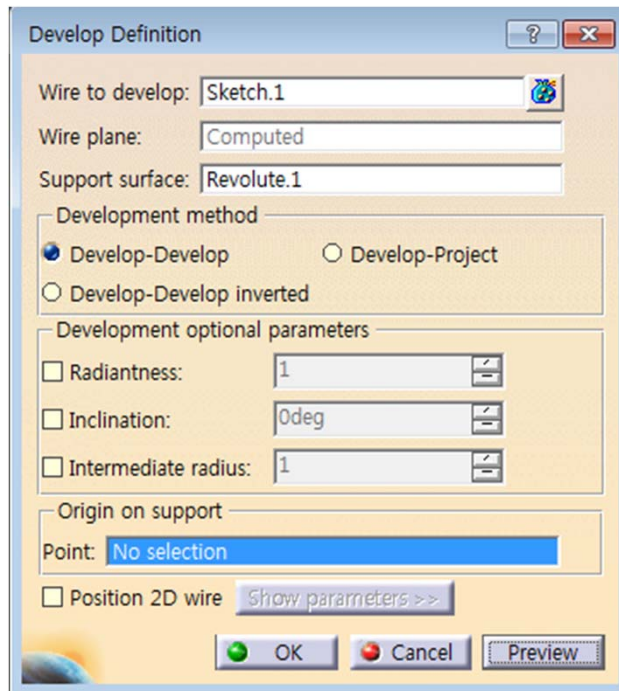
Developed Shapes



Develop

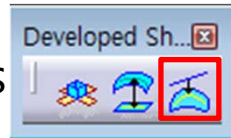


- Wireframe 요소를 회전된 곡면 형상 위에 투영시킴



GENERATIVE SHAPE DESIGN TOOL

Developed Shapes

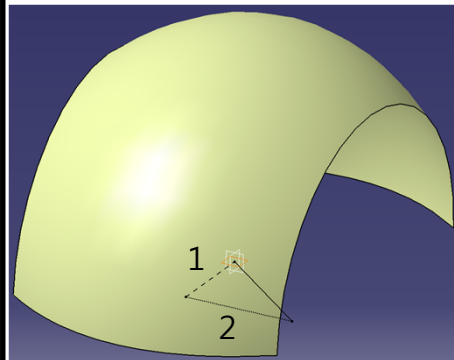


Develop

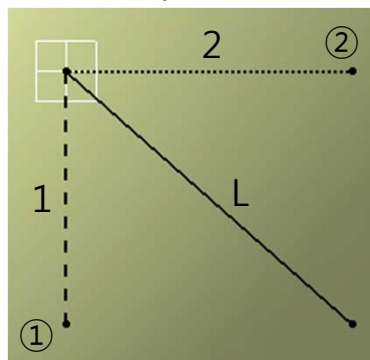


- Wireframe 요소를 회전된 곡면 형상 위에 투영시킴

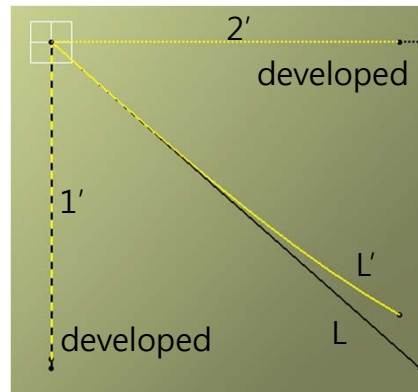
Develop-Develop



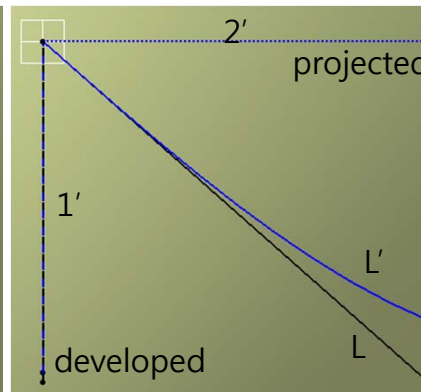
Top view



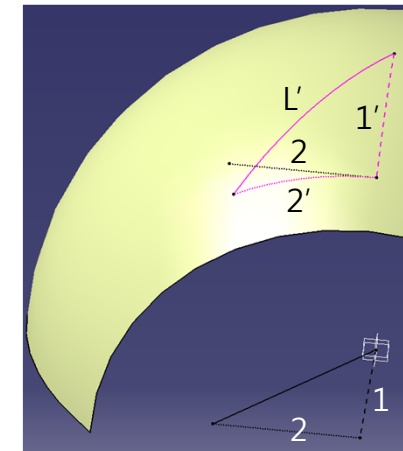
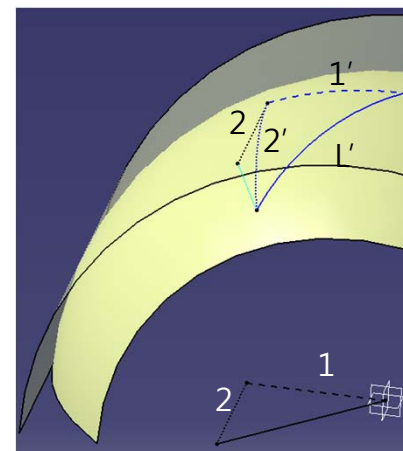
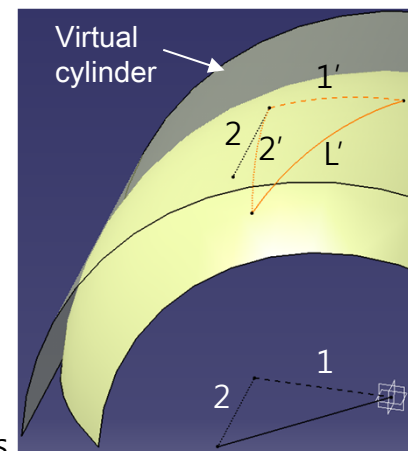
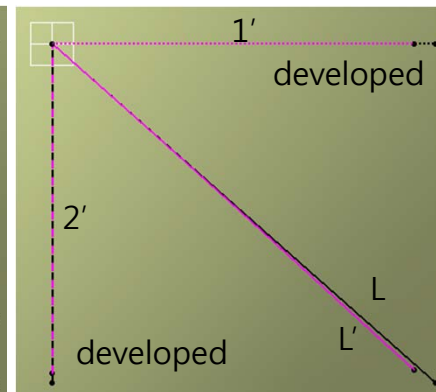
- ①: direction of revolution
②: direction of revolution axis



Develop-Project

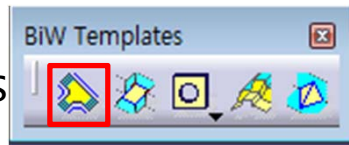


Develop-Develop inverted



GENERATIVE SHAPE DESIGN TOOL

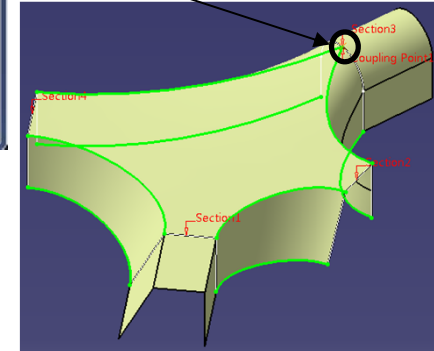
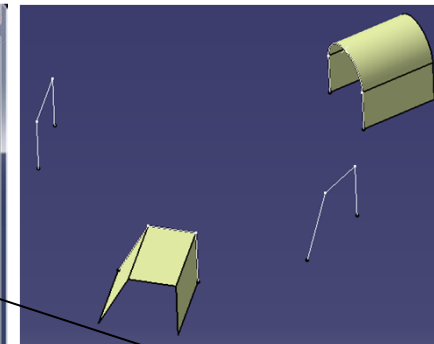
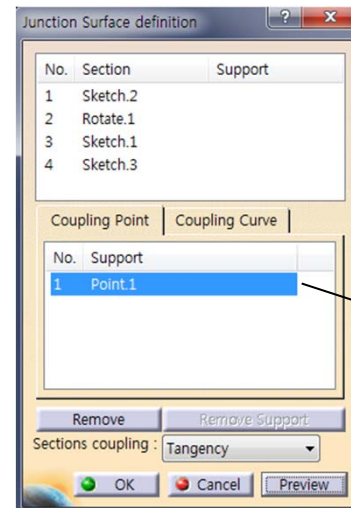
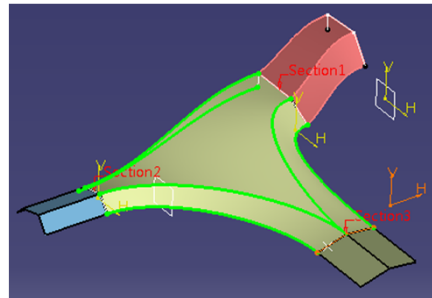
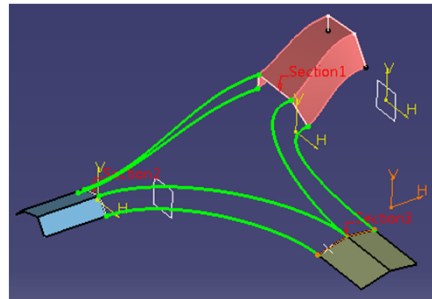
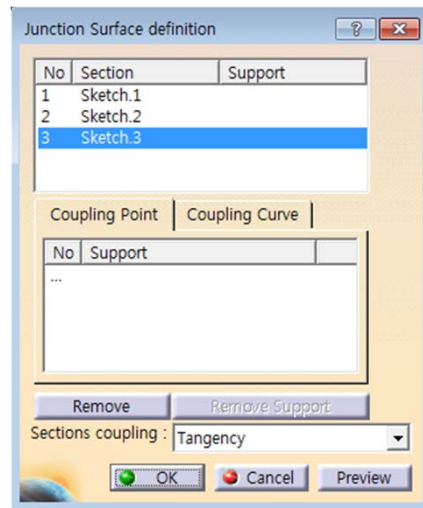
BIW Templates



Junction

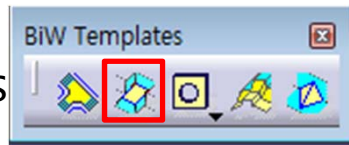


- 두 개 이상의 Surface를 이어주는 기능



GENERATIVE SHAPE DESIGN TOOL

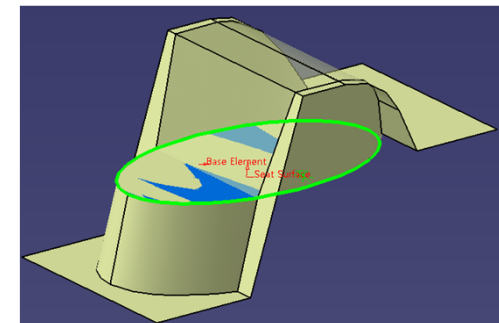
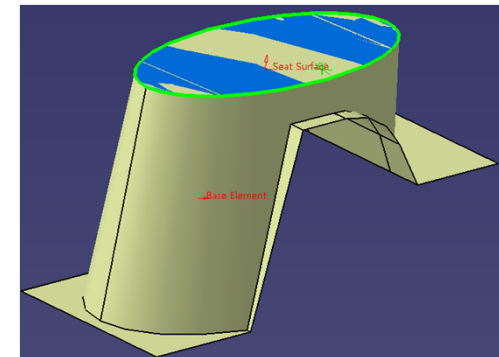
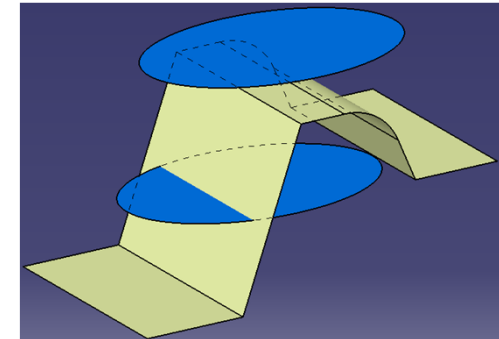
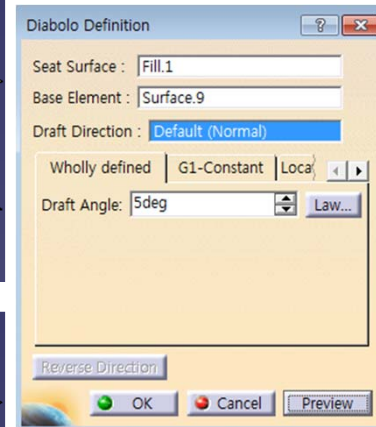
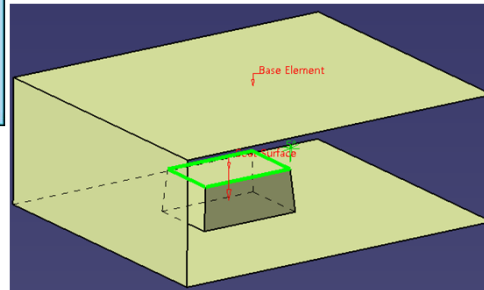
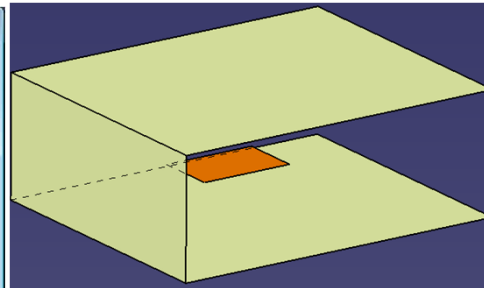
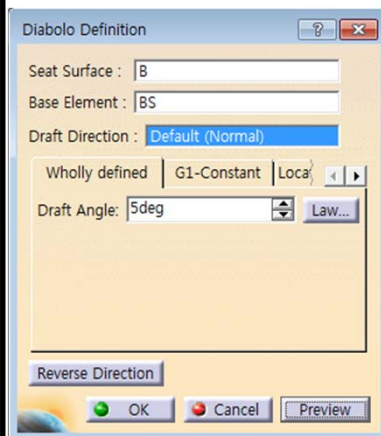
BIW Templates



Diabolo

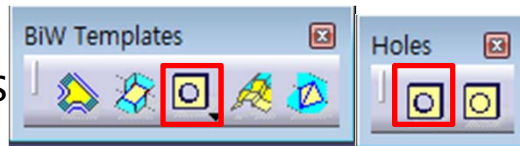


- 하나의 Surface에 또 다른 Surface 를 합쳐 넣는 기능



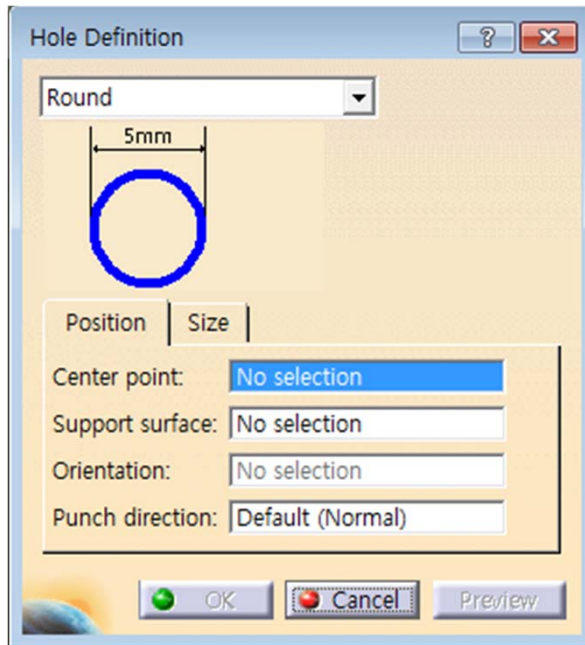
GENERATIVE SHAPE DESIGN TOOL

BIW Templates

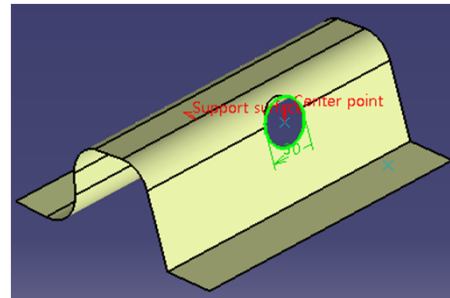


Hole

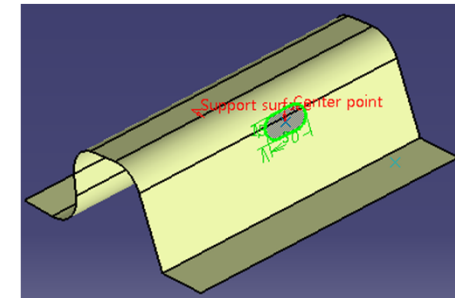
- Hole, Rectangle, Square, Elongated Hole 형상을 Surface 상에서 제거



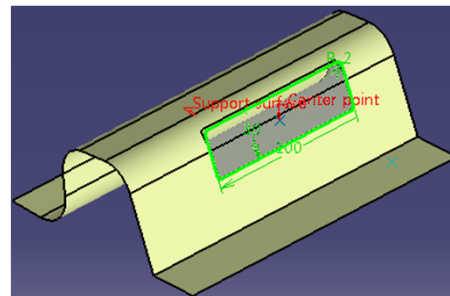
Round



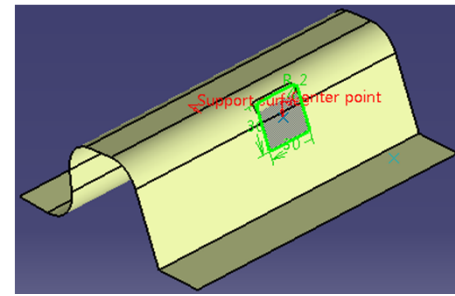
Slot



Rectangle

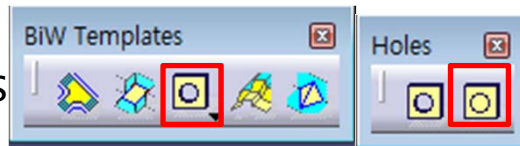


Square



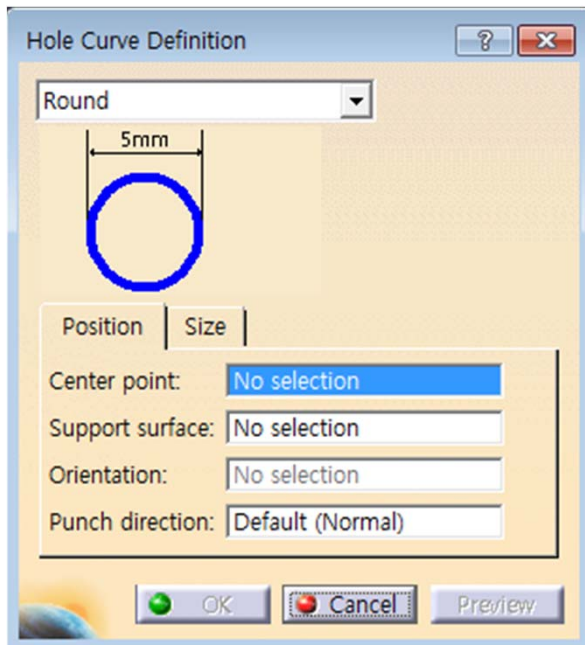
GENERATIVE SHAPE DESIGN TOOL

BIW Templates

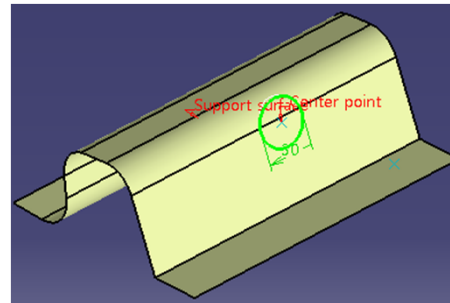


Hole Curve 

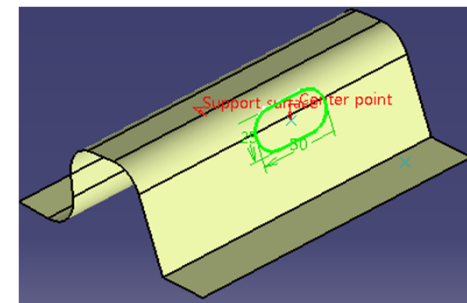
- Hole 기능과는 다르게 생성한 도형 내부를 제거하지 않고 wireframe을 생성함



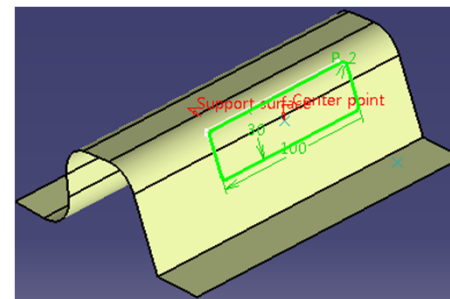
Round



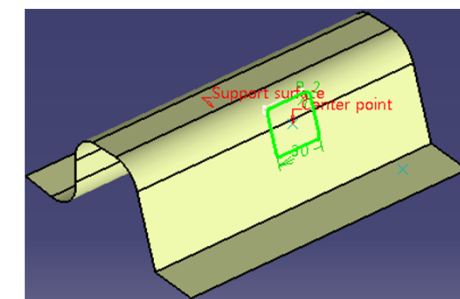
Slot



Rectangle

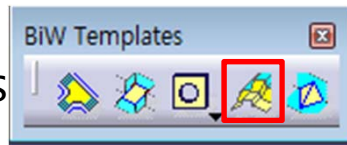


Square



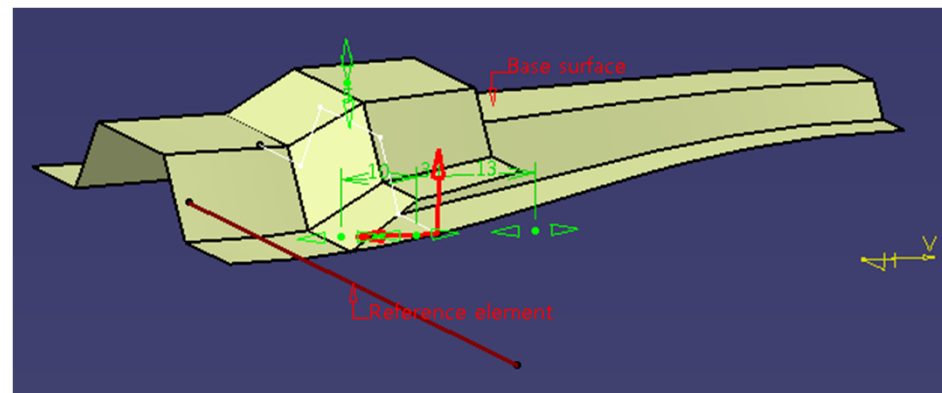
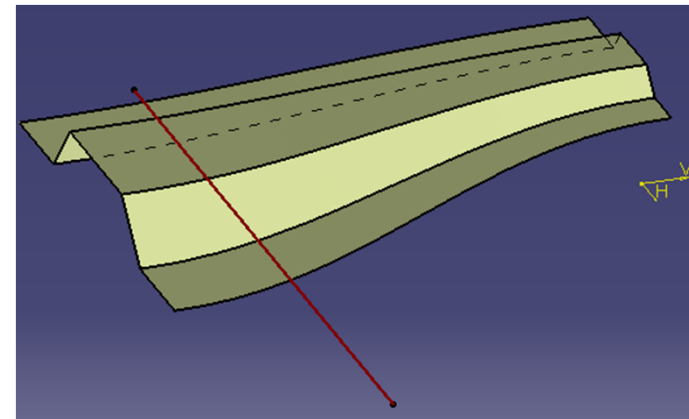
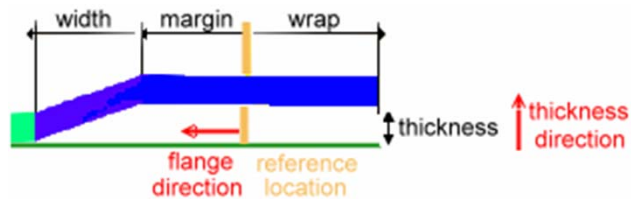
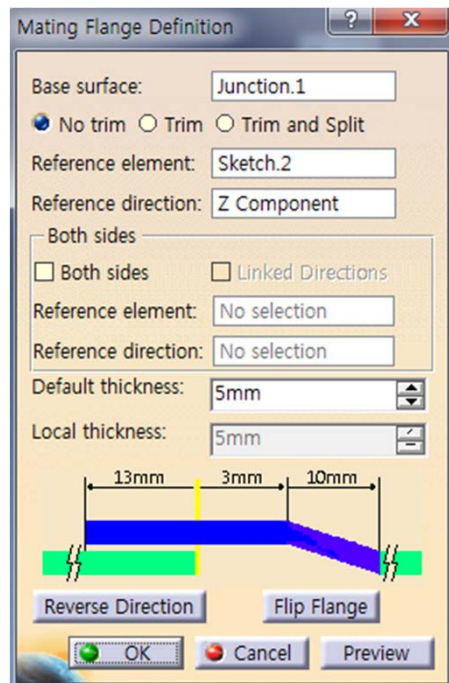
GENERATIVE SHAPE DESIGN TOOL

BIW Templates

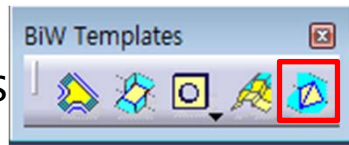


Mating Flange 

- Surface 상에 Flange 형상을 생성



BIW Templates



Bead



- Surface 상에 보강 부위 생성

