

SKETCHER

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



한양대학교
HANYANG UNIVERSITY



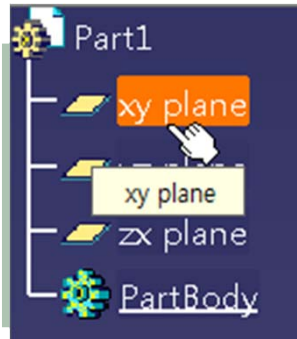
CDL

Computational
Design
Lab

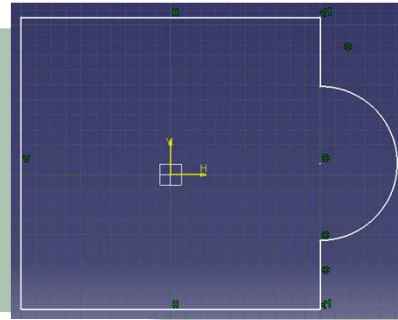
CONTENTS

- ✓ **시작하기**
- ✓ Profile 을 이용한 스케치
- ✓ Constraint 을 이용한 스케치
- ✓ Operation 을 이용한 스케치

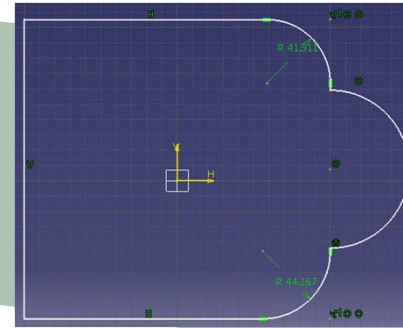
일반적인 스케치 순서



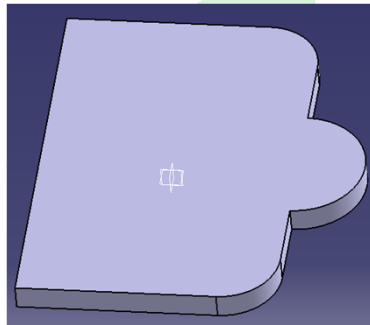
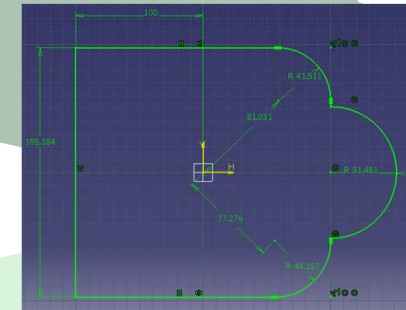
기준평면 선택



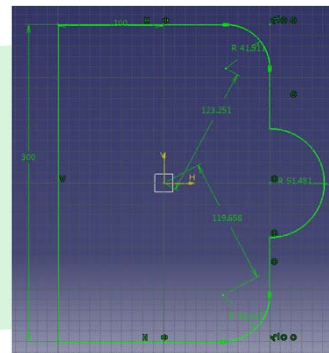
대략적인 스케치



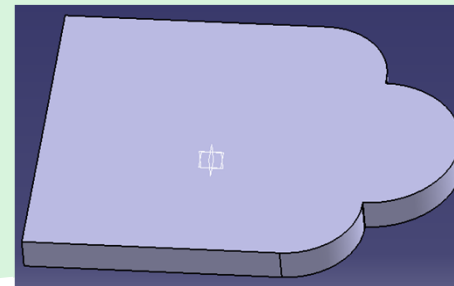
주요부분 수정



최종 모델 완성



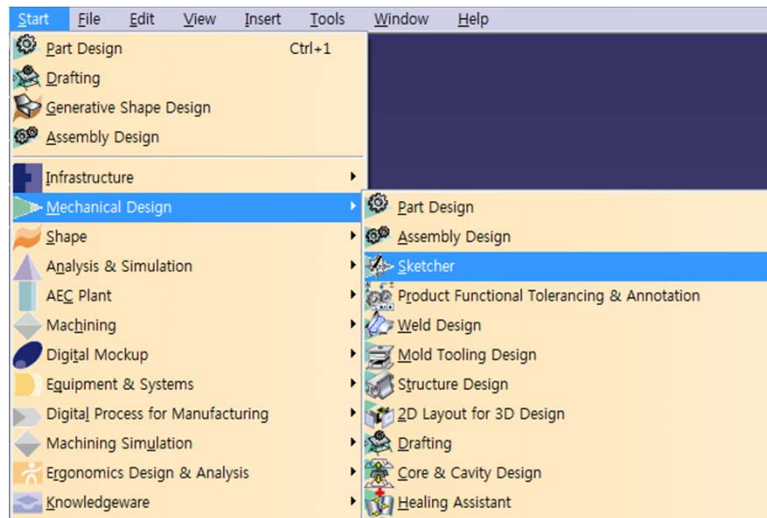
스케치 수정



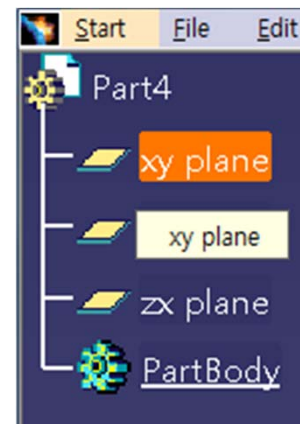
스케치 기반 모델 생성

SKETCHER 시작하기

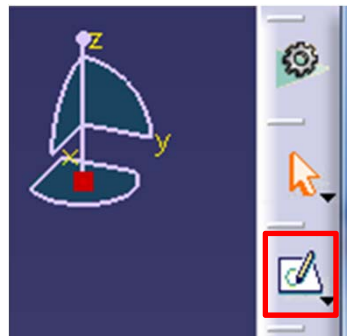
Start 메뉴에서 Sketcher 선택 후 기준(작업) 평면 선택



작업 평면 선택



혹은, 화면 우측 툴바에서 Sketch 선택 후 작업 평면 선택

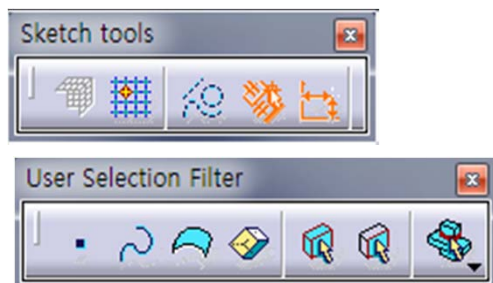


SKETCHER 작업화면

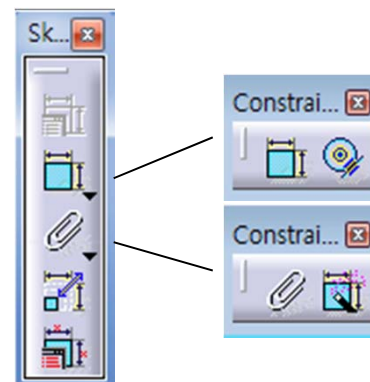


SKETCHER 툴바 종류

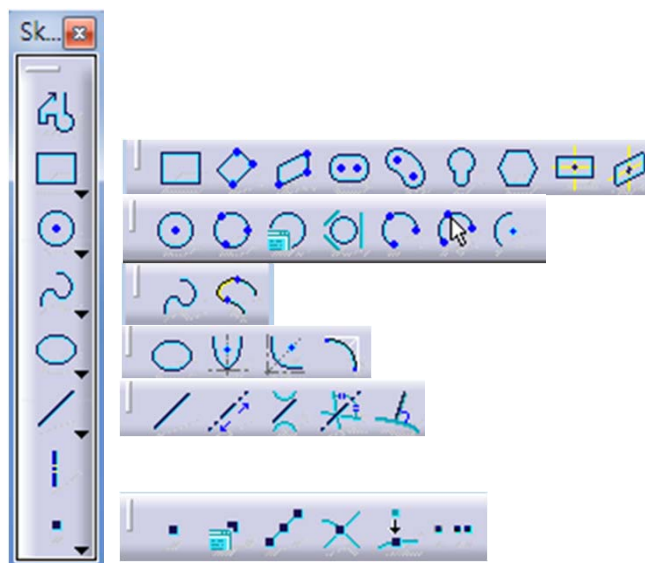
Work Mode 툴바



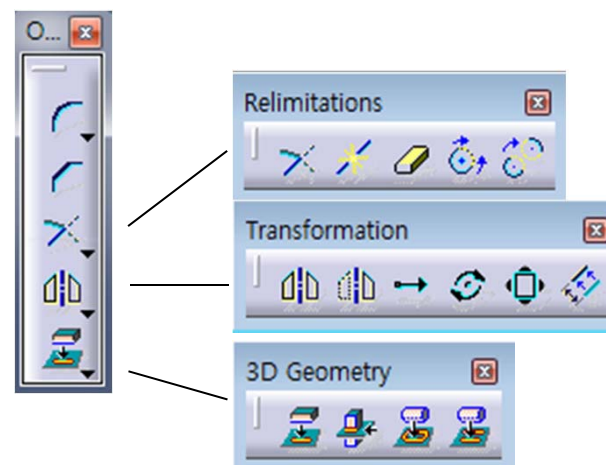
Constraint 툴바



Profile 툴바

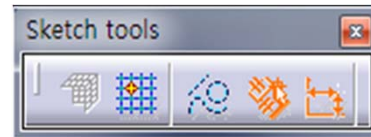


Operation 툴바



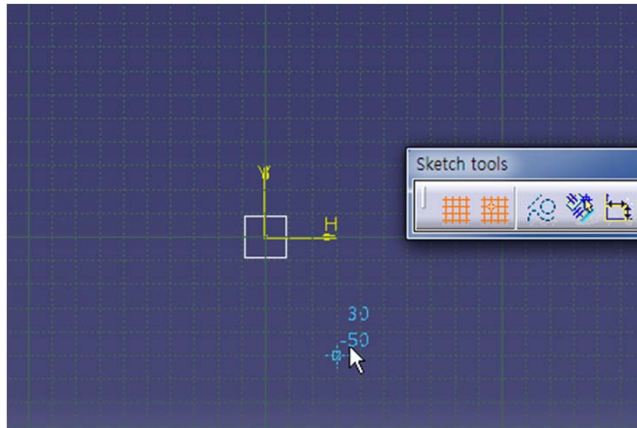
SKETCHER TOOLS

Sketcher Work Mode



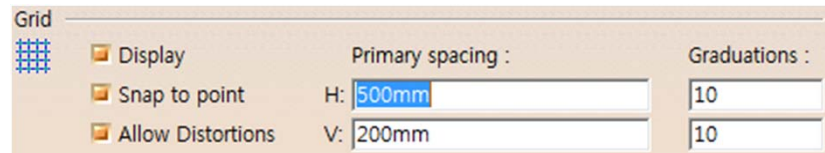
Snap to Point 

- Grid point 에만 점이 찍히도록 함



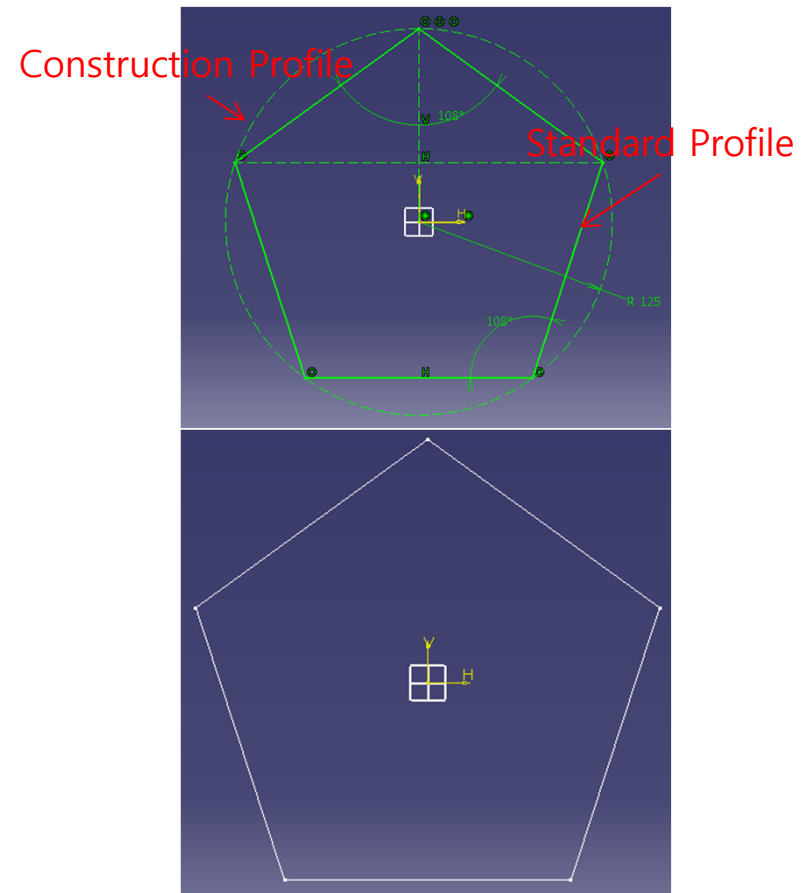
Grid 

- 화면상에 Grid Line을 표시함.
(Tools→Options→Mechanical Design→Sketcher에서 간격 수정)



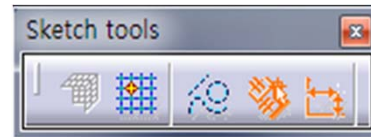
Construction/Standard Element 

- 점선 형태의 보조선 생성



SKETCHER TOOLS

Sketcher Work Mode



Geometrical Constraints

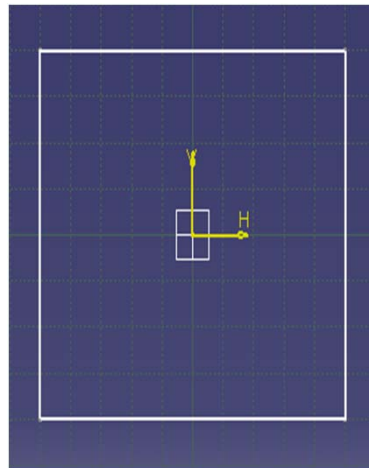
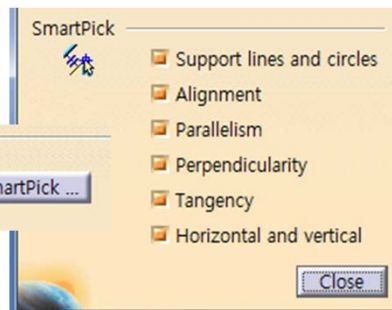
- Constraints/SmartPic에서 정의된 구속조건 자동 생성.

Tools→Options→Mechanical Design→Sketcher

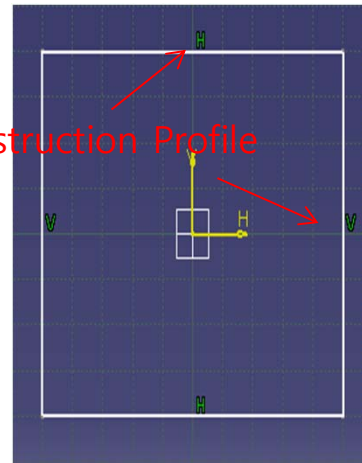
Constraint

- ☒ Creates the geometrical constraints
- ☐ Creates the dimensional constraints

SmartPick ...

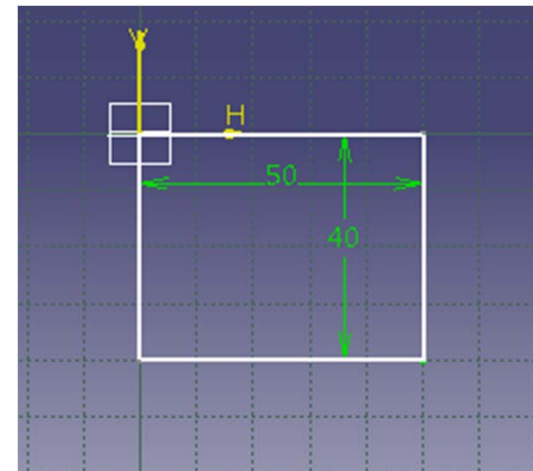
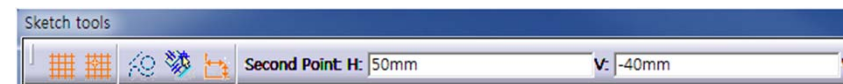


Construction Profile



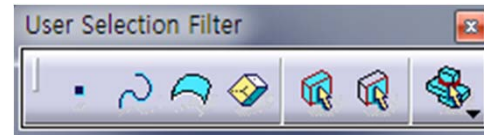
Dimensional Constraints

- Sketcher Tool Bar에서 사용자가 입력한 값에 대한 치수 구속 적용 (tab 키 혹은 마우스 사용)



SKETCHER TOOLS

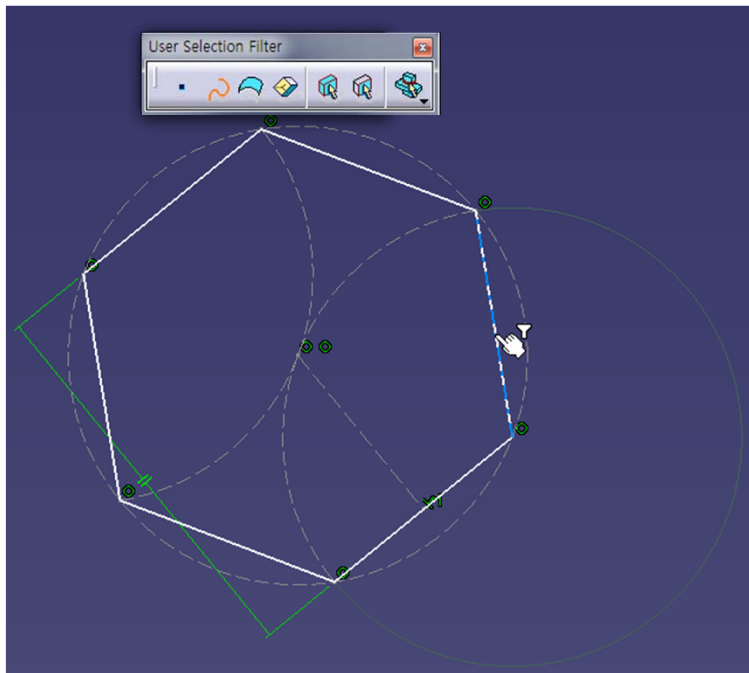
Sketcher Work Mode



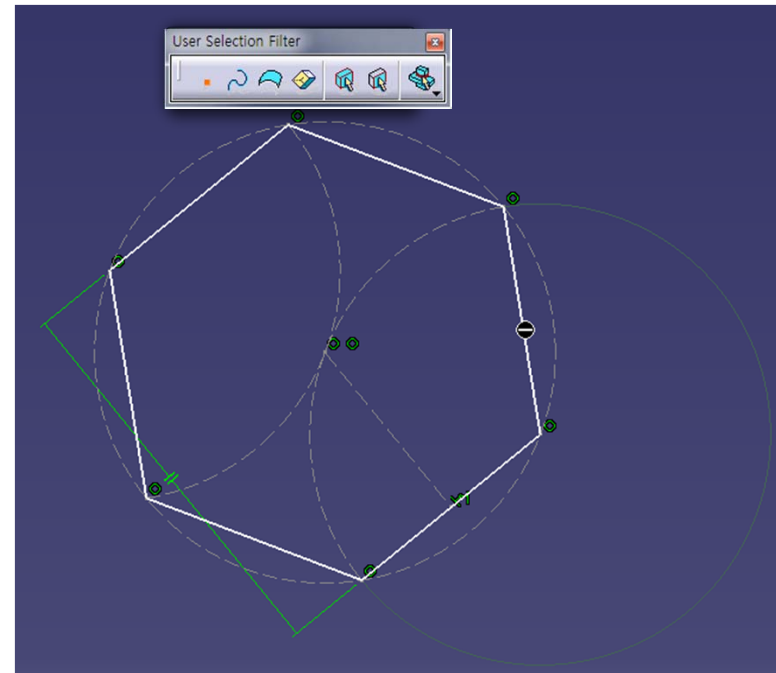
User Selection Filter

- 해당 요소만 선택 가능하도록 해줌

Line 선택 시



Point 선택 시

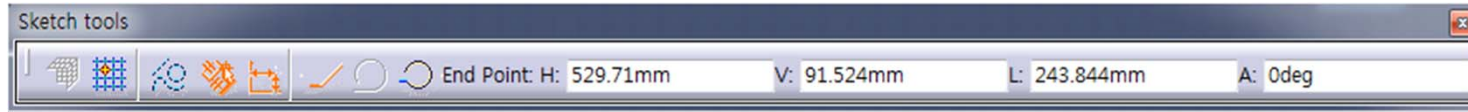


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SKETCHER PROFILE

Profile

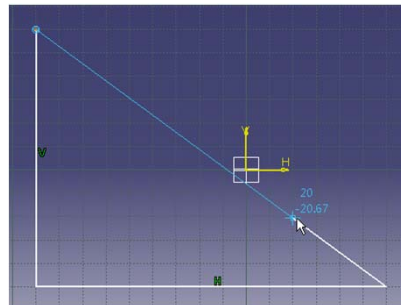


Three Point Arc : 3점을 지나는 원호를 생성

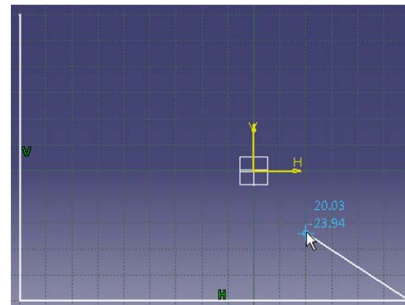
Tangent Arc : 이전 Line에 Tangent 한 원호를 생성

Line : 연속적인 직선을 생성

생성된 Profile 간의 구속을 사용하지 않을 경우 경우 Shift 키를 이용

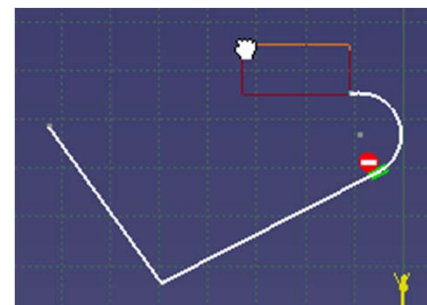


<Shift 키 사용 x>

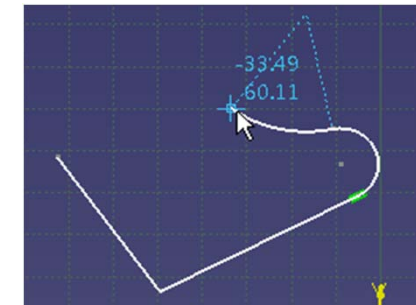


<Shift 키 사용>

Tangent Arc의 경우 툴바에서 클릭하거나 마우스 왼쪽 버튼을 이용하여 생성 가능



<마우스 왼쪽 버튼을 누른 채로 약간 움직이면 사용가능>

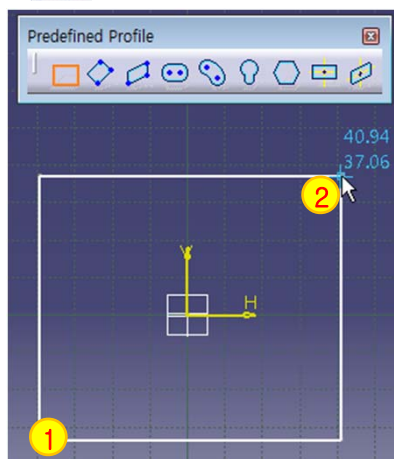


SKETCHER PROFILE

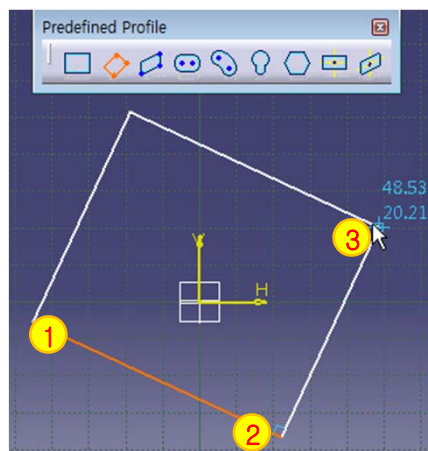
Predefined Profile



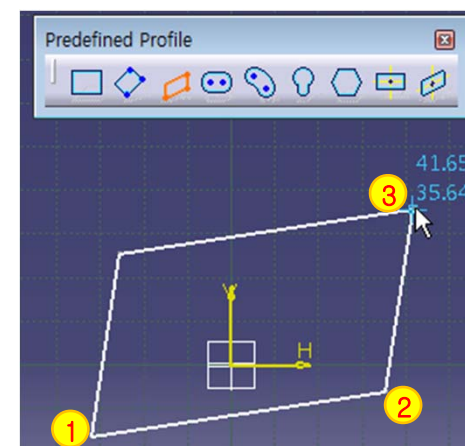
 Rectangle



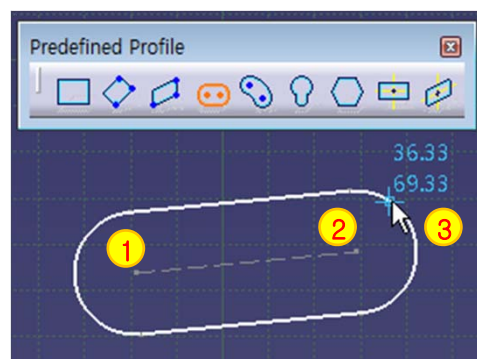
 Oriented Rectangle



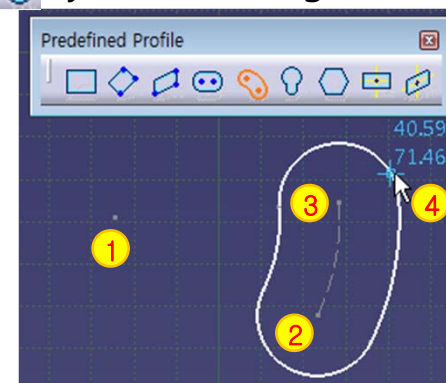
 Parallelogram



 Elongated Hole

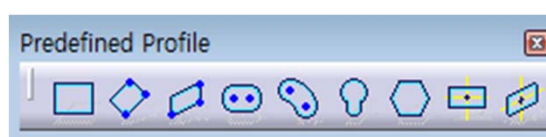


 Cylindrical Elongated Hole

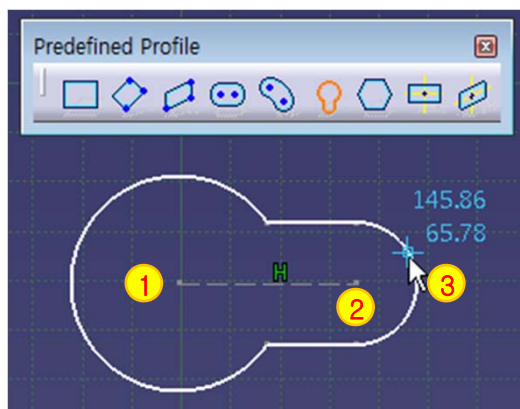


SKETCHER PROFILE

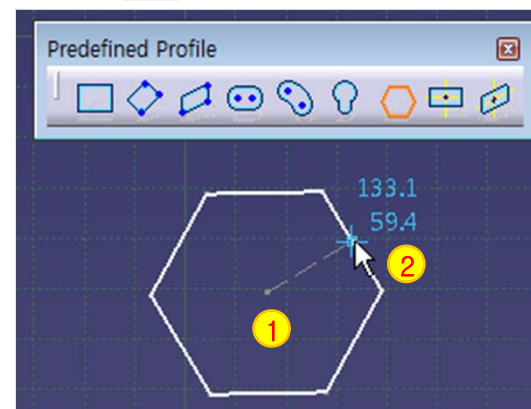
Predefined Profile



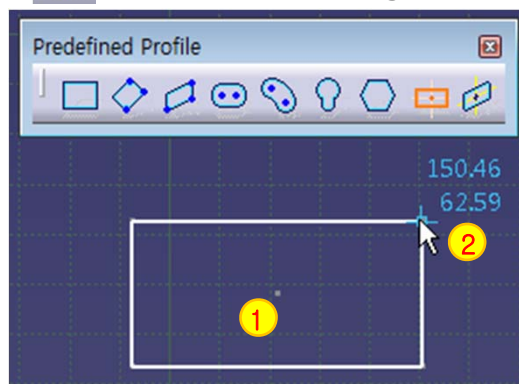
Keyhole Profile



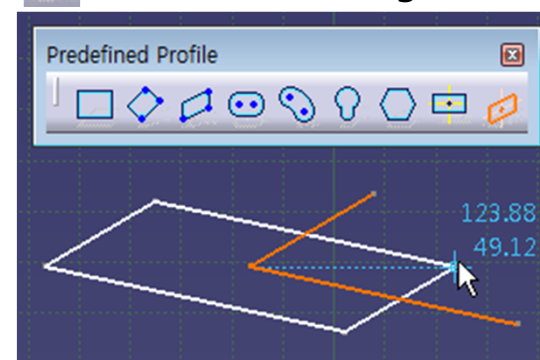
Hexagon



Centered Rectangle



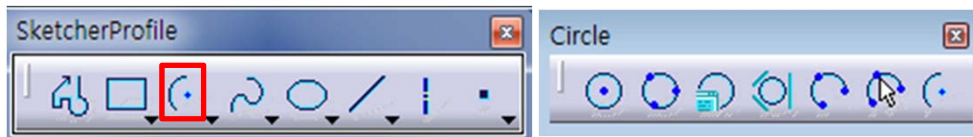
Centered Parallelogram



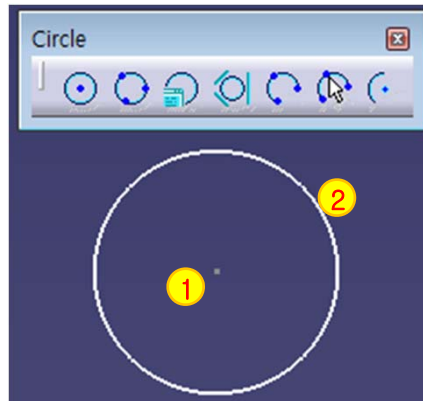
<방향을 잡아줄 2개의 직선이 필요함>

SKETCHER PROFILE

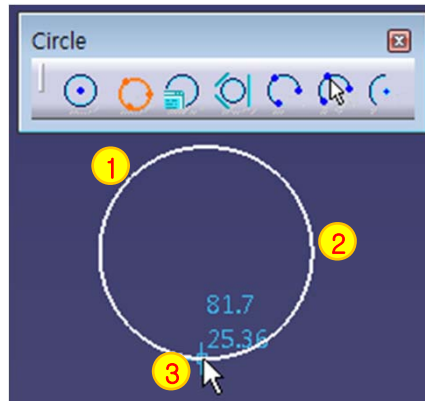
Circle



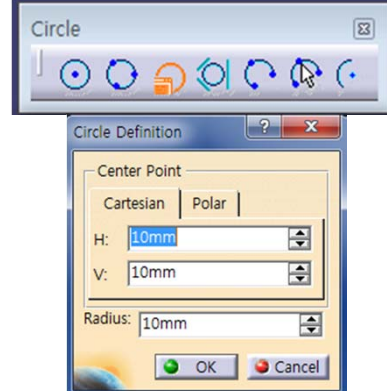
Circle



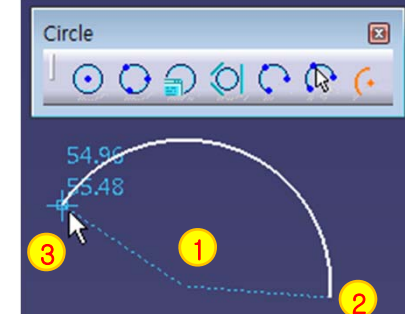
Three Point Circle



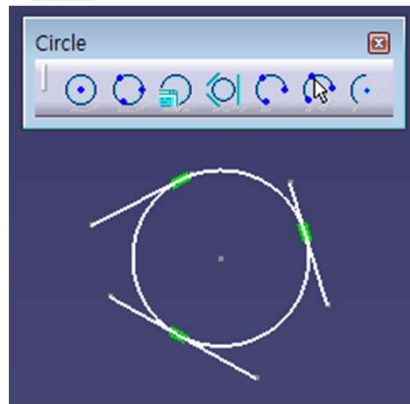
Circle Using Coordinates



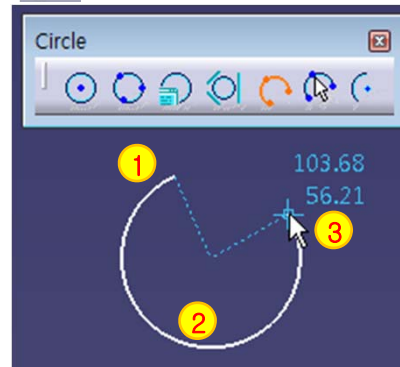
Arc



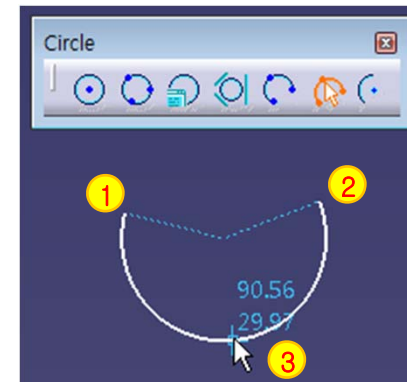
Tri-Tangent Circle



Three Point /Arc



Three Point Arc Starting with Limits



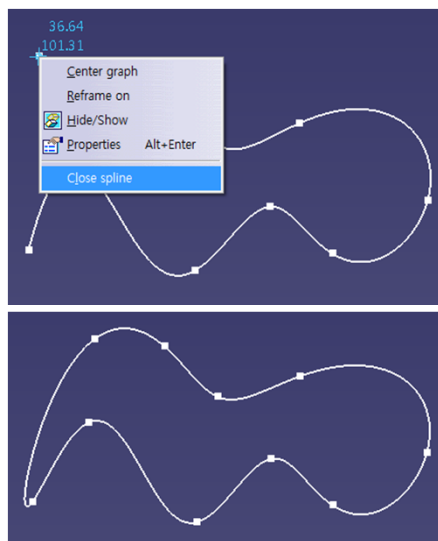
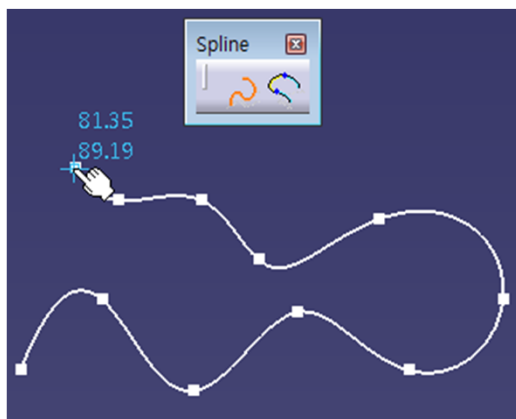
<3개의 직선에 접하는 원>

SKETCHER PROFILE

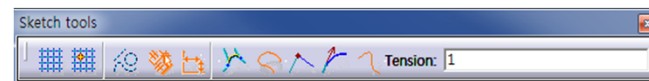
Spline



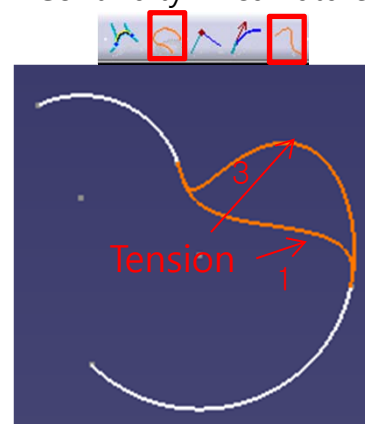
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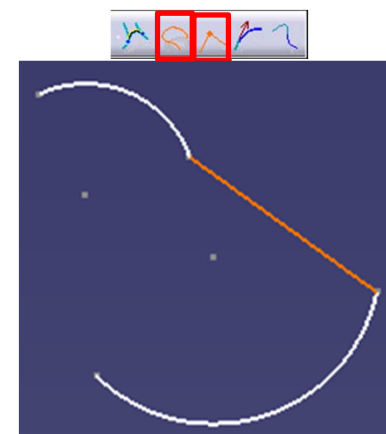
Connect



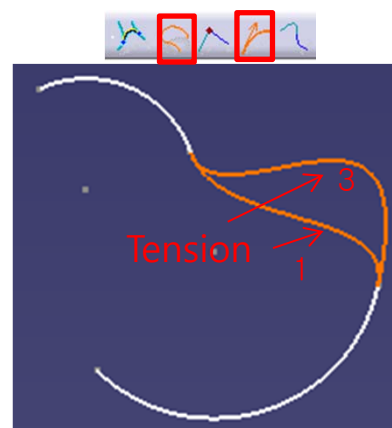
<Continuity in curvature>



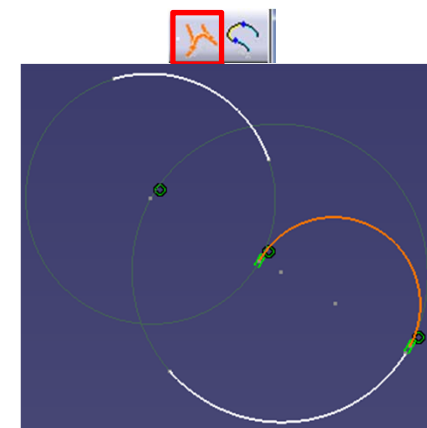
<Continuity in point>



<Continuity in tangency>



<Connect with an Arc>



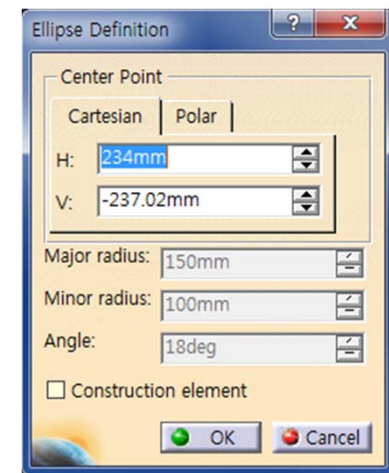
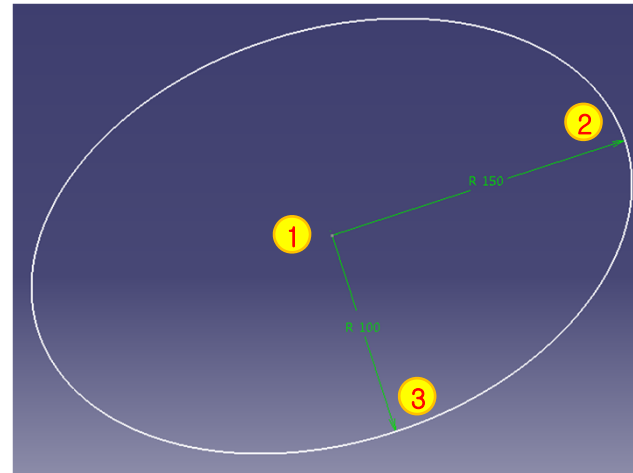
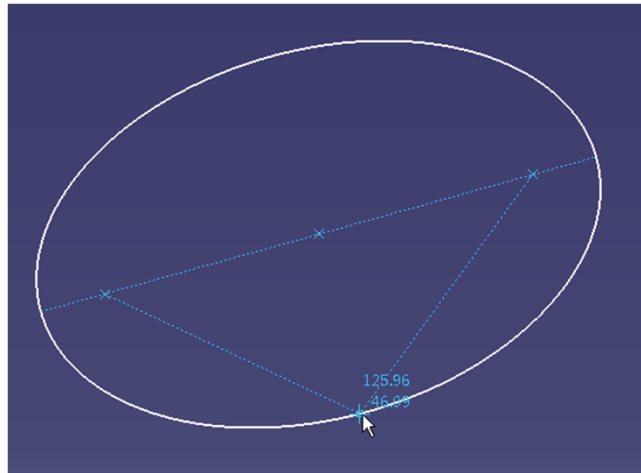
SKETCHER PROFILE

Conic



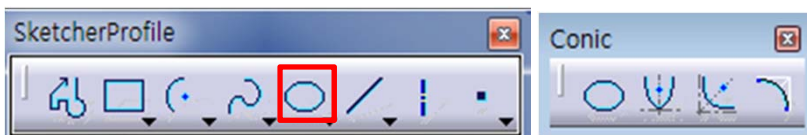
Ellipse

- 장축과 단축으로 정의된 타원 생성.

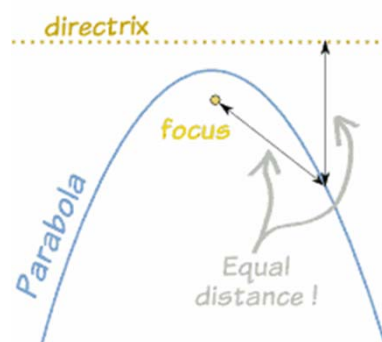
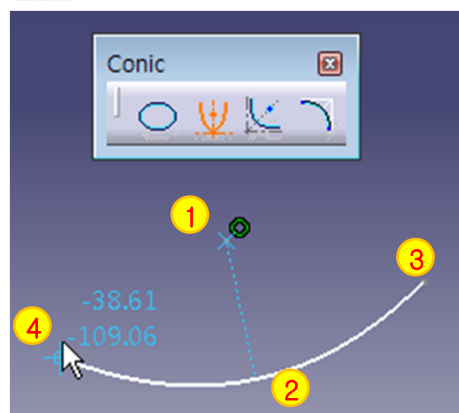


SKETCHER PROFILE

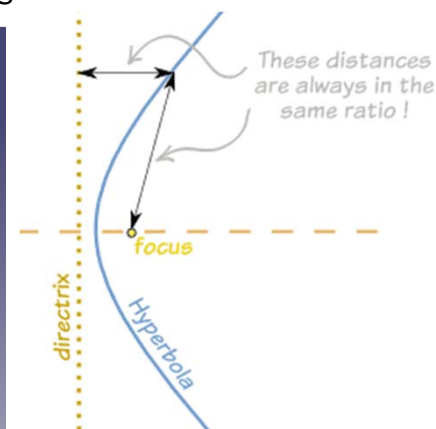
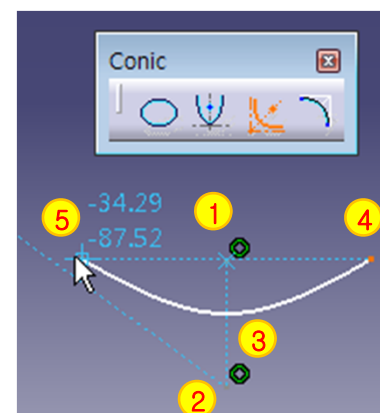
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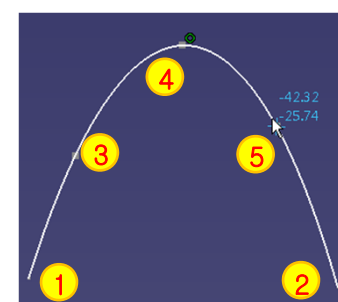
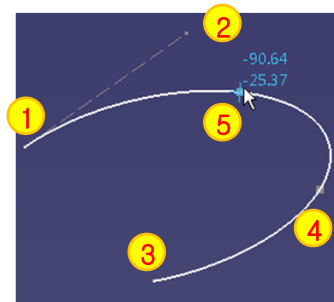
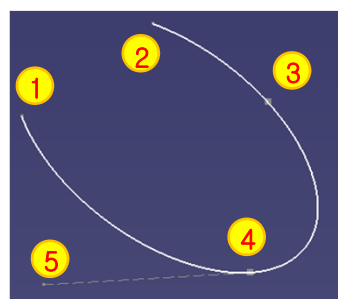
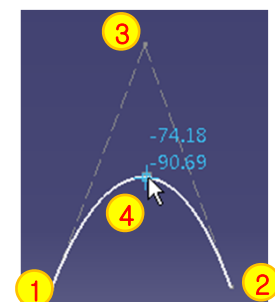
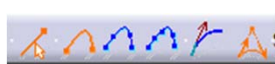
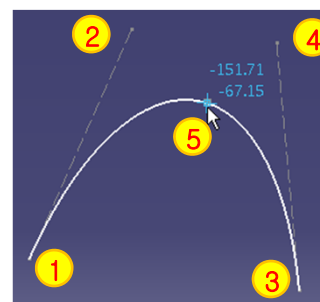
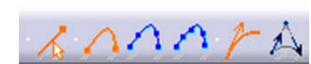
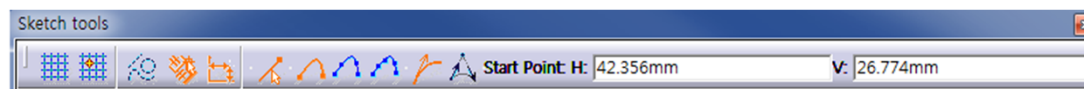
Parabola by Focus



Hyperbola by Focus



Conic

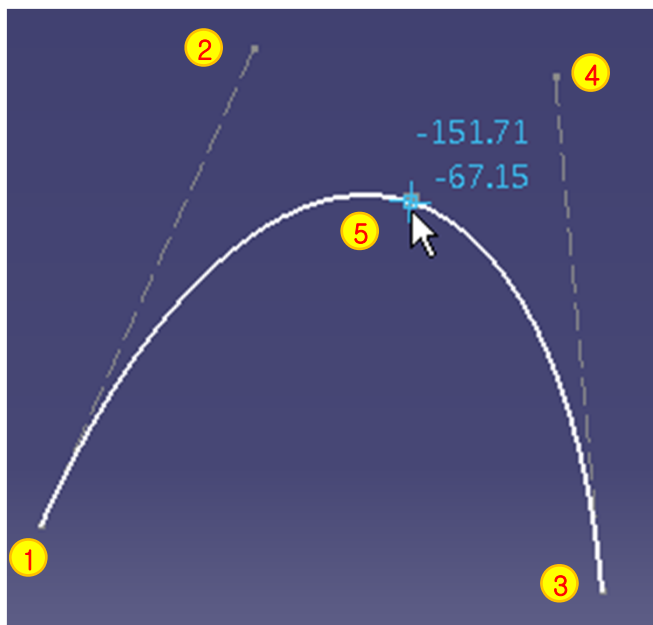
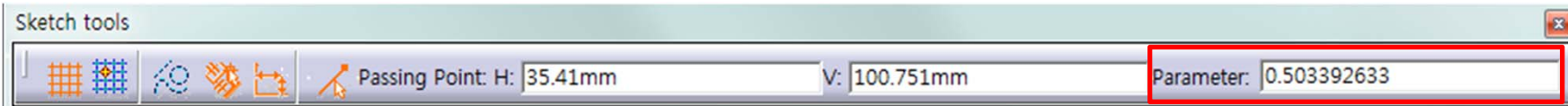


SKETCHER PROFILE

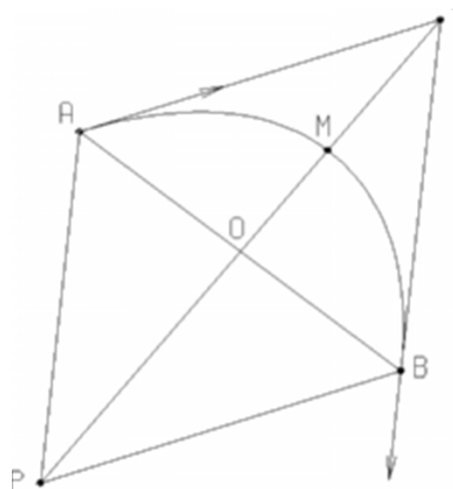
Conic



Conic



- If parameter = 0.5, parabola.
- If $0 < \text{parameter} < 0.5$, arc of ellipse.
- If $0.5 < \text{parameter} < 1$, hyperbola.



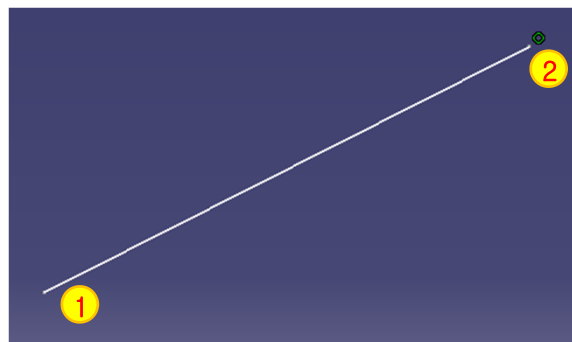
$$\text{Parameter} = \frac{OM}{OT}$$

SKETCHER PROFILE

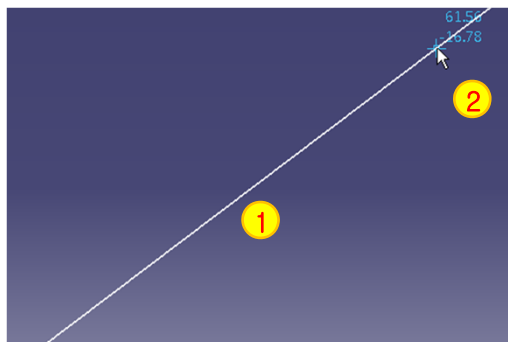
Line



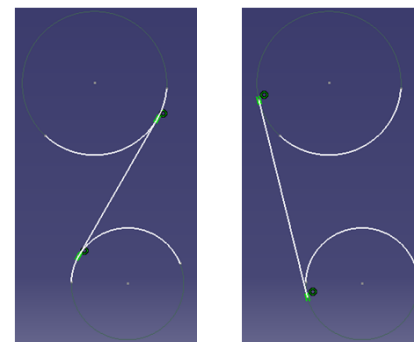
Line



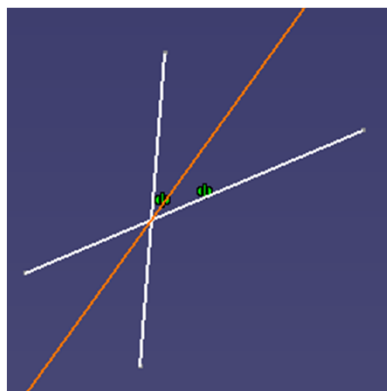
Infinite Line



Bi-Tangent Line



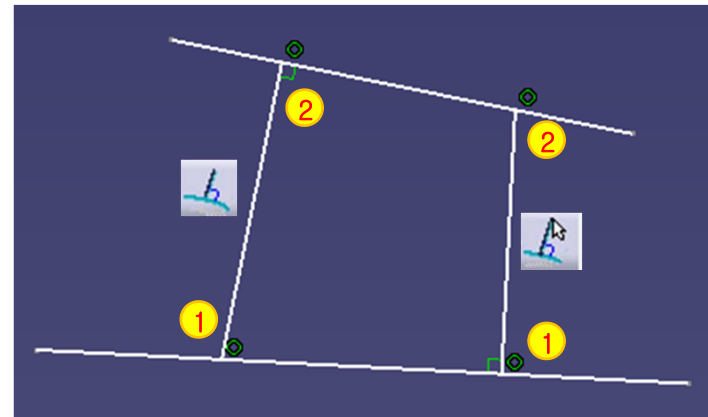
Bisecting Line



Line Normal To Curve /



Select a Curve before

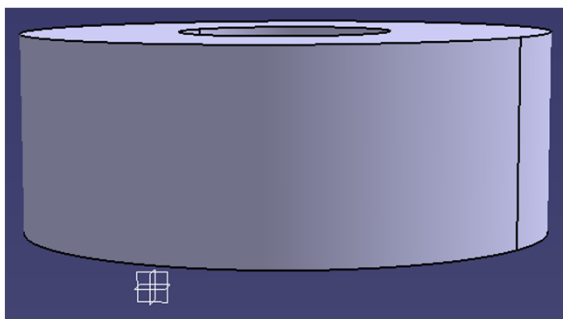
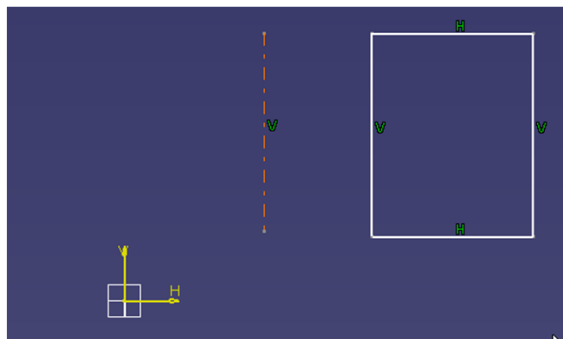


SKETCHER PROFILE

Axis



회전체의 중심 축 역할을 한다.
(Construction element이기 때문에 3D
작업화면에서는 나타나지 않는다.)

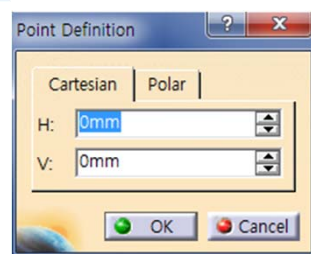


Point



Point by Clicking

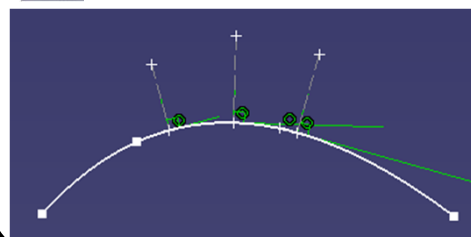
Point by Using Coordinates



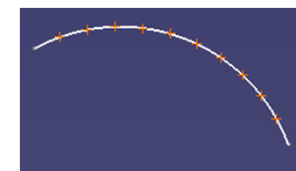
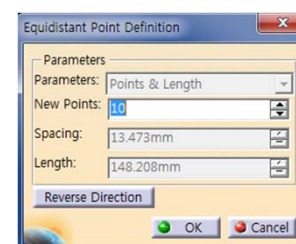
Intersection Point



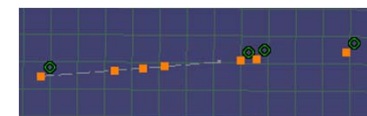
Projection Point



Equidistant Point



Align Points

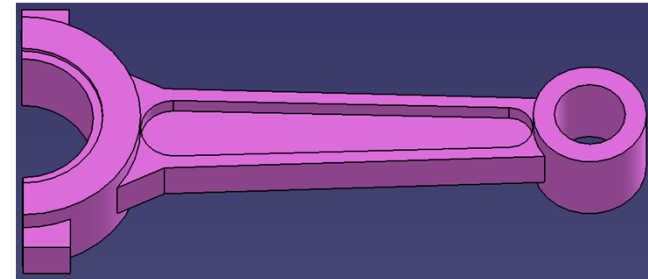
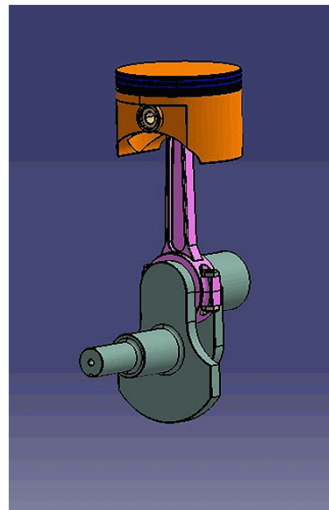
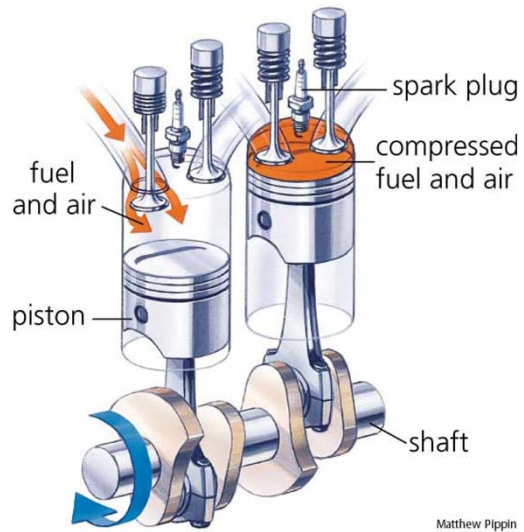


실습 예제

Piston Connecting Rod

Connecting Rod

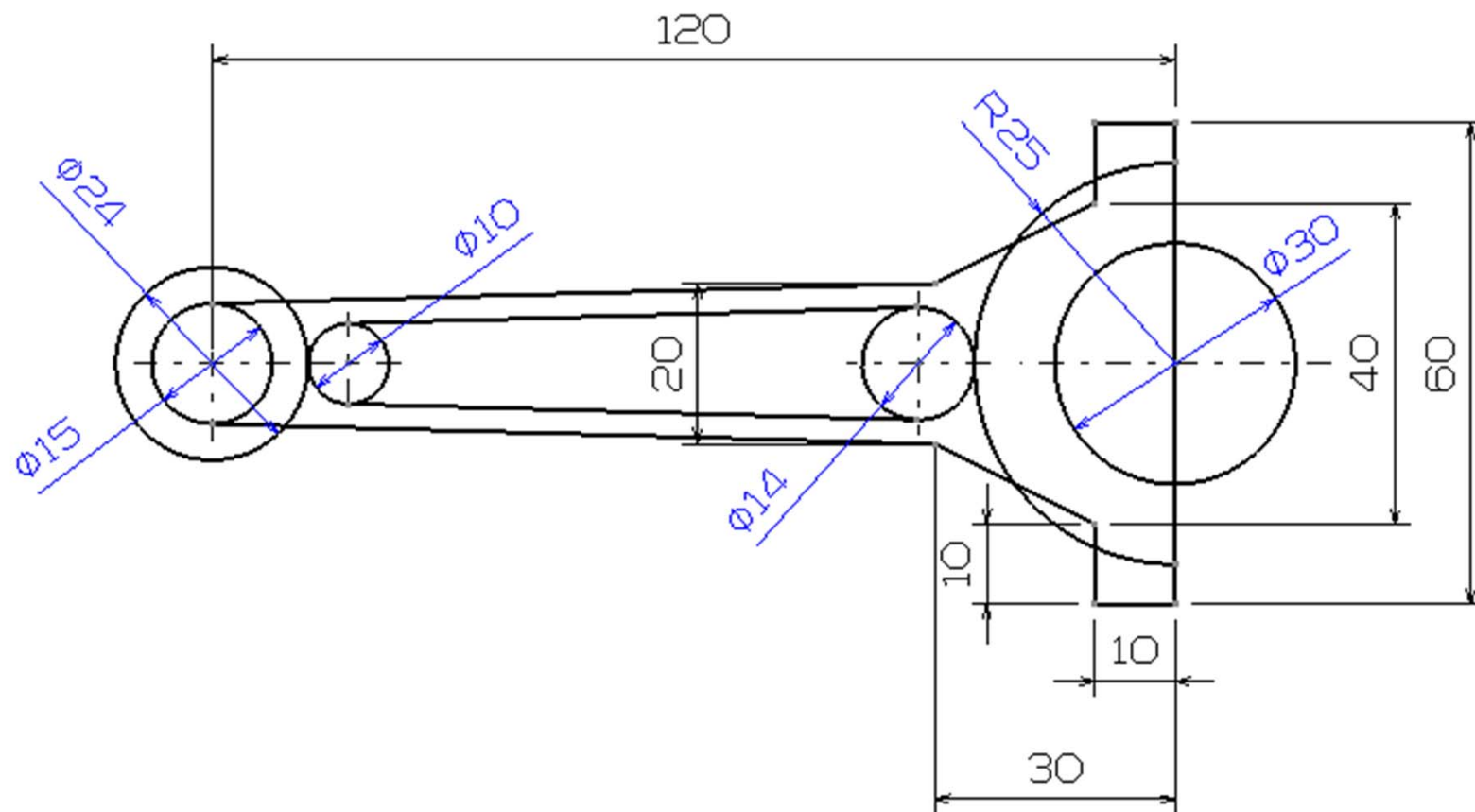
- 피스톤과 크랭크 축을 연결하는 부품으로 피스톤의 왕복운동을 크랭크 축의 회전운동으로 바꿔줌



실습 예제

Piston Connecting Rod

Connecting Rod



CONTENTS

- ✓ 시작하기
- ✓ Profile 을 이용한 스케치
- ✓ **Constraint 을 이용한 스케치**
- ✓ Operation 을 이용한 스케치

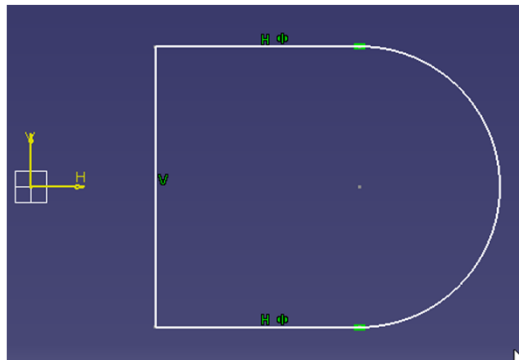
SKETCHER CONSTRAINT

Sketcher Constraint

- 구속조건을 부여하여 스케치가 정확한 값/위치를 갖도록 함

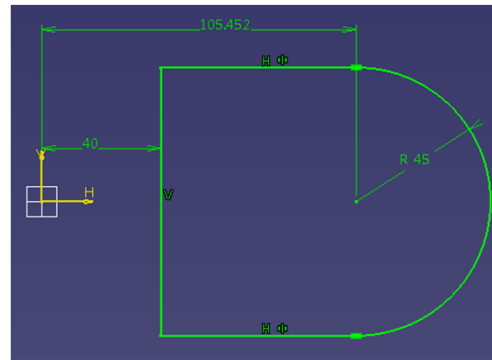
Under-Constraint (White)

- 구속이 부족한 상태

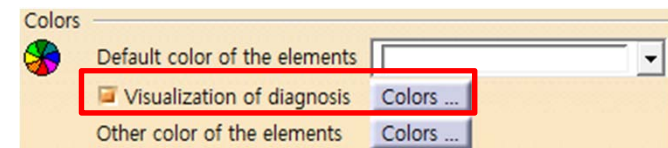


Fully-Constraint (Green)

- 완전 구속되어 움직이지 않음

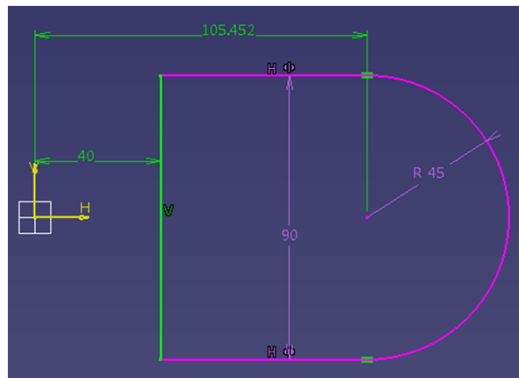


Tools → Options → Mechanical Design
→ Sketcher



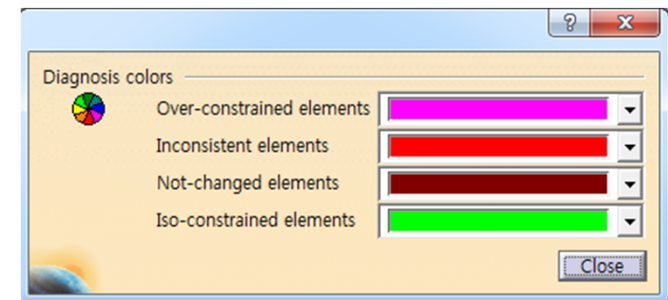
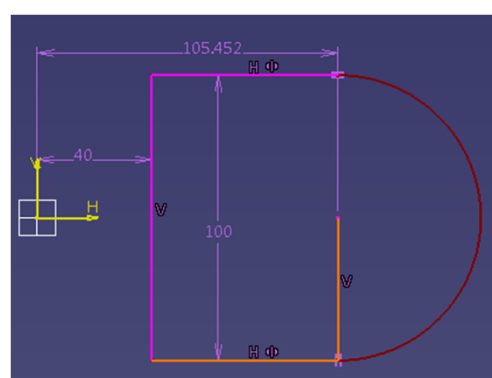
Over-Constraint (Purple)

- 중복된 구속이 존재함



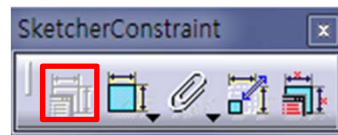
Inconsistent-Constraint (Red)

- 모순된 구속이 존재함

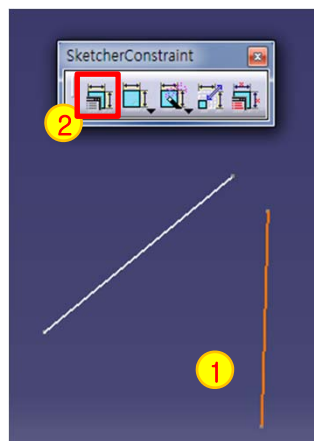


SKETCHER CONSTRAINT

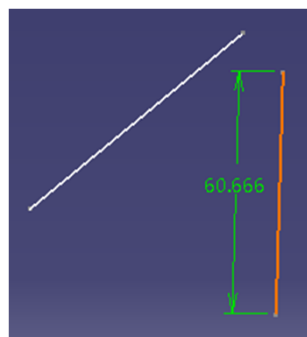
SketcherConstraint



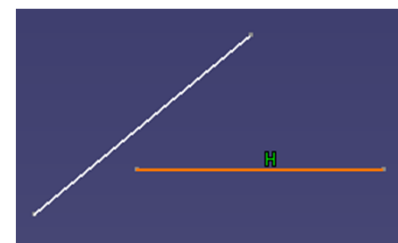
Constraints Defined in Dialog Box



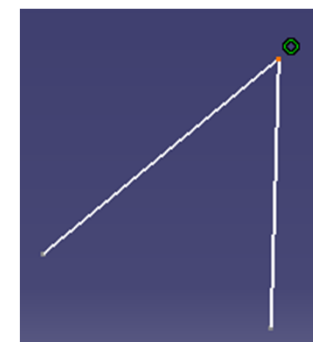
Length



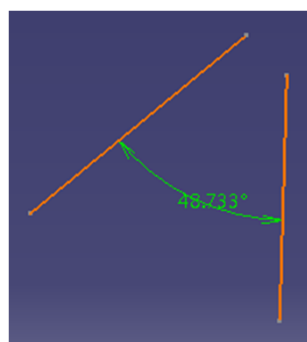
Horizontal



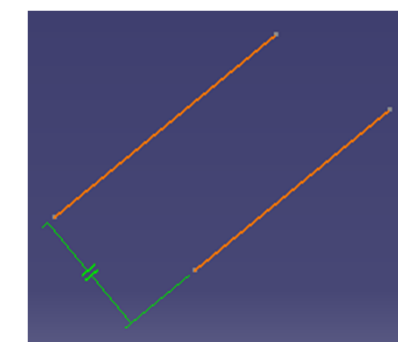
Coincidence



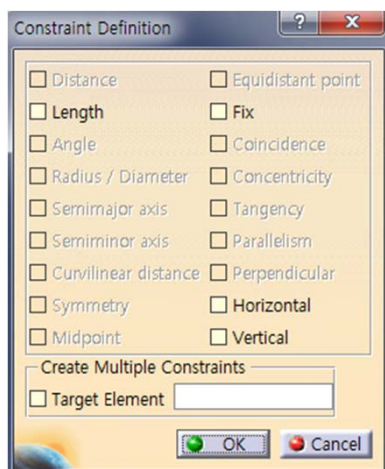
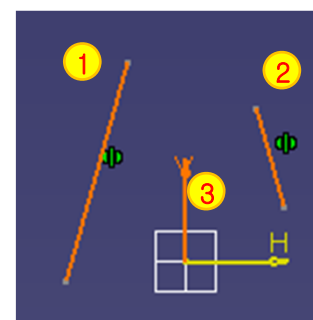
Angle



Parallelism

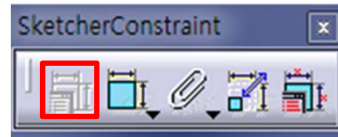


Symmetry

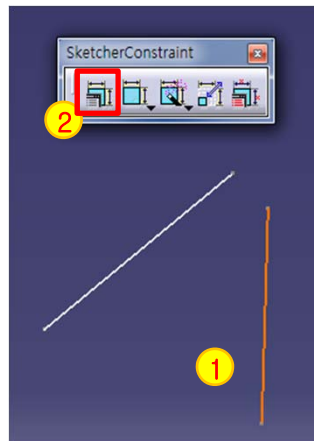


SKETCHER CONSTRAINT

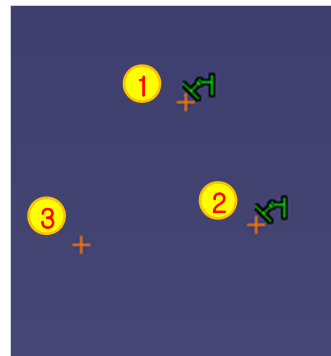
SketcherConstraint



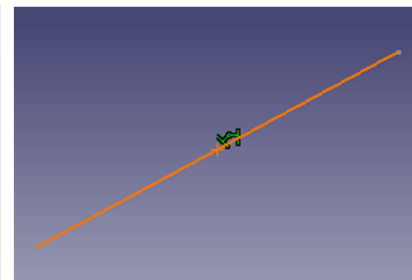
Constraints Defined in Dialog Box



Equidistant point



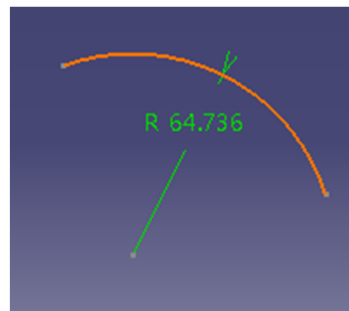
Midpoint



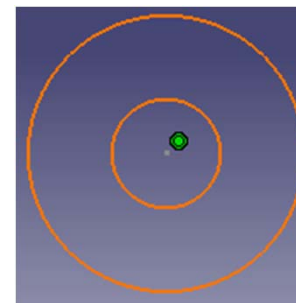
Semimajor axis
Semiminor axis



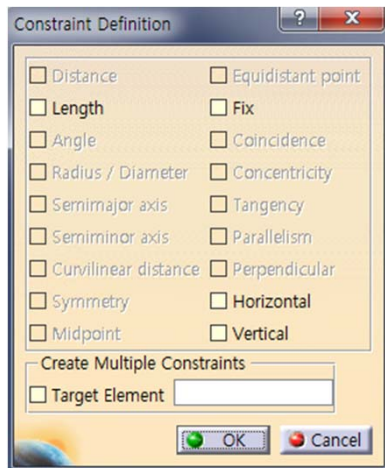
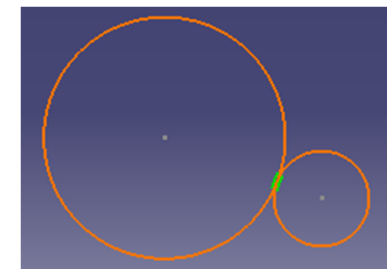
Radius / Diameter



Concentricity



Tangency



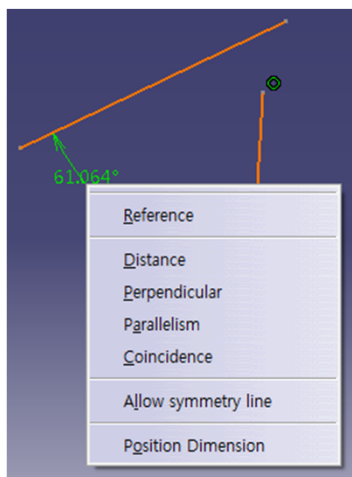
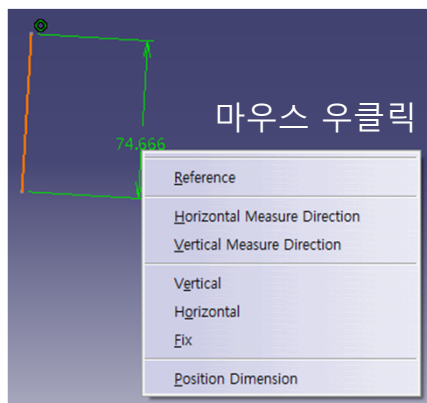
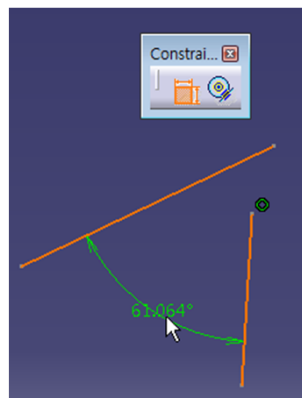
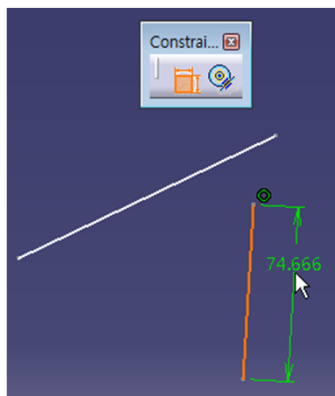
SKETCHER CONSTRAINT

SketcherConstraint



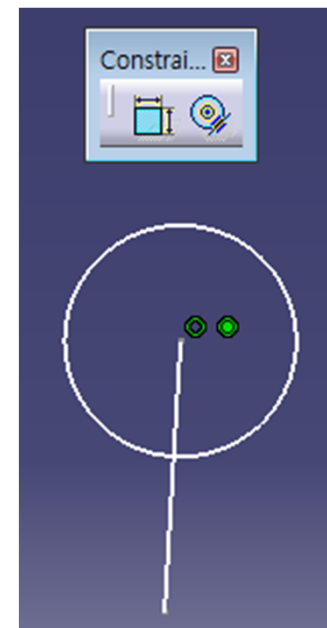
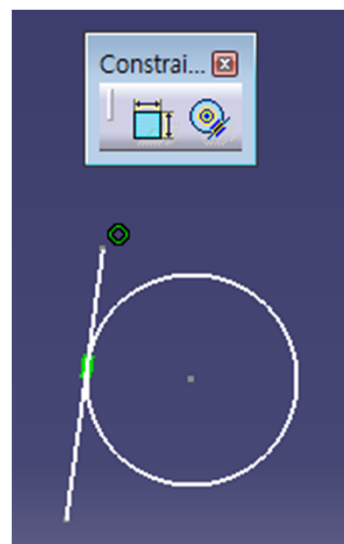
Constraints

- 보다 편하게 구속 부여 가능.



Contact Constraints

- 접촉 구속조건(나중에 선택한 요소가 이동)



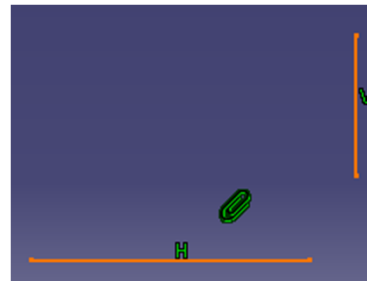
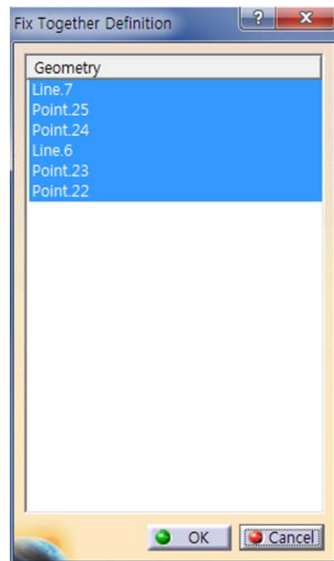
SKETCHER CONSTRAINT

SketcherConstraint



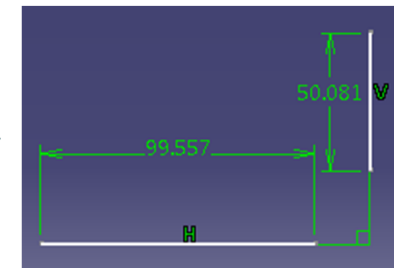
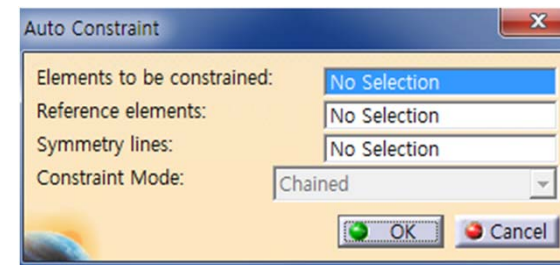
Fix Together

- 여러 profile을 하나로 묶음.



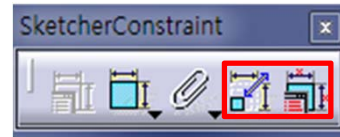
Auto Constraints

- 선택한 요소 사이의 구속을 자동으로 부여



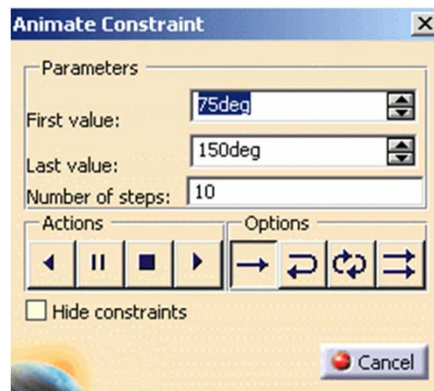
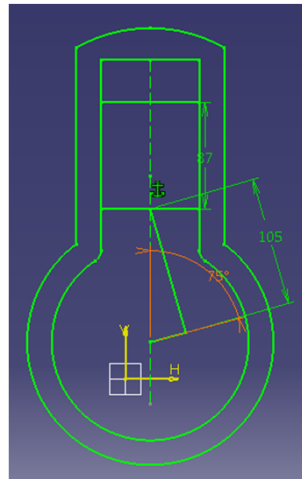
SKETCHER CONSTRAINT

SketcherConstraint



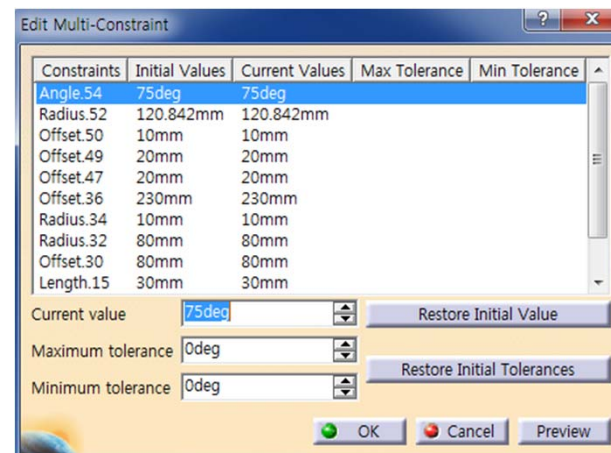
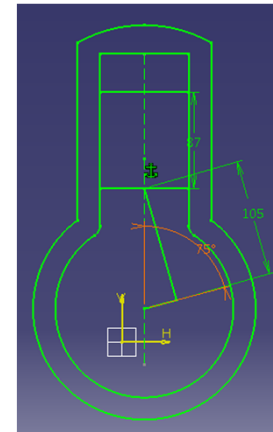
Animate Constraints

- 변경시키고자 하는 구속 값 클릭

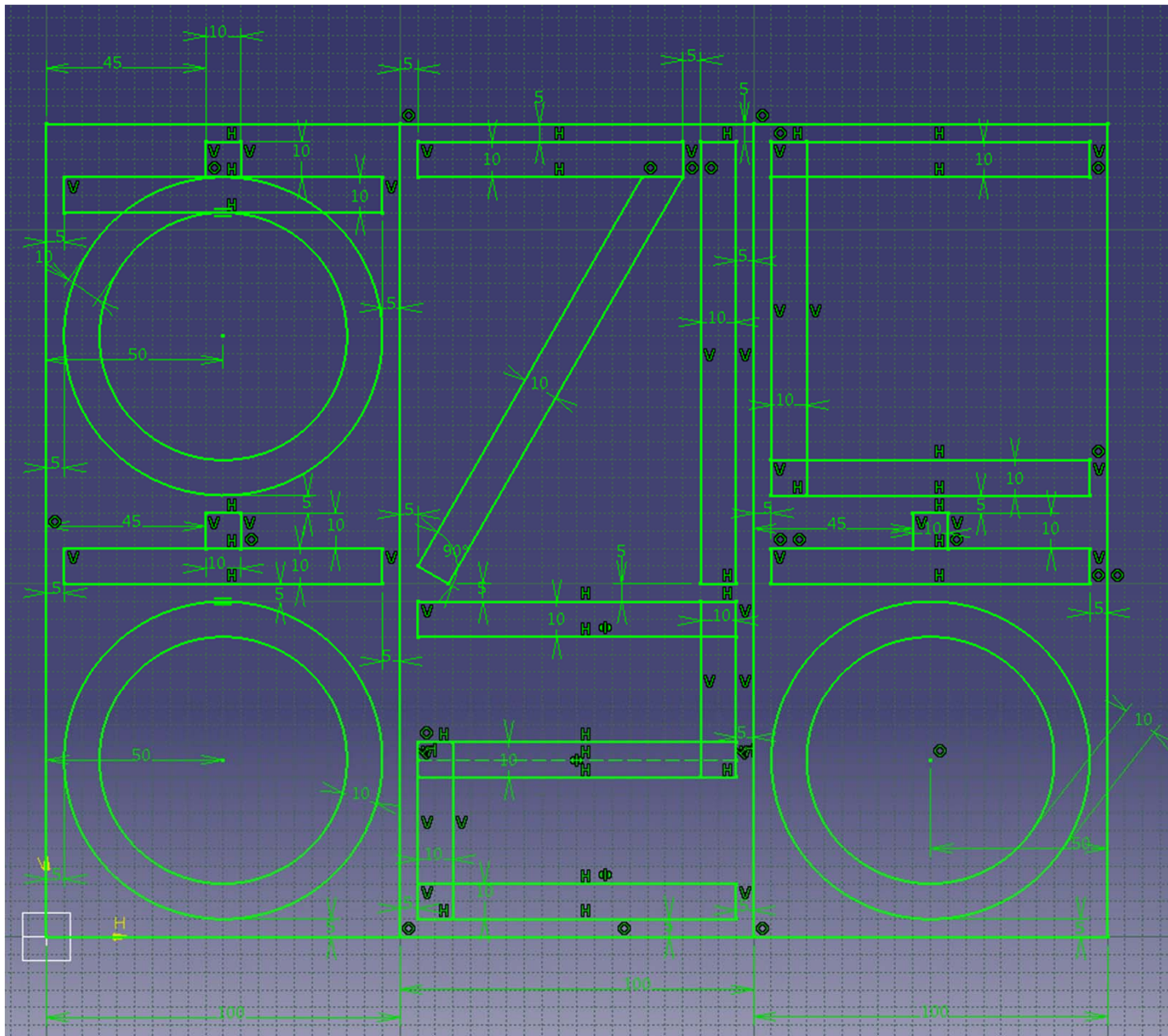


Edit-Multi Constraints

- 여러 구속조건을 한번에 편집가능.



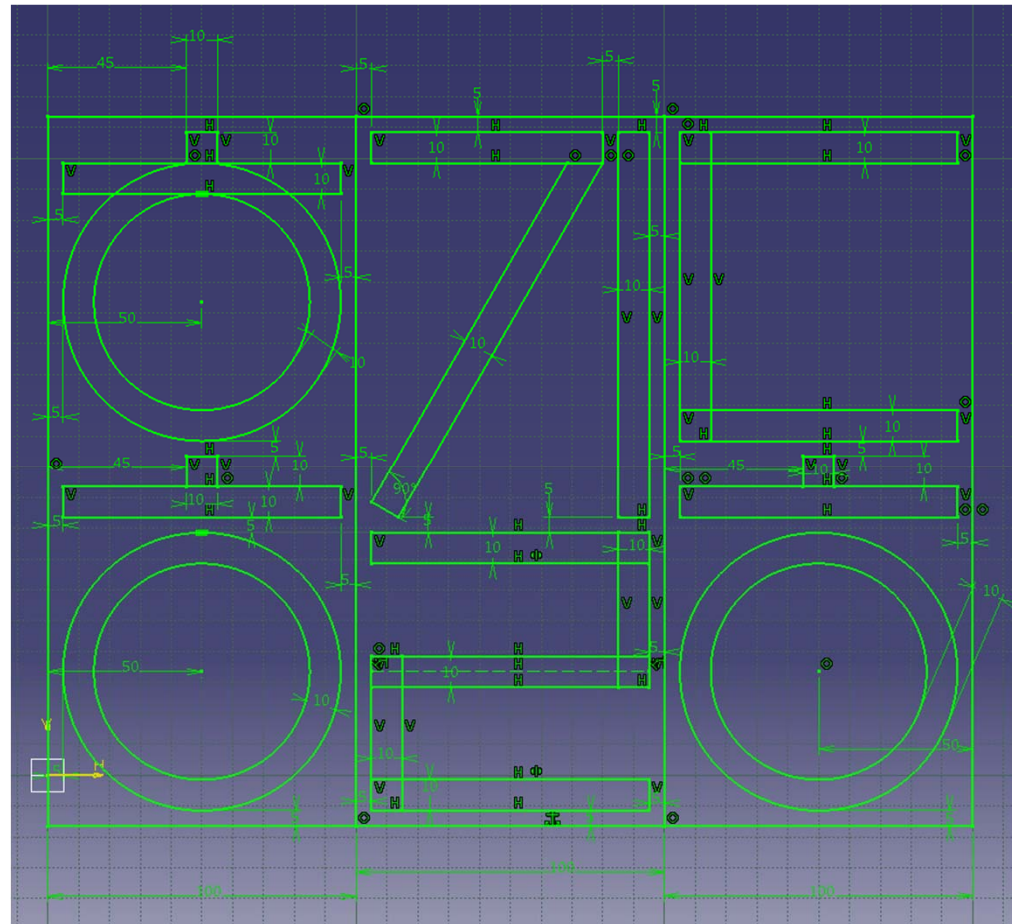
실습 예제



실습 과제 1

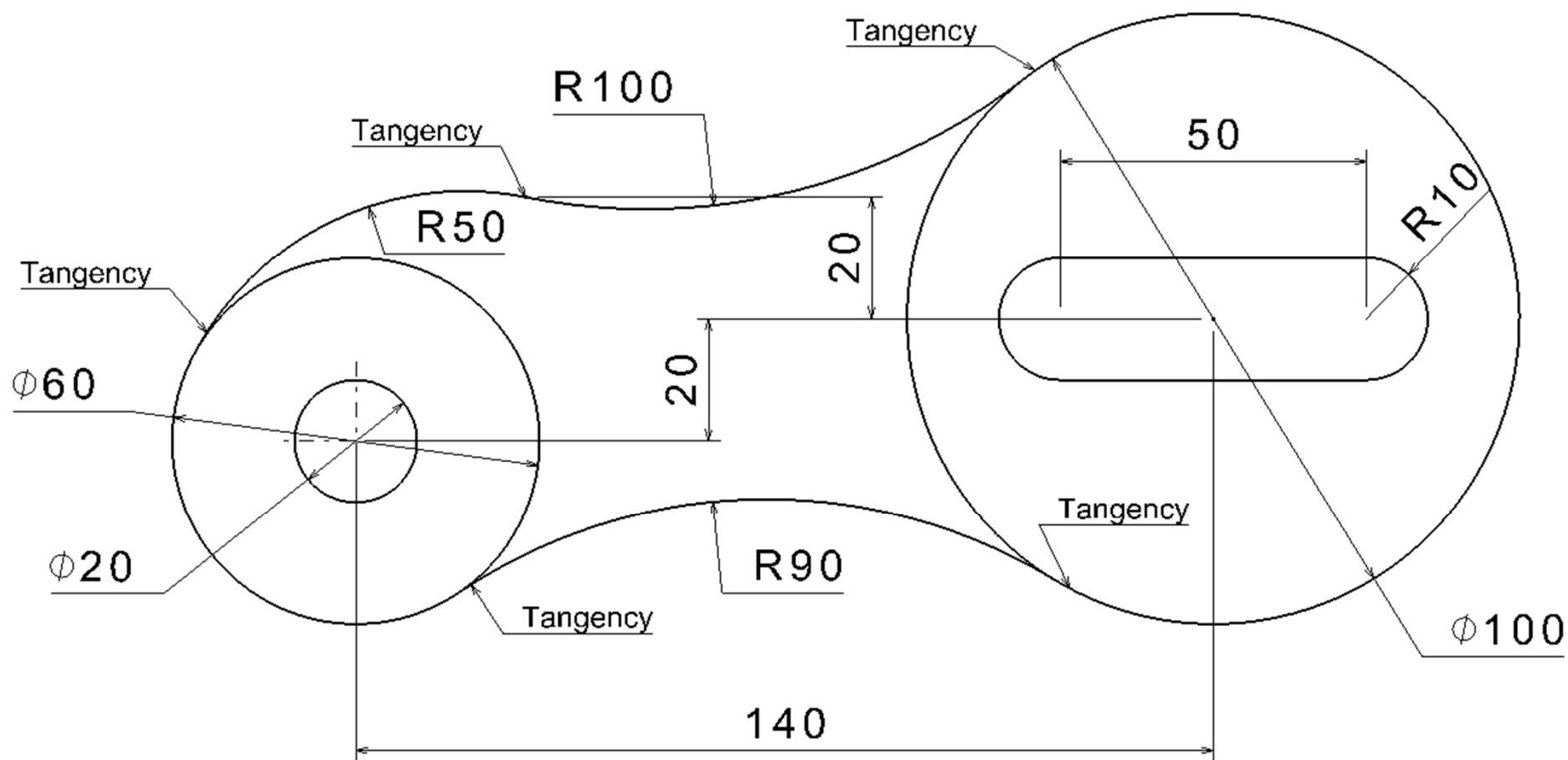
- 예제에 했던 방법으로 **자신의 이름**을 스케치 해보기

(<ftp://cdl.hanyang.ac.kr> 의 CAD → HW → Week → '학번_이름(영문)_과제번호' 형태로 업로드)



실습 과제 2

- 아래의 도면을 보고 스케치 해보기

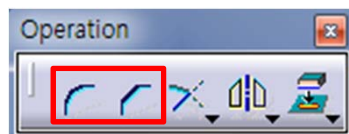


CONTENTS

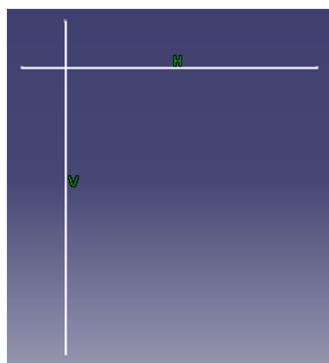
- ✓ 시작하기
- ✓ Profile 을 이용한 스케치
- ✓ Constraint 을 이용한 스케치
- ✓ **Operation 을 이용한 스케치**

SKETCHER OPERATION

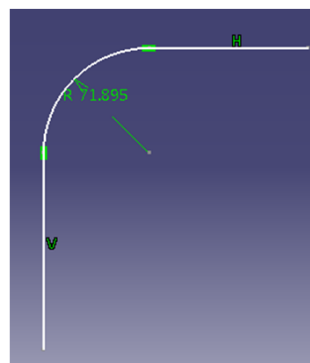
Corner/Chamfer



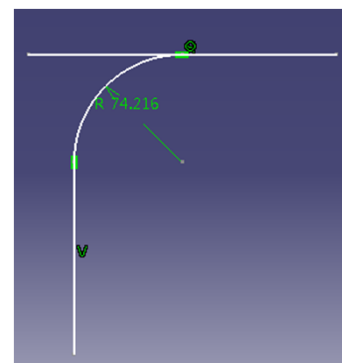
No Corner



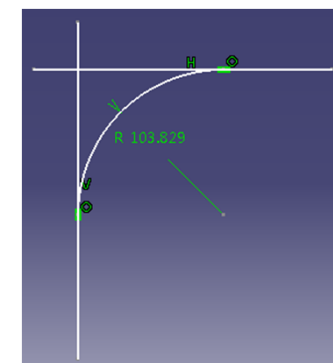
All Trim Element



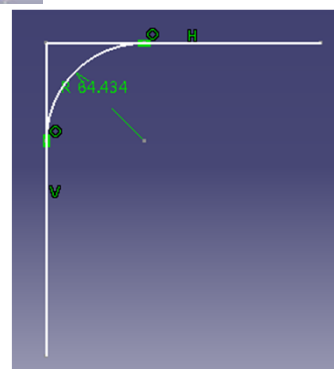
Trim First Element



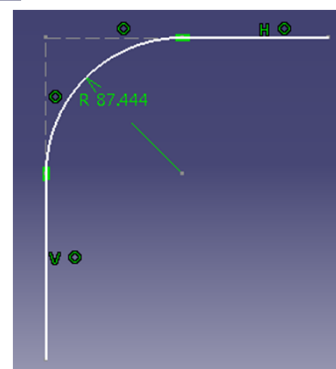
No Trim



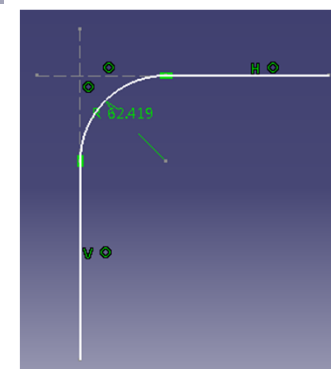
Standard Lines Trim



Construction Lines Trim

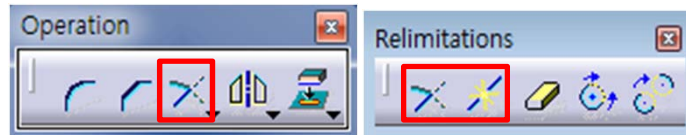


Construction Lines No Trim



SKETCHER OPERATION

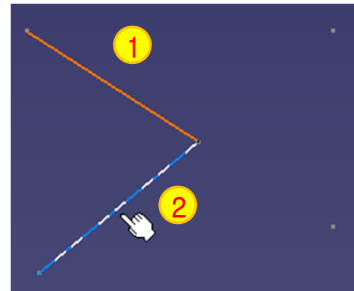
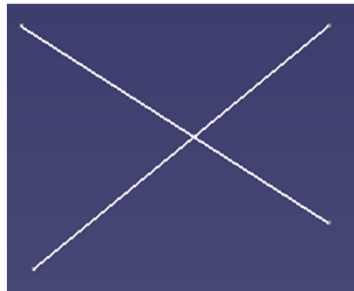
Relimitations



Trim



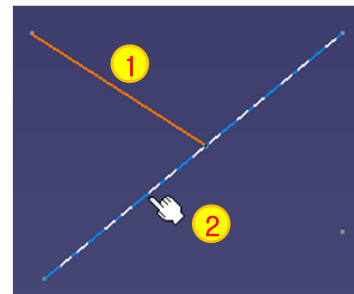
(Trim All Elements)



Trim

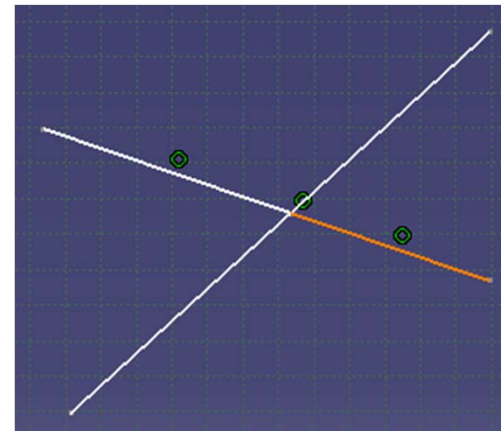
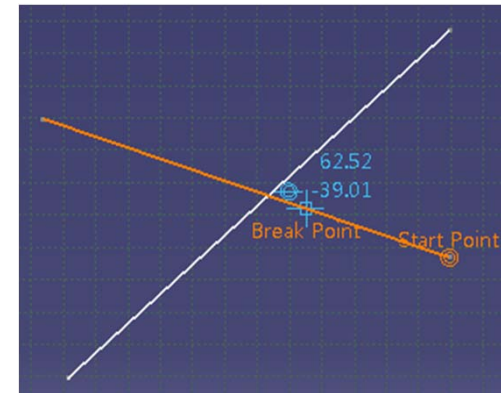


(Trim First Elements)



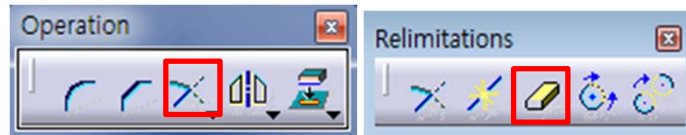
Break

- 선택한 라인을 분할



SKETCHER OPERATION

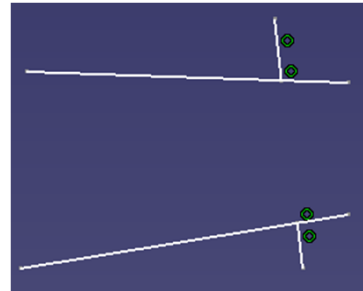
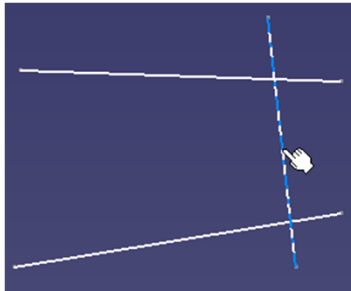
Relimitations



Quick Trim



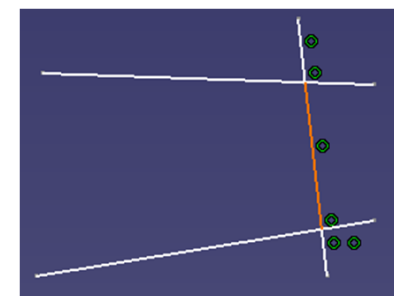
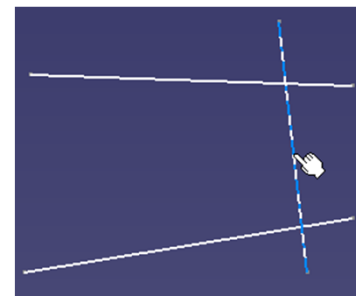
(Break And Rubber In)



Quick Trim



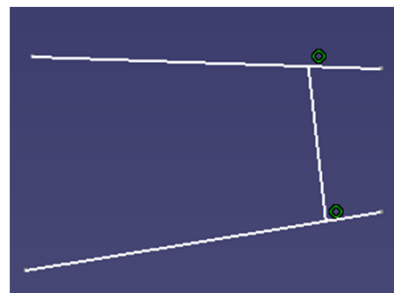
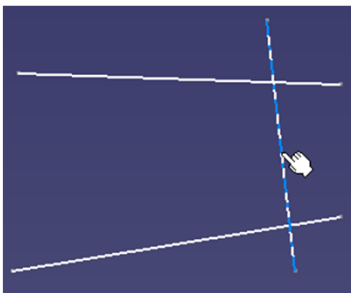
(Break And Keep)



Quick Trim

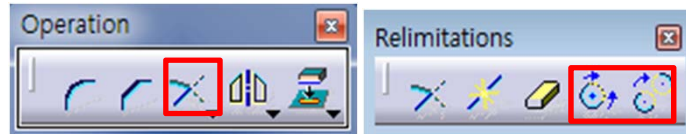


(Break And Rubber Out)

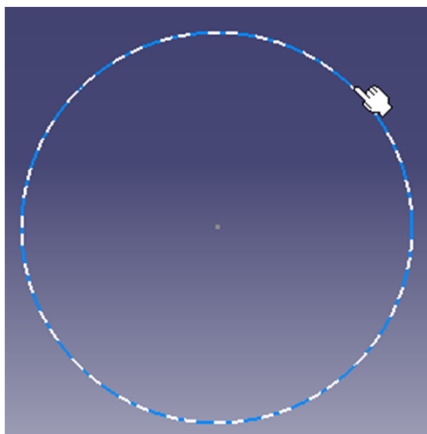
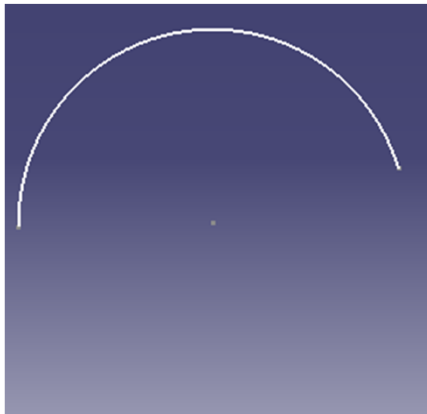


SKETCHER OPERATION

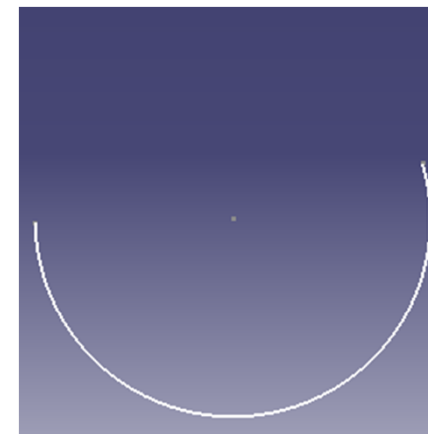
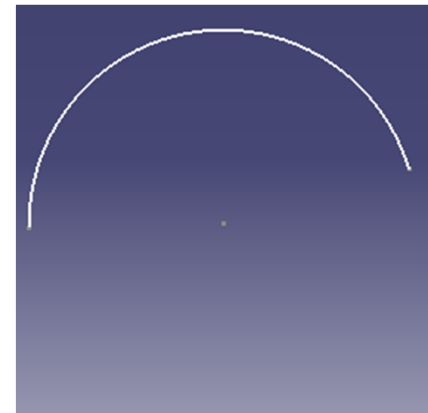
Relimitations



 Close arc: 원의 남은 부분을 생성



 Complement: 원의 나머지 부분으로 변경

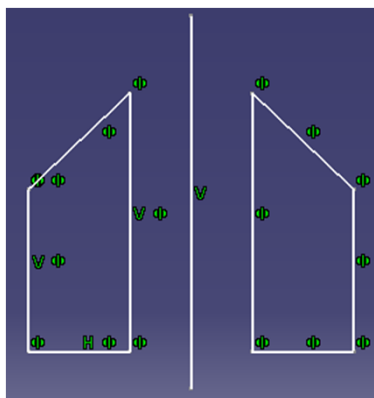
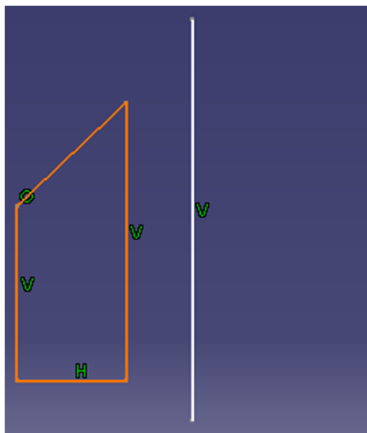


SKETCHER OPERATION

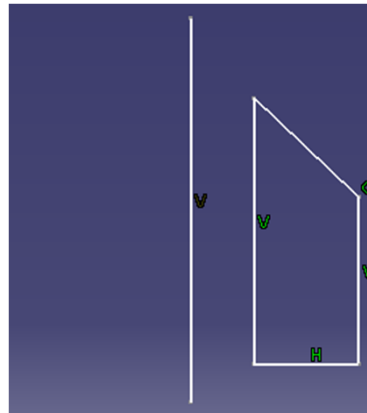
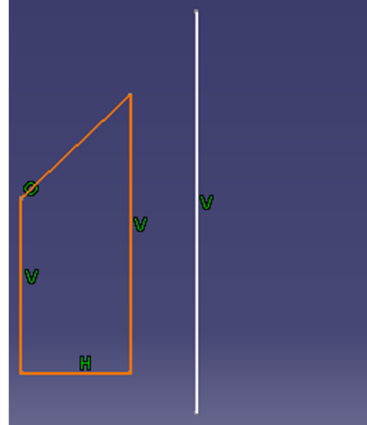
Transformation



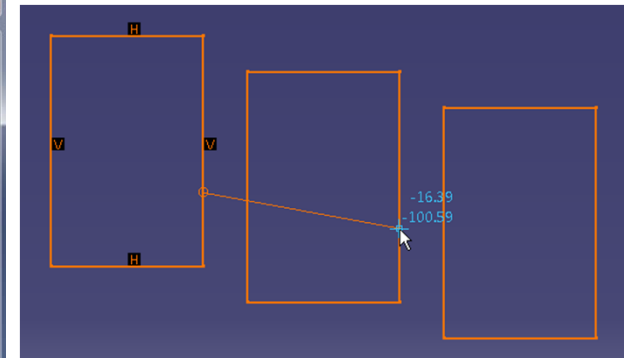
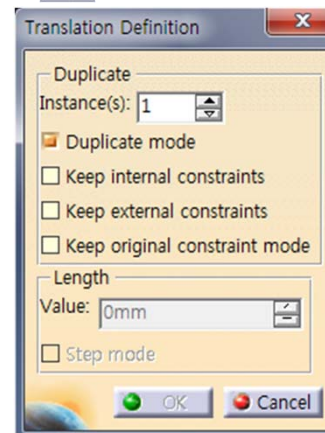
Mirror (대칭 복사)



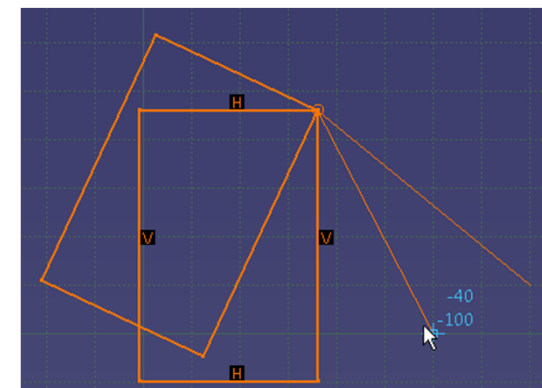
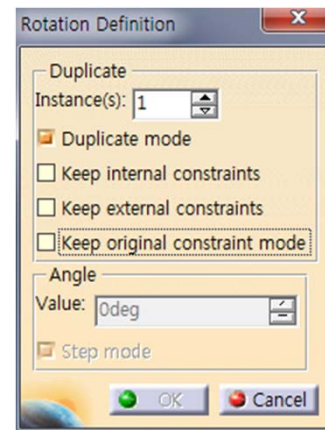
Symmetry (대칭 이동)



Translate



Rotate

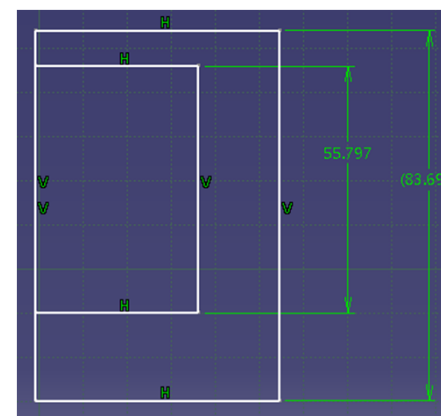
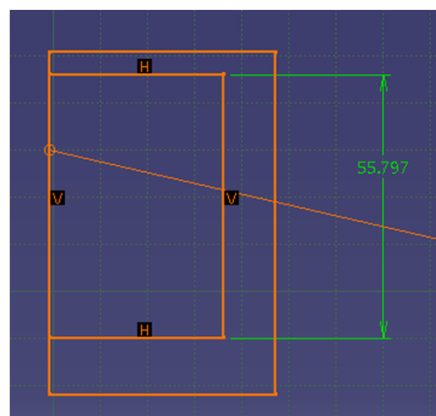
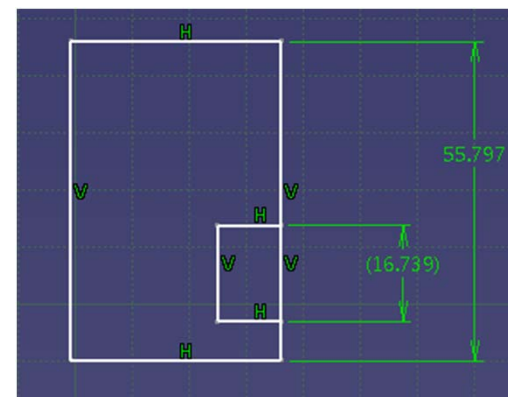
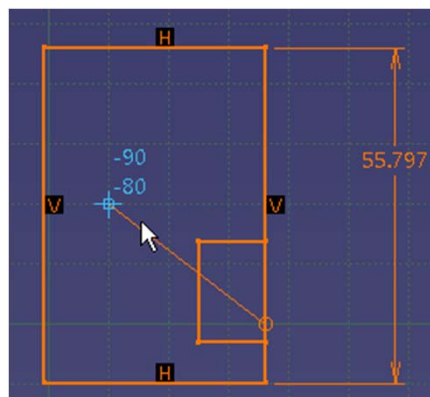
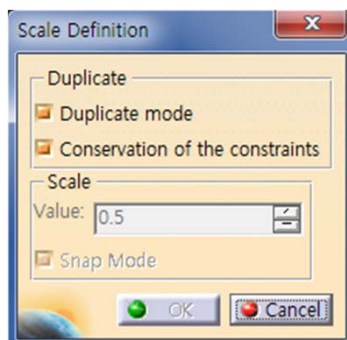


SKETCHER OPERATION

Transformation



 Scale

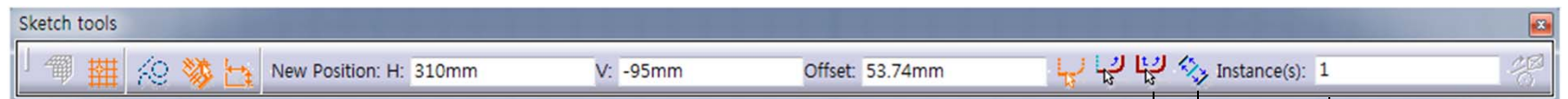


SKETCHER OPERATION

Transformation



Offset : 설정한 값만큼 기존 스케치로부터 동일한 간격의 스케치 생성

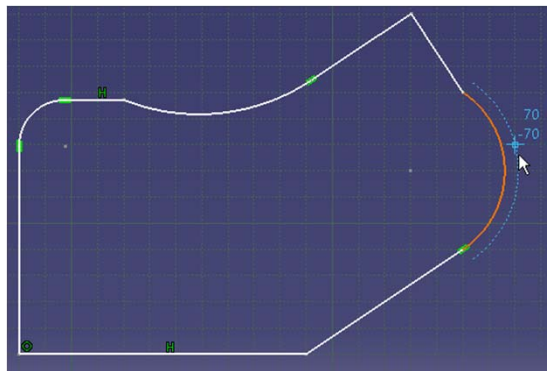


No Propagation
 Tangent Propagation
 Point Propagation
 Both Side Offset

Offset 개수



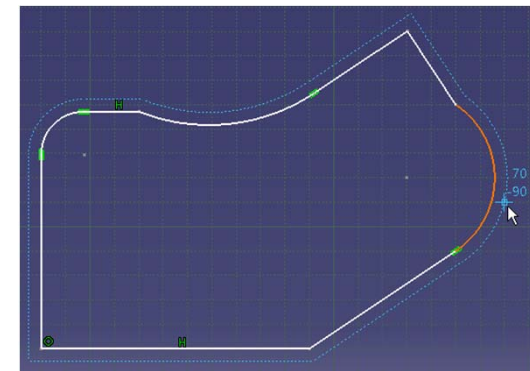
No Propagation



Tangent Propagation



Point Propagation



SKETCHER OPERATION

Transformation



Offset : 설정한 값만큼 기존 스케치로부터 동일한 간격의 스케치 생성

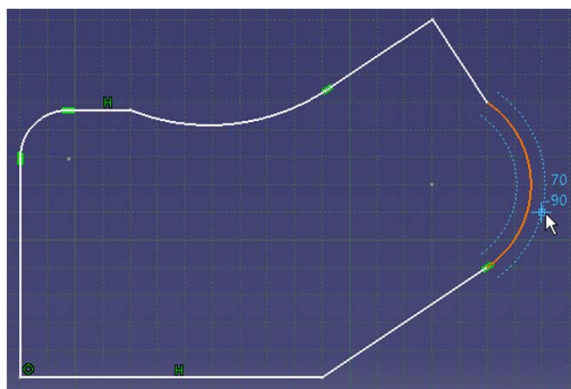


No Propagation
Tangent Propagation
Point Propagation
Both Side Offset

Offset 개수

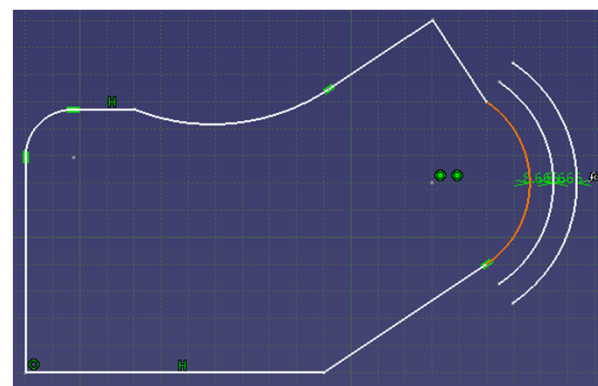


Both Side Offset



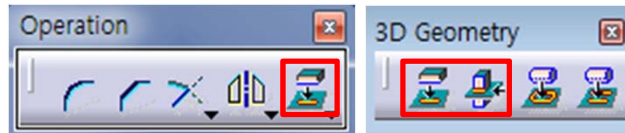
Instance(s): 2

Offset 개수가 2개 일 경우



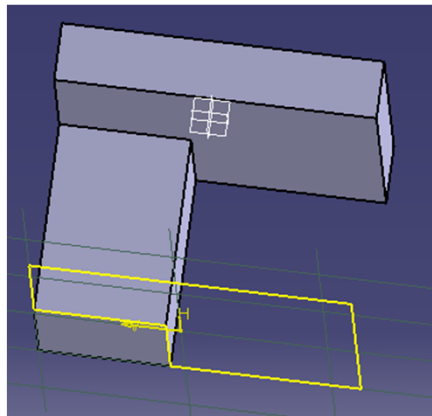
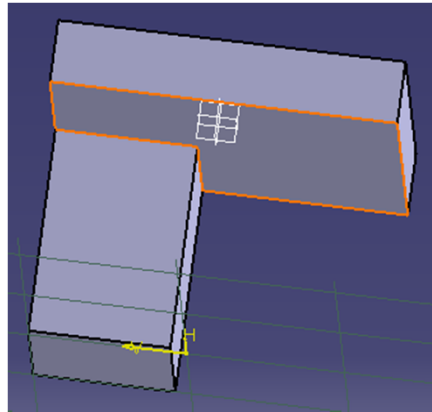
SKETCHER OPERATION

3D Geometry



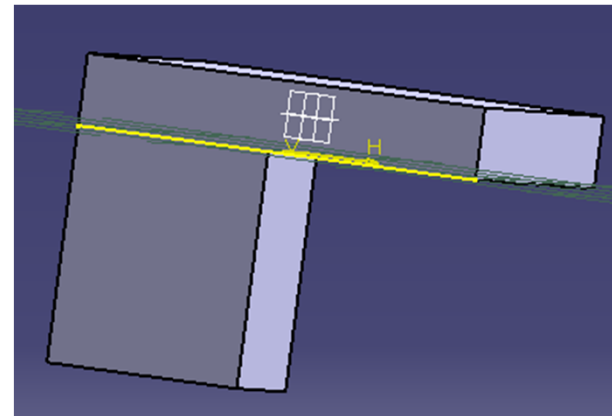
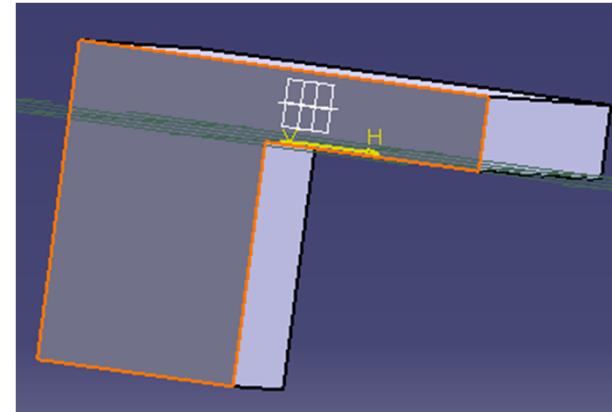
Project 3D Elements

- 3D 모델의 요소를 평면에 투영함



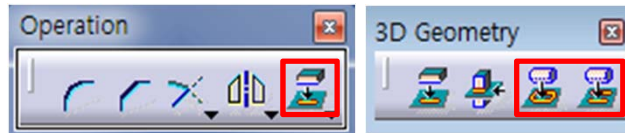
Intersect 3D Element

- 3D 모델과 평면이 교차하는 요소를 생성



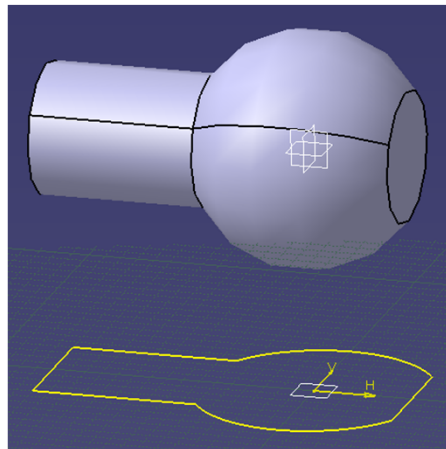
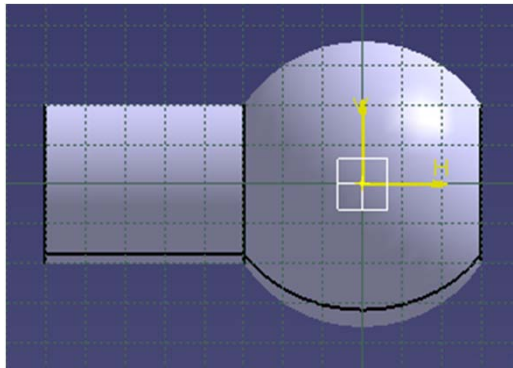
SKETCHER OPERATION

3D Geometry



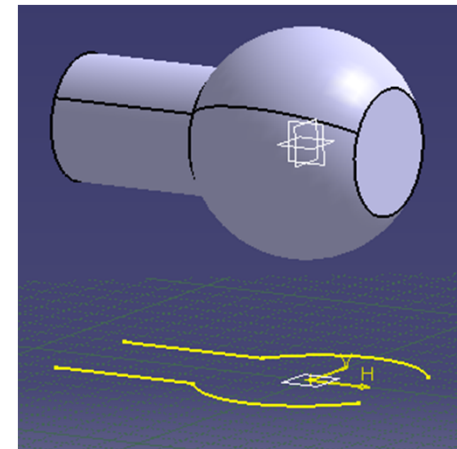
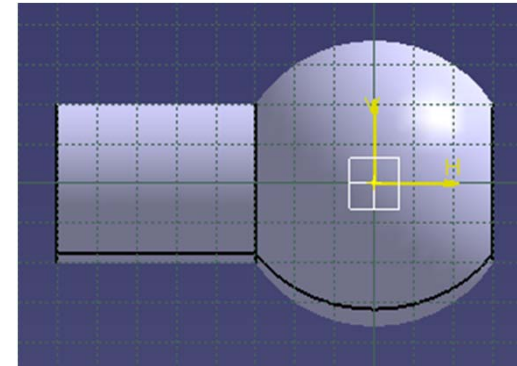
Project 3D Silhouette Edges

- 회전체의 실루엣을 투영함



Project 3D Canonical Silhouette Edges

- 회전체의 실루엣을 투영함(회전면)

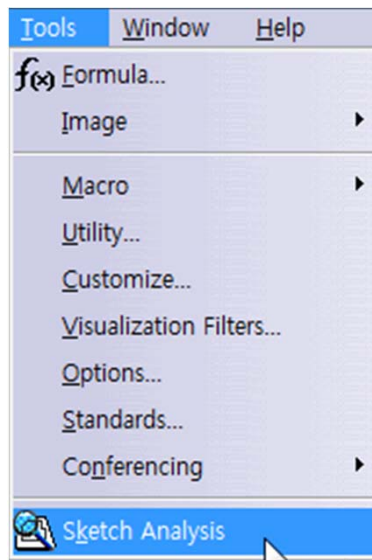


SKETCHER OPERATION

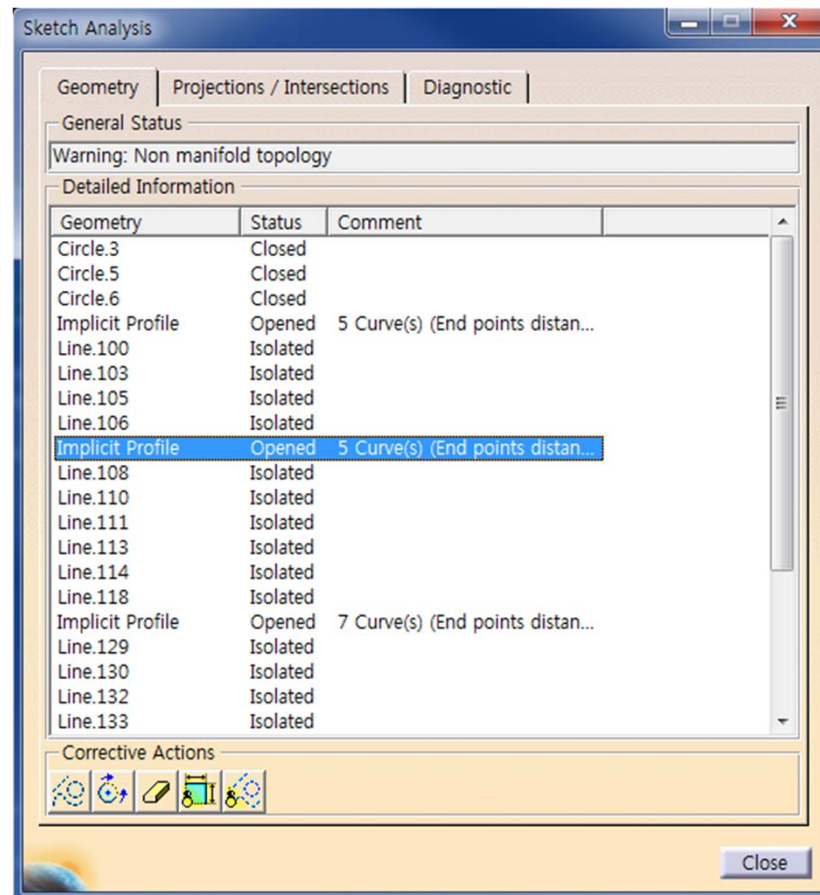
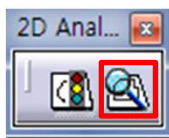
Sketch Analysis

- 완성된 Sketch를 점검하는 기능

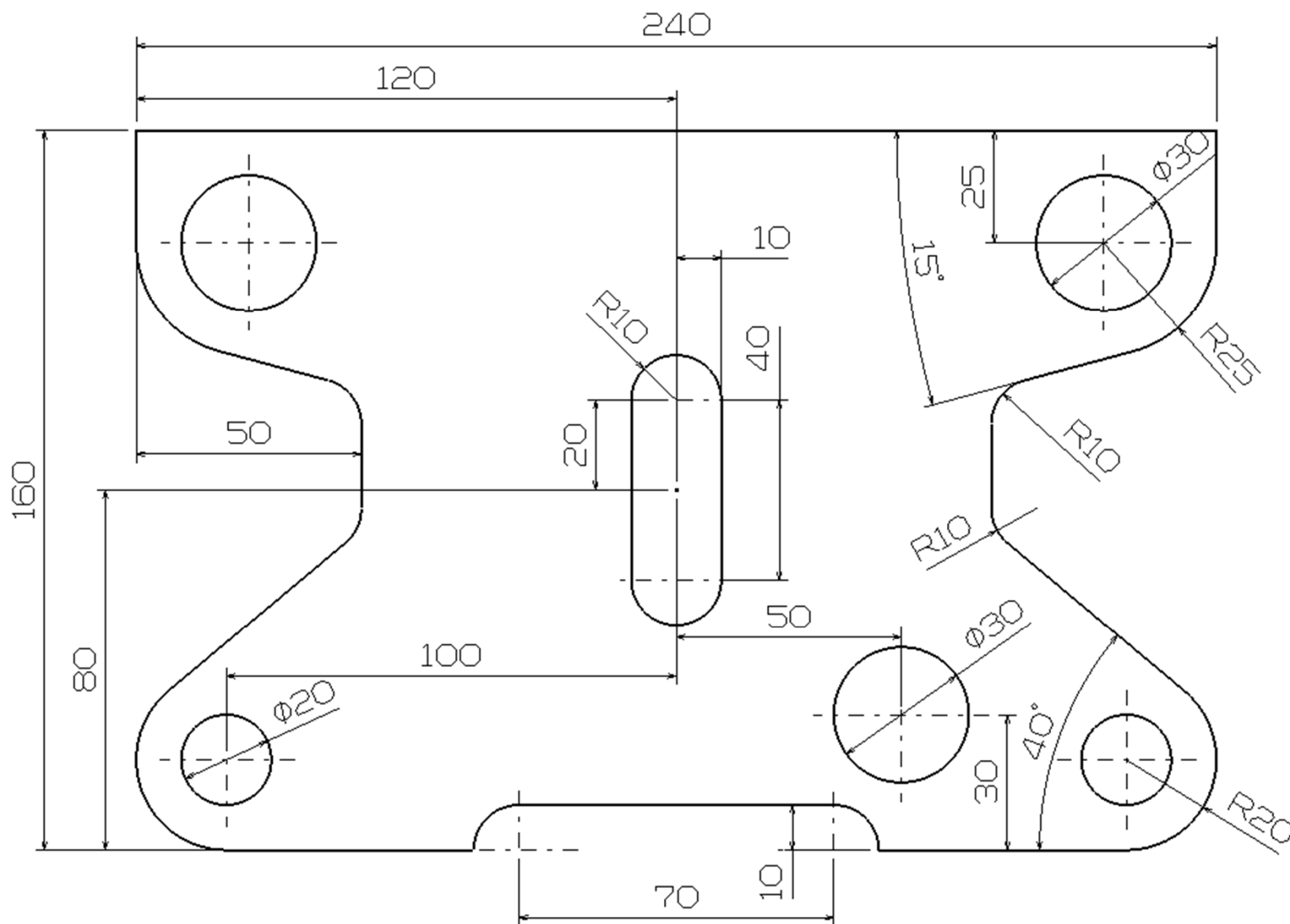
Tools → Sketch Analysis



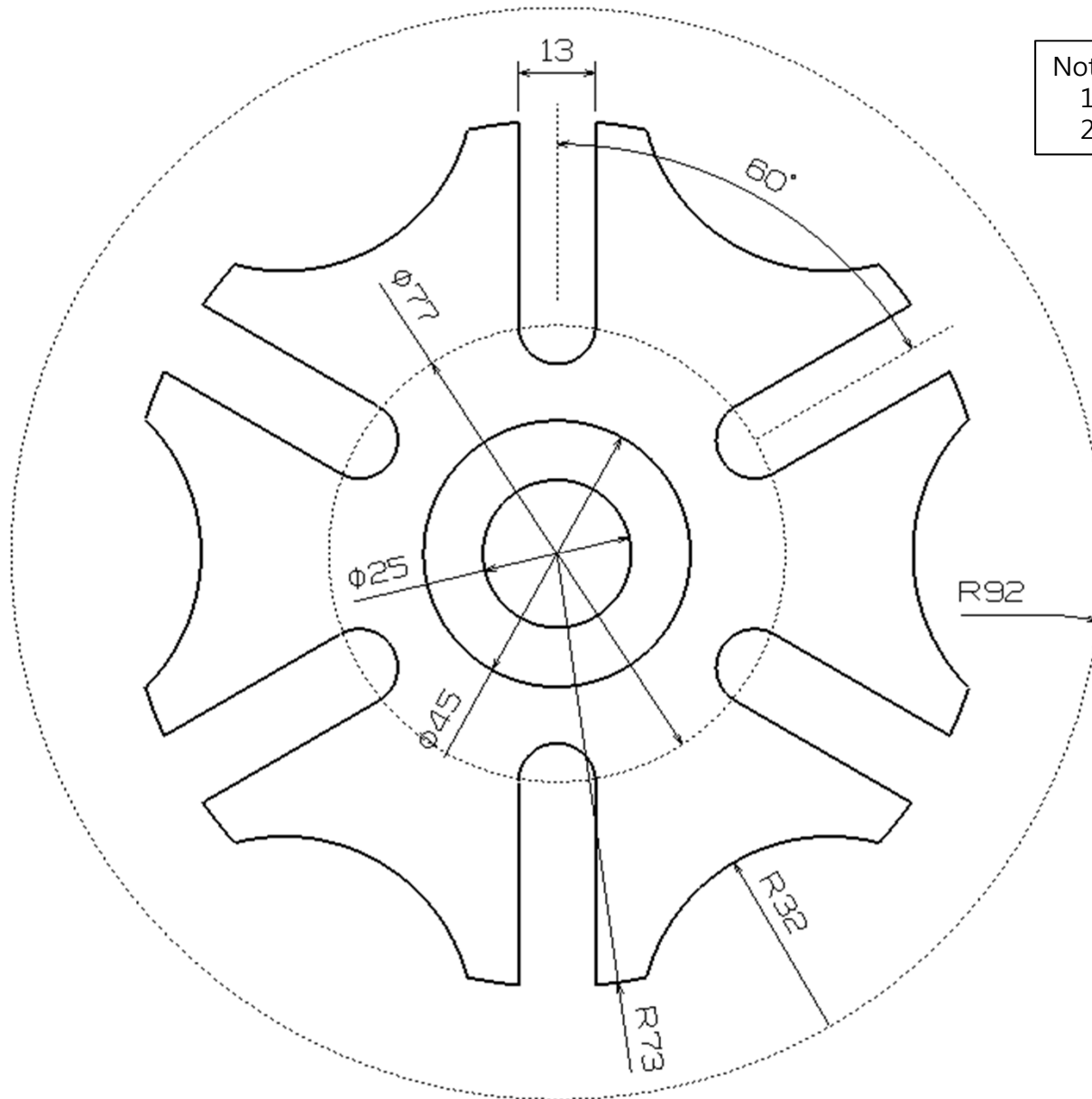
또는 화면 하단의 툴바 이용



실습 예제 1



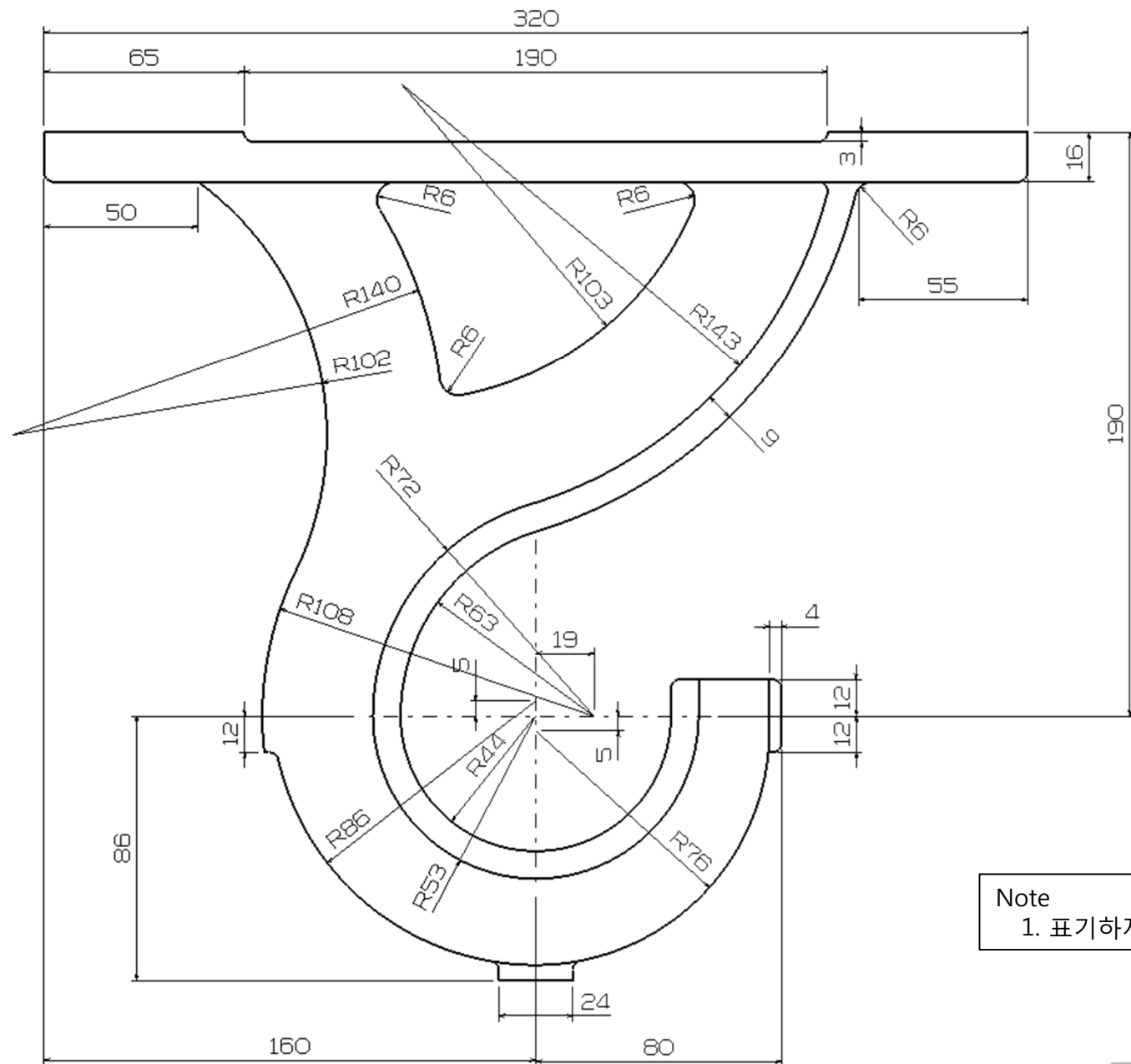
실습 예제 2



Note

1. Transformation의 Rotation 기능 이용
2. 완전 구속 할 필요 없음

실습 예제 3



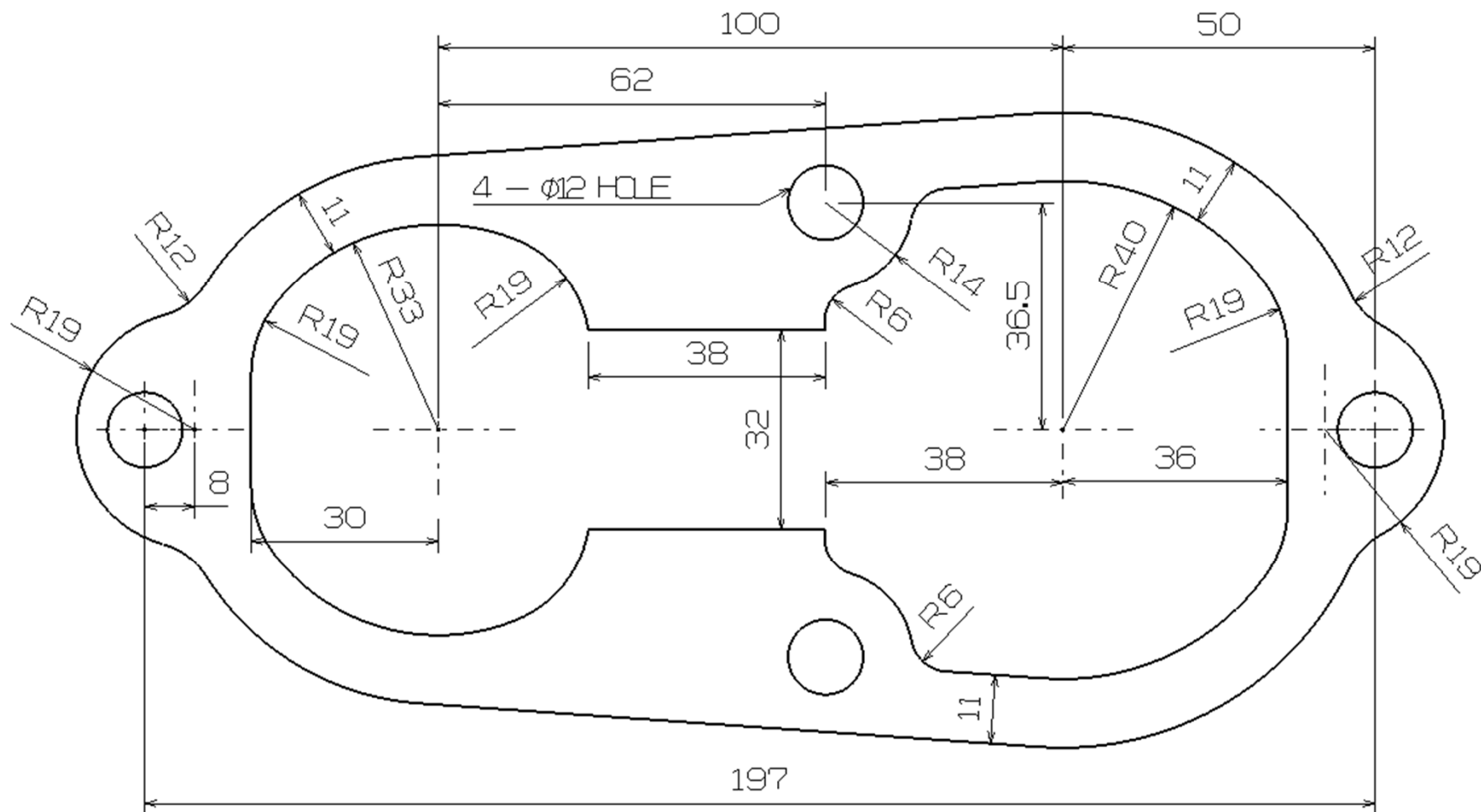
Note
1. 표기하지 않은 R=3

실습 과제 1

- 아래의 도면을 보고 스케치 해보기

Note

1. 선 사이의 연결은 tangency constraint 이용



실습 과제 2

- 아래의 도면을 보고 스케치 해보기

