

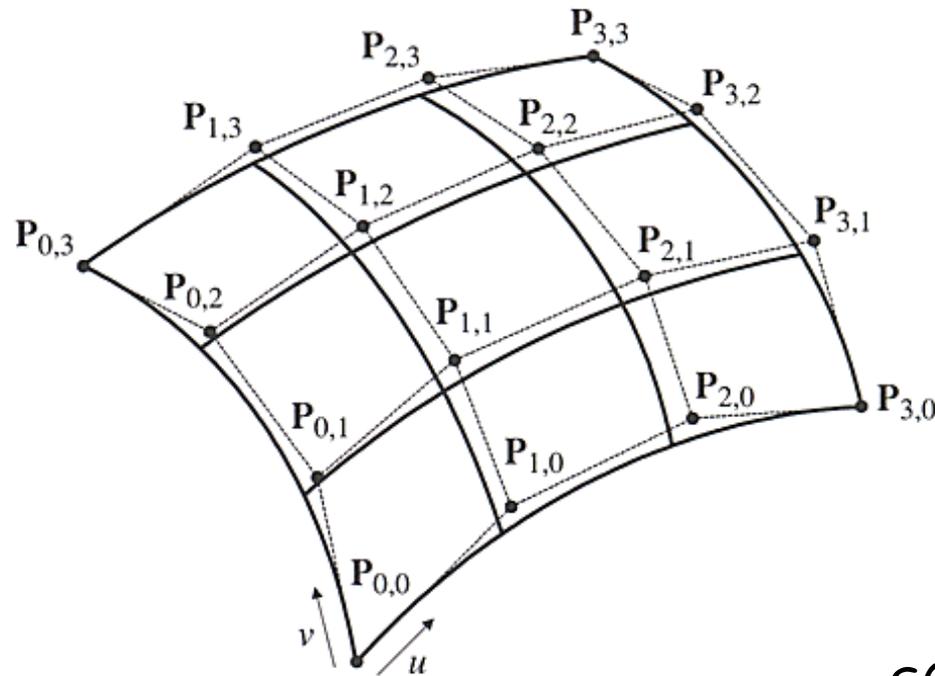
المحاضرة التاسعة التصميم و التصنيع بمساعدة الحاسب

الدكتور المهندس
تمام سلّوم



NURBS Surfaces

انواع و معادلات السطوح



$$S(u, v) = \frac{\sum_{i=0}^n \sum_{j=0}^m N_{i,p}(u) N_{j,q}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^n \sum_{j=0}^m N_{i,p}(u) N_{j,q}(v) w_{i,j}}$$





Extrude Surfaces

1 courbe NURBS: $C(u) = \frac{\sum_{i=0}^n w_i N_{i,d}(u) P_i}{\sum_{i=0}^n w_i N_{i,d}(u)}$ $U = [u_0, u_1, u_2, \dots, u_{m-1}, u_m]$

1 vecteur z (direction)

1 scalaire δ

$$S(u, v) = \frac{\sum_{i=0}^n \sum_{j=0}^1 N_{i,d}(u) N_{j,1}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^n \sum_{j=0}^1 N_{i,d}(u) N_{j,1}(v) w_{i,j}}$$

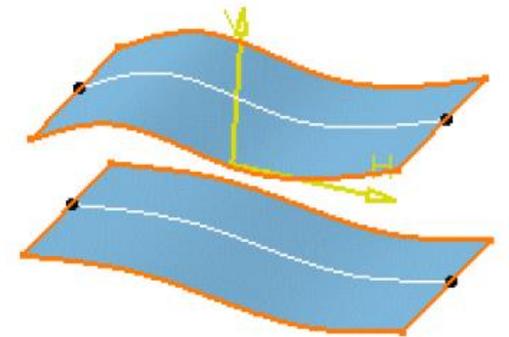
$$U = [u_0, u_1, u_2, \dots, u_{m-1}, u_m]$$

$$V = [0, 0, 1, 1]$$

$$P_{i,0} = P_i$$

$$P_{i,1} = P_i + \delta z$$

$$w_{i,0} = w_{i,1} = w_i$$

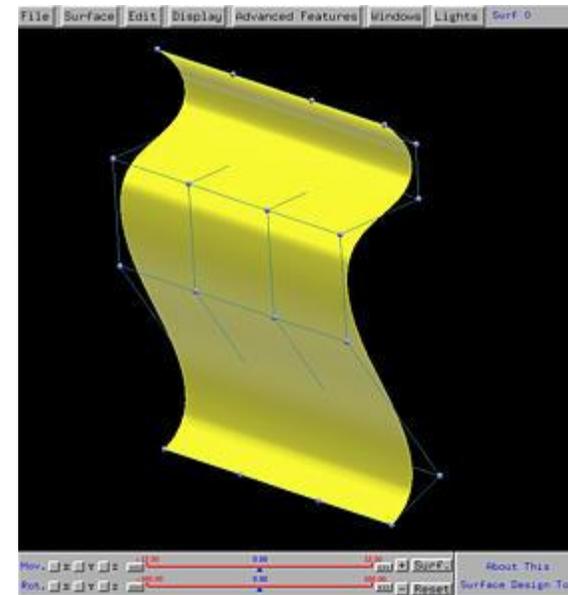
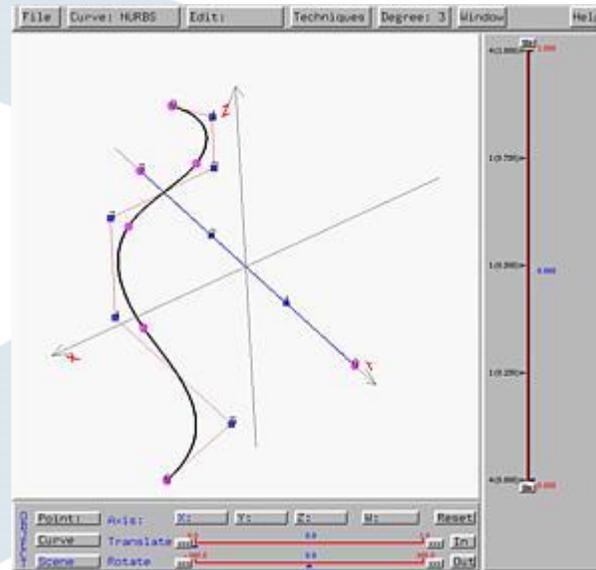


Extruded Surfaces



Extrude Surfaces

انشاء سطح عن طريق البثق



Extrude Surfaces

انشاء سطح عن طريق البثق

2 courbes NURBS:

$$C(u) = \frac{\sum_{i=0}^n w_i N_{i,d}(u) P_i}{\sum_{i=0}^n w_i N_{i,d}(u)} \quad \text{Génératrice}$$

$$U = [u_0, u_1, u_2, \dots, u_{m-1}, u_m]$$

$$D(v) = \frac{\sum_{j=0}^p s_j N_{j,e}(v) Q_j}{\sum_{j=0}^p s_j N_{j,e}(v)} \quad \text{Guide}$$

$$V = [v_0, v_1, v_2, \dots, v_{p-1}, v_p]$$

$$S(u, v) = \frac{\sum_{i=0}^n \sum_{j=0}^p N_{i,d}(u) N_{j,e}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^n \sum_{j=0}^p N_{i,d}(u) N_{j,e}(v) w_{i,j}}$$

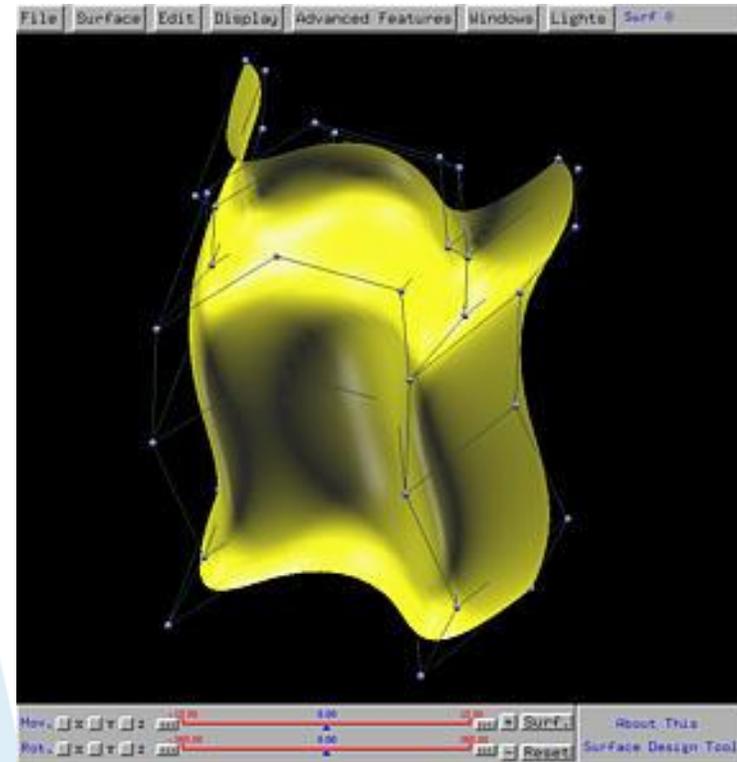
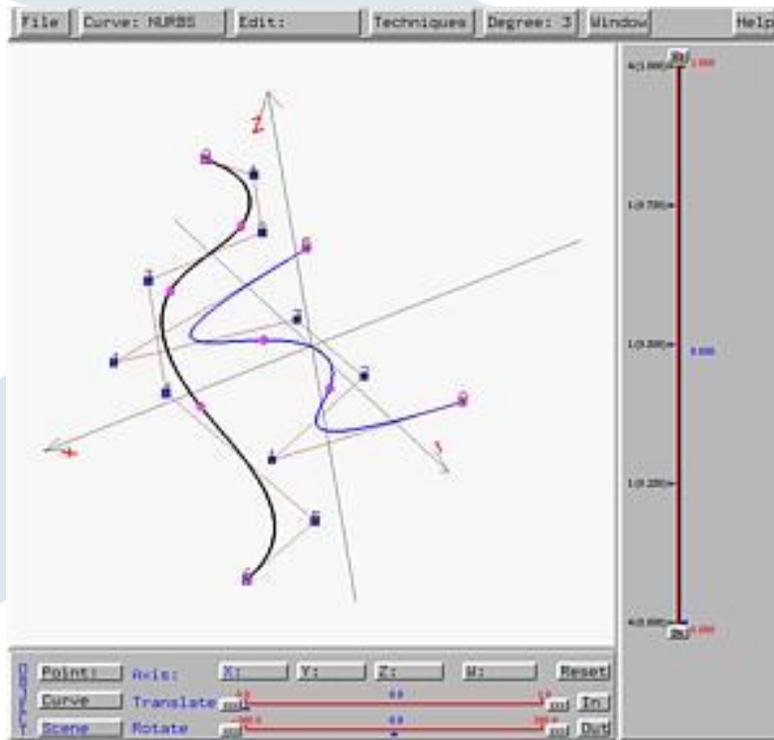
$$P_{i,j} = P_i + Q_j$$

$$w_{i,j} = w_i s_j$$



Extrude Surfaces

انشاء سطح عن طريق البثق



Ruled Surfaces



السطوح الموجهة

2 courbes NURBS:

$$C(u) = \frac{\sum_{i=0}^n w_i N_{i,d}(u) P_i}{\sum_{i=0}^n w_i N_{i,d}(u)}$$

$$U = [u_0, u_1, u_2, \dots, u_{m-1}, u_m]$$

$$D(u) = \frac{\sum_{i=0}^n s_i N_{i,d}(u) Q_i}{\sum_{i=0}^n s_i N_{i,d}(u)}$$

$$U = [u_0, u_1, u_2, \dots, u_{m-1}, u_m]$$

$$S(u, v) = \frac{\sum_{i=0}^n \sum_{j=0}^1 N_{i,d}(u) N_{j,1}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^n \sum_{j=0}^1 N_{i,d}(u) N_{j,1}(v) w_{i,j}}$$

$$P_{i,0} = P_i$$

$$P_{i,1} = Q_i$$

$$w_{i,0} = w_i$$

$$w_{i,1} = s_i$$

$$U = [u_0, u_1, u_2, \dots, u_{m-1}, u_m]$$

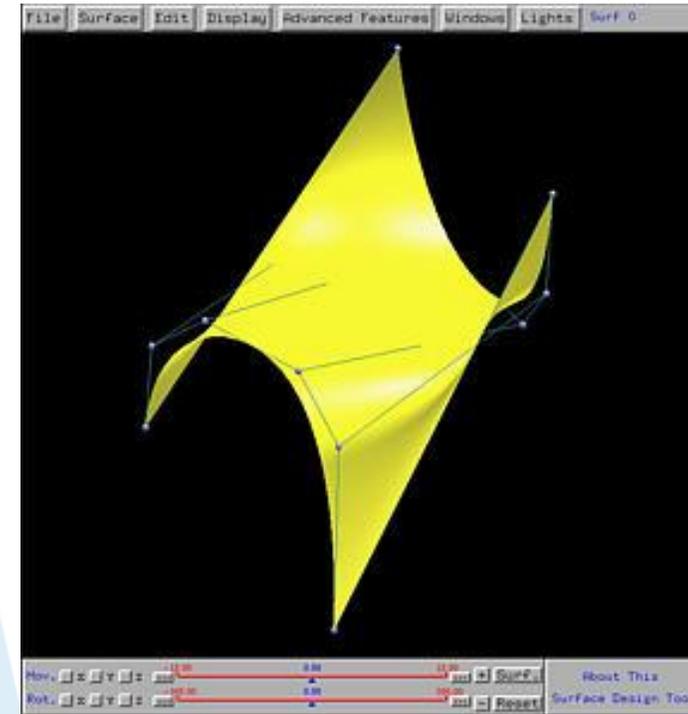
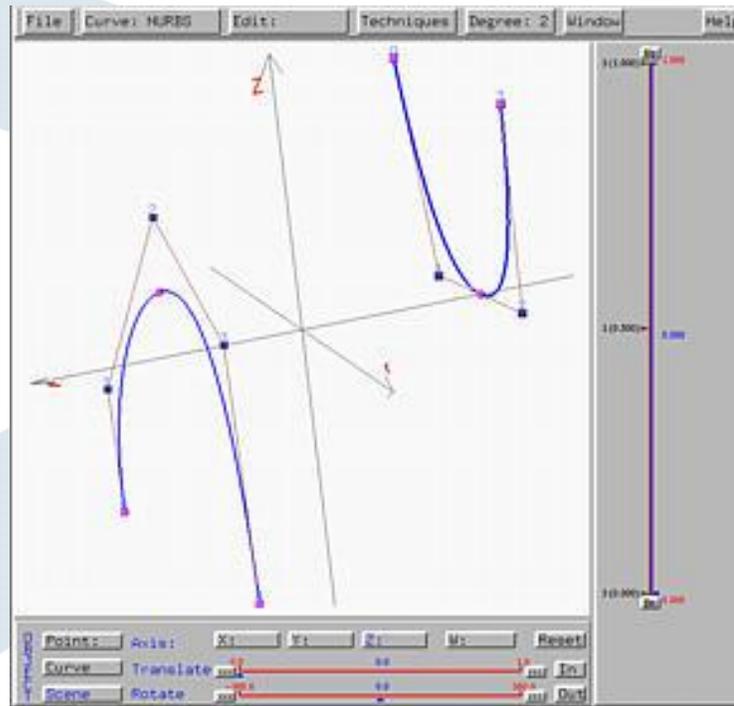
$$V = [0, 0, 1, 1]$$

تستخدم هذه السطوح
في انشاء قوالب الحقن
للنماذج البلاستيكية



Ruled Surfaces

السطوح الموجهة



Surfaces of Revolution

انشاء سطوح عن طريق التدوير

1 courbes NURBS:

$$C(u) = \frac{\sum_{i=0}^n w_i N_{i,d}(u) P_i}{\sum_{i=0}^n w_i N_{i,d}(u)}$$

$$U = [u_0, u_1, u_2, \dots, u_{m-1}, u_m]$$

1 droite (Δ)

$$P_i^* = \text{Proj}(P_i, \Delta)$$

$$\delta_i = \text{dist}(P_i, \Delta)$$

$$S(u, v) = \frac{\sum_{i=0}^n \sum_{j=0}^p N_{i,d}(u) N_{j,2}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^n \sum_{j=0}^p N_{i,d}(u) N_{j,2}(v) w_{i,j}}$$

$$w_{i,j} = w_i s_j$$

$$P_{i,j} = \delta_i Q_j \leftarrow P_i^*$$

$$U = [u_0, u_1, u_2, \dots, u_{m-1}, u_m]$$

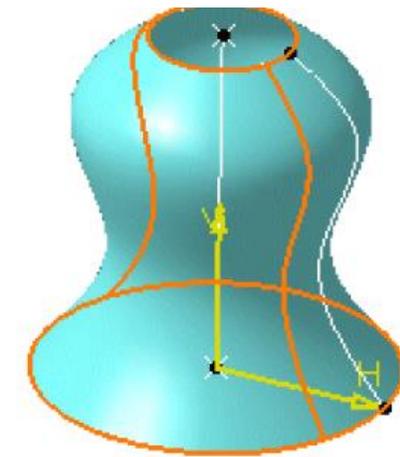
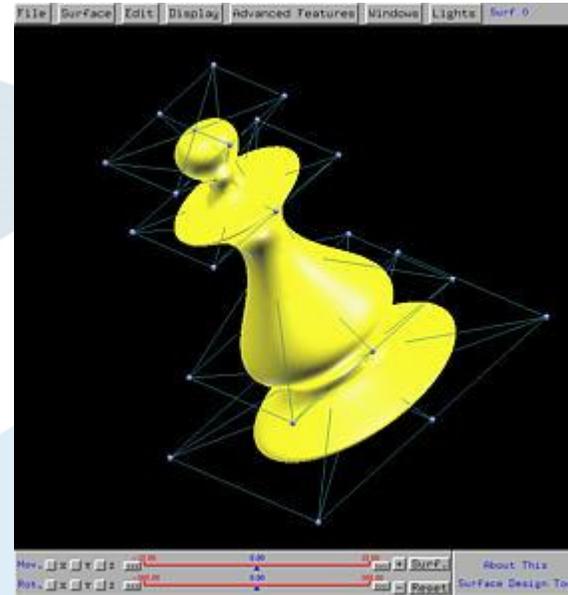
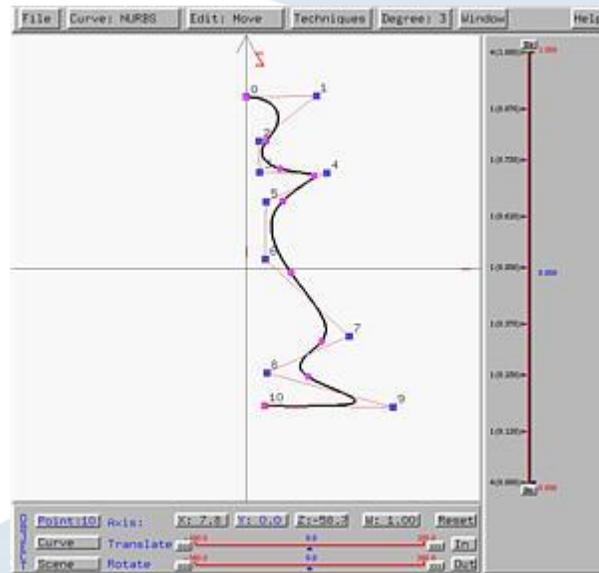
$$V = [s_0, s_1, s_2, \dots, s_{q-1}, s_q]$$



Surfaces of Revolution



انشاء سطوح عن طريق التدوير



Surfaces of Revolution

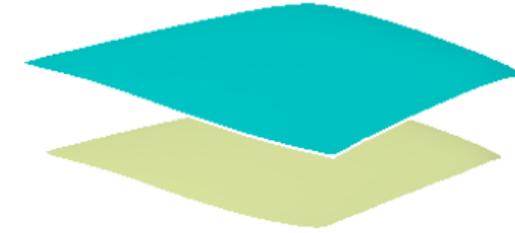


Offset Surfaces

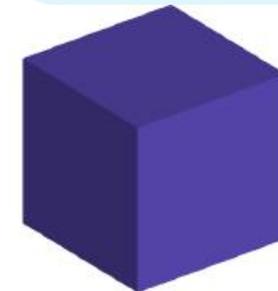
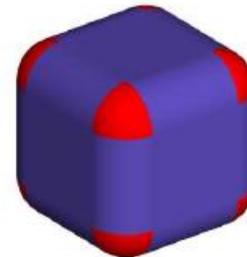
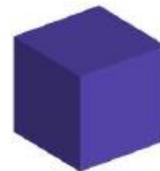
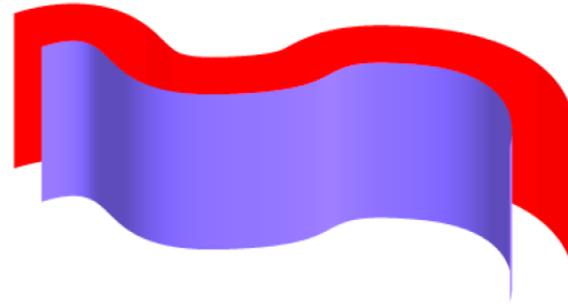
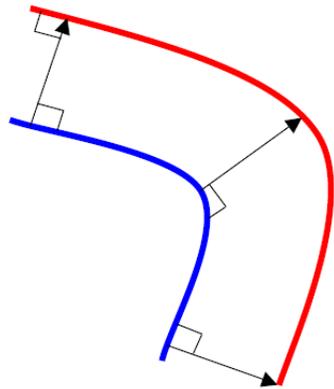
انشاء سطح بالازاحة

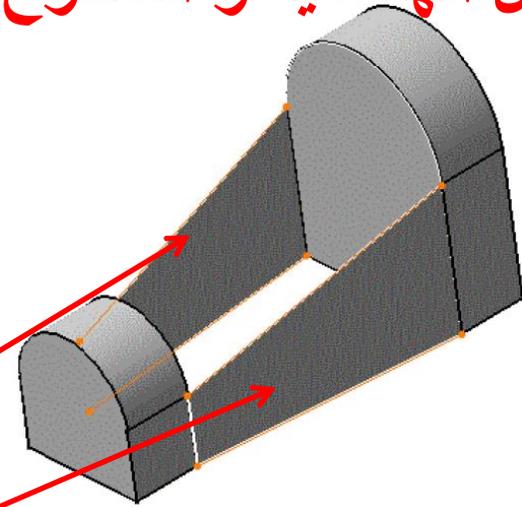
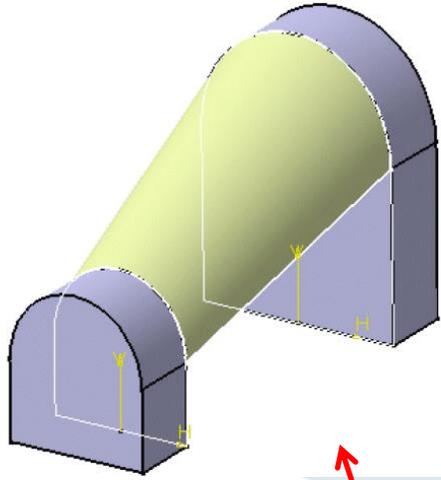


$$S_{\text{off}}(u, v) = S(u, v) + dN(u, v)$$

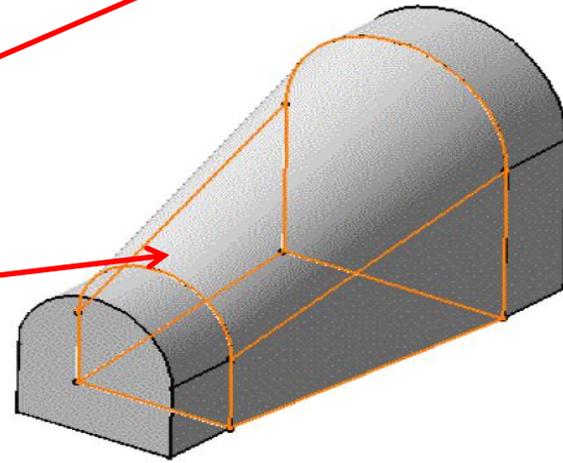


Offset Surfaces



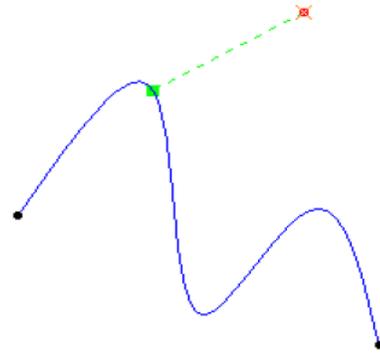


- Sweep.2
- Sweep.1
- Loft.2
- Join.1



Creating Wireframe Geometry

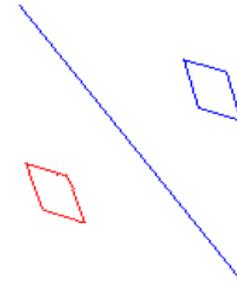
توليد الاشكال الهندسية بكافة أنواعها



Points



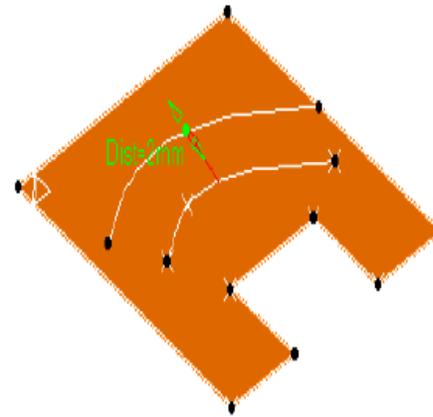
Lines



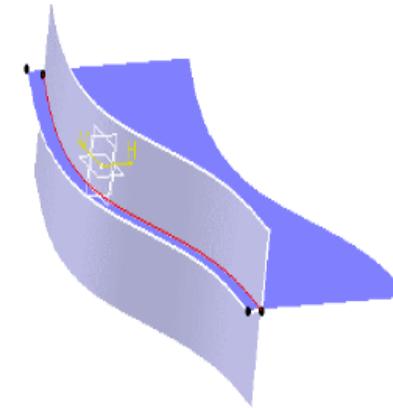
Planes



Splines

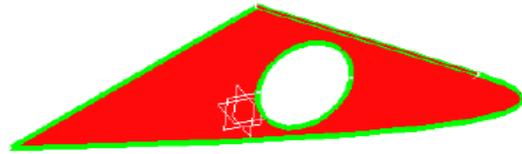


Parallel Curves

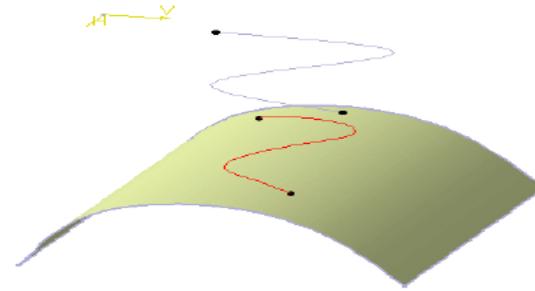


Intersections

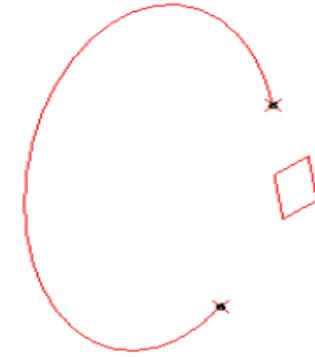




Boundary Curves



Projections



Circles

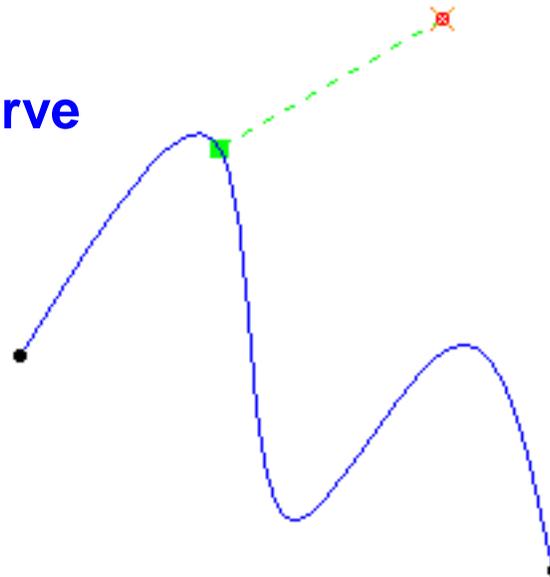


Corners



النقاط Points

- 1- by coordinates
- 2- on a curve
- 3- on a plane
- 4- on a surface
- 5- at a circle center
- 6- tangent points on a curve



Point Definition [?] [X]

Point type:

X =

Y =

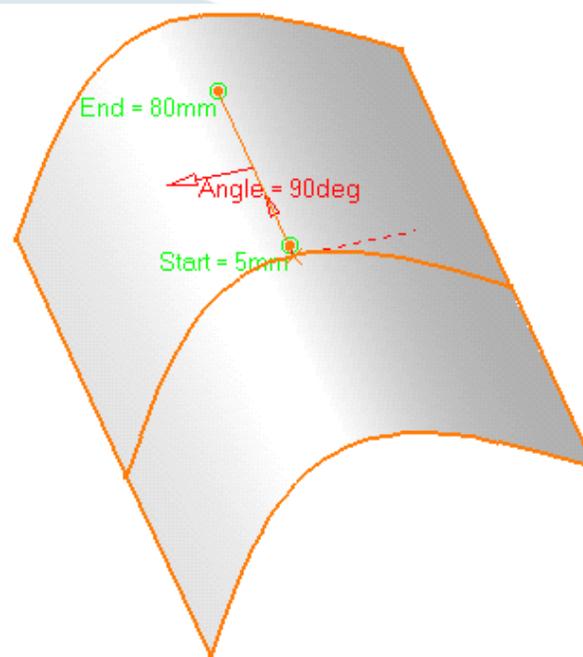
Z =



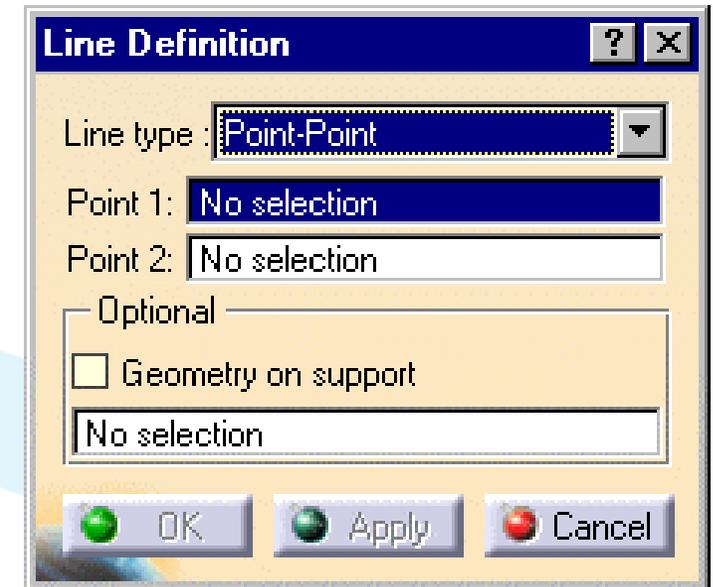


المستقيمات Lines

- 1- point to point
- 2- point and direction
- 3- angle or normal to curve
- 4- tangent to curve
- 5- normal to surface.

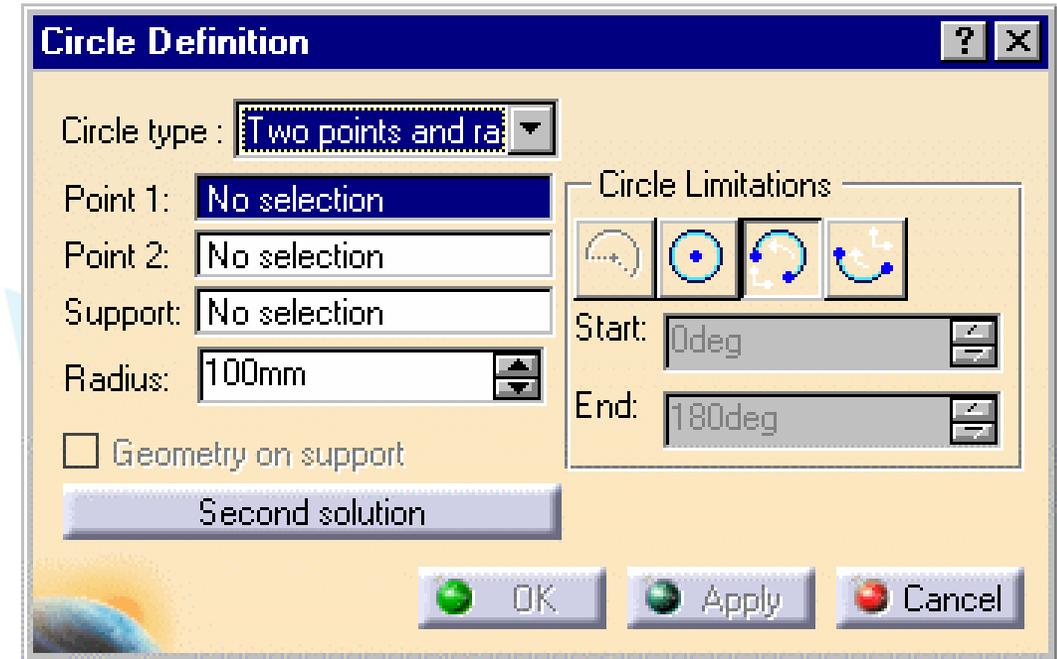
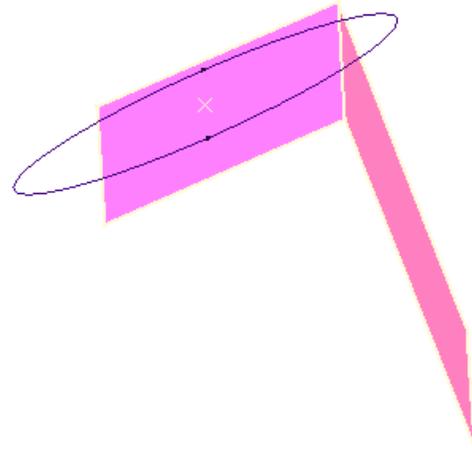


Angle or normal to curve



الدوائر Circles

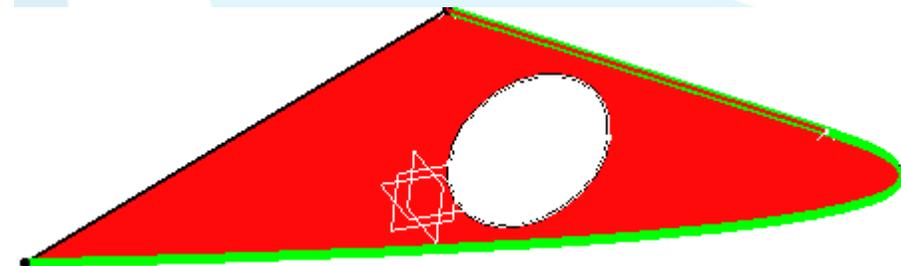
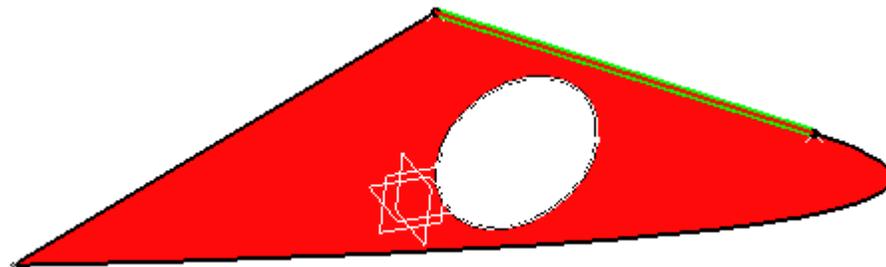
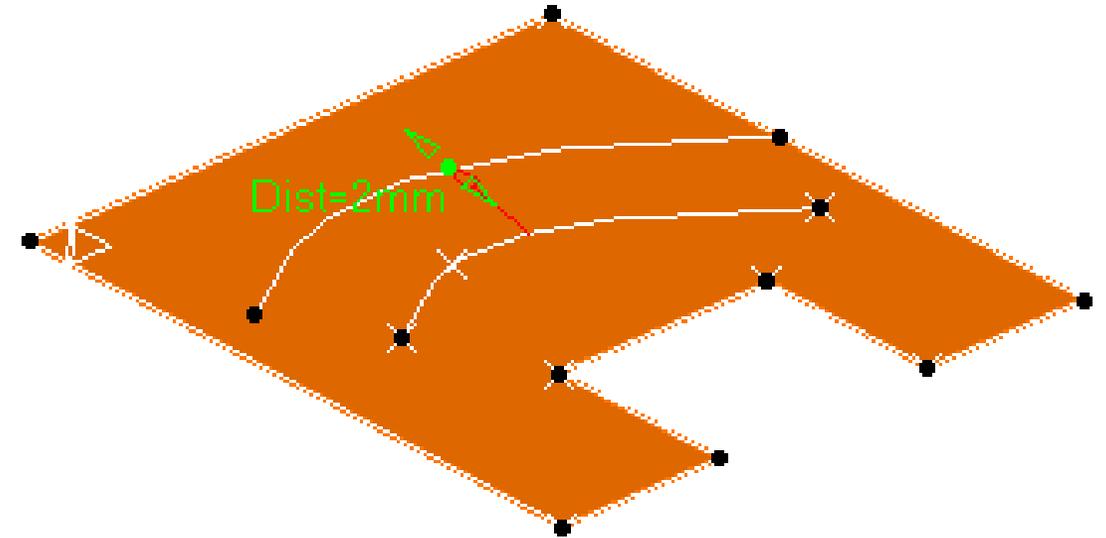
- 1- center and radius
- 2- center and point
- 3- two points and radius
- 4- three points
- 5- bitangent and radius
- 6- bitangent and point
- 7- tritangent

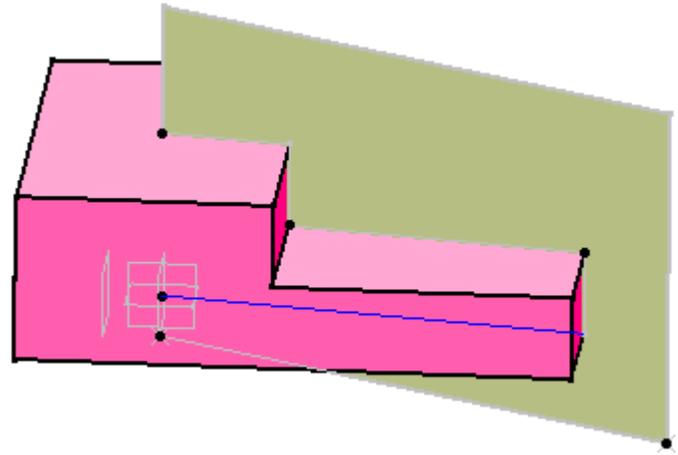
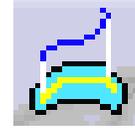




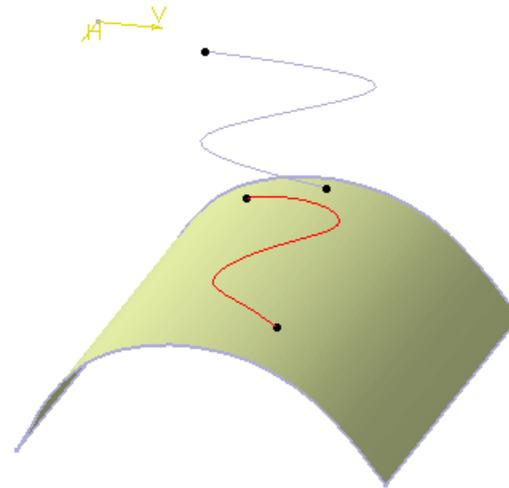
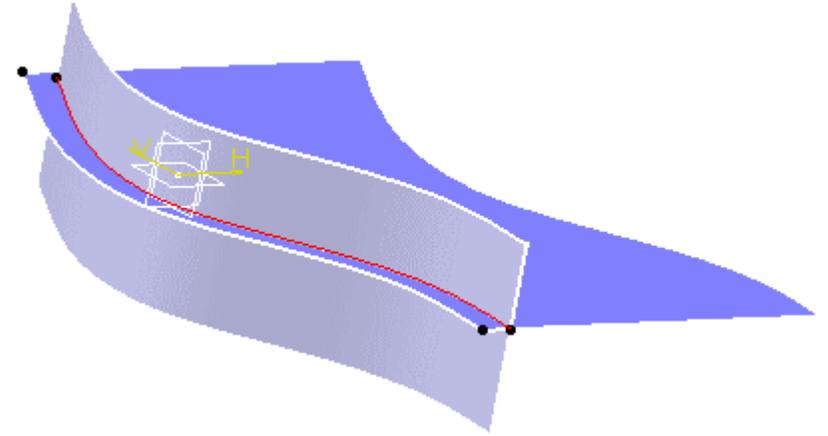
Parallel Curves

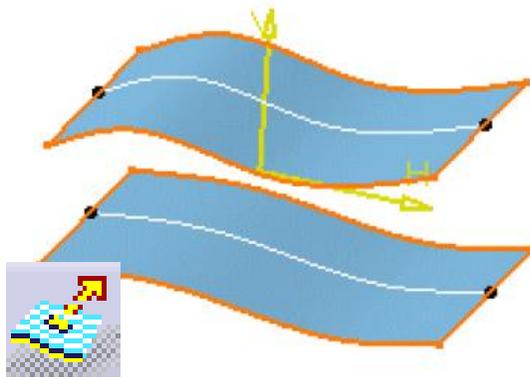
Boundary Curves



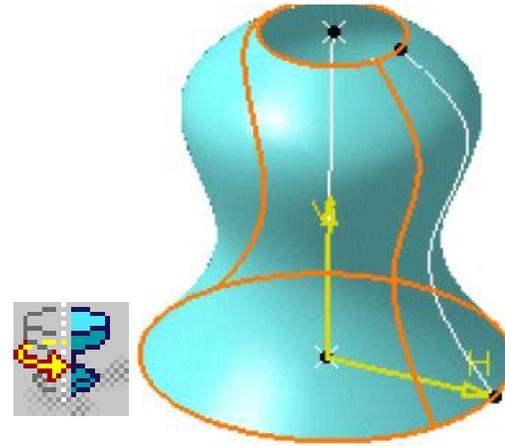


Projections
الإسقاطات

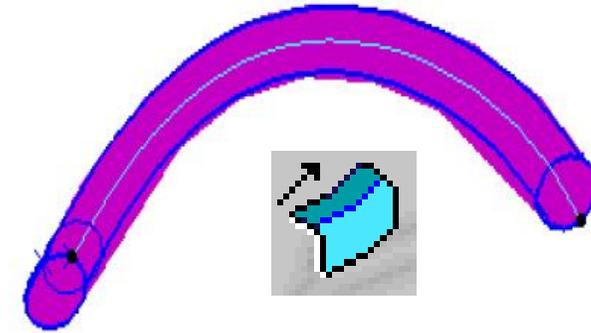




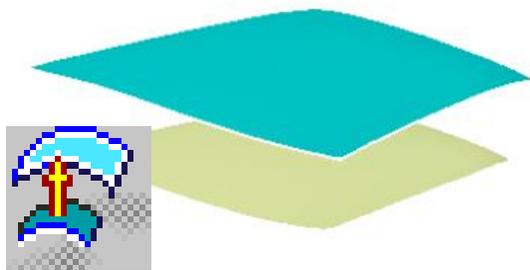
Extruded Surfaces



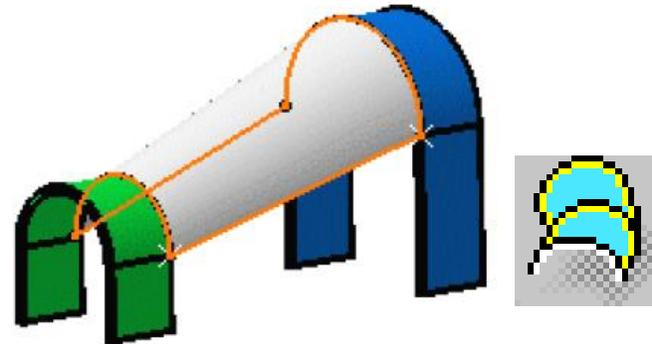
Surfaces of Revolution



Swept Surfaces



Offset Surfaces



Lofted Surfaces

