

# Déformation de la valve Aortique: première approche mécanique

Azzami, Cherigui, Frelat, Karouia & Lagrée

Université Paris VI

# But

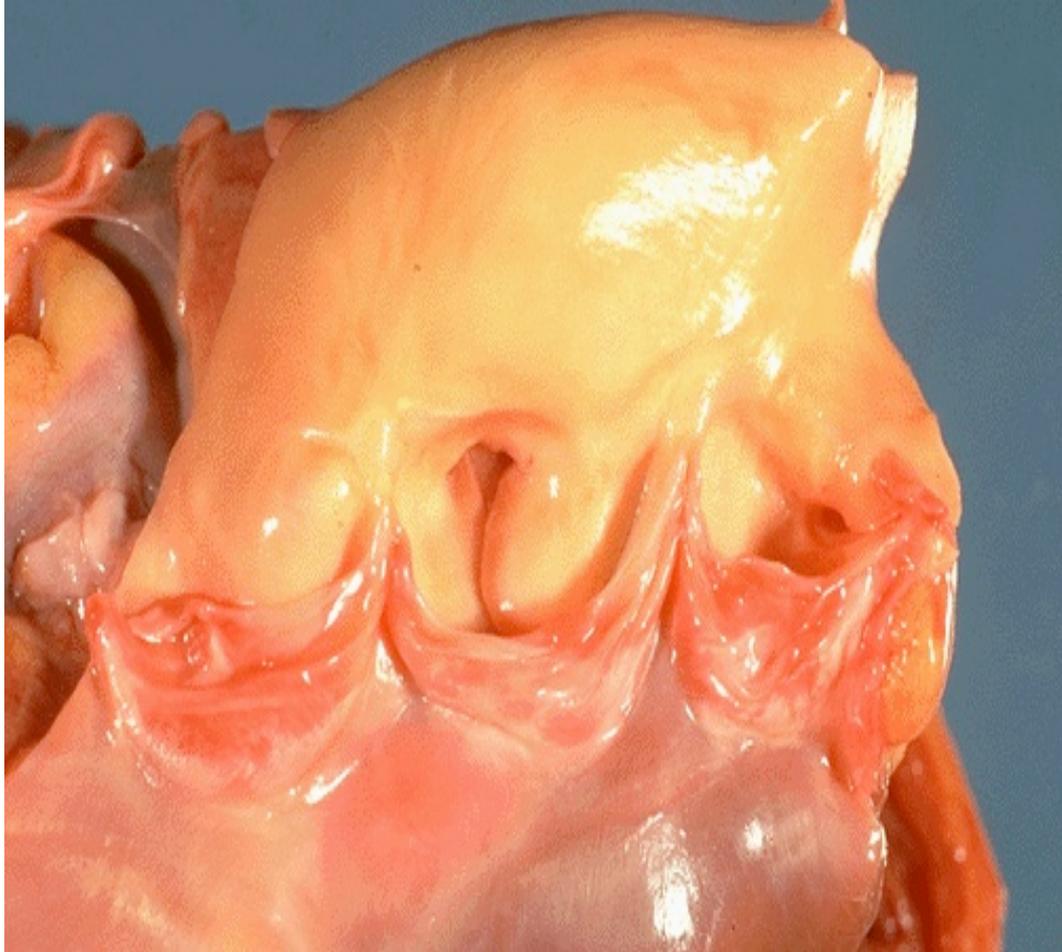
- Construire un modèle numérique.
- Évaluer la déformation de la valve, étudier les déplacements sous chargement.
- Modélisation de la valve sous 2 logiciels, de conception et de calcul.

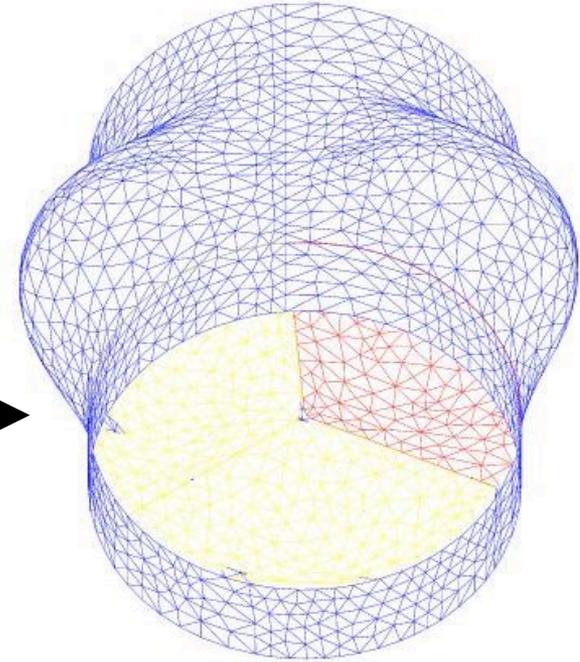
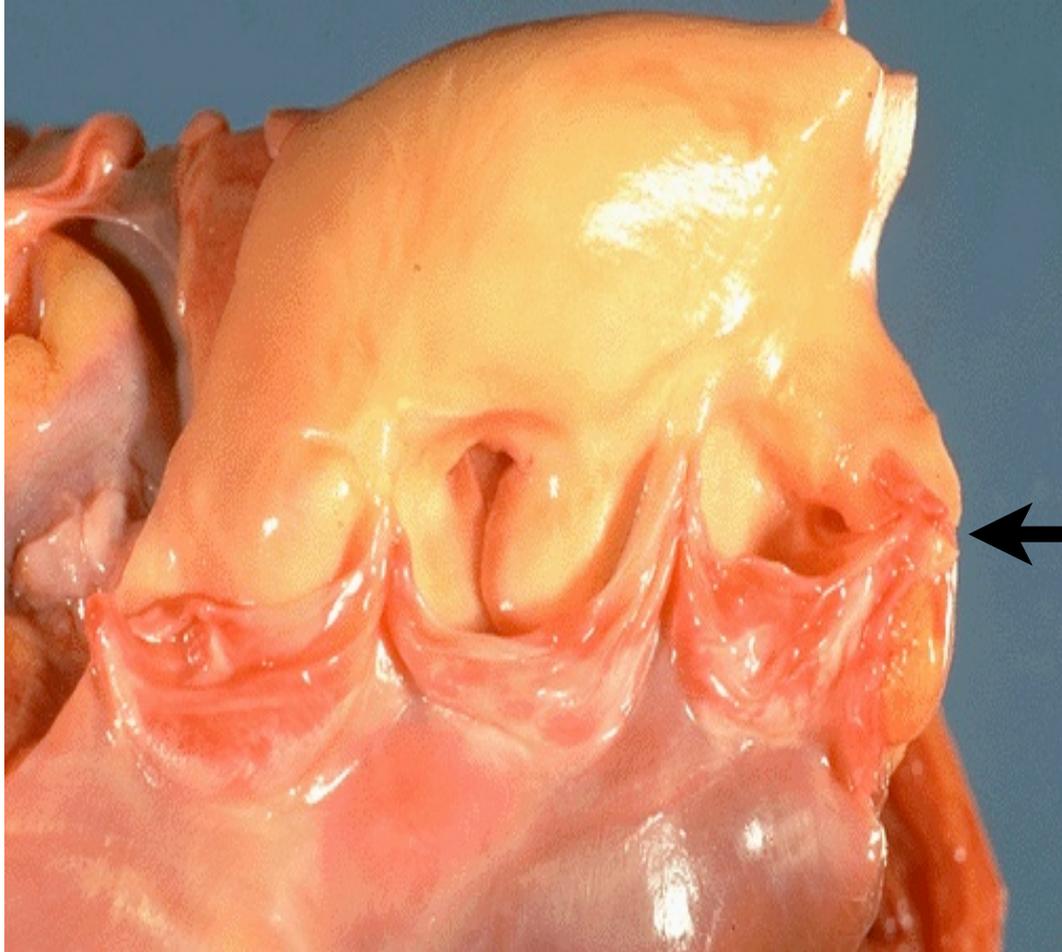
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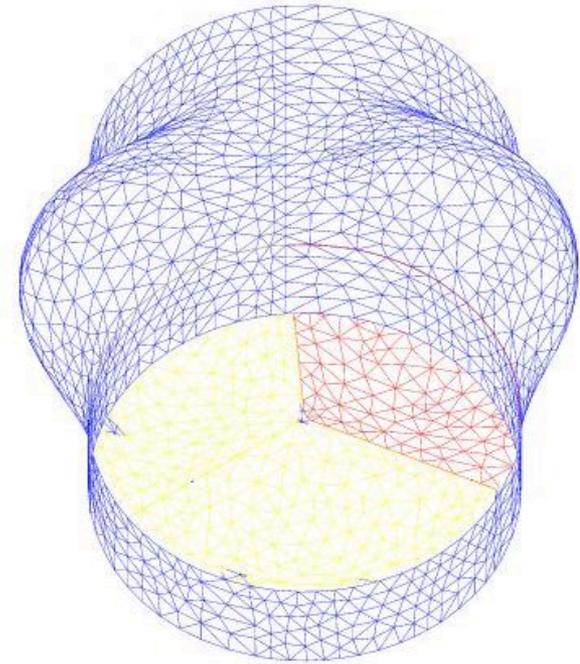
Castem 3M & Catia V5

**POUR L'INSTANT PAS DE FLUIDE!**

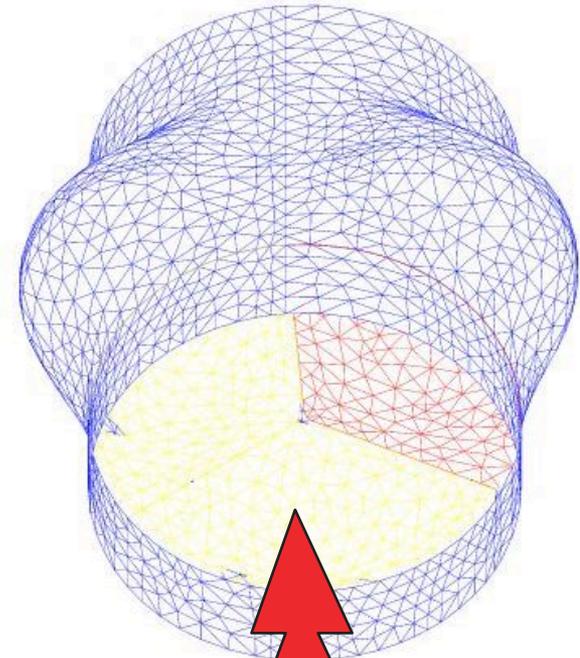




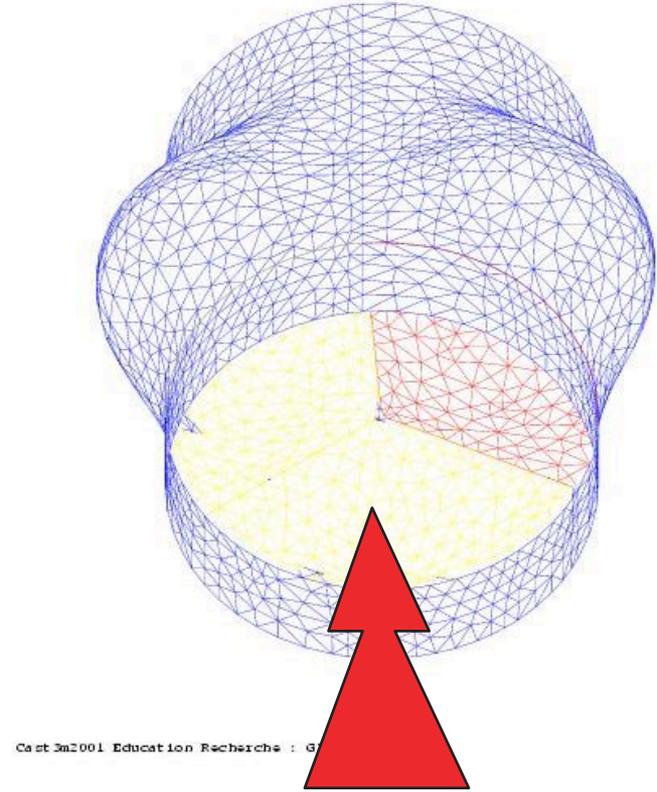
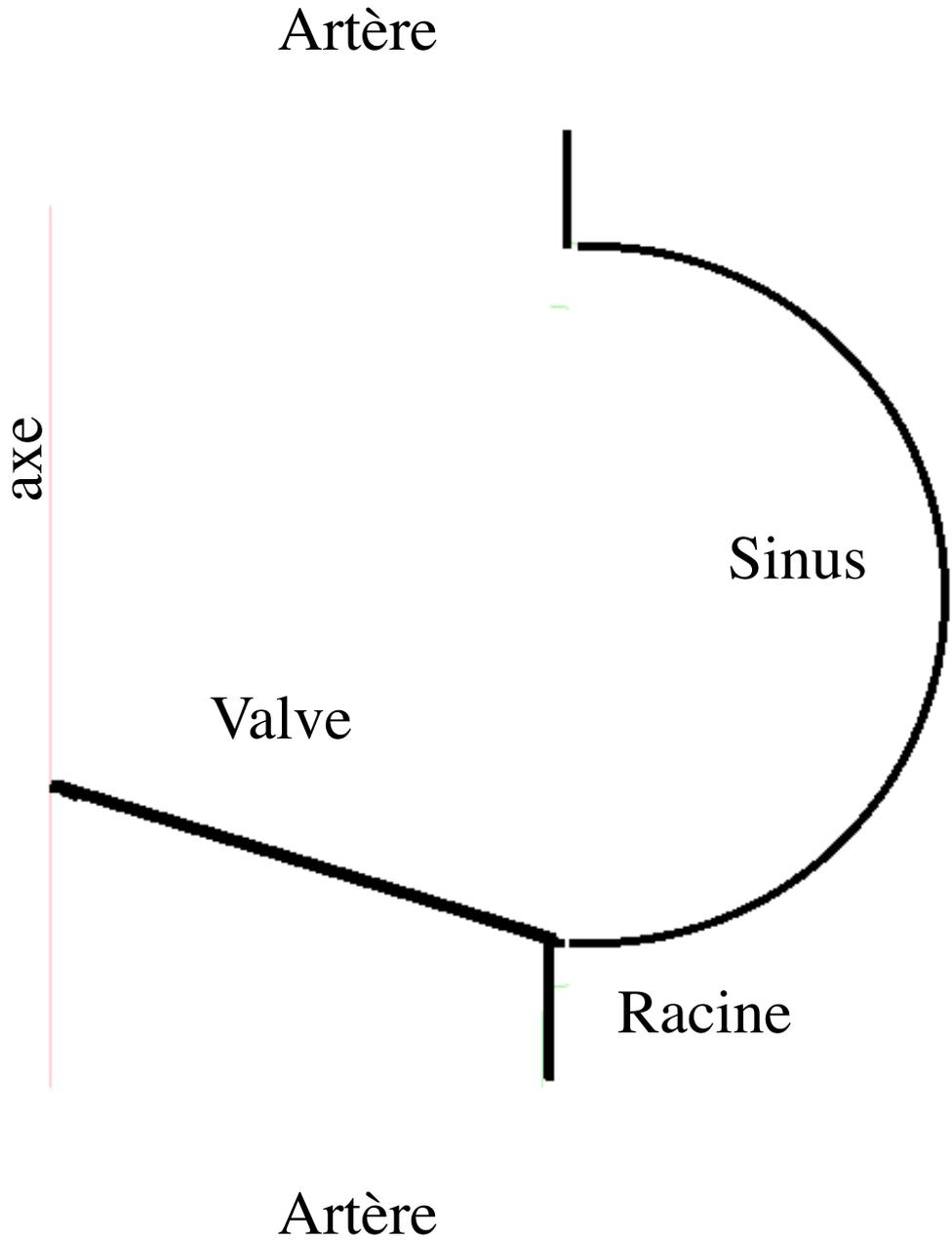
Cent 3m2001 Education Recherche : GIBI FBCIT



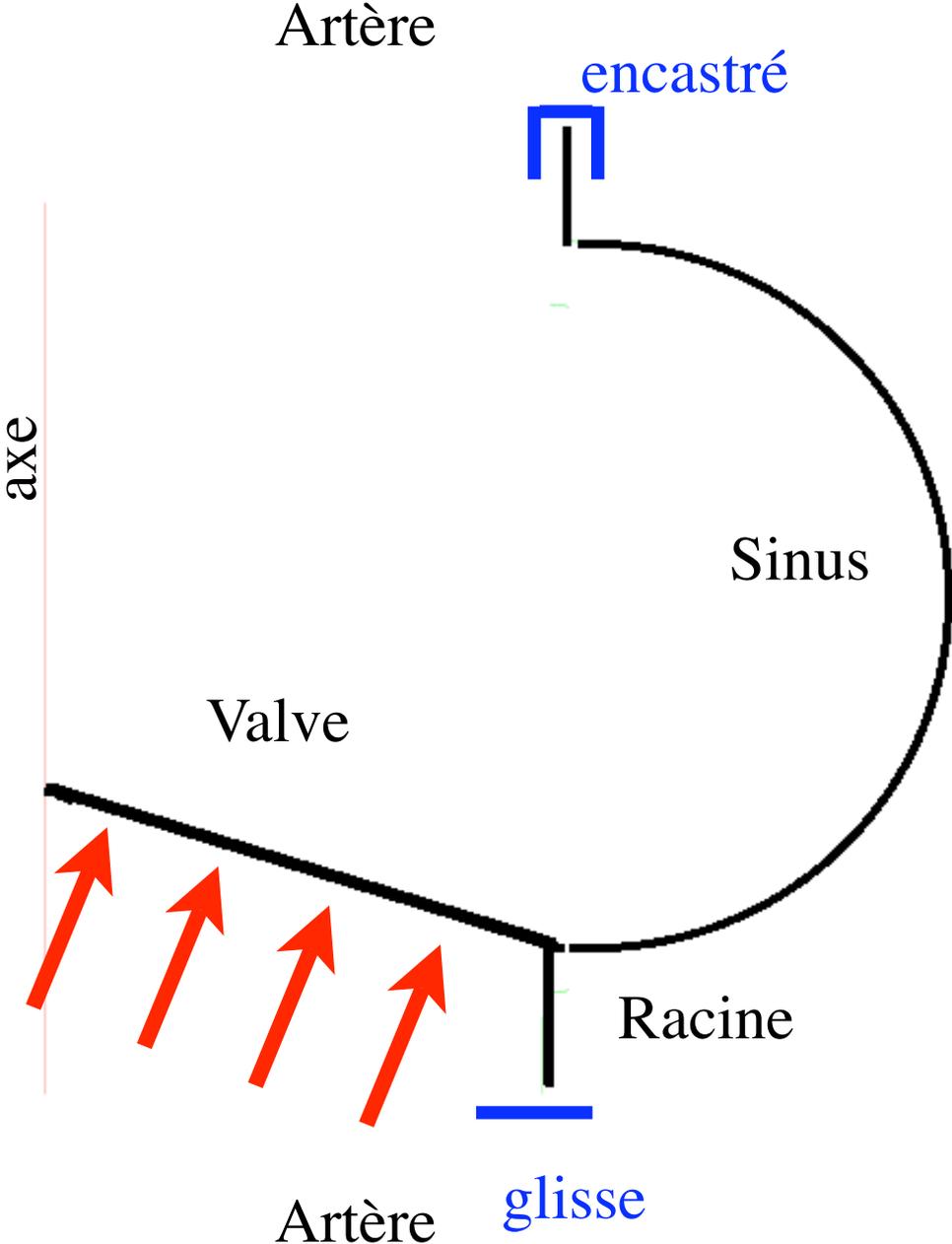
Cent 3n2001 Education Recherche : GIBI FBCIT



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# Propriétés Mécaniques

Propriété	Feuillet	Mur aortique
Épaisseur (mm)	0,500	1,000
Comportement	Isotrope	Isotrope
M. Young (MPa)	0,900	6,000
Coef de Poisson	0,450	0,450

# Propriétés Mécaniques

Propriété	Valve aortique	Racine aortique
Ecir (KPa)	200,000	334,000
Erad (KPa)	200,000	-
Elong (KPa)	-	350,000
Nu	0,450	0,450

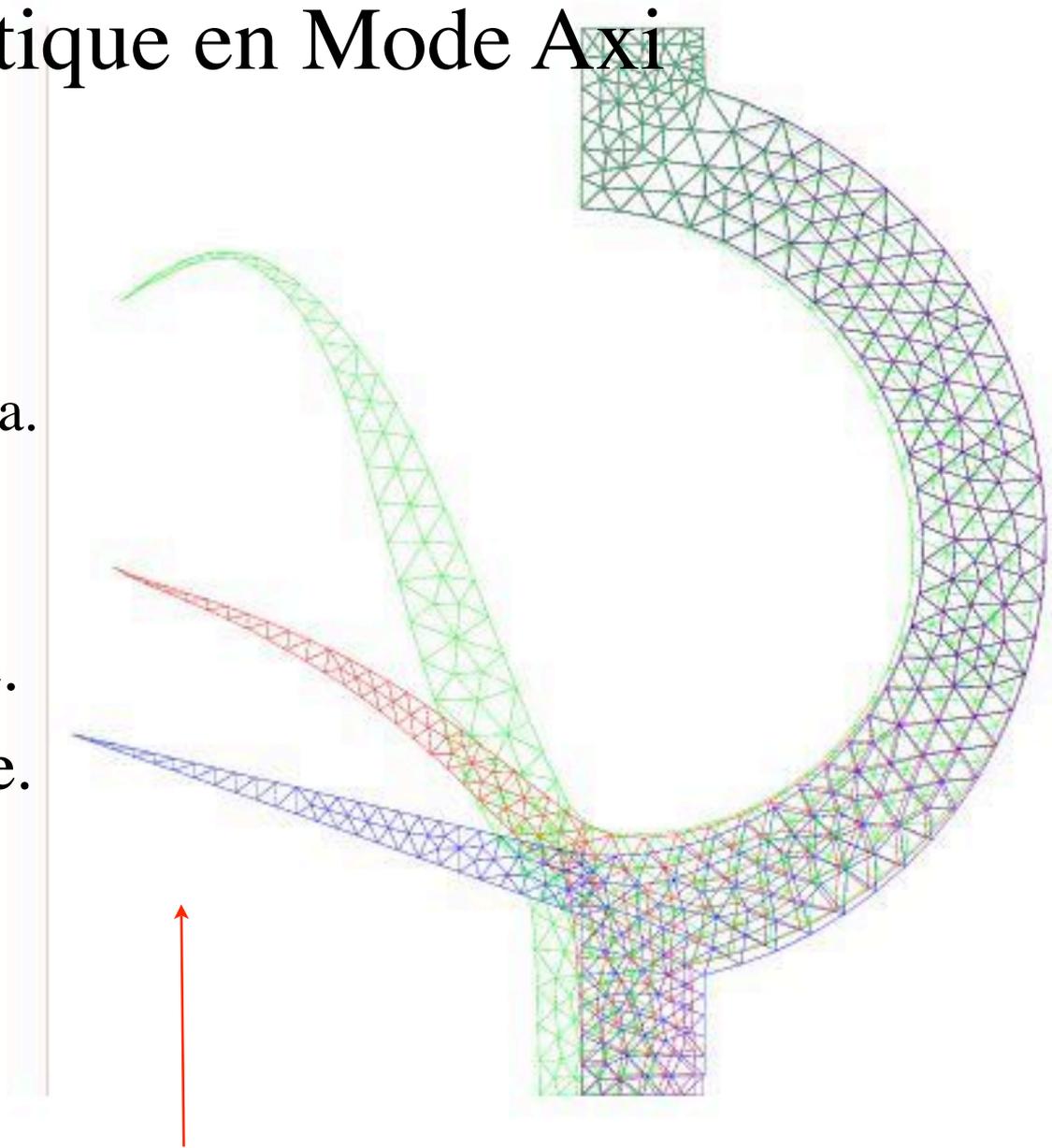
# Calcul sous Castem

Imposition d'un chargement (pression) et on fait varier:

- Les formes géométriques des sinus aortiques:  
Forme circulaire et forme exponentielle.
- Les propriétés mécaniques.
- Les modèles: Solide et Coque en mode:
  - Plan (éléments linéaires quadratiques) et
  - Axisymétrique.

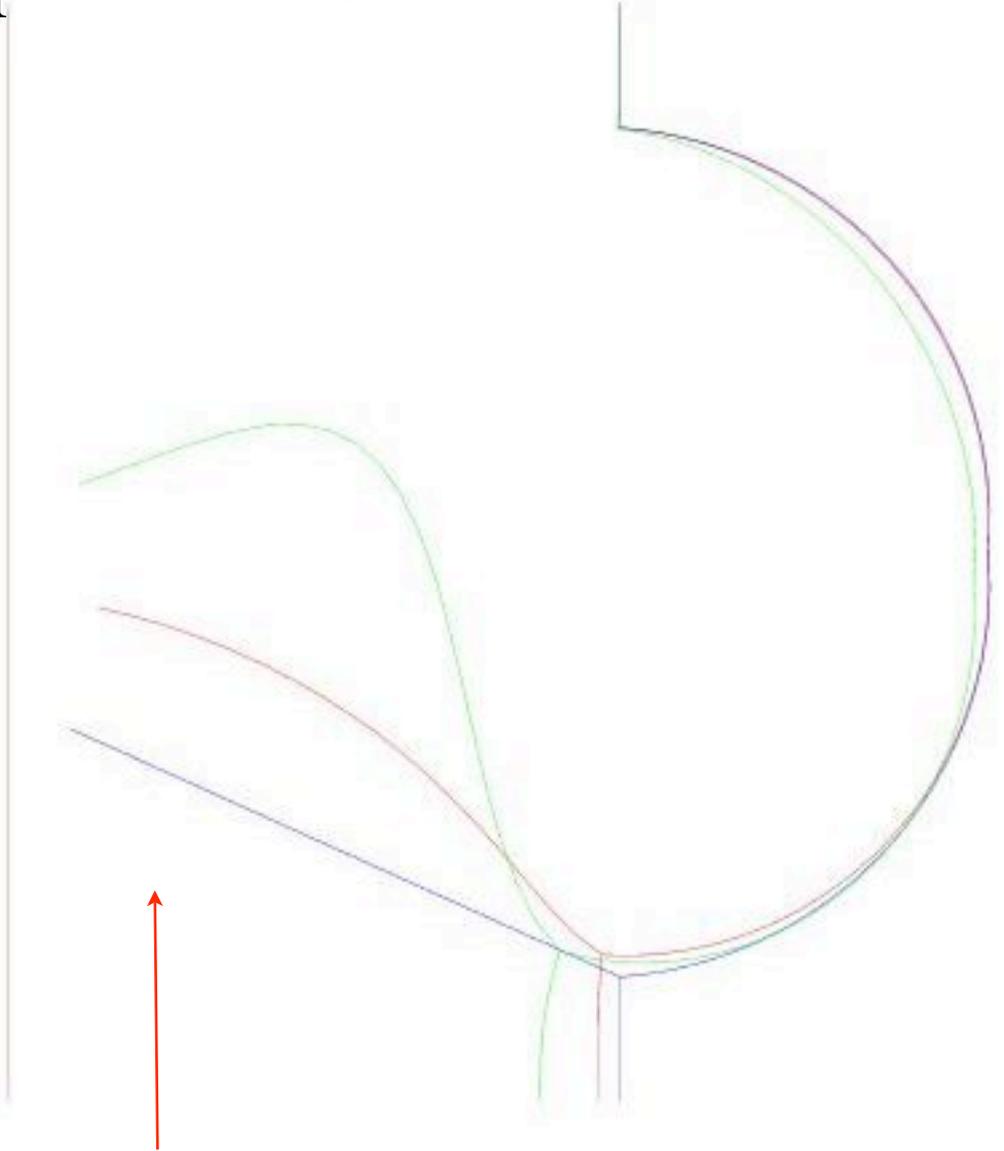
# Modèle élastique en Mode Axi

- 2 matériaux utilisés:
- $E1= 0,9\text{MPa}$ ,  $E2=0,2\text{MPa}$ .
- $\nu= 0,45$  et  $\Delta P= 10500\text{Pa}$   
(79mmHg).
- En bleu: valve fermée.
- En rouge: non-linéaire.
- En vert: linéaire.



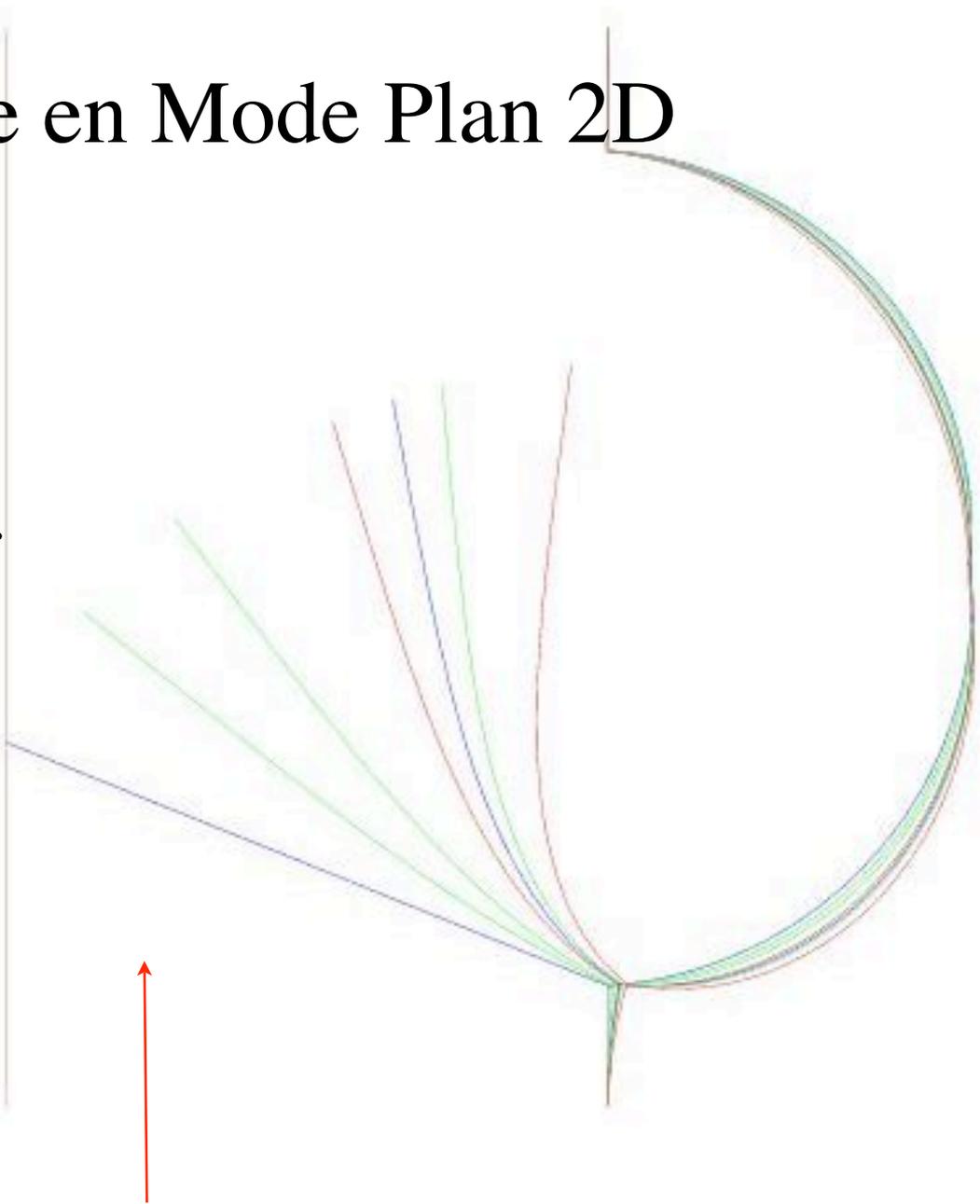
# Modèle Coque en Mode Axi

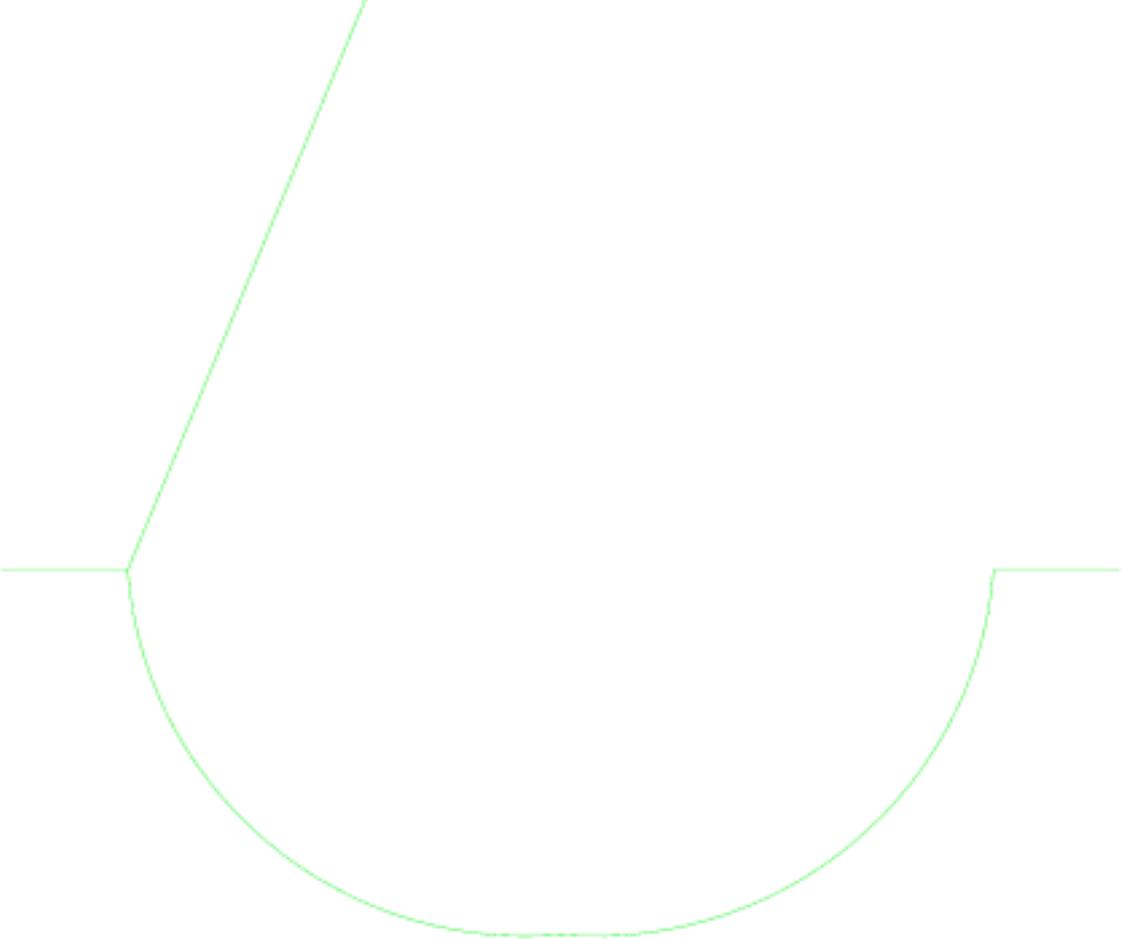
- $E = 0,9\text{MPa}$ .
- $e=0,5\text{mm}$  pour les feuillets.
- $\nu = 0,45$  et  $\Delta P = 10500\text{Pa}$ .  
(79mmHg).
- En bleu: valve fermée.
- En rouge: non-linéaire.
- En vert: linéaire.



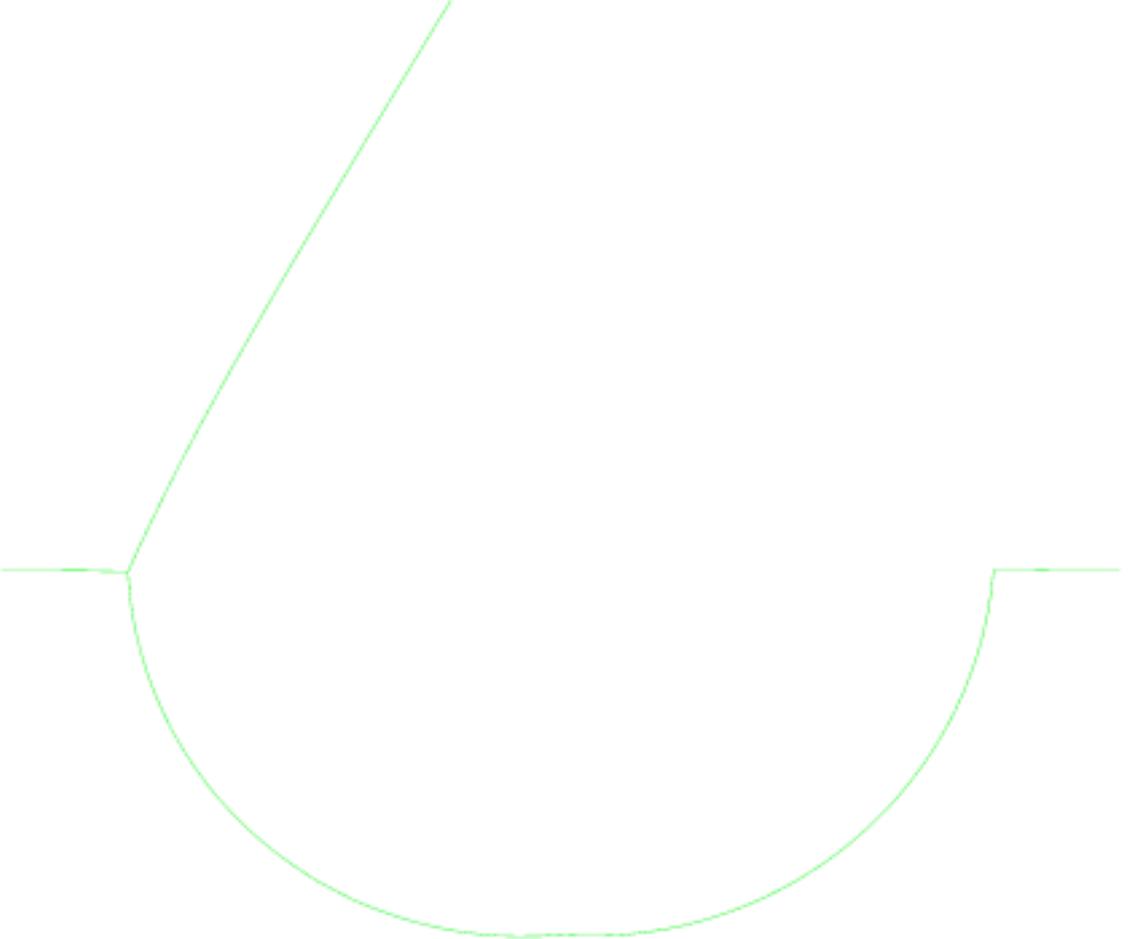
# Modèle Coque en Mode Plan 2D

- Forme géométrique des sinus aortique: circulaire.
- 2 matériaux utilisés:  
 $E1=0,9\text{MPa}$  et  $E2=0,2\text{MPa}$ .
- $\nu=0,45$ .
- $t = 0:0.05:1$ .



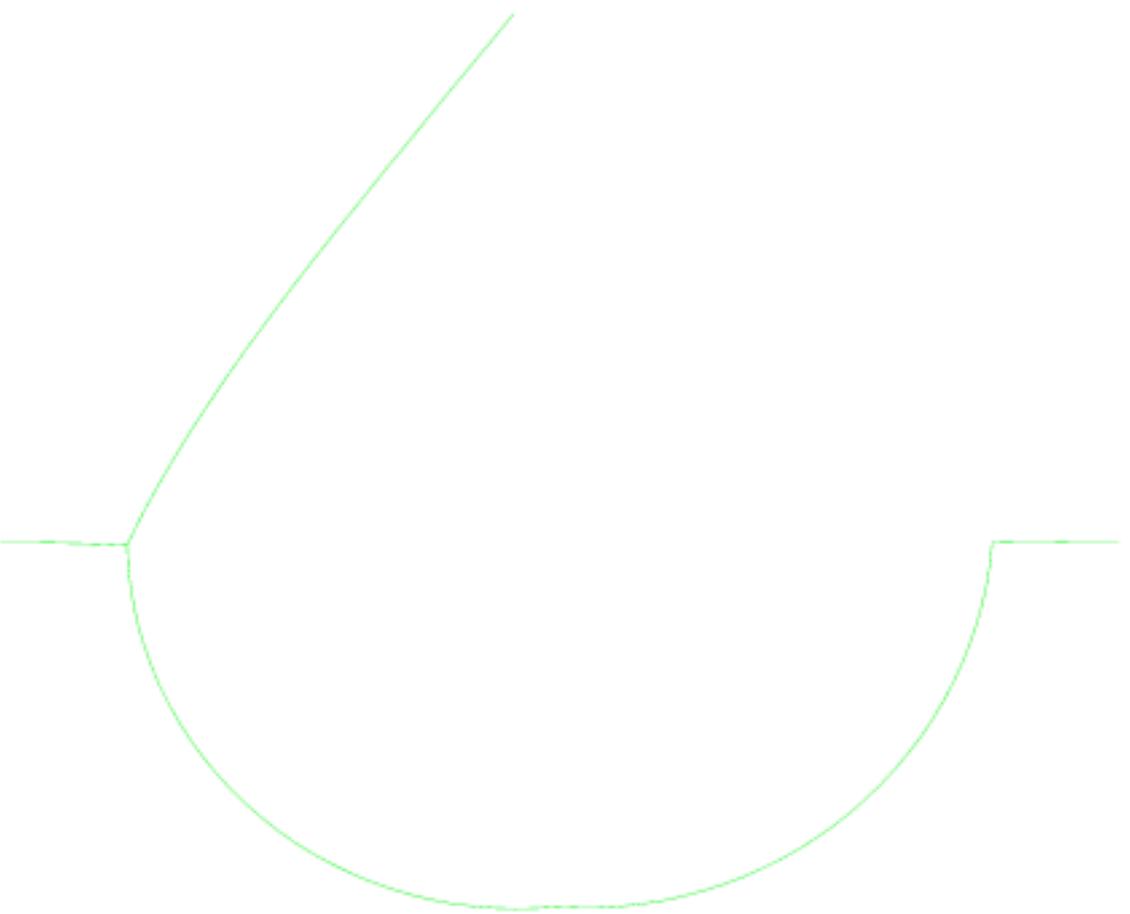


Education Recherche : maillage de la sphere

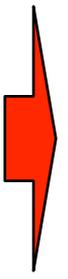


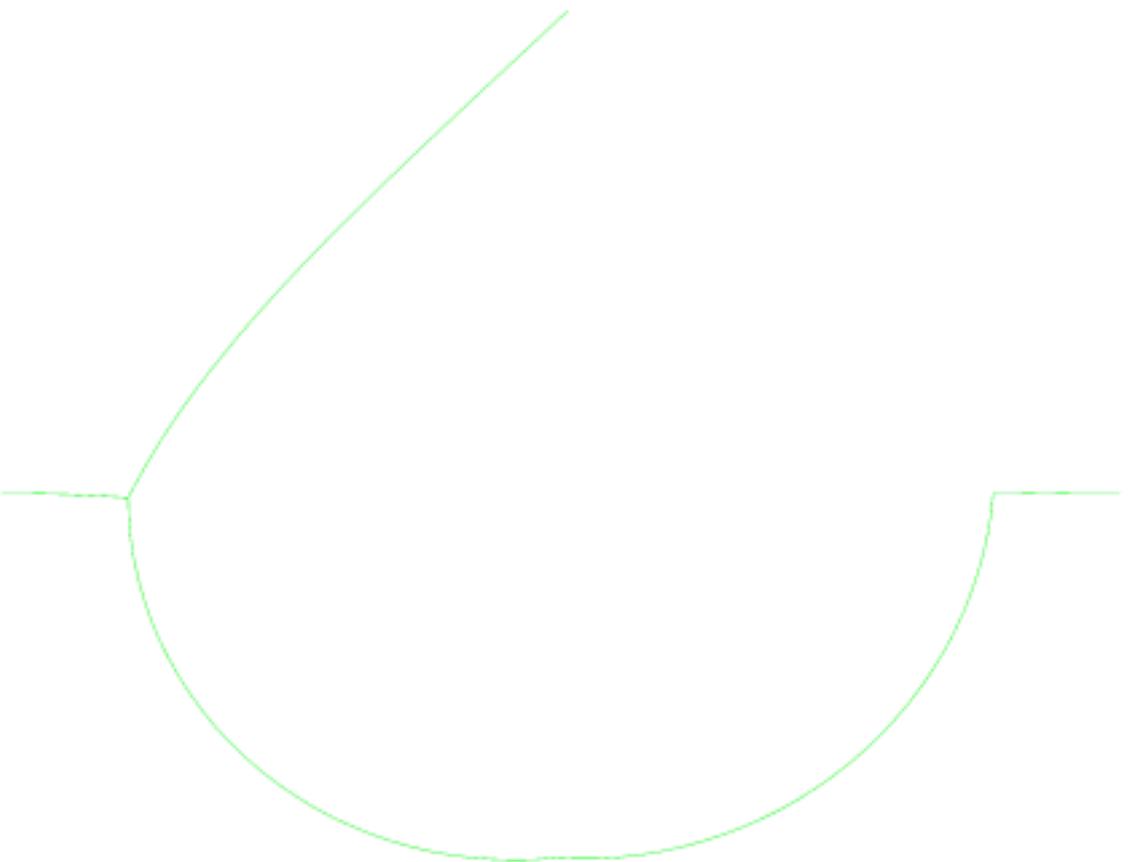
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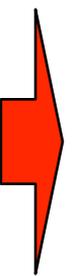


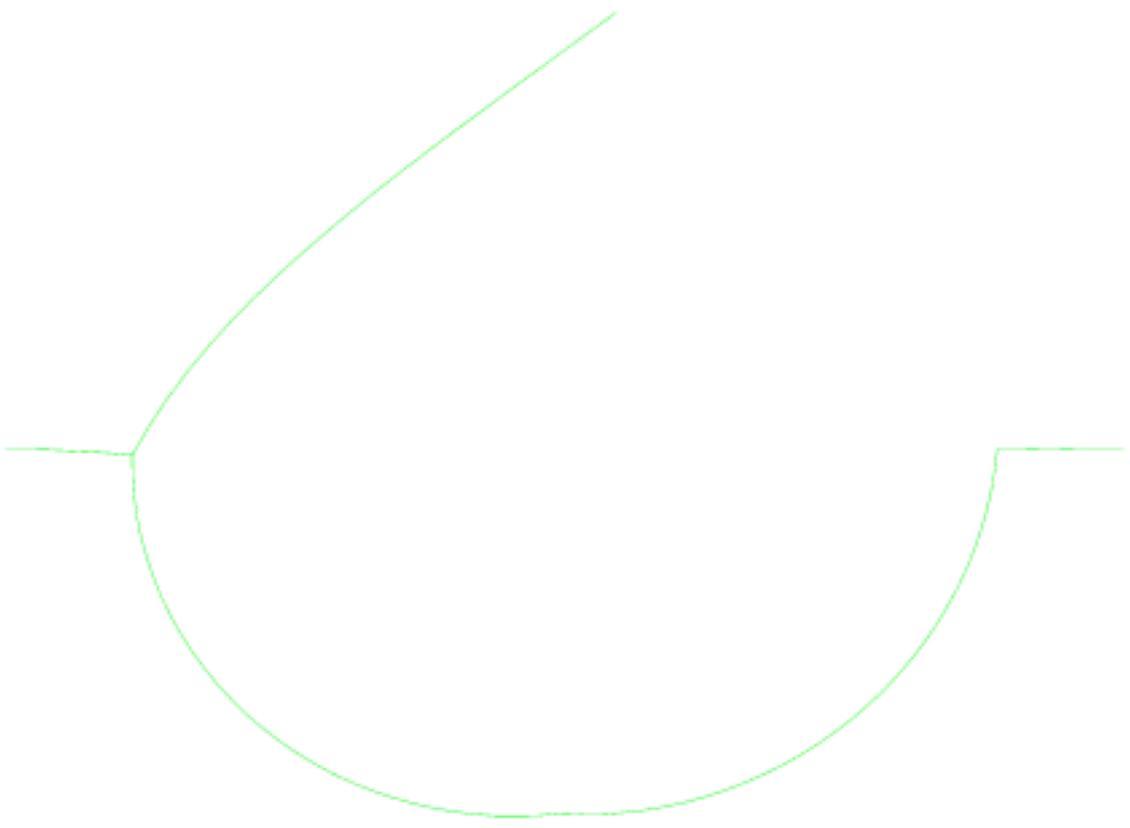
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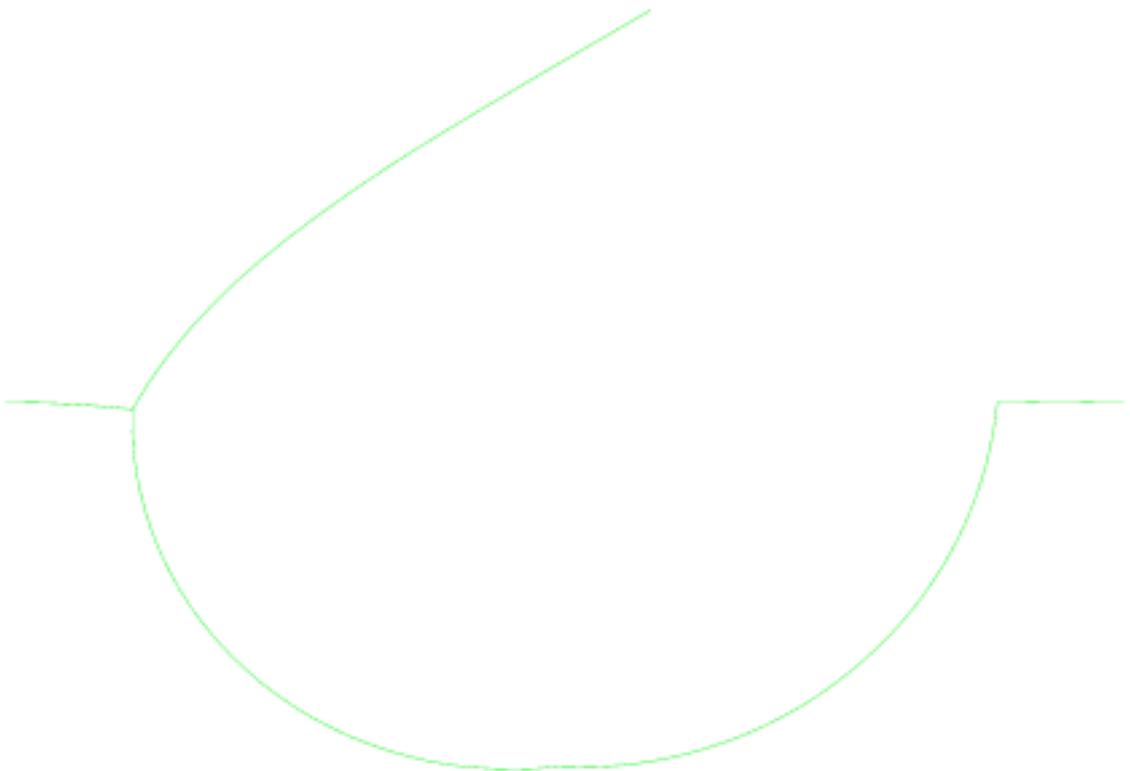
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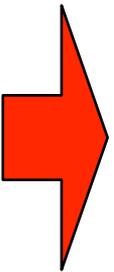


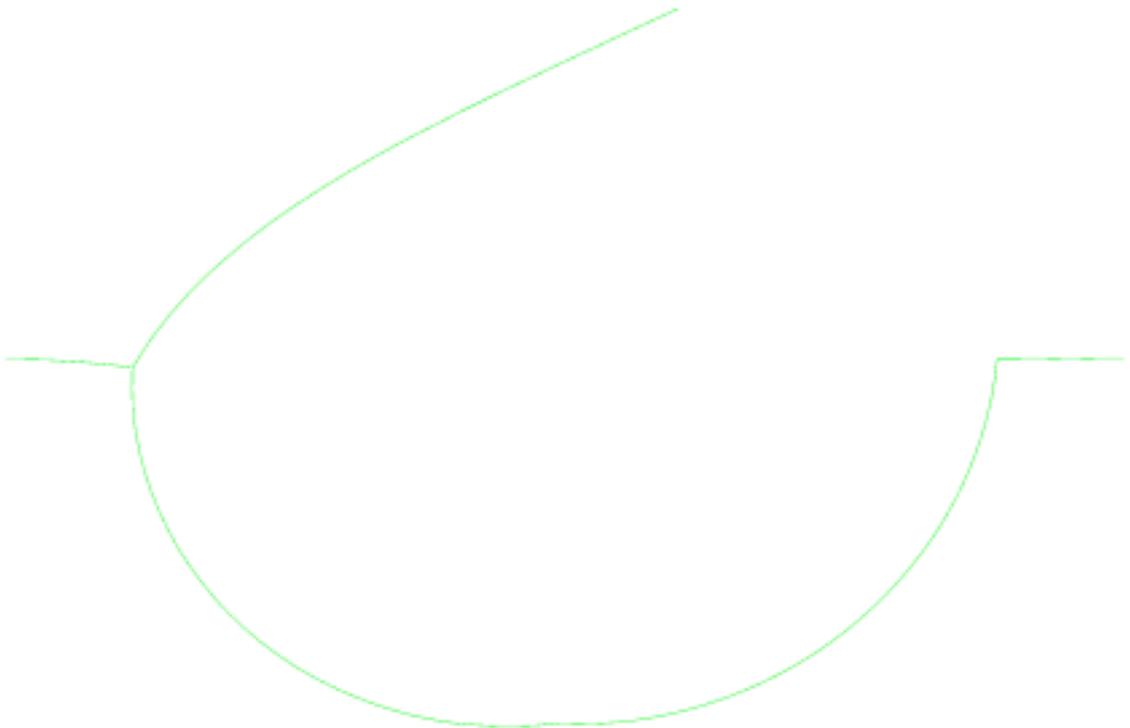
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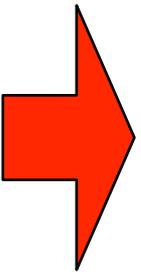


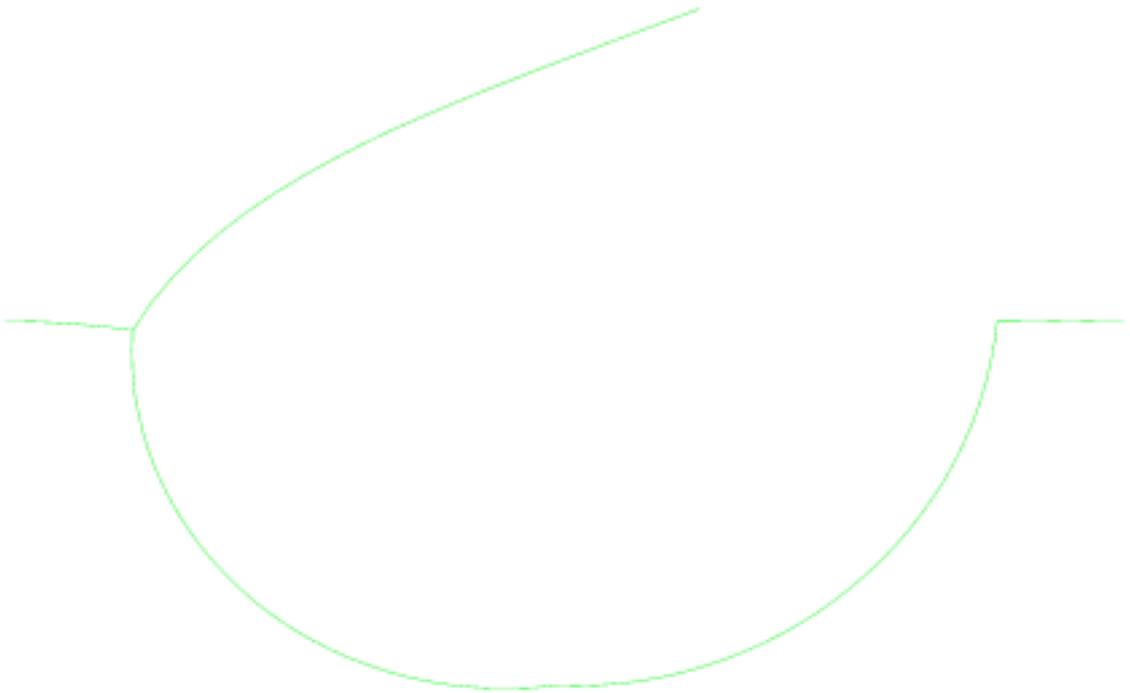
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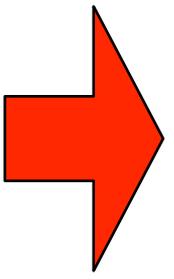


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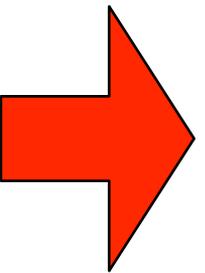


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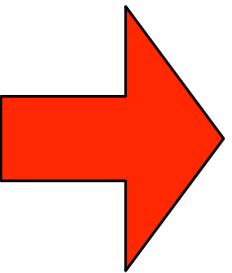


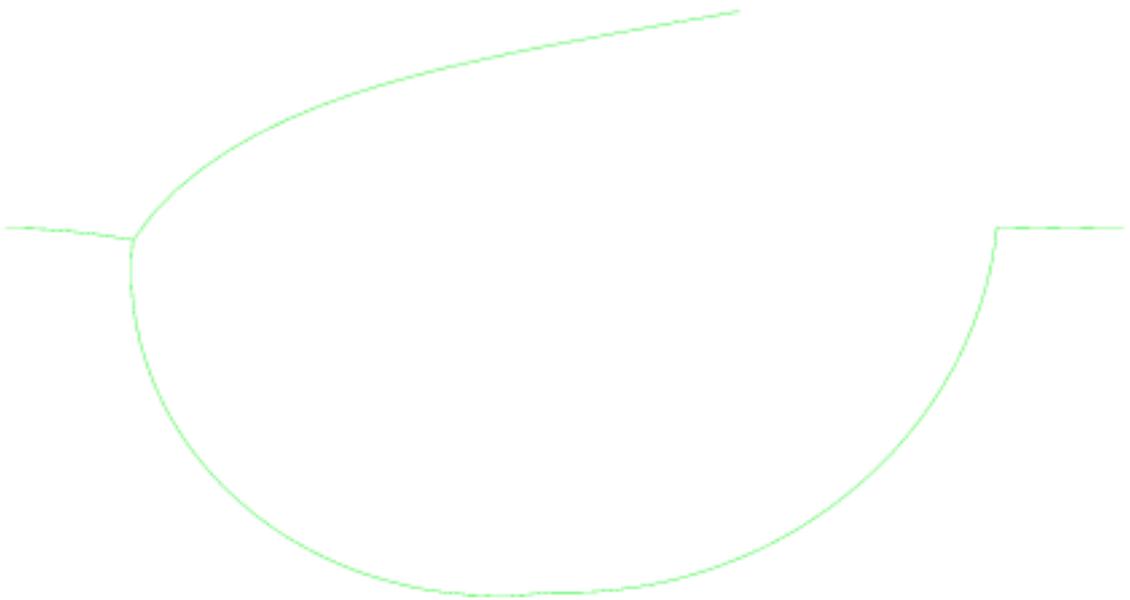
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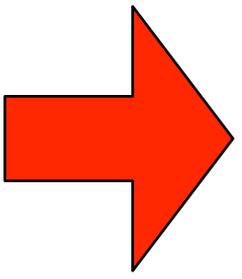


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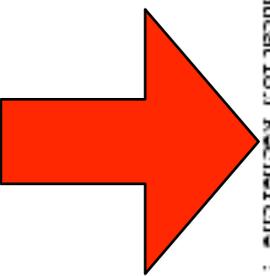
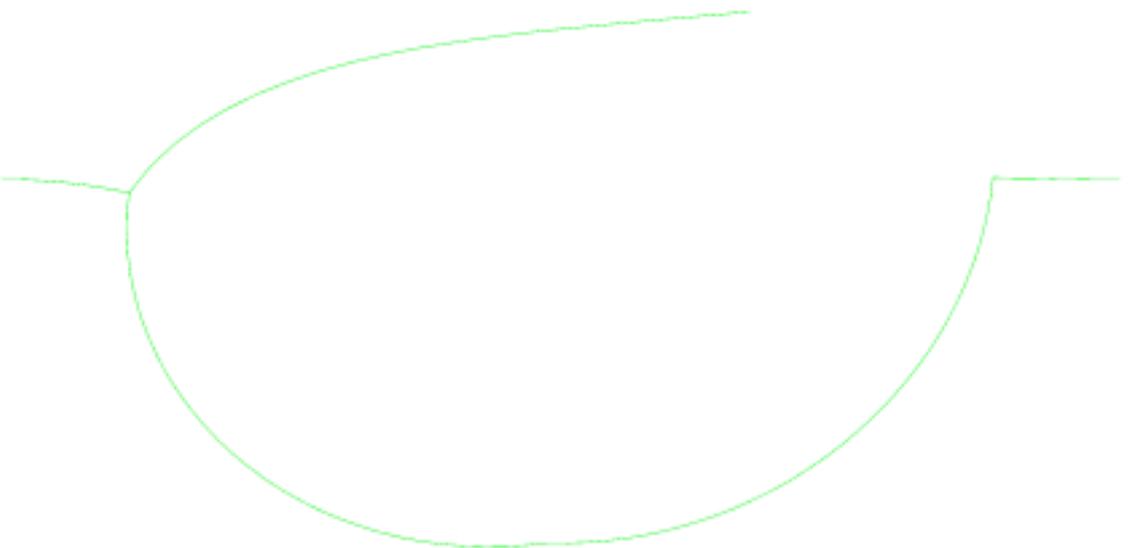


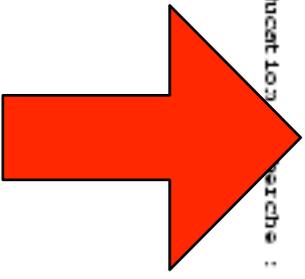
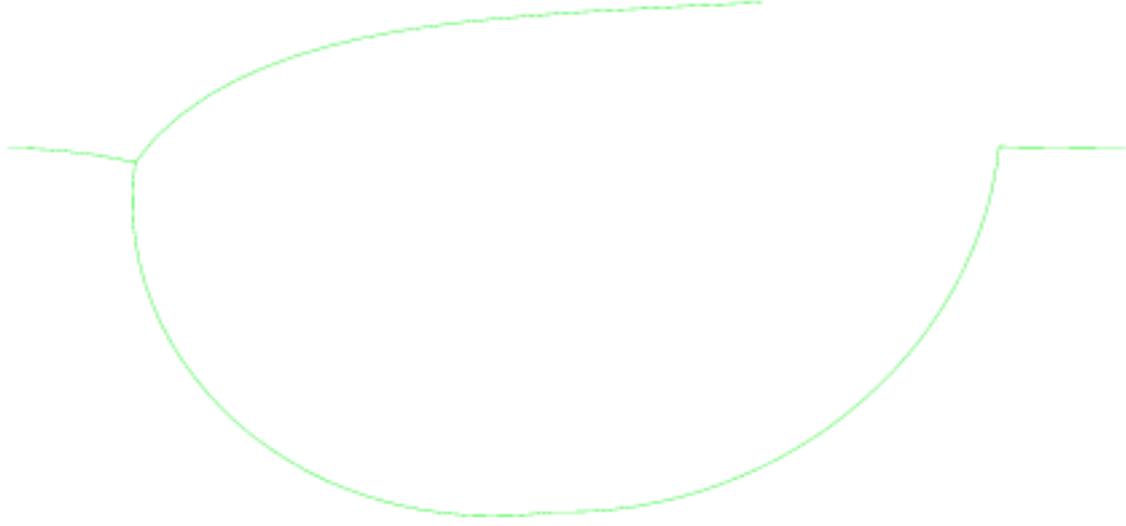


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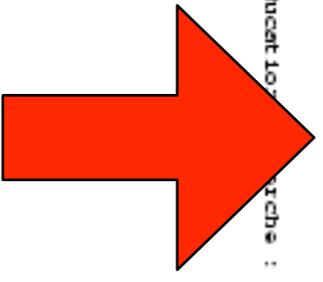
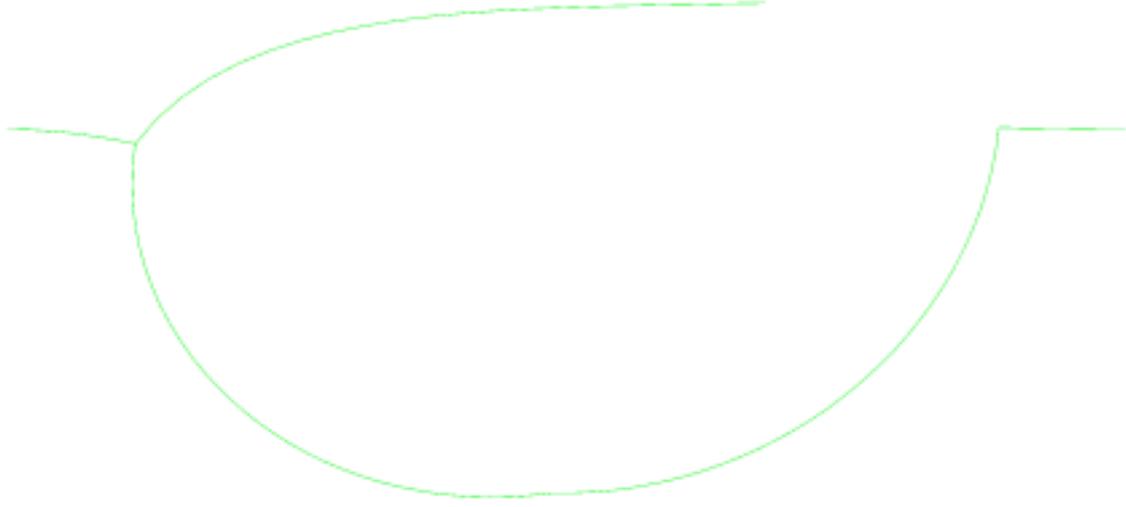


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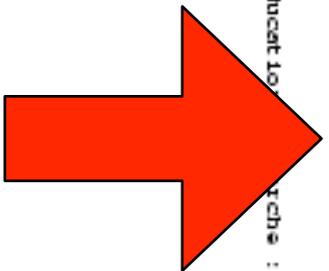
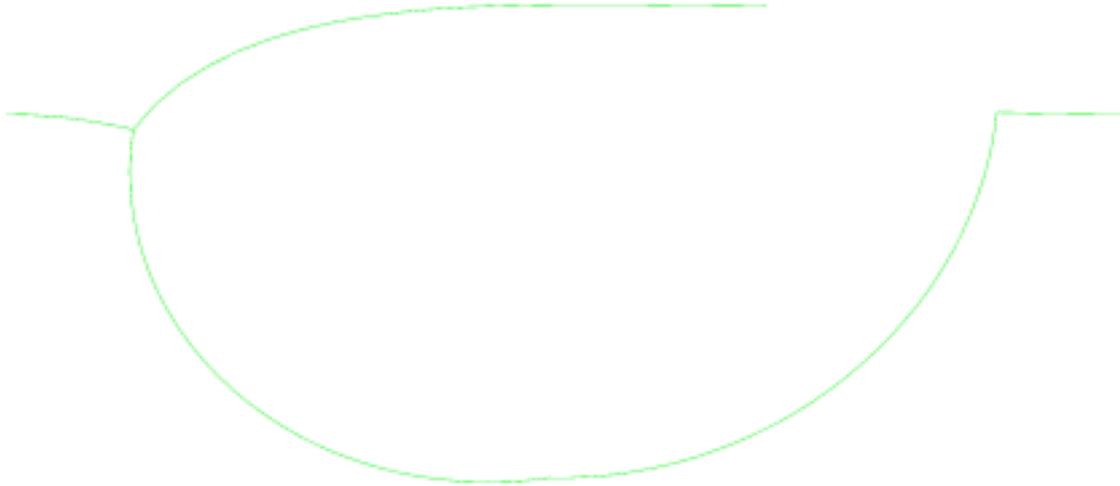




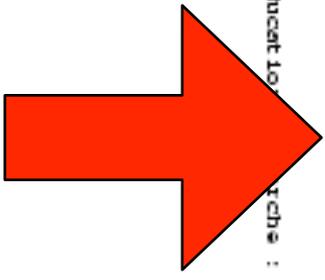
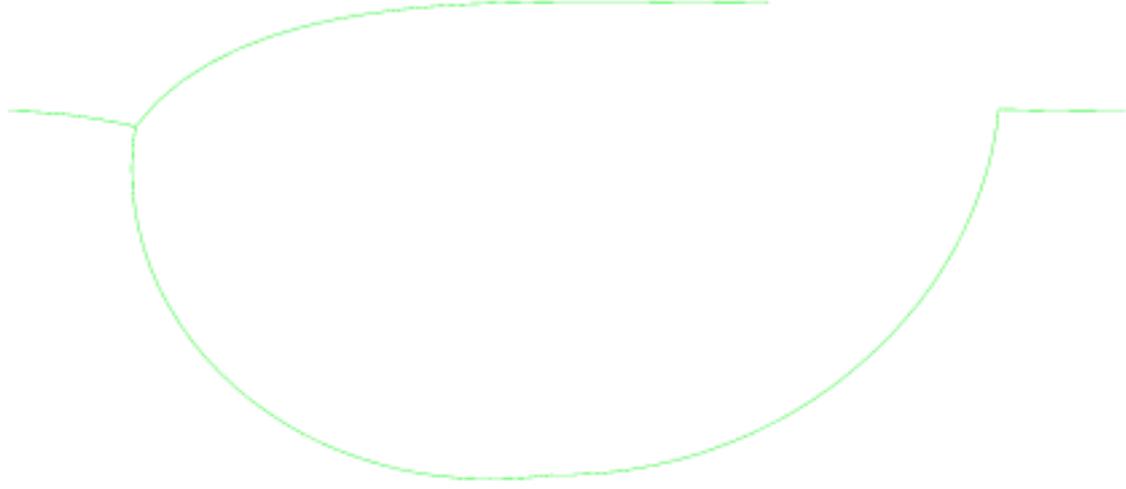
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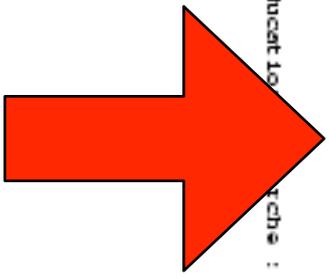
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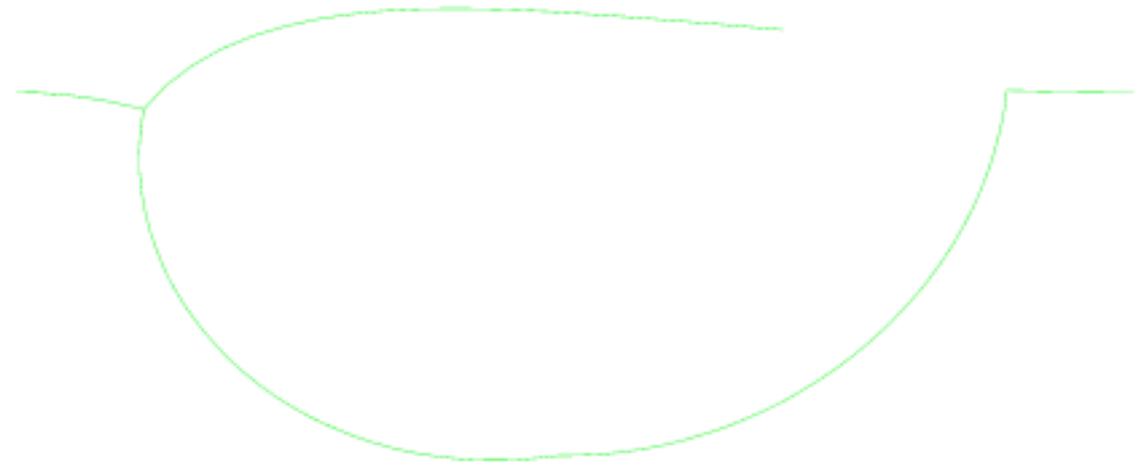
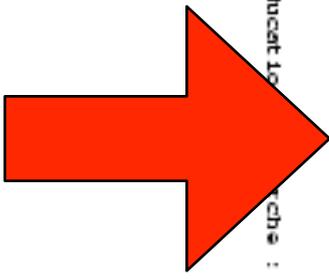


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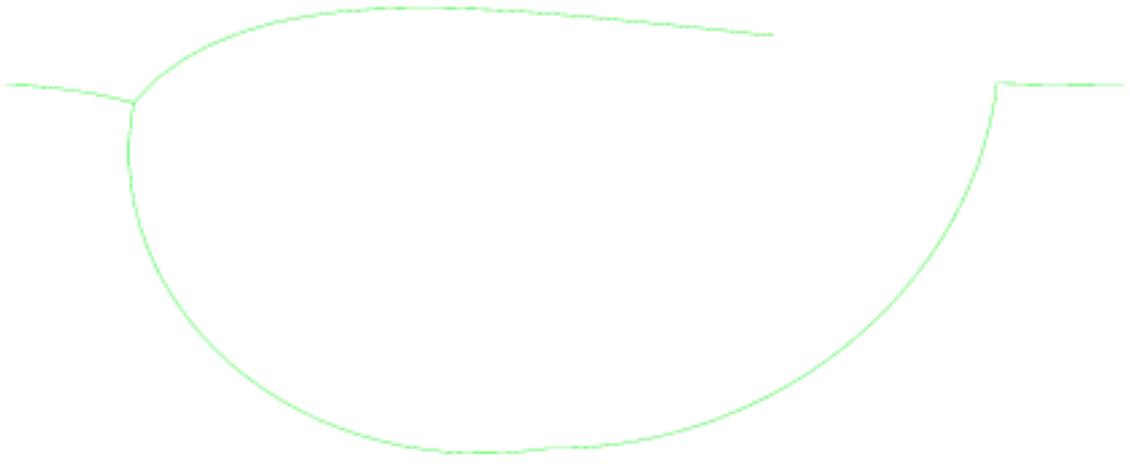
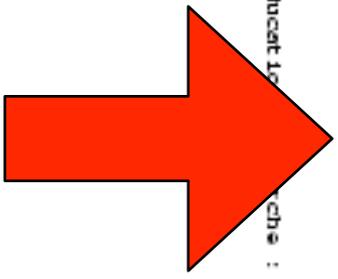


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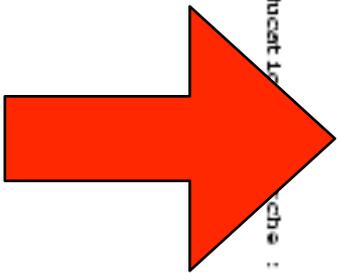


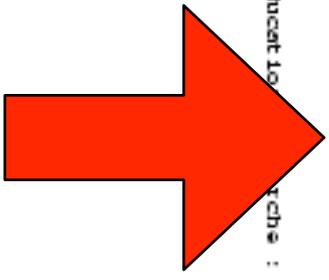


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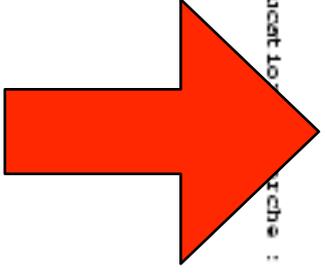
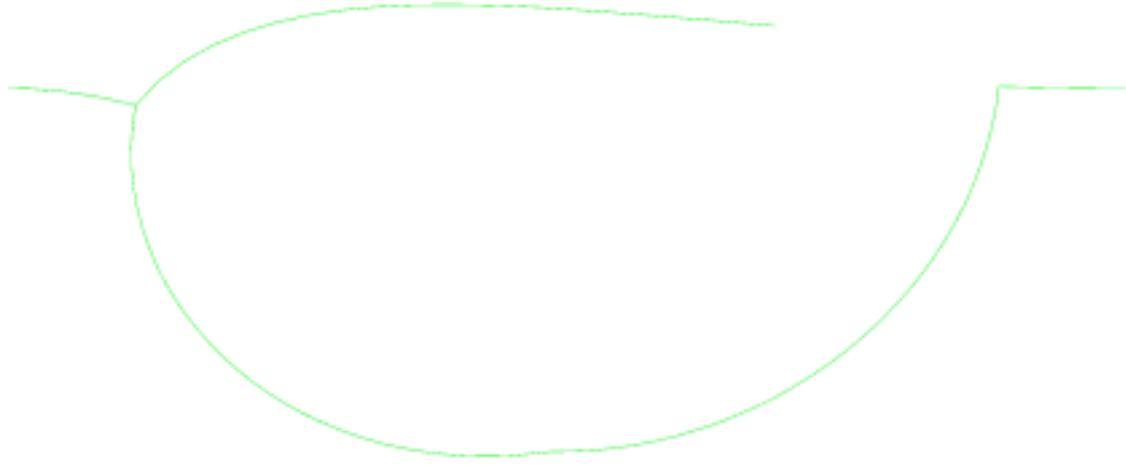


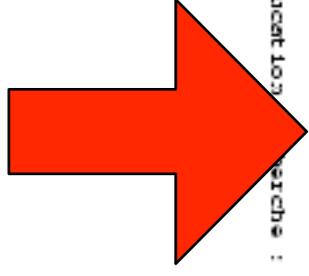
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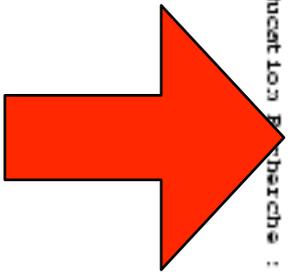
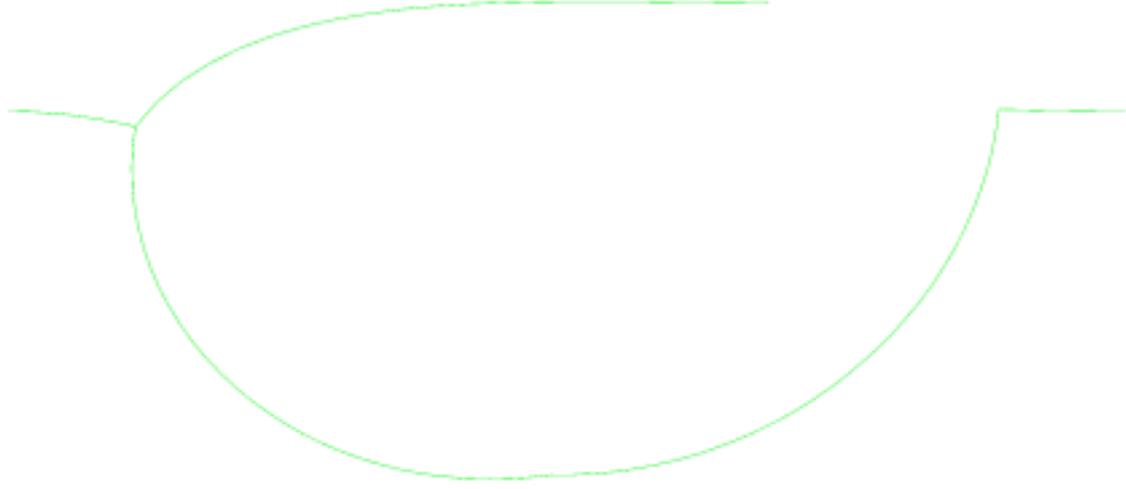


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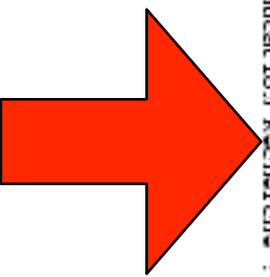
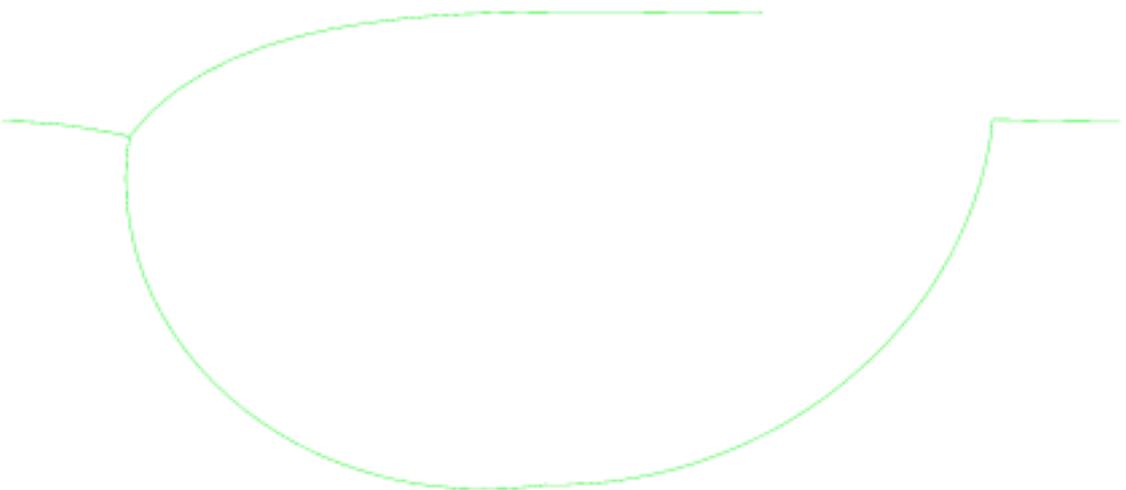


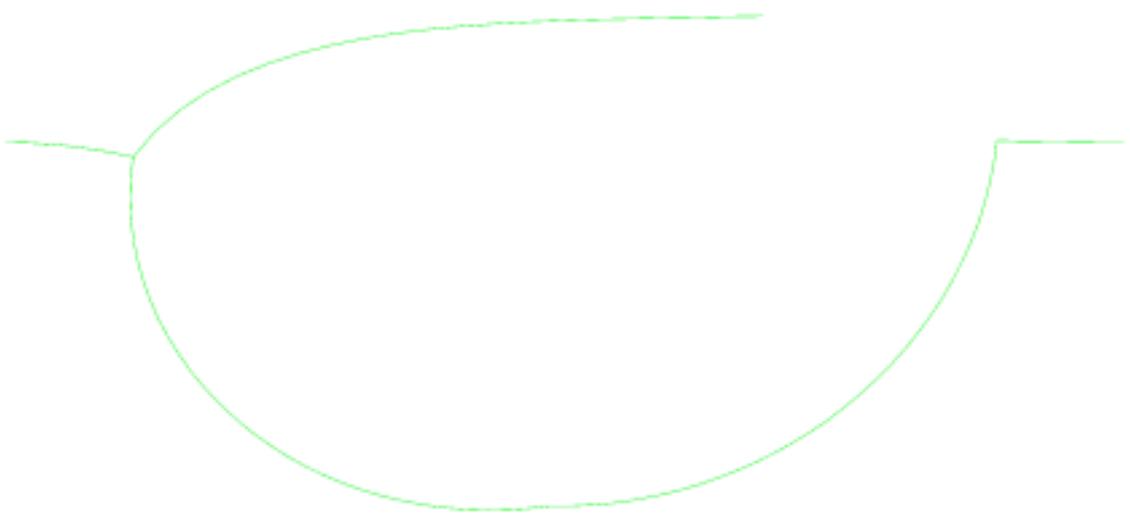


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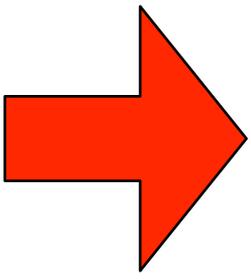


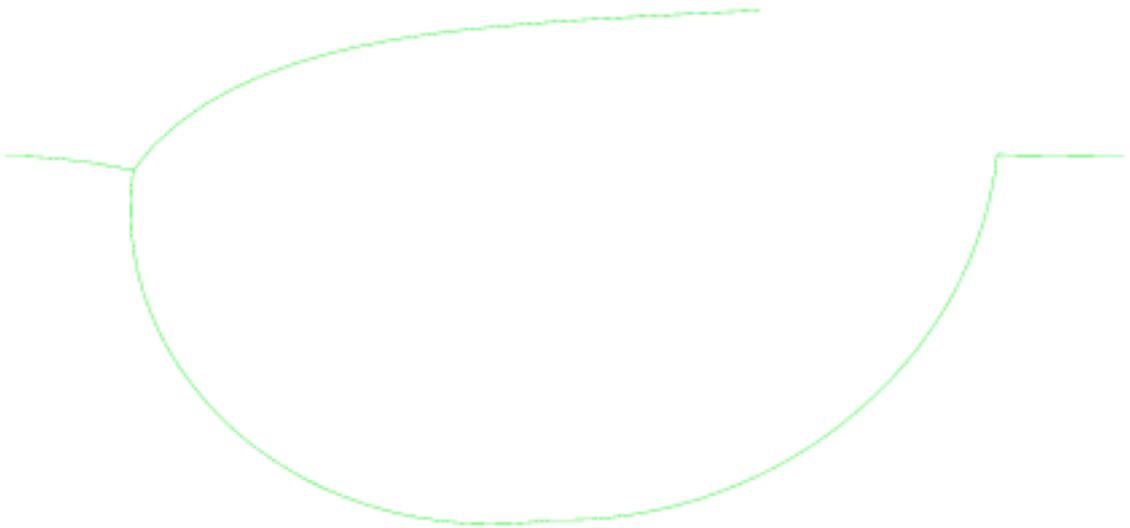
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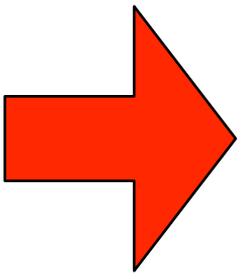


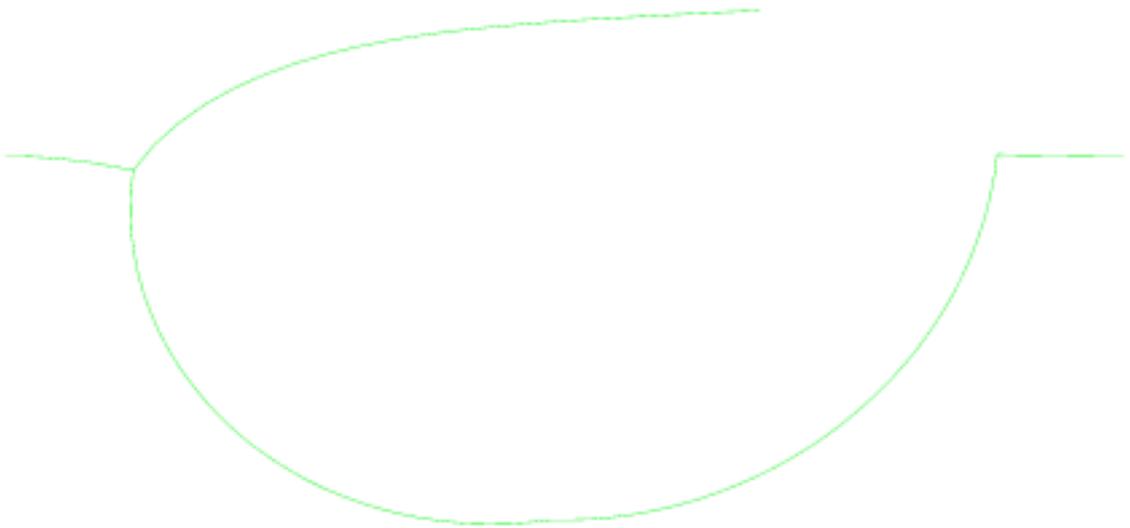
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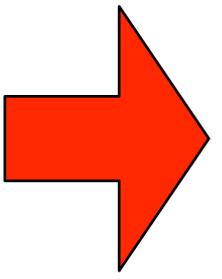


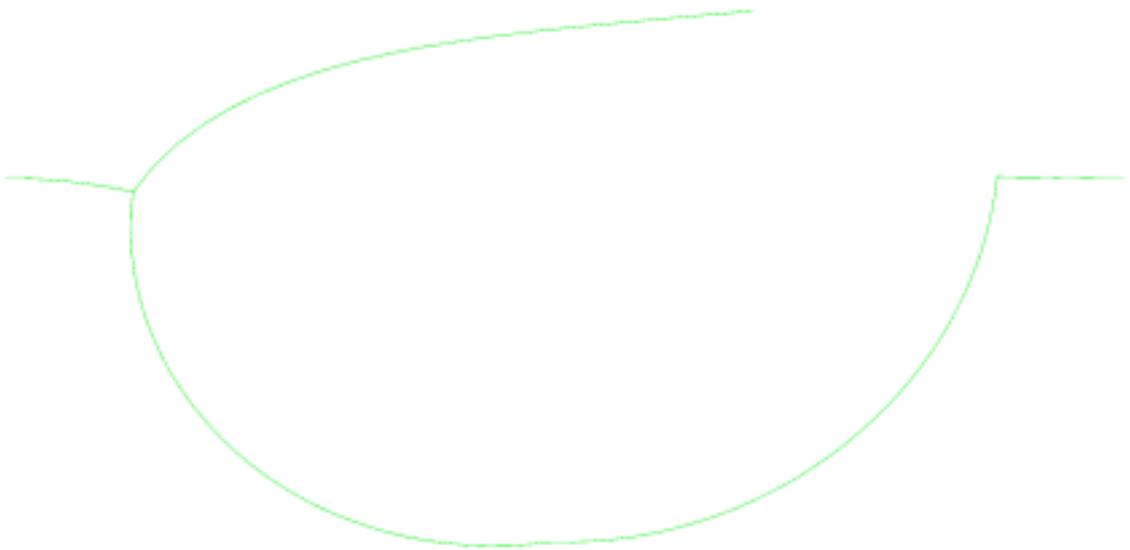
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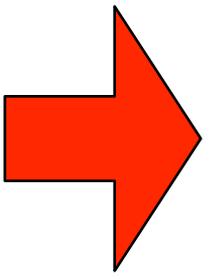


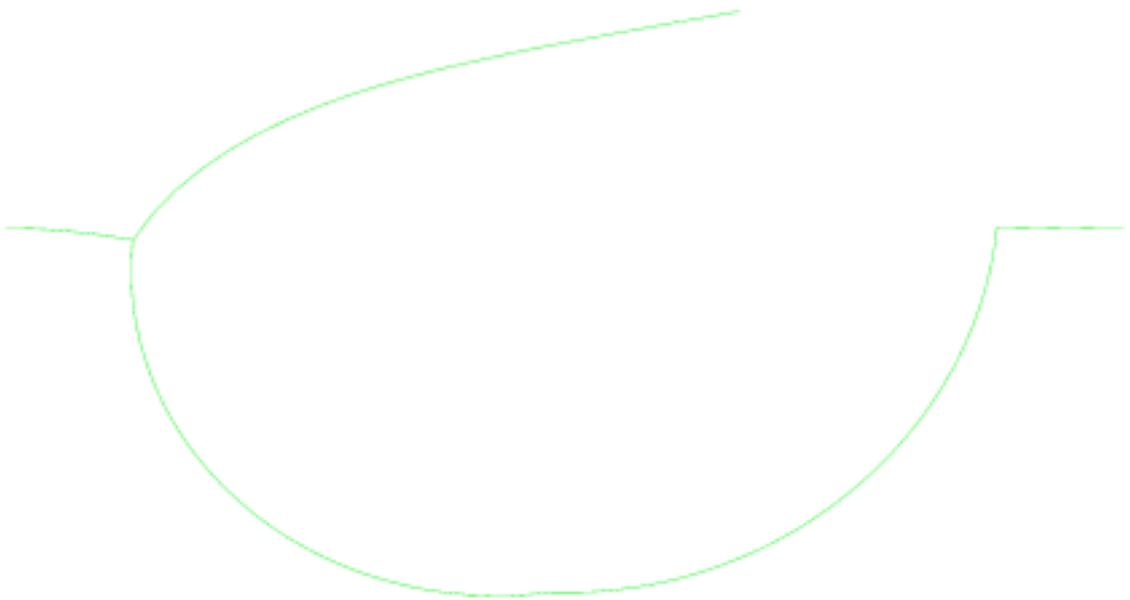
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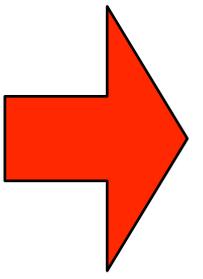


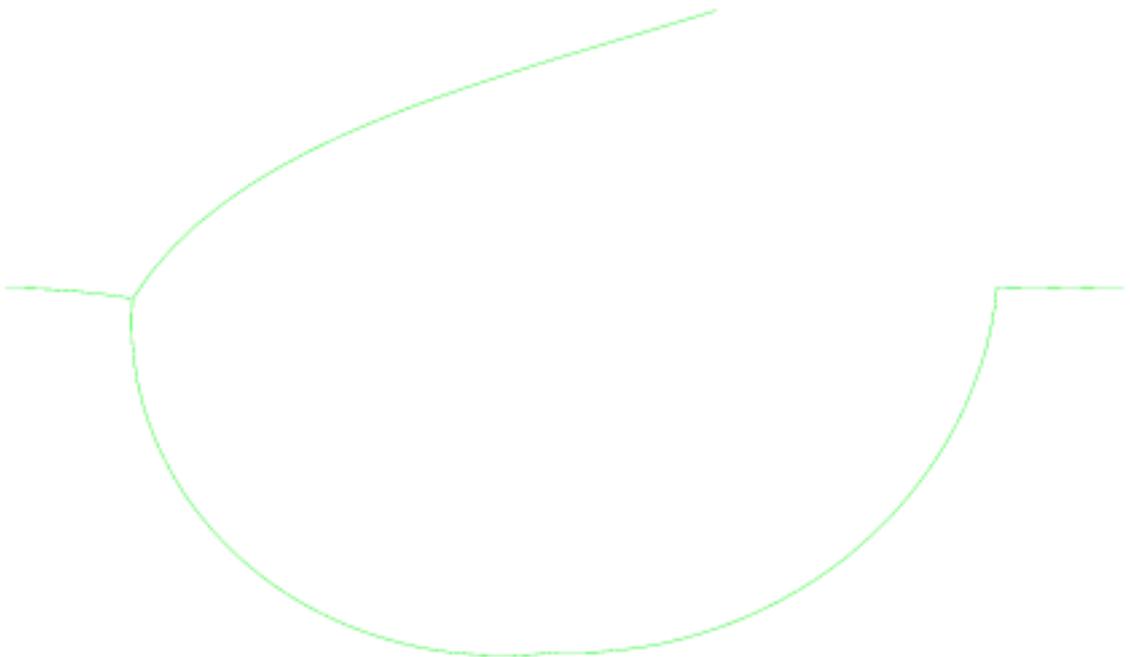
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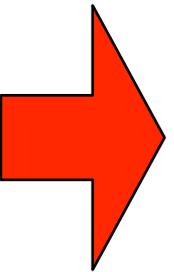


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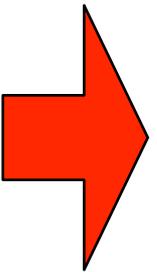


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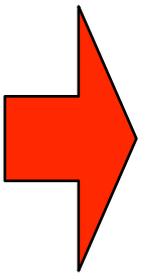


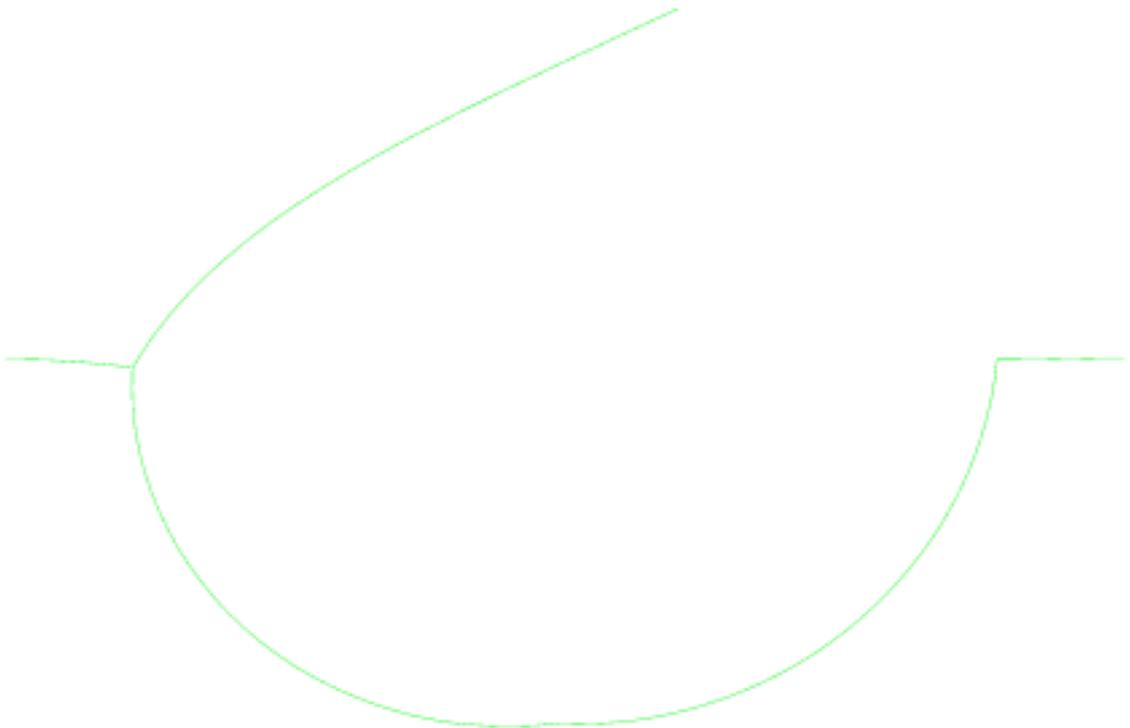
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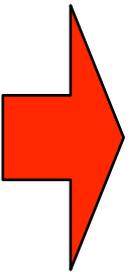


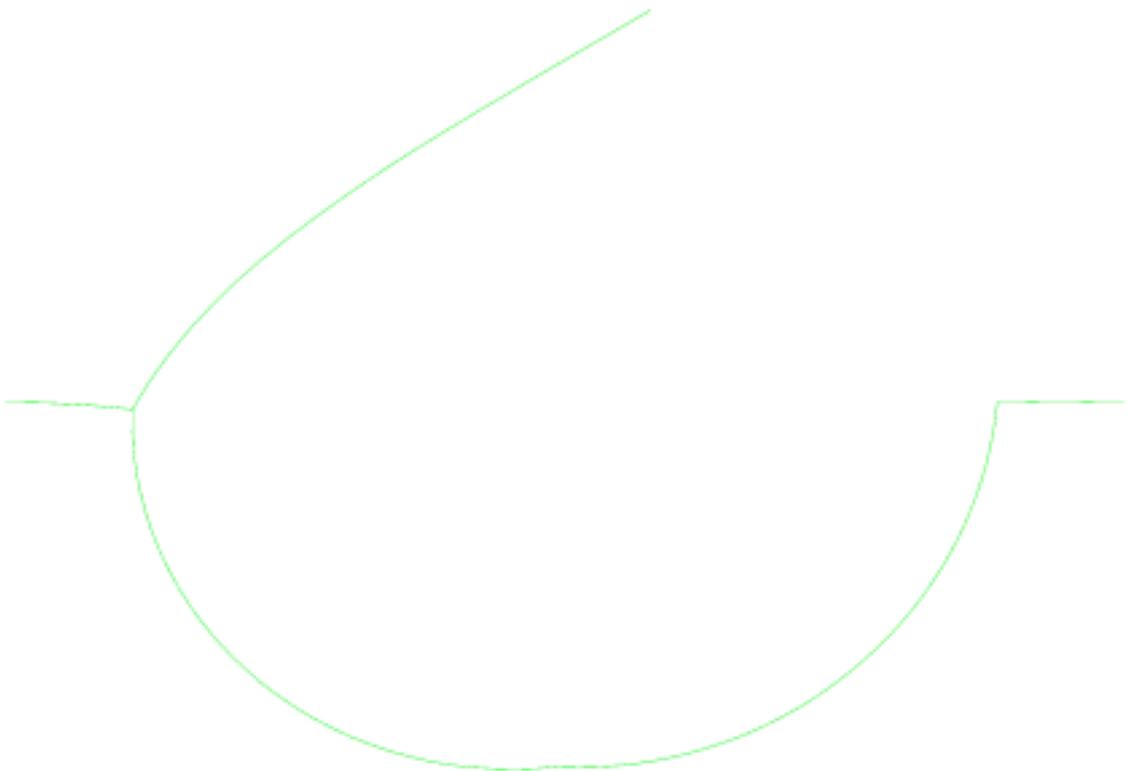
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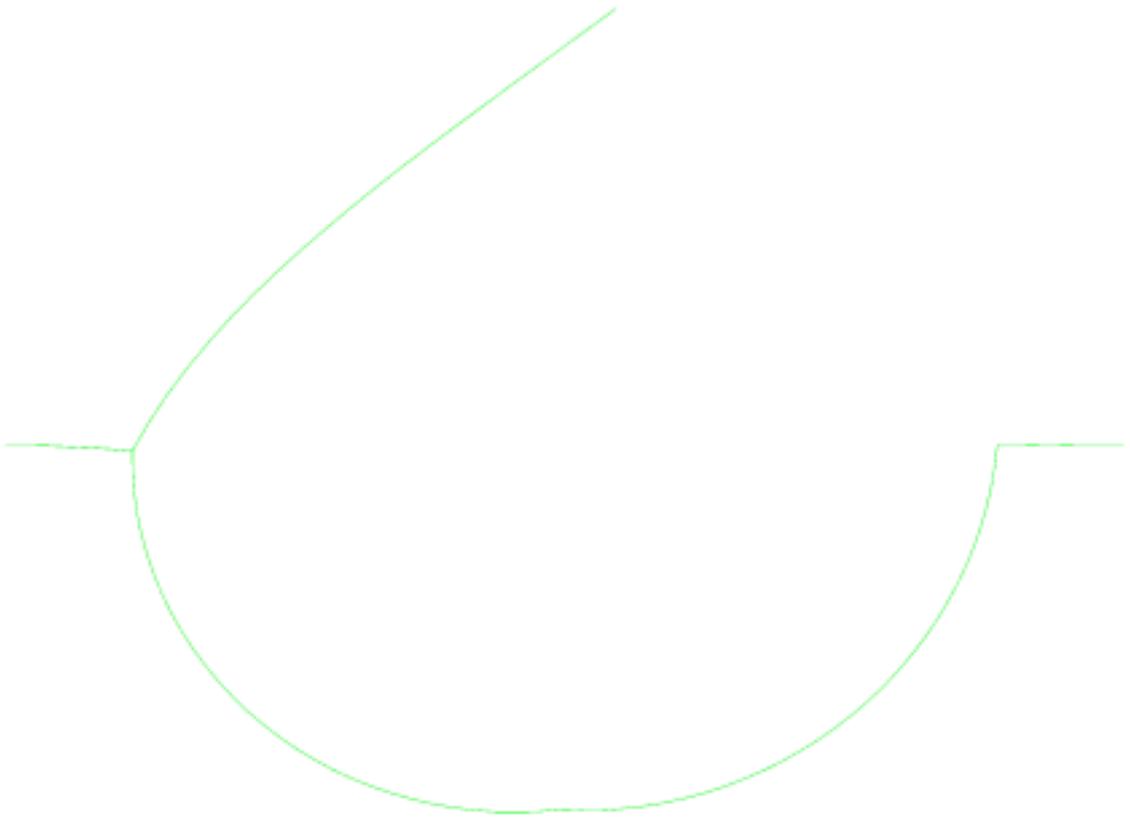
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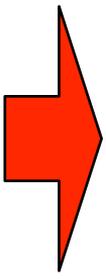


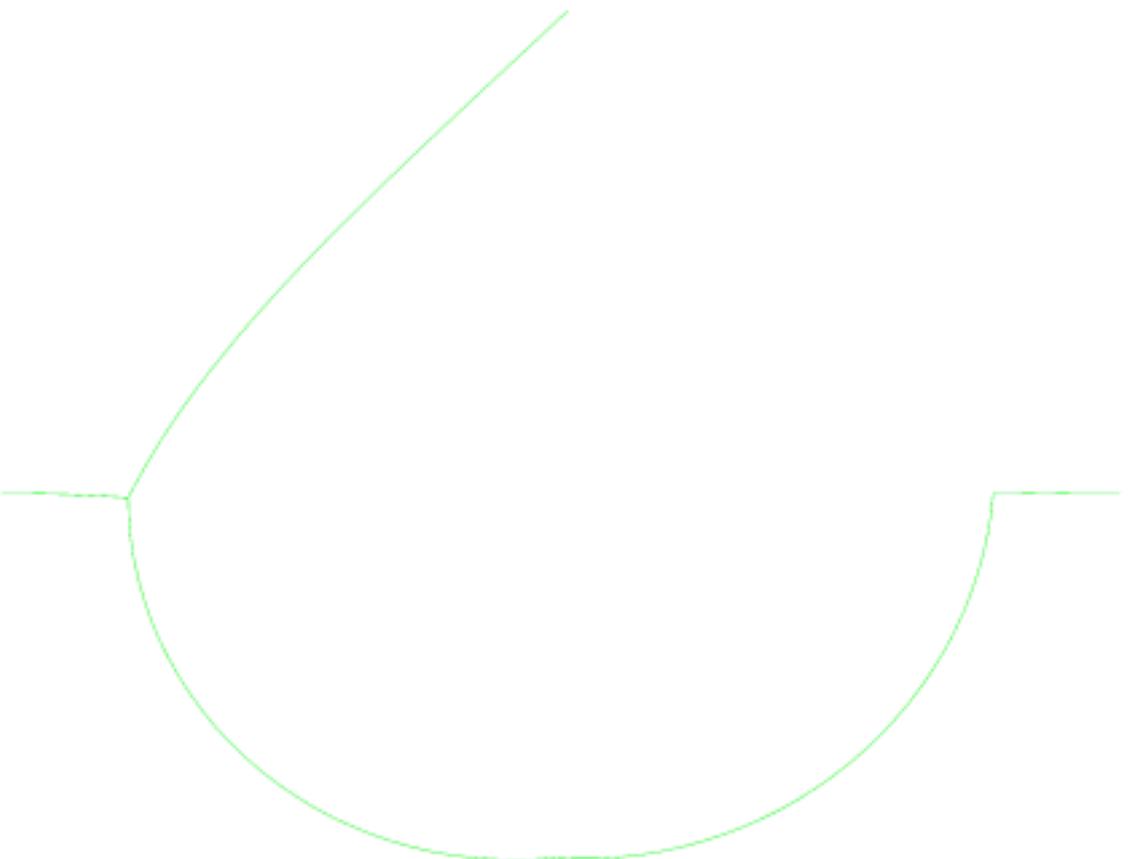
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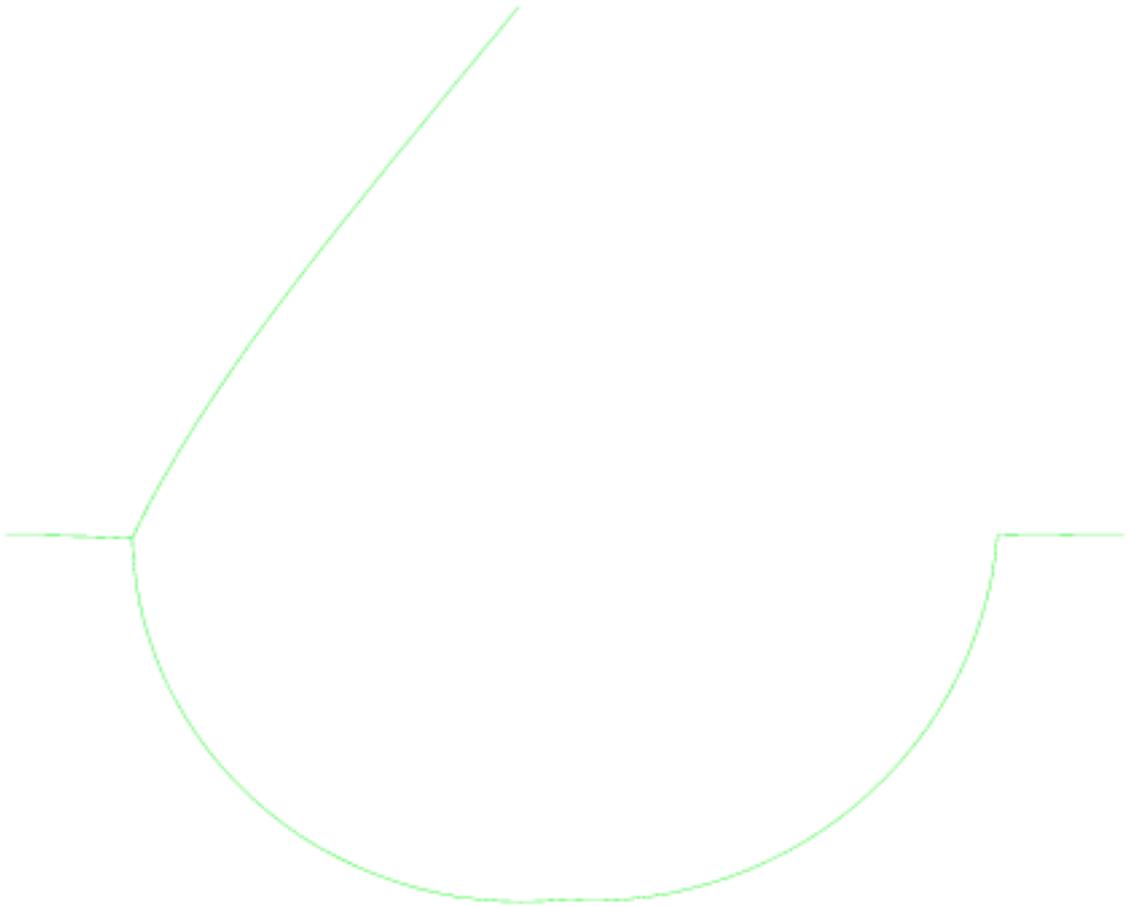
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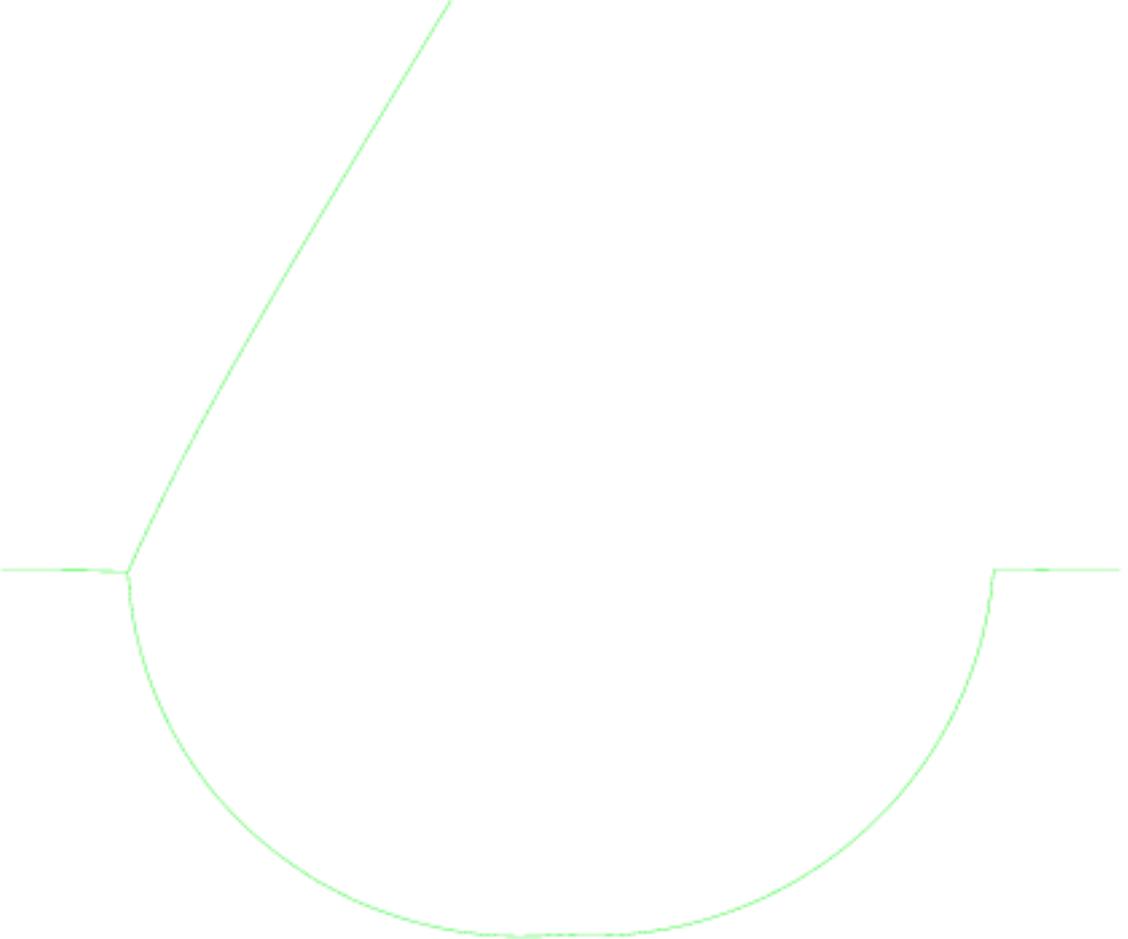
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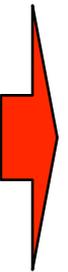


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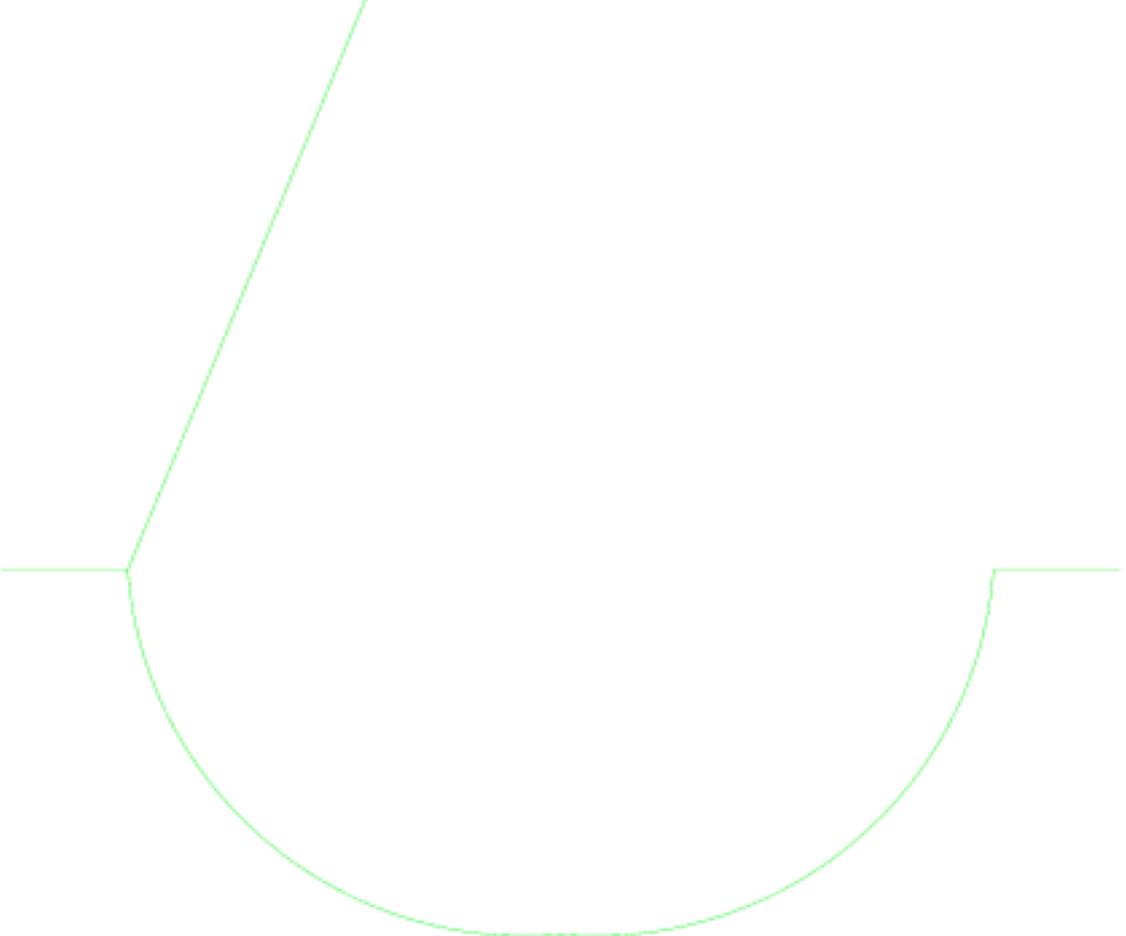


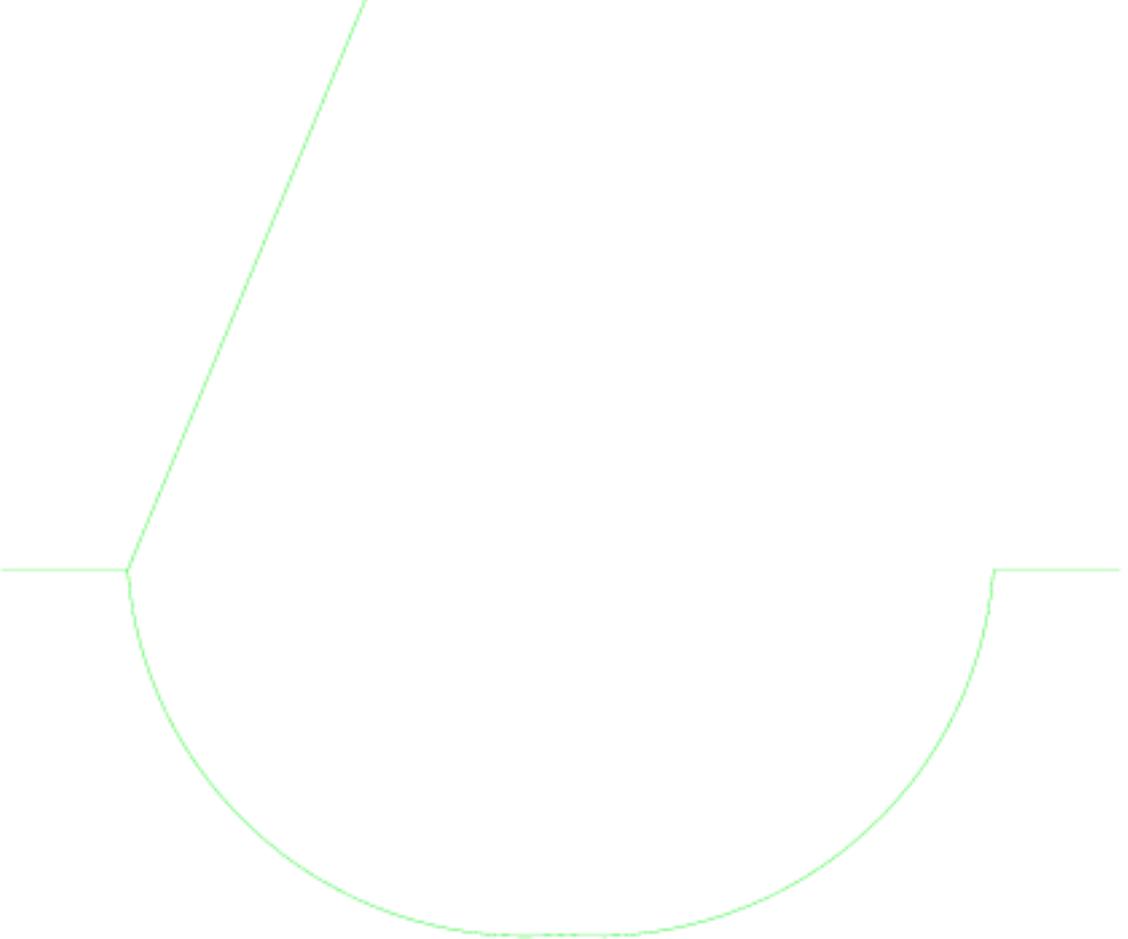


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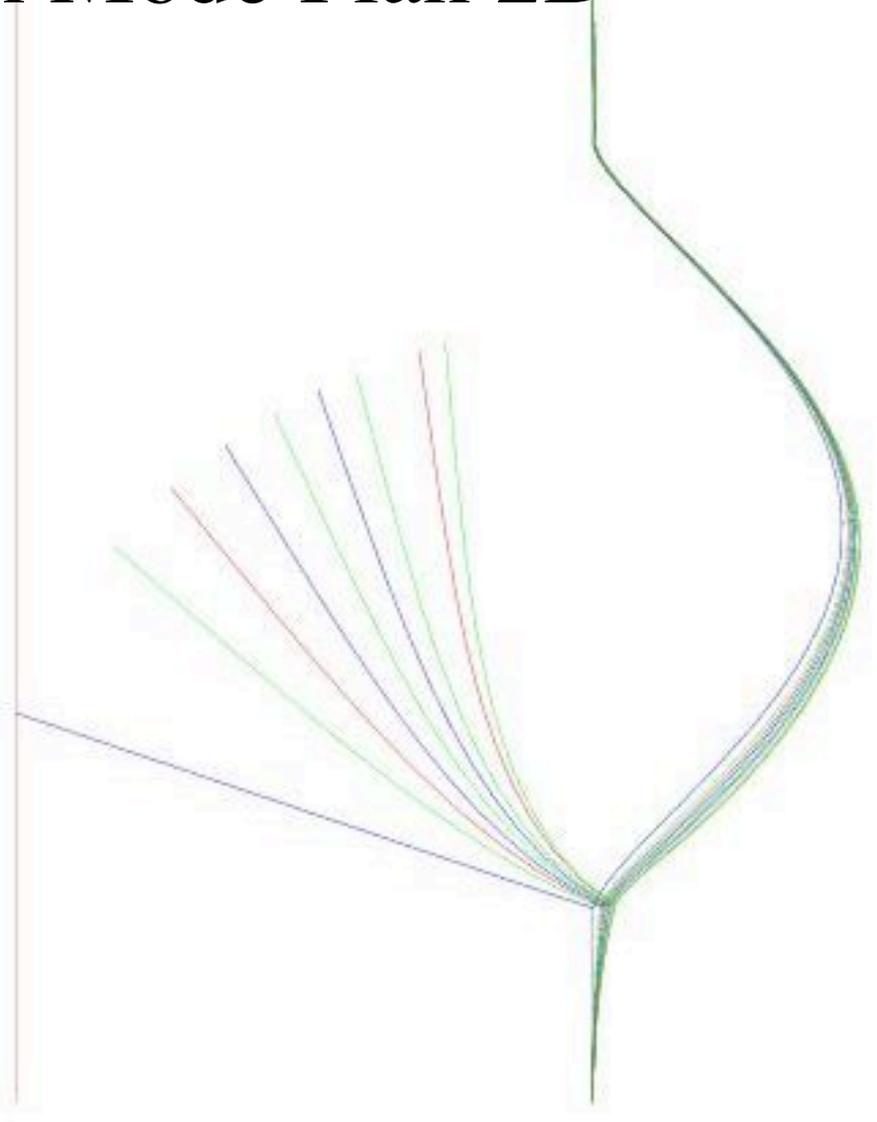




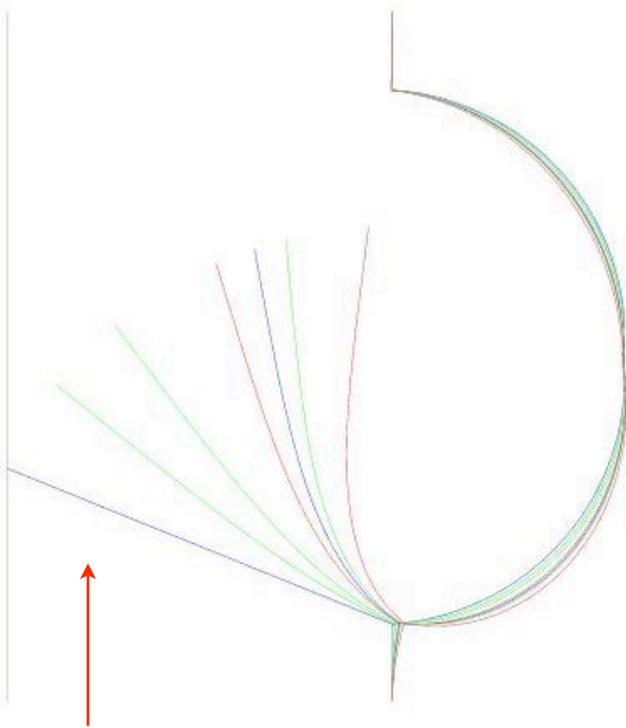
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# Modèle Coque en Mode Plan 2D

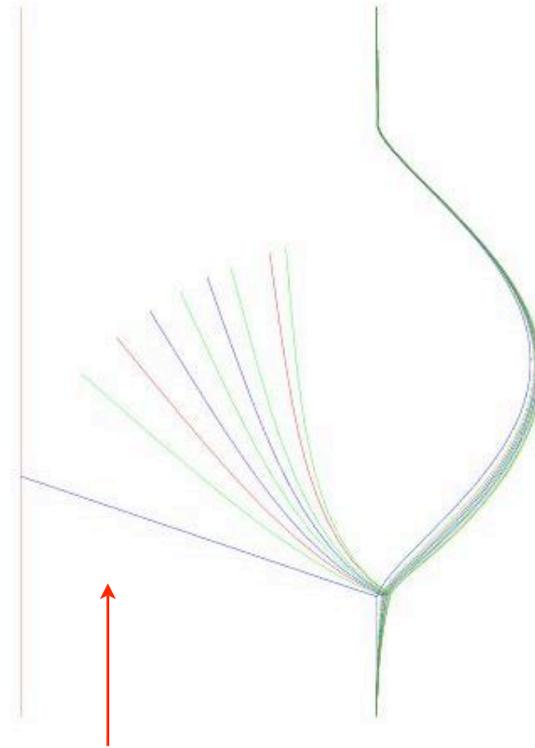
- Forme géométrique des sinus: exponentielle (ovale).
- 2 matériaux utilisés:  
 $E1=0,9\text{MPa}$  et  $E2=0,2\text{MPa}$ .
- $\nu=0,45$ .
- $t = 0:0.05:1$ .



# Forme du sinus



Contaminé - Kerosene - Kerosene - 4 mai - 10g de la spirale

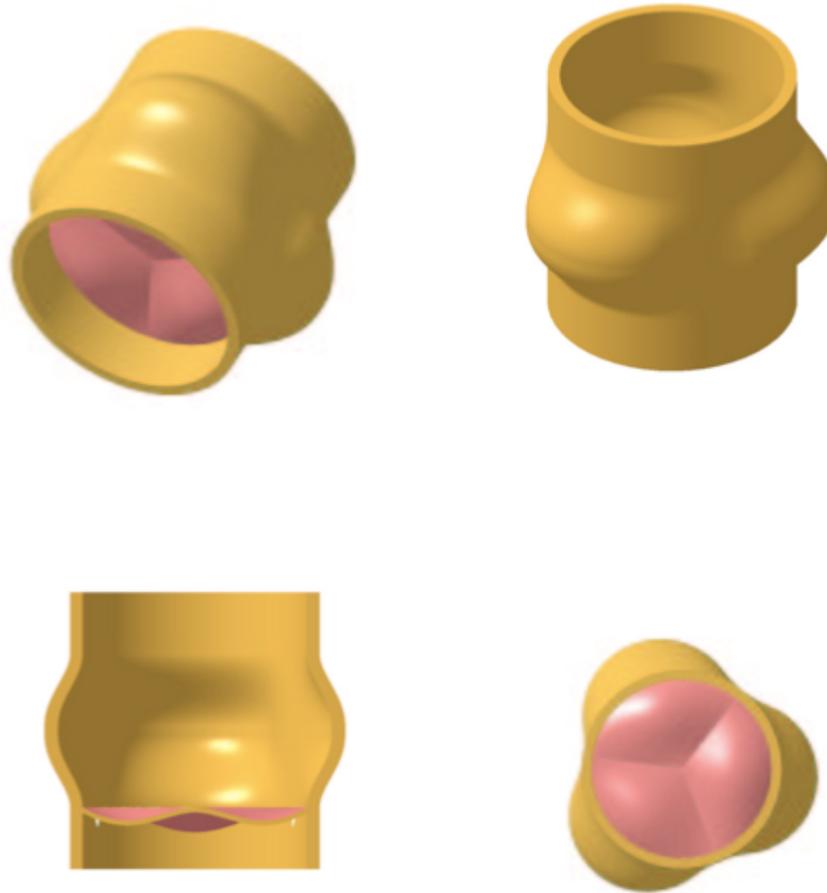


Contaminé - Kerosene - Kerosene - 4 mai - 10g de la spirale

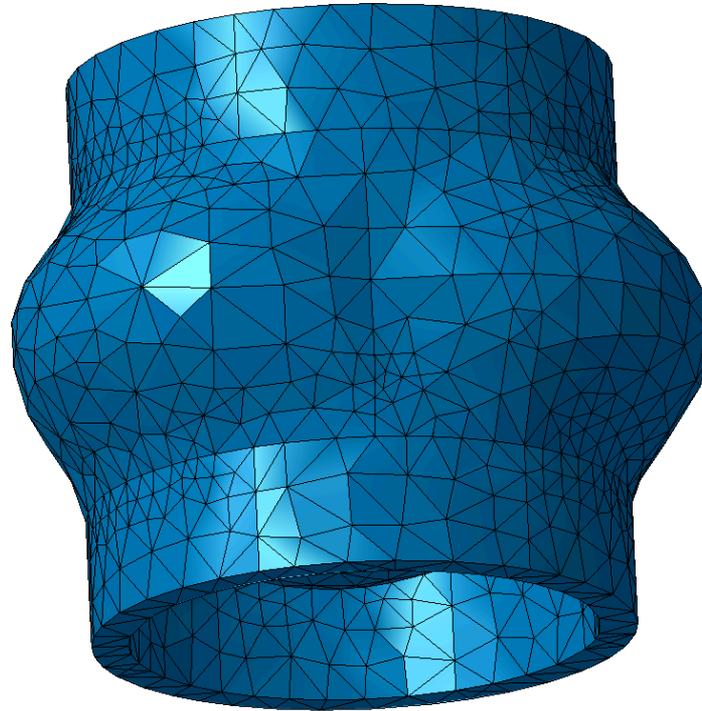
# Conclusion du 2D/Axi

- La forme géométrique des sinus peut influencer sur l'ouverture de la valve aortique.
- La valve s'ouvre plus facilement en 2D plan.

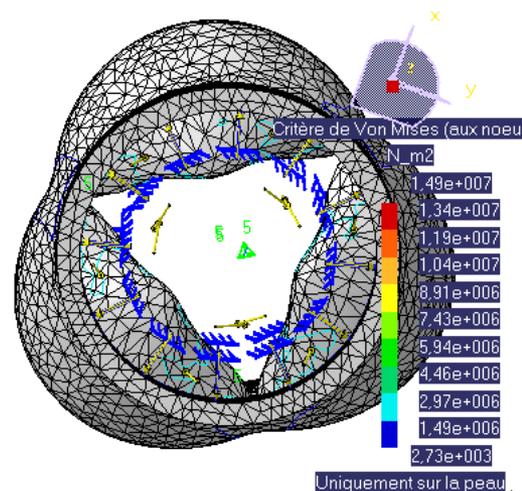
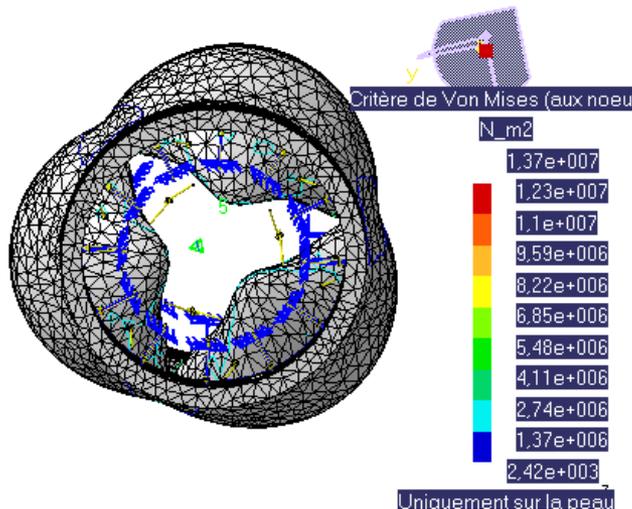
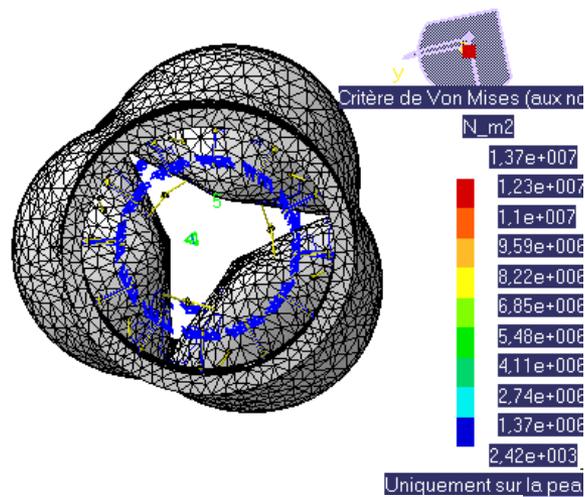
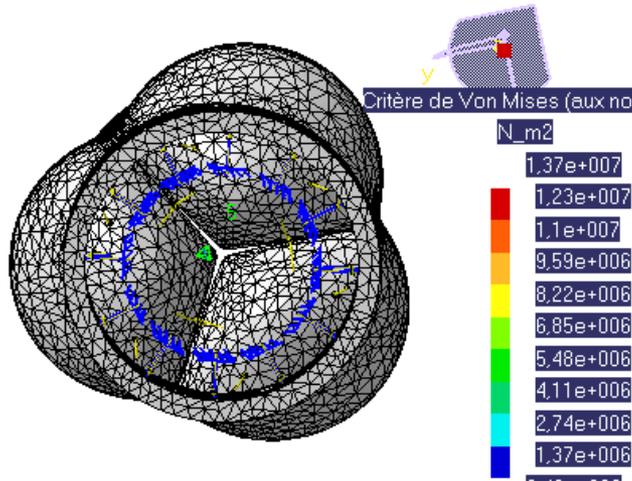
# Vue 3D: Catia V5



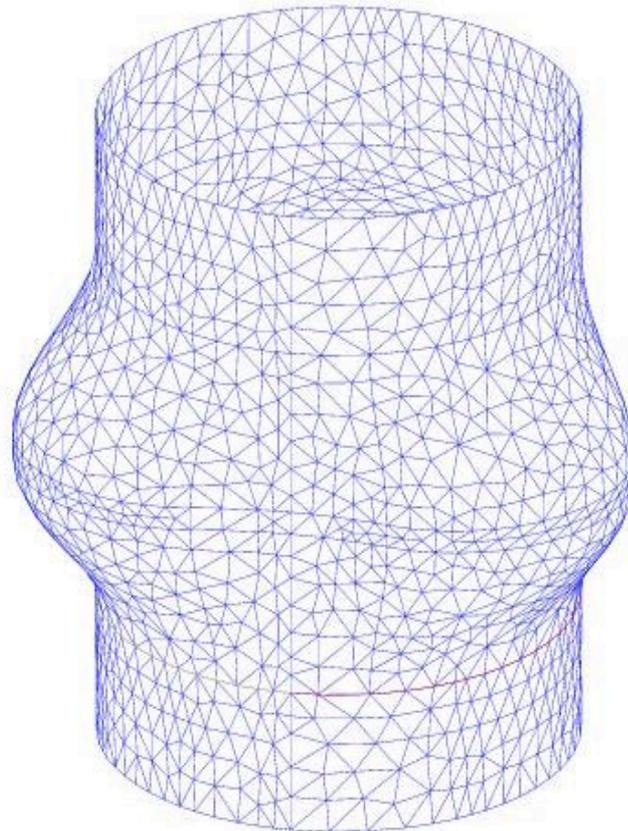
# Maillage sous Catia



# Maillage et déformation linéaires sous Catia V5

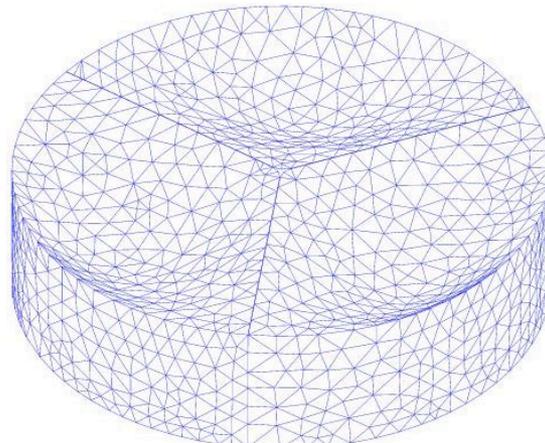


# Maillage sous Catia V5 avec un calcul grands déplacements sous Castem 3M

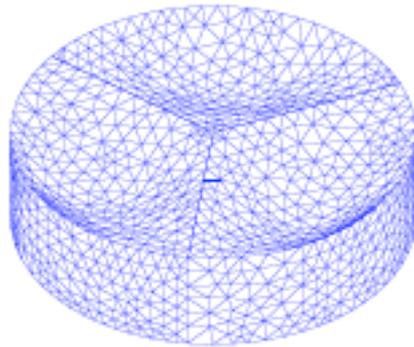


# Maillage sous Catia V5 avec un calcul grands déplacements sous Castem 3M

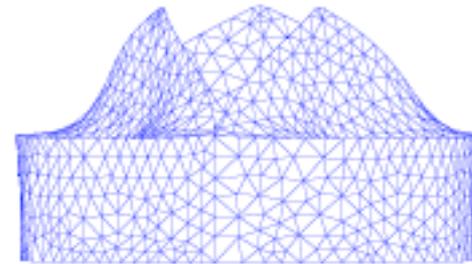
- partie inférieure de la valve (racine aortique et feuillets)
- Éléments DKT



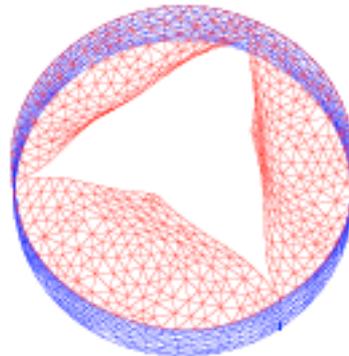
# Maillage sous Catia V5 avec un calcul grands déplacements sous Castem 3M



CATIA V5 - Éléments - Éléments - Éléments



CATIA V5 - Éléments - Éléments - Éléments



CATIA V5 - Éléments - Éléments - Éléments

Éléments  
1.0

Éléments  
1.0

# conclusion

- une première analyse mécanique
- calculs 2D/Axi avec CASTEM, élastique / coque
  - influence sur l'ouverture
  - influence de la forme des sinus
  - influence des grands déplacements, rigidification
- calculs 3D
  - linéaires avec CATIA
  - non linéaires avec CASTEM:
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# conclusion

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Mieux évaluer la pression!

etc.

