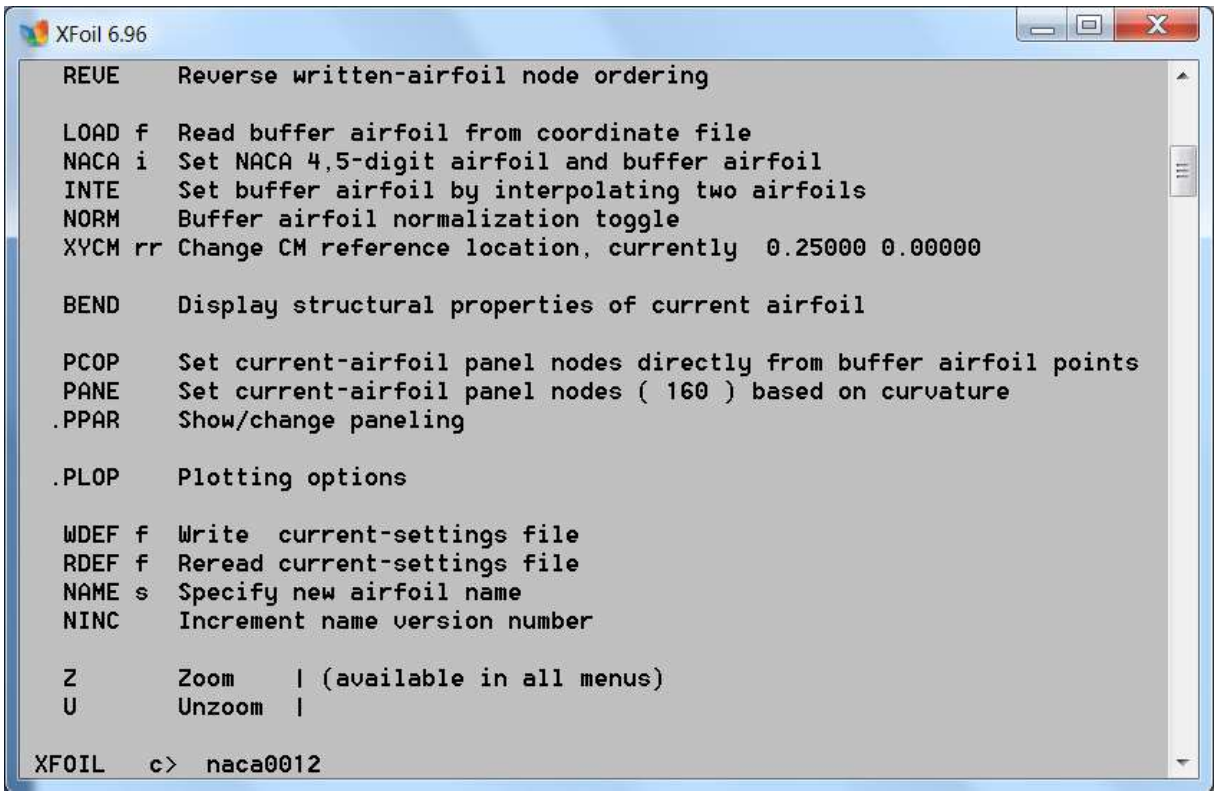
Tutorial para Geração de Malha no ICEM-CFD

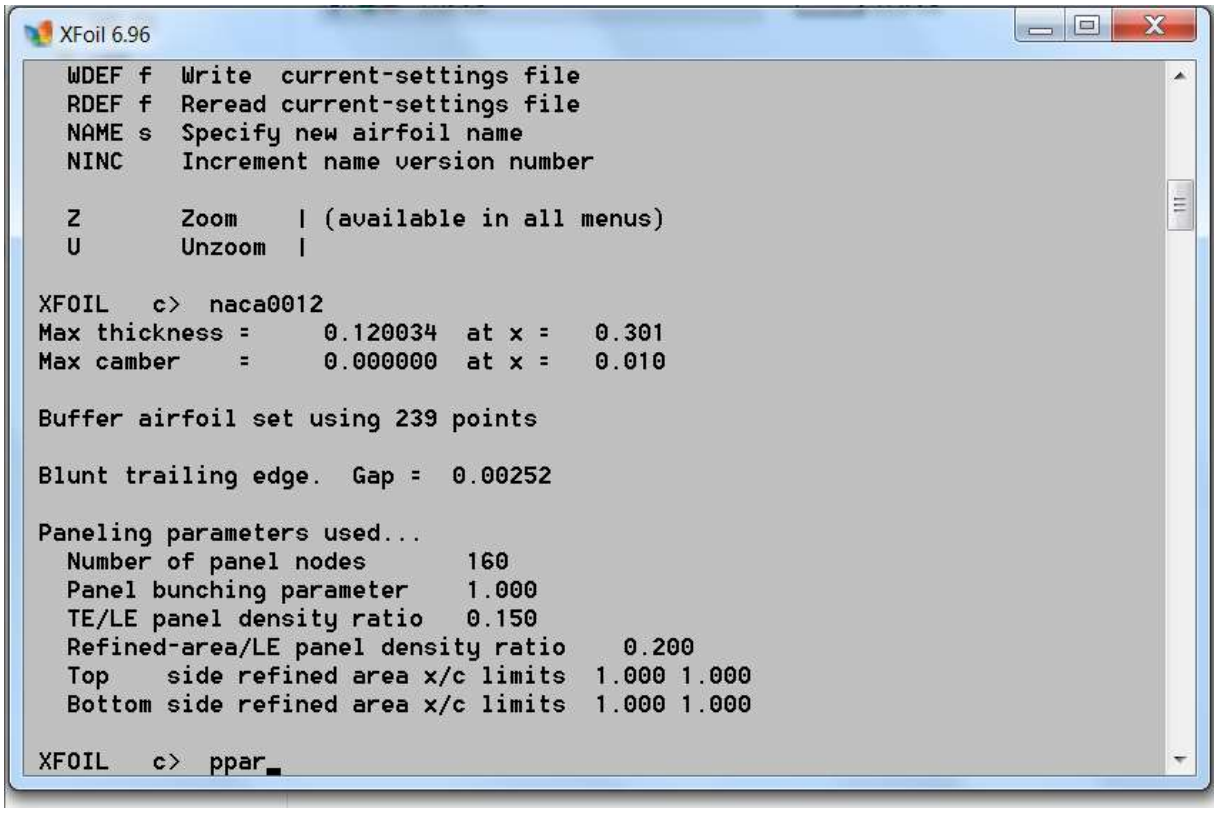
Seção de Aerofólio

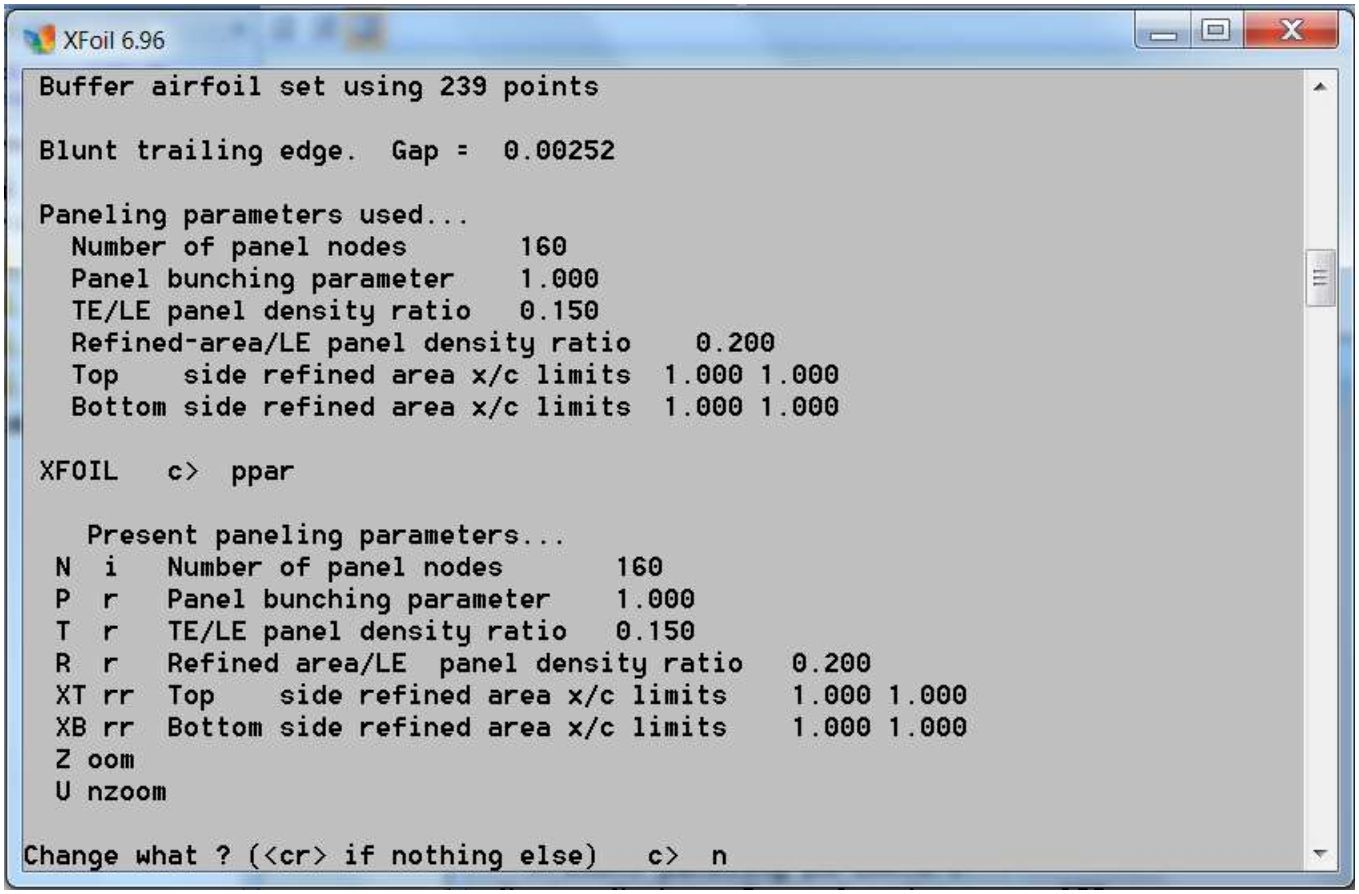
1. No XFoil

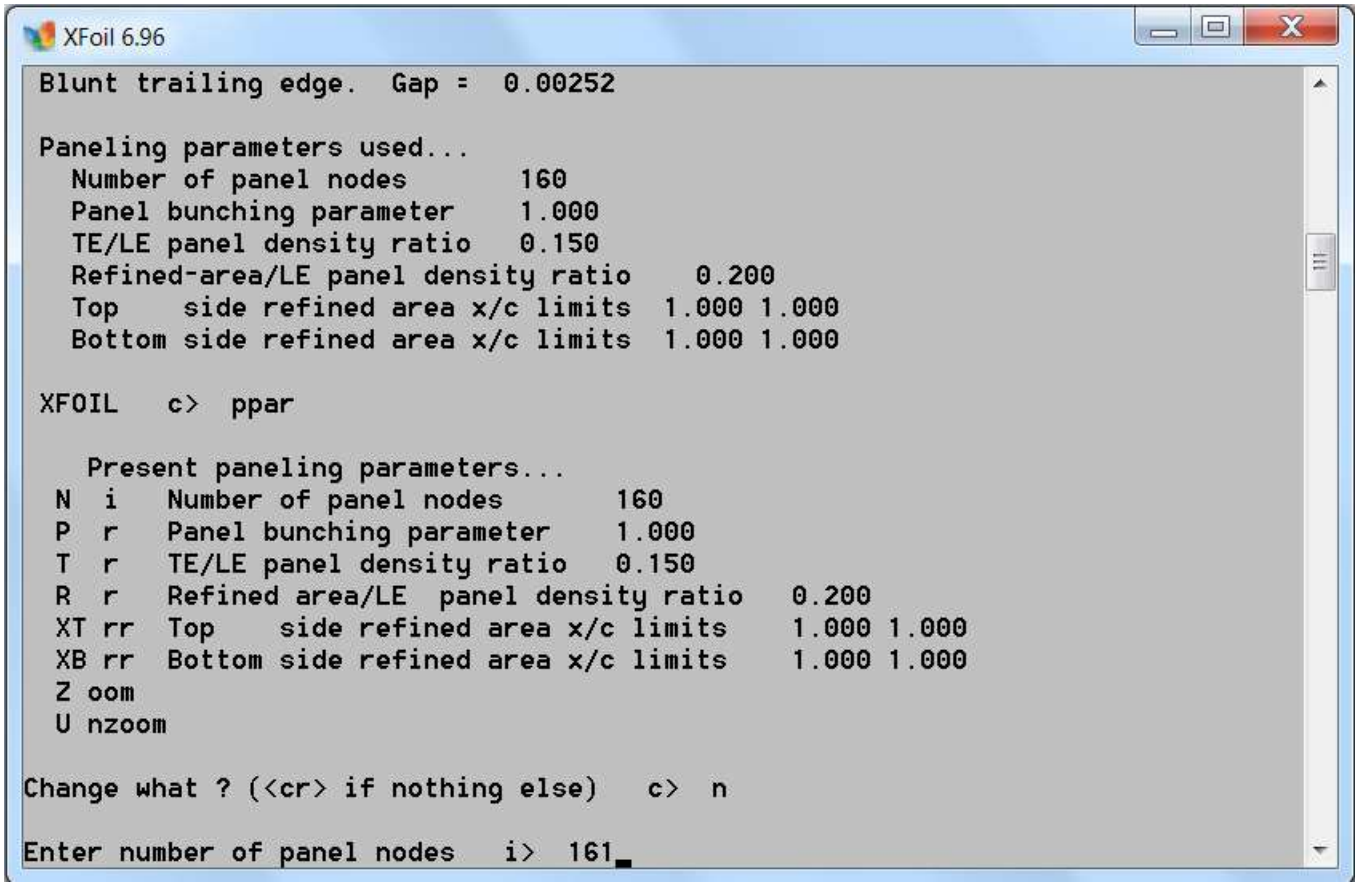
1.1. Digite o nome da seção NACA.

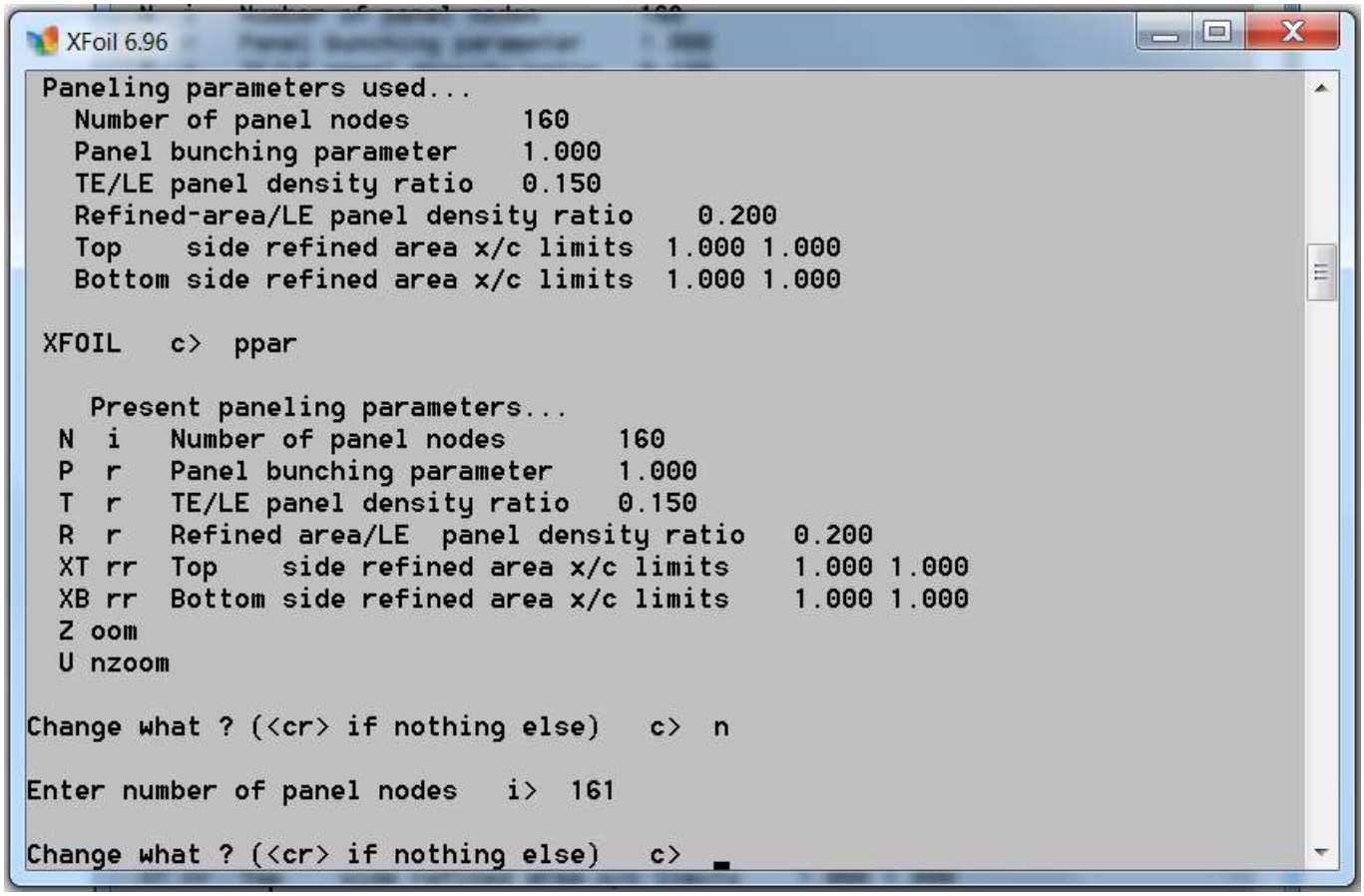


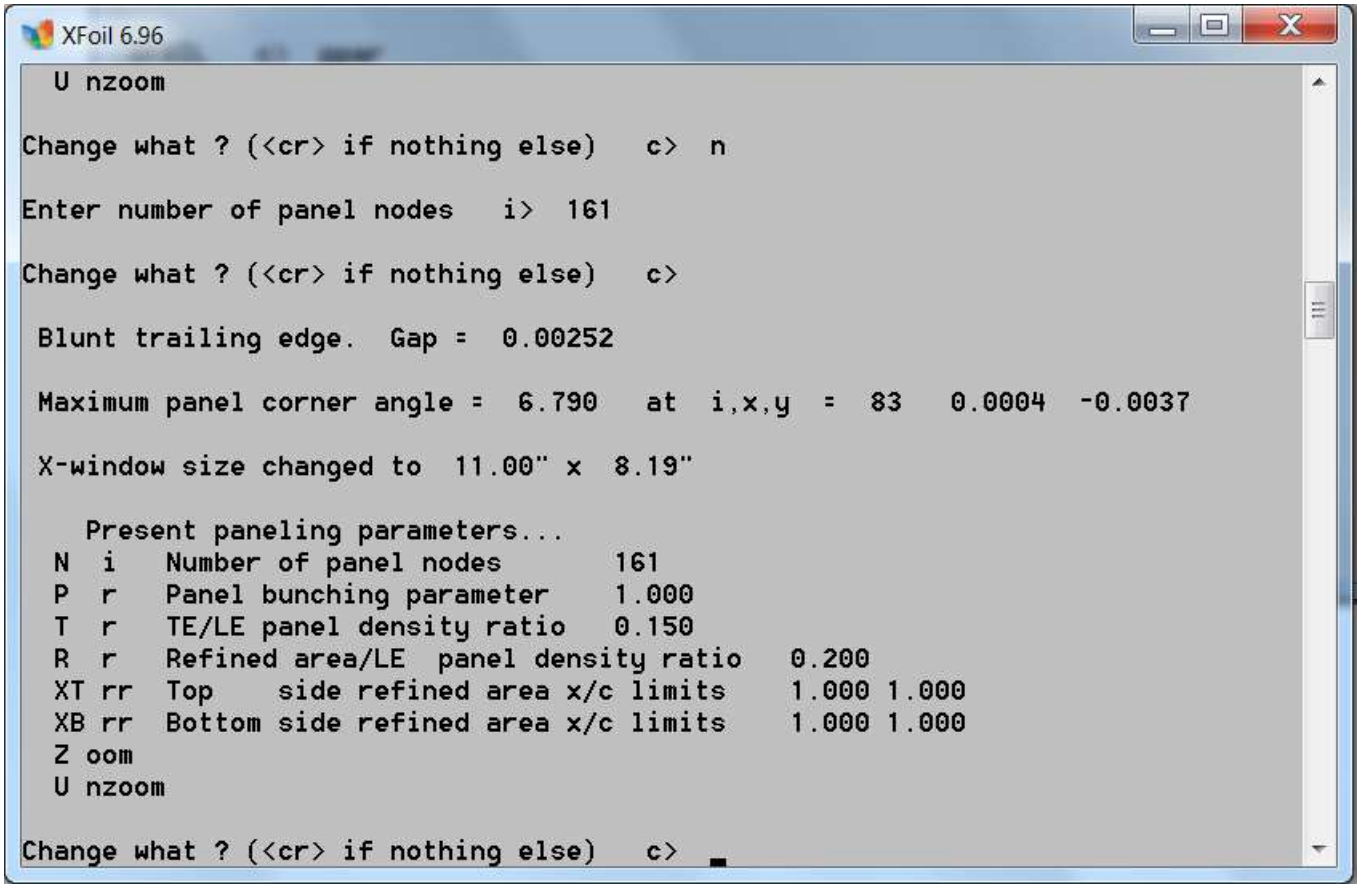
1.2. Use o comando ppar para ajustar o número de painéis (é necessário ter um número ímpar de painéis).



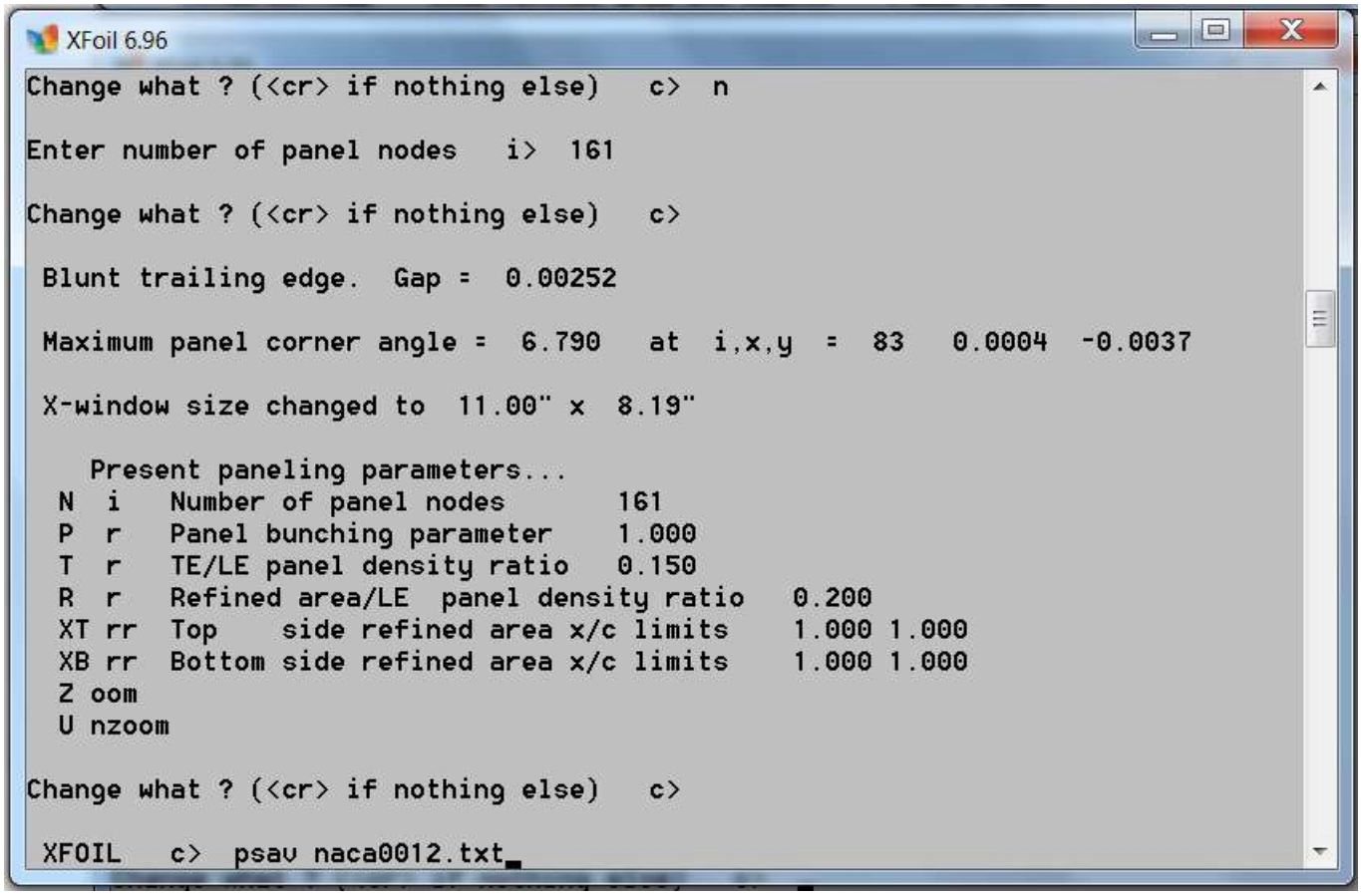

XFoil 6.96
Buffer airfoil set using 239 points
Blunt trailing edge. Gap = 0.00252
Paneling parameters used...
Number of panel nodes 160
Panel bunching parameter 1.000
TE/LE panel density ratio 0.150
Refined-area/LE panel density ratio 0.200
Top side refined area x/c limits 1.000 1.000
Bottom side refined area x/c limits 1.000 1.000
XFOIL c> ppar
Present paneling parameters...
N i Number of panel nodes 160
P r Panel bunching parameter 1.000
T r TE/LE panel density ratio 0.150
R r Refined area/LE panel density ratio 0.200
XT rr Top side refined area x/c limits 1.000 1.000
XB rr Bottom side refined area x/c limits 1.000 1.000
Z oom
U nzoom
Change what ? (<cr> if nothing else) c> n


XFoil 6.96
Blunt trailing edge. Gap = 0.00252
Paneling parameters used...
Number of panel nodes 160
Panel bunching parameter 1.000
TE/LE panel density ratio 0.150
Refined-area/LE panel density ratio 0.200
Top side refined area x/c limits 1.000 1.000
Bottom side refined area x/c limits 1.000 1.000
XFOIL c> ppar
Present paneling parameters...
N i Number of panel nodes 160
P r Panel bunching parameter 1.000
T r TE/LE panel density ratio 0.150
R r Refined area/LE panel density ratio 0.200
XT rr Top side refined area x/c limits 1.000 1.000
XB rr Bottom side refined area x/c limits 1.000 1.000
Z oom
U nzoom
Change what ? (<cr> if nothing else) c> n
Enter number of panel nodes i> 161

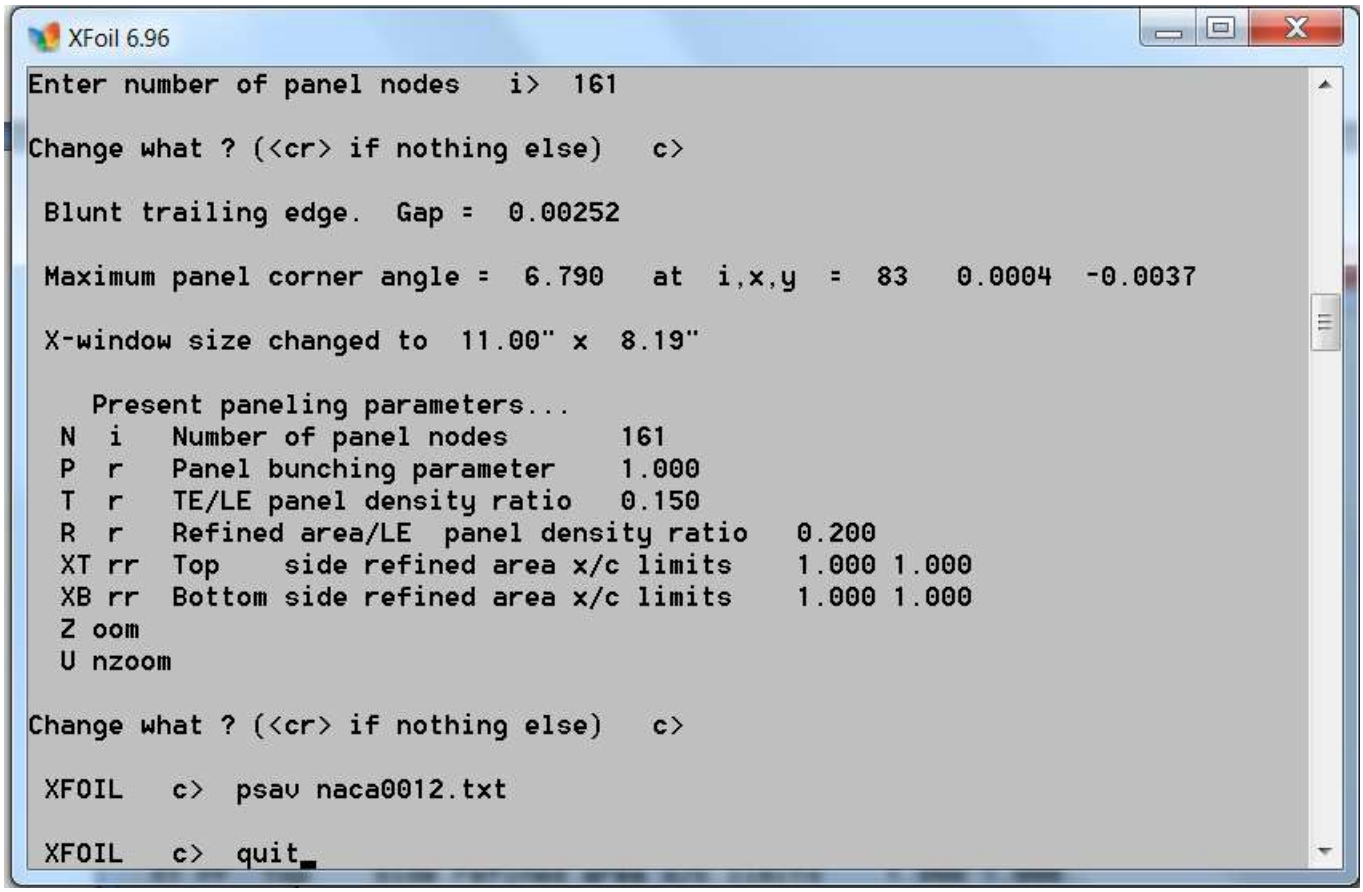

XFoil 6.96
Paneling parameters used...
Number of panel nodes 160
Panel bunching parameter 1.000
TE/LE panel density ratio 0.150
Refined-area/LE panel density ratio 0.200
Top side refined area x/c limits 1.000 1.000
Bottom side refined area x/c limits 1.000 1.000
XFOIL c> ppar
Present paneling parameters...
N i Number of panel nodes 160
P r Panel bunching parameter 1.000
T r TE/LE panel density ratio 0.150
R r Refined area/LE panel density ratio 0.200
XT rr Top side refined area x/c limits 1.000 1.000
XB rr Bottom side refined area x/c limits 1.000 1.000
Z oom
U nzoom
Change what ? (<cr> if nothing else) c> n
Enter number of panel nodes i> 161
Change what ? (<cr> if nothing else) c>


XFoil 6.96
U nzoom
Change what ? (<cr> if nothing else) c> n
Enter number of panel nodes i> 161
Change what ? (<cr> if nothing else) c>
Blunt trailing edge. Gap = 0.00252
Maximum panel corner angle = 6.790 at i,x,y = 83 0.0004 -0.0037
X-window size changed to 11.00" x 8.19"
Present paneling parameters...
N i Number of panel nodes 161
P r Panel bunching parameter 1.000
T r TE/LE panel density ratio 0.150
R r Refined area/LE panel density ratio 0.200
XT rr Top side refined area x/c limits 1.000 1.000
XB rr Bottom side refined area x/c limits 1.000 1.000
Z oom
U nzoom
Change what ? (<cr> if nothing else) c>

1.4. Salve as coordenadas da seção de aerofólio em um arquivo texto.

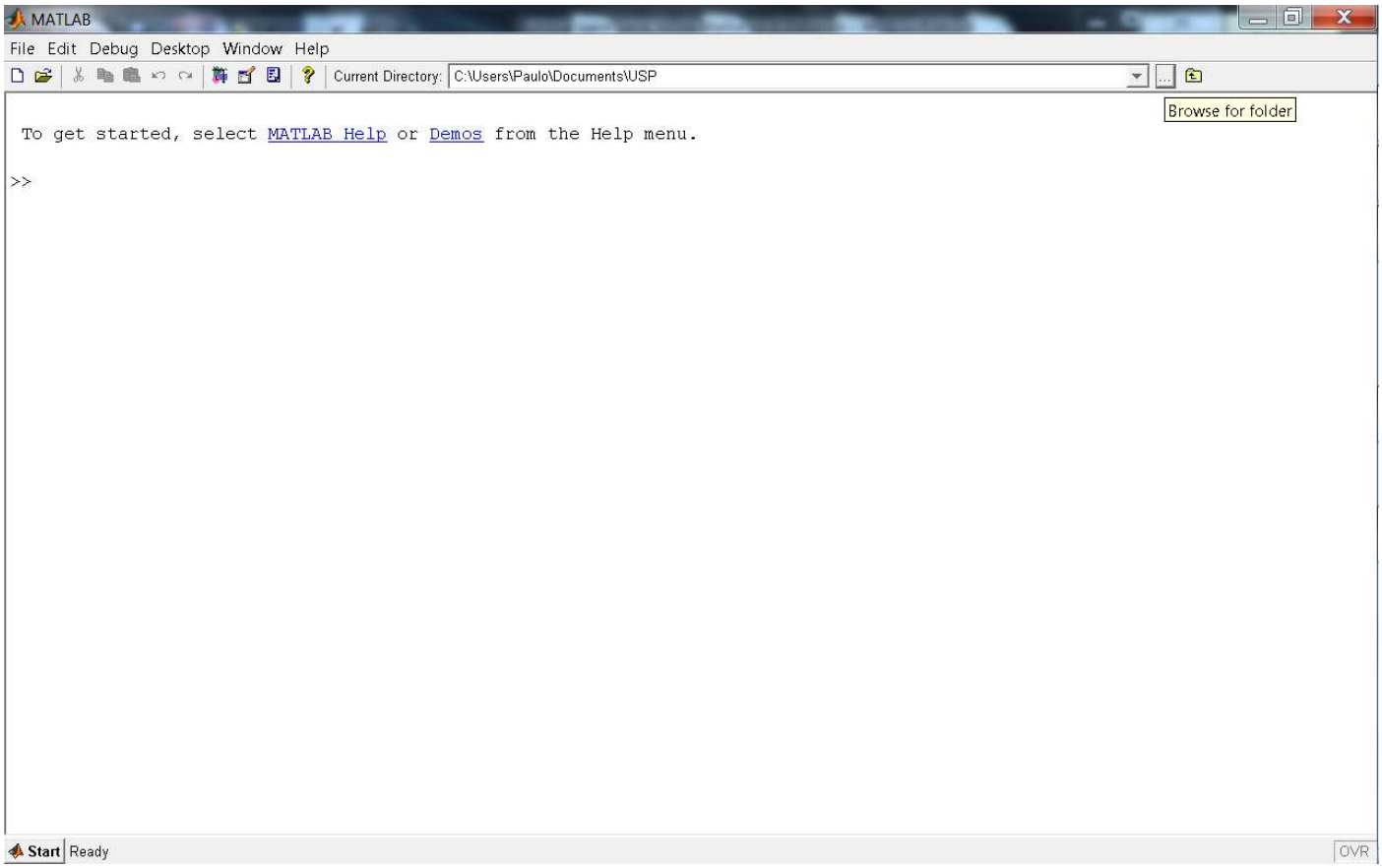


1.5. Saia do XFoil.

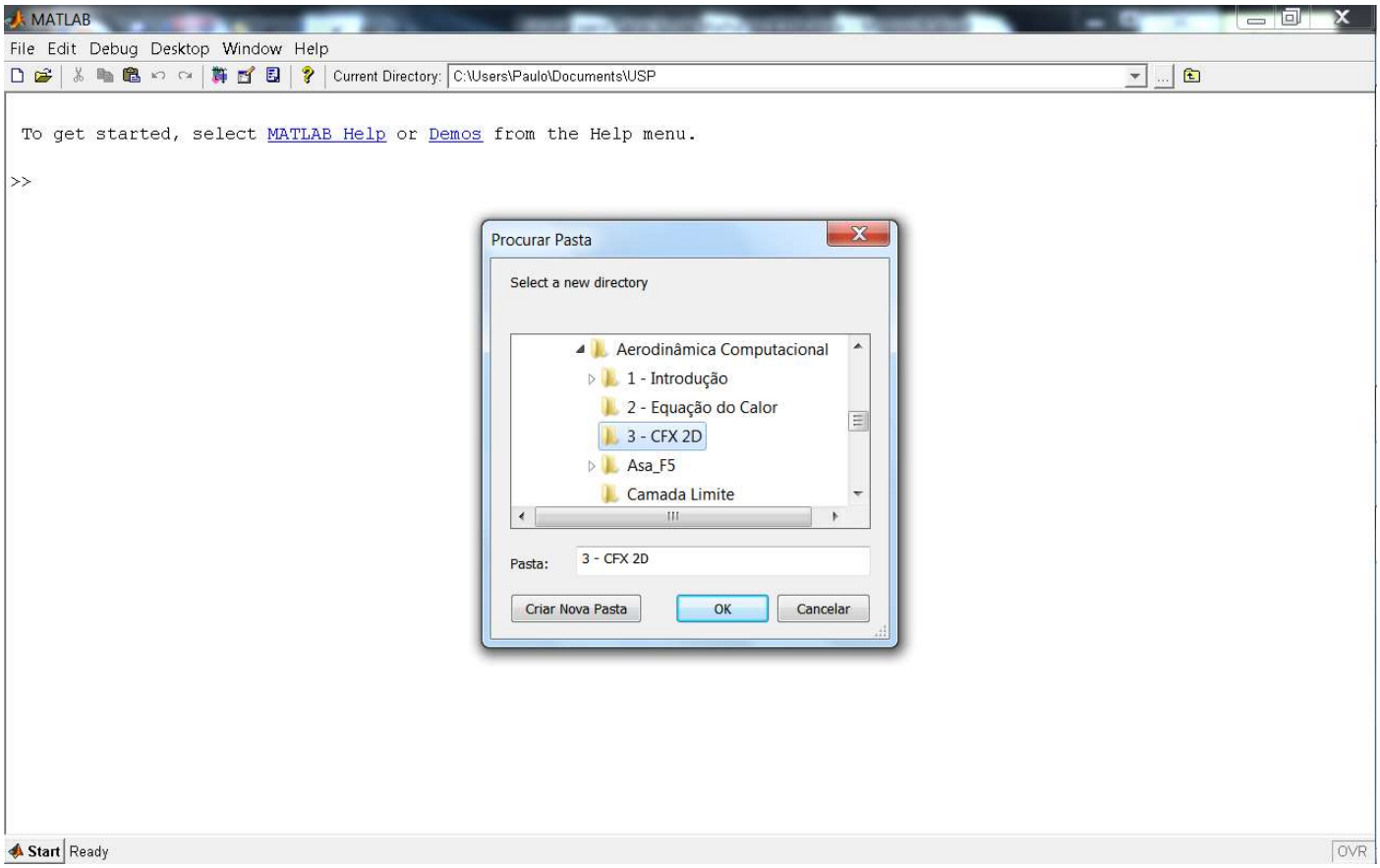


2. No Matlab.

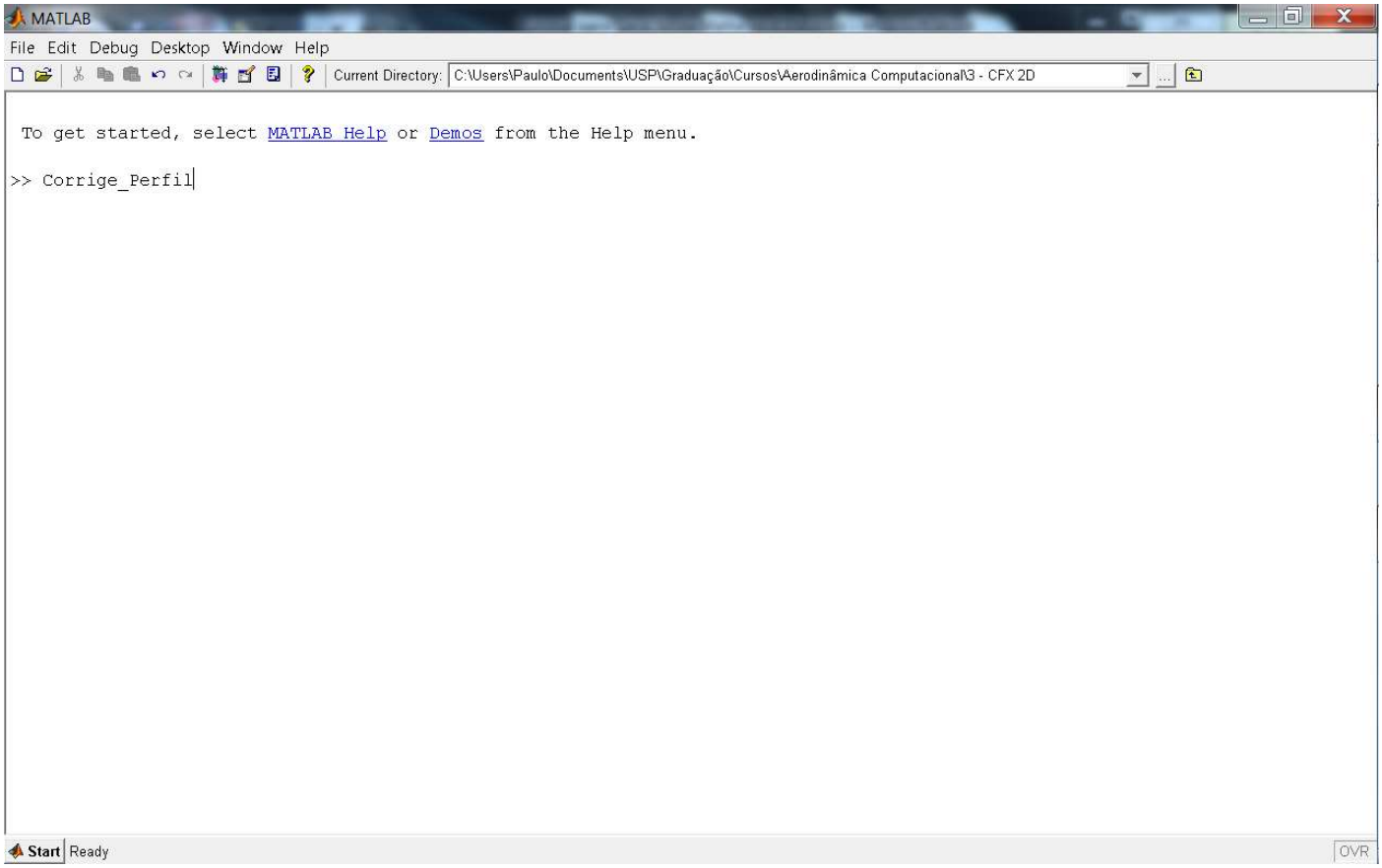
2.1. Selecione "Browse for folder".



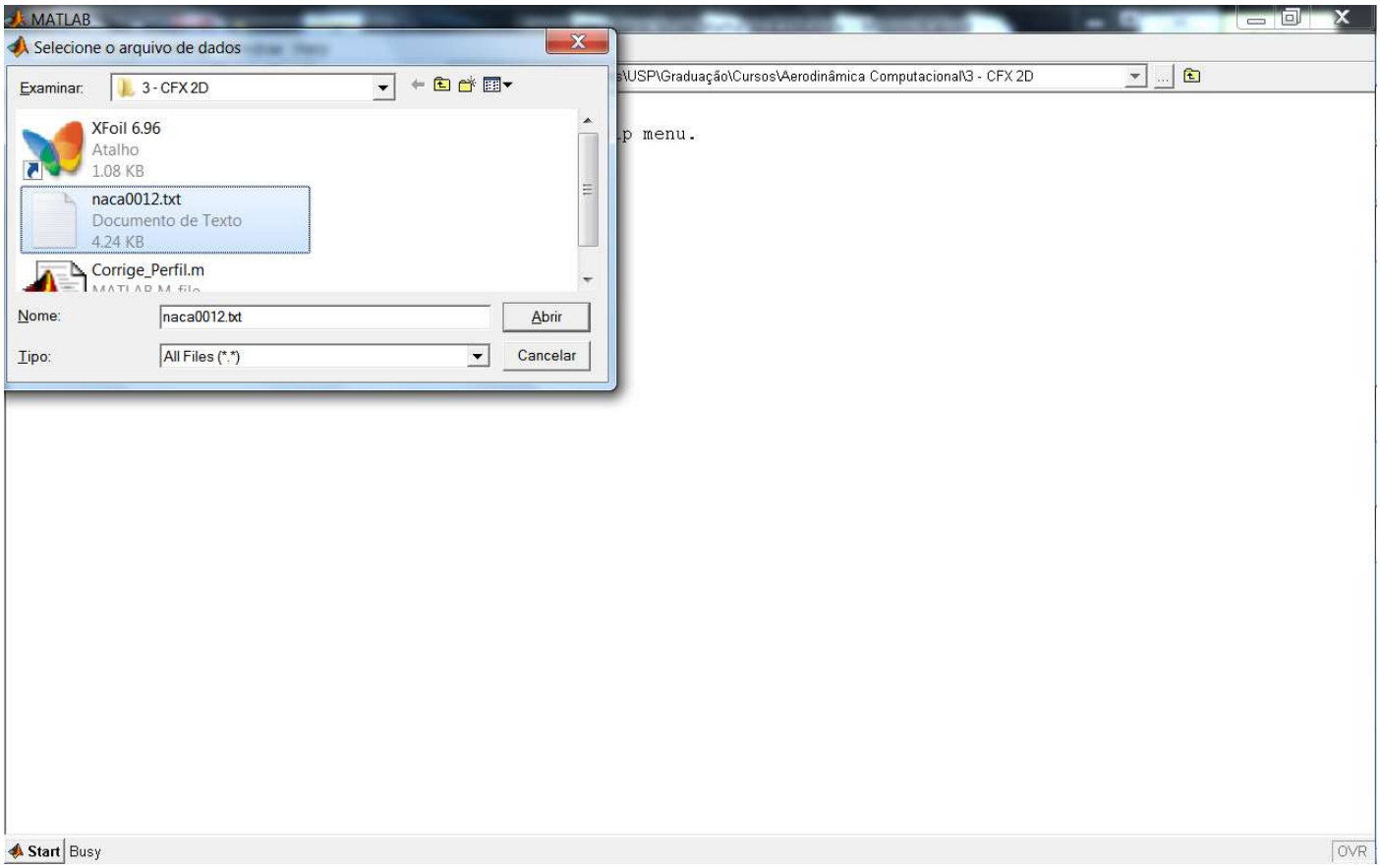
2.2. Selecione a pasta com o arquivo de coordenadas da seção de aerofólio.



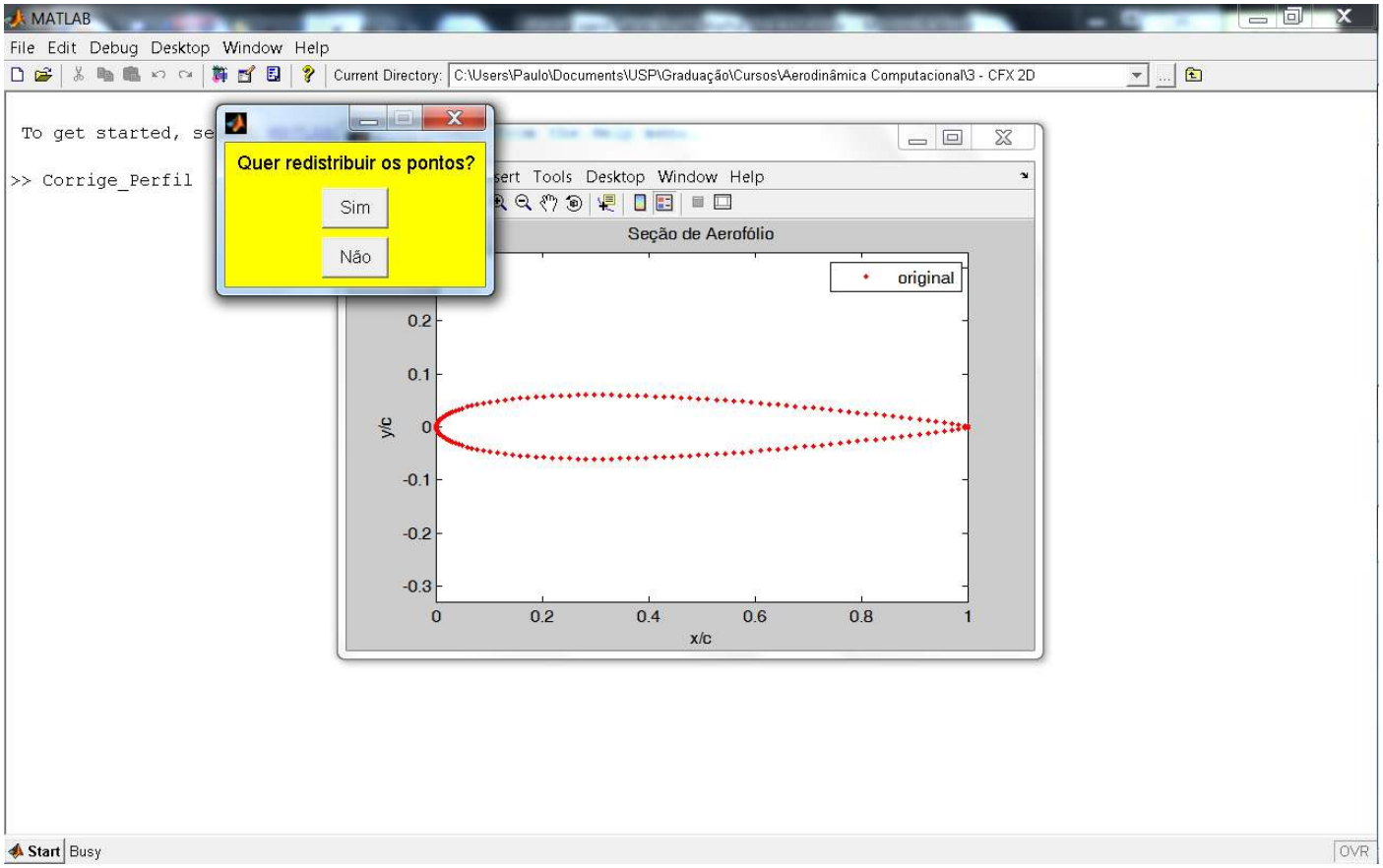
2.3. Execute o script "Corrige_Perfil". Esse script prepara o arquivo para o gerador de malha.



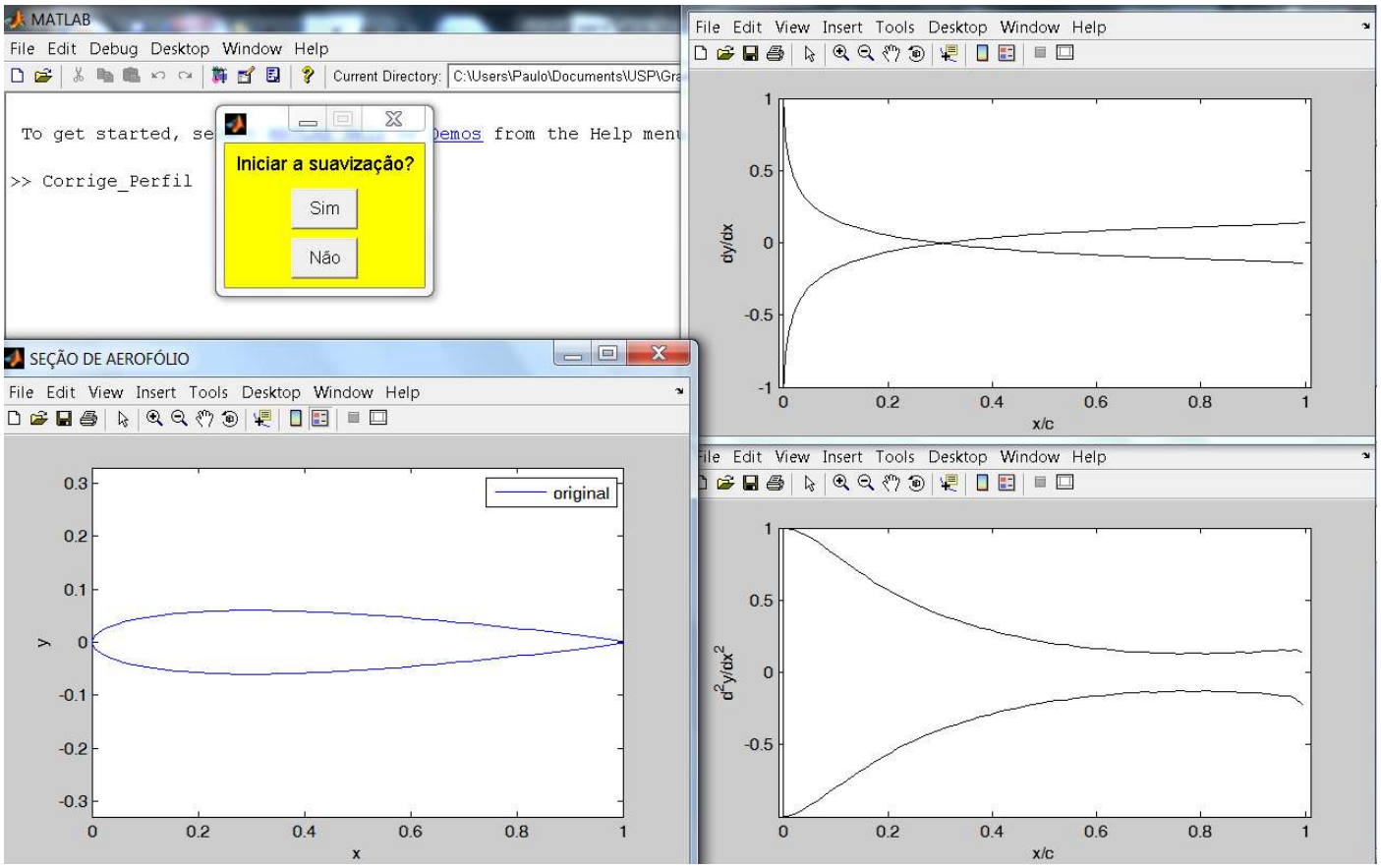
2.4. Selecione o arquivo com as coordenadas.



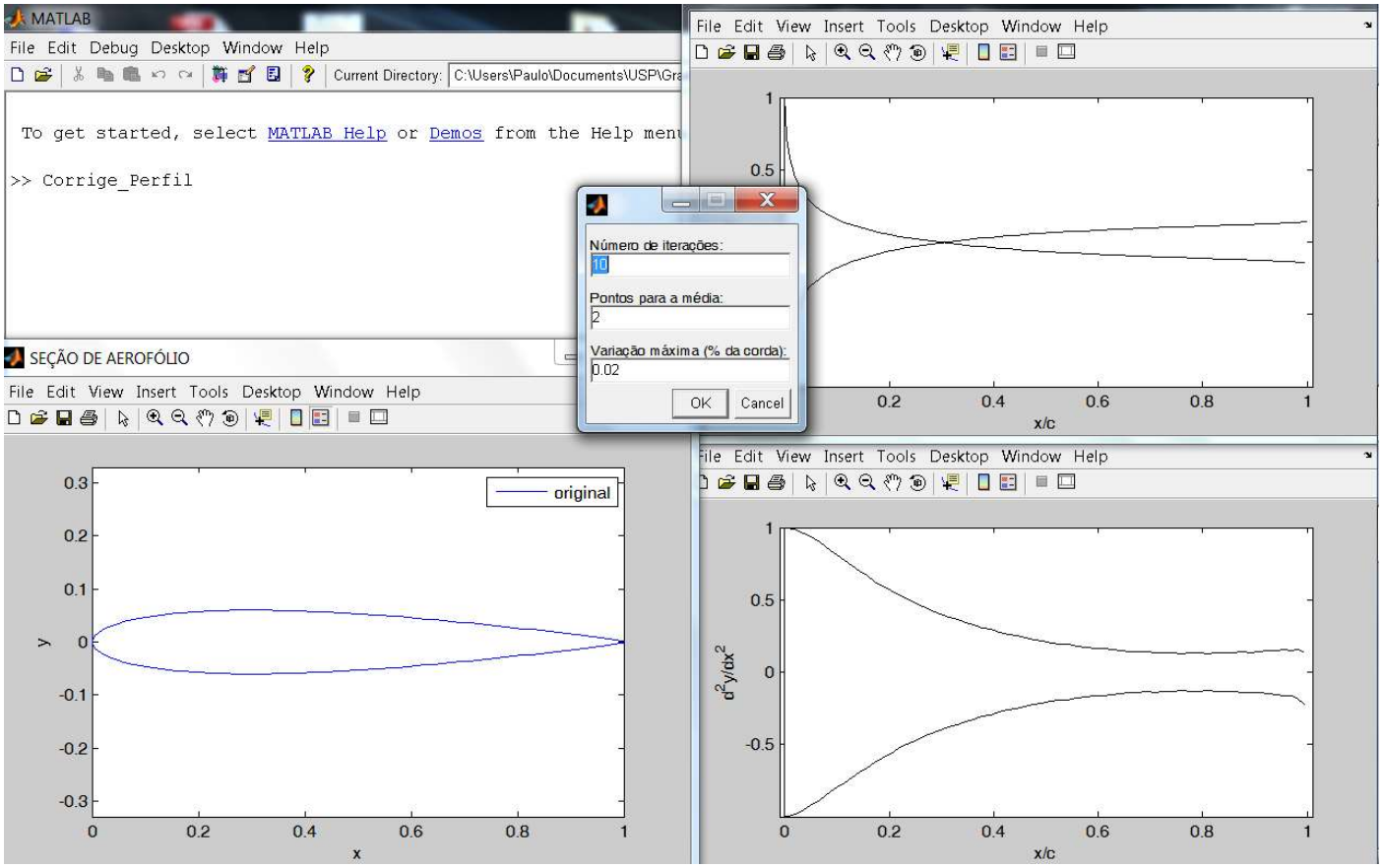
2.5. Selecione "Não" em "Quer redistribuir os pontos?".



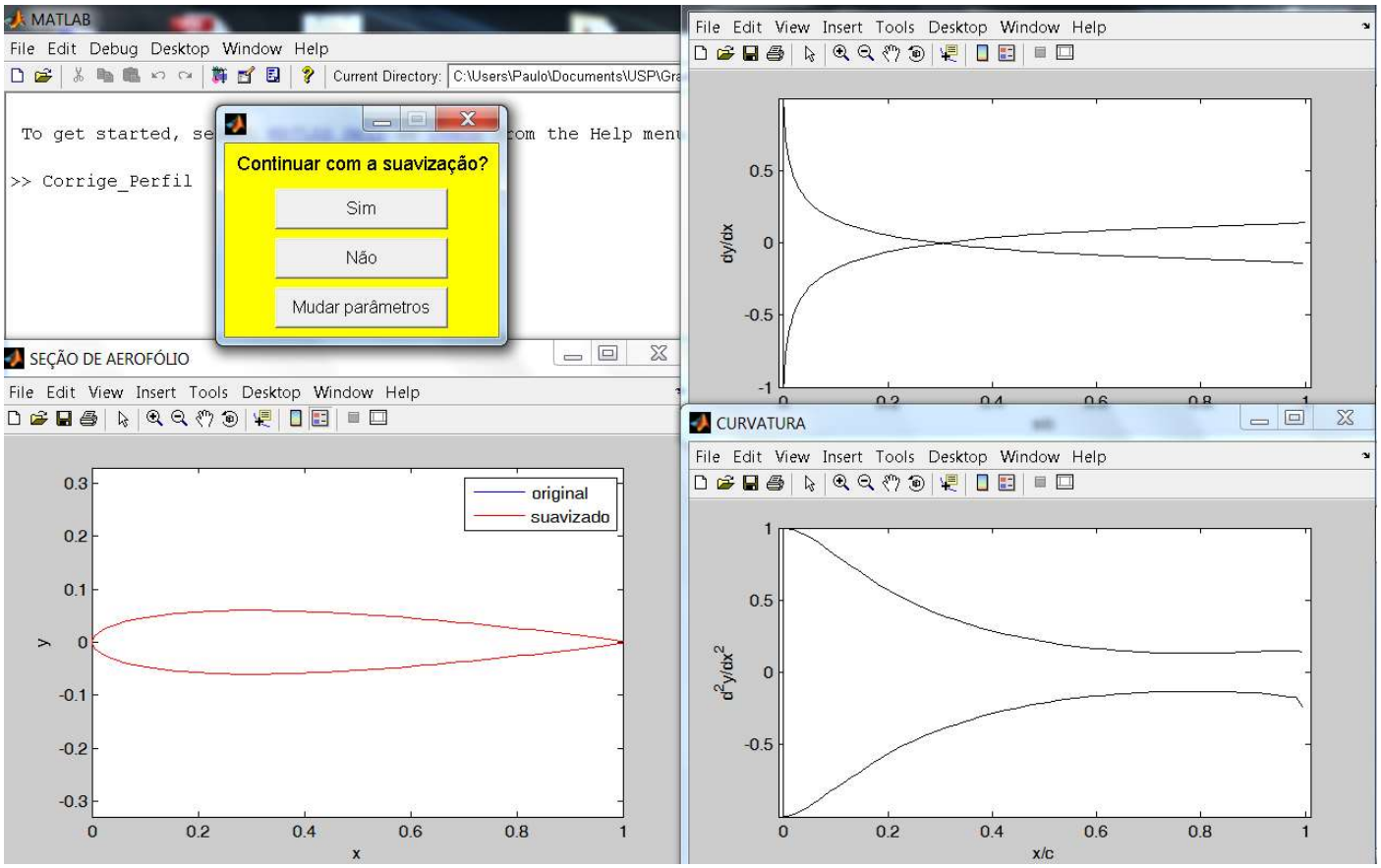
2.6. Selecione "Sim" em "Iniciar a suavização?".



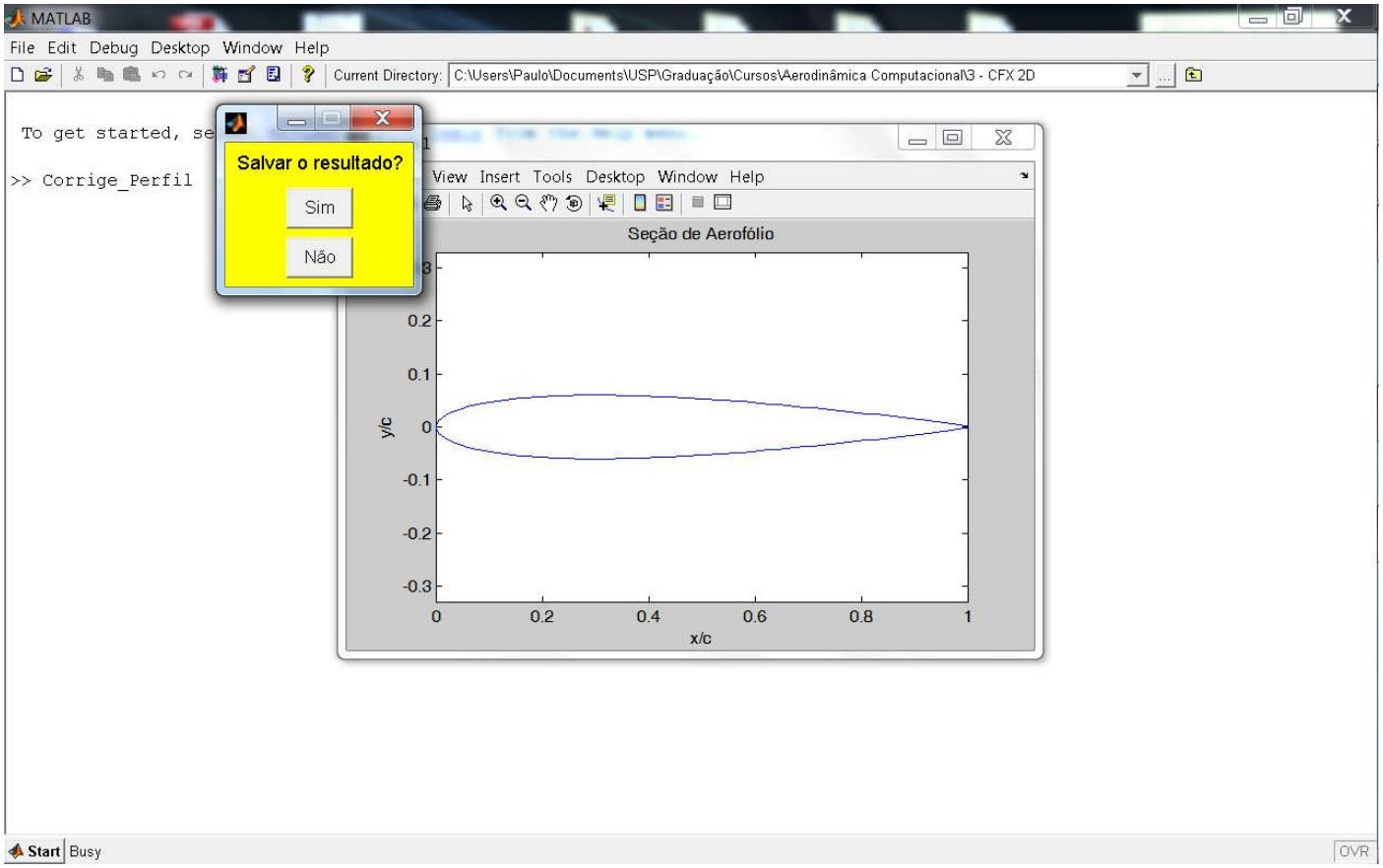
2.7. Selecione "OK" e aguarde o fim do processamento.



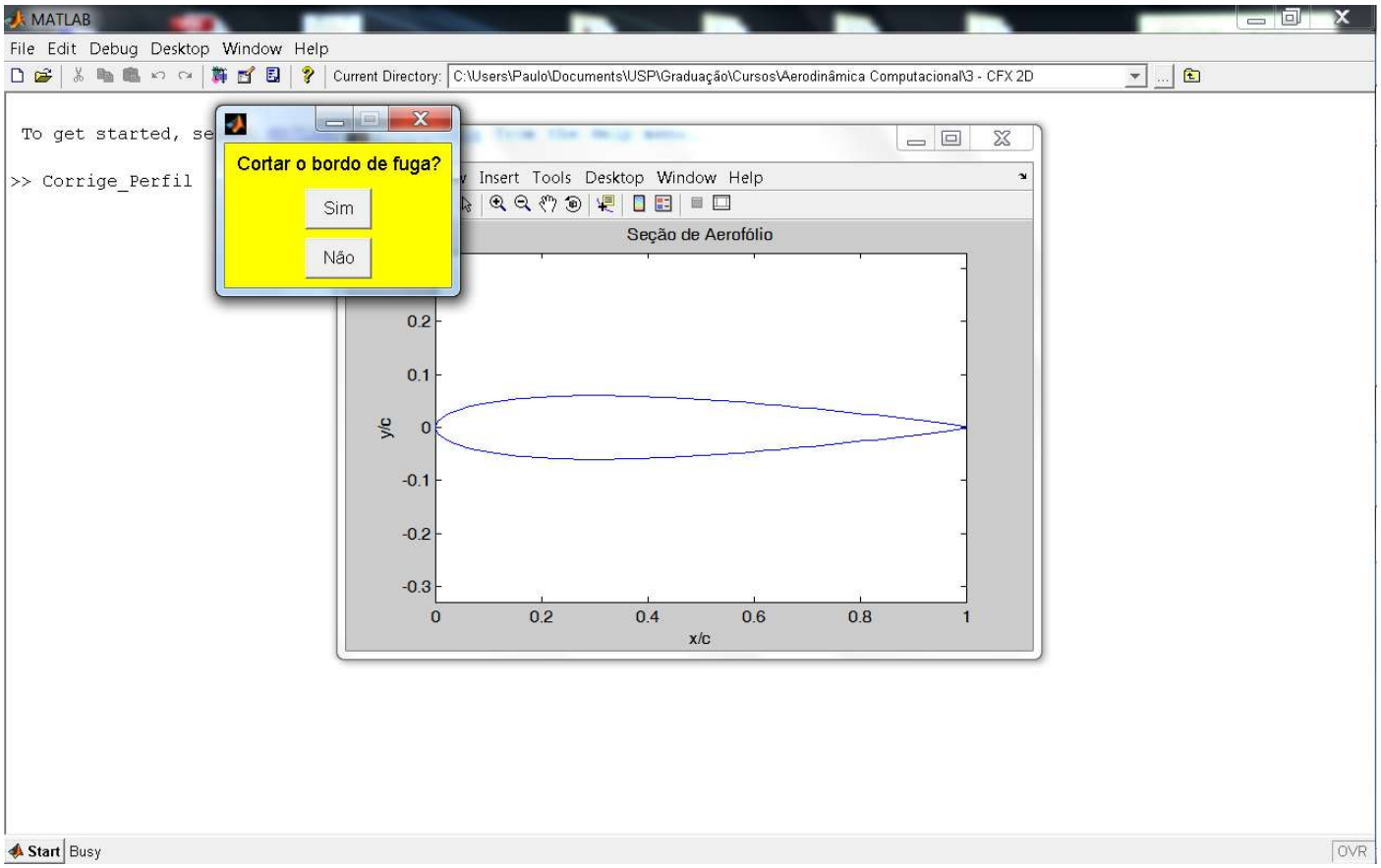
2.8. Selecione "Não" em "Continuar com a suavização?".



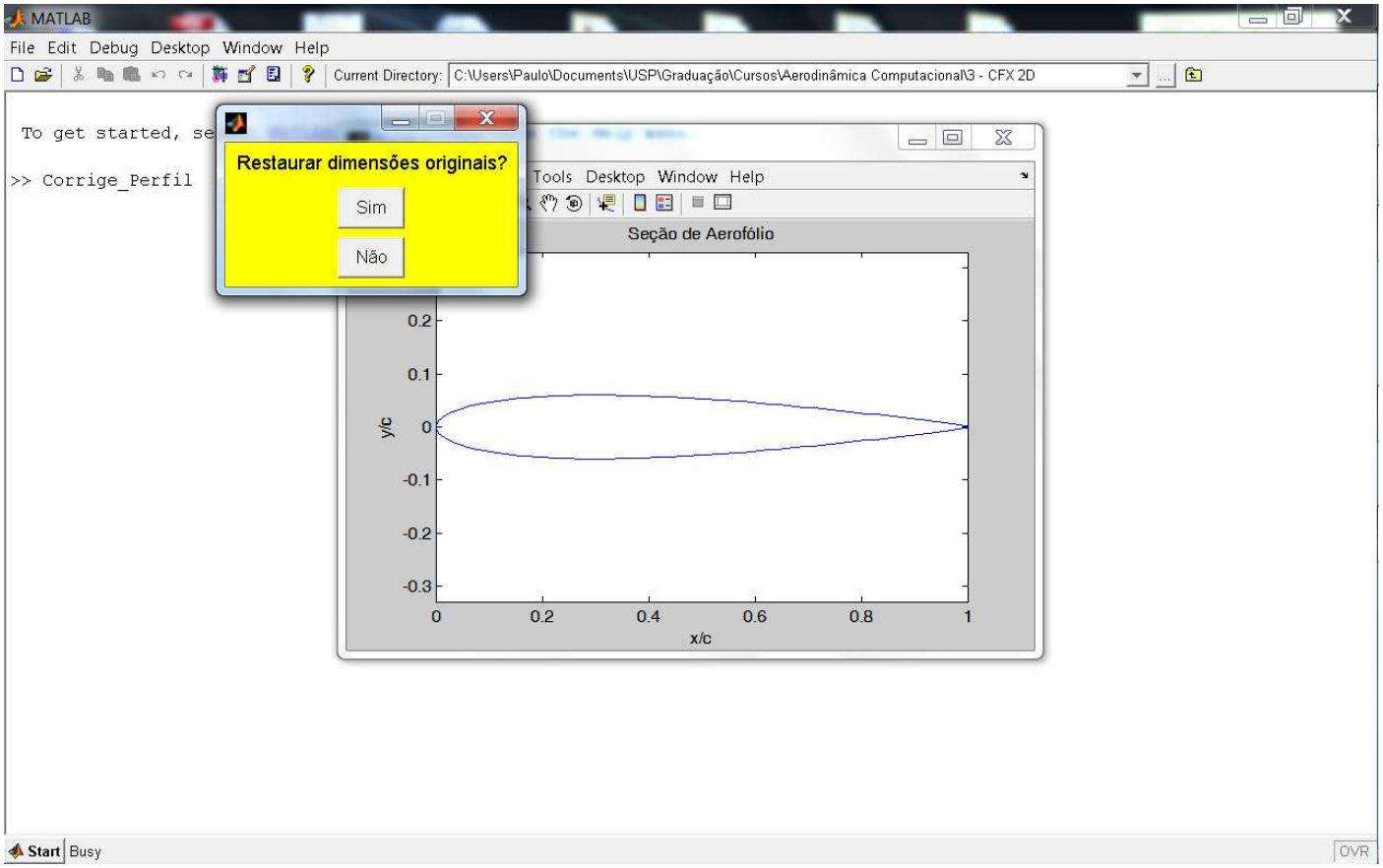
2.9. Selecione "Sim" em "Salvar o resultado?".



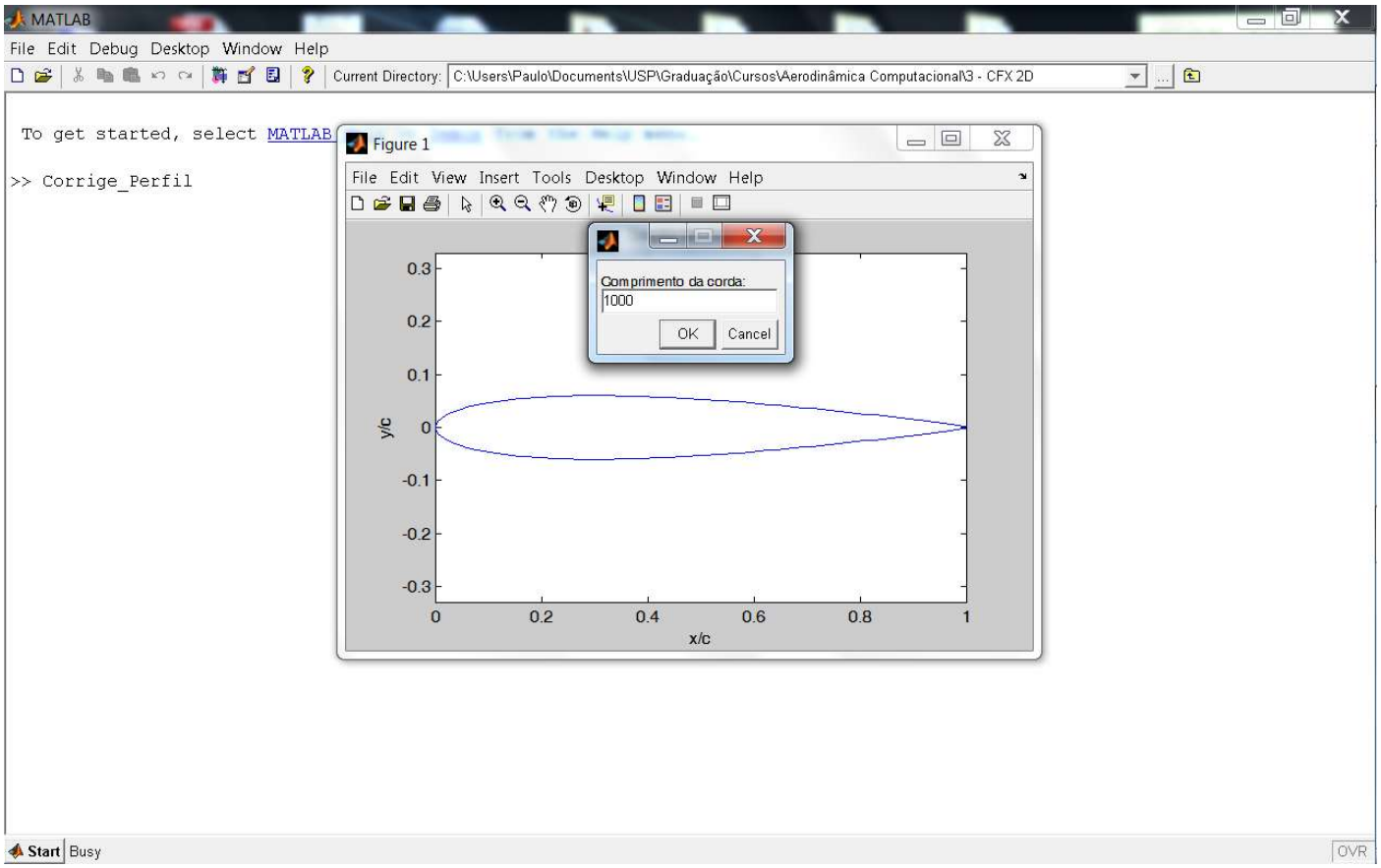
2.10. Selecione "Não" em "Cortar o bordo de fuga?".



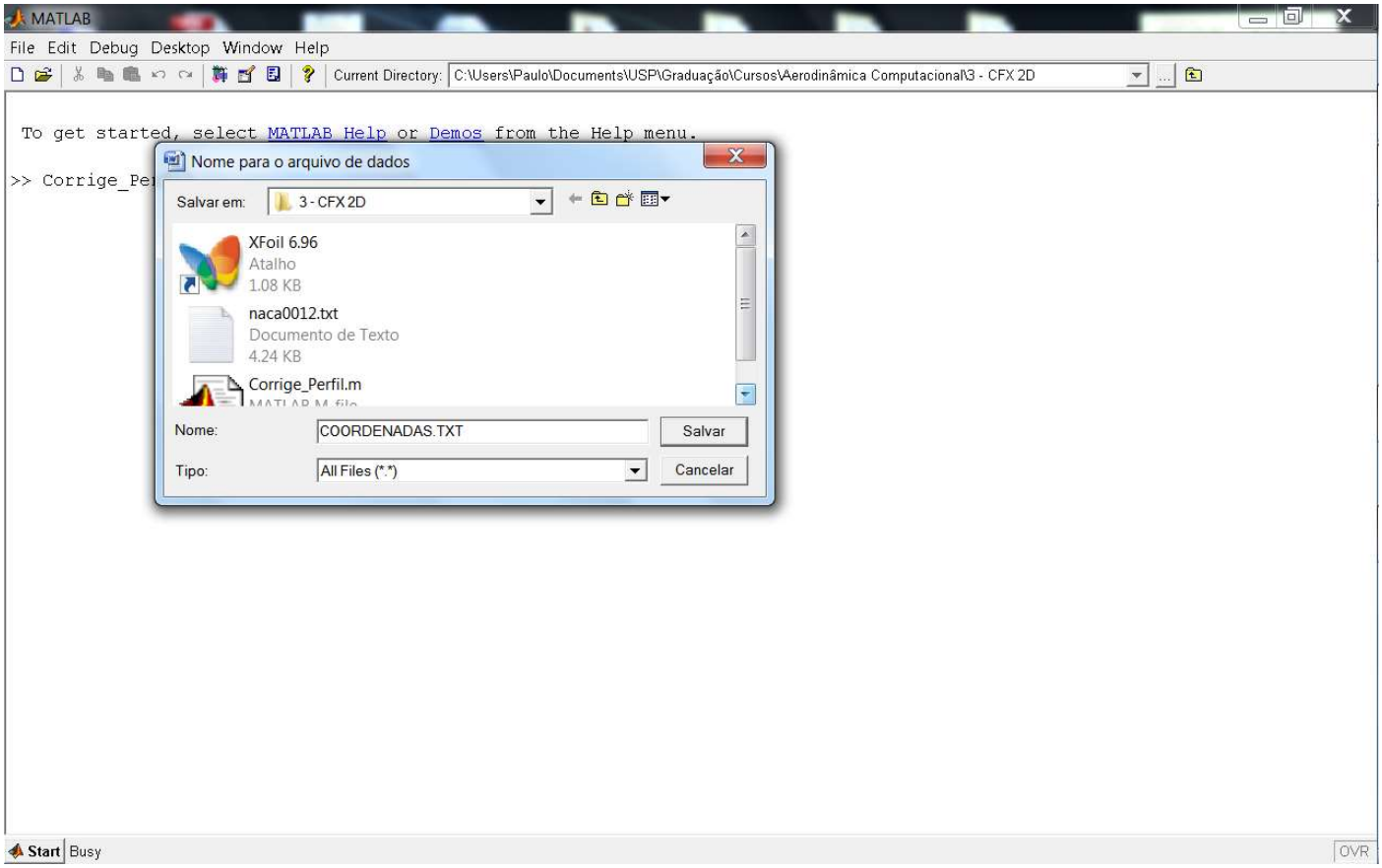
2.11. Selecione "Não" em "Restaurar dimensões originais?".



2.12. Entre o valor "1000" para o comprimento da corda (usaremos corda de 1000 mm).



2.13. Salve as coordenadas suavizadas em um novo arquivo.

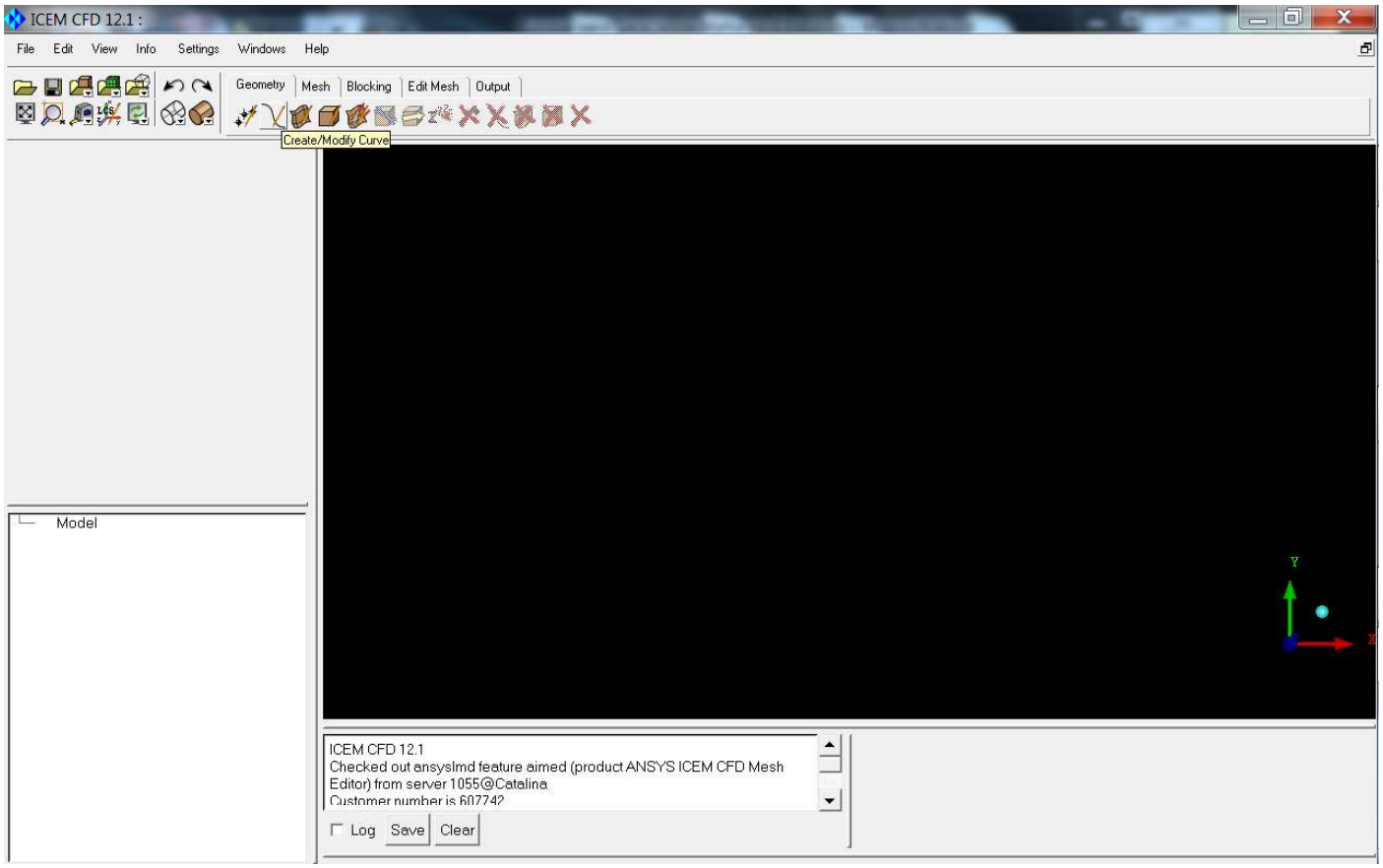


2.14. Saia do Matlab.

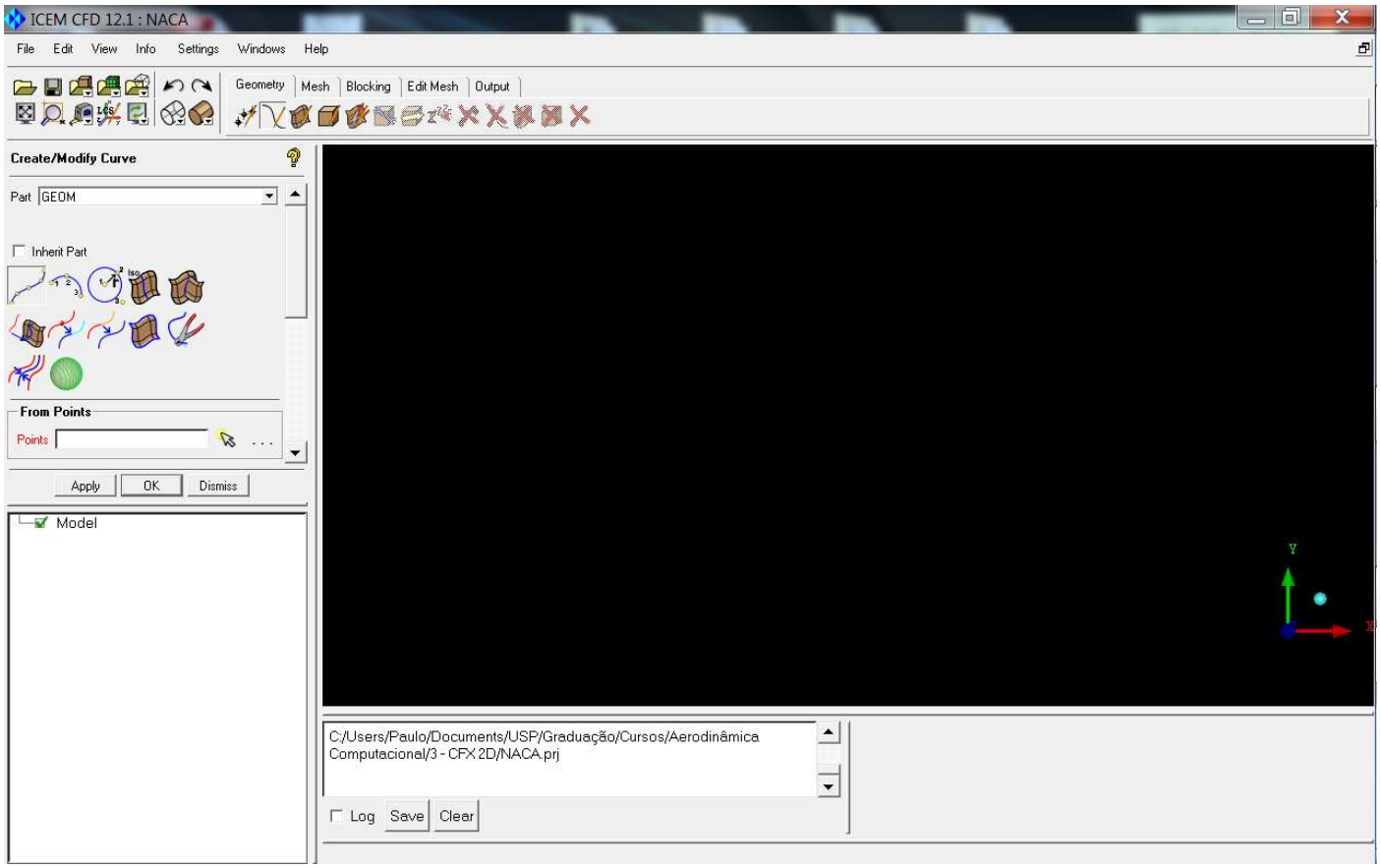
3. No ICEM-CFD.

3.1. Salve o projeto na pasta que contém o arquivo de coordenadas da seção de aerofólio.

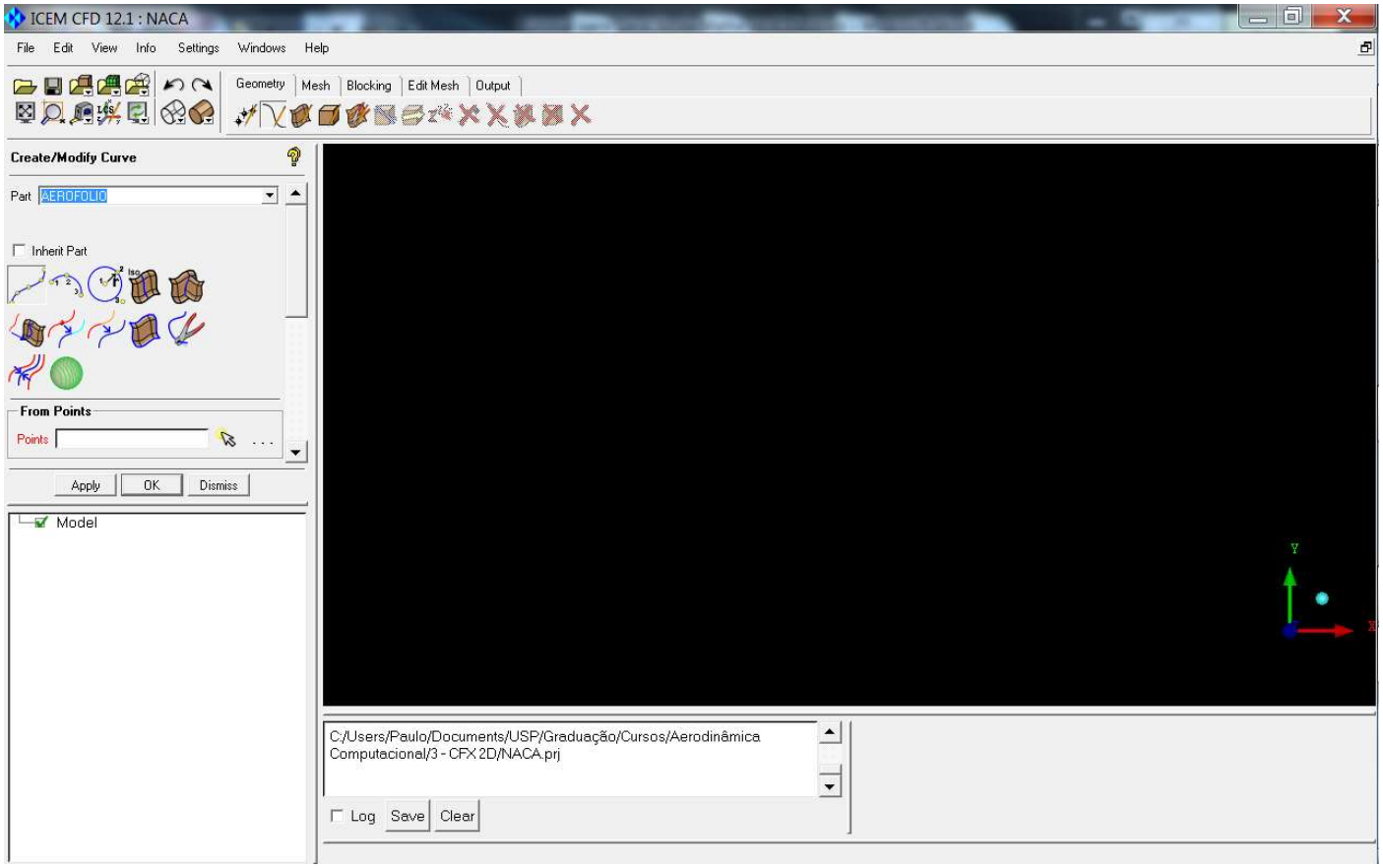
3.2. Selecione a ferramenta "Create/Modify Curve".



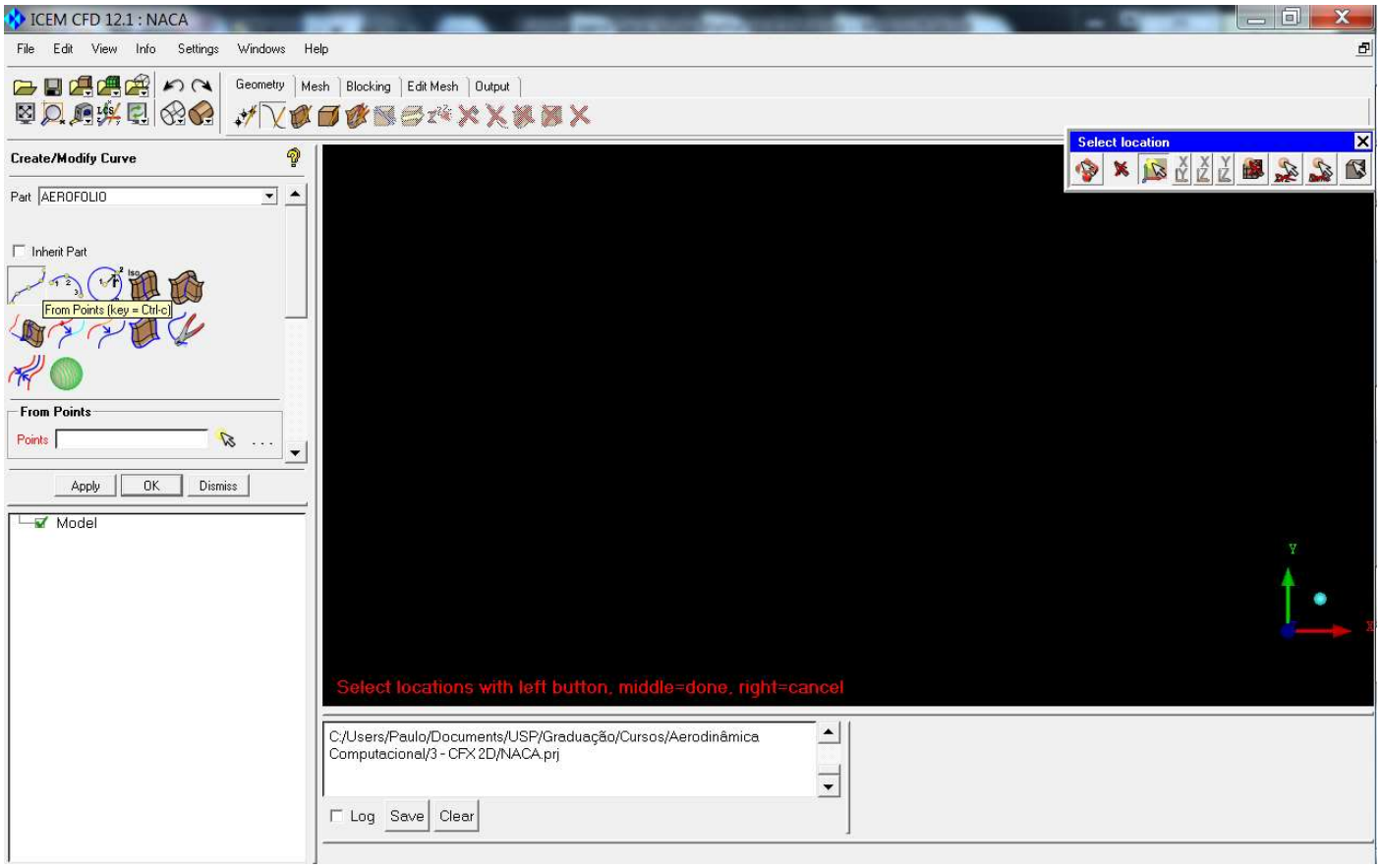
3.3. Remova a seleção de "Inherit Part".



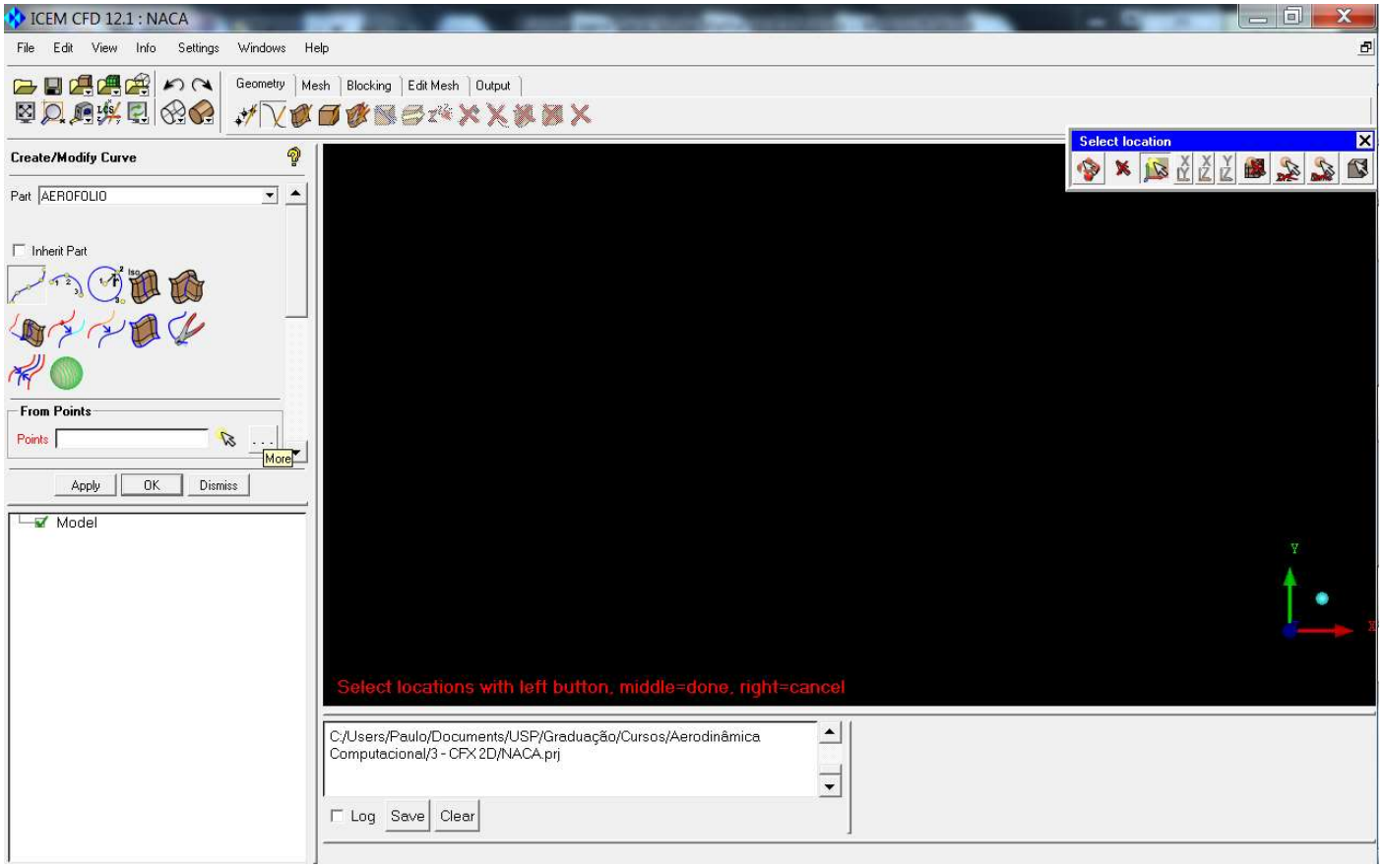
3.4. Dê o nome de "AEROFOLIO" para a parte.



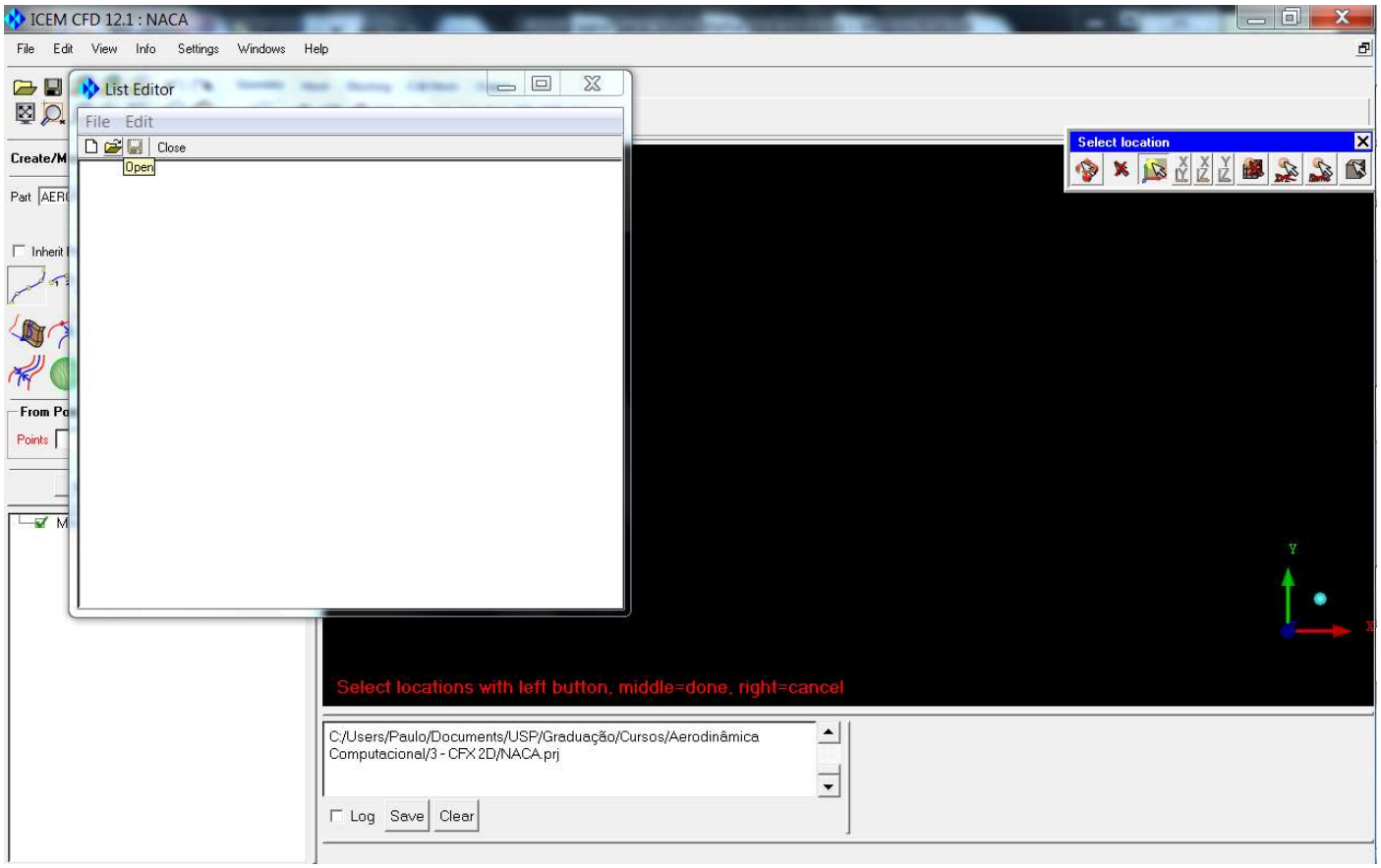
3.5. Selecione a sub-ferramenta "From Points".



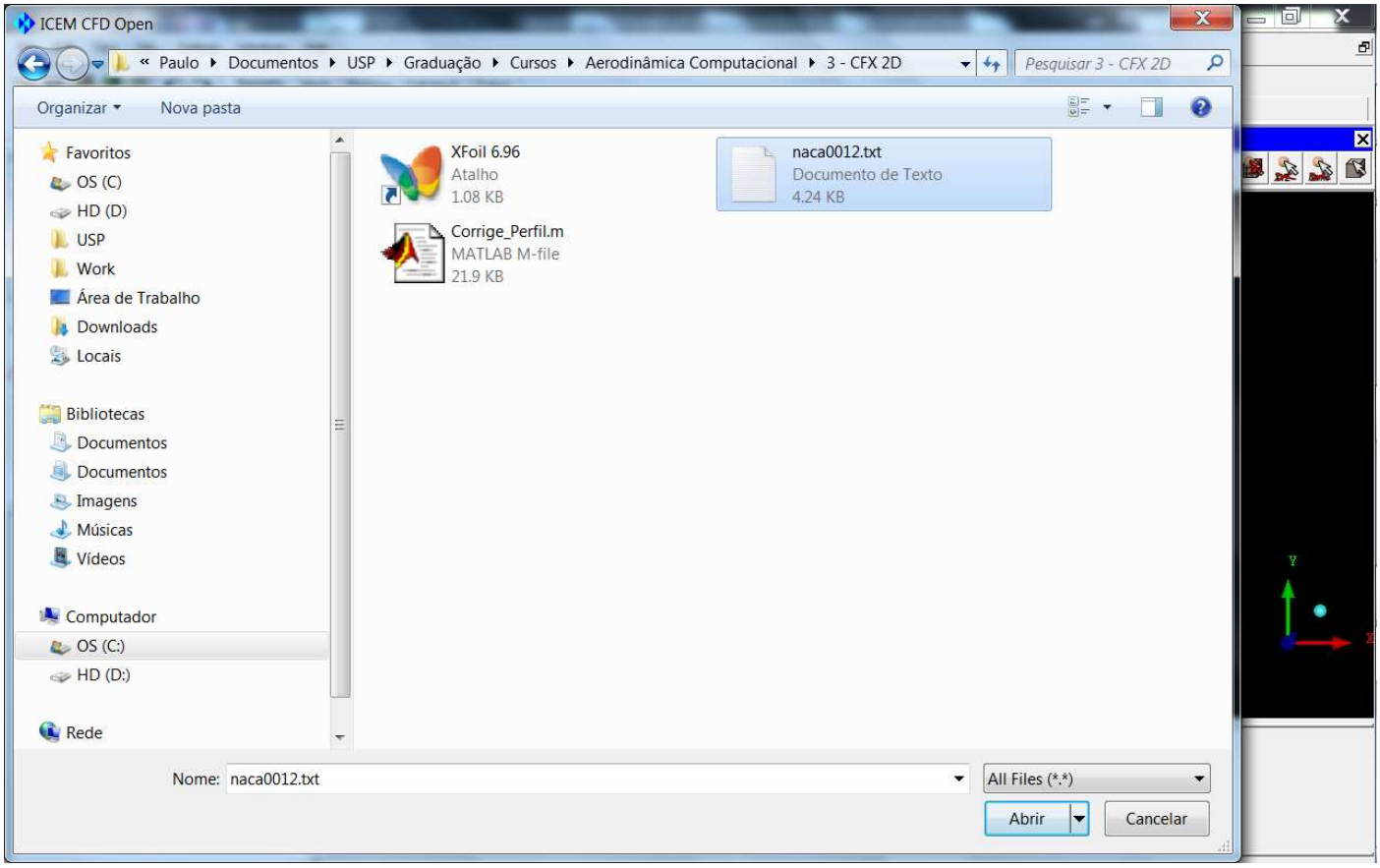
3.6. Select "More".



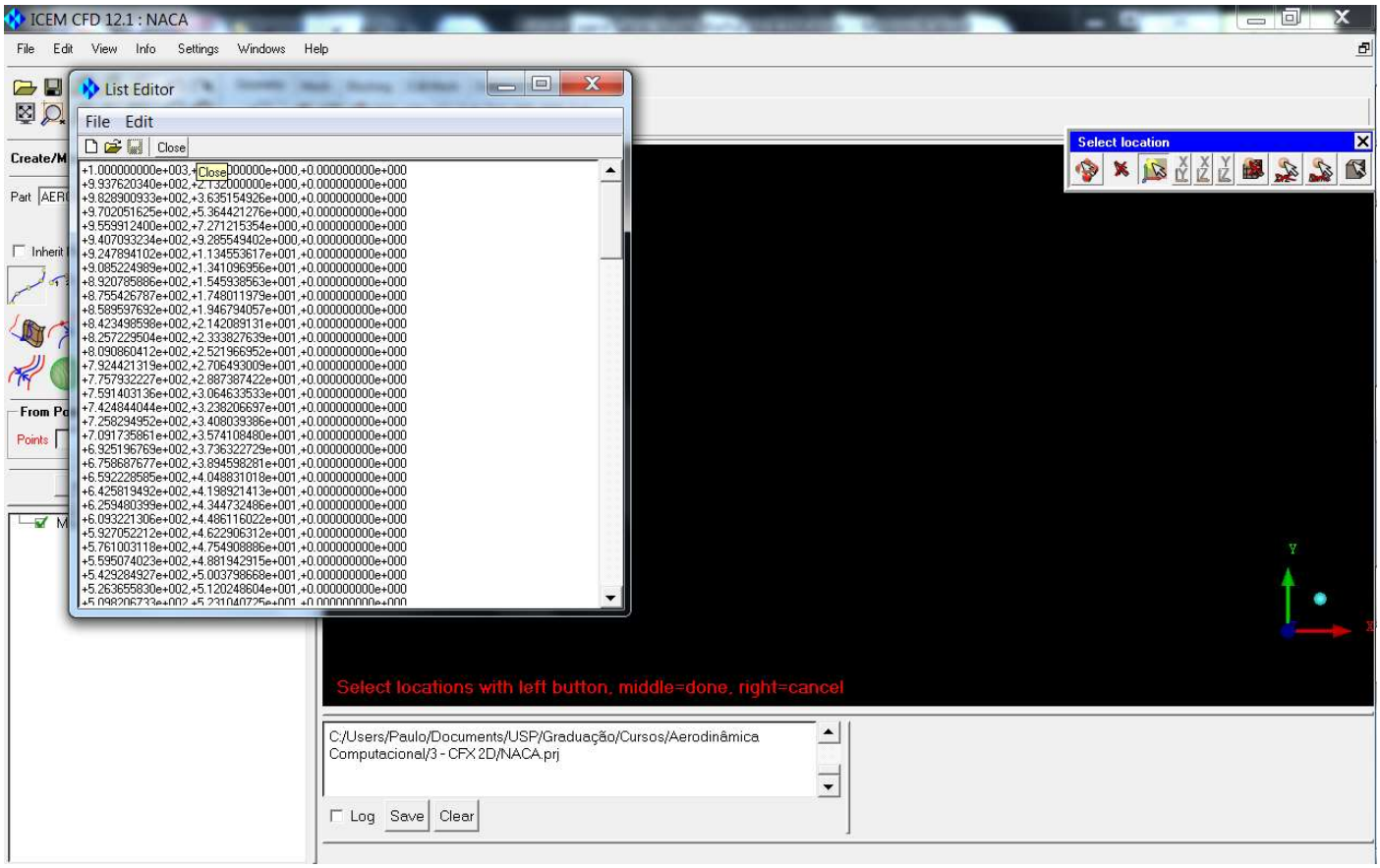
3.7. Select "Open".



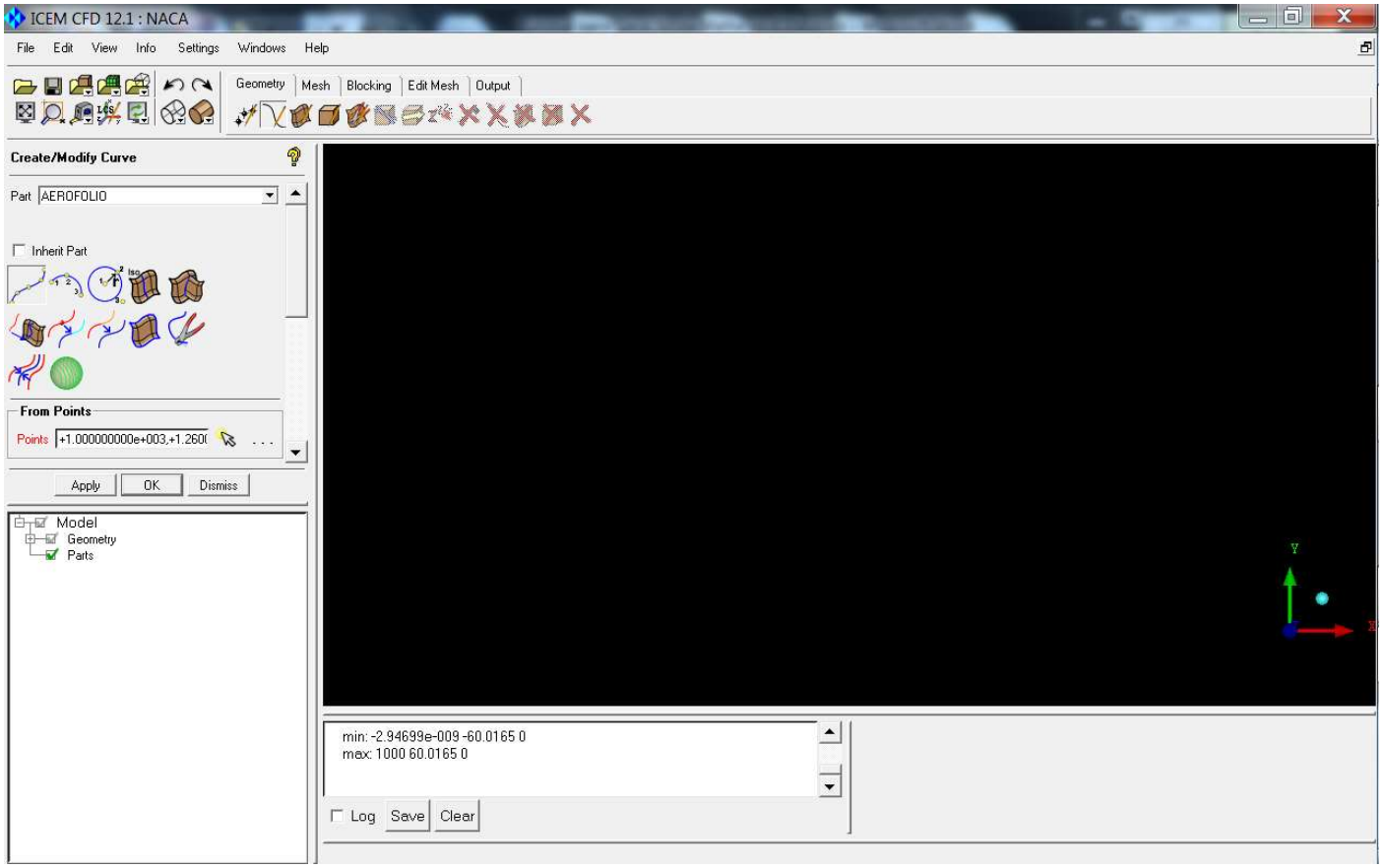
3.8. Selecione o arquivo de coordenadas da seção



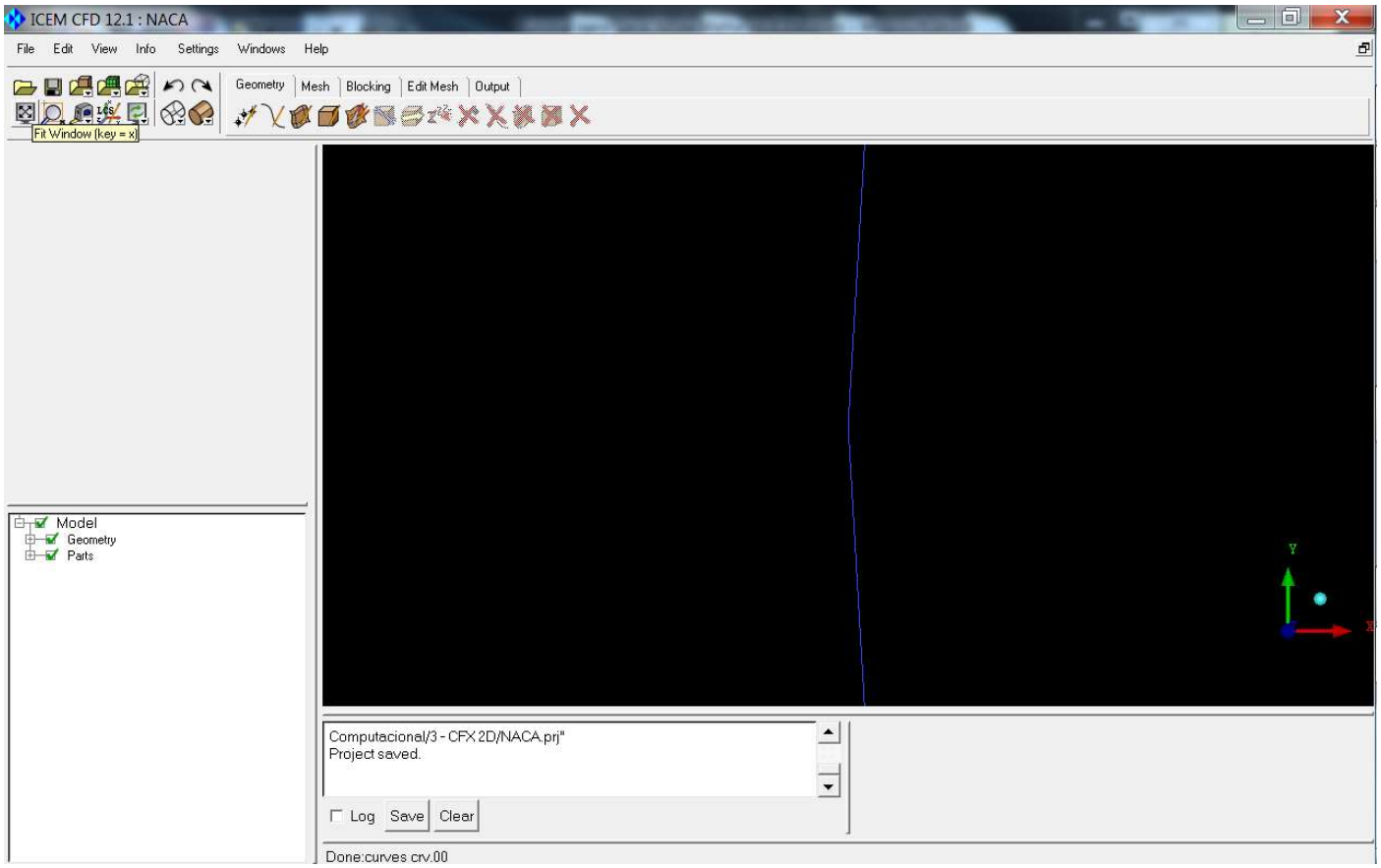
3.9. Selecione a janela "List Editor" na barra de tarefas do Windows, clique em "Close" e "OK" em "Accept the changes...".



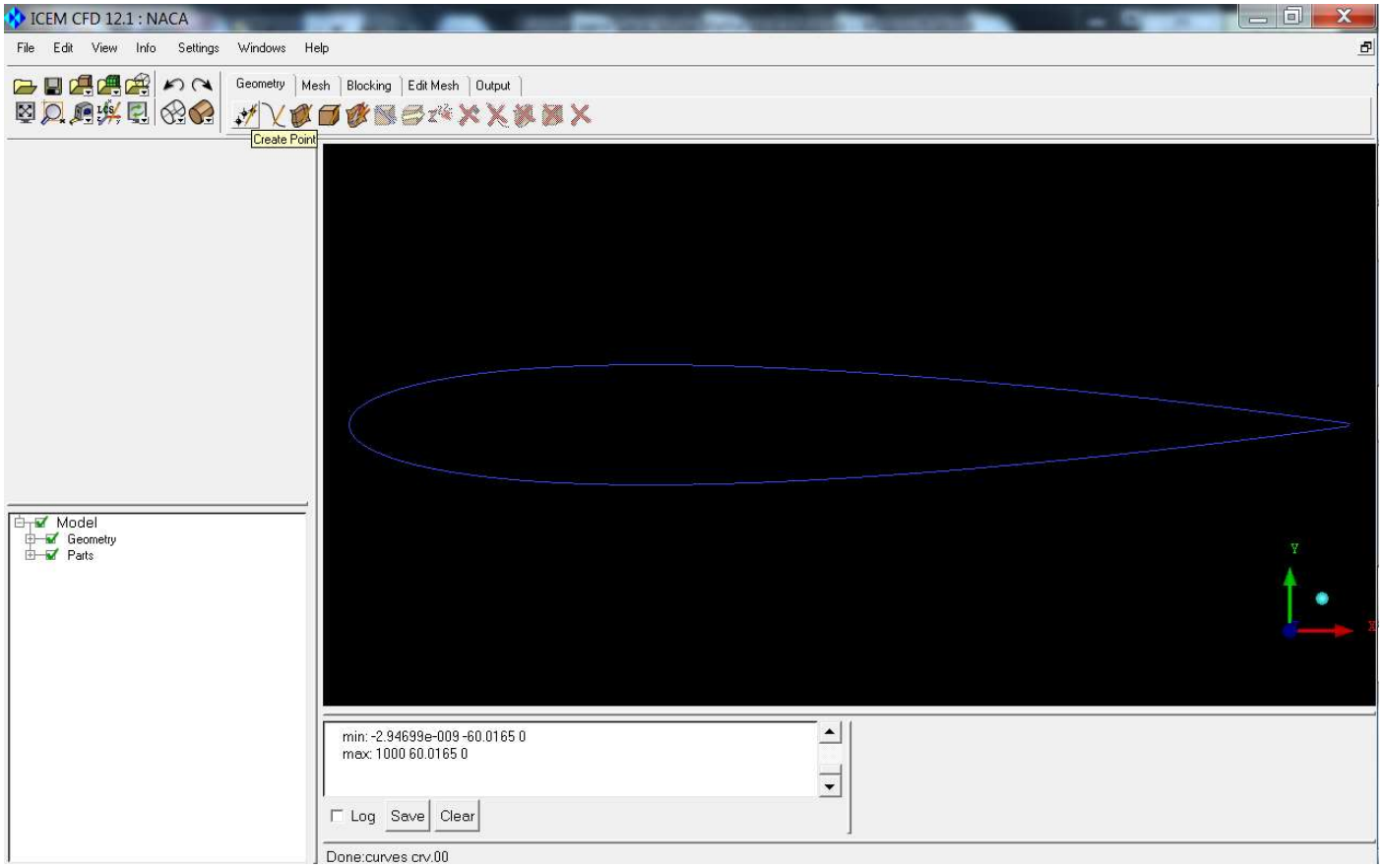
3.10. Clique em "OK".



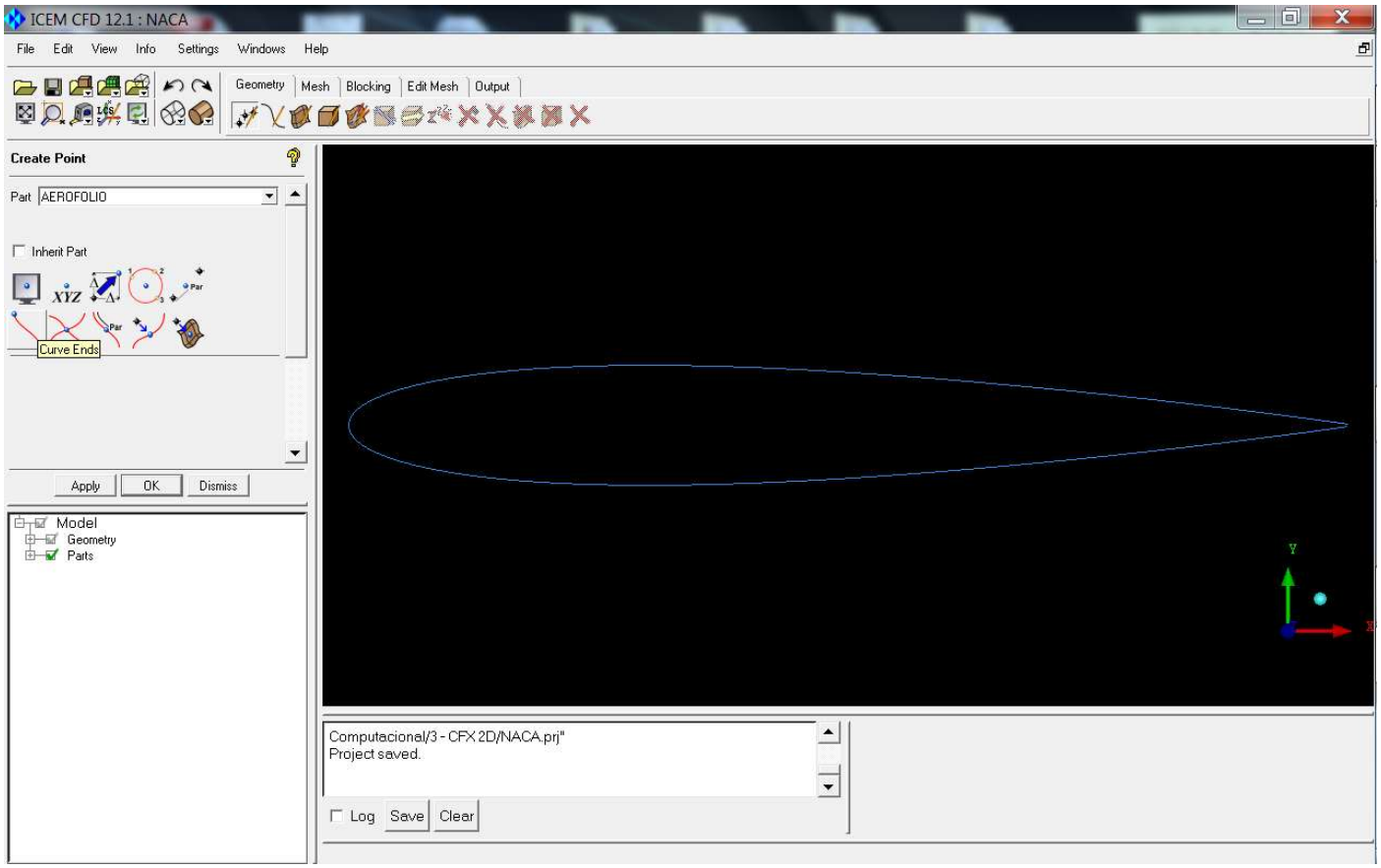
3.11. Clique em "Fit Window".



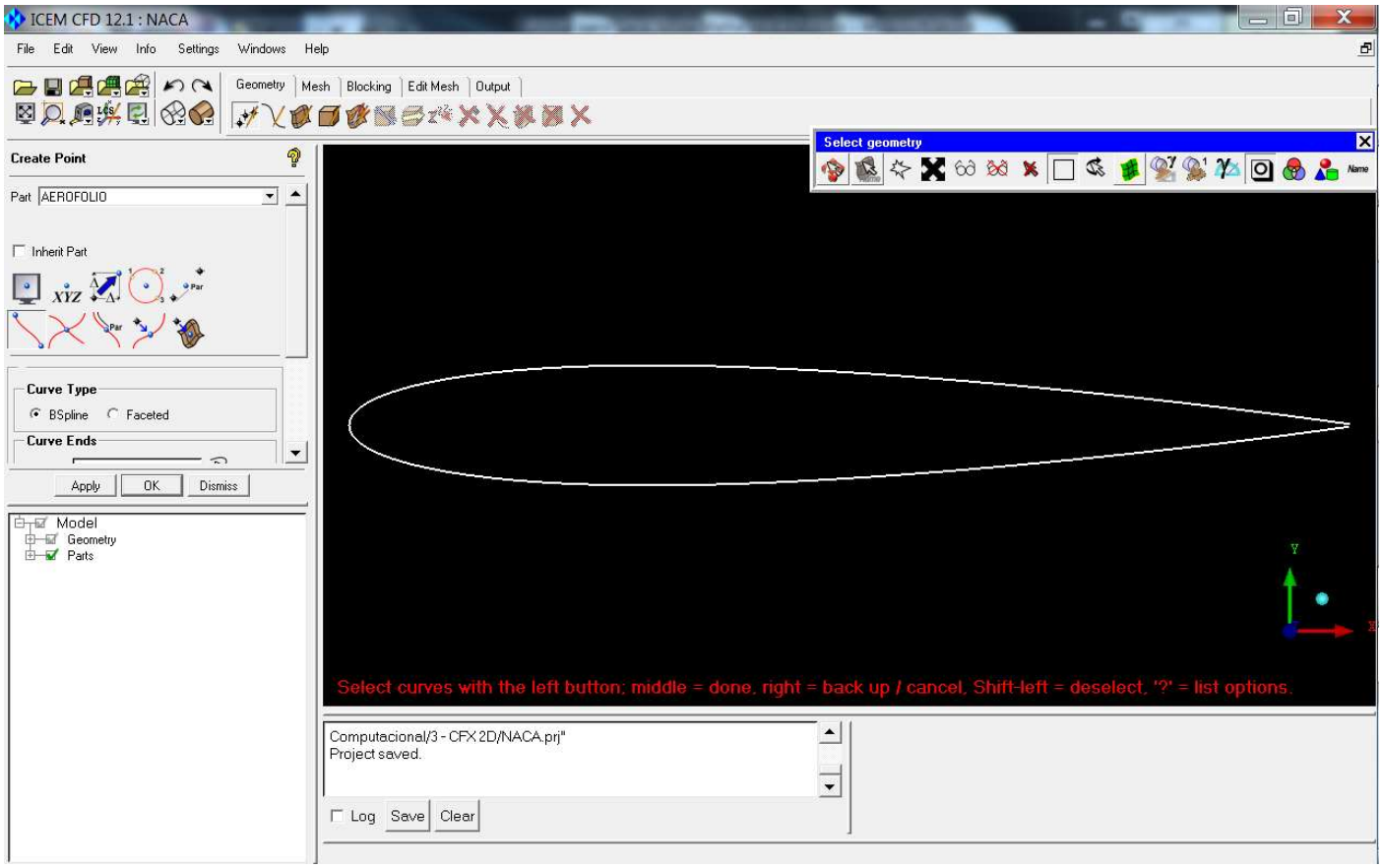
3.12. Selecione a ferramenta "Create Point".



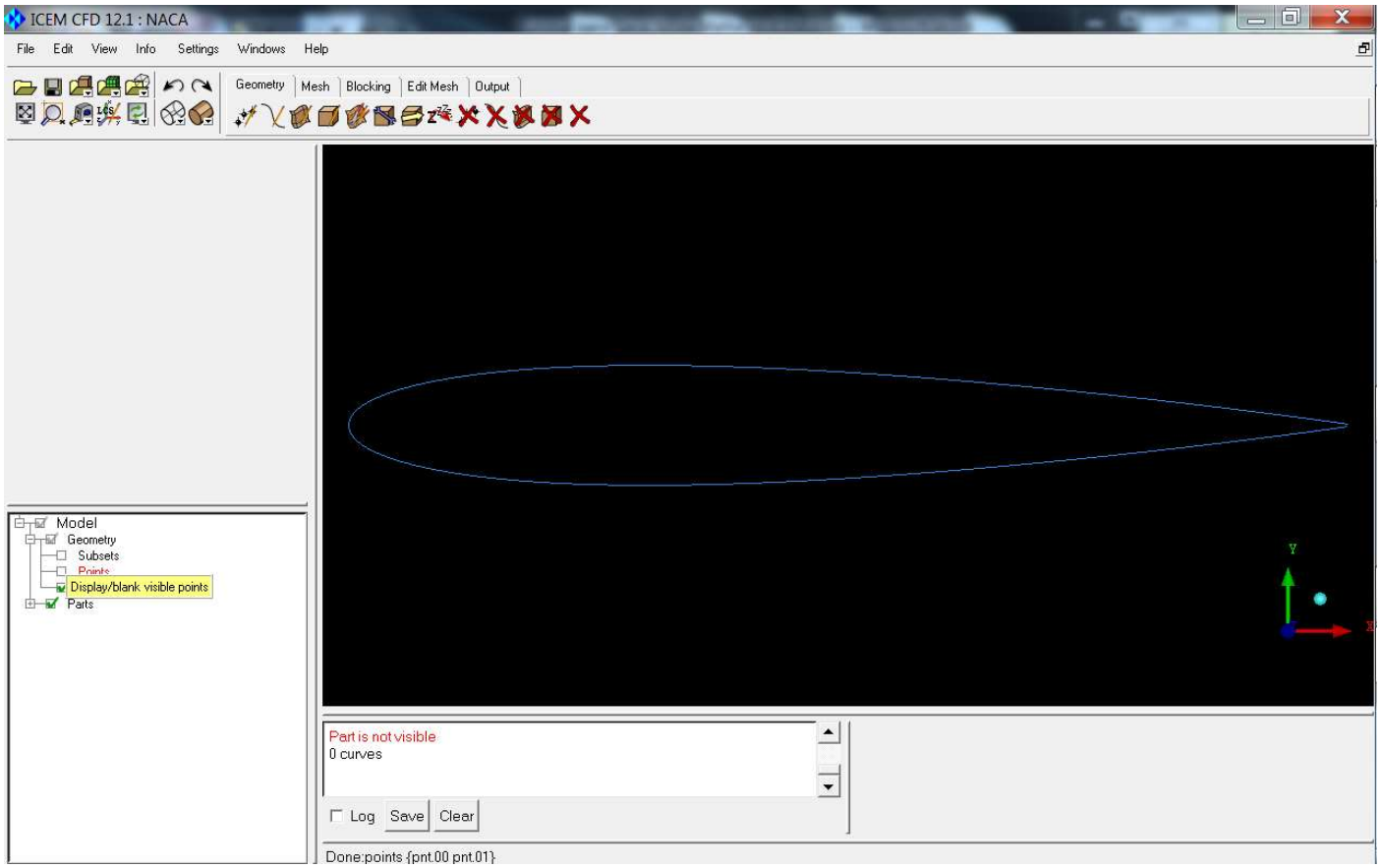
3.13. Selecione a sub-ferramenta "Curve Ends".



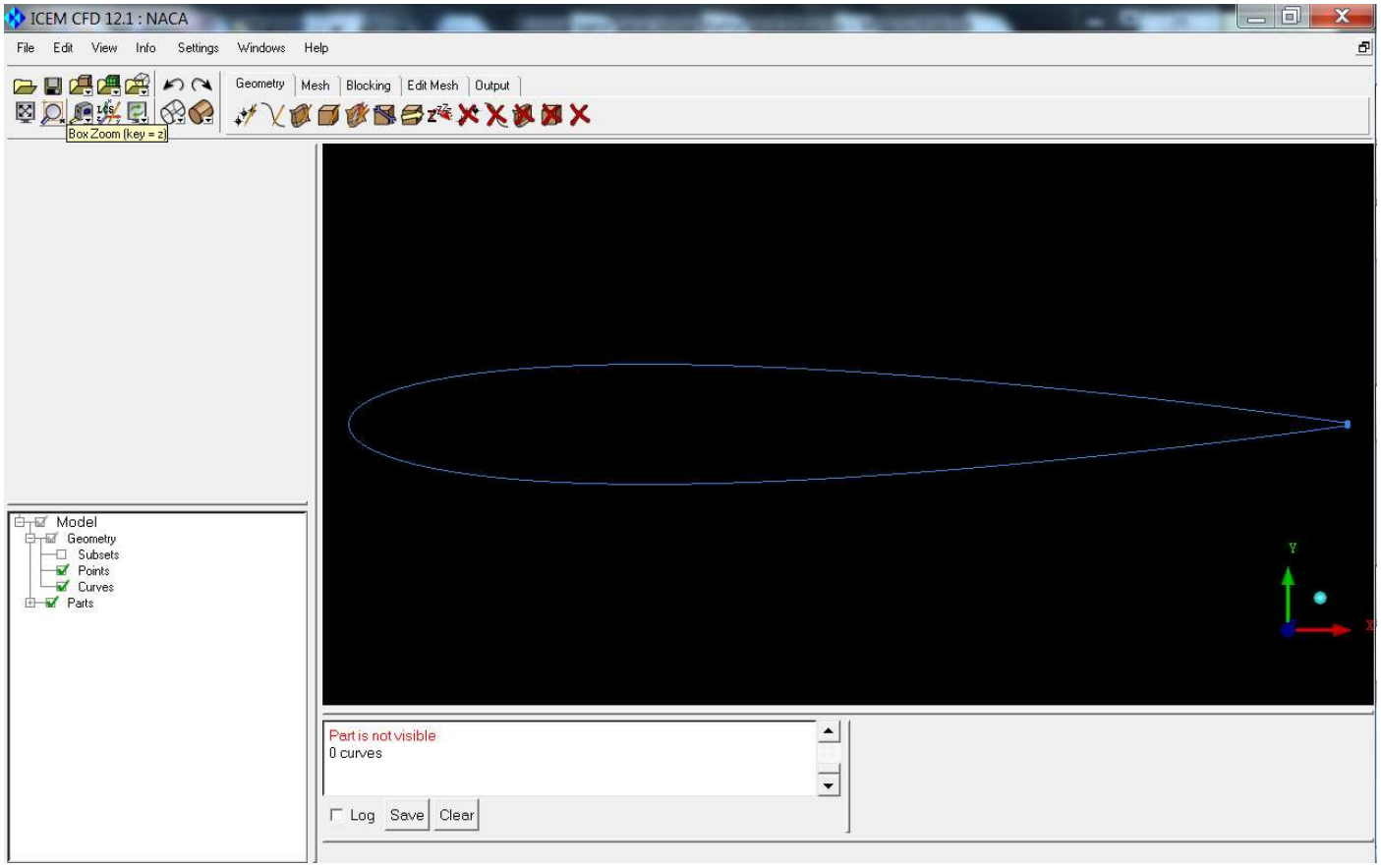
3.14. Selecione a curva do aerofolio com o botão esquerdo do mouse e confirme com o botão do meio. Clique em "Dismiss".



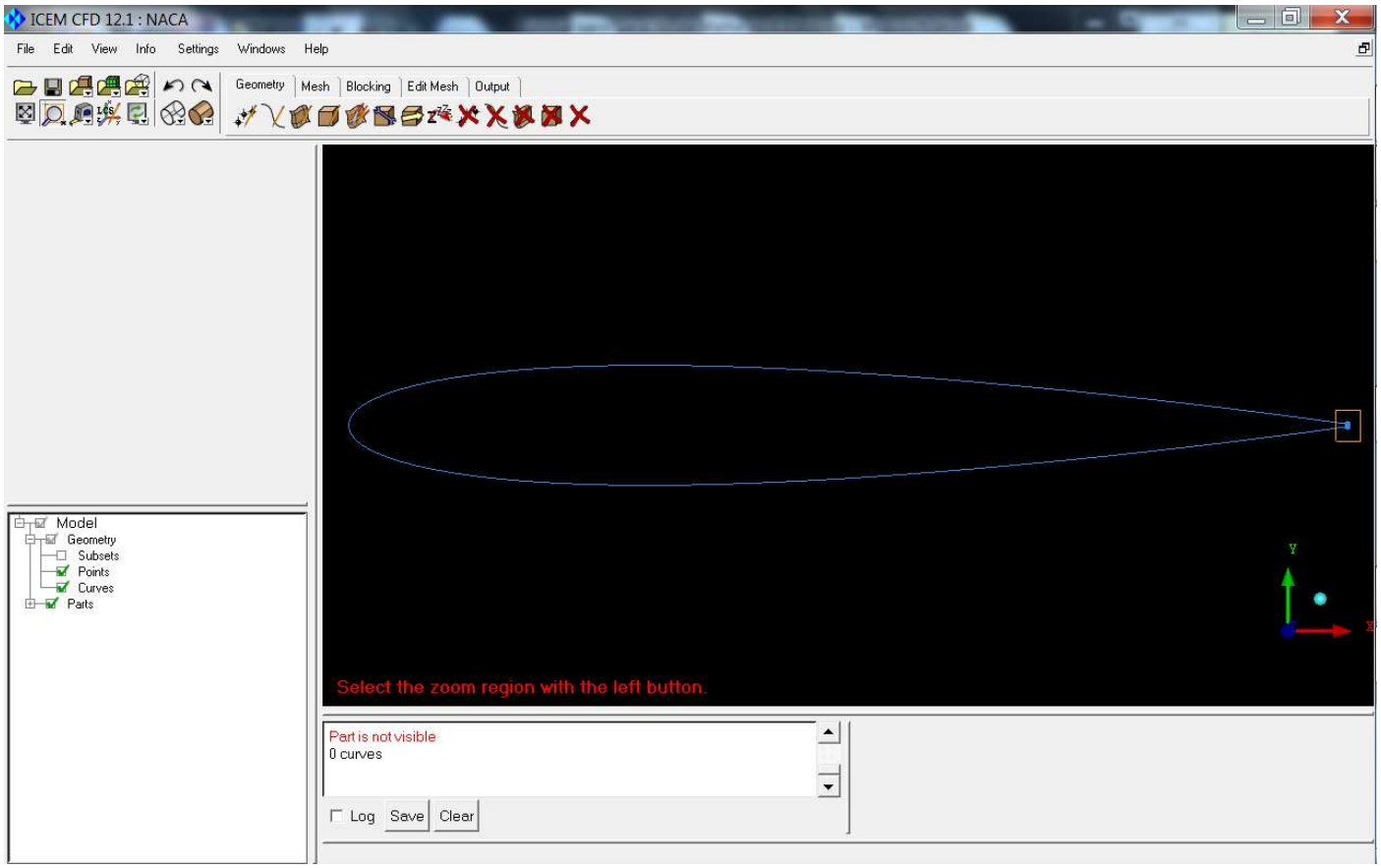
3.15. Selecione a caixa "Points" para visualizar os pontos.



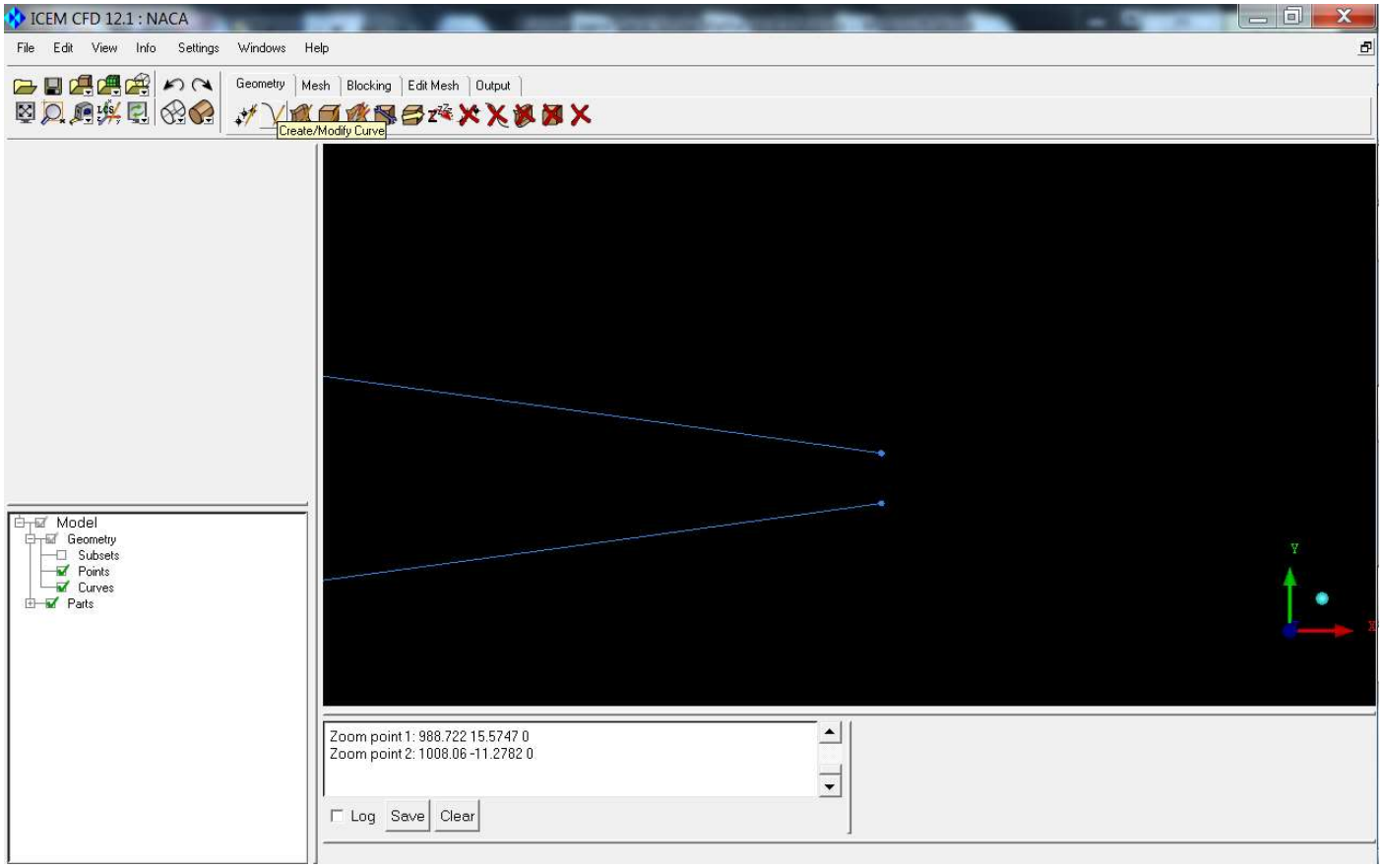
3.16. Selecione a ferramenta "Box Zoom".



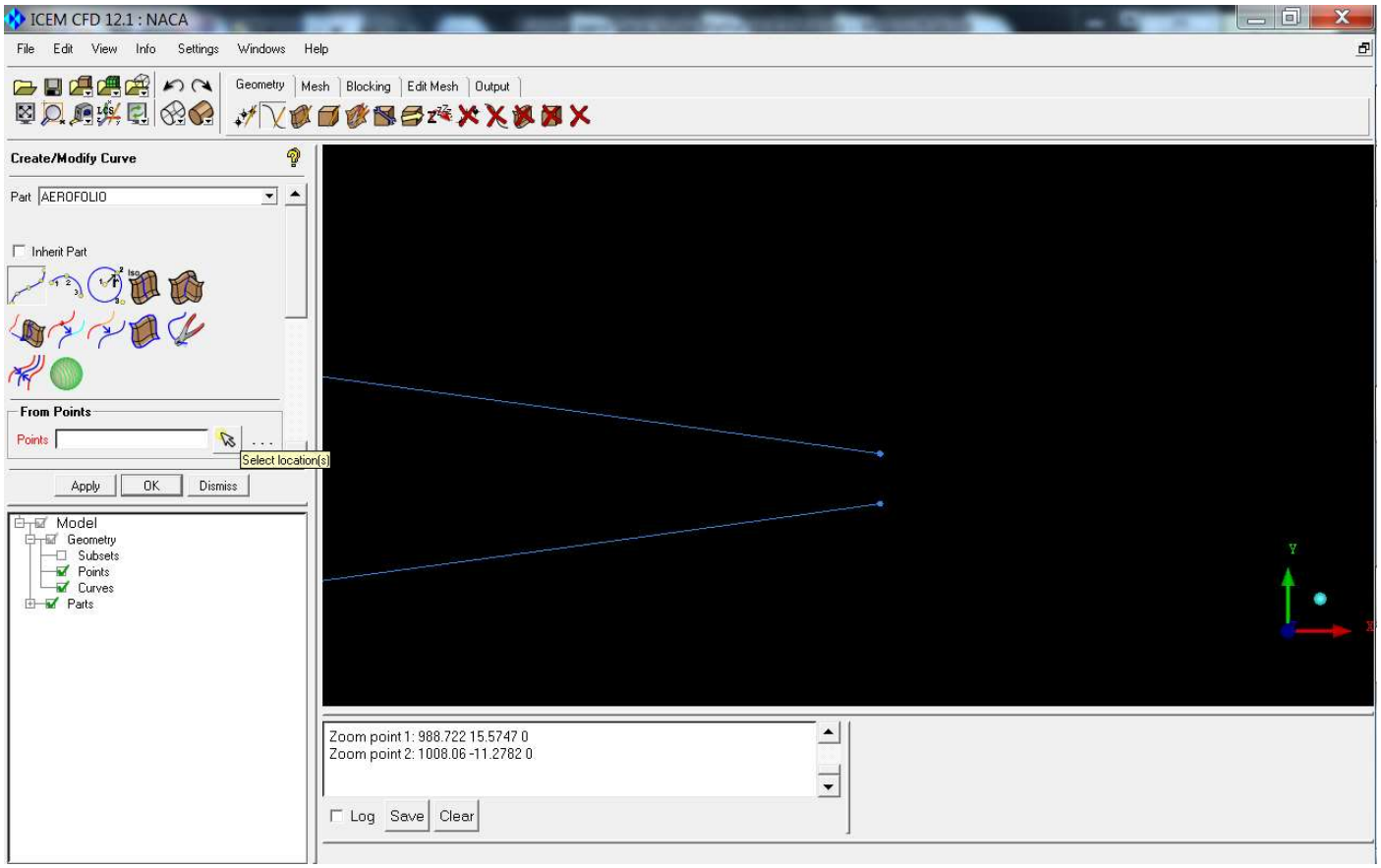
3.17. Arraste o mouse com o botão esquerdo para fazer o zoom em uma caixa pequena em torno do bordo de fuga.



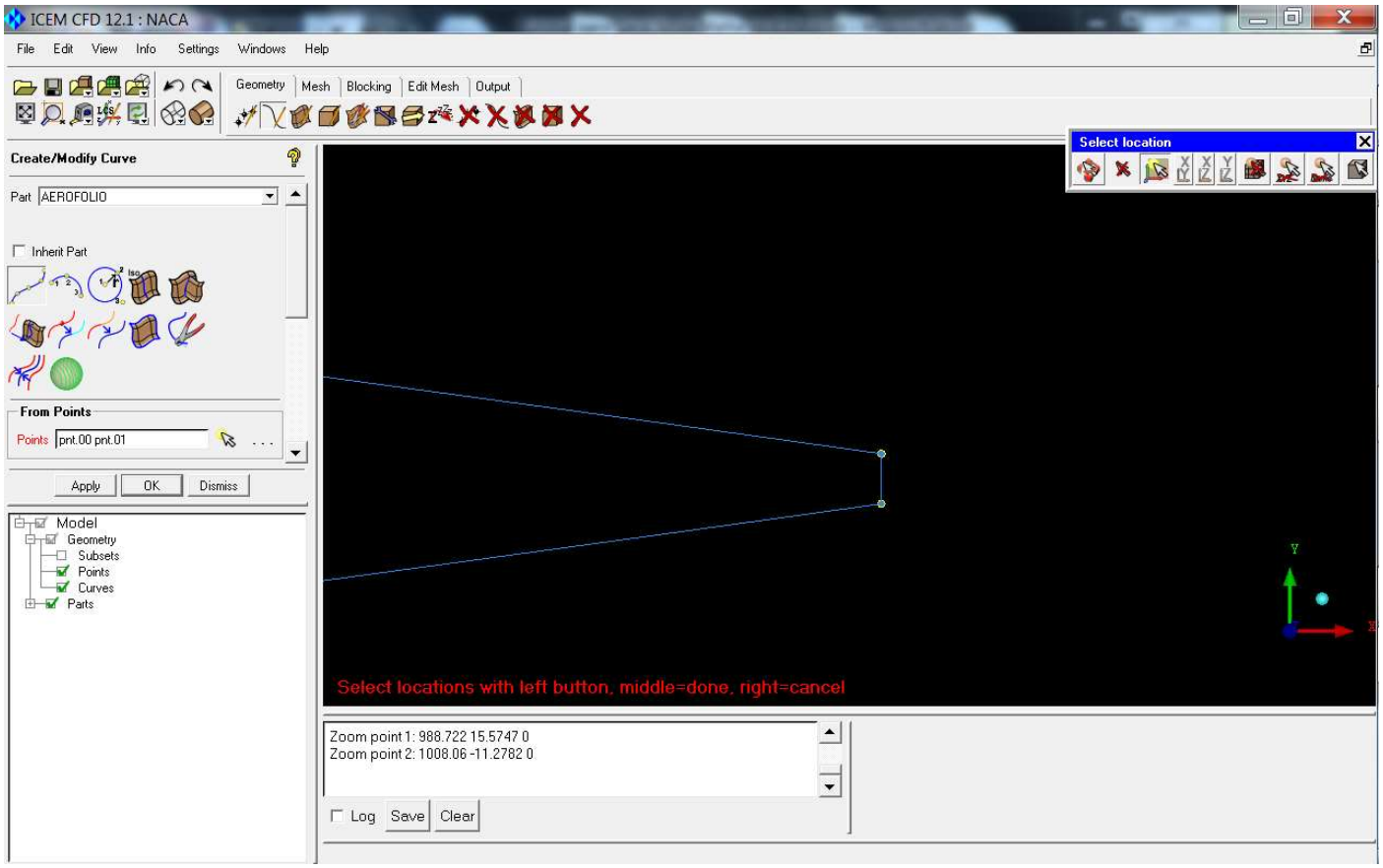
3.18. Selecione a ferramenta "Create/Modify Curve".



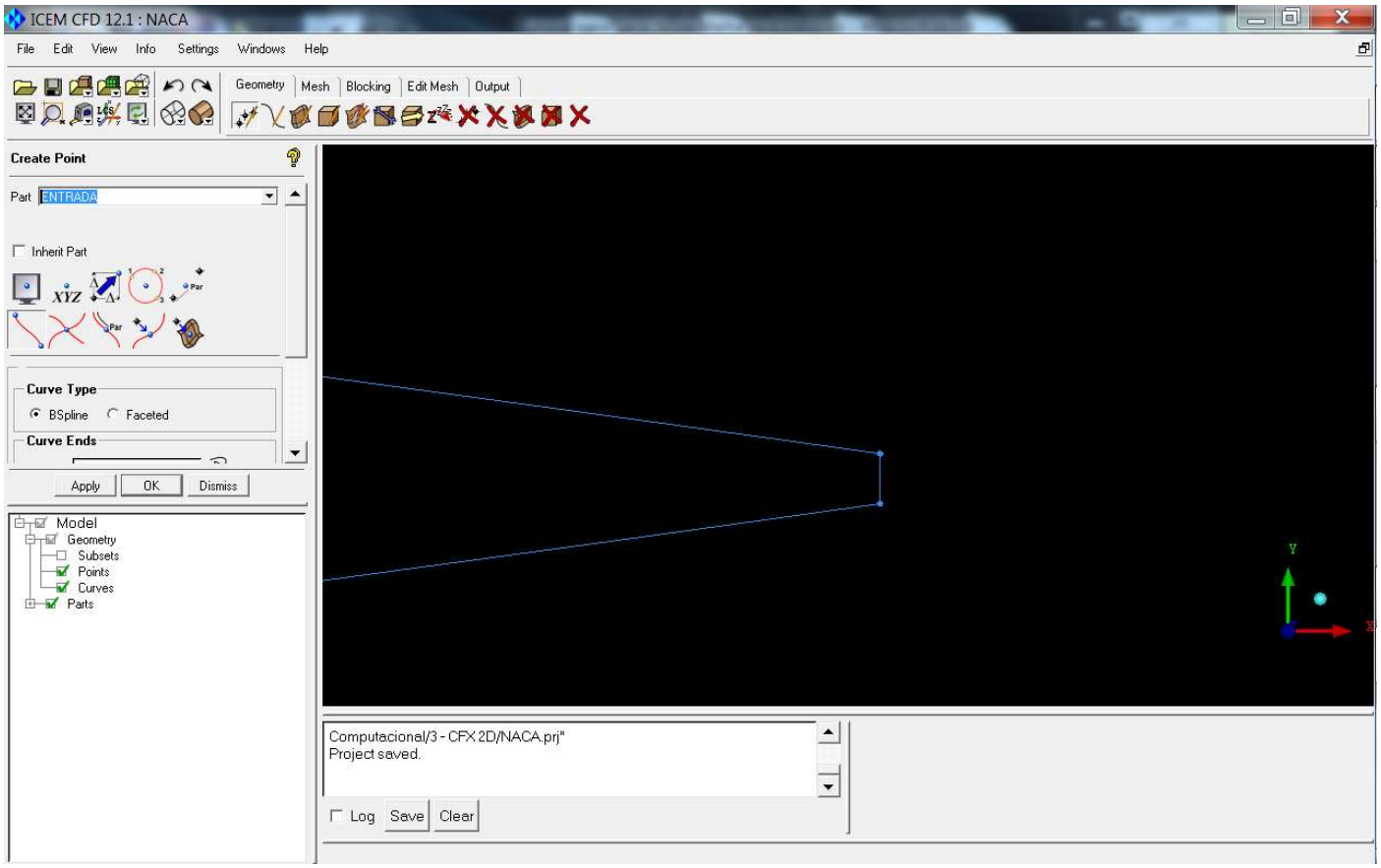
3.19. Clique em "Select location(s)".



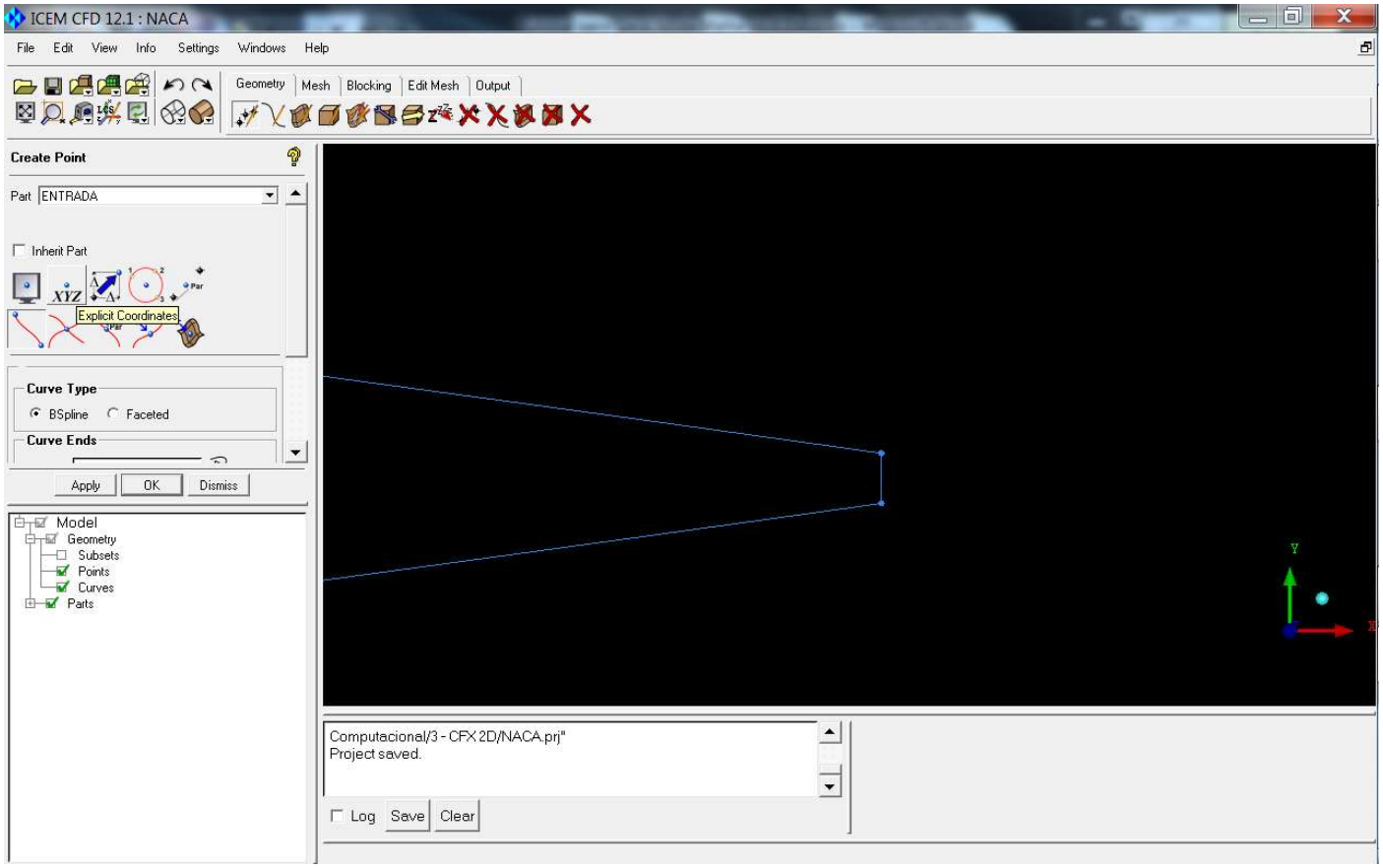
3.20. Com o botão esquerdo selecione os dois pontos no bordo de fuga e confirme com o botão do meio. Uma reta é desenhada fechando a geometria. Feche a ferramenta clicando em "Dismiss".



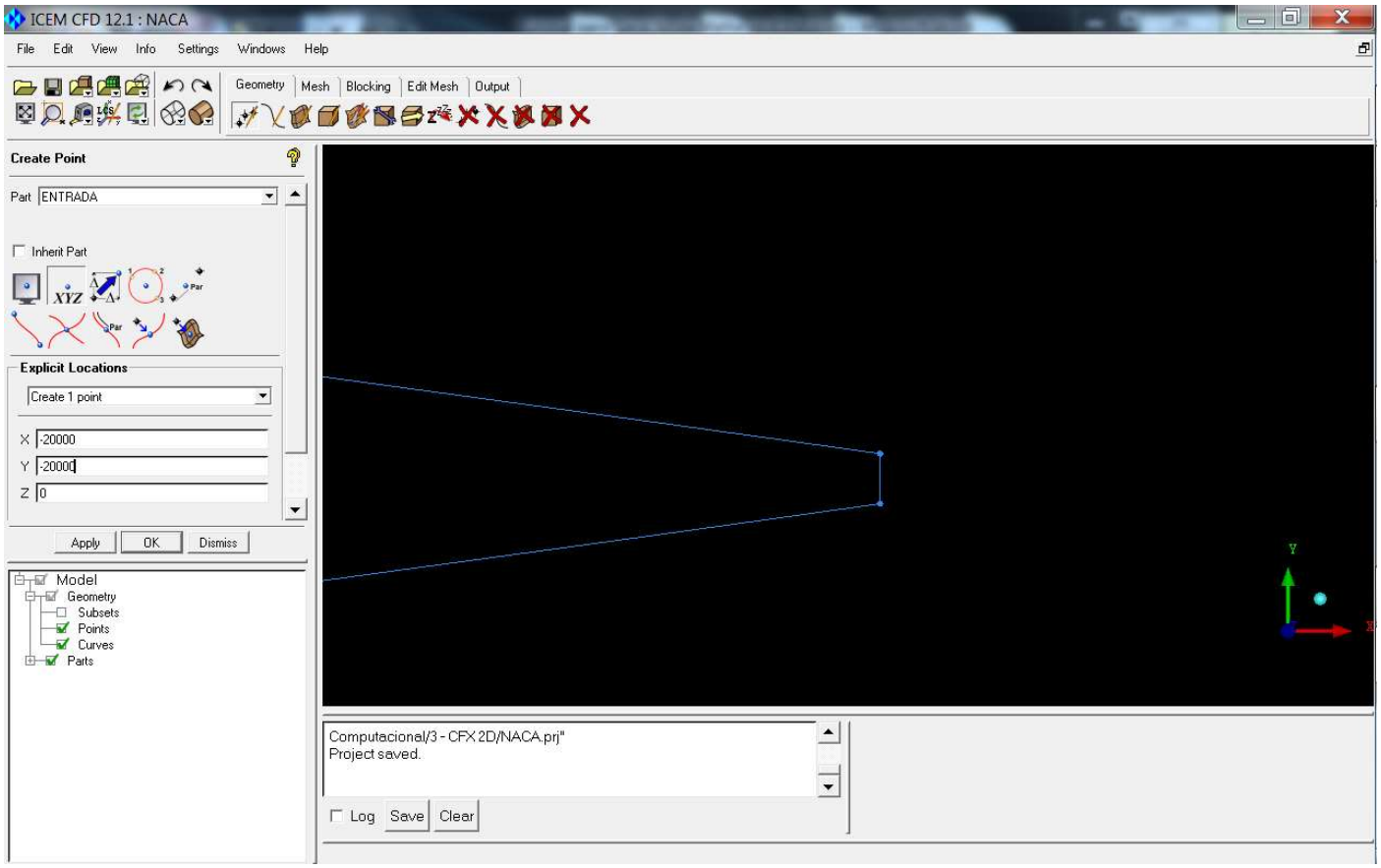
3.21. Selecione a ferramenta "Create Point" e modifique o nome da parte para "ENTRADA".



3.22. Selecione a sub-ferramenta "Explicit Coordinates".



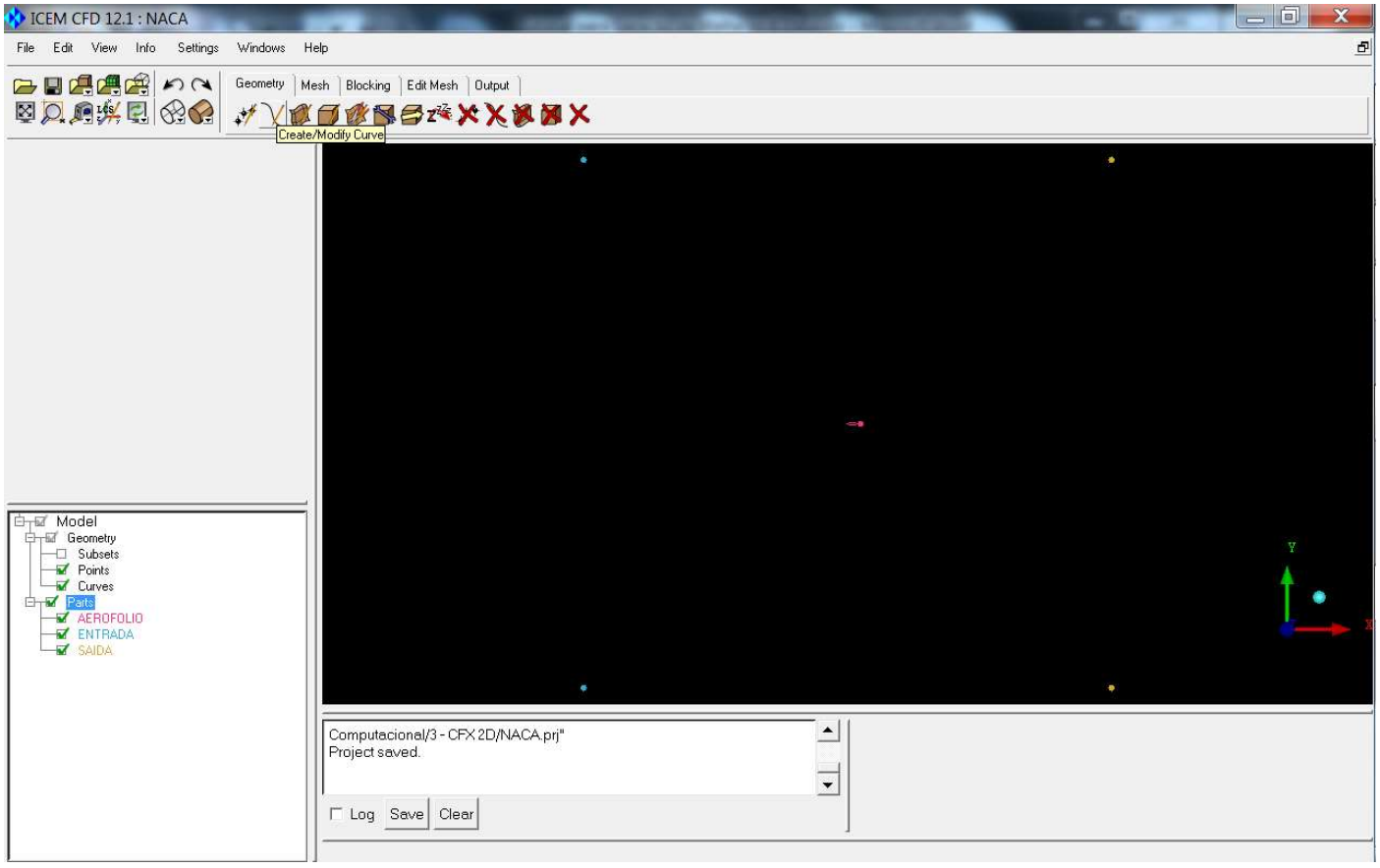
3.23. Digite as coordenadas $X = -20000$, $Y = -20000$ e Z$= 0$. Clique em "Apply".



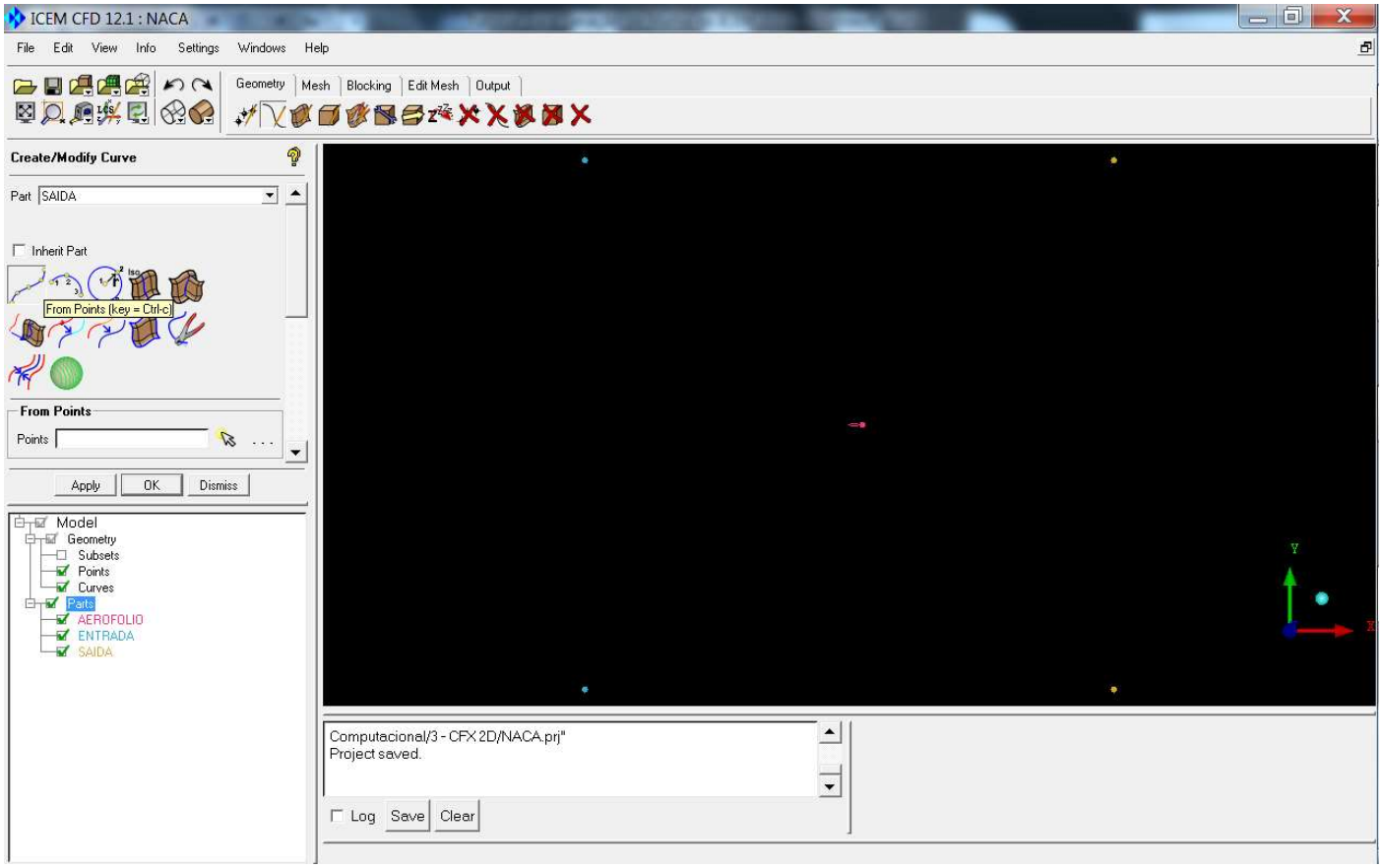
3.24. Mude as coordenadas para $X = -20000$, $Y = 20000$ e Z= 0. Clique em "Apply".3.25. Mude o nome da parte para "SAIDA". Mude as coordenadas para $X = 20000$, $Y = -20000$ e Z= 0. Clique em "Apply".
3.26. Mude as coordenadas para $X = 20000$, $Y = 20000$ e Z= 0. Clique em "Apply". Clique em "Dismiss".

3.27. Clique em "Fit Window". Temos quatro pontos que definem as fronteiras do domínio da simulação (túnel de vento virtual). Clique com o botão direito em "Parts" na janela do canto inferior esquerdo da tela e selecione "Good Colors". Isso facilita a diferenciação das partes do desenho.

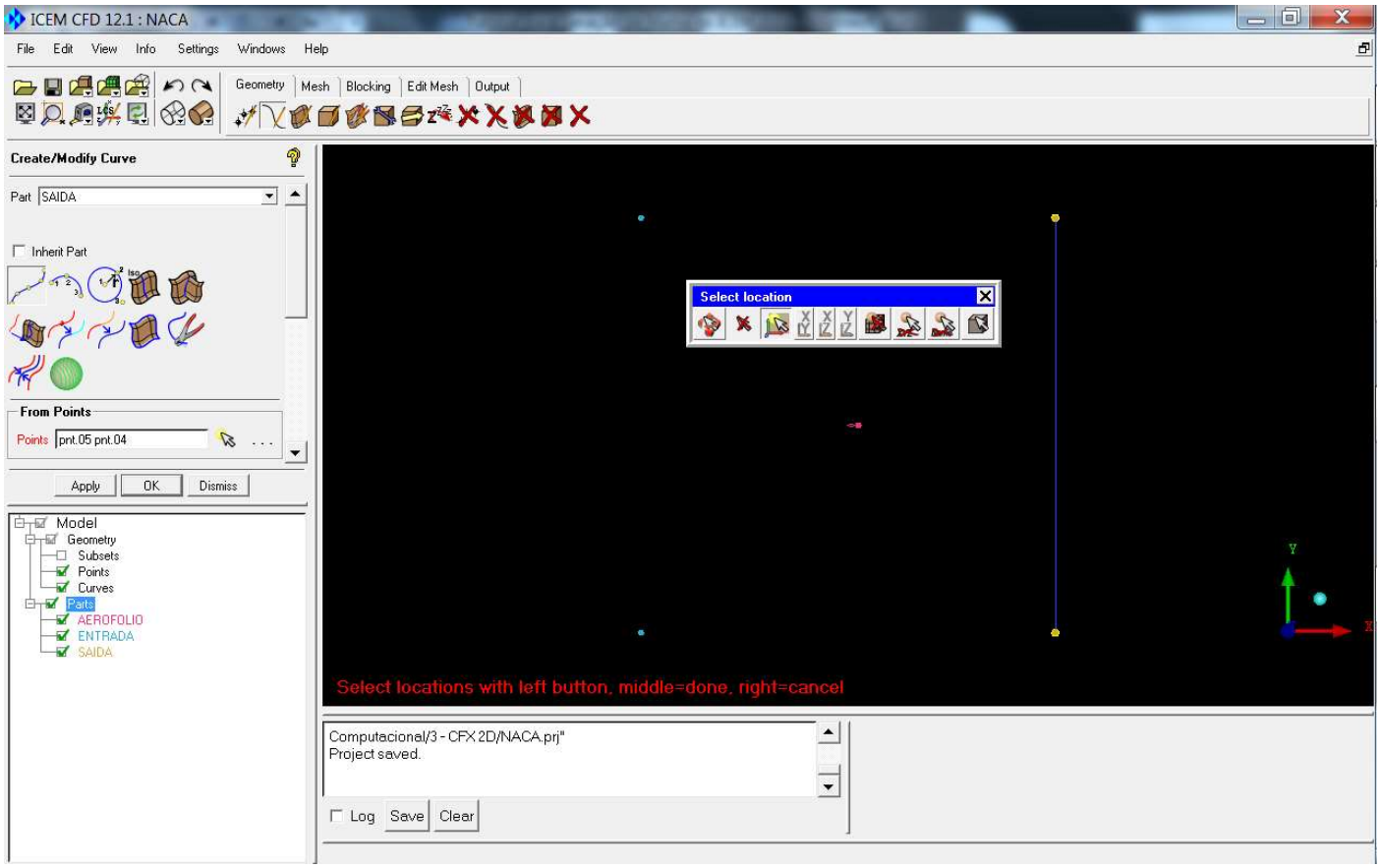
3.28. Selecione a ferramenta "Create/Modify Curve".



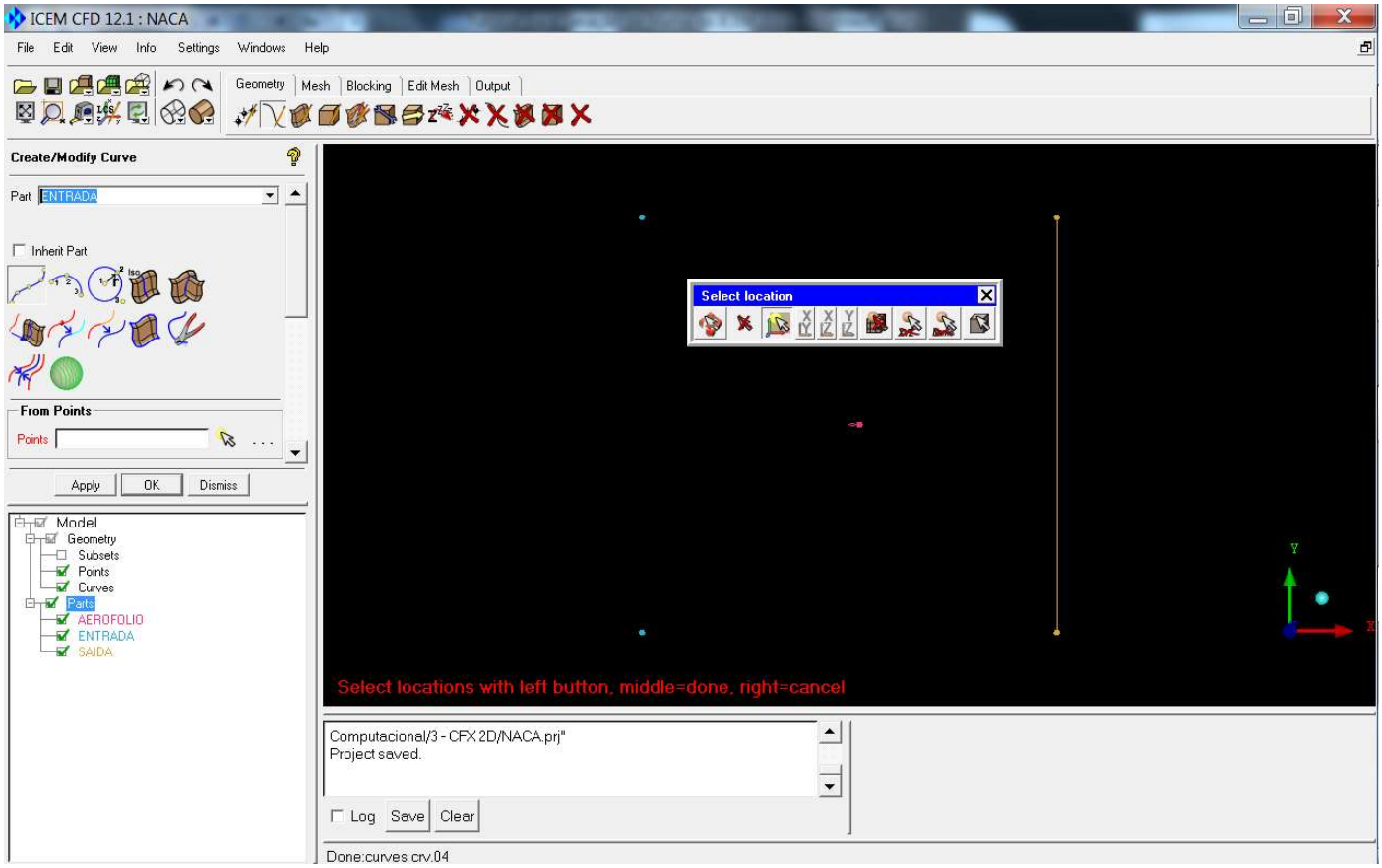
3.29. Selecione a sub-ferramenta "From Points".



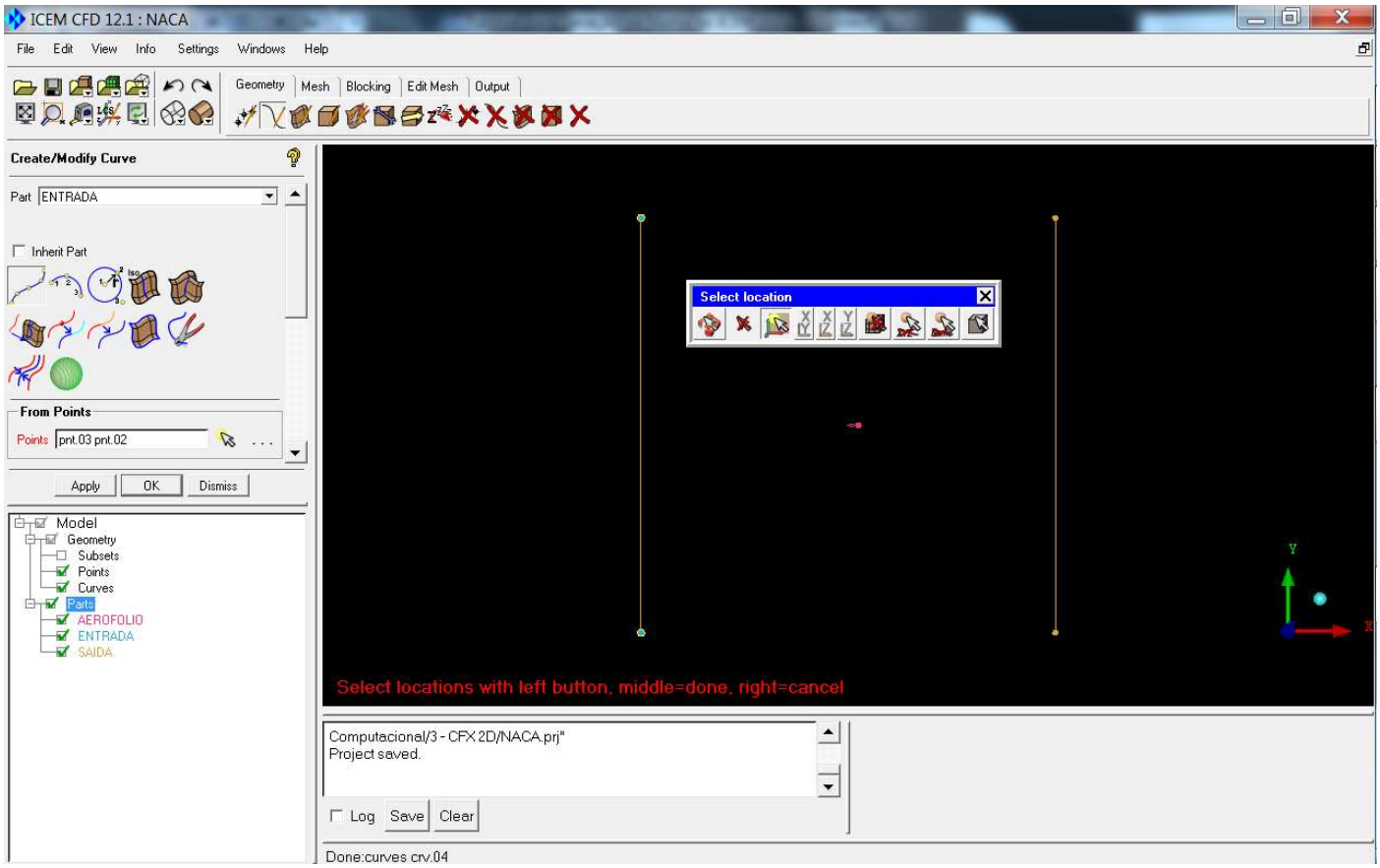
3.30. Com o botão esquerdo selecione os dois pontos correspondentes à parte "SAIDA" e confirme com o botão do meio.



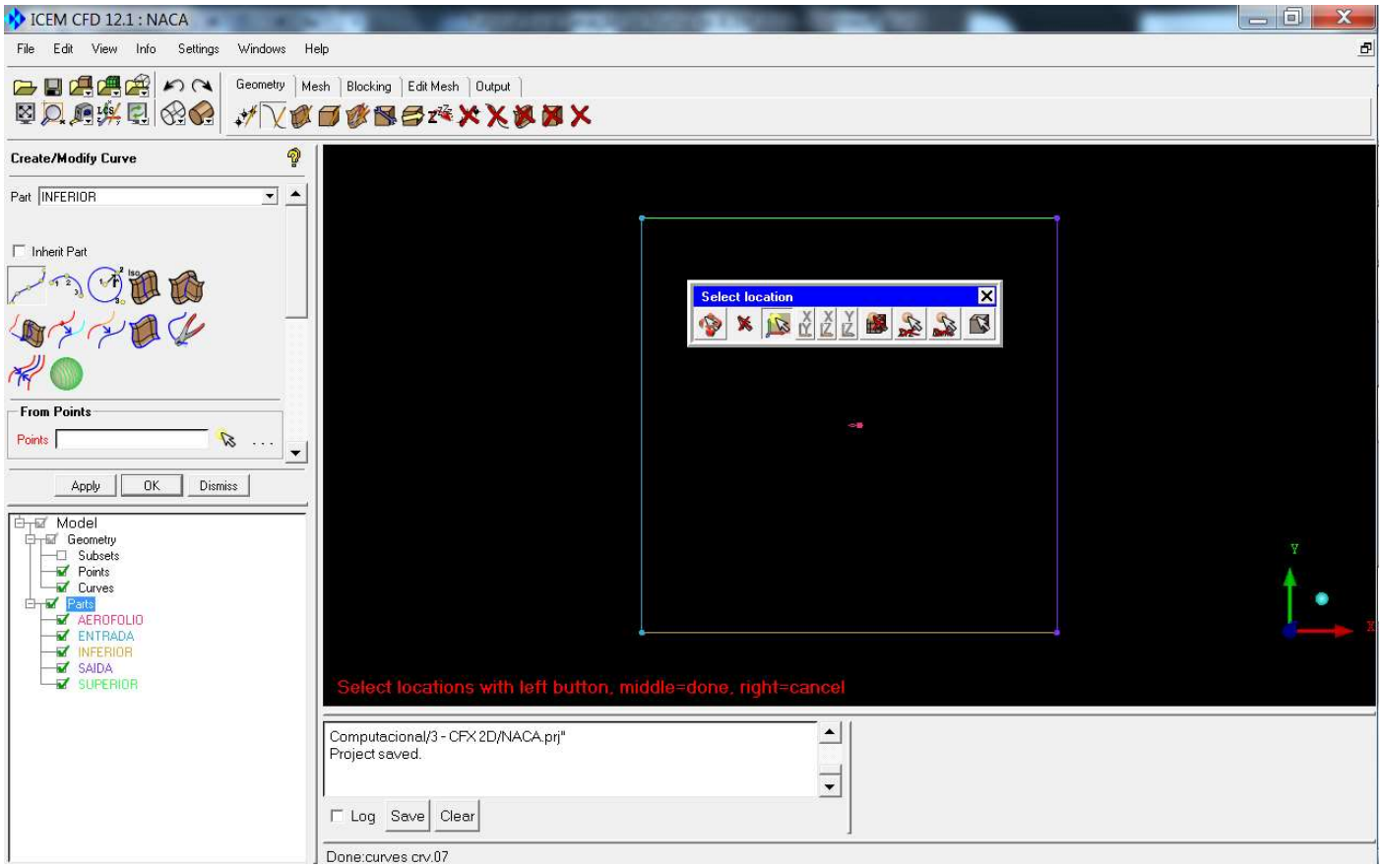
3.31. Mude o nome da parte para "ENTRADA".



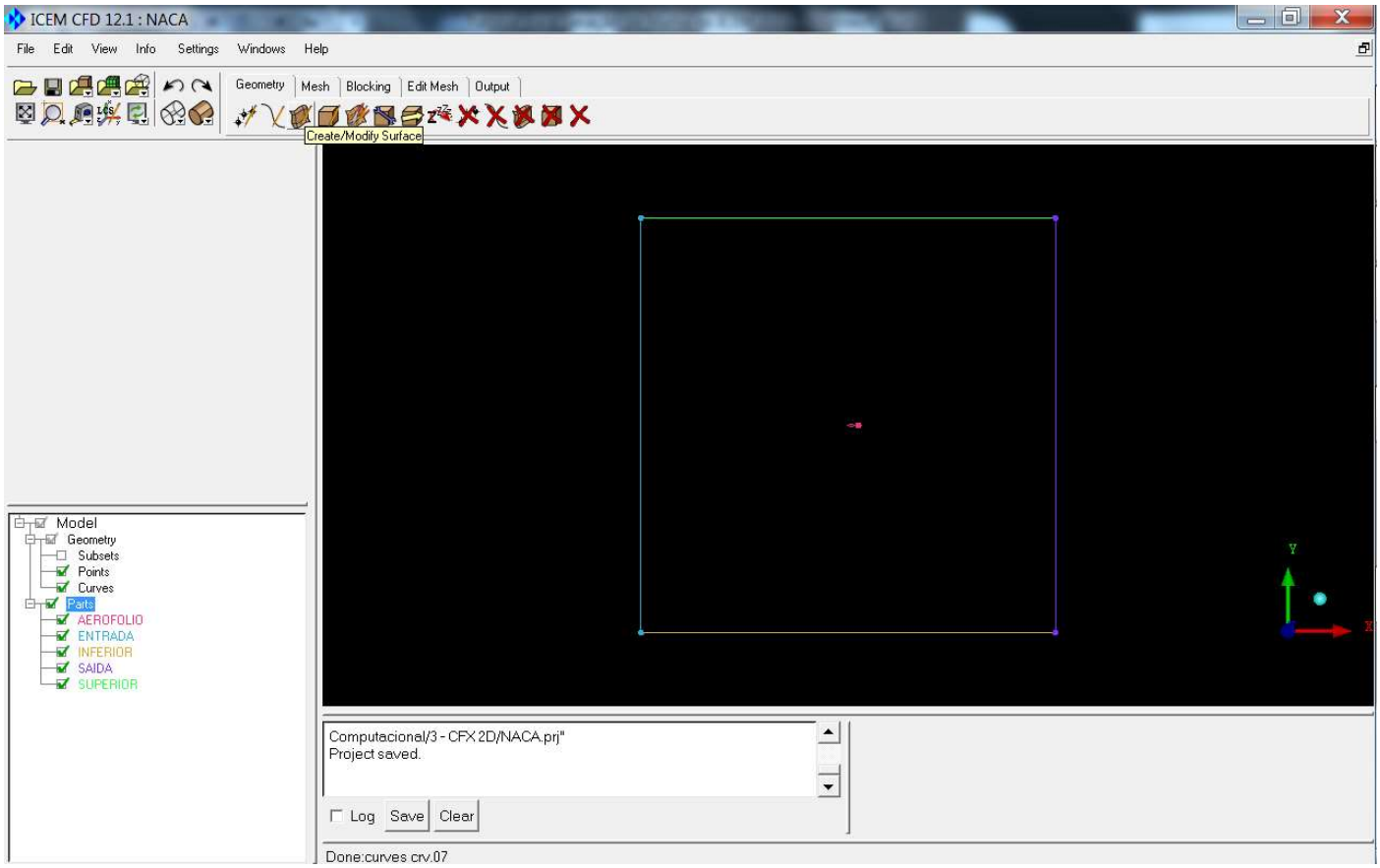
3.32. Com o botão esquerdo selecione os dois pontos correspondentes à parte "ENTRADA" e confirme com o botão do meio.



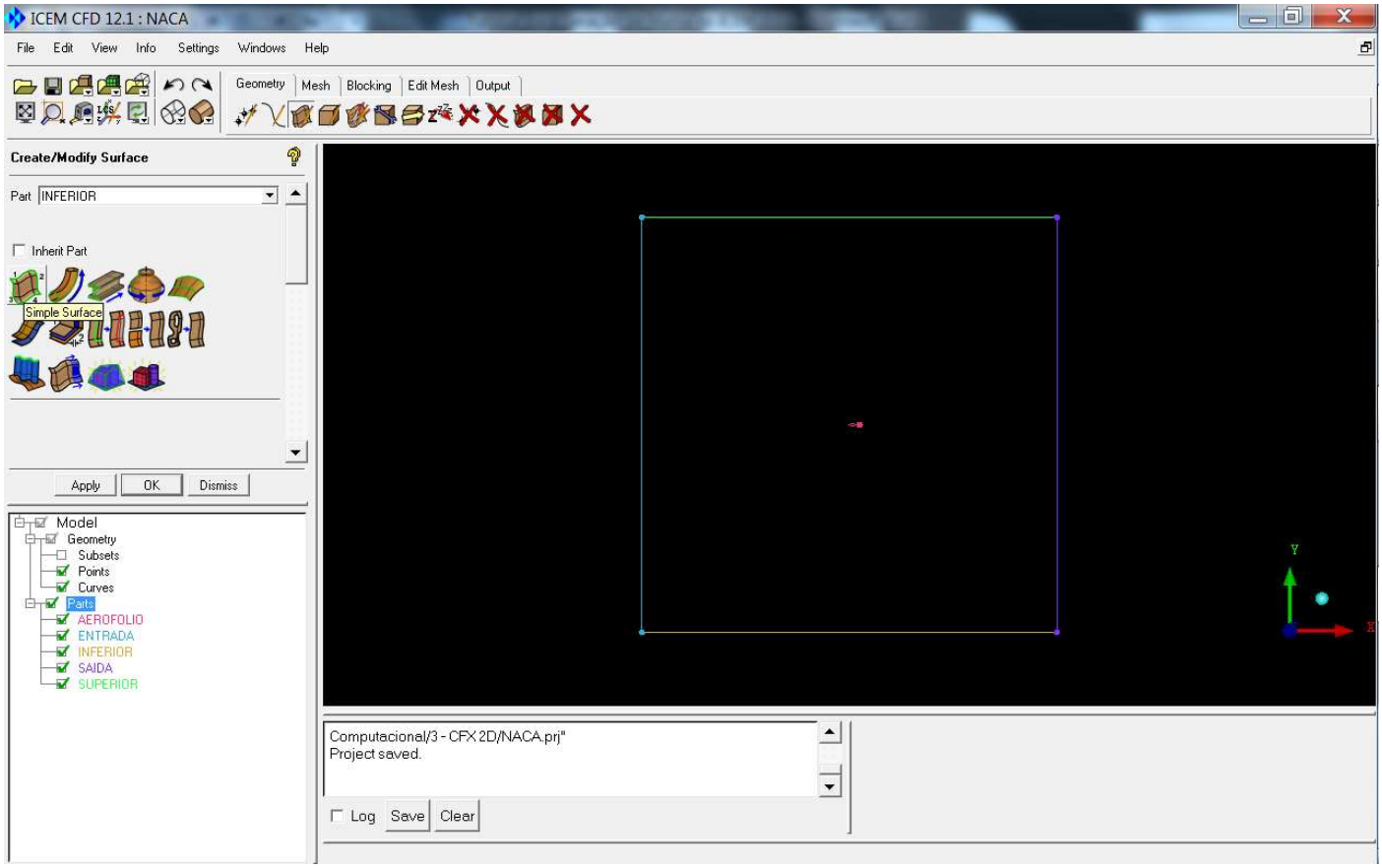
3.33. Repita o procedimento usando agora os nomes "SUPERIOR" e "INFERIOR" para as fronteiras horizontais.



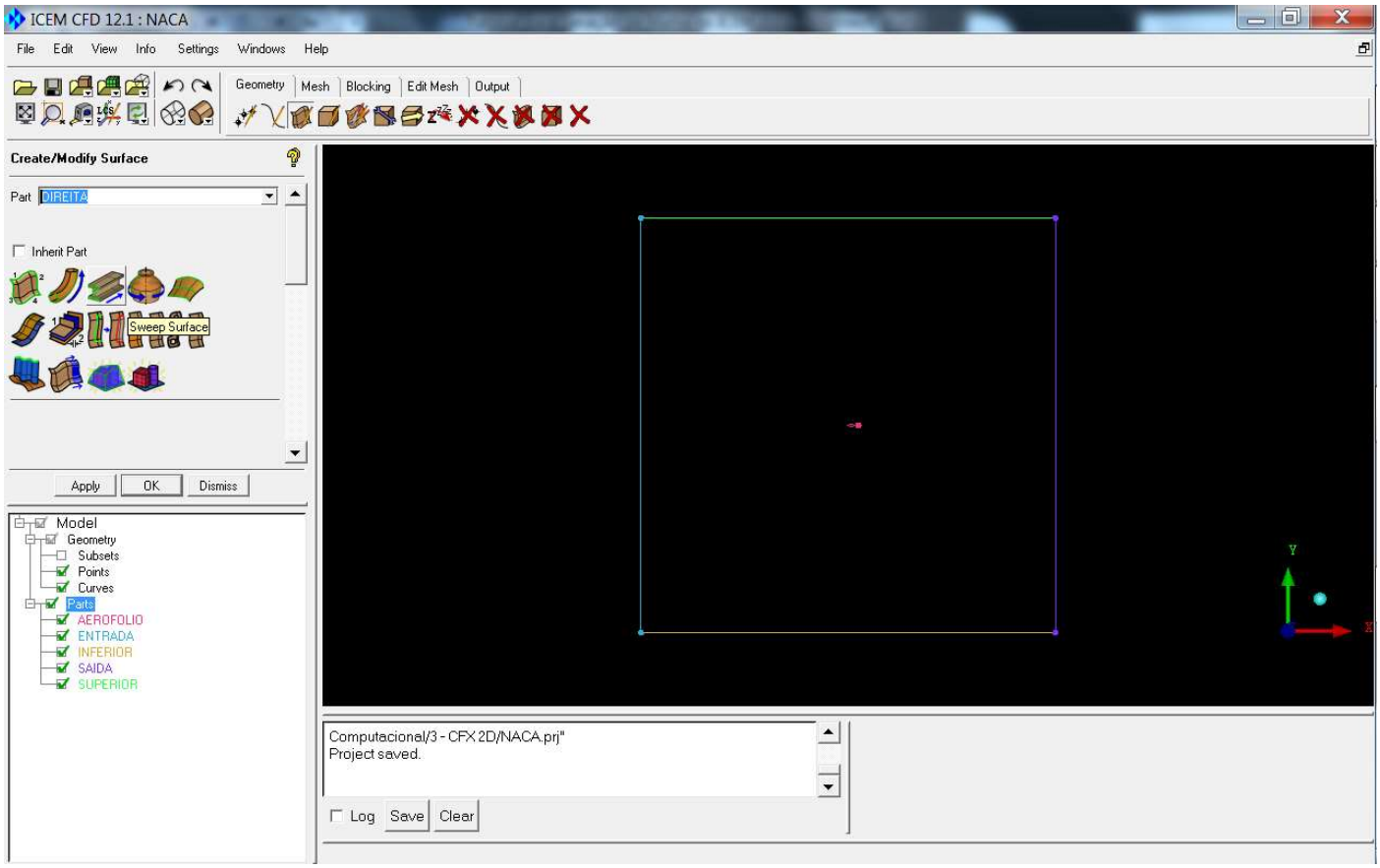
3.34. Clique em "Dismiss" e selecione a ferramenta "Create/Modify Surface".



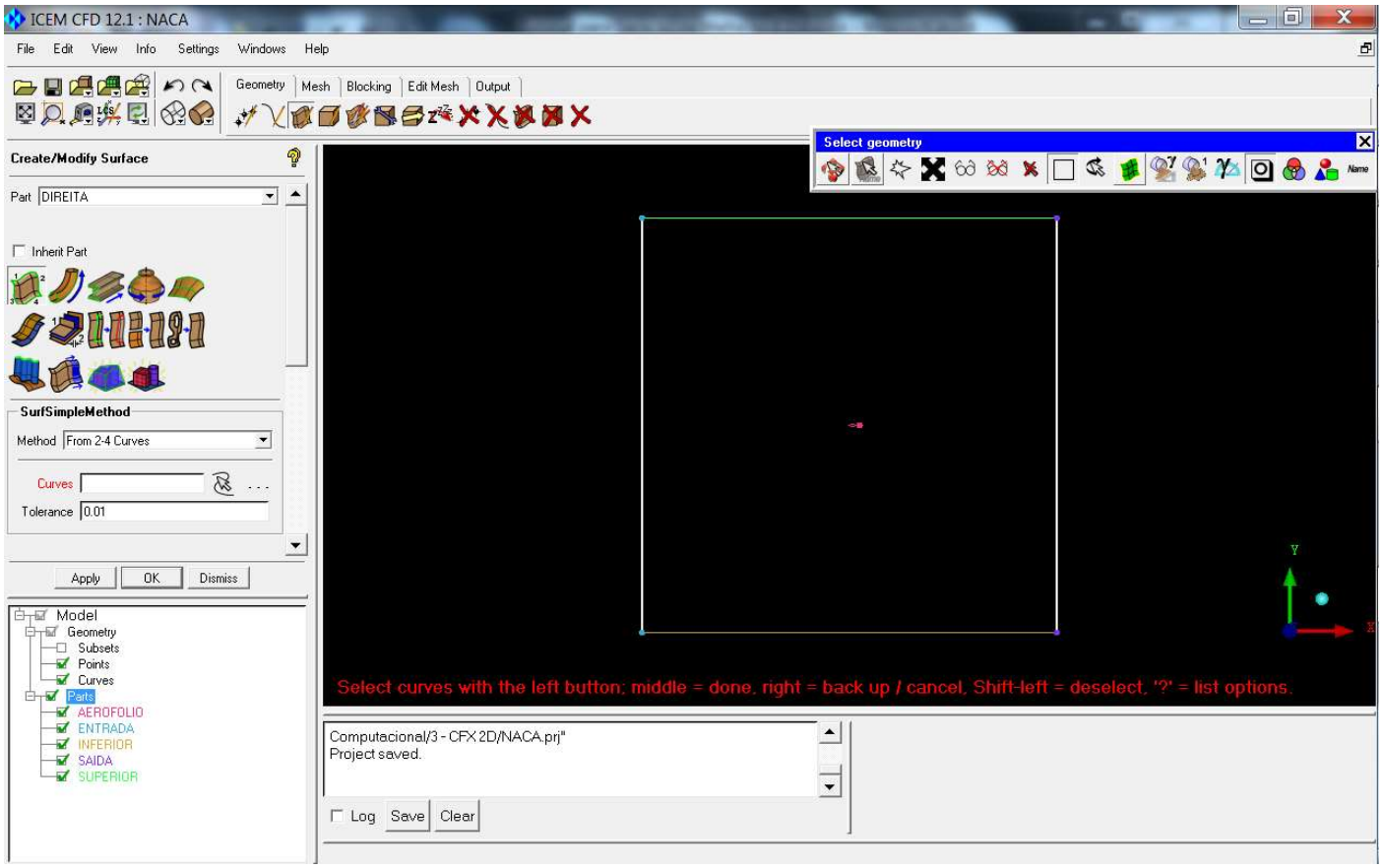
3.35. Selecione a sub-ferramenta "Simple Surface".



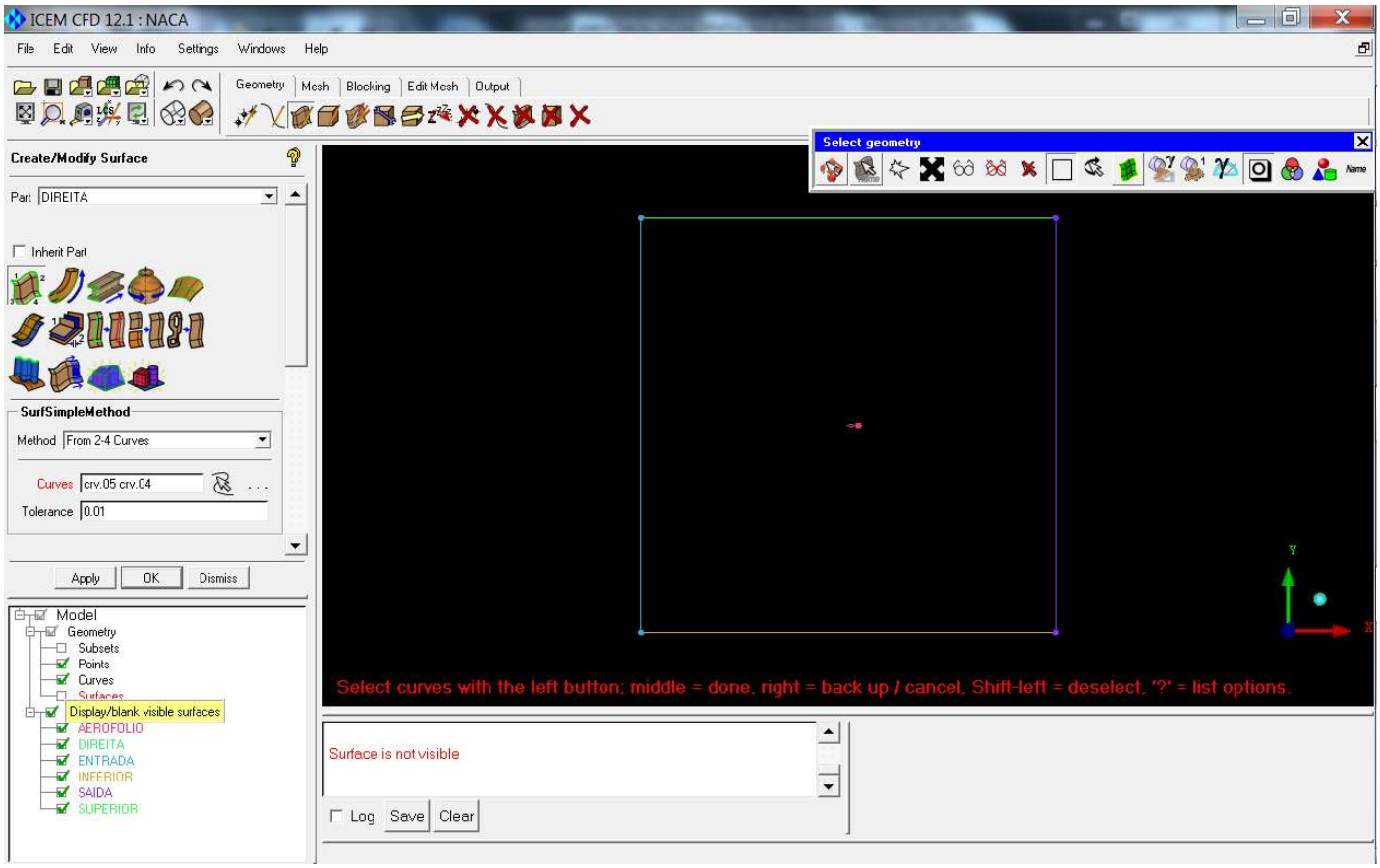
3.36. Mude o nome da parte para "DIREITA".



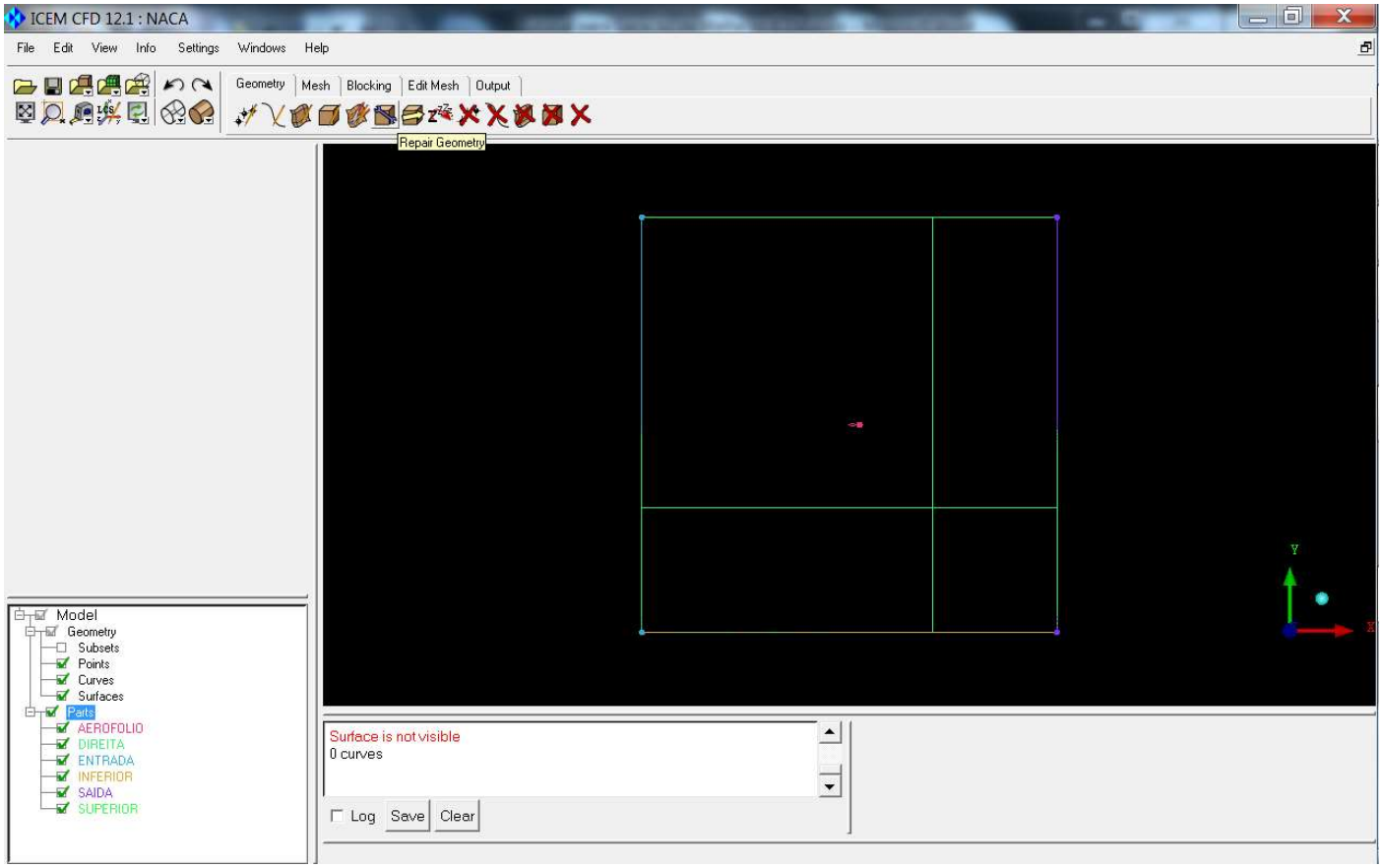
3.37. Selecione com o botão esquerdo as retas correspondentes à "ENTRADA" e à "SAIDA" e confirme com o botão do meio.



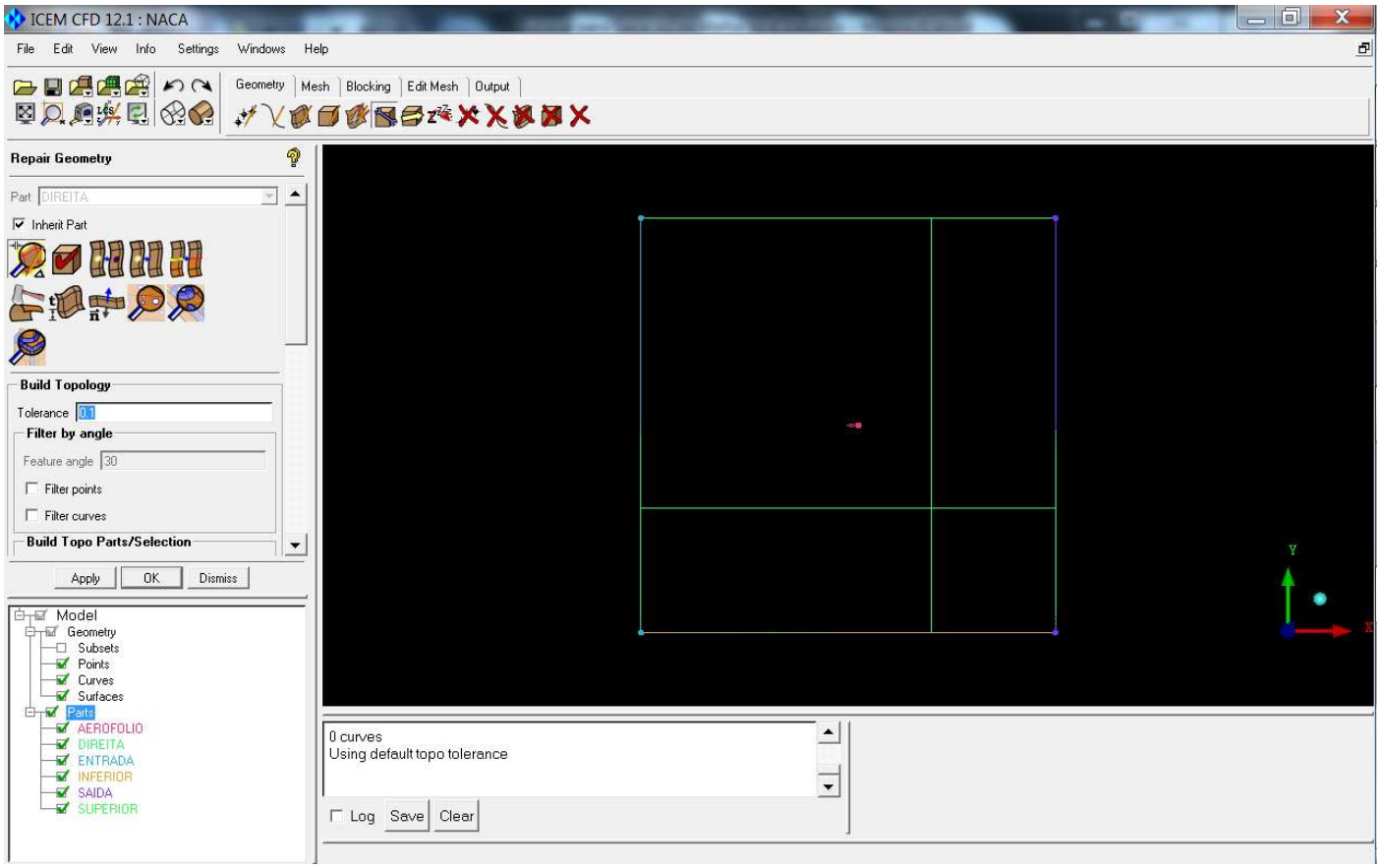
3.38. Ative a visualização de superfícies e clique em "Dismiss".



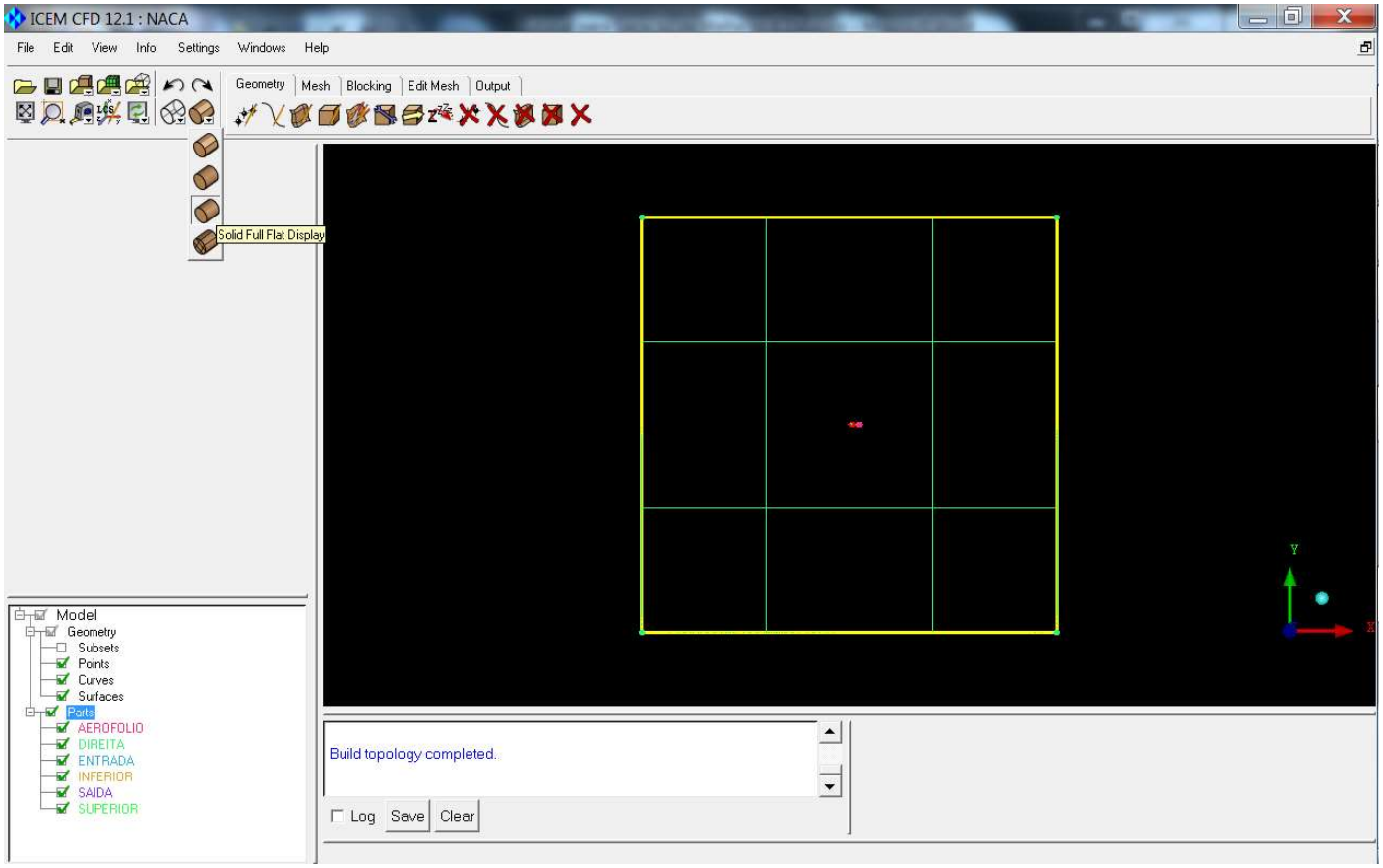
3.39. Selecione a ferramenta "Repair Geometry".



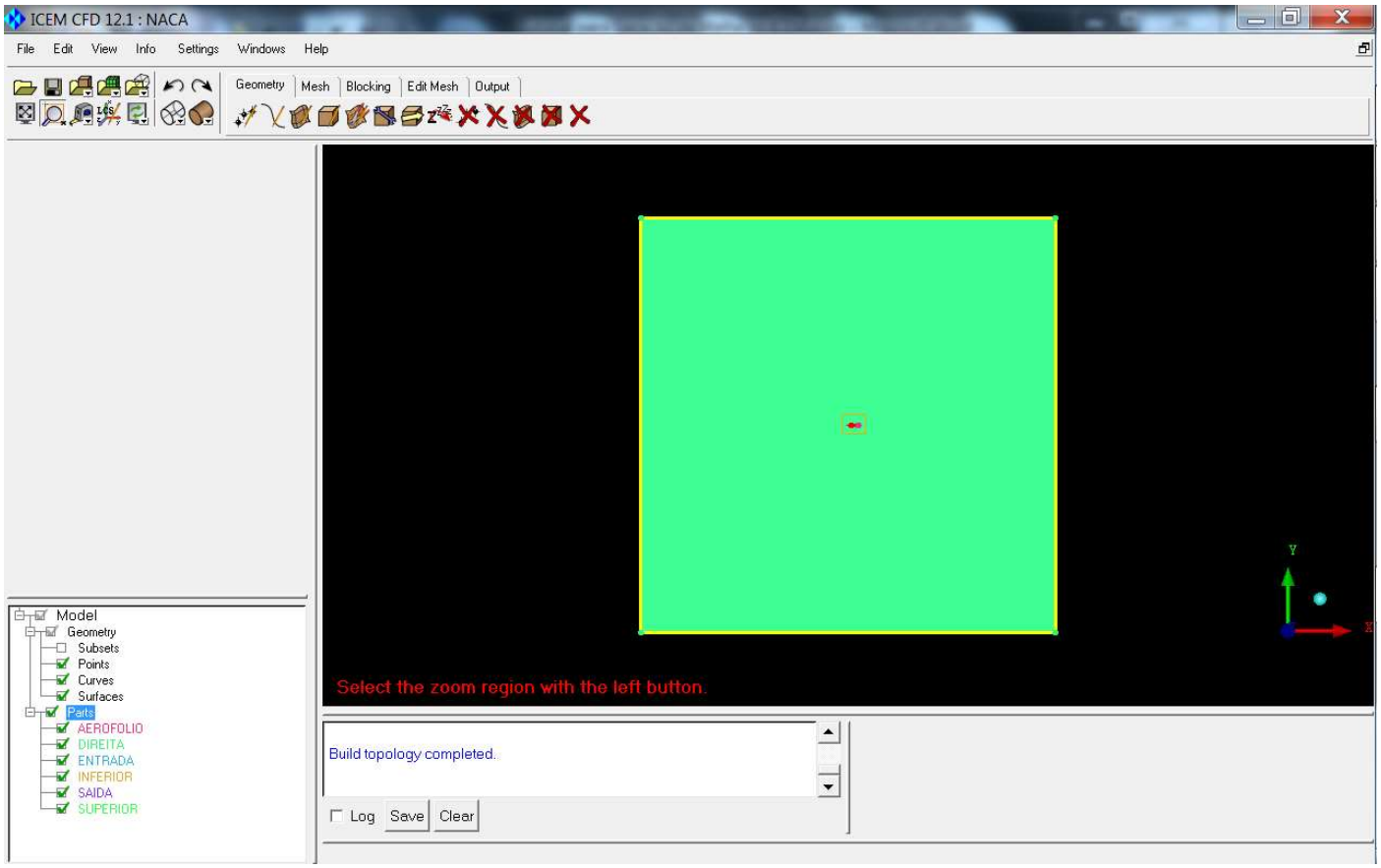
3.40. Selecione a opção "Inherit Part", mude o valor em "Tolerance" para 0.1 e clique em "OK".



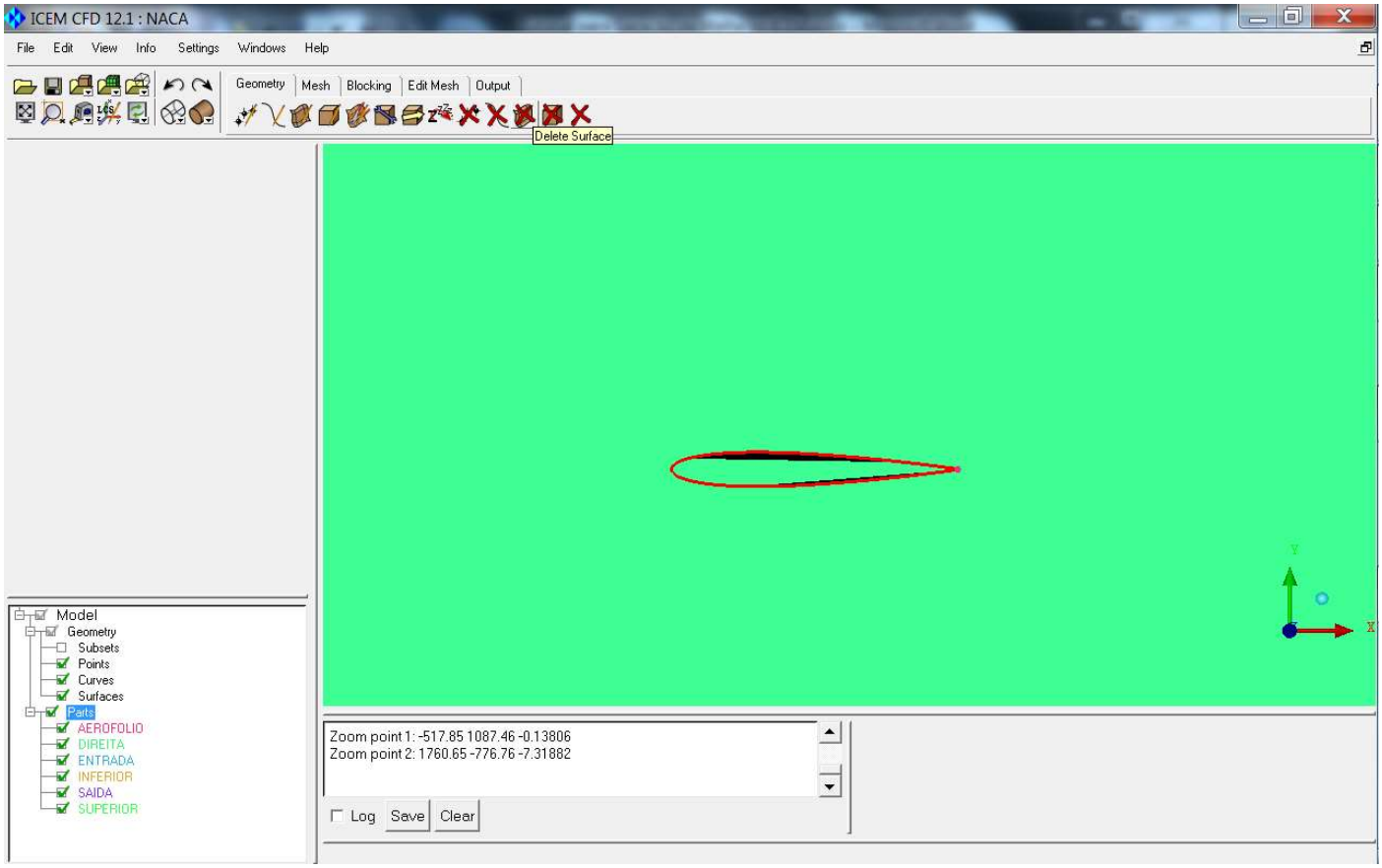
3.41. Selecione a opção de visualização de superfícies "Solid Full Flat Display".



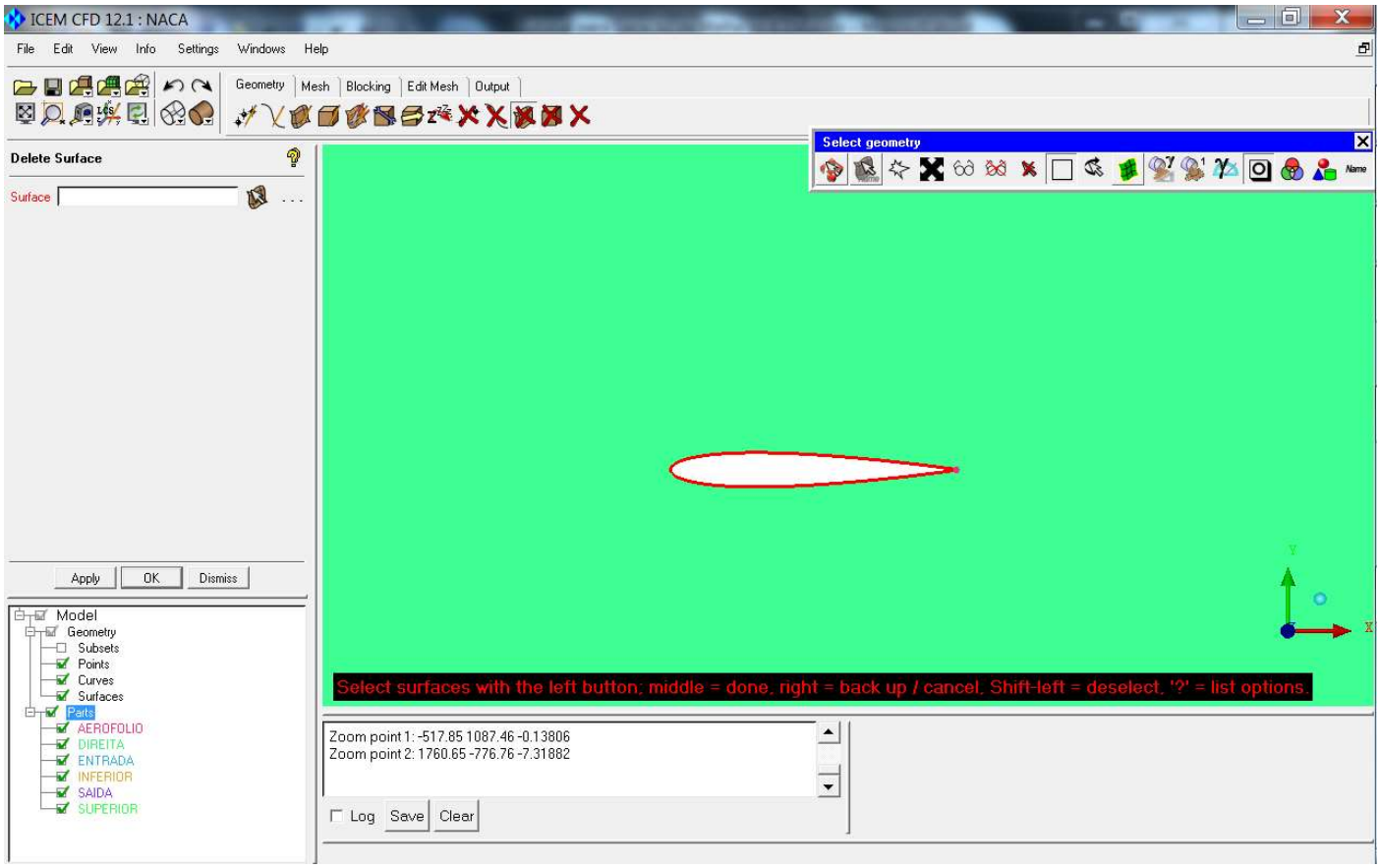
3.42. Dê um zoom na região da seção de aerofólio.



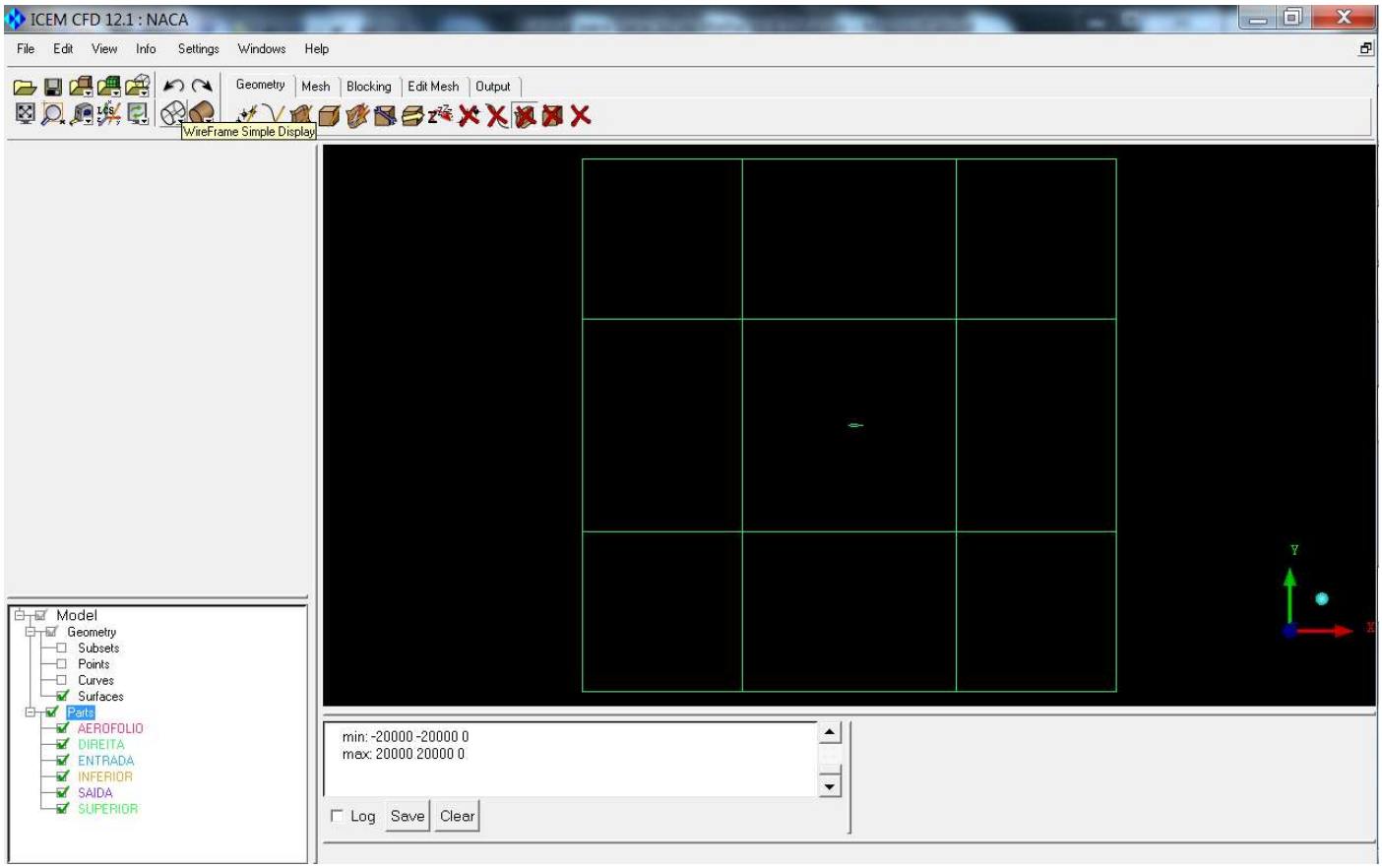
3.43. Selecione a ferramenta "Delete Surface".



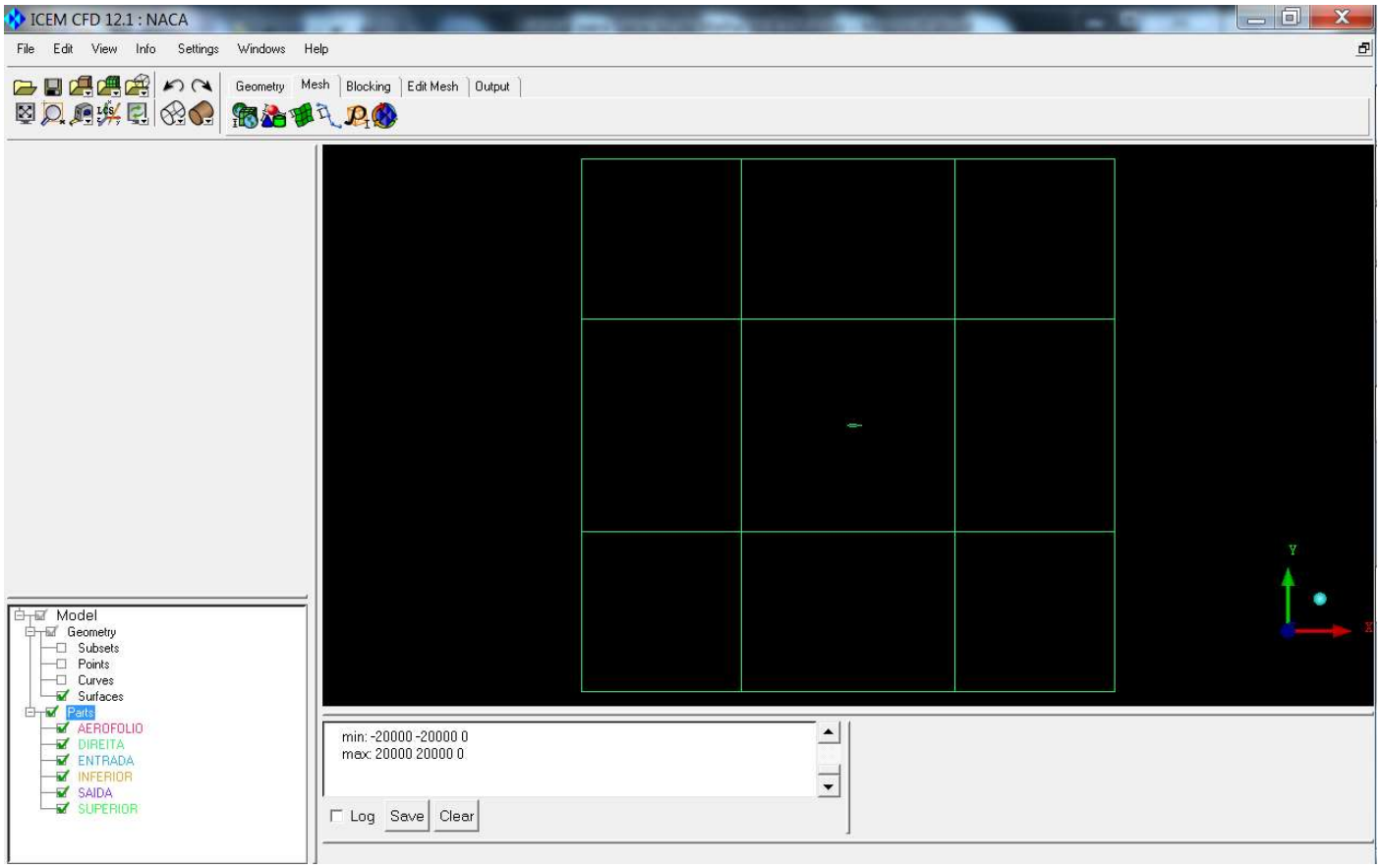
3.44. Selecione a superfície no interior da seção, confirme com o botão do meio e clique em "Dismiss".



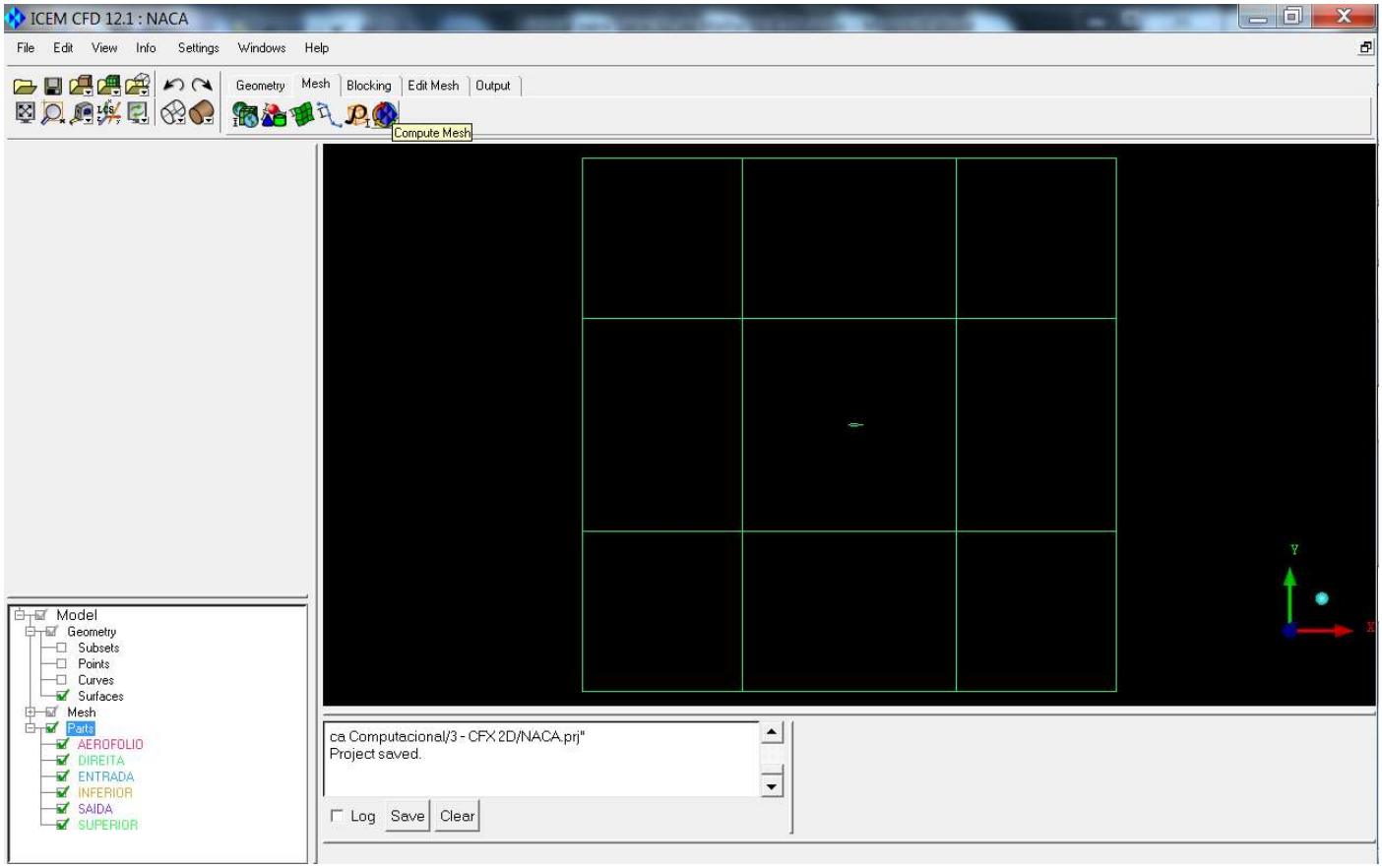
3.45. Clique em "WireFrame Simple Display", em "Fit Window", para dar um zoom em todo o desenho, e desabilite a visualização de "Points" e "Curves" na janela inferior esquerda.



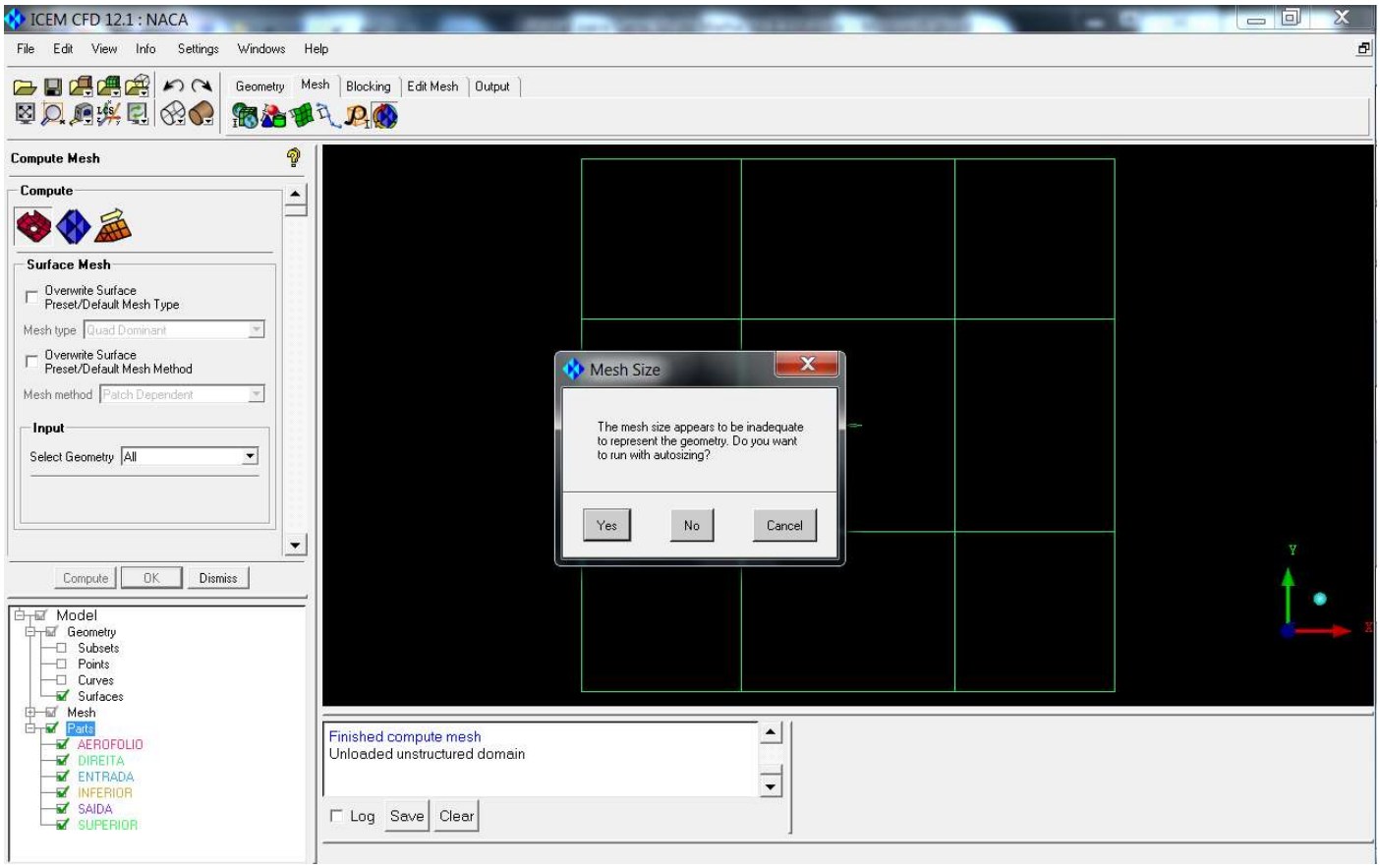
3.46. Selecione o tab "Mesh".



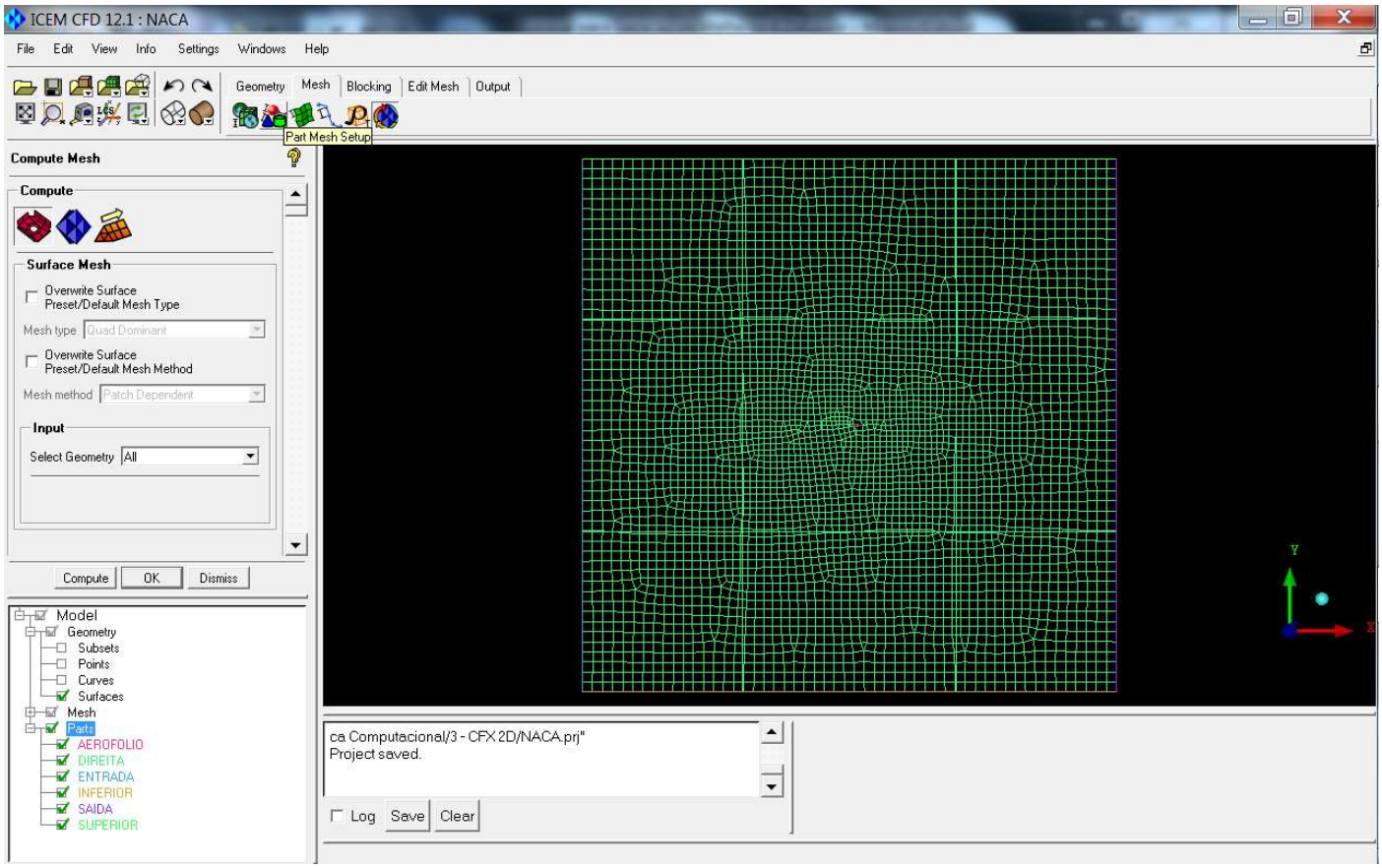
3.47. Selecione a ferramenta "Compute Mesh".



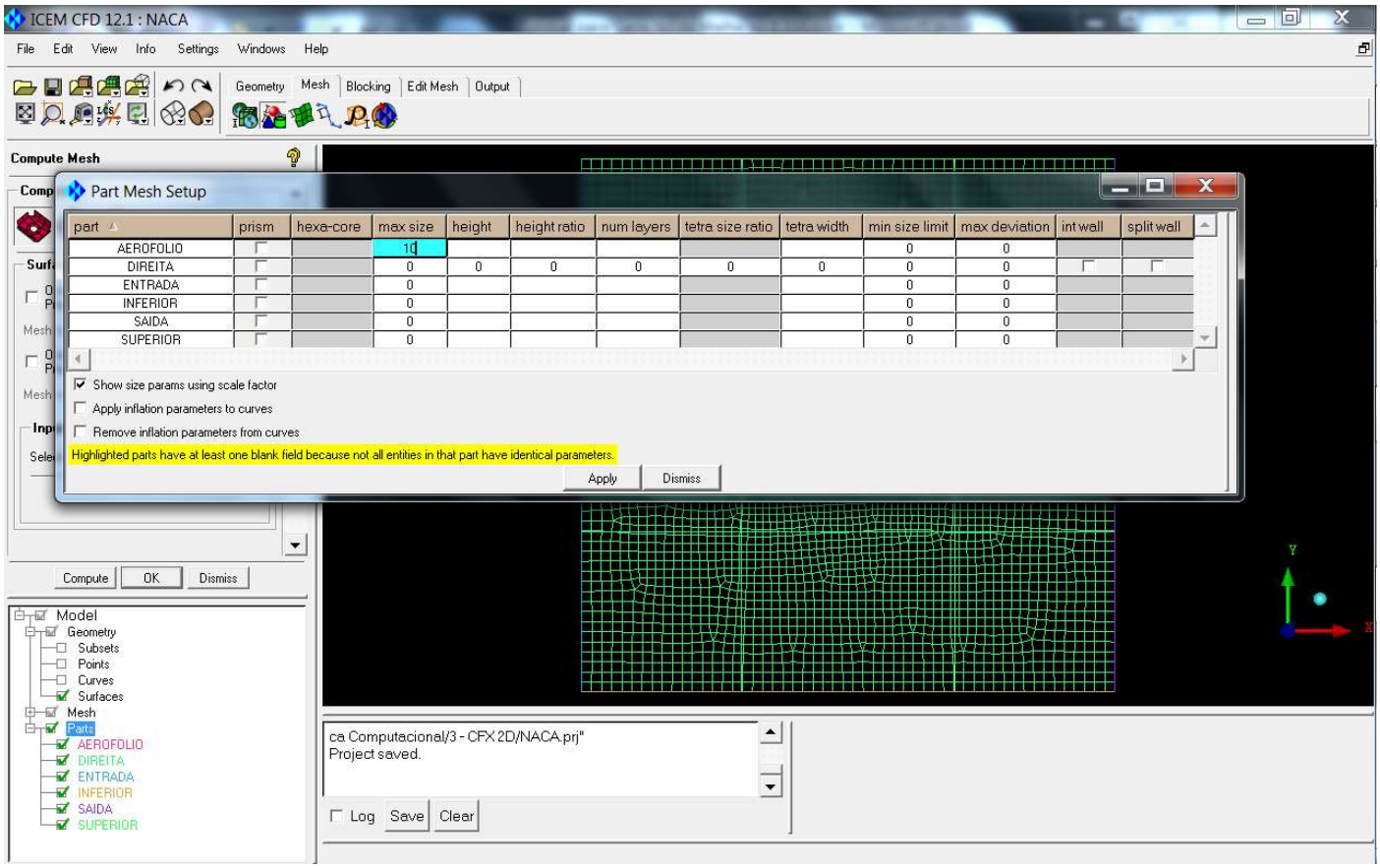
3.48. Clique em "Compute" e responda "Yes" na caixa de diálogo.



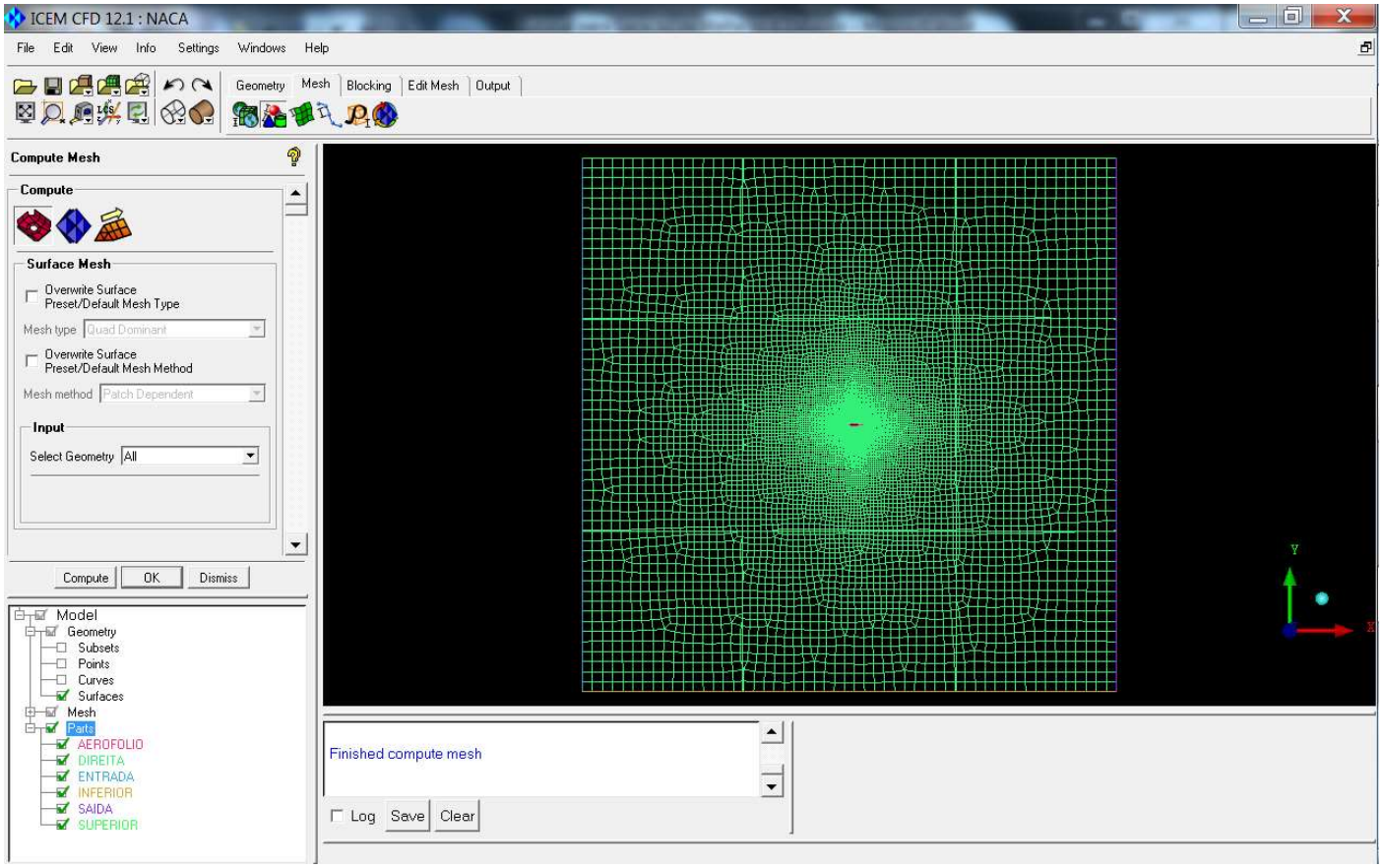
3.49. A malha computacional resultante ainda é muito grosseira na região da seção de aerofólio. Para refinar a malha selecione a ferramenta "Part Mesh Setup".



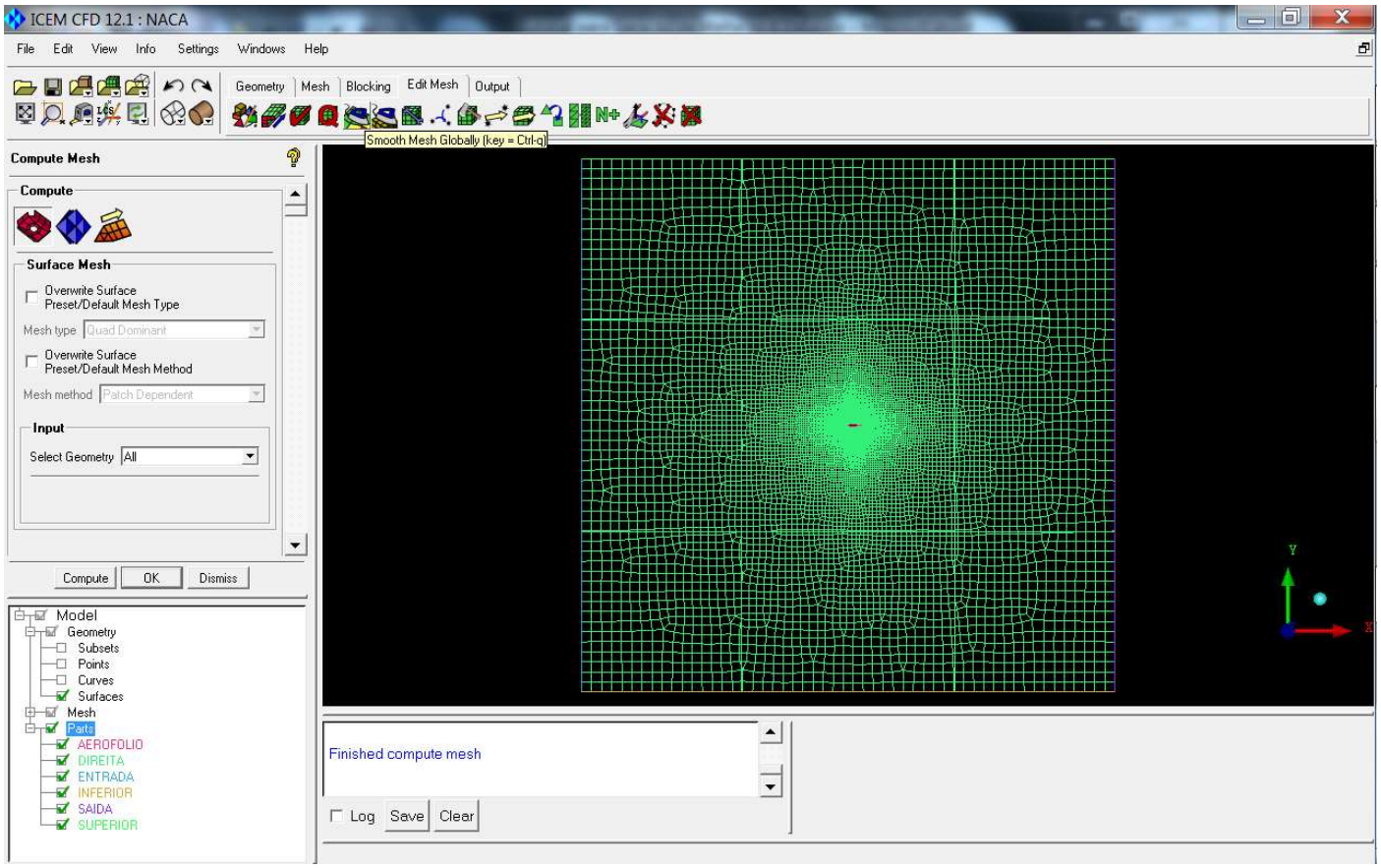
3.50. Mude para 10 o valor máximo de tamanho de célula para o "AEROFOLIO". Clique em "Apply" seguido de "Dismiss".



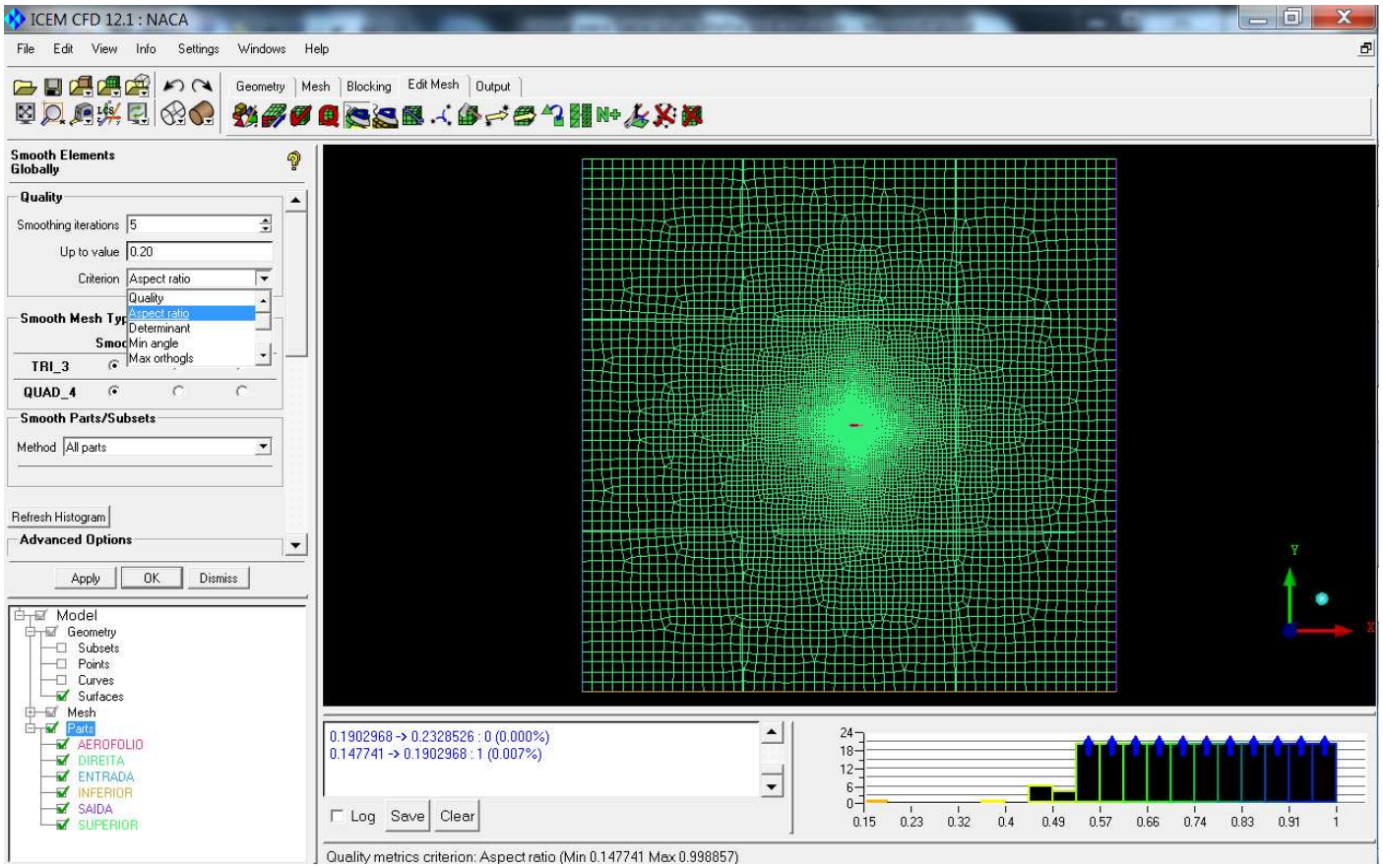
3.51. Clique em "Compute". A nova malha gerada está mais refinada na região do aerofólio.



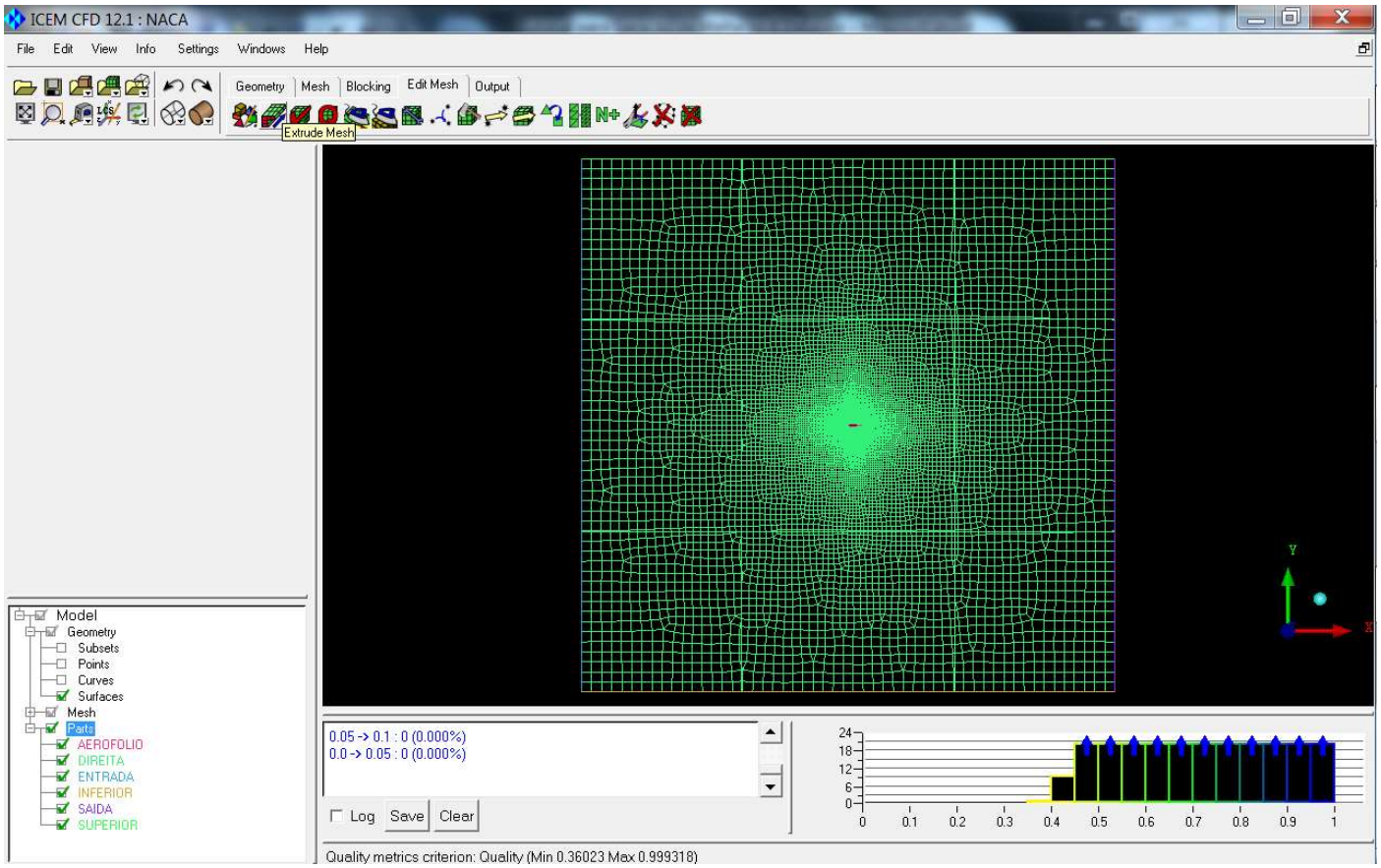
3.52. Selecione o tab "Edit Mesh" e selecione a ferramenta "Smooth Mesh Globally".



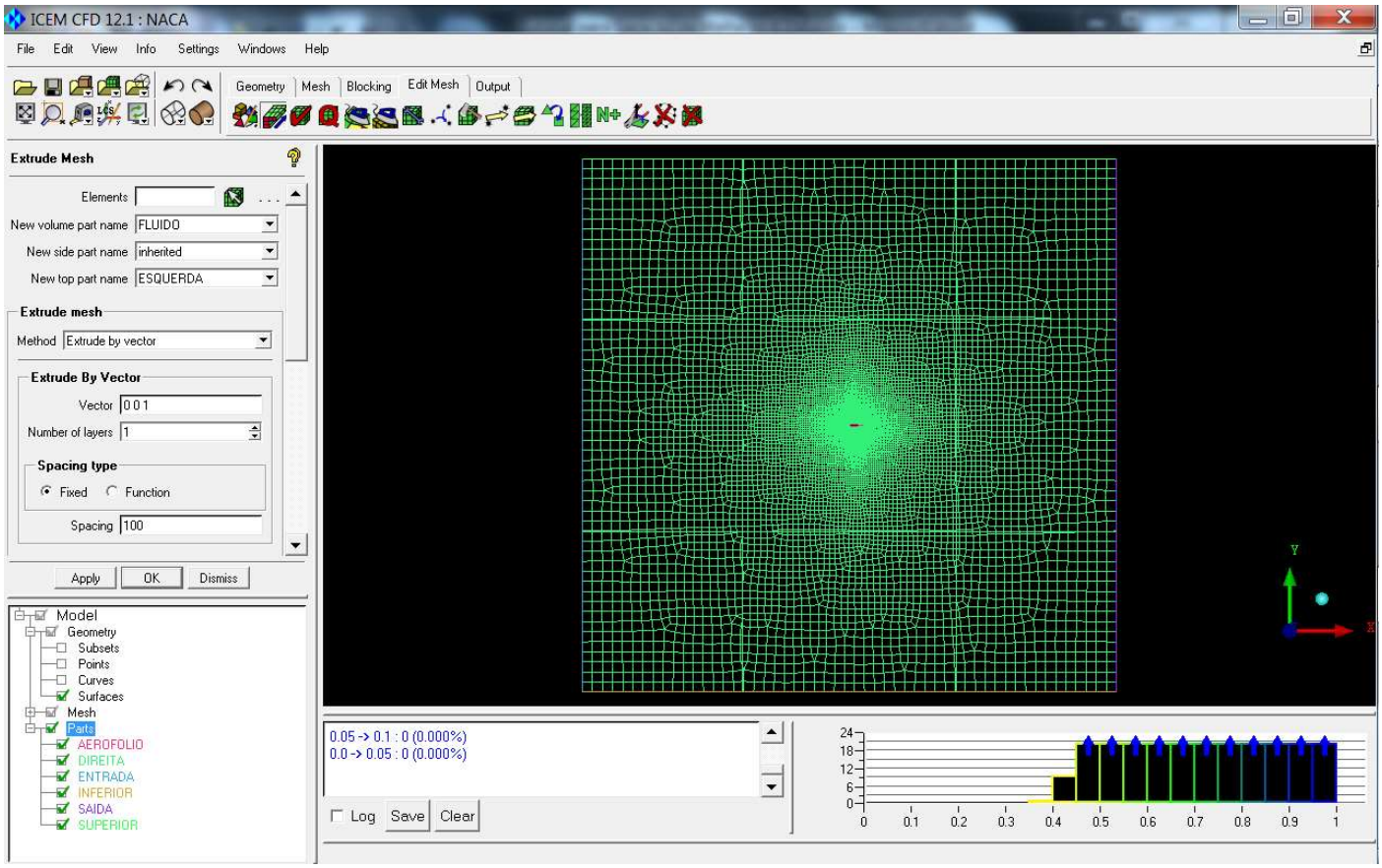
3.53. Mude o critério de qualidade para "Quality". Clique em "Apply". A qualidade de todos os elementos deve ficar acima de 0.2.



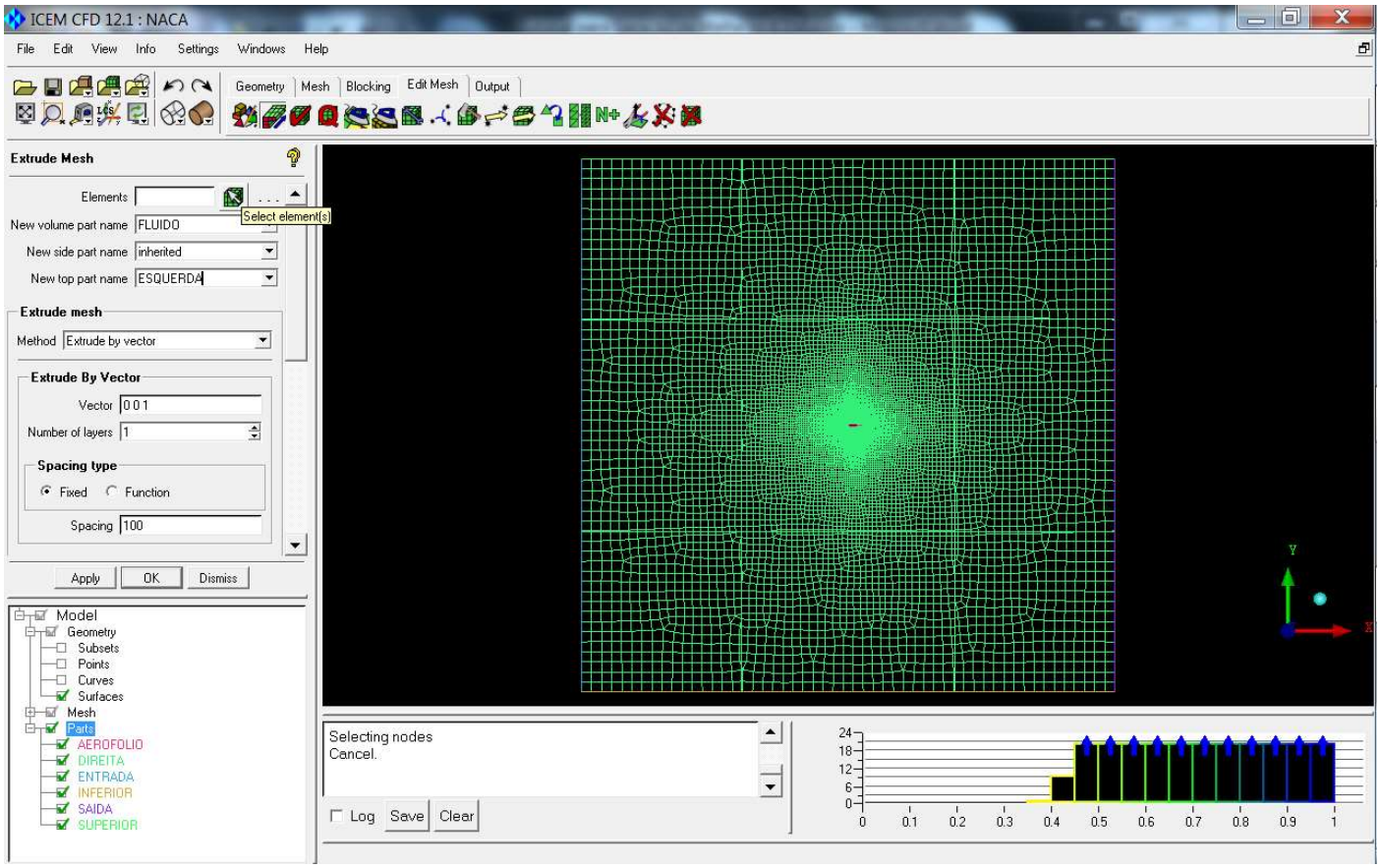
3.54. Clique em "Dismiss" e selecione a ferramenta "Extrude Mesh".



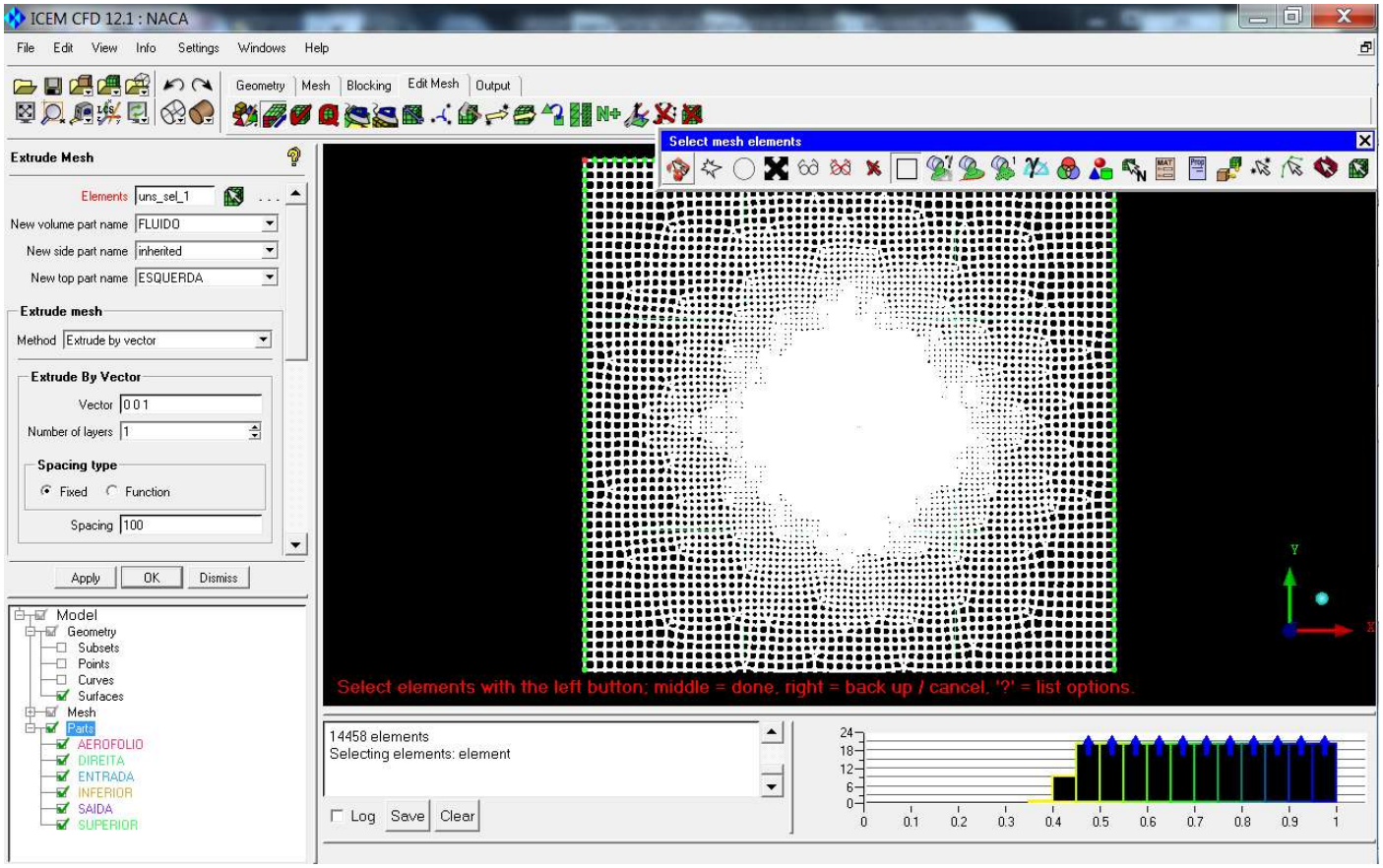
3.55. Mude "New volume part name" para "FLUIDO", "New top part name" para "ESQUERDA", "Method" para "Extrude by vector", "Vector" para "0 0 1" e "Spacing" para "100".



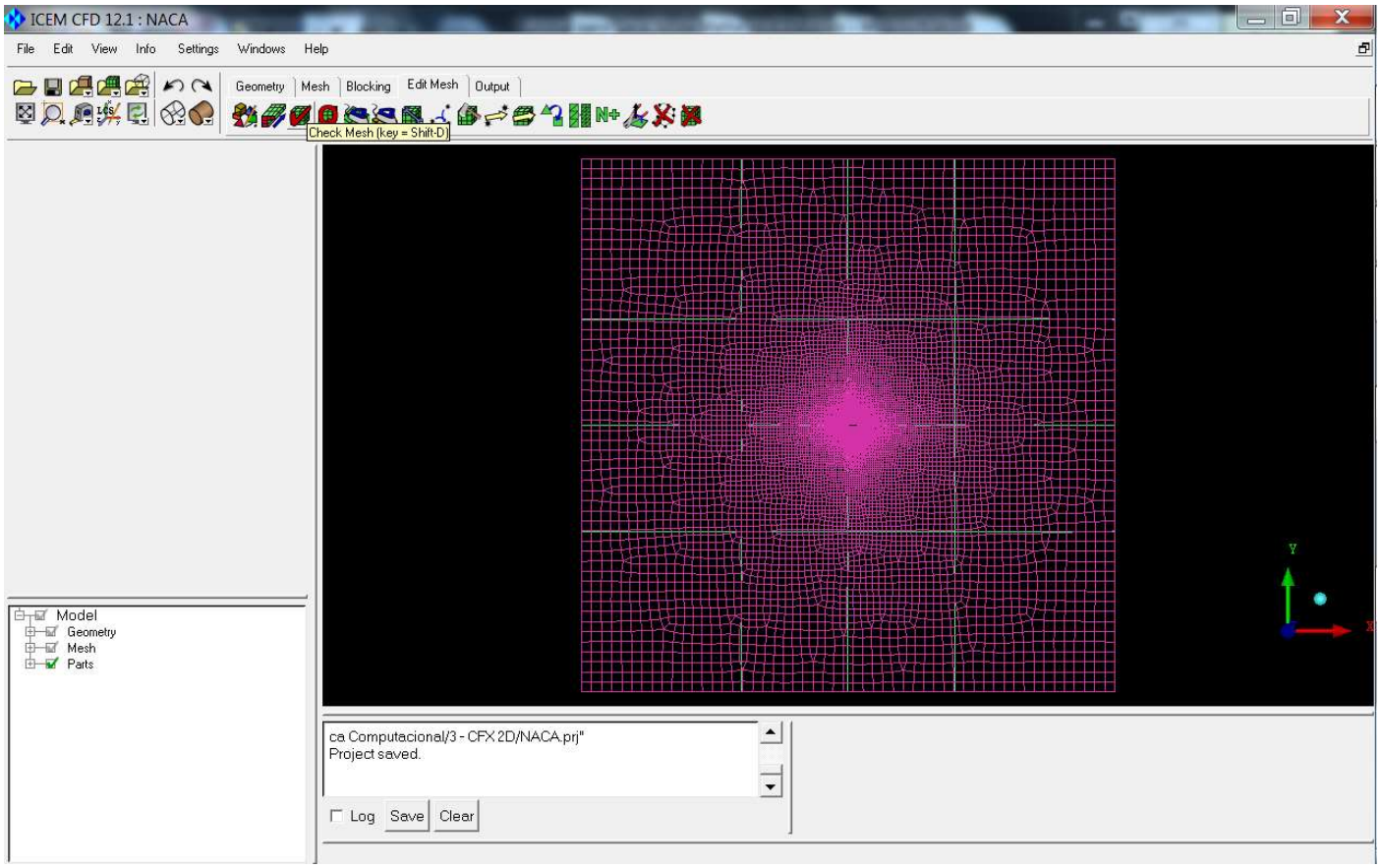
3.56. Clique em "Select Elements" e selecione todas as partes do desenho usando o mouse.



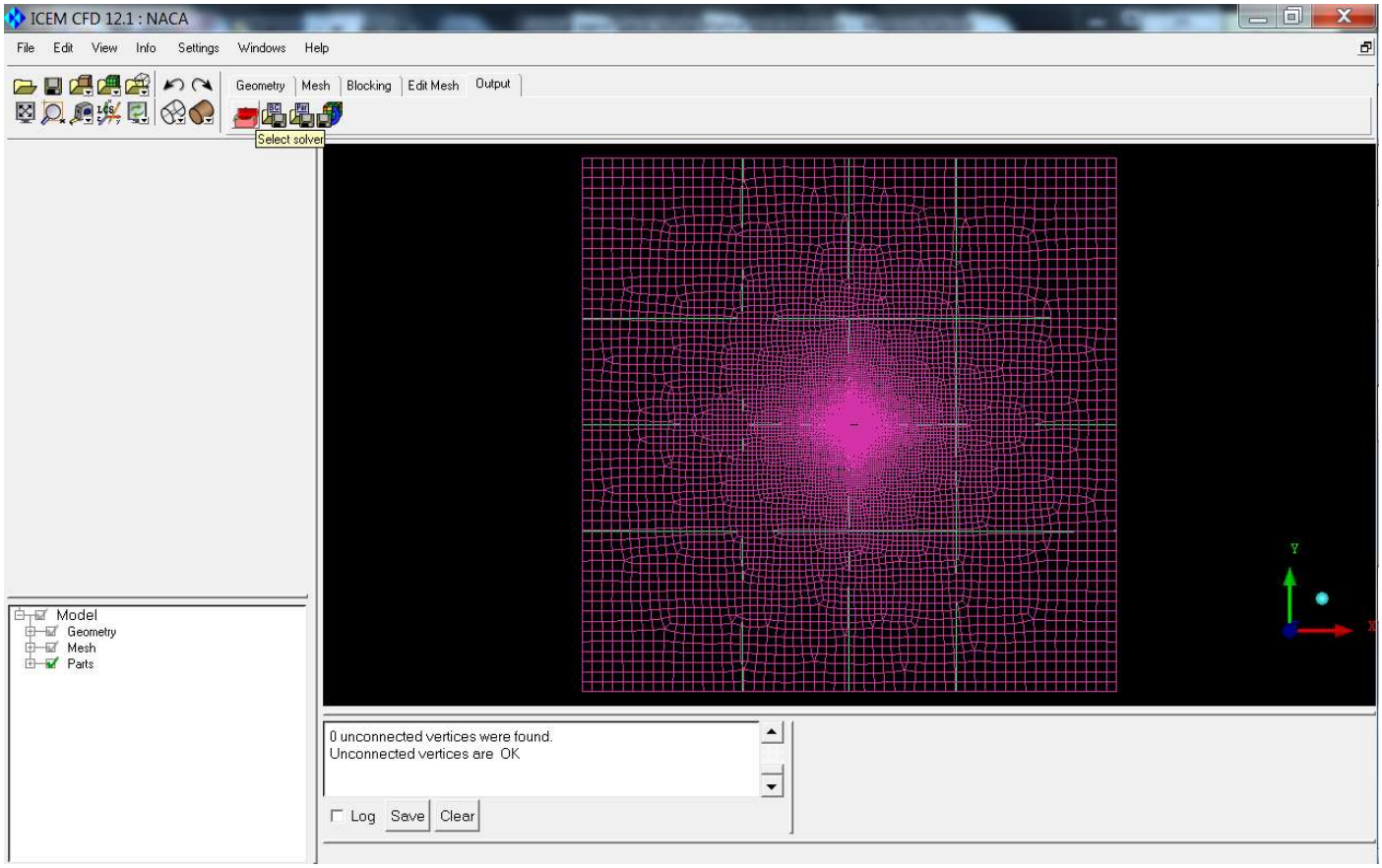
3.57. Confirme com o botão do meio e clique em "OK".



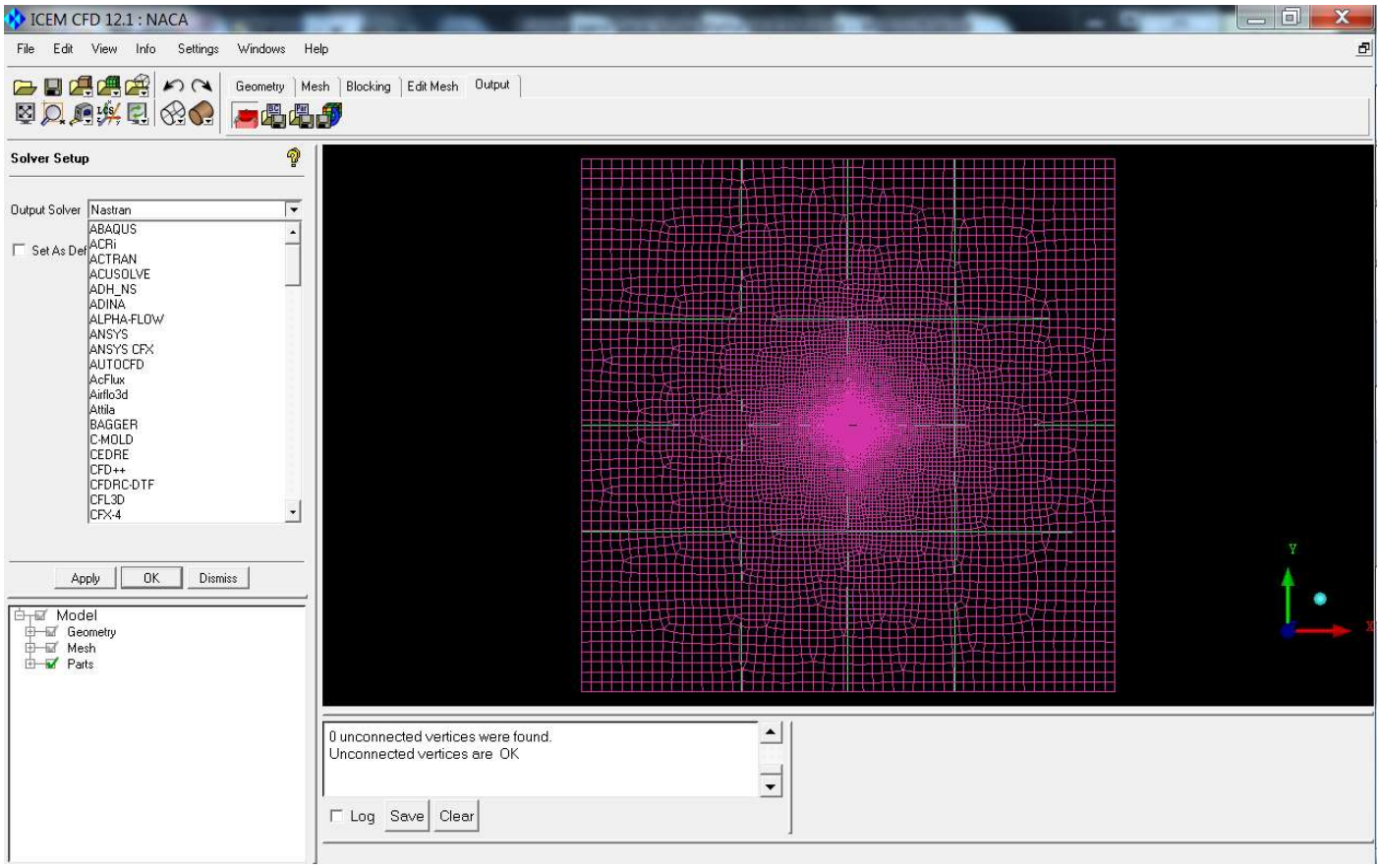
3.58. Selecione a ferramenta "Check Mesh" e clique em "OK".



3.59. Selecione o tab "Output" e selecione a ferramenta "Select Solver".



3.60. Selecione para "Output Solver" o software "ANSYS CFX" e clique em "OK".



3.61. Selecione a ferramenta "Write Input", clique em "Yes" e depois em "Done" nas caixas de diálogo que surgirão. O programa gerará o arquivo de malha computacional que será importado no software CFX.