Final Report: MAE 575 Project

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Contents

Nomenclature

$\overline{u}(x,y)$: Average velocity in the x-direction

$\overline{v}(x,y)$: Average velocity in the y-direction

$\overline{u'^2}(x,y)$: Reynold's stress

$\overline{v'^2}(x,y)$: Reynold's stress

$\overline{u'v'}(x,y)$: Reynold's stress

$k(x,y)$: Turbulence Kinetic energy

$\epsilon(x,y)$: Turbulence Kinetic Energy Dissipation

$k-\epsilon$: $k-\epsilon$ Turbulence Model

$k-\omega$: $k-\omega$ Turbulence Model

$RSTM$: Reynold's Stress Turbulence Model

H : Step height

U_{ref} : Reference Velocity (44.2 m/s)

LLE : Local, Linear and Equilibrium

LLR : Launder Reece and Rodi

$AIAA$: American Institute of Aeronautics and Astronautics

1 Introduction

The aim of this project was to utilize Ansys Fluent, a commercial solver, to solve a turbulent flow problem in a backward step geometry using three distinct Turbulence models. The performance of these models was then compared against the experimental data provided by Driver and Seegmiller (1985), as published in the AIAA Journal, Volume 23, pages 163-171. The problem was modeled as a 2D Turbulence model, with zero mean velocity in the z direction and fluctuations only in the x and y directions.

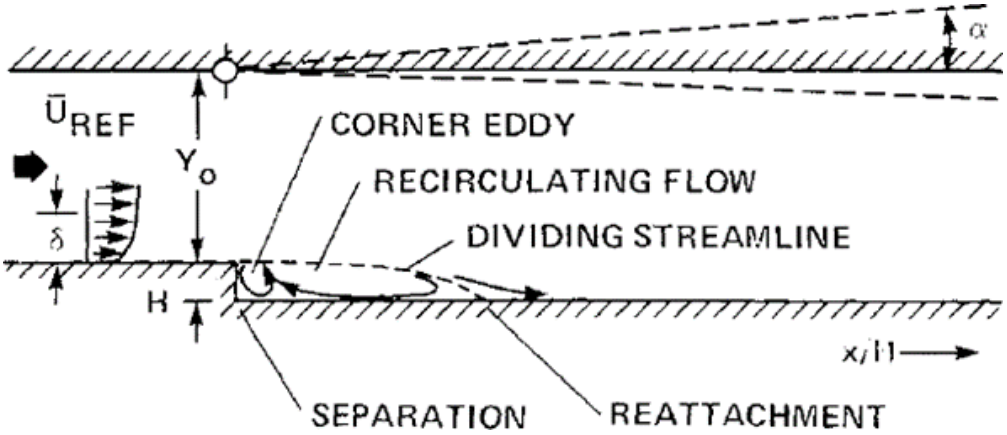


Figure 1: Experimental Setup

The project required the creation of a geometry similar to the experimental case with a height of 1.27 cm and other dimensions as specified. This geometry is shown in Figure 1. Three different meshes were then created with increasing quad size to obtain a Coarse, Medium, and Fine mesh. Three different types of Turbulence models, namely $k-\epsilon, k-\omega$, and RSTM, were used to simulate the turbulent flow in the backward step. The inlet velocity was set to 44.2 m/s at the channel inlet, and the outlet was modeled as a pressure outflow boundary condition.

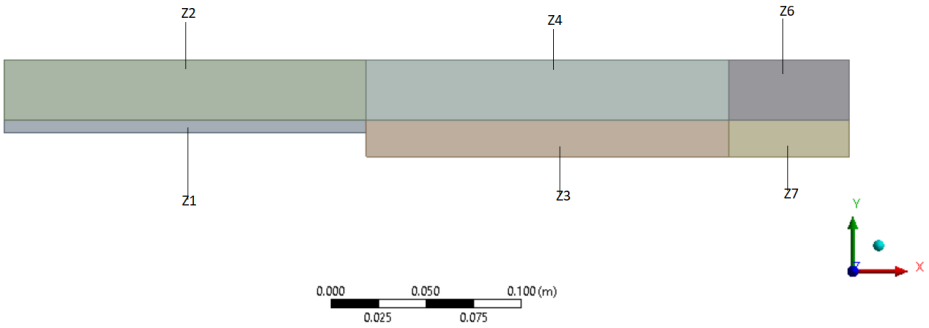
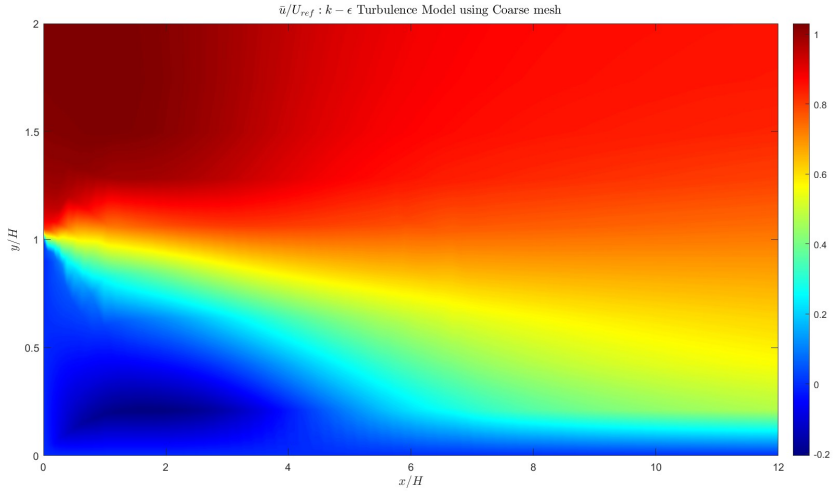


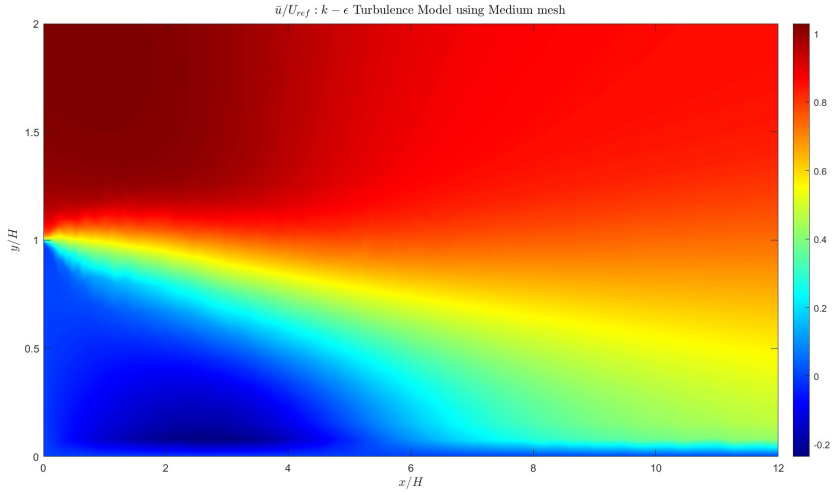
Figure 2: Geometry showing six zones

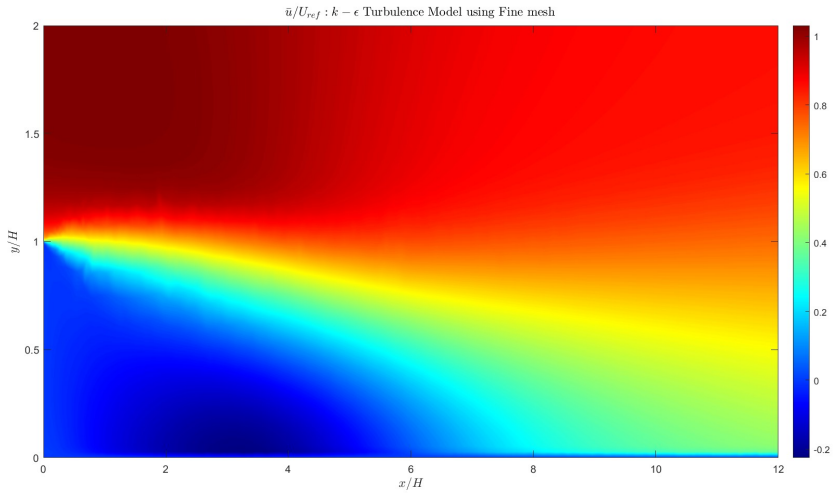
Seven different parameters characterizing the flow, including $\overline{u}(x,y)$, $\overline{v}(x,y)$, $\overline{u'^2}(x,y)$, $\overline{v'^2}(x,y)$, $\overline{u'v'}(x,y)$, $k(x,y)$, and $\epsilon(x,y)$, were measured. The entire geometry was divided into six zones, and the turbulence properties of these parameters were measured at four different locations, namely, $x/H = 1, 4, 6, 10$, which corresponds to the experimental data. The measurements were normalized using the reference velocity $U_{\text{ref}} = 44.2m/s$, as in the experiment.

2 Influence of Mesh: Contour Plots and Discussion

Average Horizontal Velocity $\bar{u}/U_{ref}$







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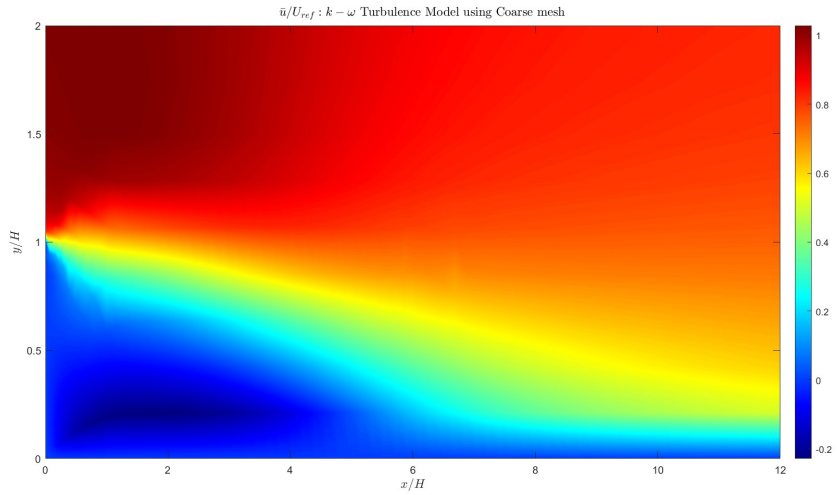

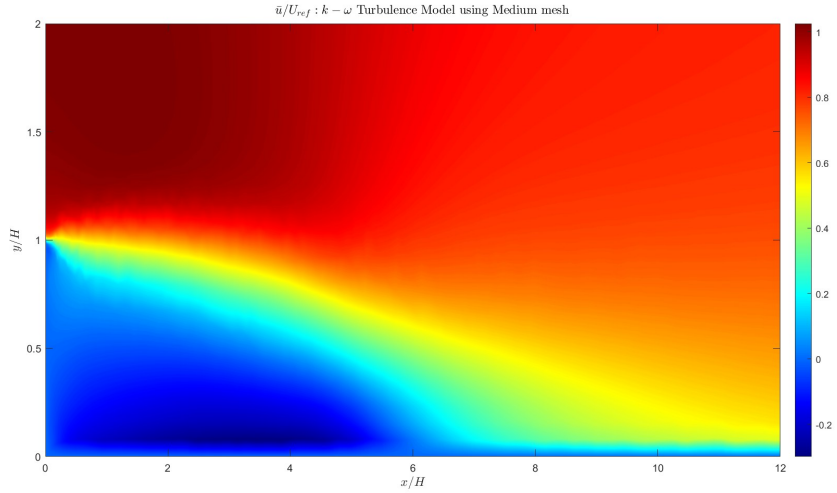

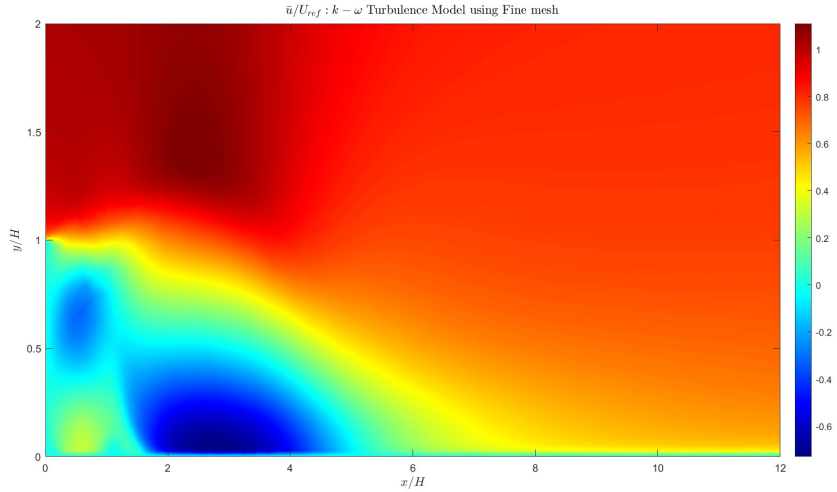

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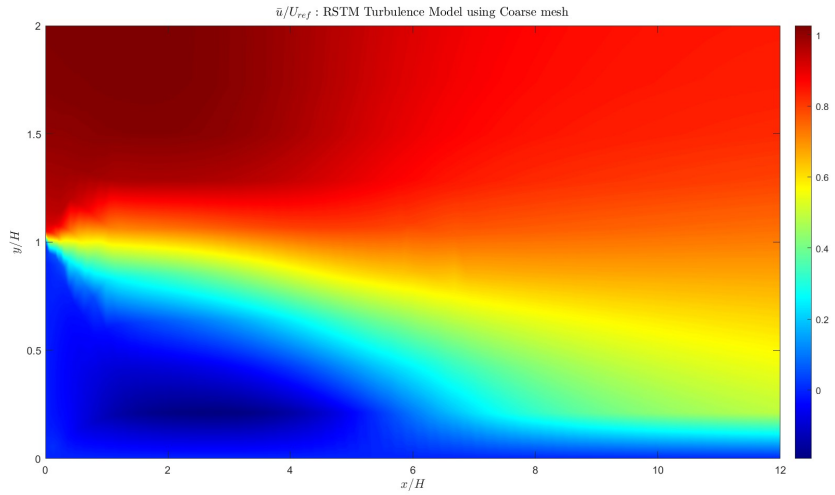

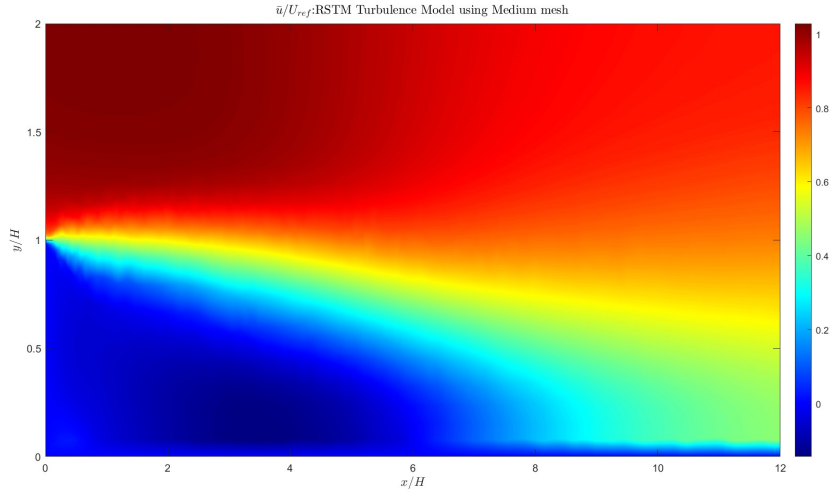

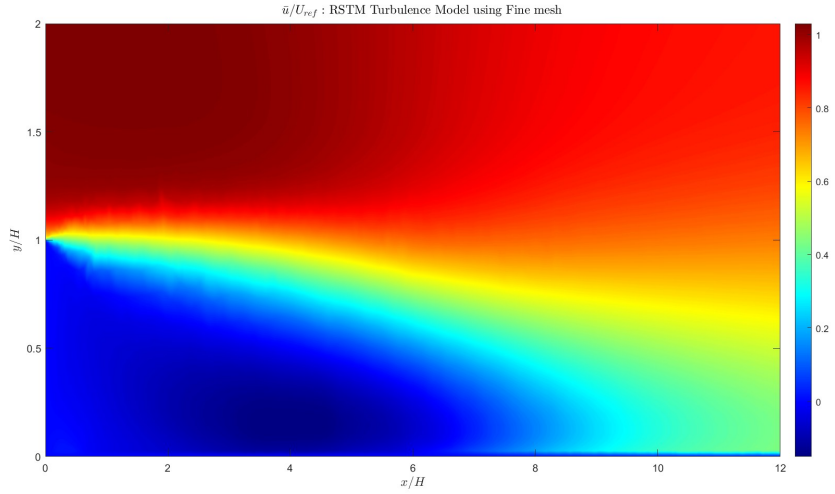

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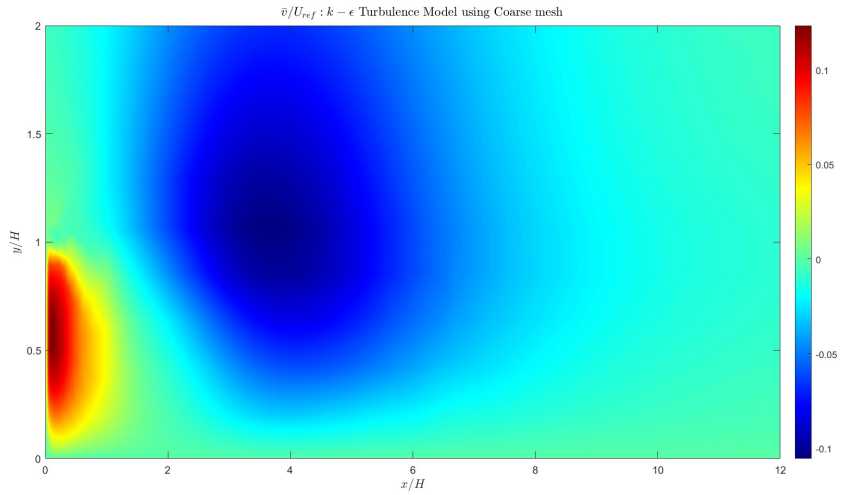

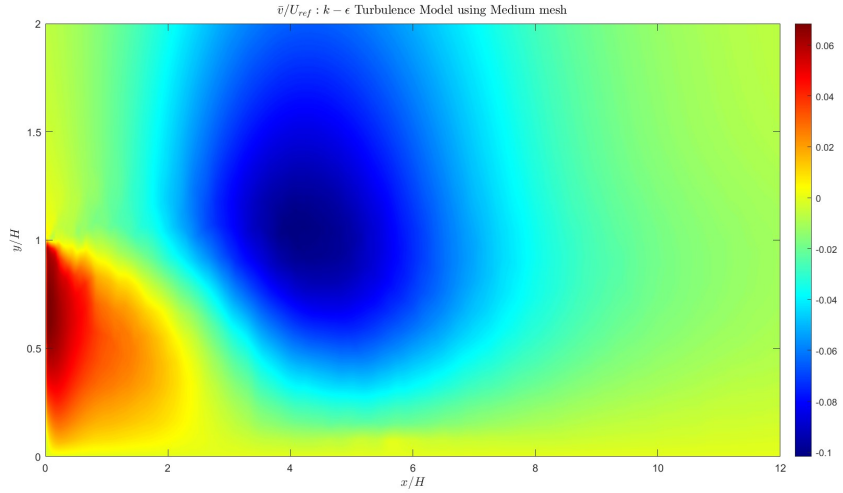

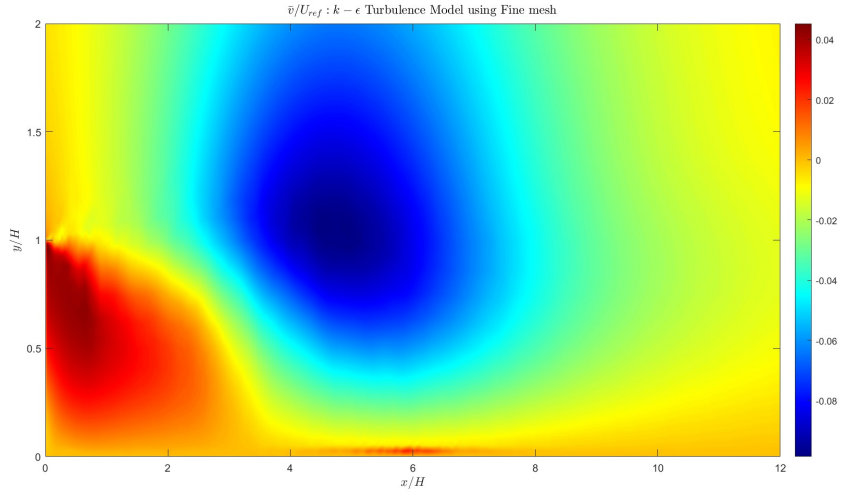

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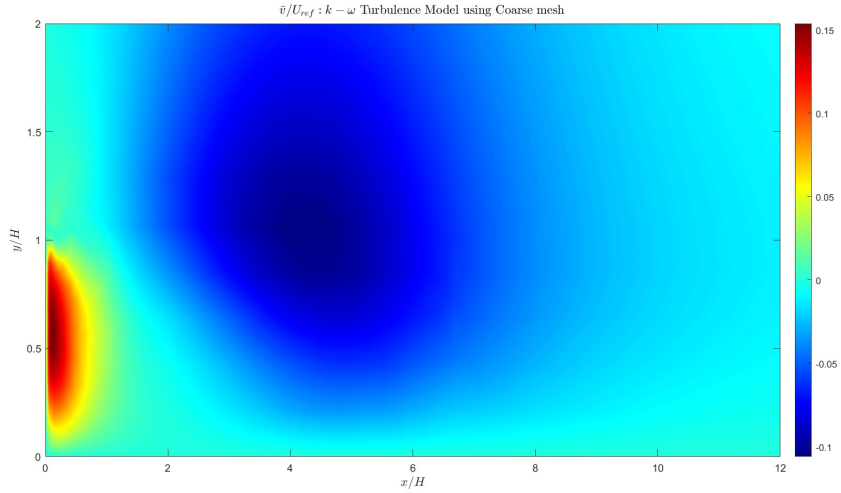

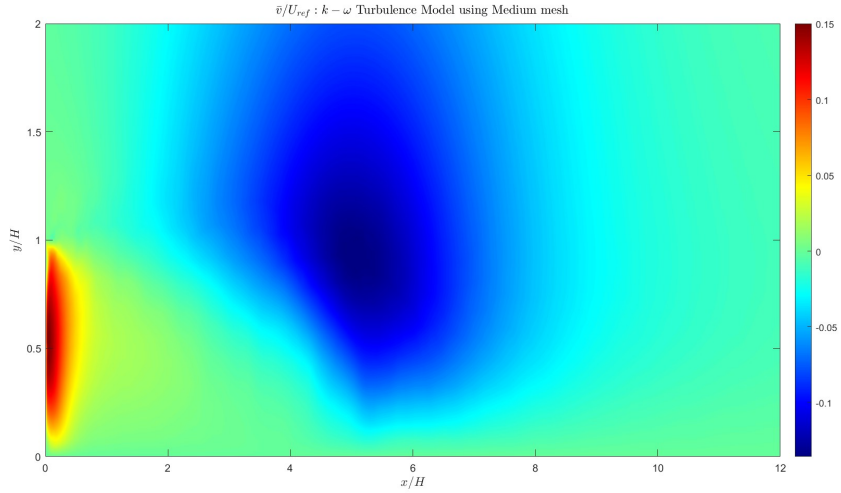

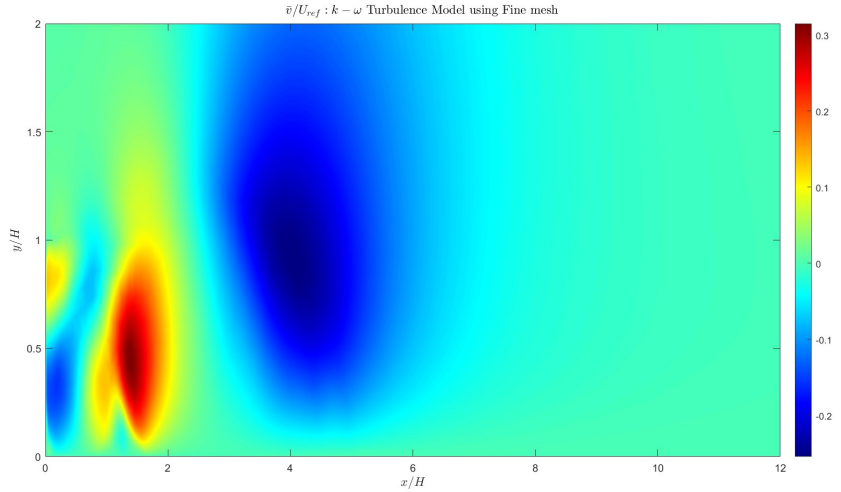

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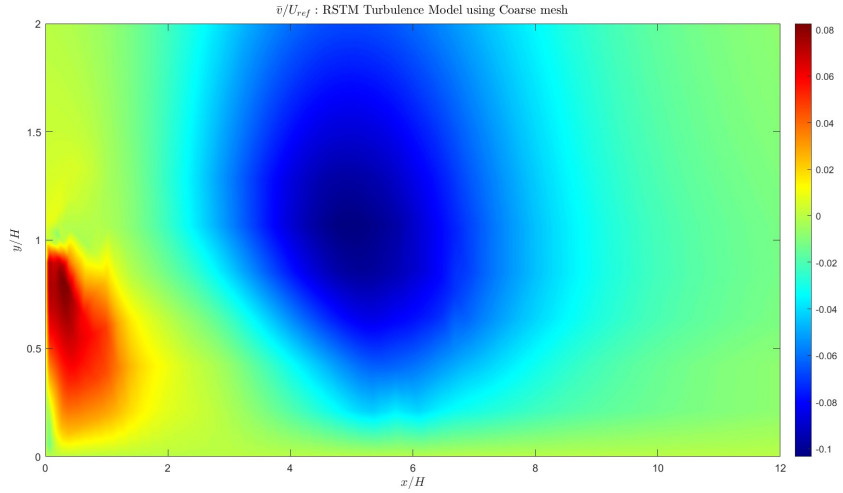
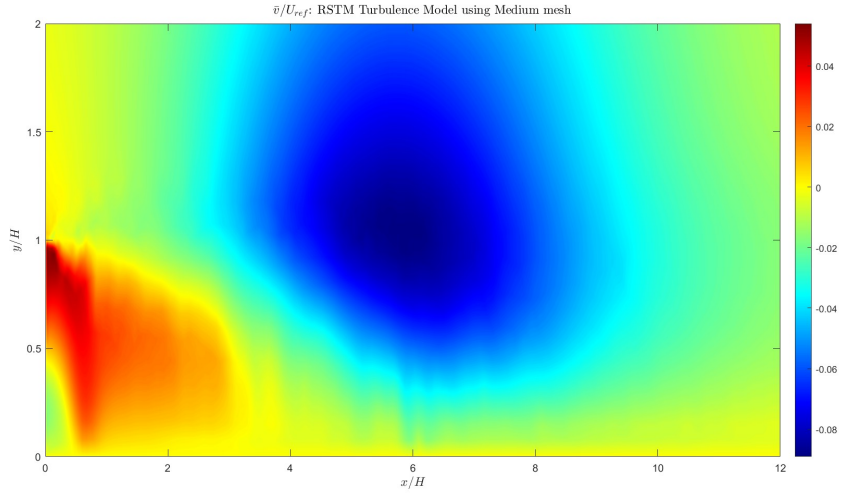
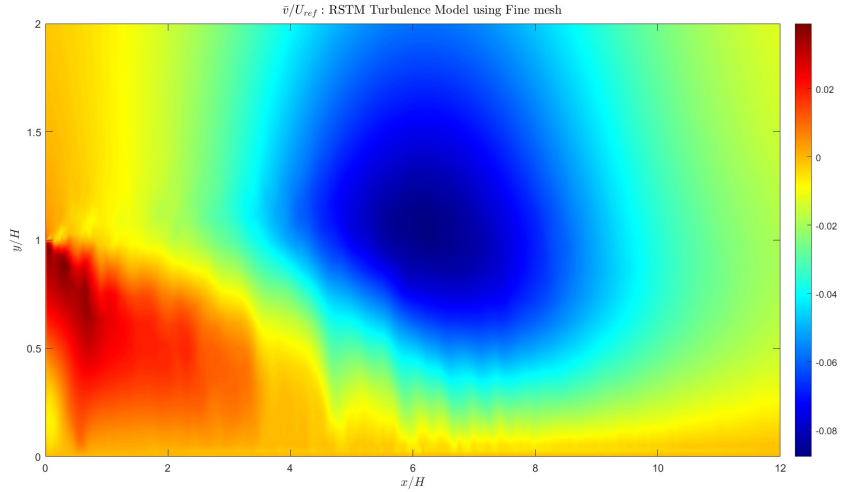
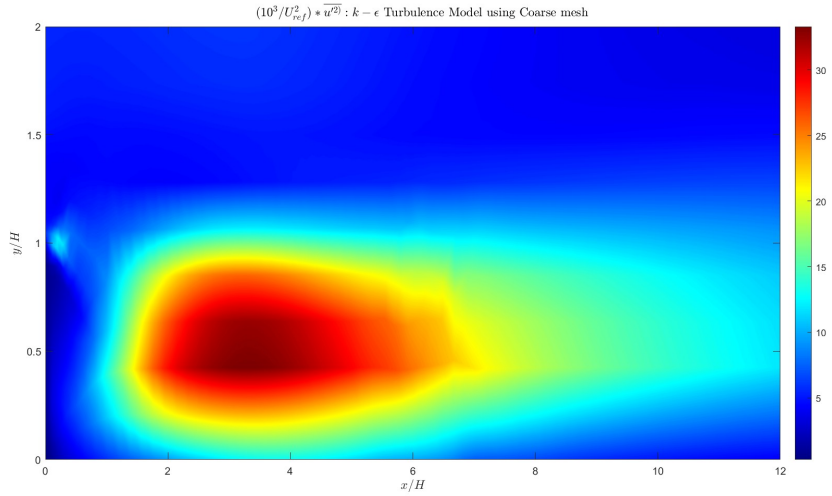
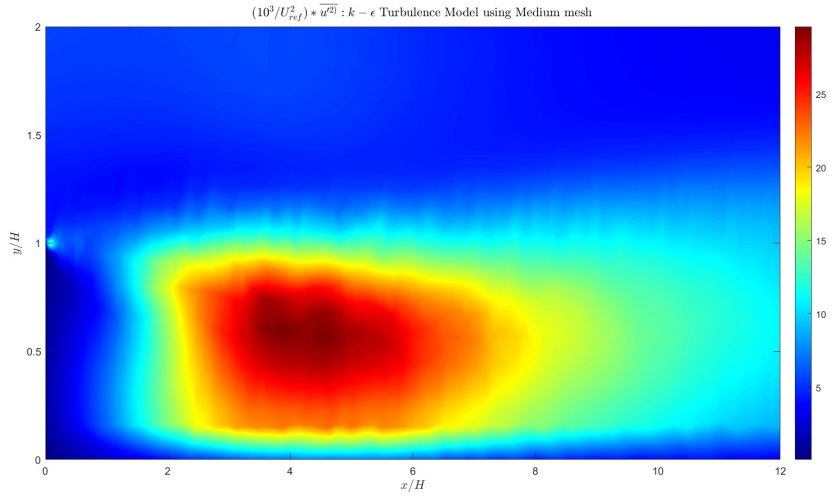


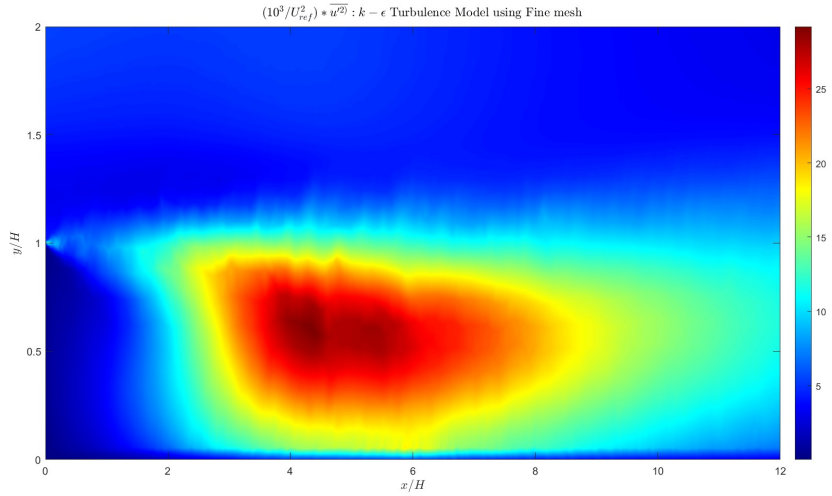




$(10^3/U_{ref}^2) * \overline{u'^2}$ Reynold's Stress







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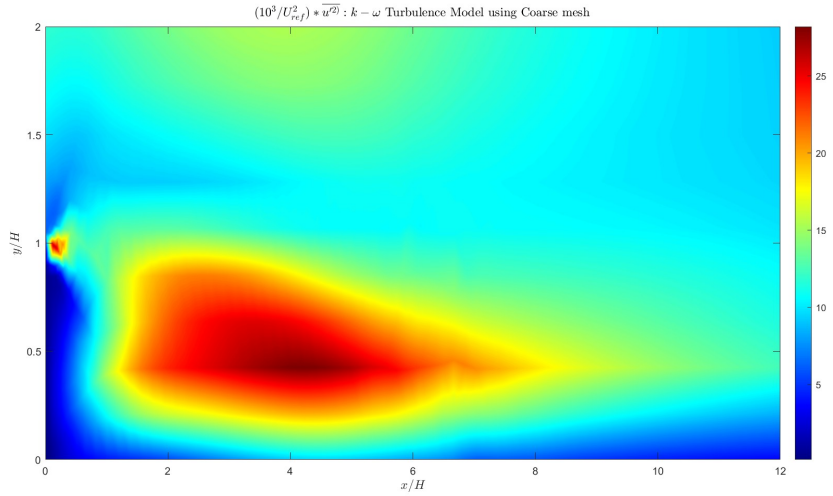

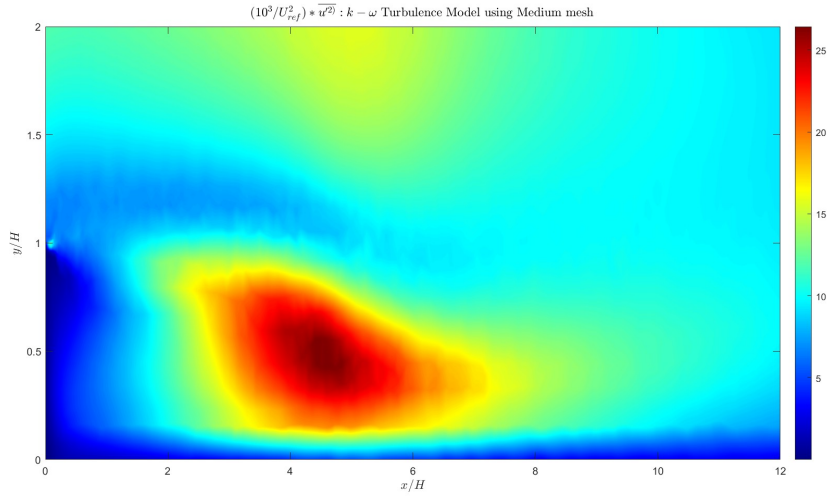

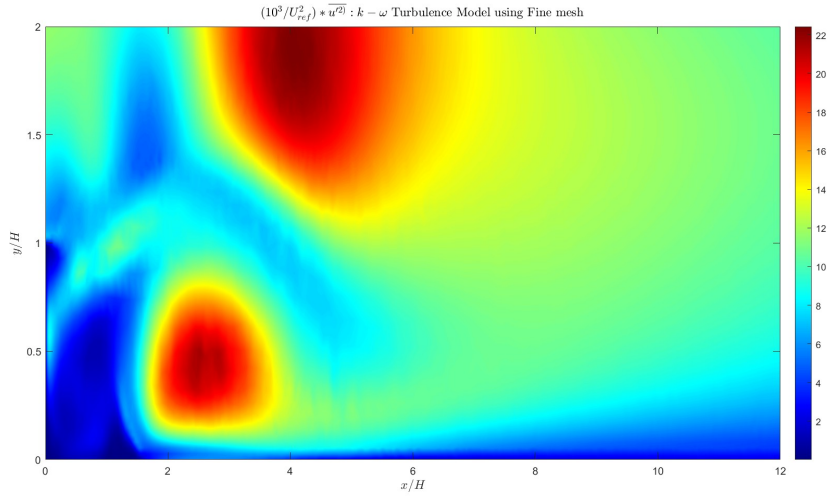

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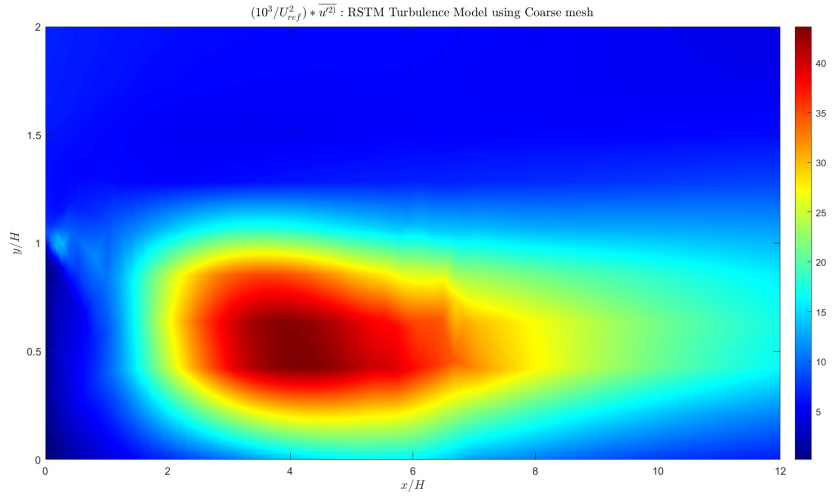
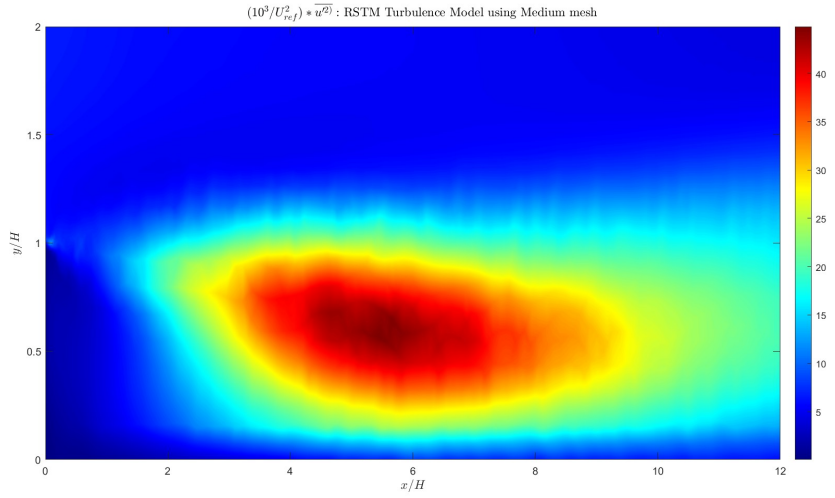
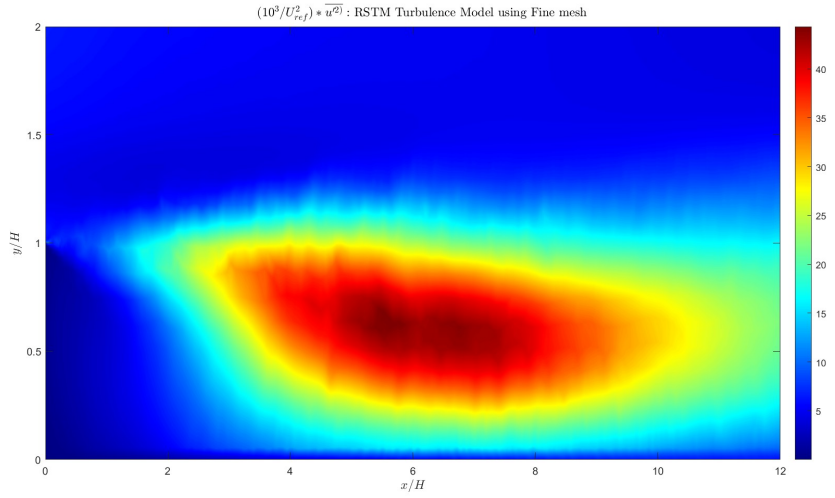
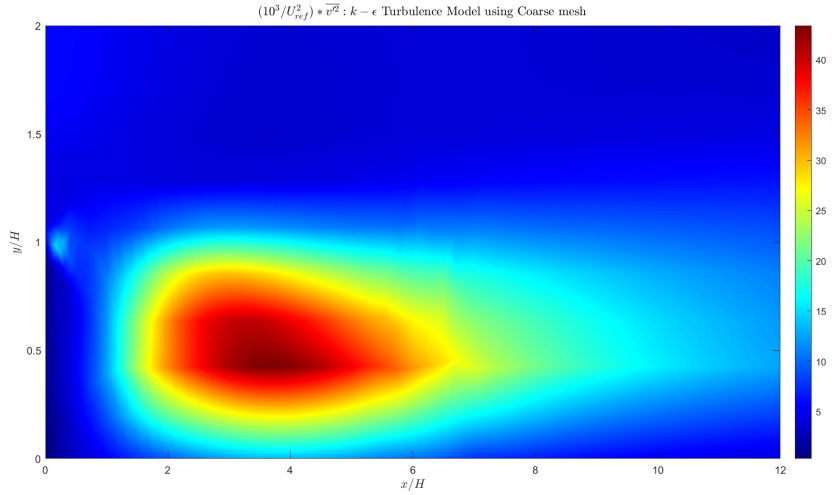
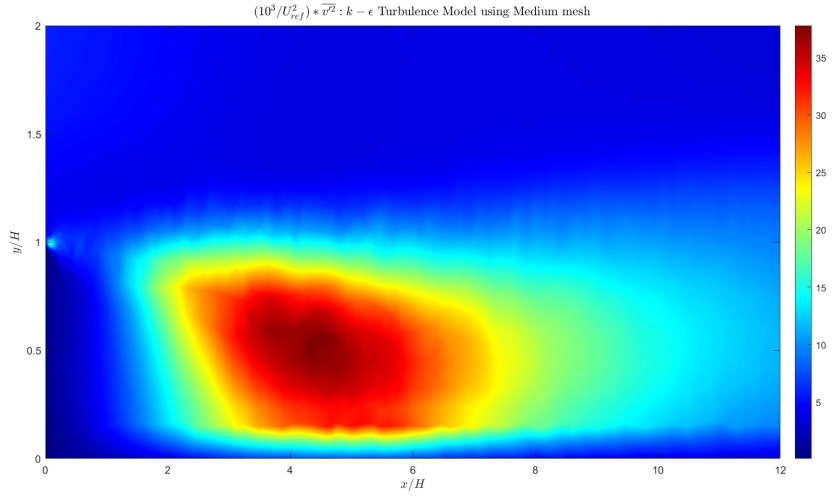


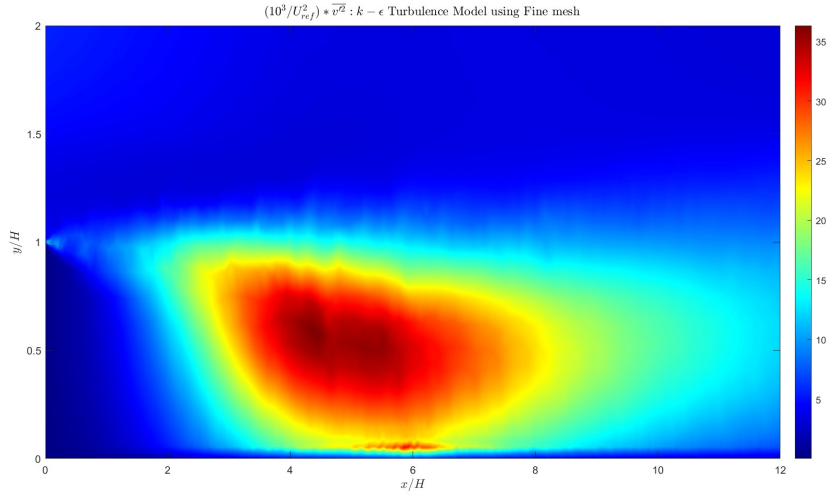




$(10^3/U_{ref}^2) * \overline{v'^2}$ Reynold's Stress







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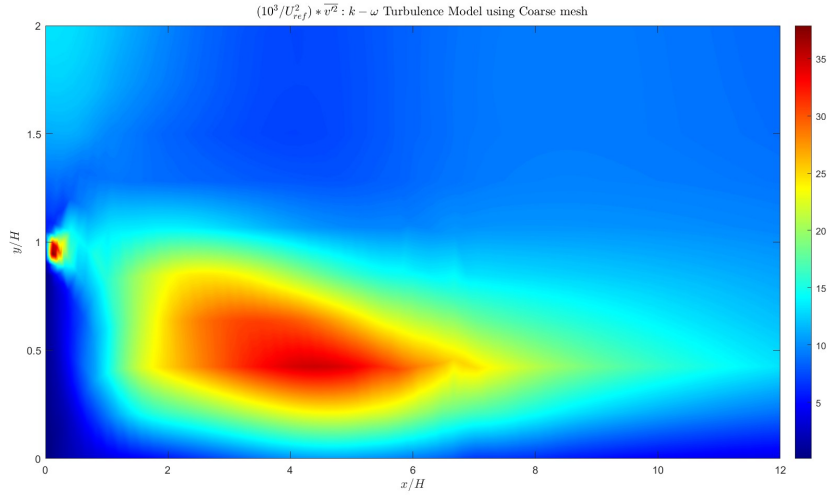

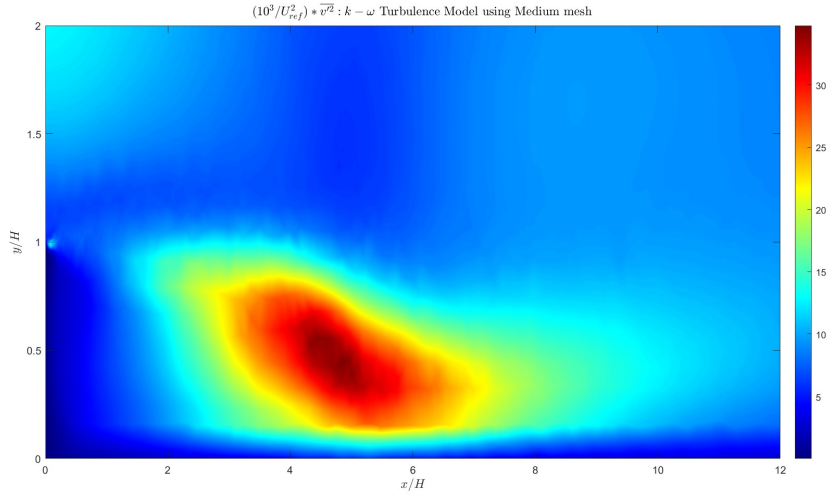

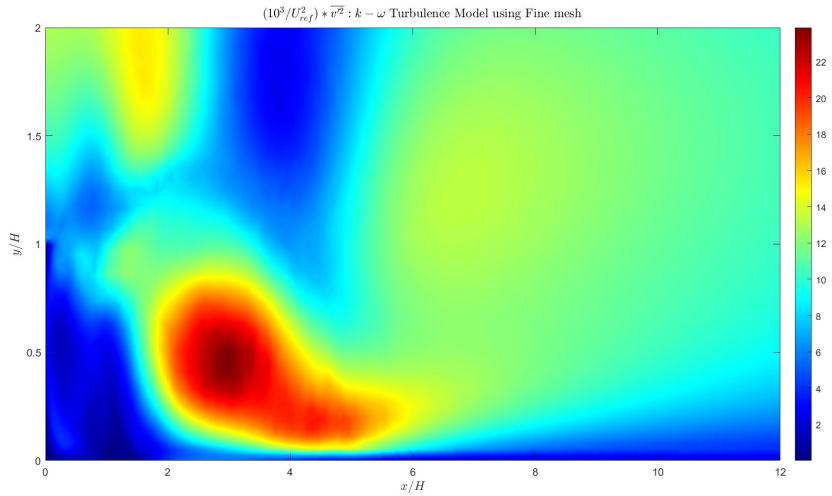

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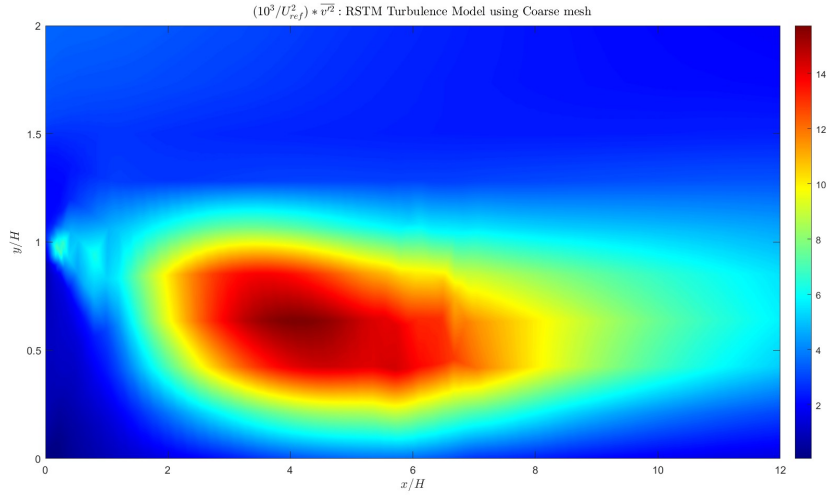

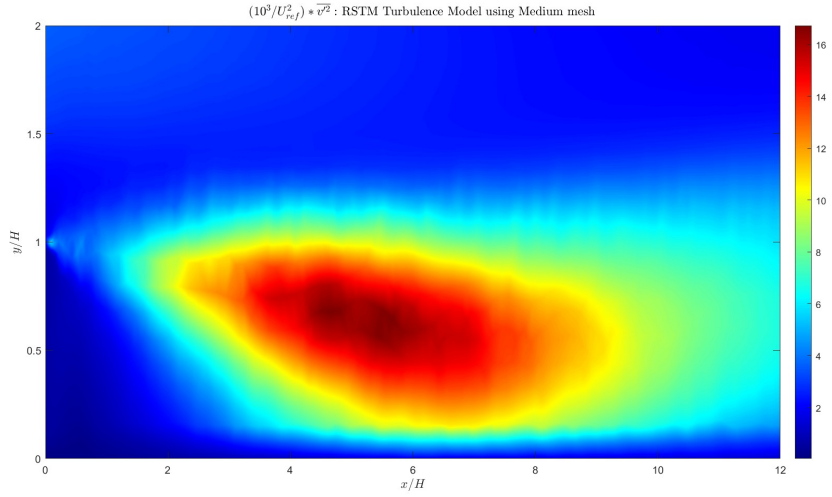

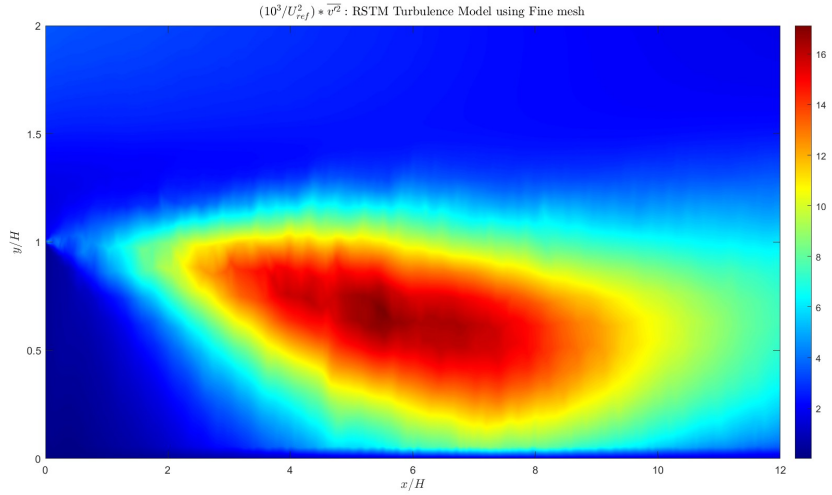

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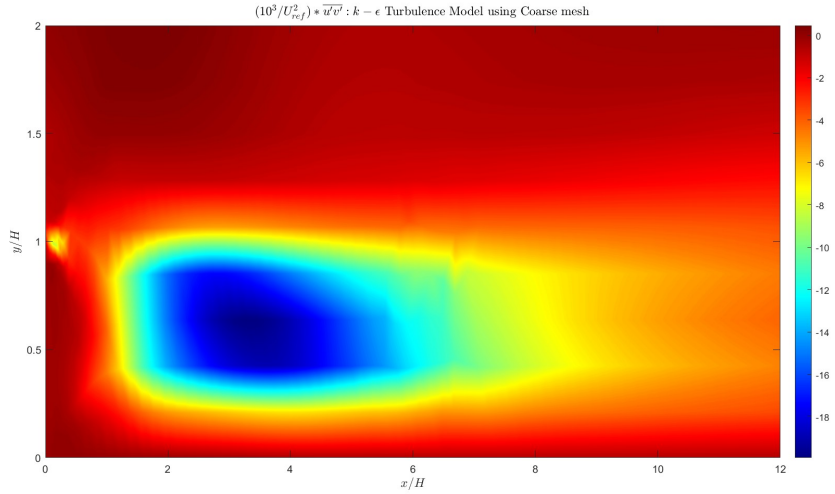

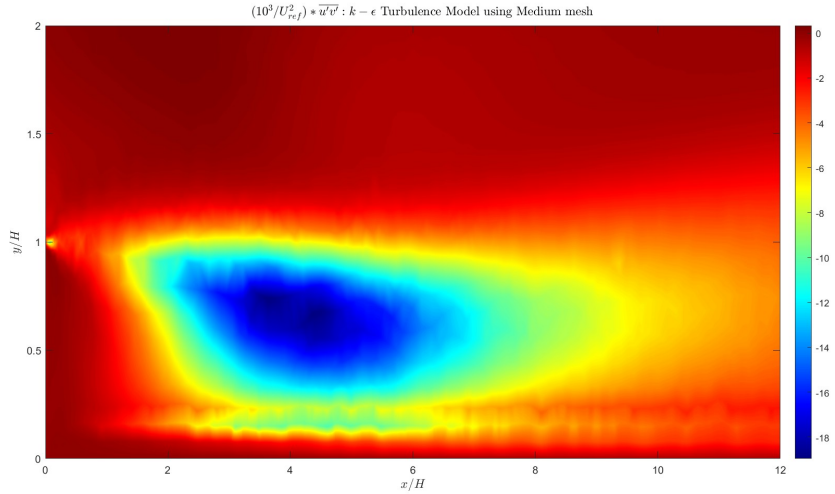

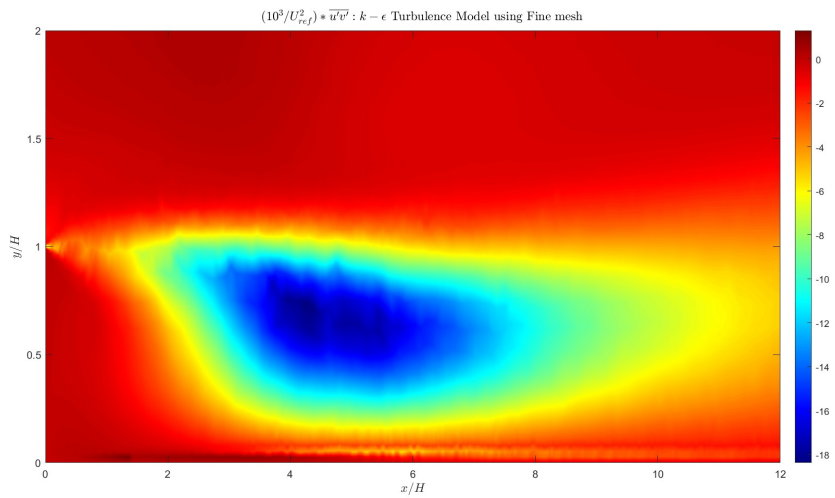

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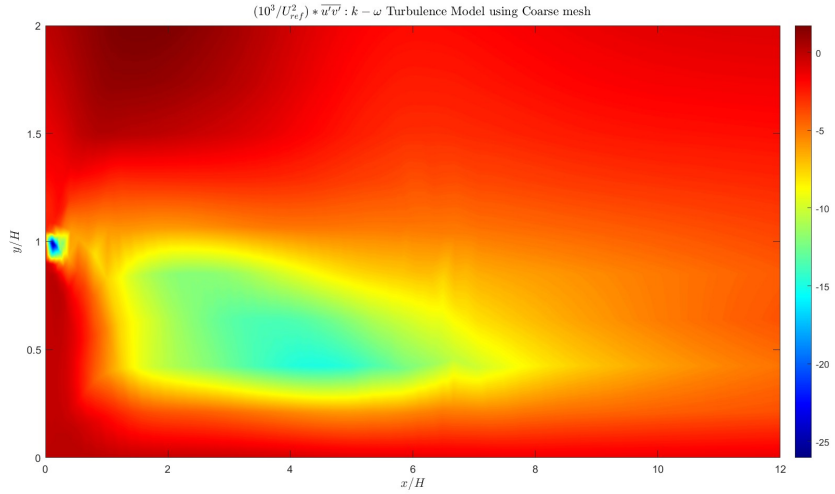

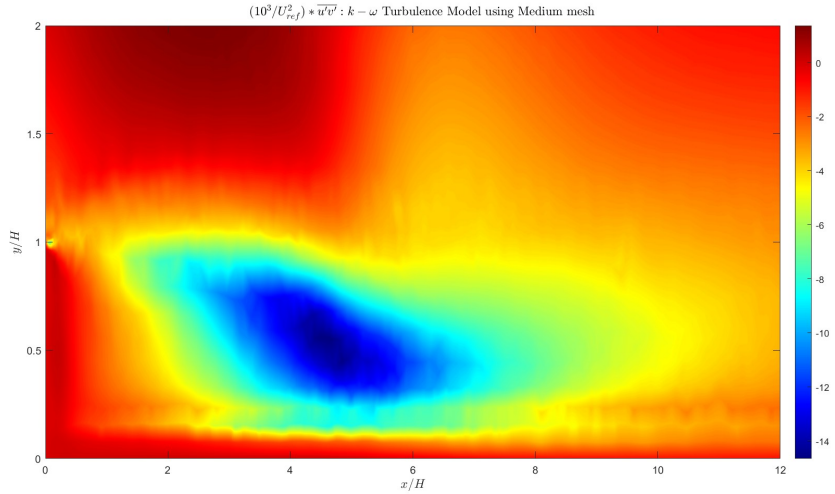

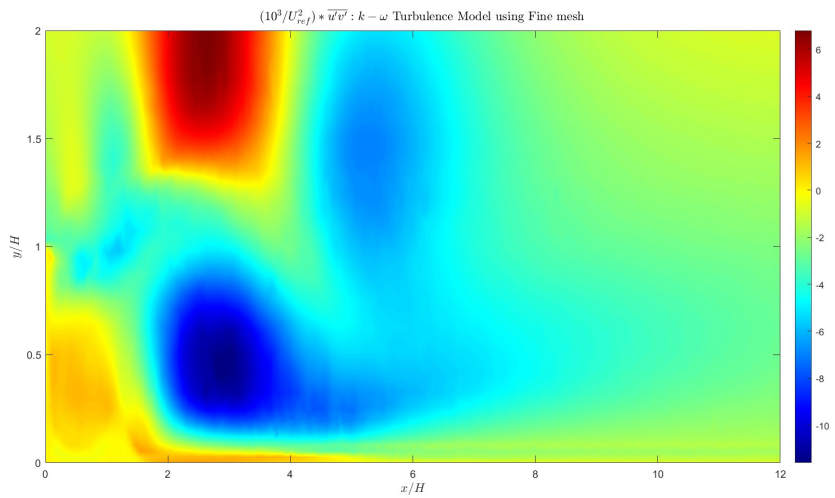

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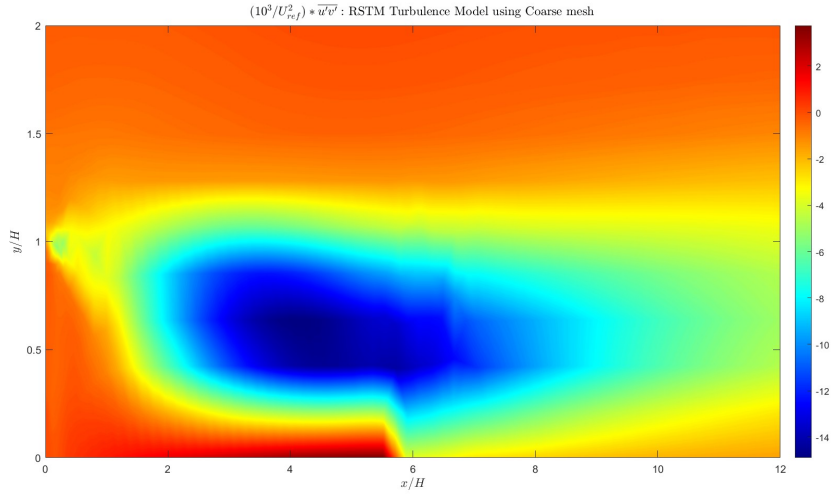
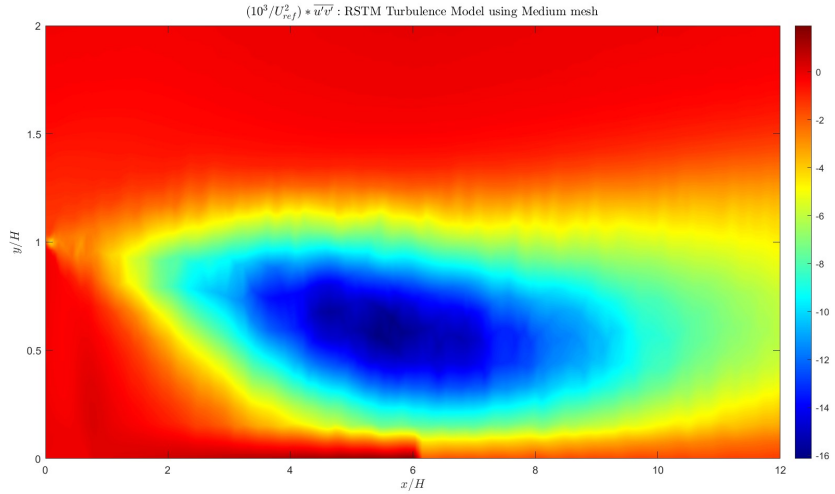
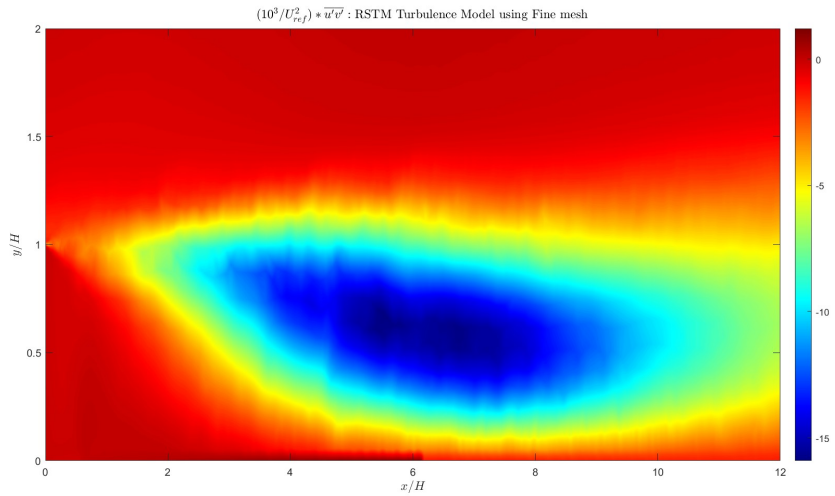
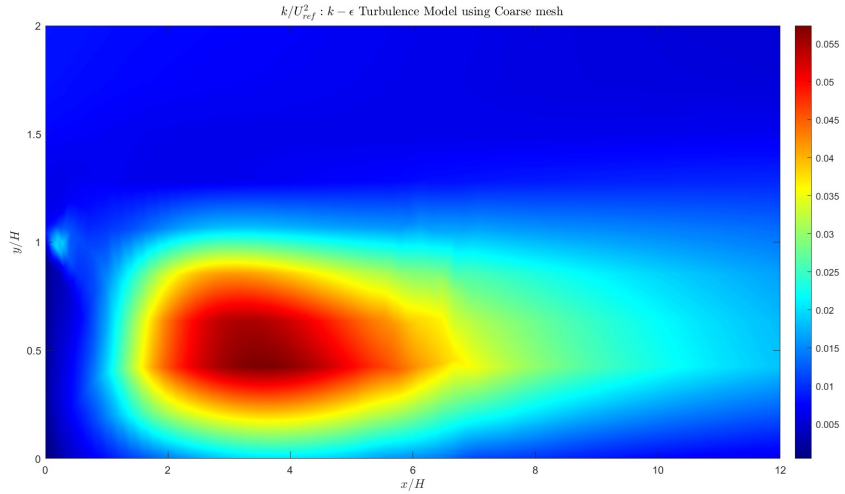
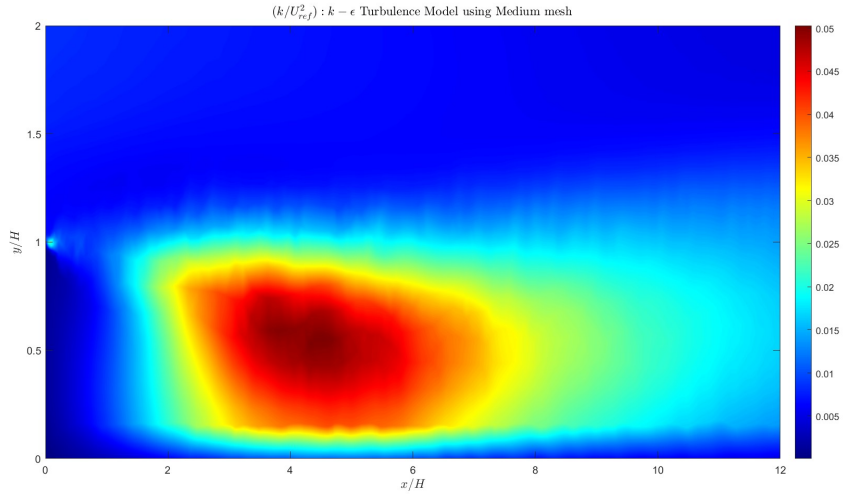


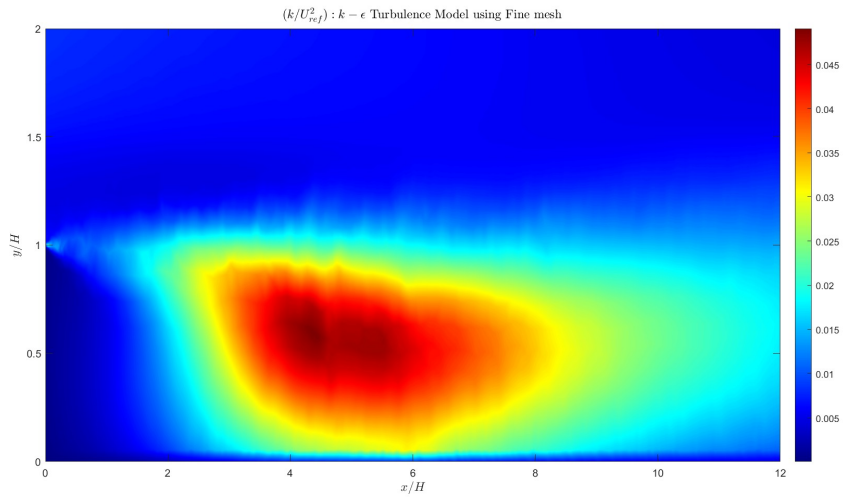




(k/U_{ref}^2) Turbulent Kinetic Energy







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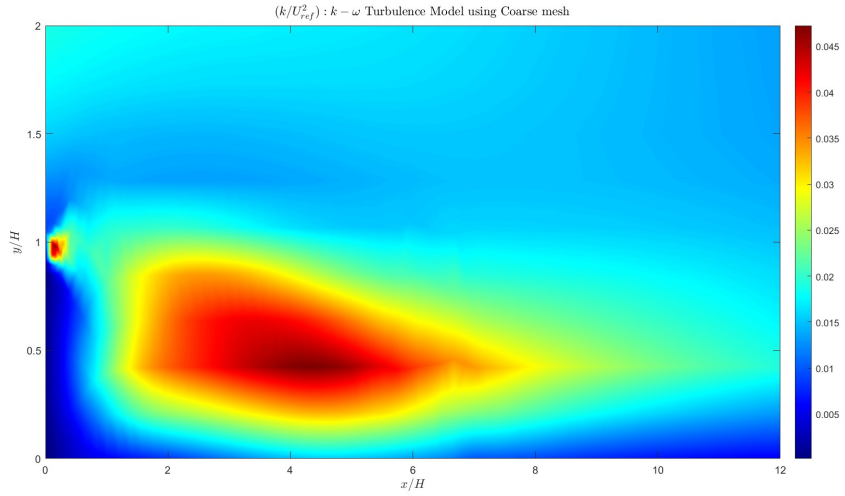

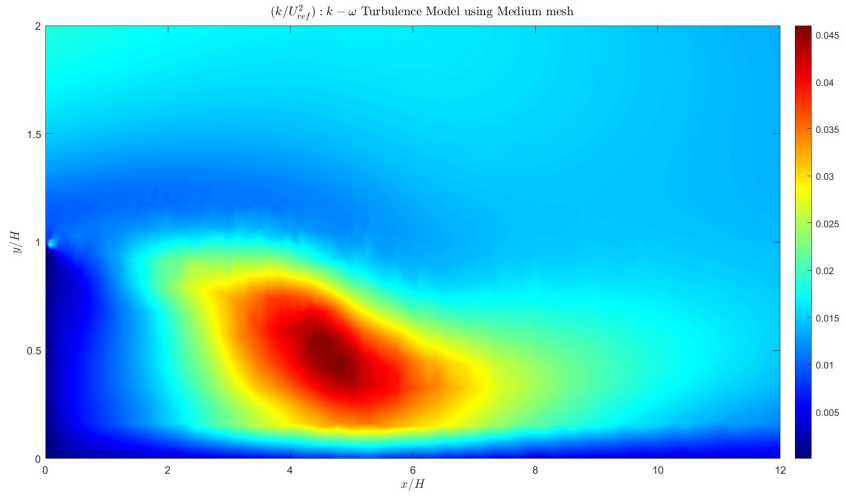

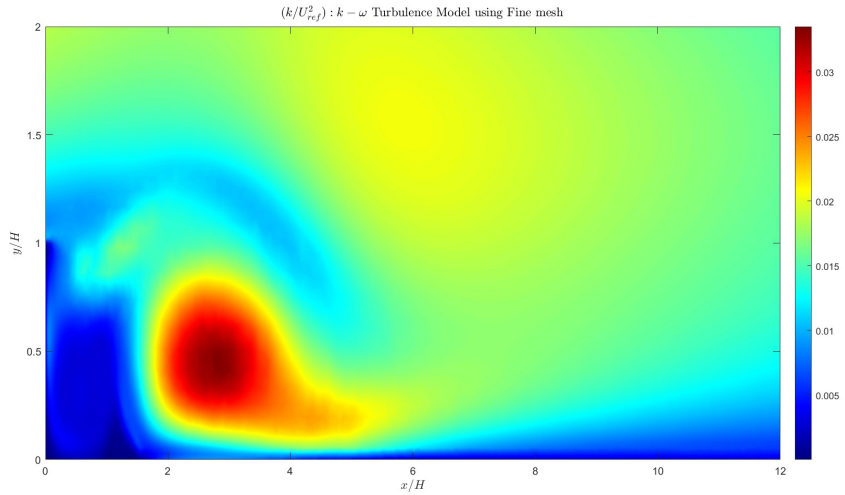

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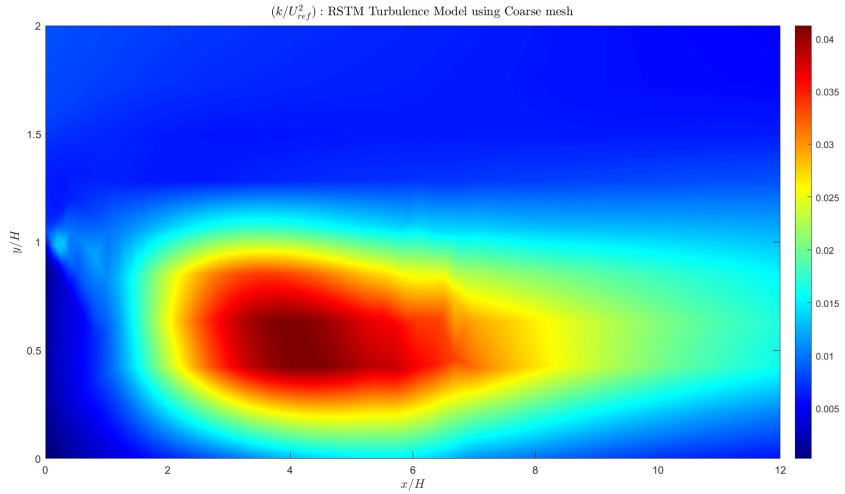
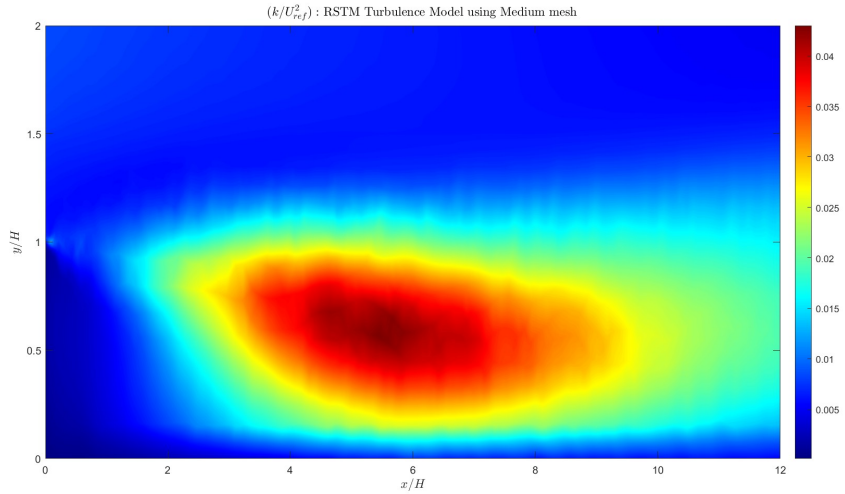
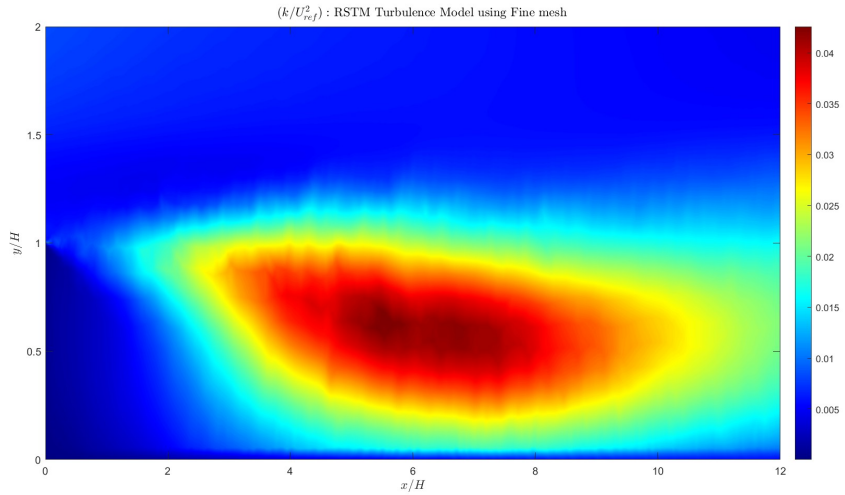
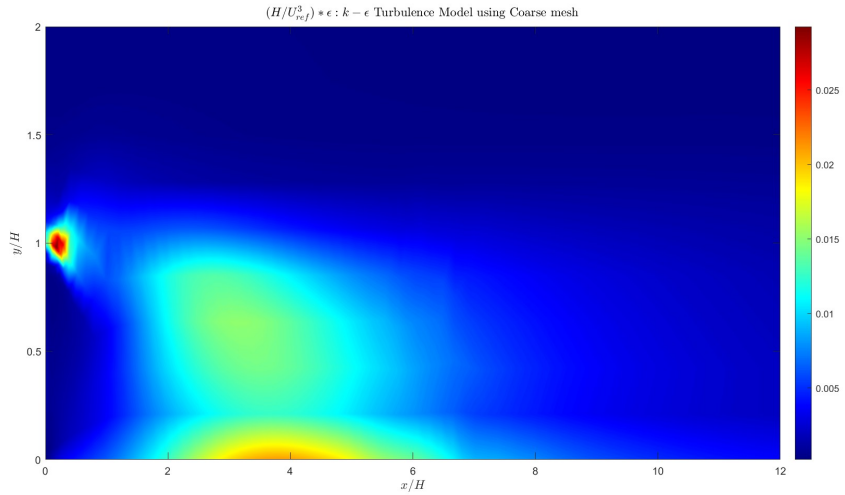
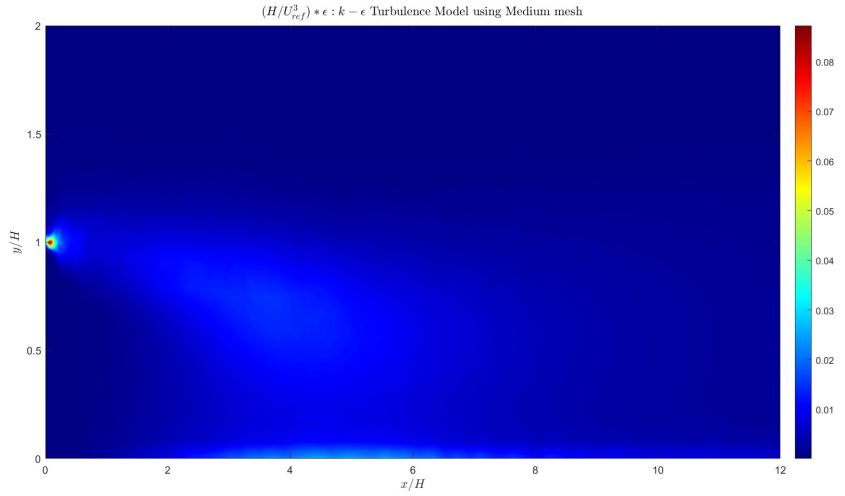


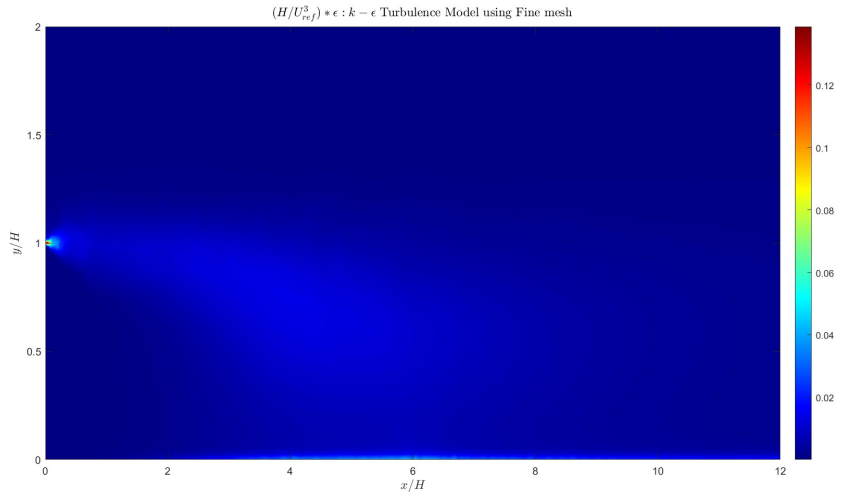




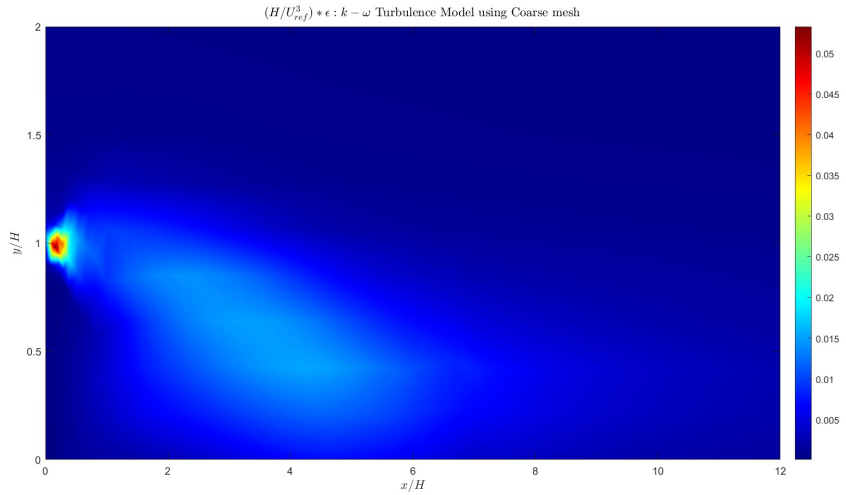
$(H/U_{ref}^3) * \epsilon$ Turbulence Dissipation Rate

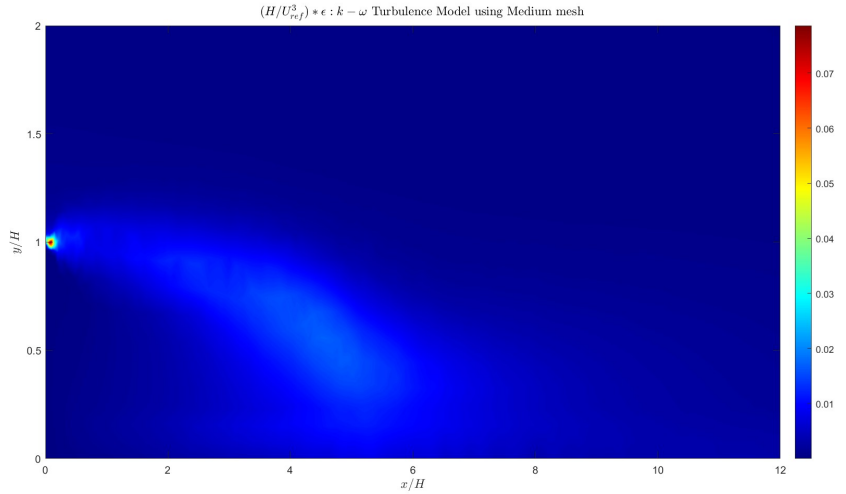


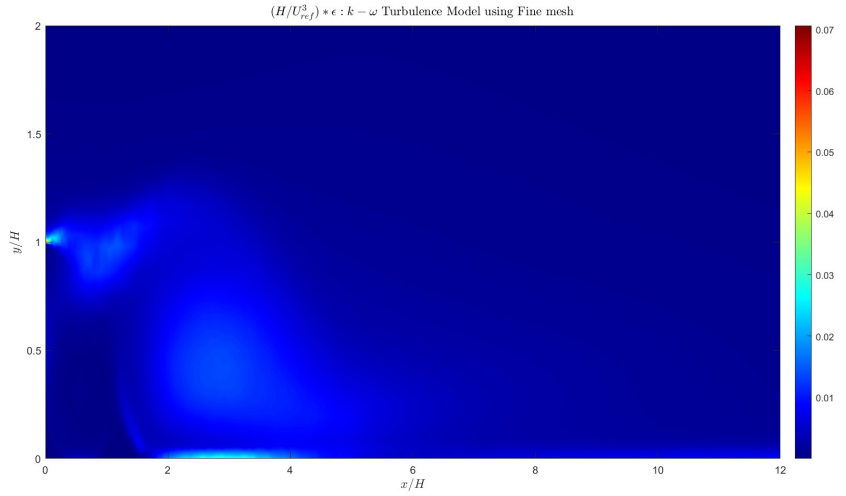




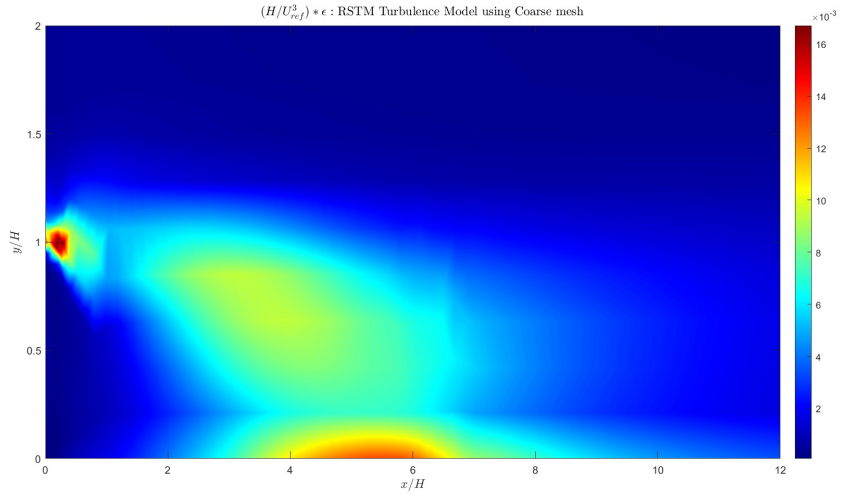
$(H/U_{ref}^3) * \epsilon$ Turbulence Dissipation Rate

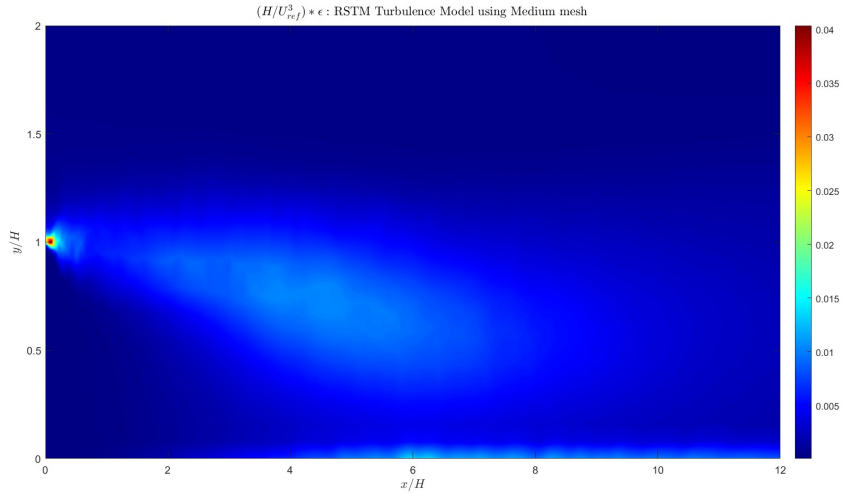


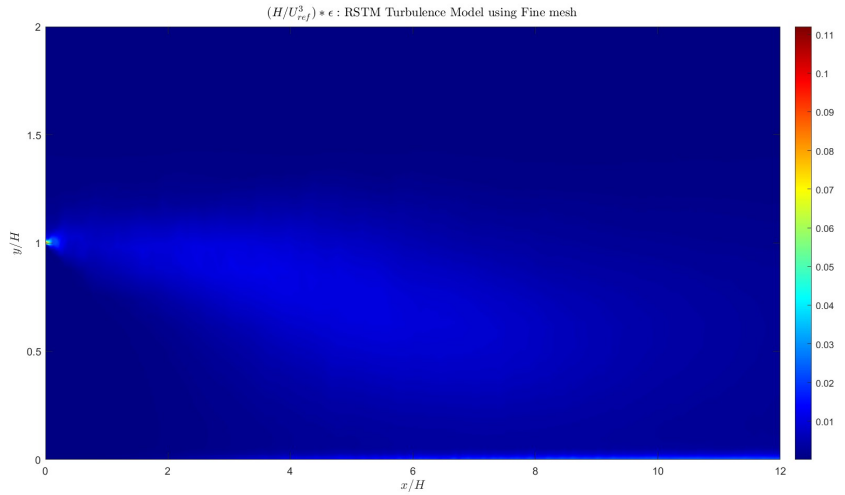




$(H/U_{ref}^3) * \epsilon$ Turbulence Dissipation Rate







Discussion

Q1: Do you see significant differences in any of these color fields among the three meshes (COARSE, MEDIUM, FINE); if so, discuss what you believe are the most important differences you see.

Answer: There are discernible changes in the results as the mesh size is refined. In the case of $\bar{u}(x, y)$, there is little variation in the plots, but larger circulation zones are noticeable in higher mesh sizes. The RSTM model with a fine mesh exhibits the largest refinement zone, which could indicate that smaller mesh sizes are not as accurate in predicting the circulation and flows near the bottom wall and step. Medium and fine meshes produce similar results, except for the $k - \omega$ case, which seems problematic.

Similarly, for $\bar{v}(x, y)$, flow characteristics around the step become more refined with higher mesh sizes, suggesting that coarse mesh is not sufficient for accurate results, and medium and fine meshes provide better results.

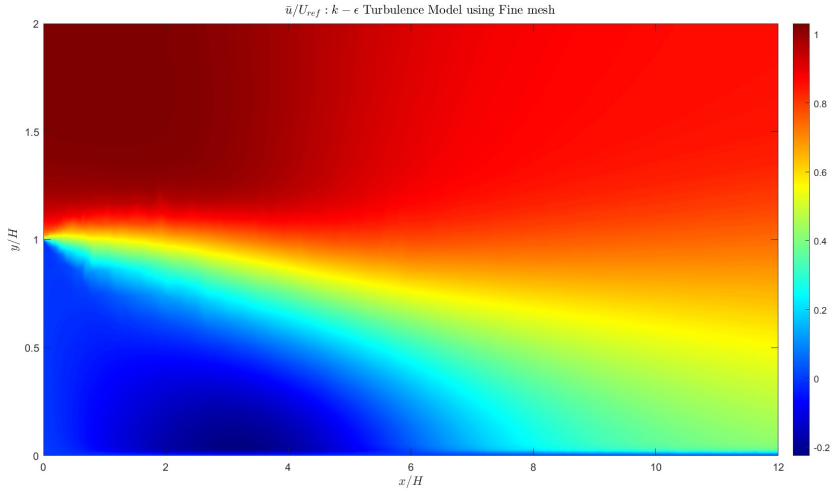
Reynolds stresses and Kinetic Energy plots exhibit differences in results with mesh refinement. Lower mesh sizes tend to average out flow velocities, creating nearly uniform lumps of stress downstream of the step. Fine meshes capture features from the start of the step and extend much further down the channel, indicating that lower mesh sizes are less accurate. Medium and fine meshes exhibit similar results, indicating mesh independence.

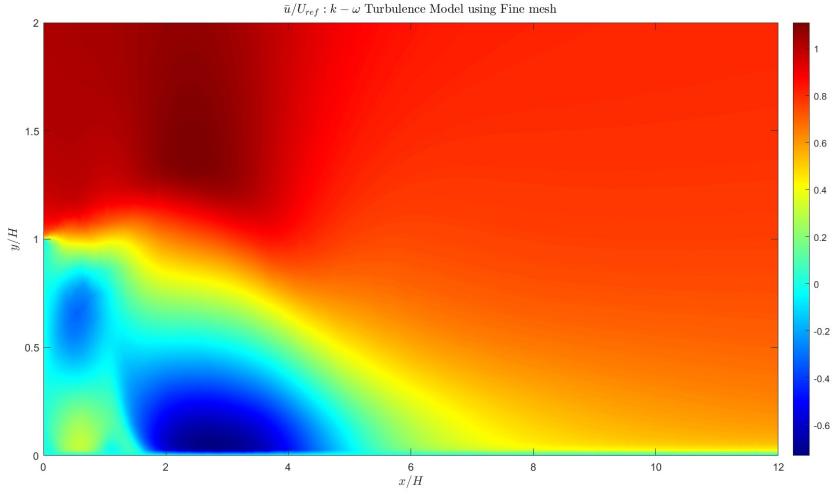
Turbulent Dissipation Rate exhibits the most significant change with mesh refinement. The lumps are messier and extend further downstream for lower mesh sizes, while finer meshes start at the step and dissipate slowly and smoothly, with a smaller region of high-energy dissipation. The lump at the step decreases with each mesh refinement, becoming increasingly precise, which aligns with the majority of dissipation occurring near the step.

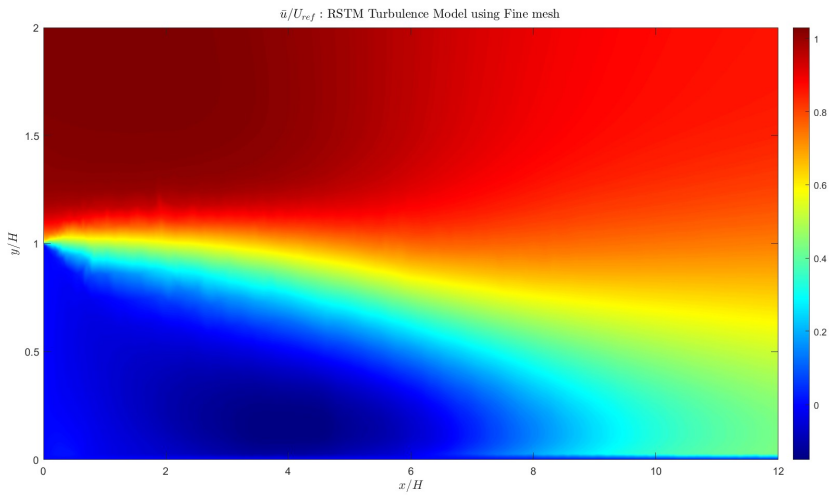
Lastly, the fine mesh for the $k - \omega$ model is markedly different from other models. It exhibits coherent structures resembling vortices, as seen in the Turbulence Dissipation Rate figure. This could be due to differences in how ω is modeled, but it is difficult to determine if this model is more accurate than others. As we have learned in this course, none of the models are entirely accurate.

3 Comparison of Models: Contour Plots and Discussion

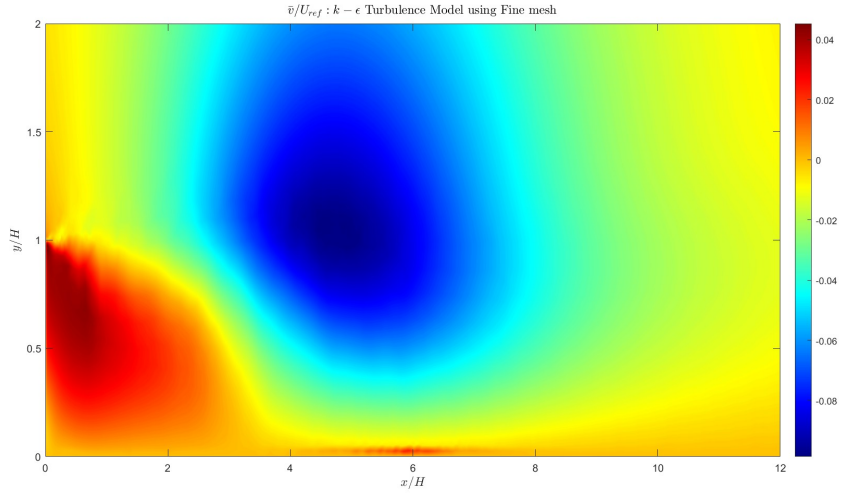
Average Horizontal Velocity $\bar{u}/U_{ref}$

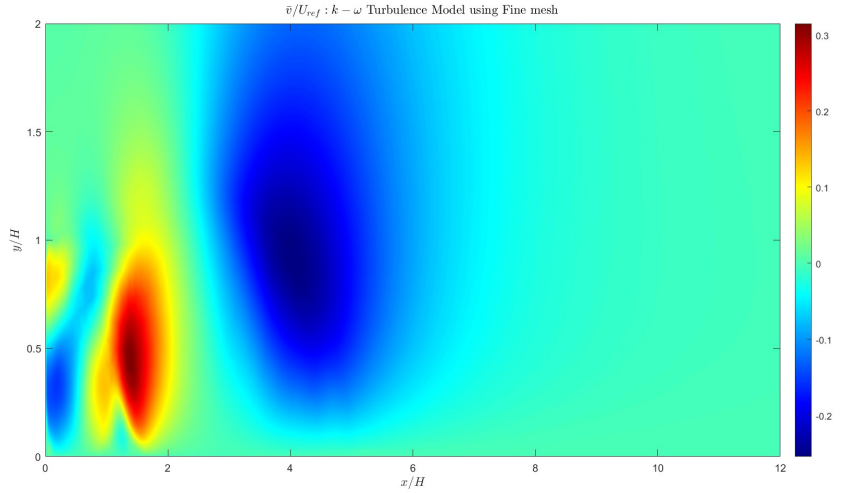


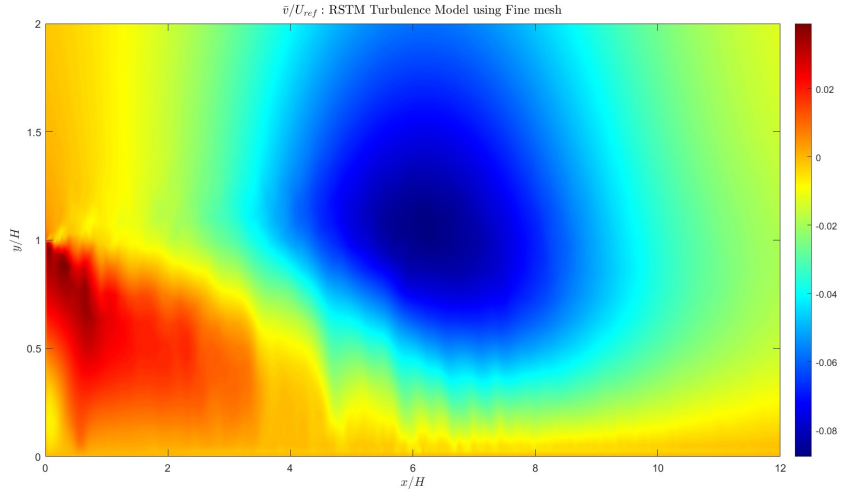




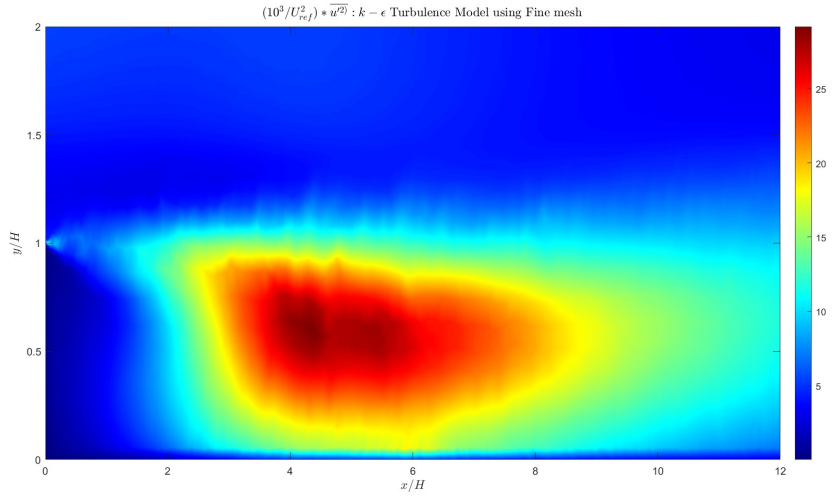
Average Vertical Velocity $\bar{v}/U_{ref}$

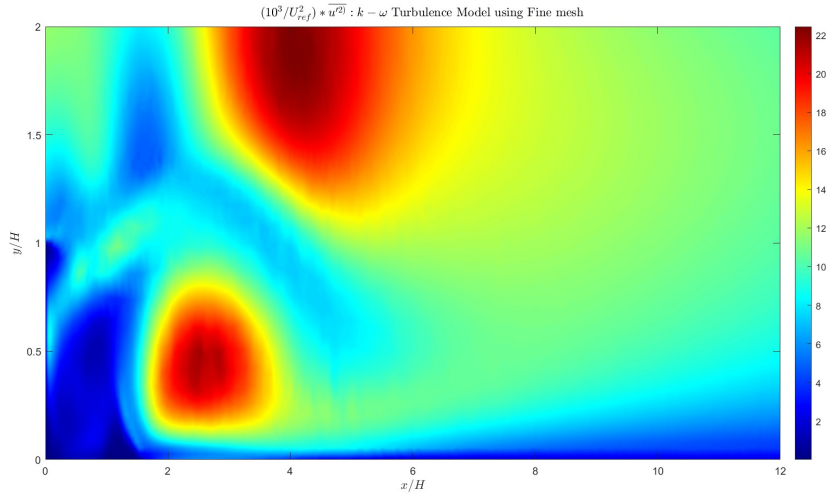


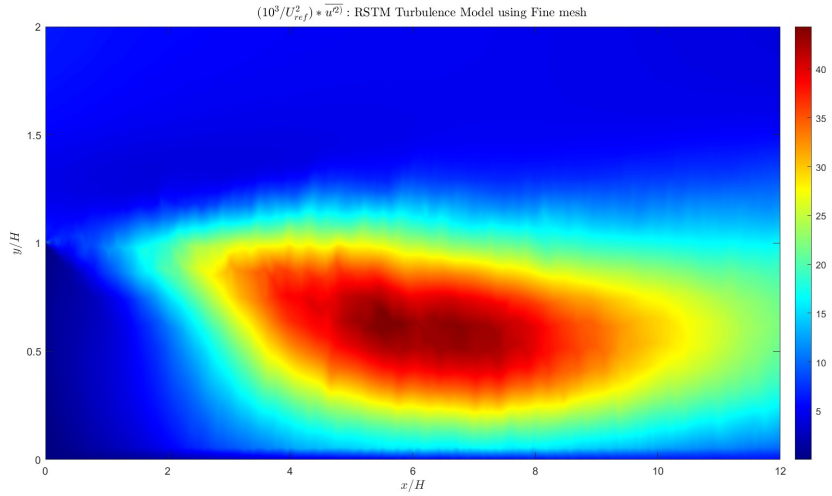




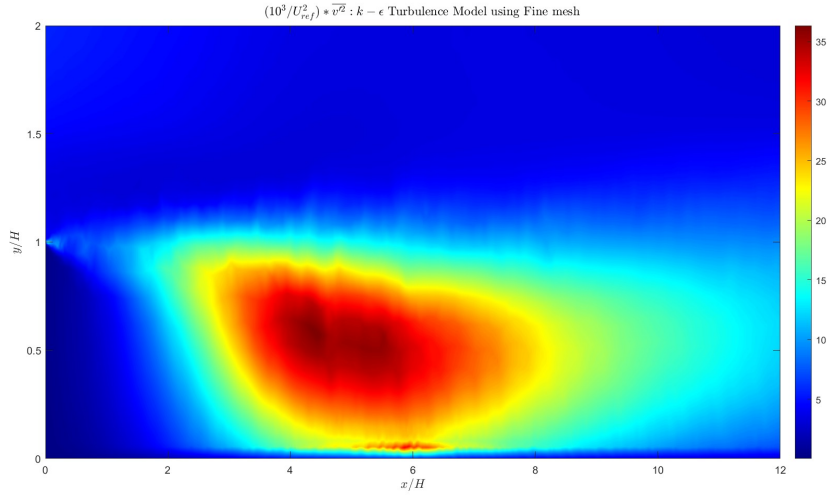
Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'^2}$

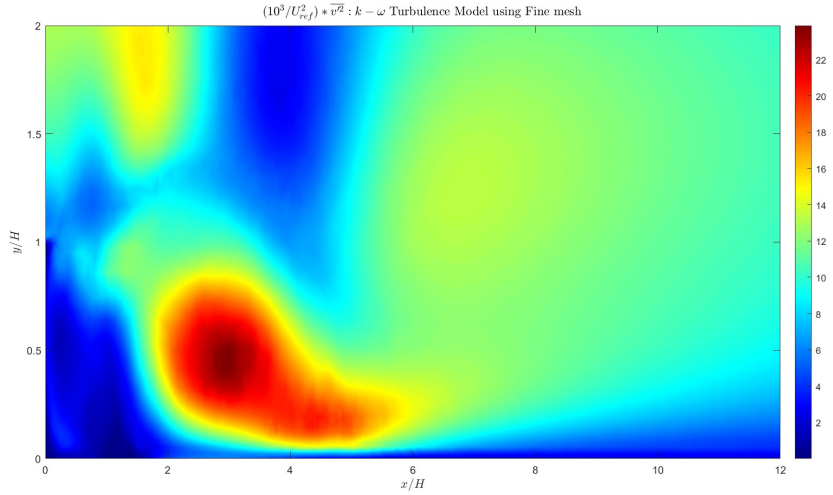


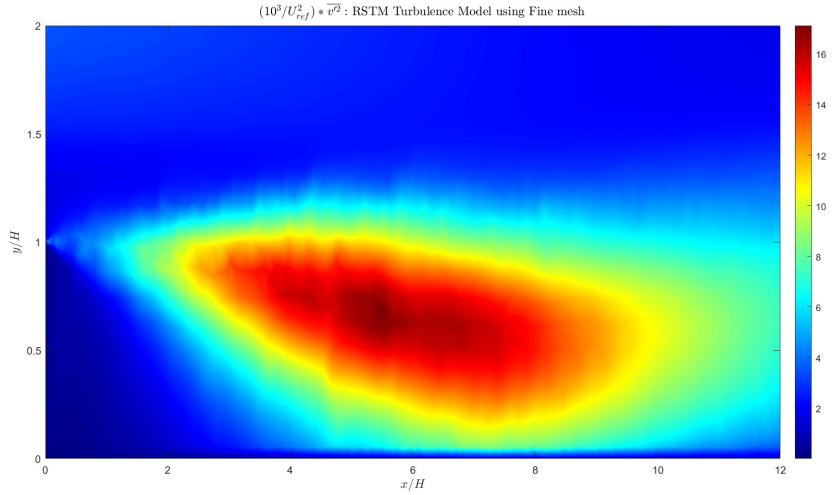




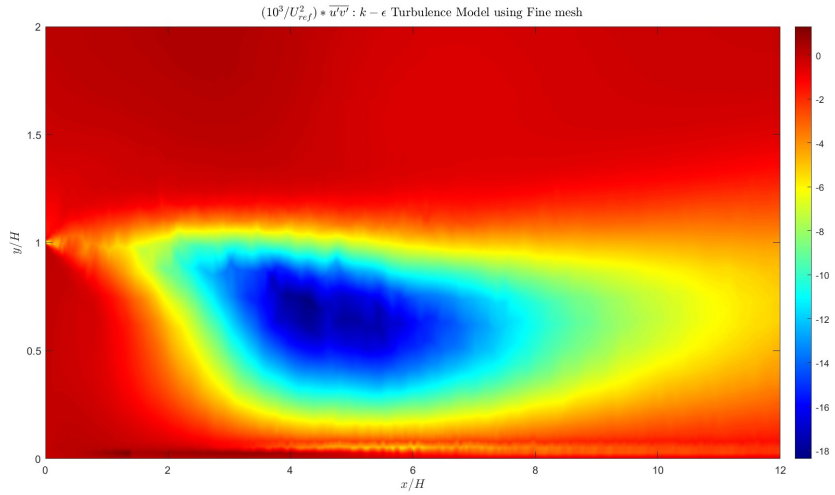
Reynold's Stress $(10^3/U_{ref}^2) * \overline{v'^2}$

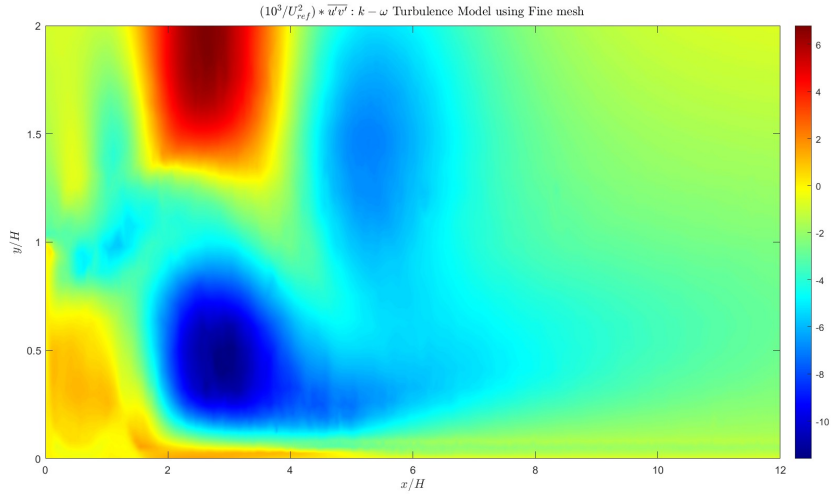


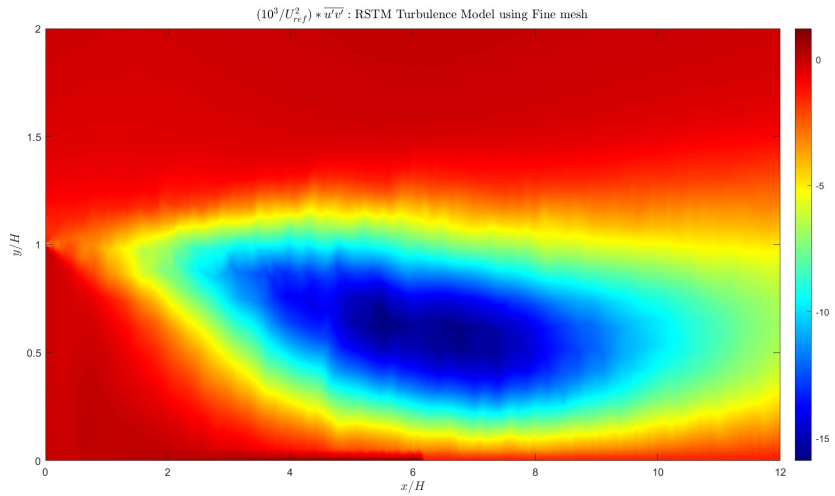




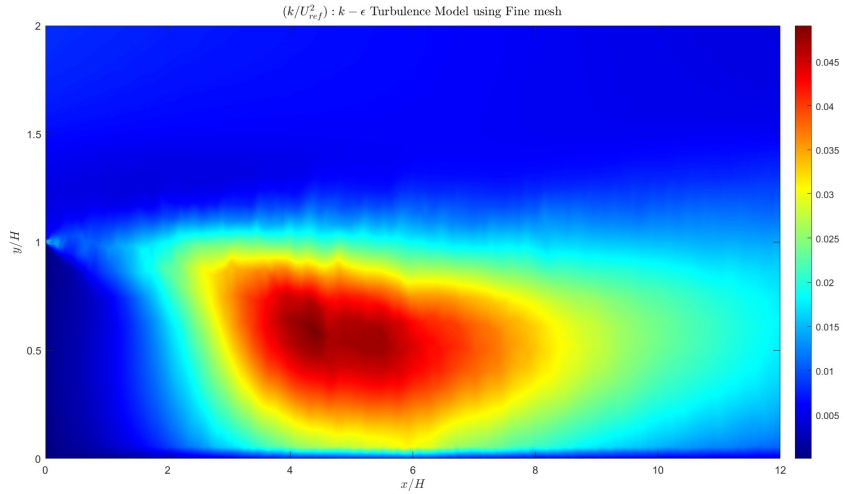
Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'v'}$

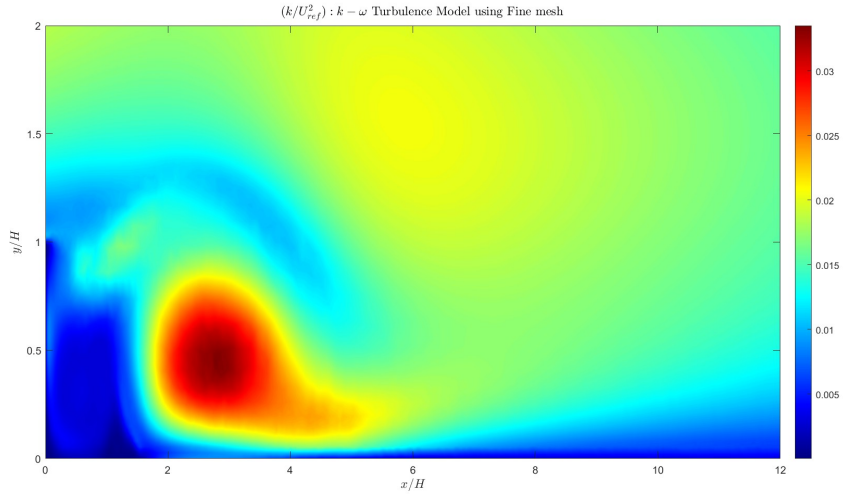


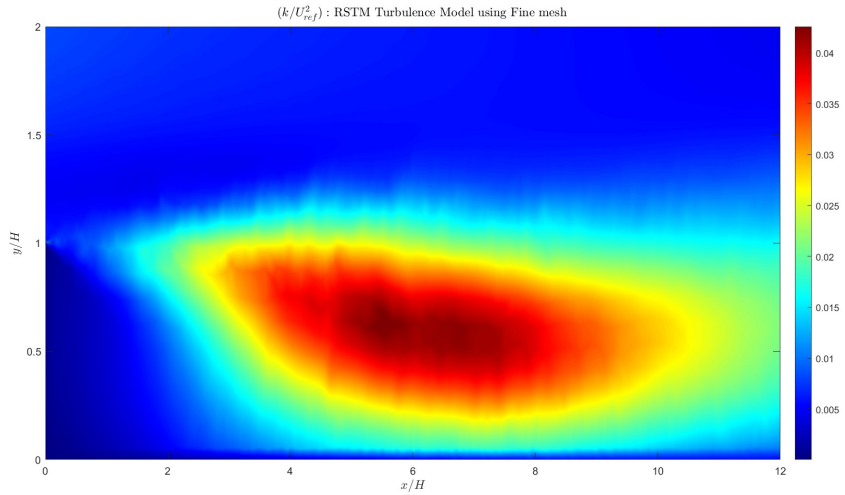




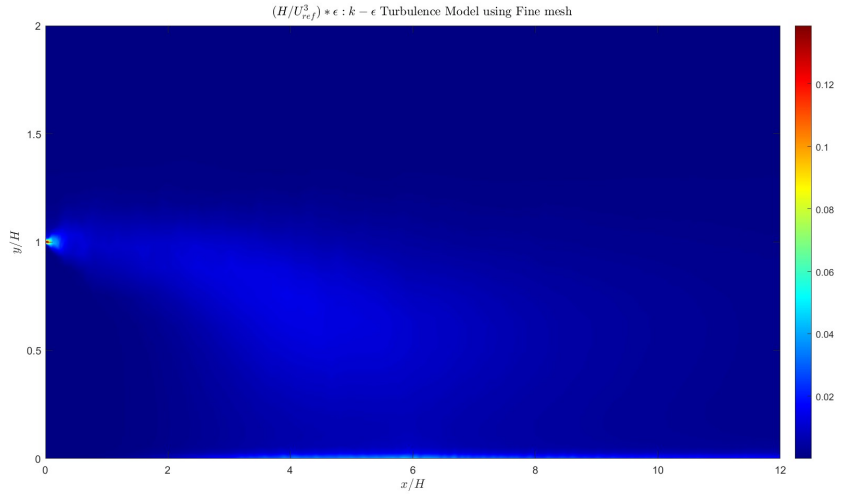
(k/U_{ref}^2) Turbulent Kinetic Energy

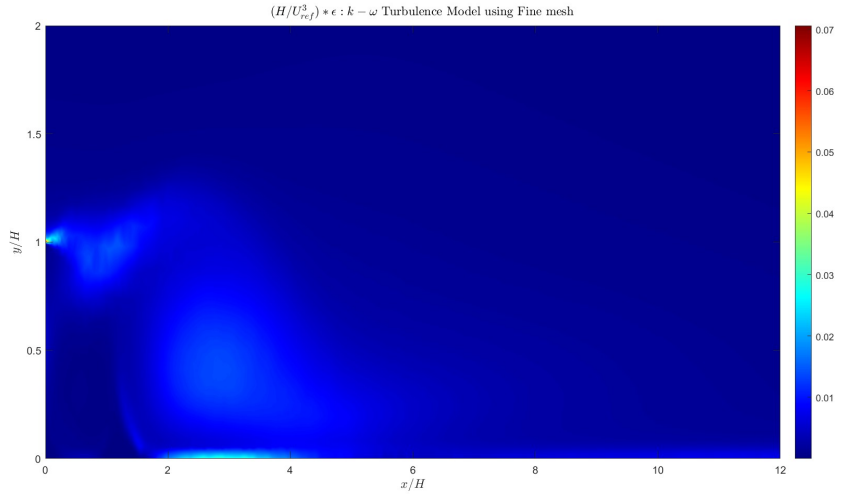


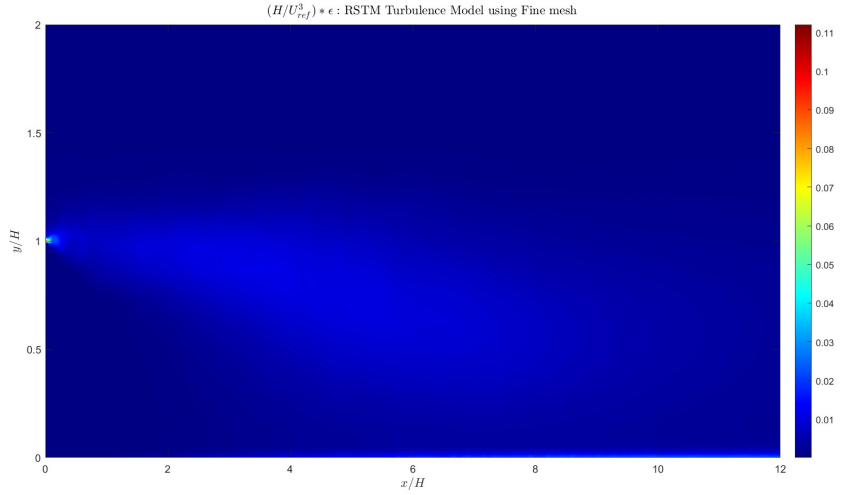




$(H/U_{ref}^3) * \epsilon$ Turbulence Dissipation Rate







Discussion

Q2: Do you see significant differences in any of the color fields among the three turbulence models ($k-\epsilon, k-\omega$, and RSTM); if so, discuss what you believe are the most important differences you see?

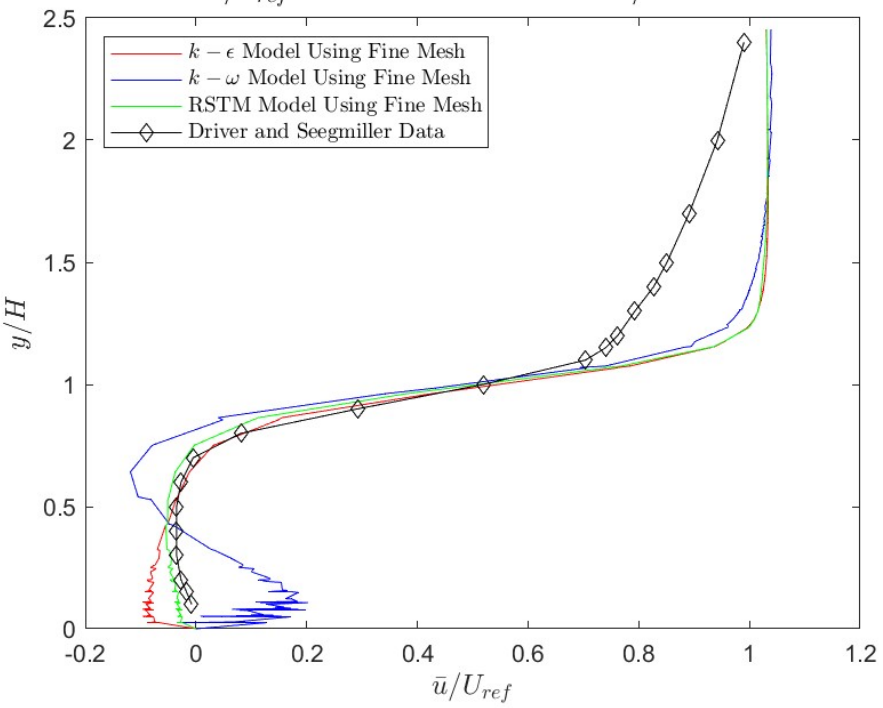
Answer: The turbulence model employed has a significant impact on the outcomes of the study. The $k-\epsilon$ and RSTM models produce comparable results, whereas the $k-\omega$ model displays unique findings. The RSTM model exhibits a larger recirculation zone than the $k-\epsilon$ model in the case of $\bar{u}(x,y)$. However, the $k-\omega$ model uncovers coherent structures right after the step, which may also be valid. The $k-\omega$ model, particularly in the fine mesh, reveals corner eddies near the left bottom of the wall for $\bar{v}(x,y)$, implying that it is more precise in capturing the actual flow characteristics, consistent with Driver and Seegmiller's reference paper on step flow.

There are minor discrepancies between the Reynolds stress findings of the $k-\epsilon$ and RSTM models. The RSTM model provides a more comprehensive distribution of Reynolds stresses across the channel and near the step, as well as for kinetic energy and kinetic energy dissipation just after the wall. The $k-\omega$ model, on the other hand, displays coherent structures in the Reynolds stresses and turbulent kinetic energy while presenting the most accurate turbulent dissipation rate. While it may be due to the distinct modelling of the $k-\omega$ model, it is difficult to determine which model is the most accurate, as none of them are completely accurate according to our understanding of turbulence models in this course.

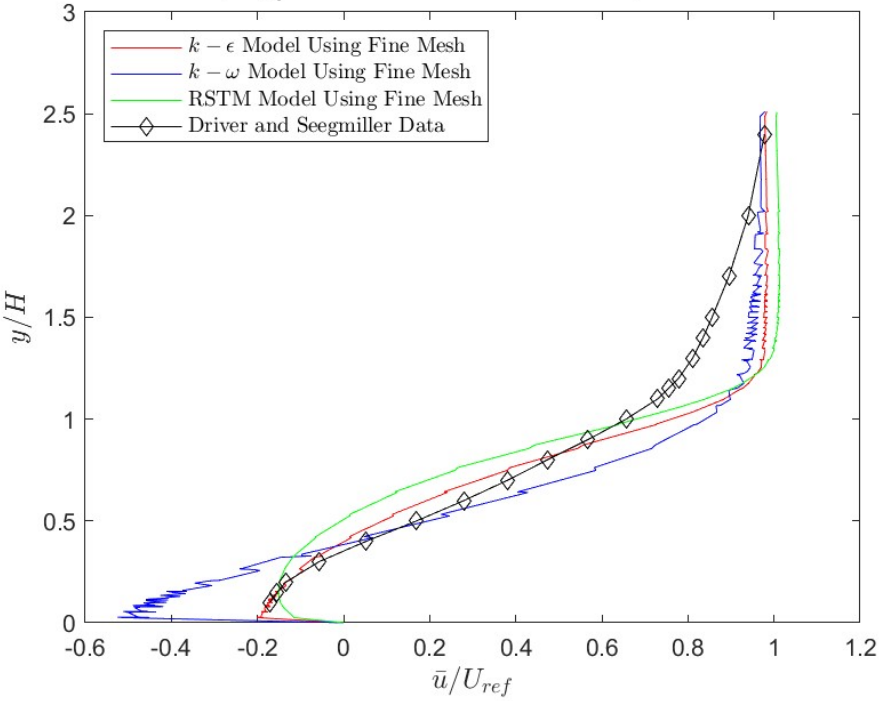
4 Turbulence Models Comparison with Experiment

Average Horizontal Velocity $\bar{u}/U_{ref}$

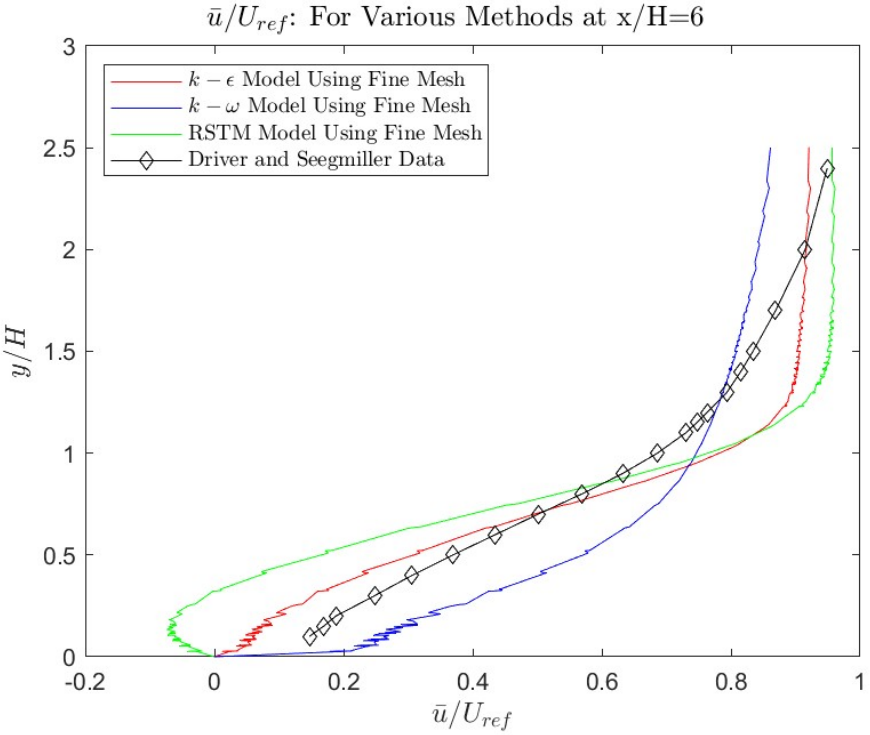
$\bar{u}/U_{ref}$: For Various Methods at x/H=1

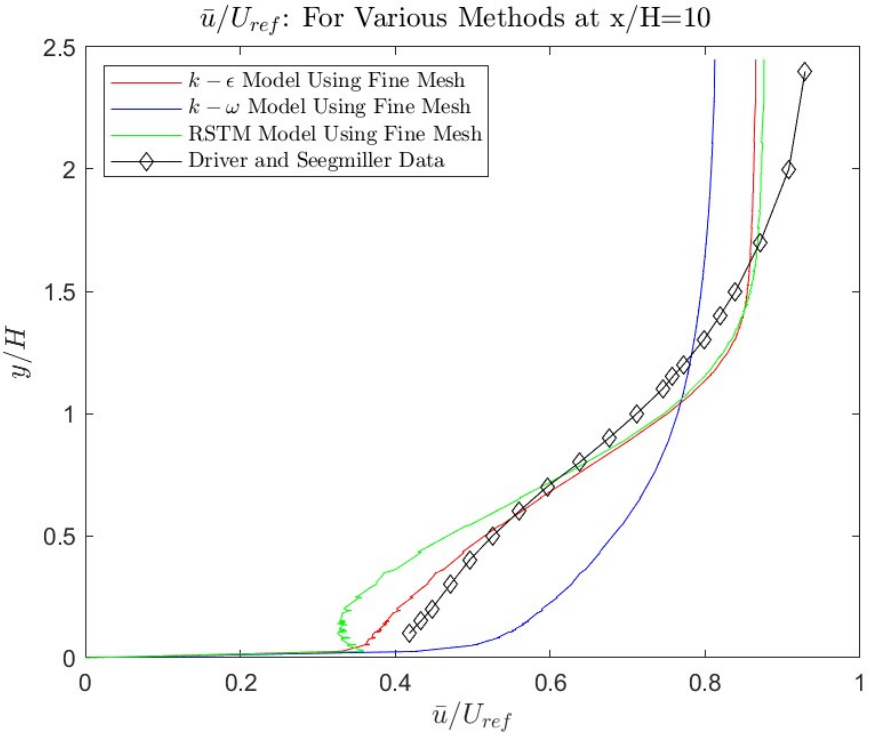


$\bar{u}/U_{ref}$: For Various Methods at x/H=4

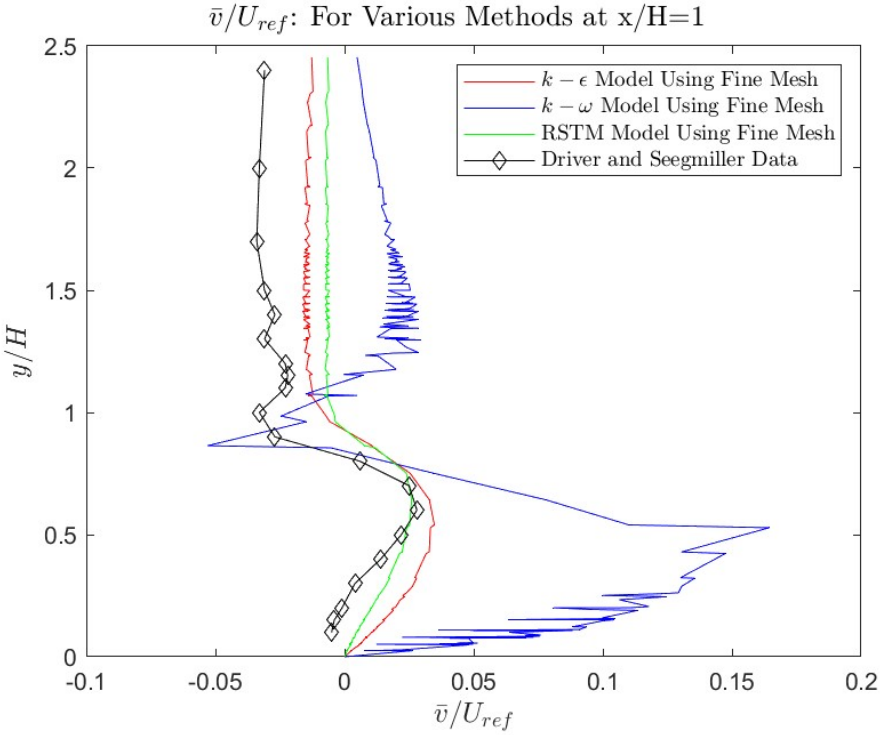


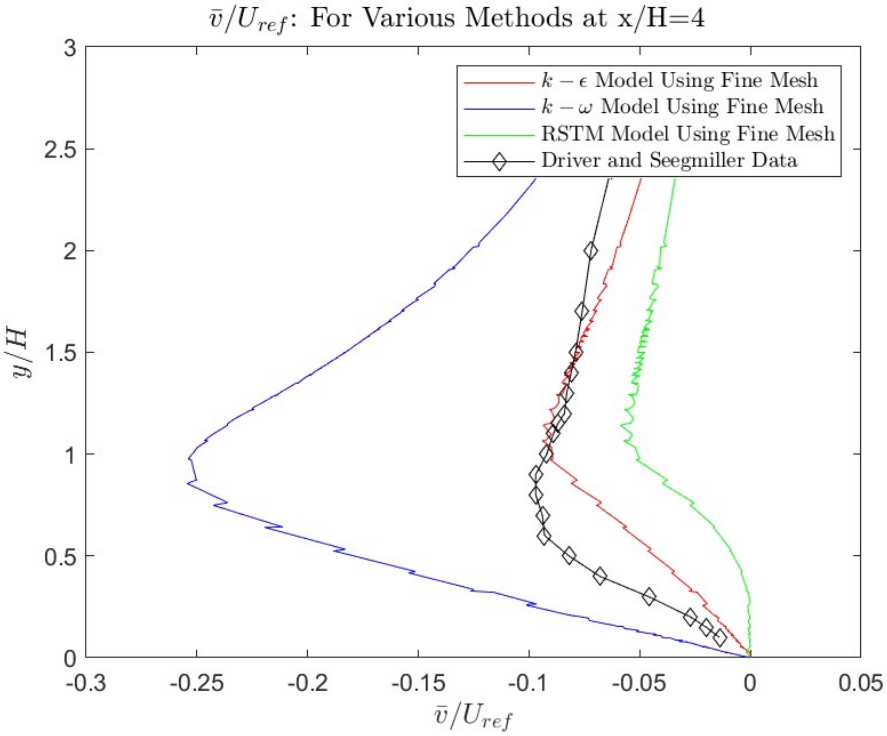
Average Horizontal Velocity $\bar{u}/U_{ref}$





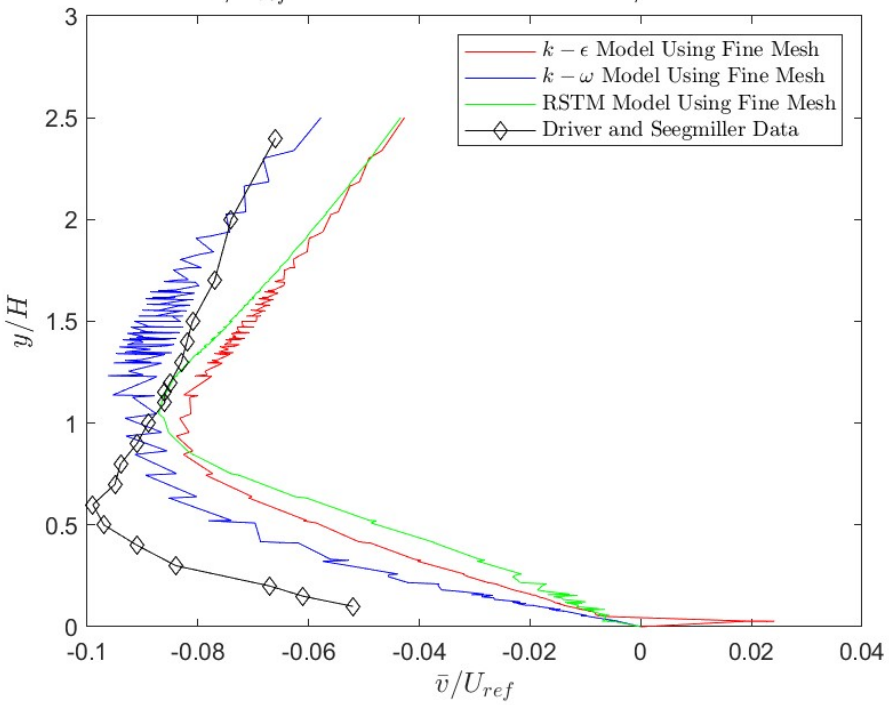
Average Vertical Velocity $\bar{v}/U_{ref}$



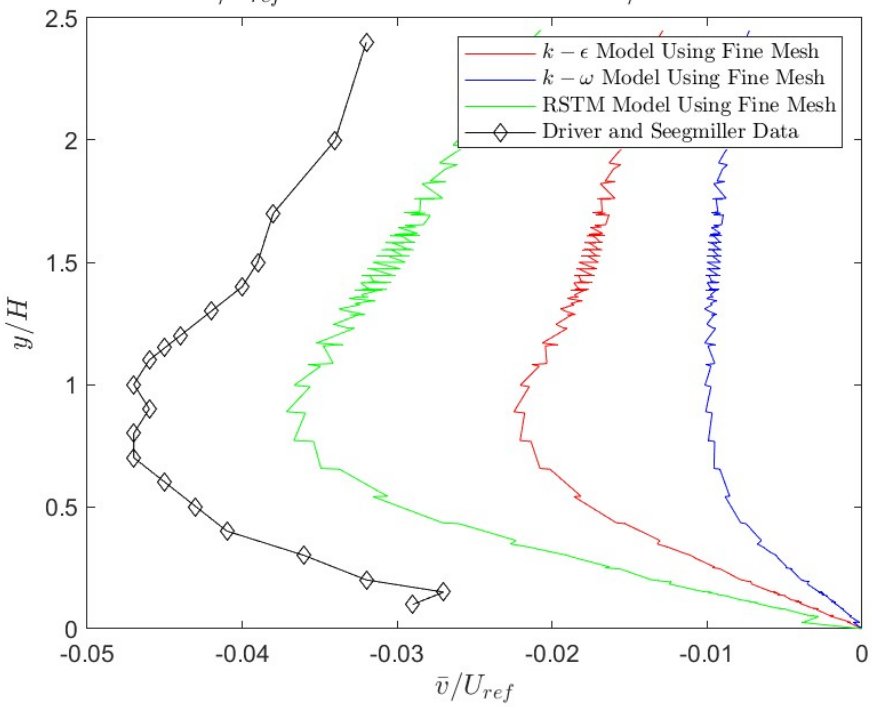


Average Vertical Velocity $\bar{v}/U_{ref}$

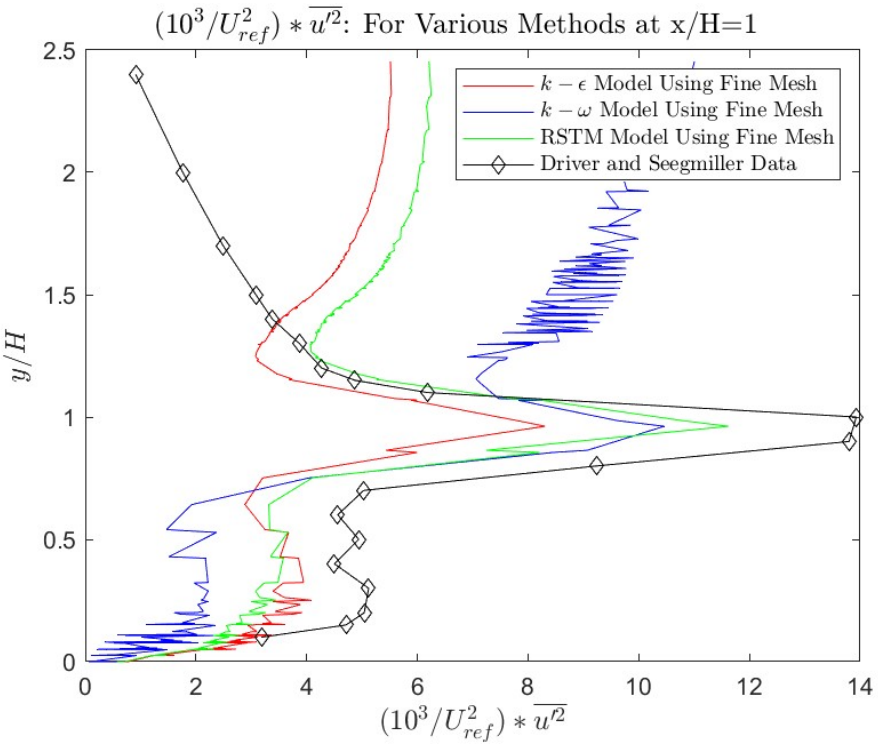
$\bar{v}/U_{ref}$: For Various Methods at x/H=6

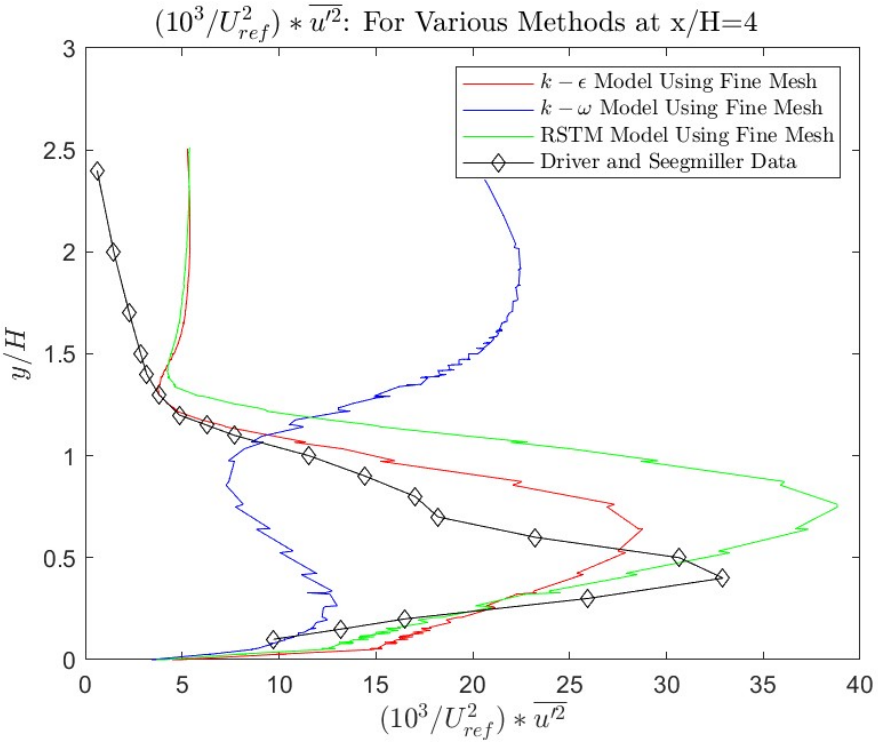


$\bar{v}/U_{ref}$: For Various Methods at x/H=10

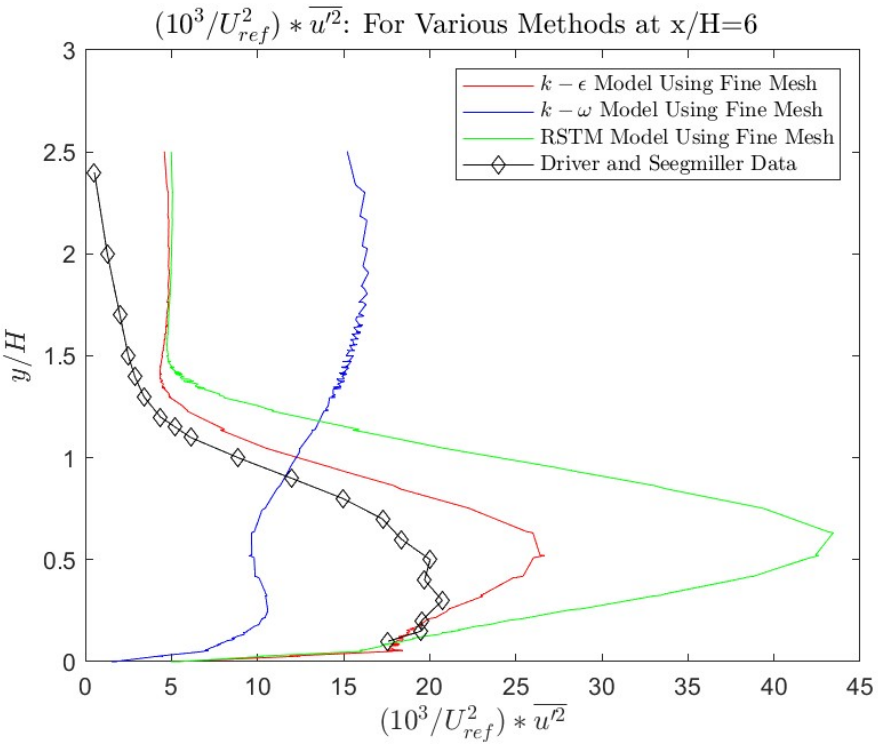


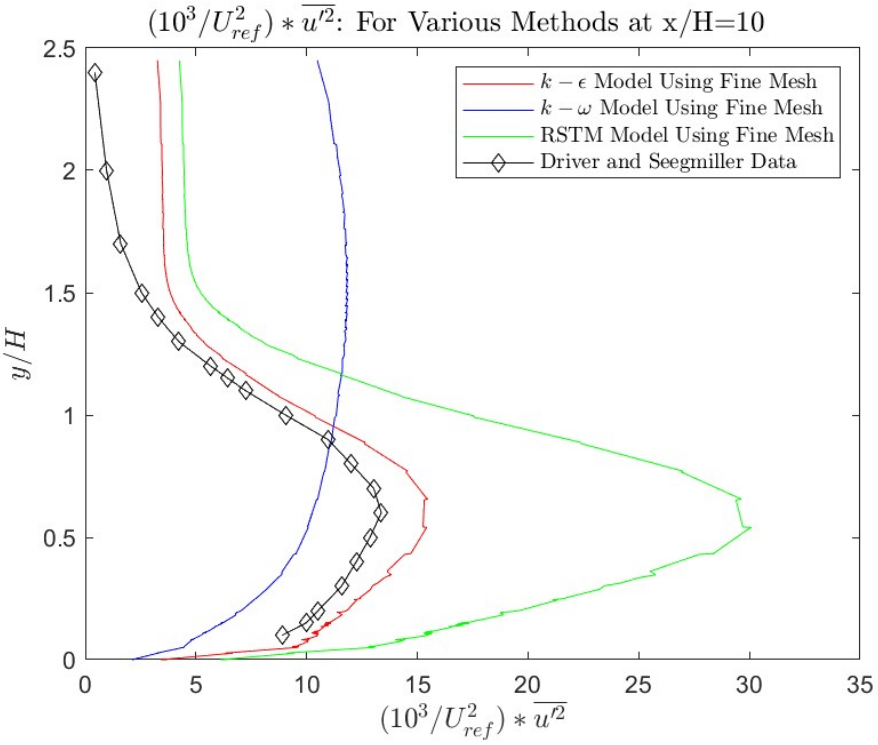
Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'^2}$



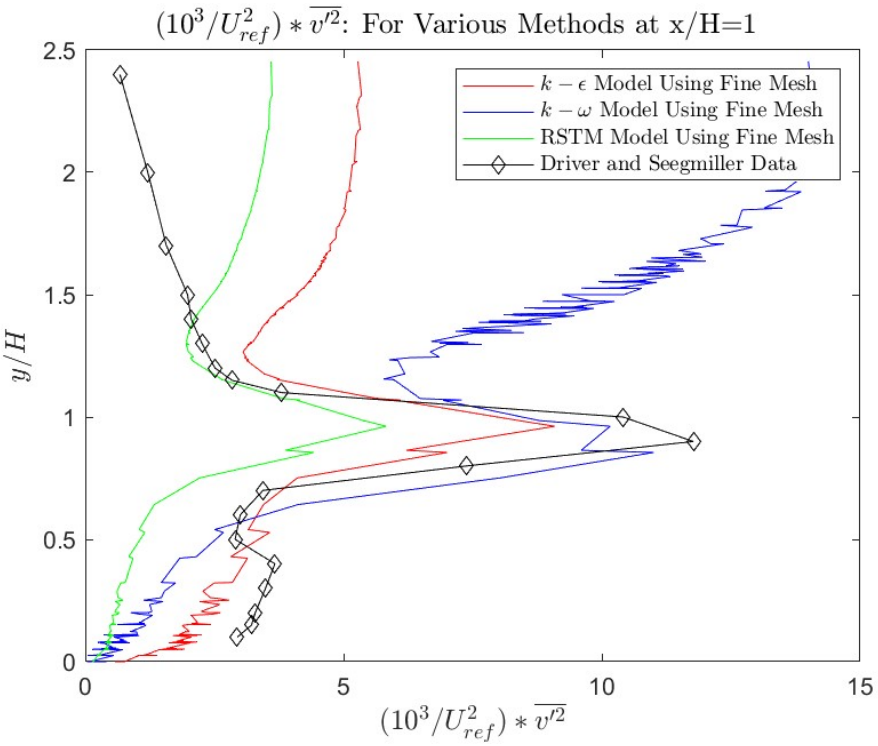


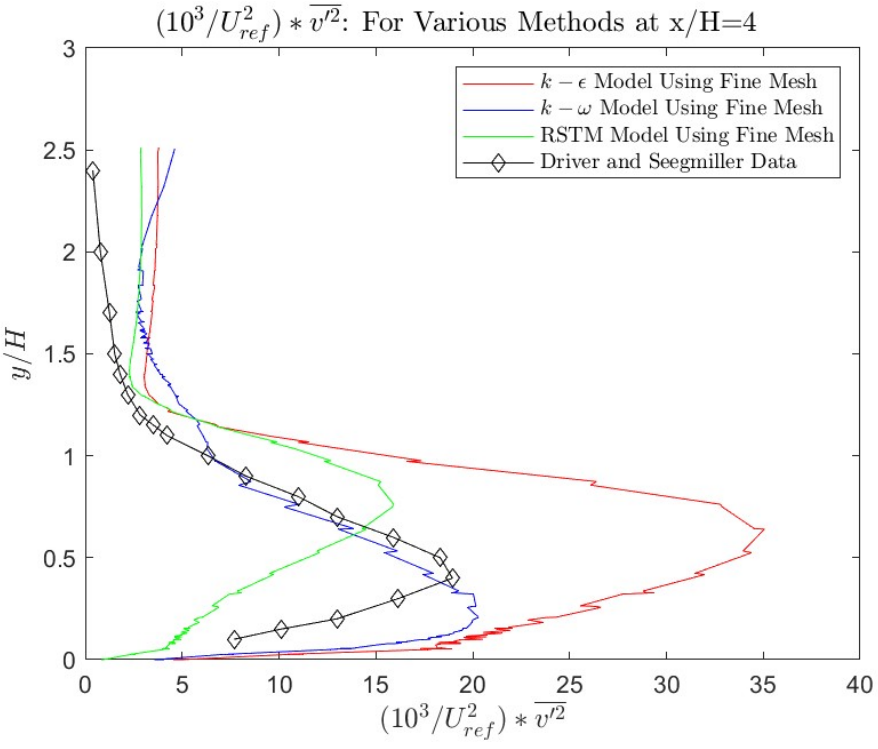
Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'^2}$



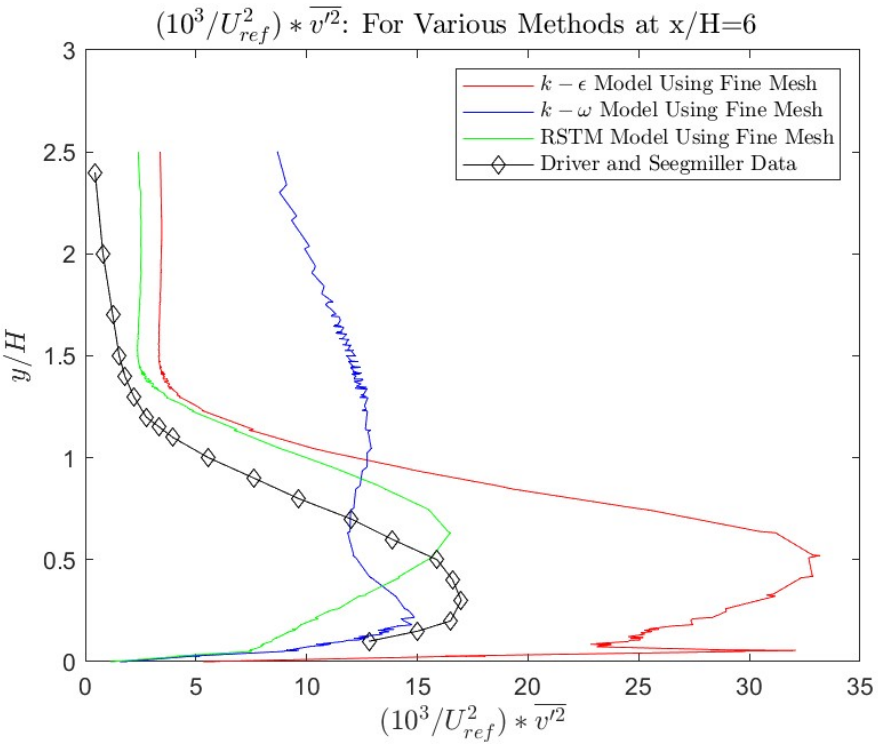


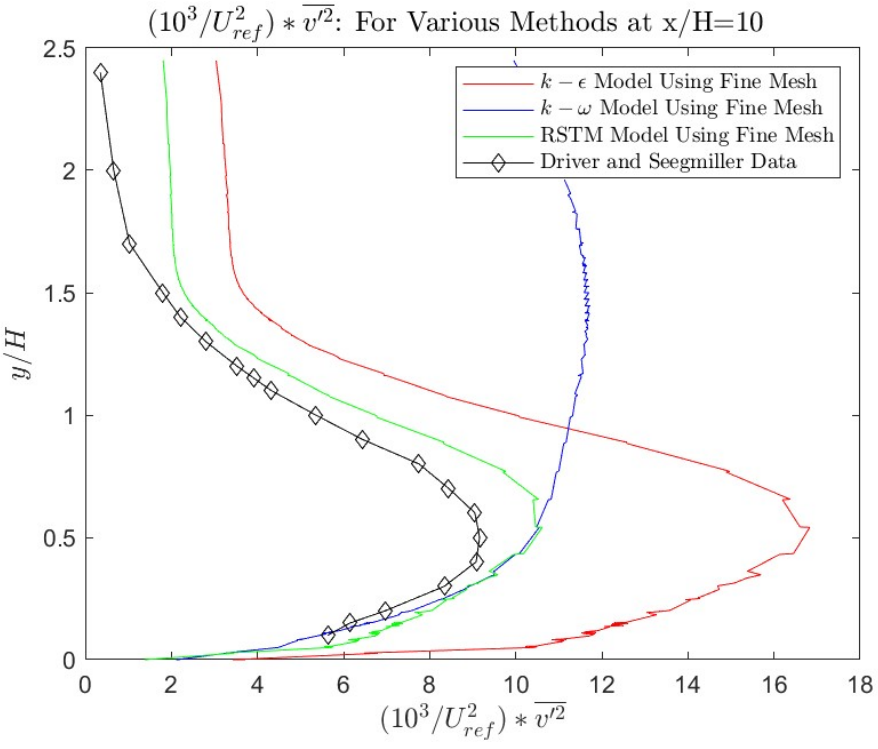
Reynold's Stress $(10^3/U_{ref}^2) * \overline{v'^2}$





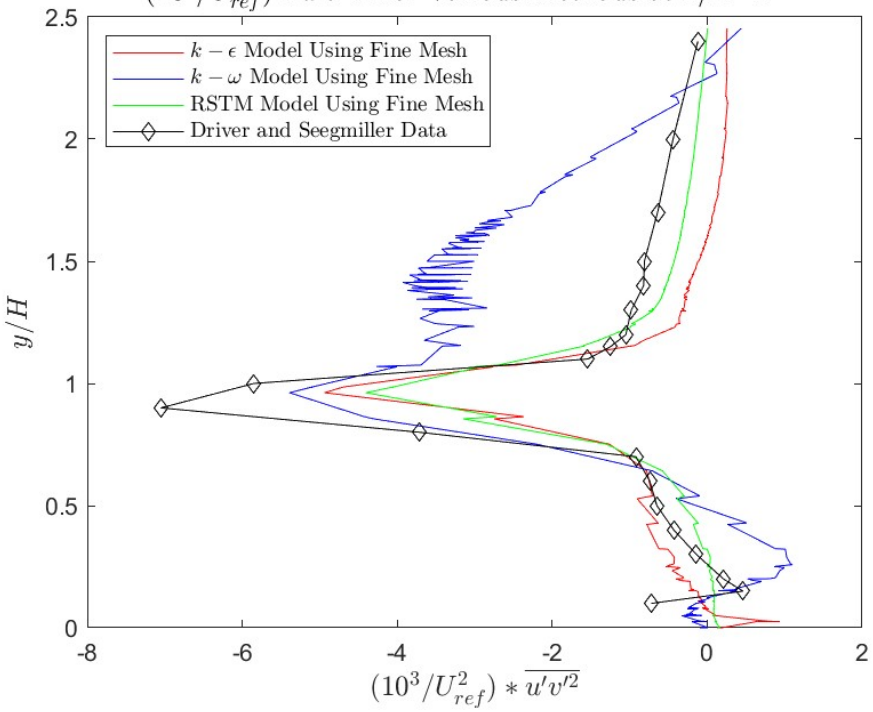
Reynold's Stress $(10^3/U_{ref}^2) * \overline{v'^2}$



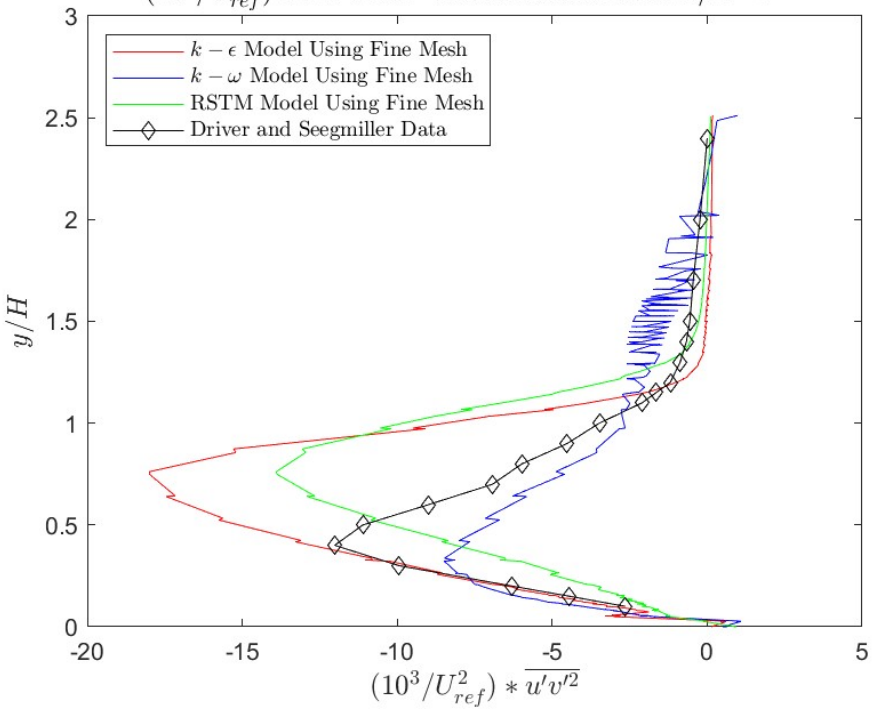


Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'v'}$

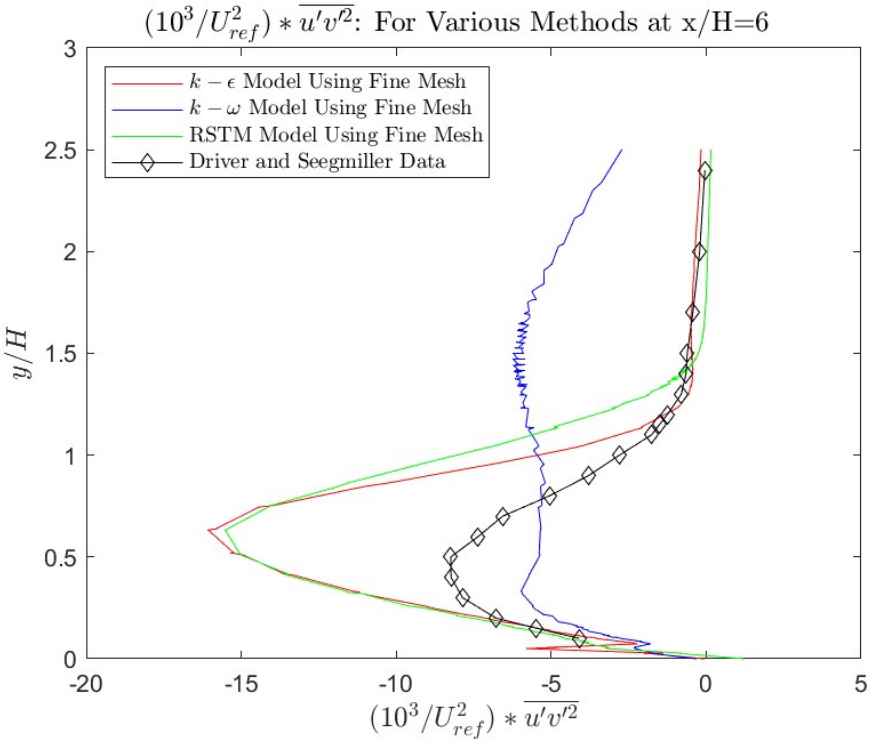
$(10^3/U_{ref}^2) * \overline{u'v'^2}$: For Various Methods at x/H=1

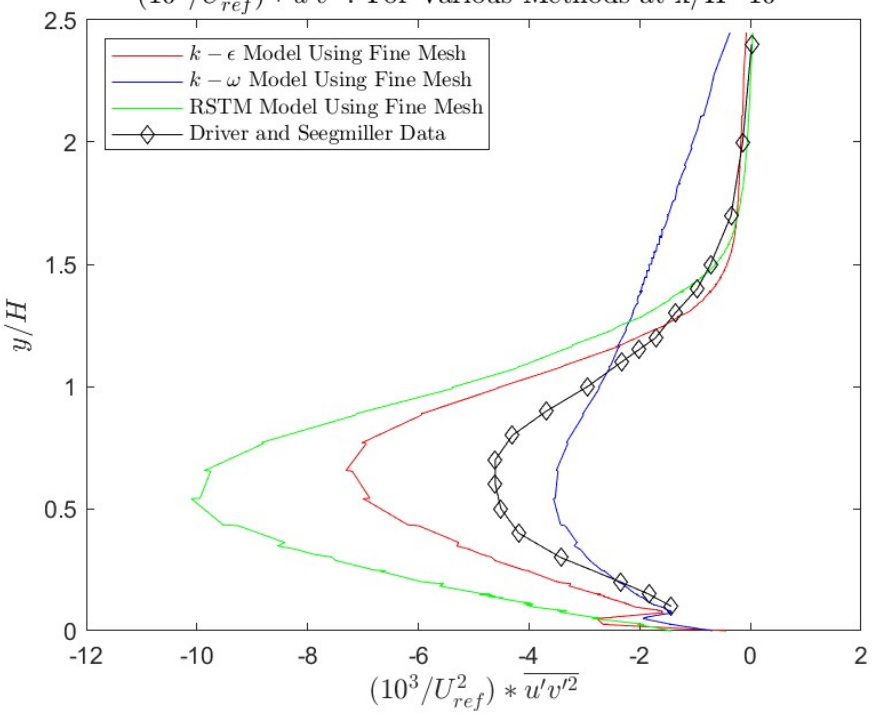


$(10^3/U_{ref}^2) * \overline{u'v'^2}$: For Various Methods at x/H=4

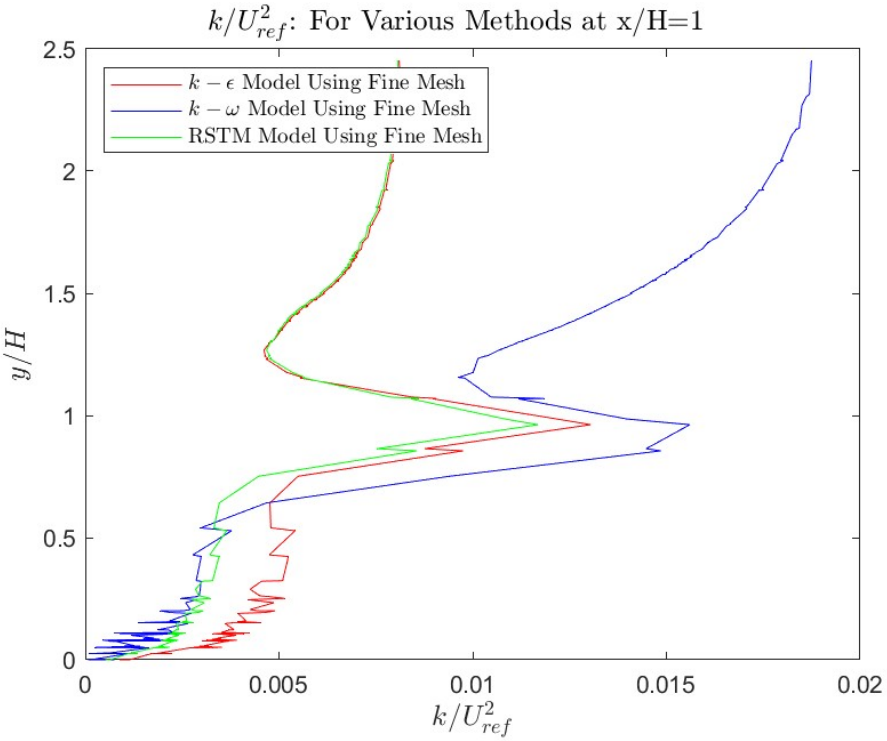


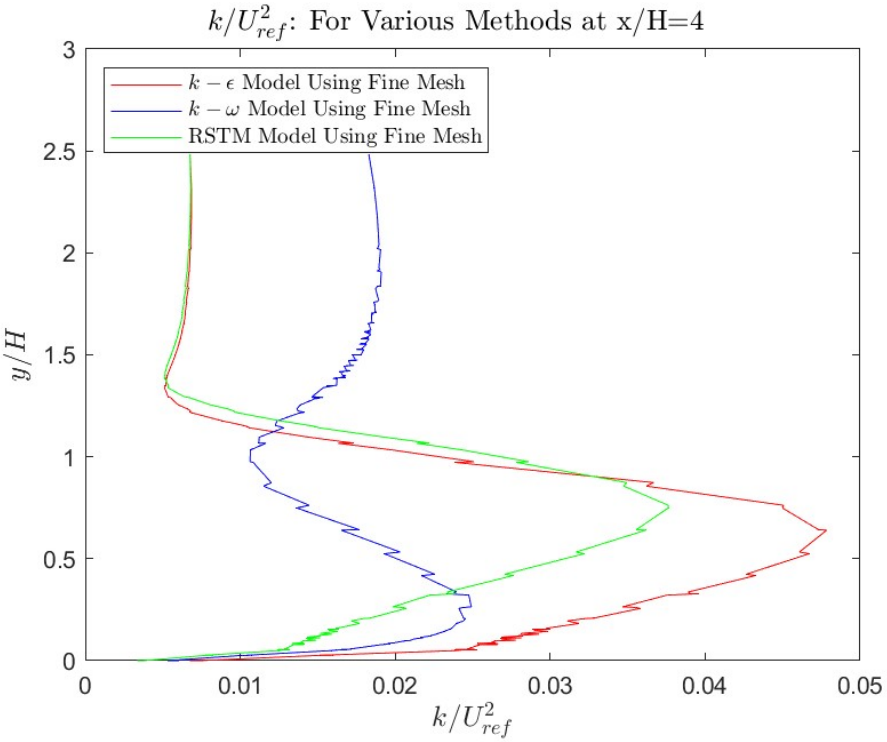
Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'v'}$



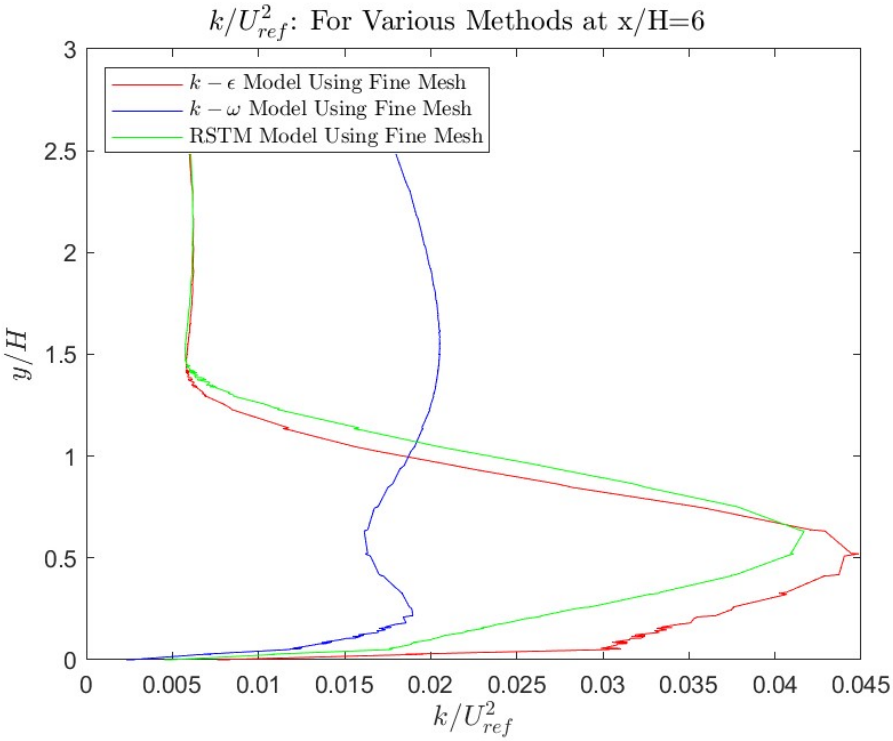


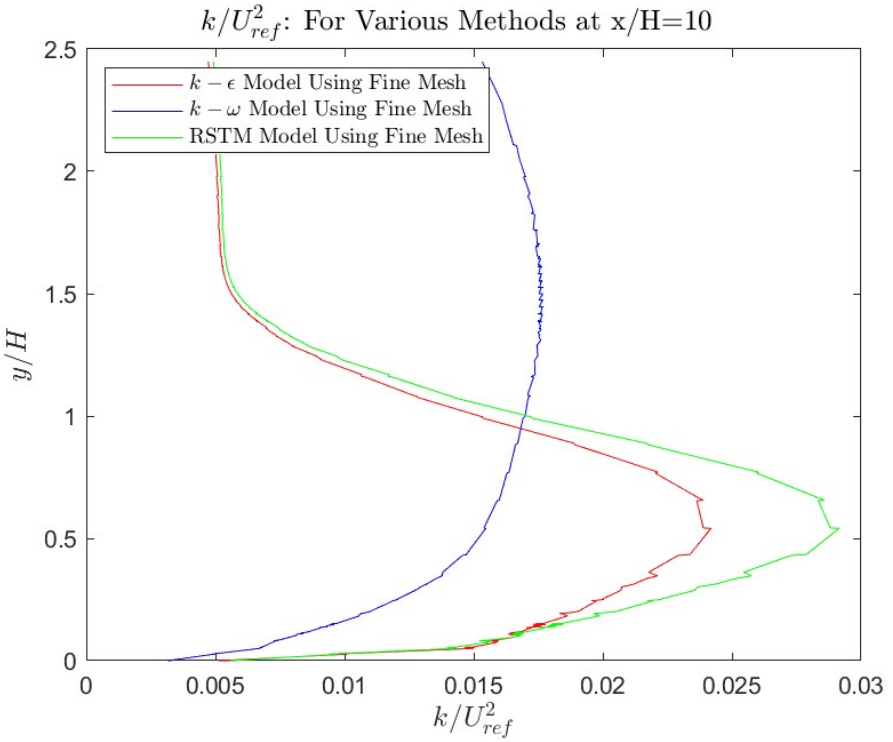
(k/U_{ref}^2) Turbulent Kinetic Energy



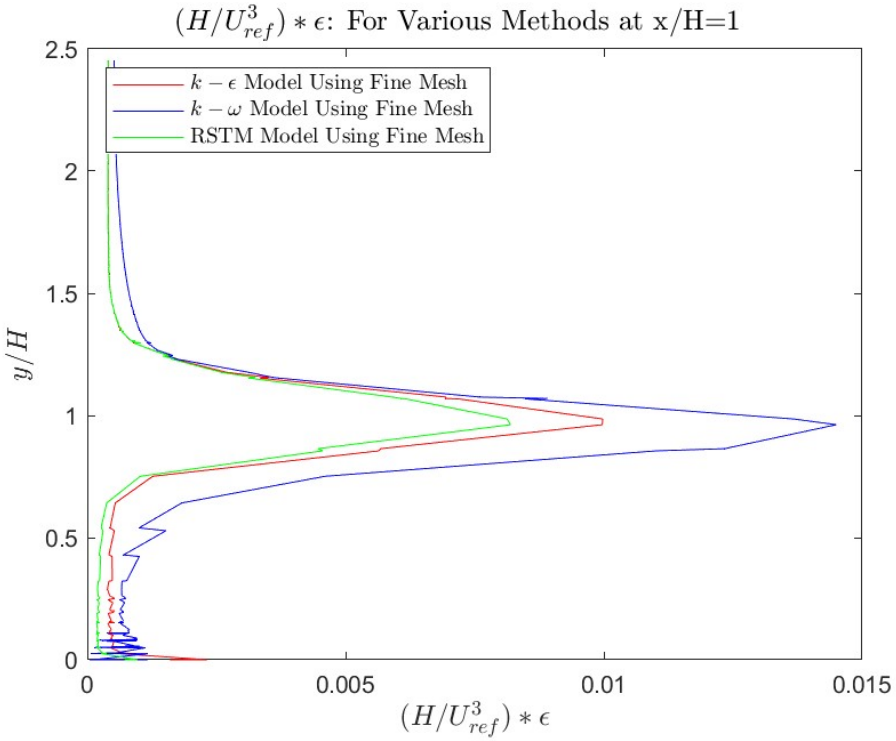


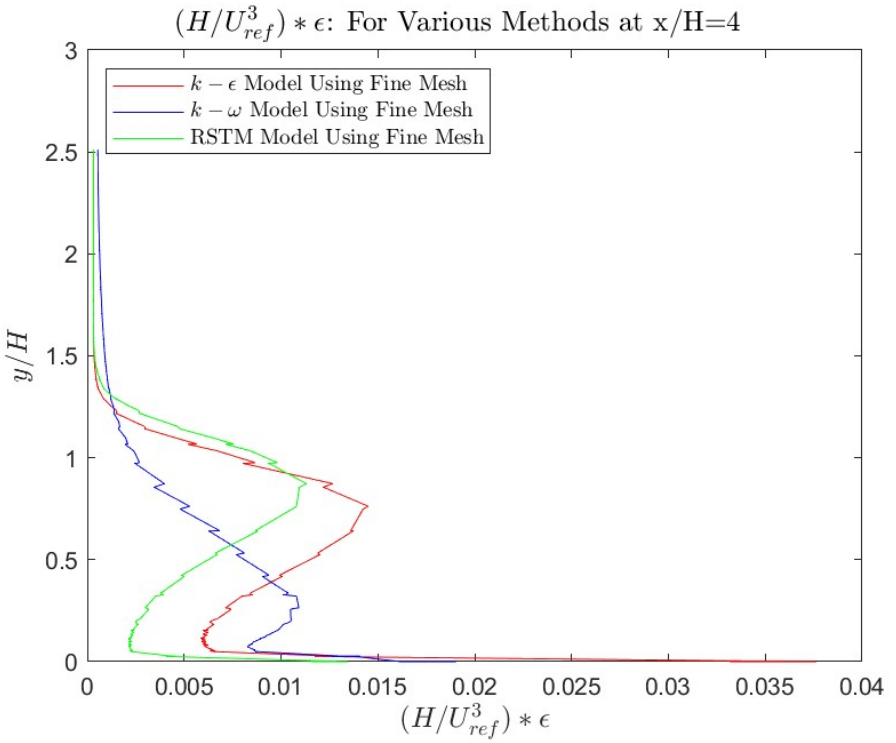
(k/U_{ref}^2) Turbulent Kinetic Energy



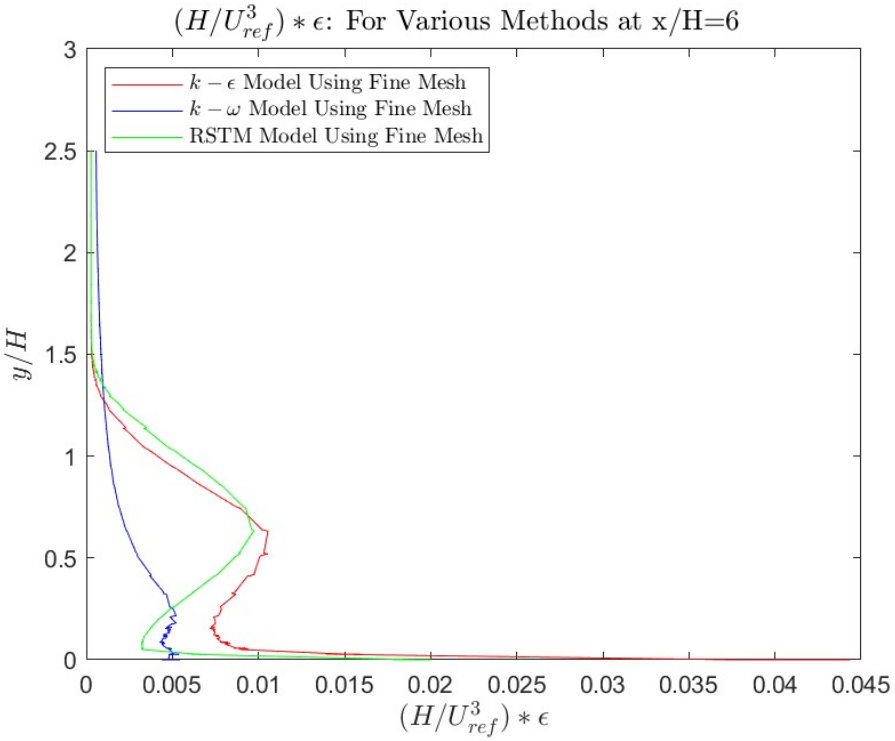


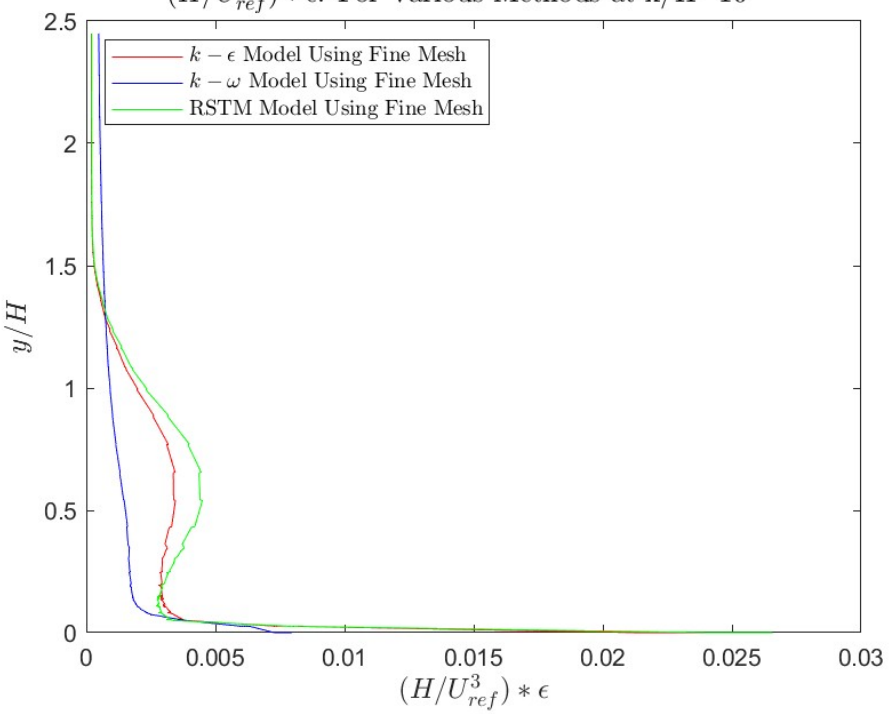
$(H/U_{ref}^3) * \epsilon$ Turbulence Dissipation Rate





$(H/U_{ref}^3) * \epsilon$ Turbulence Dissipation Rate





Q3: Discuss briefly what you think is most important in the $\overline{u}(x,y)$ and $\overline{v}(x,y)$ graphs, and comment on how accurately or inaccurately these models predict these quantities.

Answer: In my opinion, the most significant features in the $\overline{u}(x,y)$ and $\overline{v}(x,y)$ graphs are the regions near the step at $y < 0.5$ for $\overline{u}(x,y)$ and the peak at $y/H = 1$ for $\overline{v}(x,y)$. The RSTM model appears to perform better in predicting those regions, although still deviating from the experimental data. In terms of x-velocity, the $k-\epsilon$ and RSTM models exhibit similar results. However, the RSTM model shows more accuracy in predicting $\overline{v}(x,y)$ compared to the other models. The $k-\omega$ model appears to deviate greatly from the experimental results, and it's possible that the fine model for $k-\omega$ is not accurately modeled or that it predicts features that other models cannot. Therefore, it's difficult to conclude which model is the most accurate in predicting these quantities

Q4: Does any of these three turbulence models consistently predict and more accurately than the others, and if so which one?

Answer: The $k-\epsilon$ and RSTM models yield comparable predictions for the x-velocity. However, in terms of predicting $\overline{v}(x,y)$, the RSTM model appears to be significantly more accurate. Therefore, while the difference between the models may not be particularly significant, the RSTM model does seem to provide a more accurate prediction of the experimental results.

Q5: Discuss briefly what you think is most important in the $\overline{u_i'u_j'}(x,y)$ graphs, and comment on how accurately or inaccurately these turbulence models predict these quantities.

Answer: In my opinion, the most significant feature of the $\overline{u_i'u_j'}(x,y)$ graphs is the peak-like structure that occurs at around $y/H = 1$. Based on the available data, it appears that the $k-\epsilon$ model provides the most accurate prediction of $\overline{u'^2}(x,y)$, while the RSTM model yields better predictions for $\overline{v'^2}(x,y)$ and $\overline{u'v'}(x,y)$. On the other hand, the $k-\omega$ model appears to be significantly divergent from the experimental data and the other models, indicating that it is not particularly effective at accurately predicting these quantities. Therefore, it is difficult to conclusively determine which model provides the most accurate predictions.

Q6: Does any of these three turbulence models consistently predict the components more accurately than the others, and if so which one?

Answer: It is evident that no single model is superior at accurately predicting all reference quantities. For example, while the RSTM model excels at predicting $\overline{v'^2}(x,y)$, it struggles with accurately predicting $\overline{u'^2}(x,y)$. On the other hand, the $k-\omega$ model exhibits significant deviation from the experiment and other models, making it difficult to draw any definitive conclusions regarding which model predicts the results most accurately. However, it is clear that the $k-\omega$ model does not perform well compared to the experiment.

Q7: Based on what you have learned in the lectures, what do you think are the greatest sources of error in each of these three turbulence models?

Answer: The major sources of error would be: 1. The need to model the transport equations involved, particularly the ϵ equation. 2. Inaccurate modelling of the ϵ equation, with the $k-\epsilon$ and $k-\omega$ models employing the LLE modelling approach, while the RSTM model utilizes the LRR modelling approach - as covered in our lectures. Given what we have learned in class, it is clear that developing our own non-linear

models is essential to accurately solve turbulence-related problems.

Q8: How certain are you that the Driver and Segmiller data are actually the "right answer"? Discuss some possible sources of error in the experimental data.

Answer: I acknowledge that Driver and Segmiller's results for this case are impressive. However, it would be unwise to assume that their findings are completely accurate, given that all experiments are subject to a certain degree of error.

Numerous factors can introduce error into their results, including their experimental setup, observations, testing, and data acquisition systems. For instance, it is impossible to create a perfectly smooth wall with a no-slip condition, or a flawless wind tunnel, or an inlet with uniform inlet velocity and a perfect pressure outlet, and these factors can introduce errors into their experimental setup. Additionally, probes and sensors used in the experiment may have sensitivity and calibration errors, and issues may arise when applying filters to the data post-experiment.

Despite these potential sources of error, as long as the results are qualitatively sound, and any errors fall within an acceptable quantitative limit, the experiment can be considered reasonable.

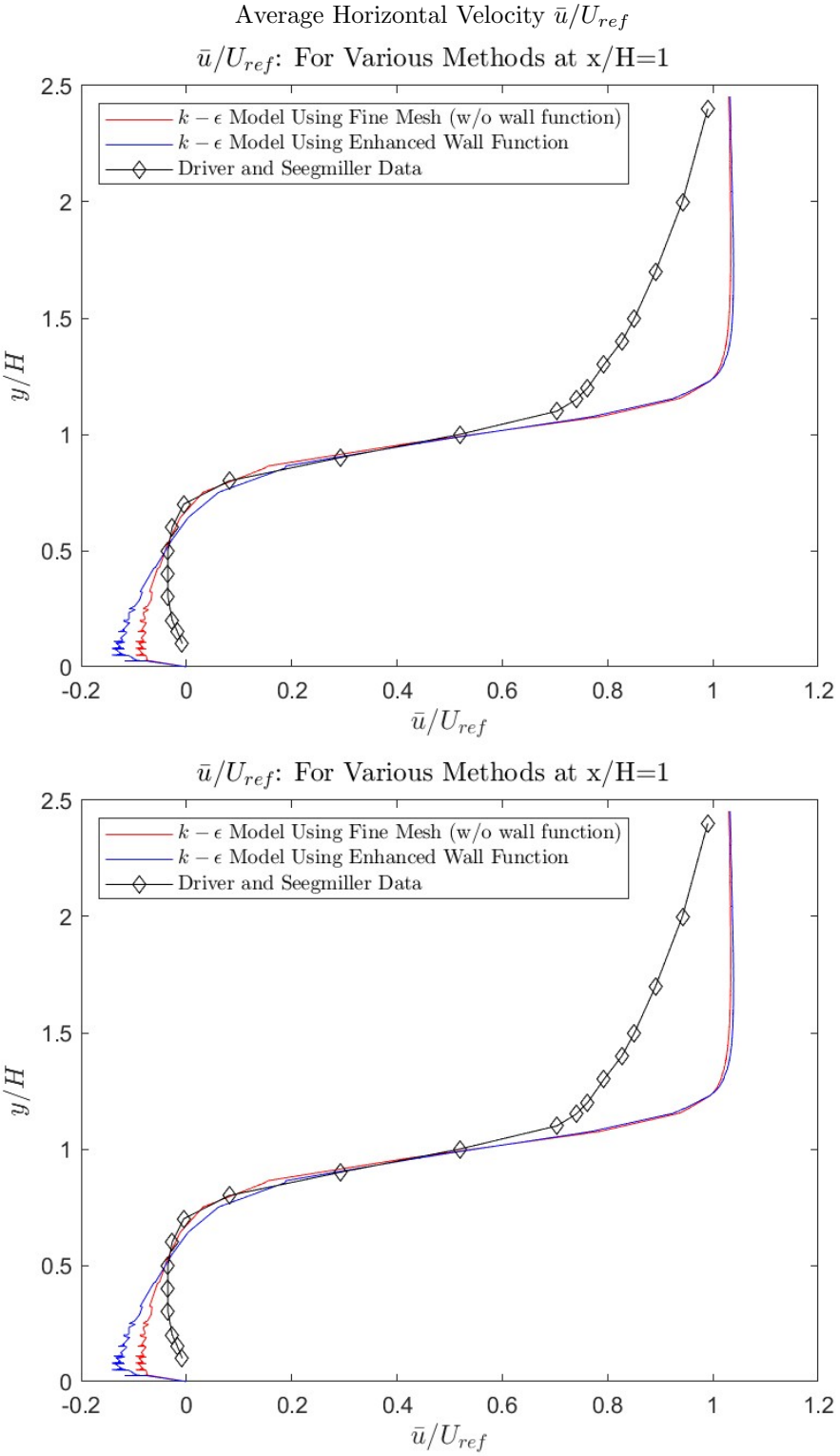
Q9: How does the magnitude of the differences between the results from the three turbulence models compare with the magnitude of the differences between turbulence model results and the experimental data?

Answer: Both the $k - \epsilon$ and RSTM models tend to overestimate the Reynolds stresses, except in a few isolated cases. This over-prediction leads to higher kinetic energy and, consequently, higher kinetic energy dissipation than what was observed in the experiment (for which no data is available). On the other hand, the $k - \omega$ model appears to underestimate the Reynolds stresses, with a distinct curve shape. While it is difficult to draw definitive conclusions regarding the differences between methods for all cases, it is clear that the fine $k - \omega$ model stands out as fundamentally different from the others.

Q10: Based on your answer to Q9, discuss what the implications of this are for choosing a turbulence model for a CFD simulation, at least in this flow but also in general?

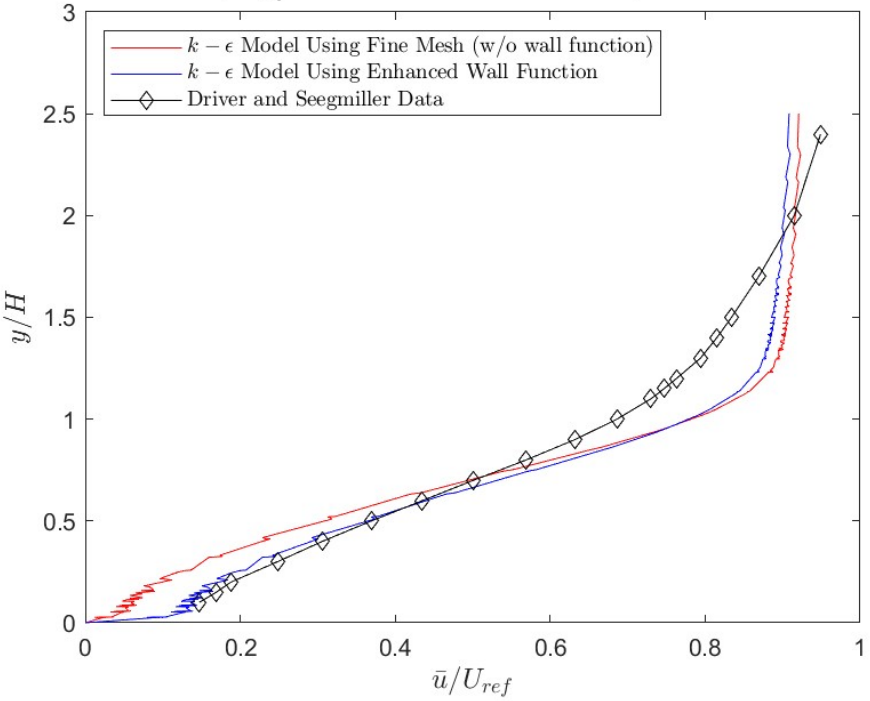
Answer: As discussed earlier, it is evident that no single model demonstrated superior predictive capabilities for all quantities. While some models outperformed others in certain scenarios, these findings cannot be universally applied. Specifically, we observed that the Reynolds stresses did not yield conclusive results. However, when examining Kinetic Energy and Kinetic energy dissipation, we noted that all methods produced nearly identical outcomes, with negligible deviations that balanced out over time. Notably, the fine $k - \omega$ model diverged significantly from all other models tested, which could be indicative of error. Or not. I can't really say. As a result, no singular method proved significantly advantageous for general use.

5 Influence of Wall Enhancement

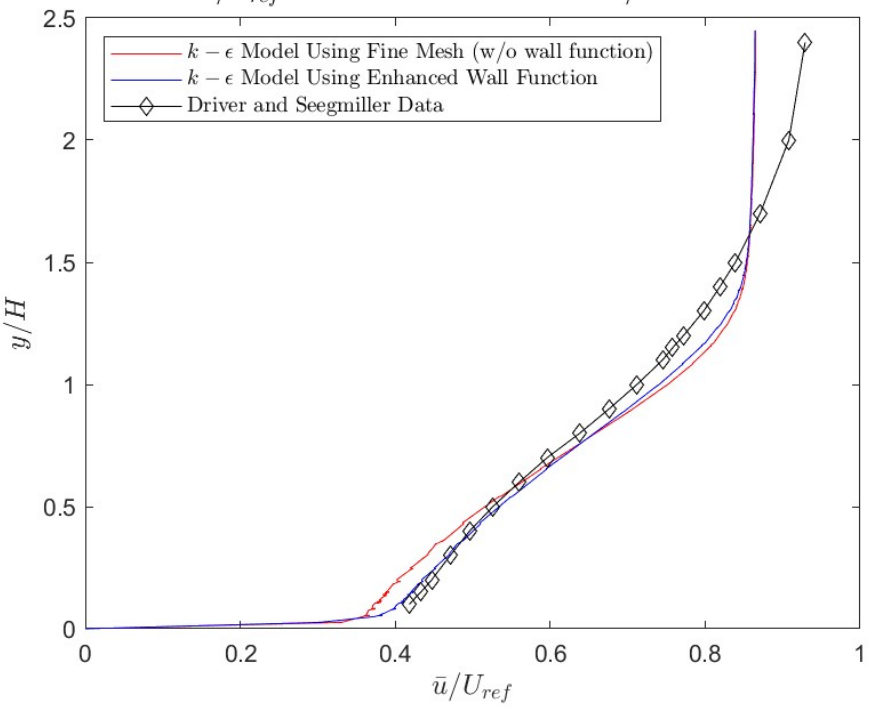


Average Horizontal Velocity $\bar{u}/U_{ref}$

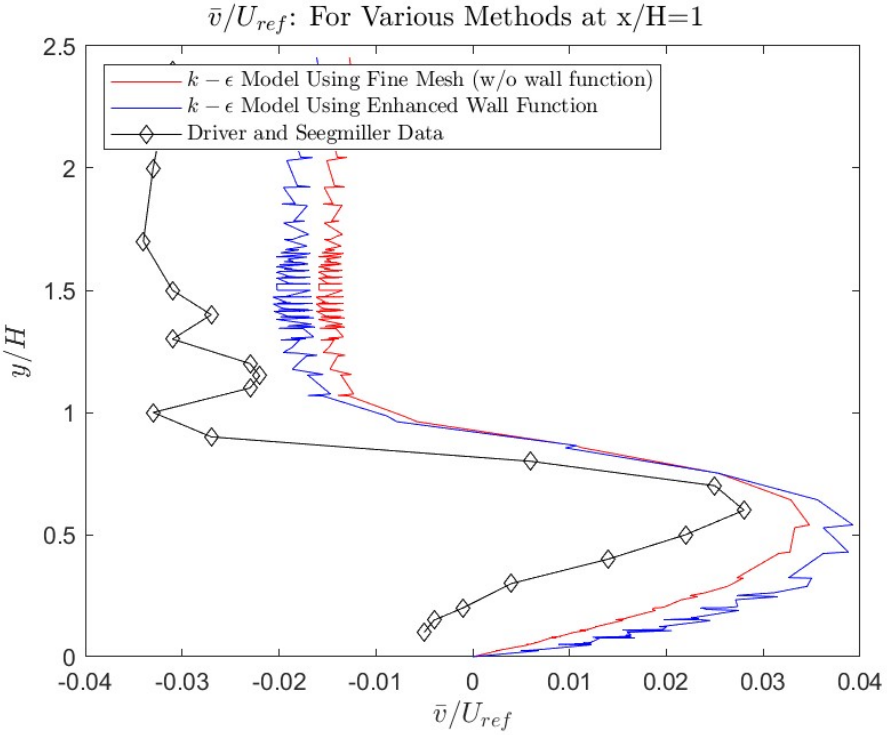
$\bar{u}/U_{ref}$: For Various Methods at x/H=6

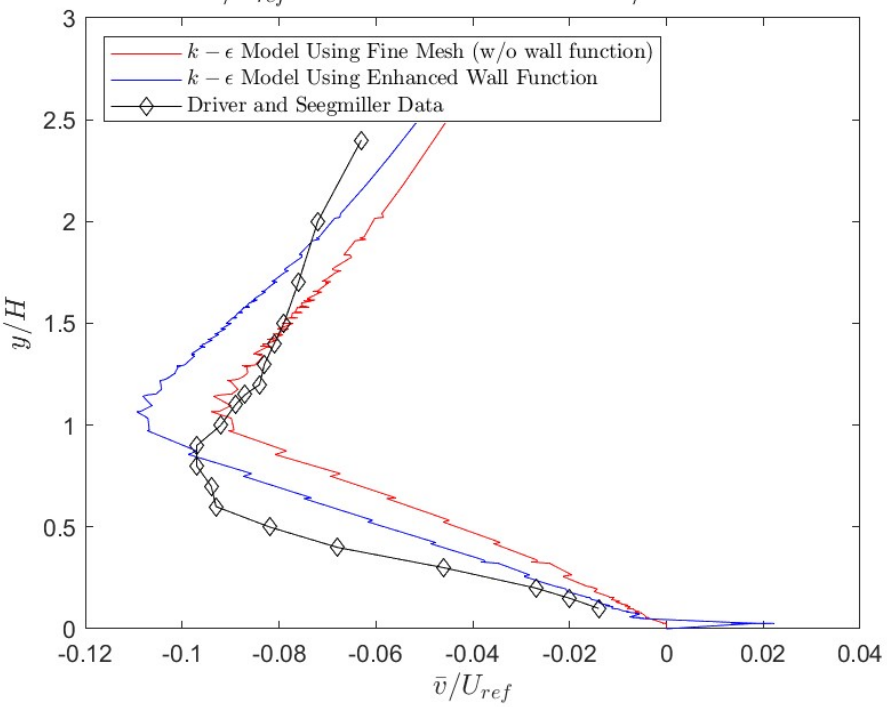


$\bar{u}/U_{ref}$: For Various Methods at x/H=10

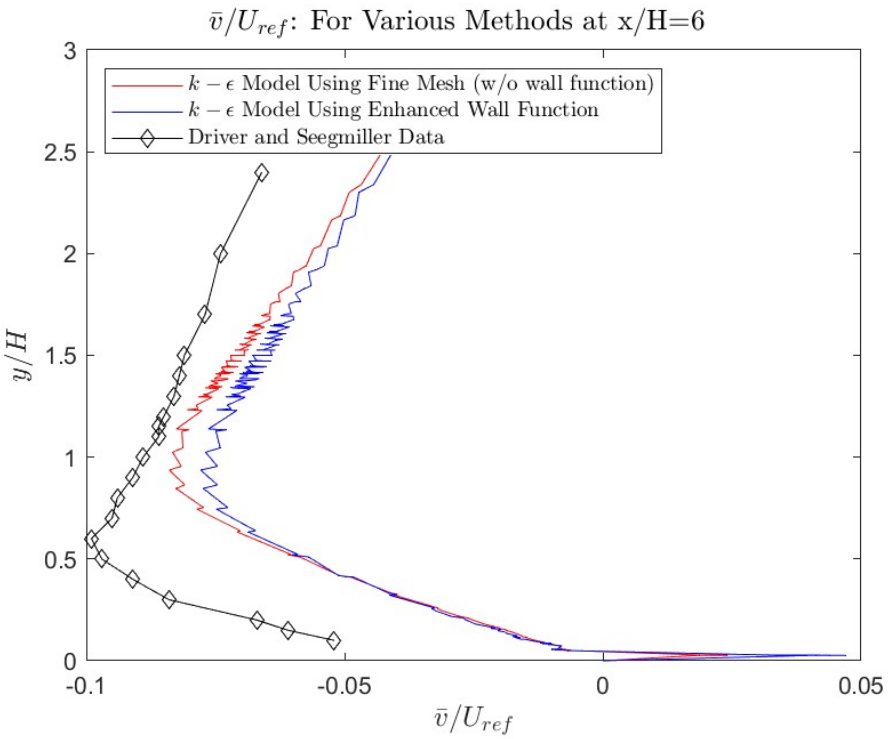


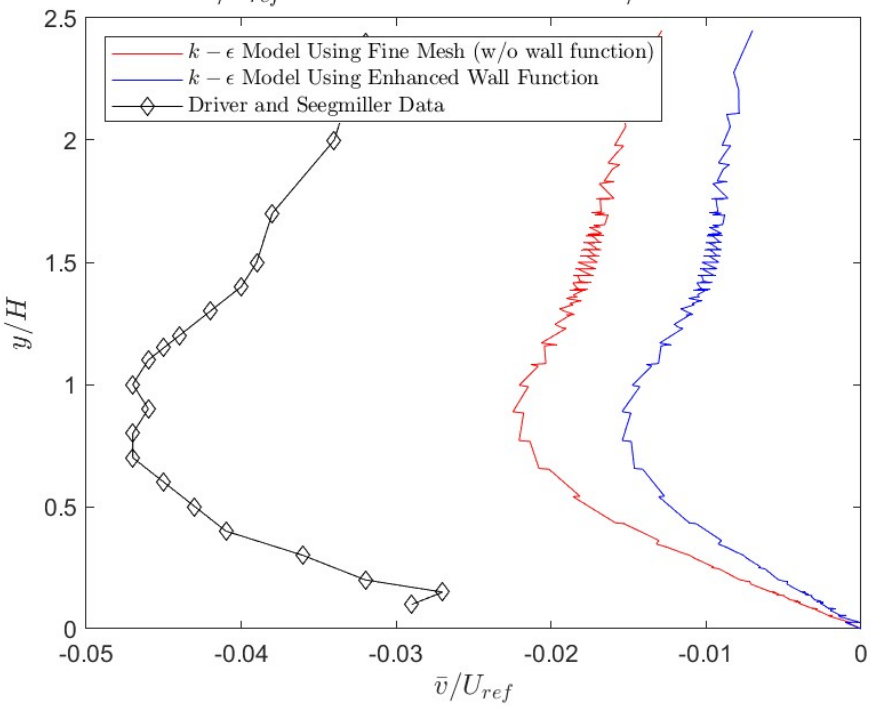
Average Vertical Velocity $\bar{v}/U_{ref}$



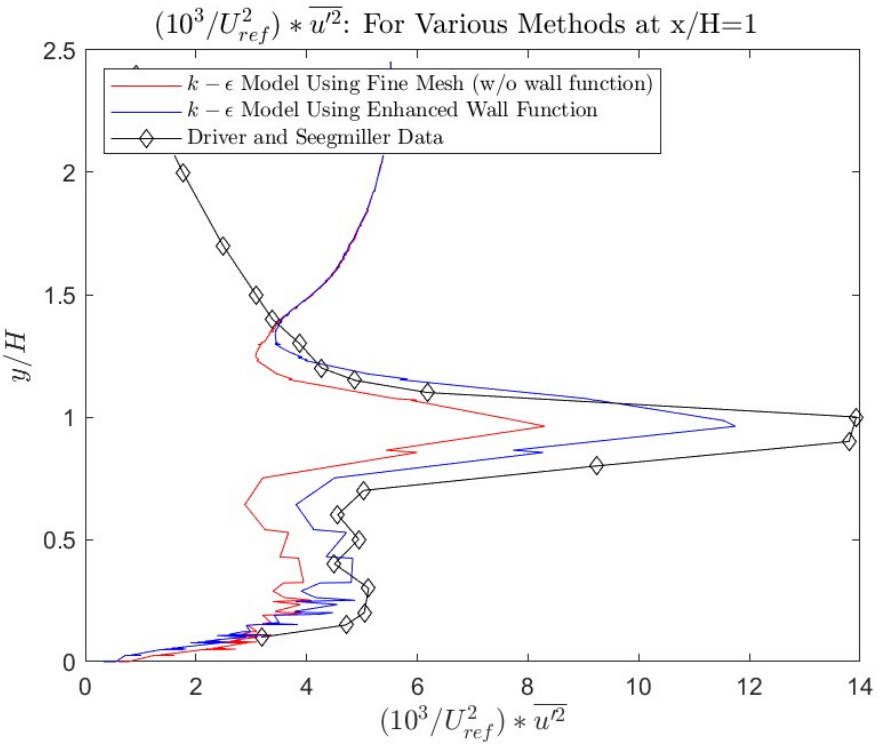


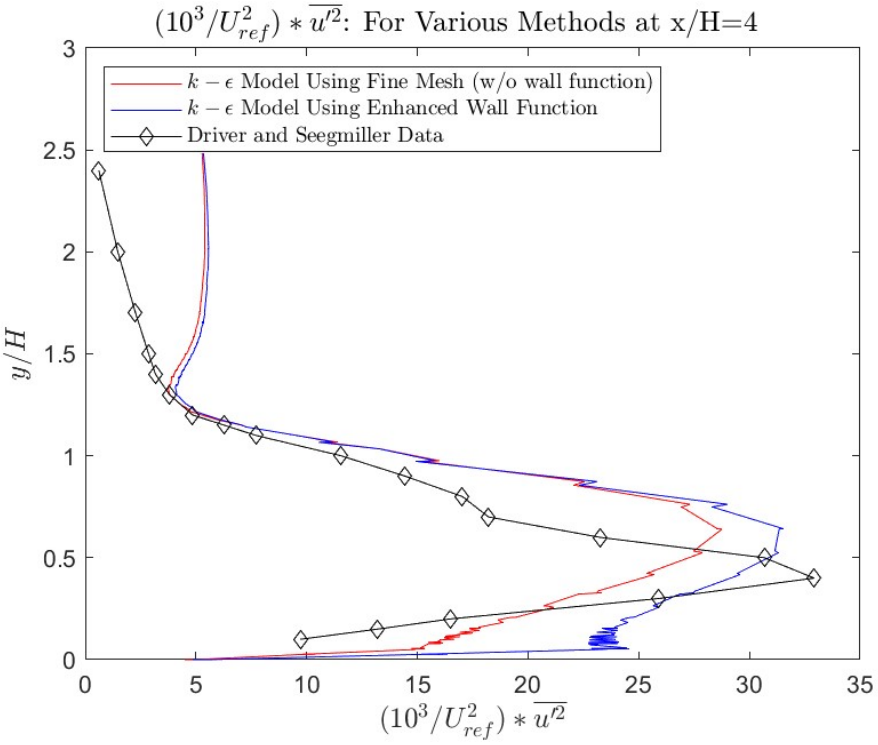
Average Vertical Velocity $\bar{v}/U_{ref}$



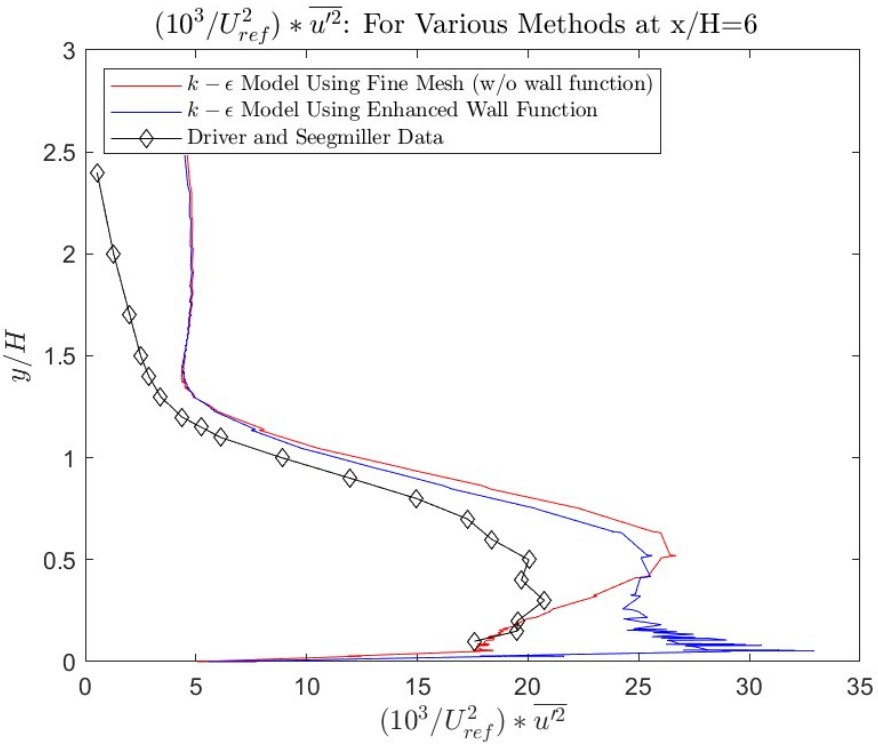


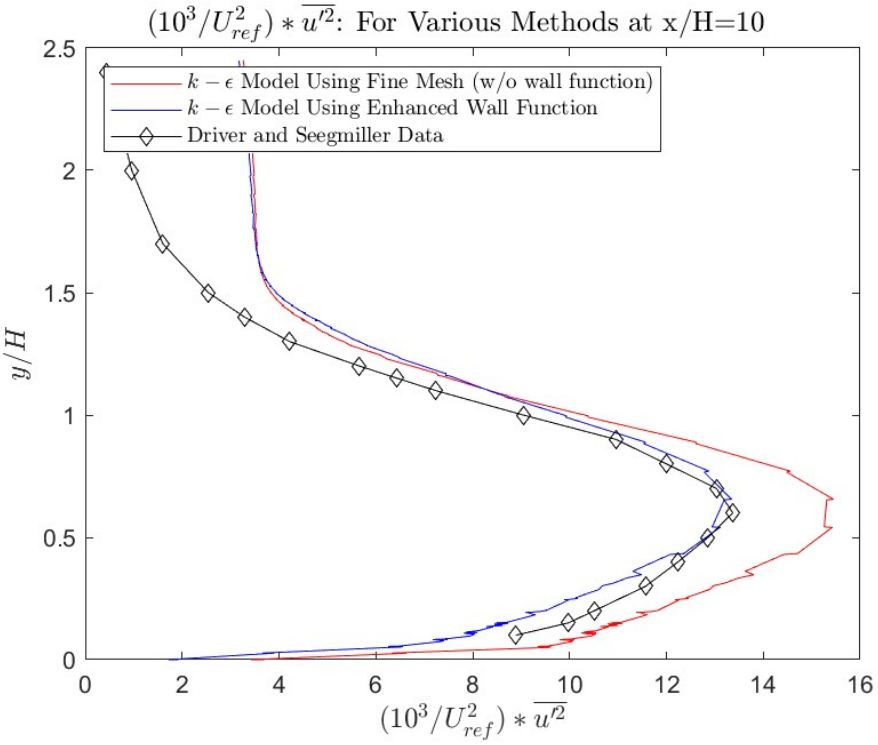
Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'^2}$



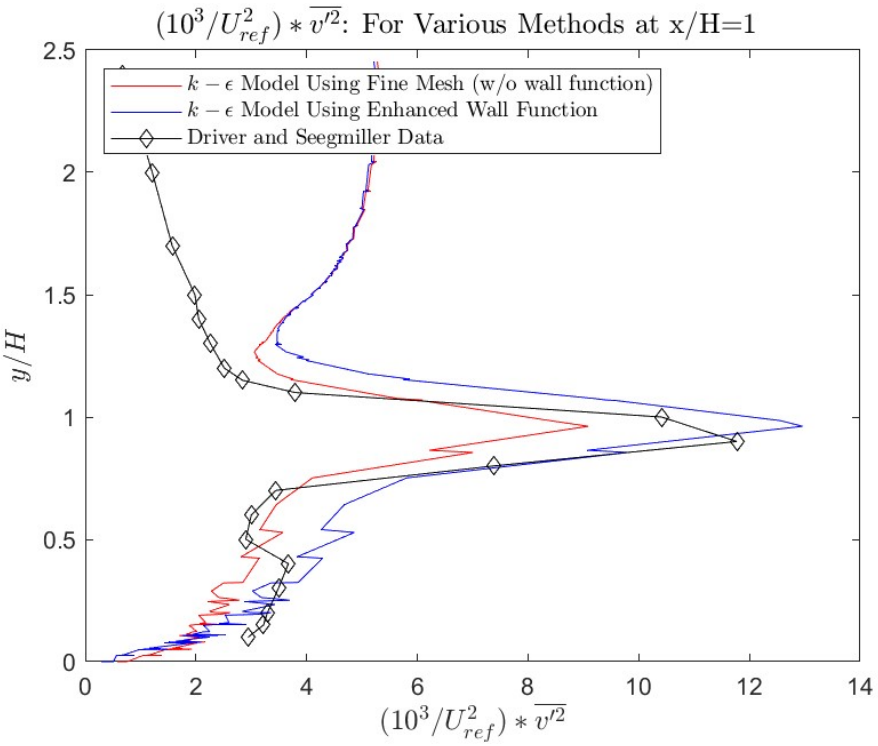


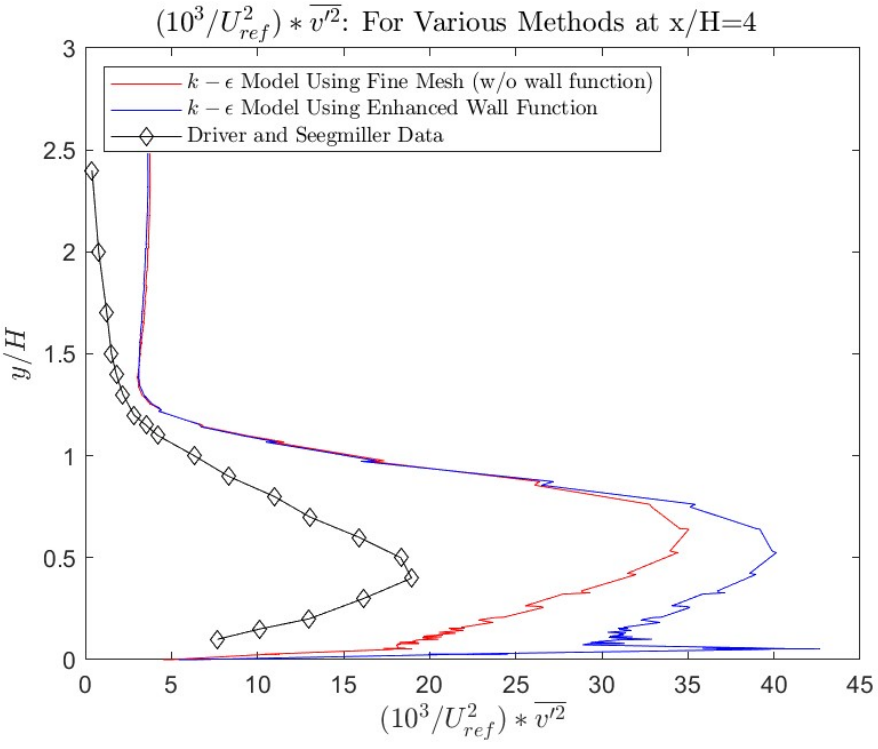
Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'^2}$



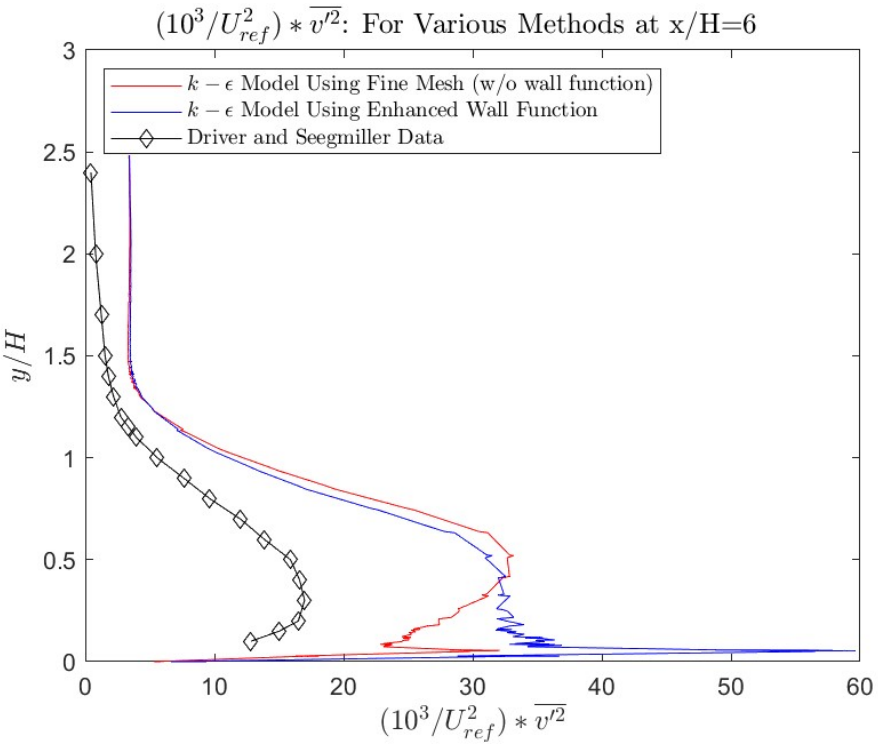


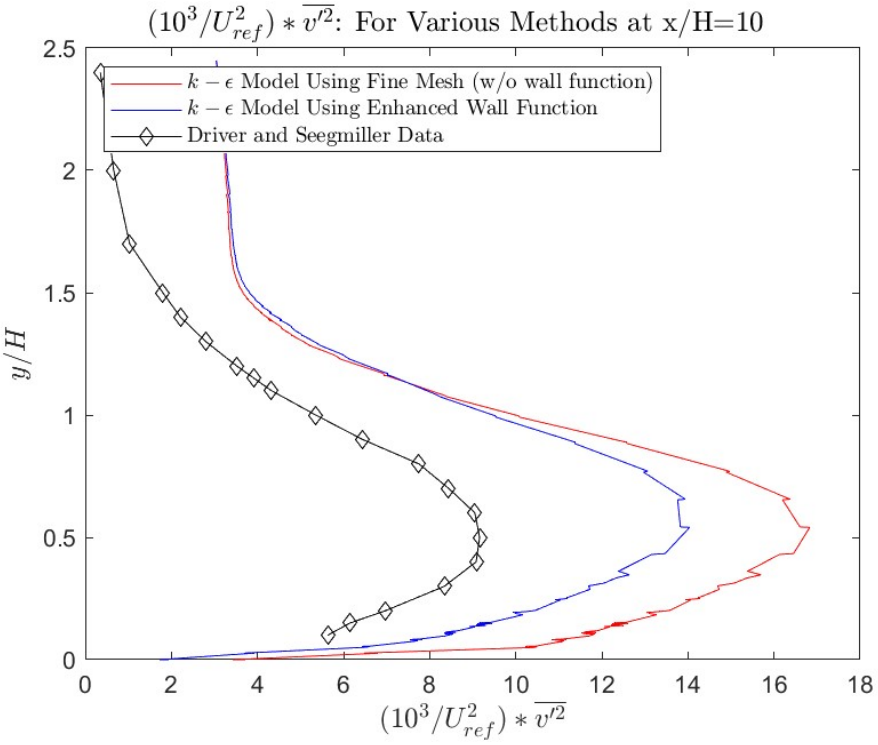
Reynold's Stress $(10^3/U_{ref}^2) * \overline{v'^2}$





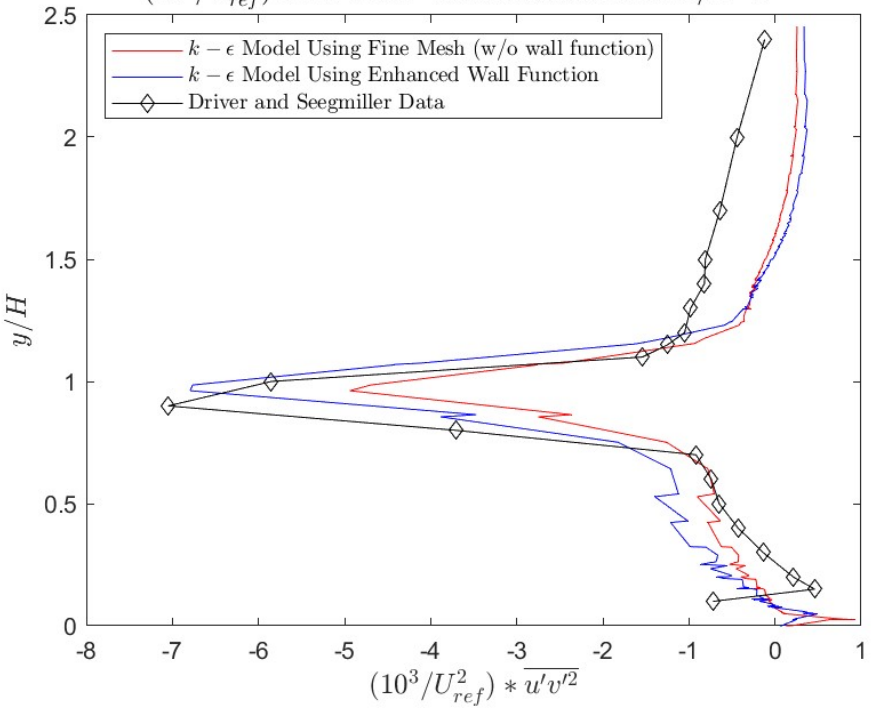
Reynold's Stress $(10^3/U_{ref}^2) * \overline{v'^2}$



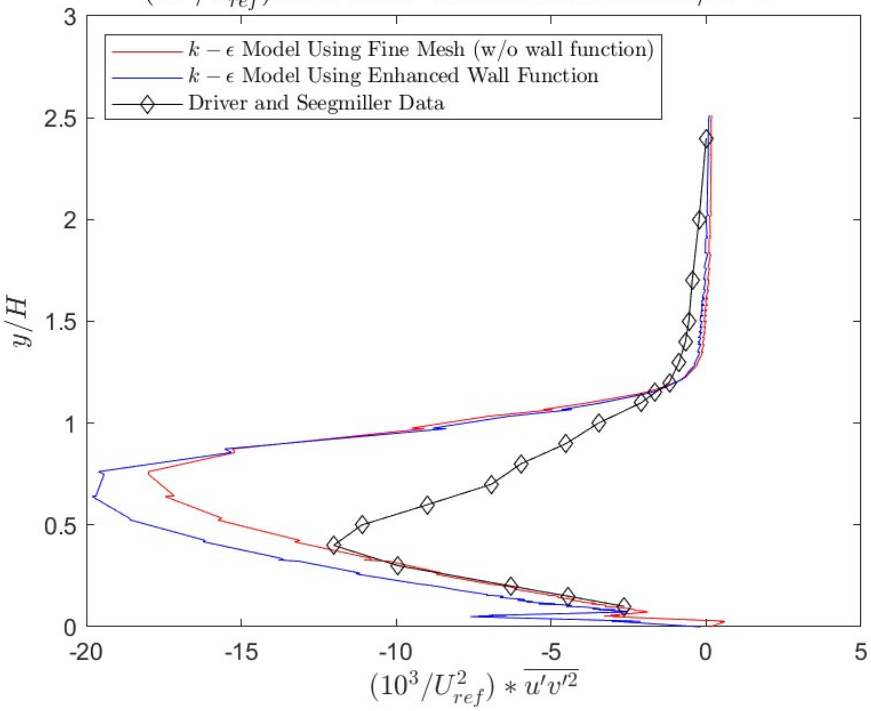


Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'v'}$

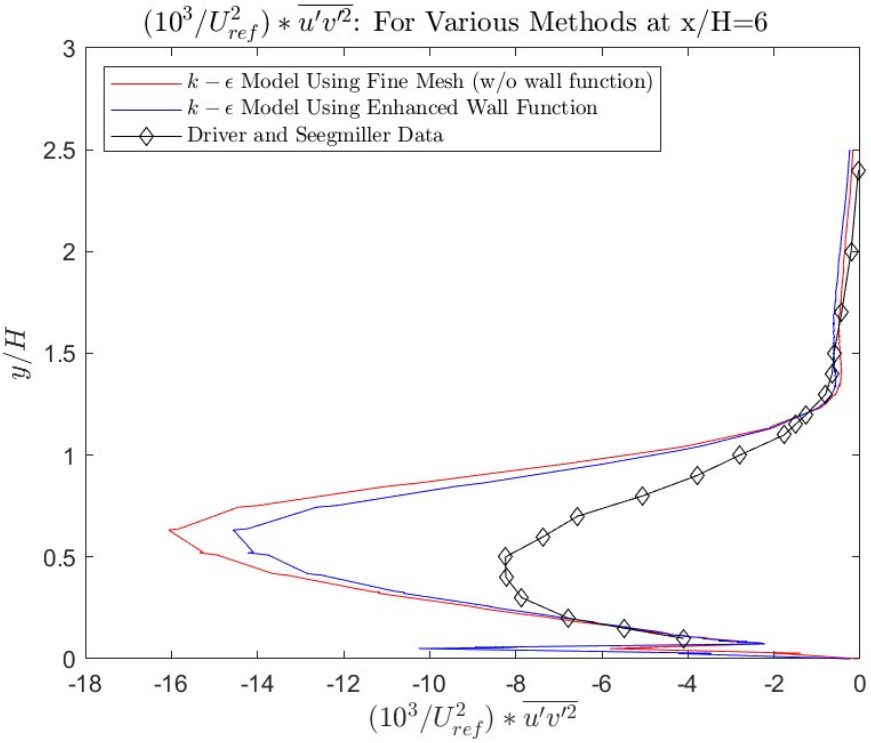
$(10^3/U_{ref}^2) * \overline{u'v'^2}$: For Various Methods at x/H=1

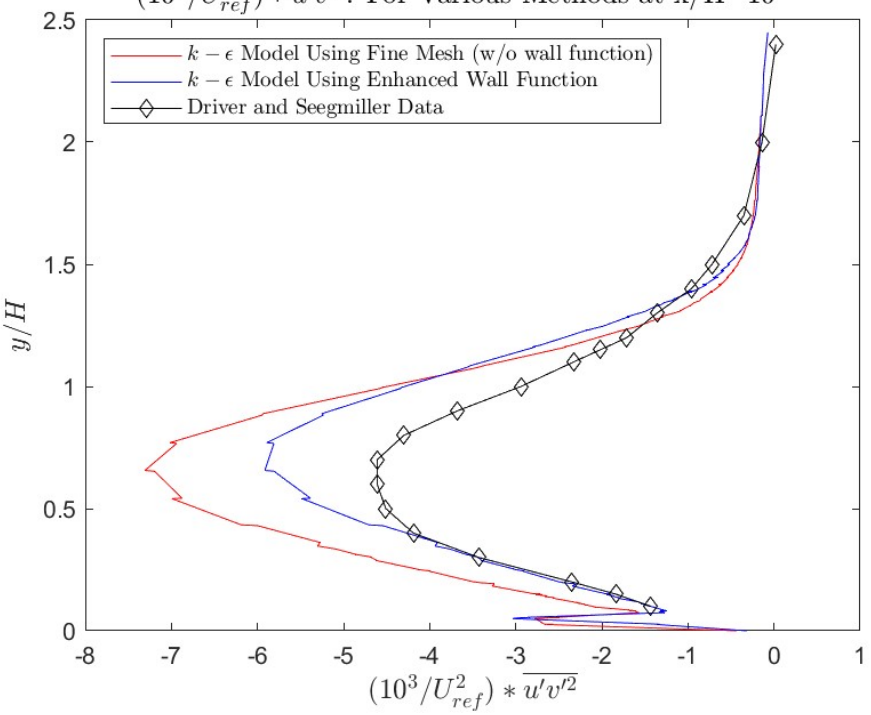


$(10^3/U_{ref}^2) * \overline{u'v'^2}$: For Various Methods at x/H=4

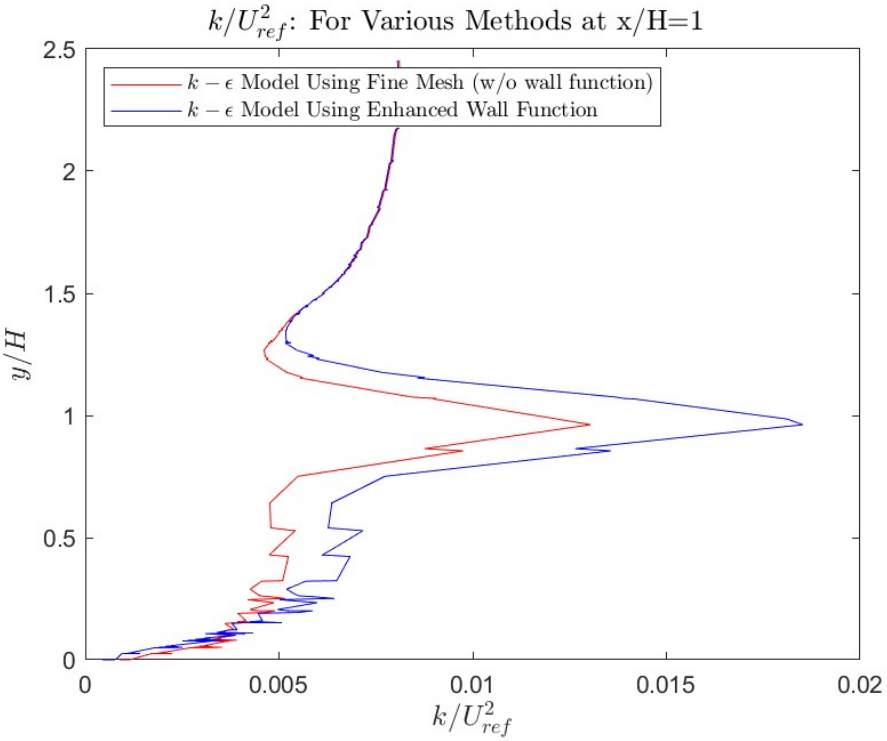


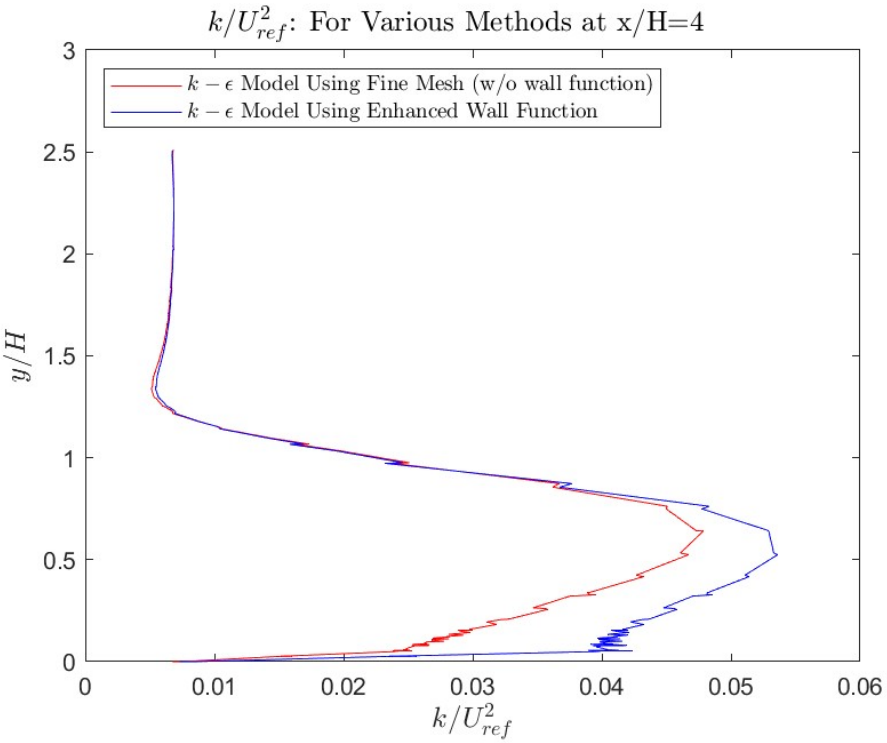
Reynold's Stress $(10^3/U_{ref}^2) * \overline{u'v'}$



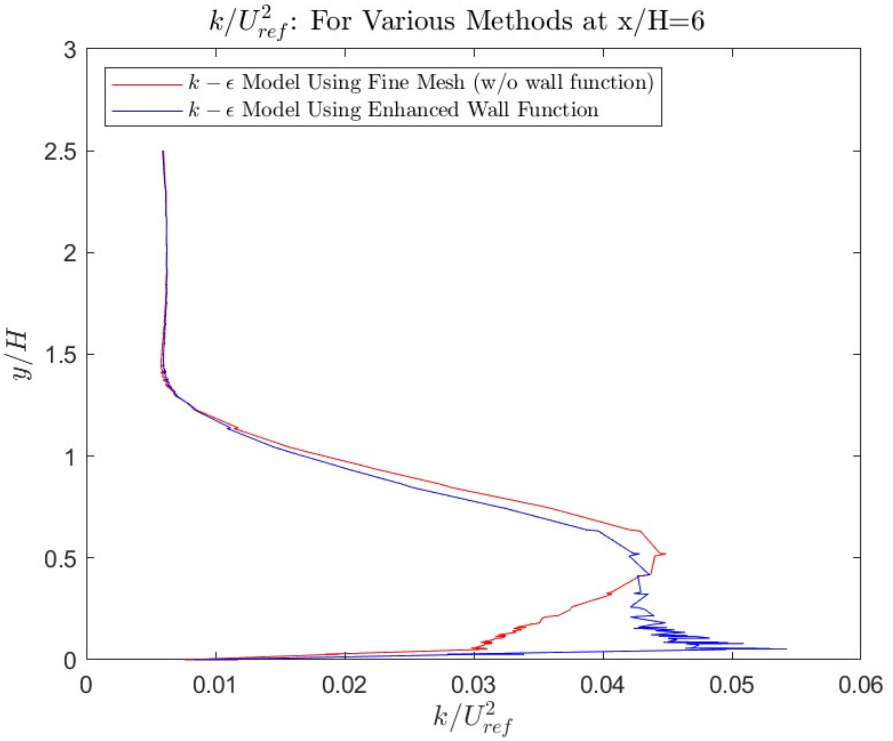


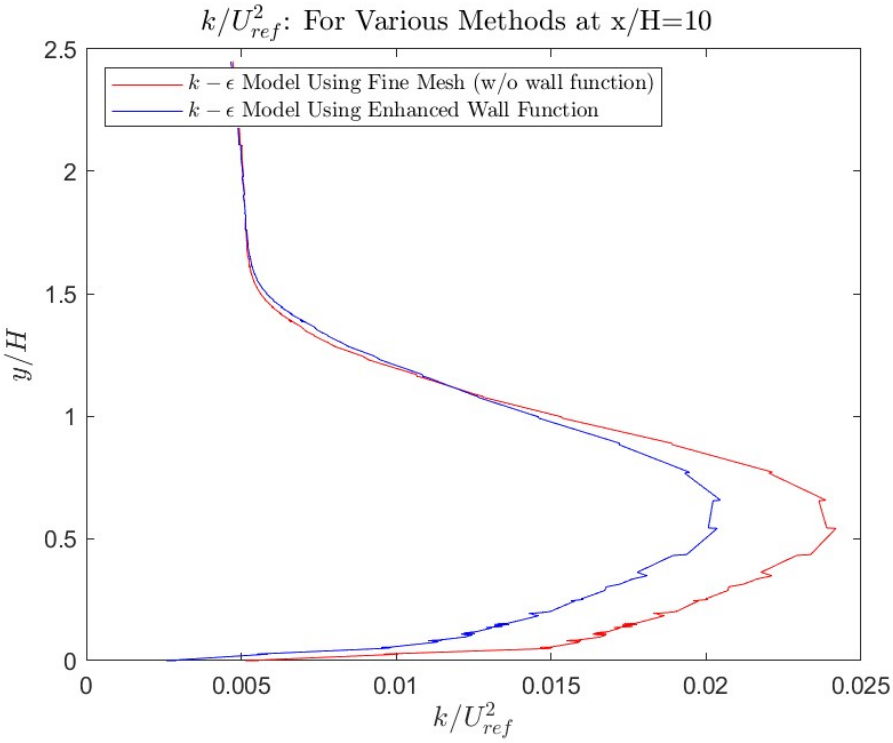
(k/U_{ref}^2) Turbulent Kinetic Energy



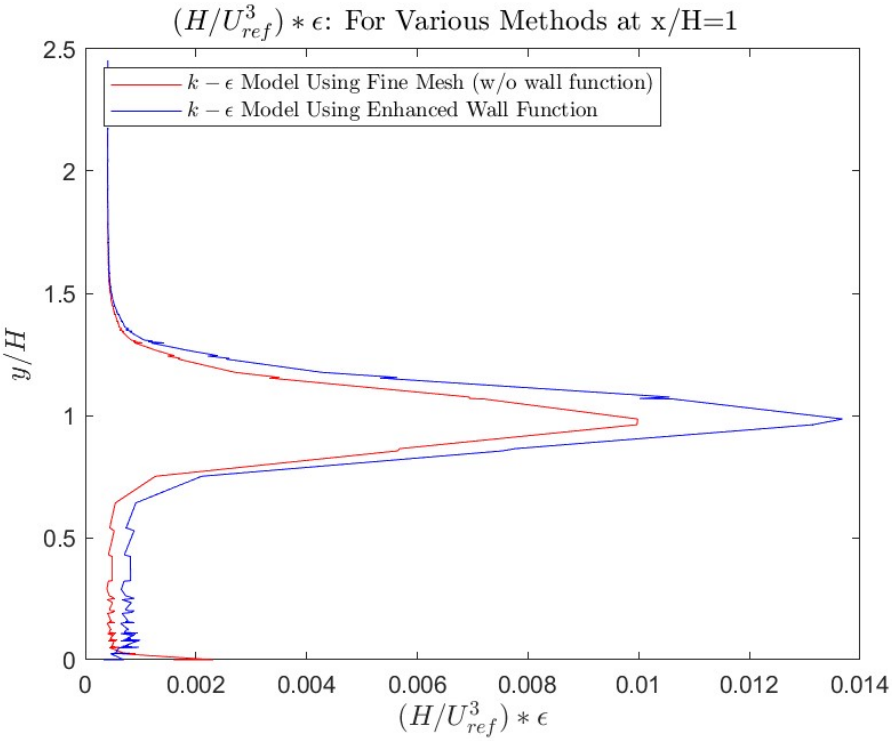


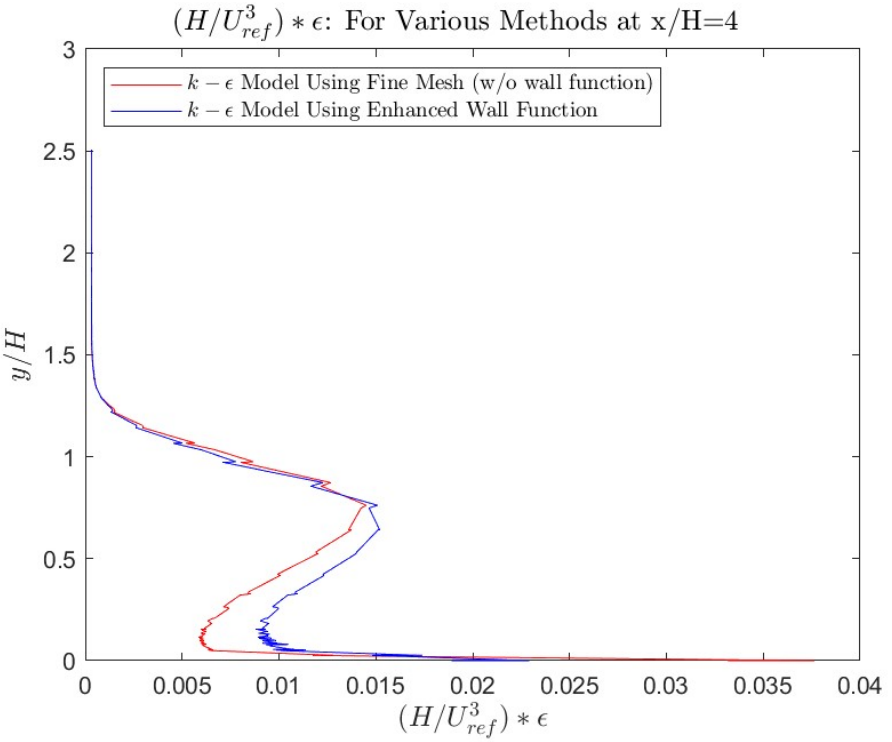
(k/U_{ref}^2) Turbulent Kinetic Energy



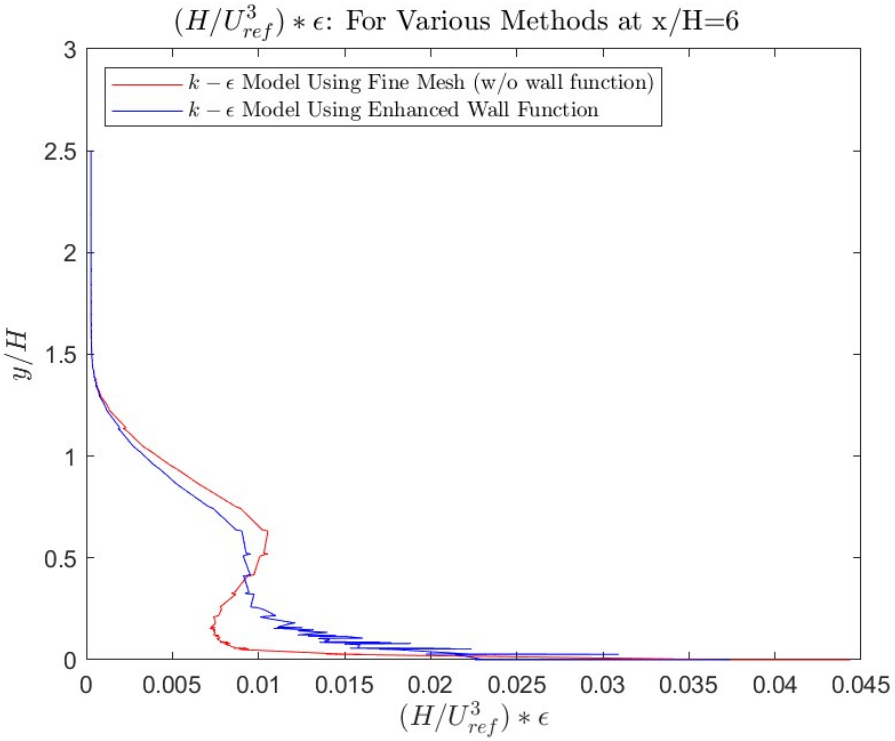


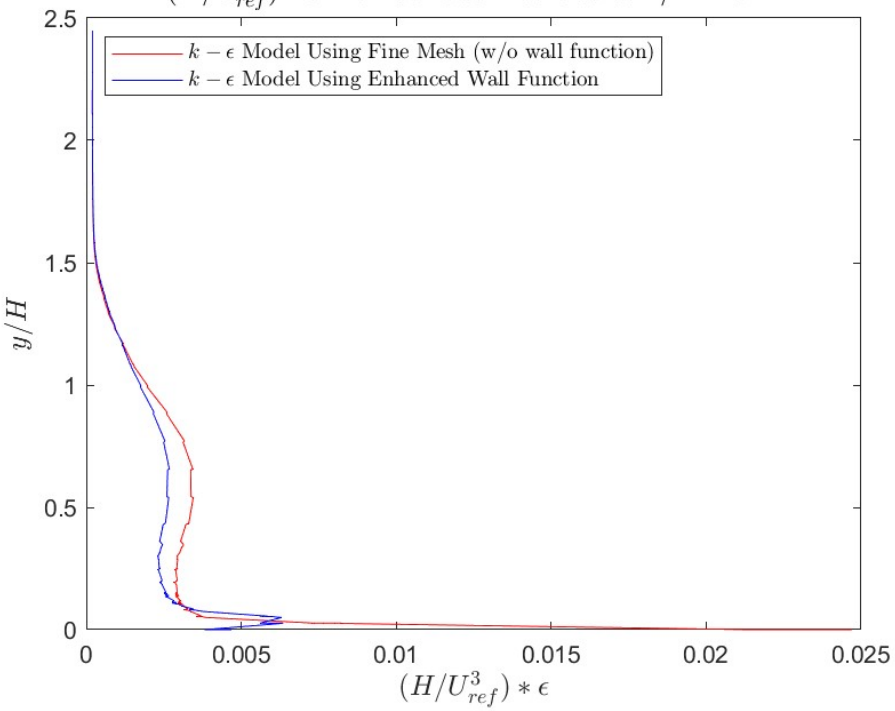
$(H/U_{ref}^3) * \epsilon$ Turbulence Dissipation Rate





$(H/U_{ref}^3) * \epsilon$ Turbulence Dissipation Rate





Q11: Does the choice of these the wall functions have any significant effect on the results from these three turbulence models for this problem?

Answer: The results for both the standard and the enhanced wall function look essentially the same for all the turbulent quantities. No clear distinction between the effects of these two wall functions can be made from the results. There is a slight deviation between the two wall functions for all the quantities, but these deviations seem to be very minuscule.

Q12: Do your results show that the "enhanced wall treatment" improves the accuracy of the model results when compared to the experimental data?

Answer: Upon comparison with the reference data from Driver and Seegmiller, it is observed that the enhanced wall functions provide more accurate results for Reynolds stress, with deviations from the reference data being smaller than those from the standard wall function. However, the x-velocities appear to be similar for both wall functions, while the y-velocities show inferior performance for the enhanced wall function. Nevertheless, the observed differences between the two wall treatments are so minimal that we cannot ascertain whether the enhanced wall treatment leads to an improvement in the accuracy of the predictions.

Q13: How does the magnitude of the differences in the model results for these two wall treatments compare with the magnitude of the overall differences between the model results and the experimental data?

Answer: As previously mentioned in Q11 and Q12, the results obtained using both the standard and enhanced wall functions exhibit minimal differences. As a result, it is difficult to distinguish any notable distinctions between the results of these two wall functions and their deviation from the Driver and Seegmiller data.

6 Conclusion

The project aimed to predict the fluid flow characteristics inside a channel with a backward step using three different turbulence models: $k-\epsilon$, $k-\omega$, and RSTM. The predicted results were compared with the reference experimental data from Driver and Seegmiller, and all three models produced good approximations of the actual flow characteristics. The RSTM model was observed to be the best overall in predicting the flow characteristics, including the extended fluid re-circulation zone, detailed Reynolds stresses, and kinetic energy and dissipation. However, the $k-\omega$ fine case predicted the corner eddies formed in the y-velocity contours, but it seemed to be off by a considerable margin, and it is unclear whether it is too wrong or too correct. Therefore, the RSTM model can be preferred over the $k-\epsilon$, $k-\omega$, and RSTM models.

The models were found to over predict the Reynolds stress, except for the $k-\omega$ model, which was slightly off. Different wall functions were also tested, but they did not yield any significant differences in the results, making it difficult to draw conclusive results.

The project also discussed various error sources, including those related to the experimental data from Driver and Seegmiller and the modelled equations used by ANSYS to solve the three turbulence models.

Appendix

Code for all $k-\epsilon$ Coarse

```
H=0.0127;
coarseke=xlsread("coarseke.csv");
x=(coarseke(:,2)/H)-15;
y=(coarseke(:,3)/H);
u=coarseke(:,7)/44.2;
v=coarseke(:,8)/44.2;
uu=(coarseke(:,4)*1000)/(44.2*44.2);
vv=(coarseke(:,5)*1000)/(44.2*44.2);
uv=(coarseke(:,6)*1000)/(44.2*44.2);
k=coarseke(:,9)/(44.2*44.2);
ep=(coarseke(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:k-\epsilon$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:k-\epsilon$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
```

```
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2)}}:k-\epsilon$ Turbulence
    Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%vv
figure(4);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,vv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:k-\epsilon$ Turbulence
    Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
```

```
103 set(gca,'xtick',0:2:12)
104 set(gcf,'position',[10,10,1050,300])
105
106 %uv
107 figure(5);
108 [X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
109 F=scatteredInterpolant(x,y,uv);
110 Z=F(X, Y);
111 contourf(X,Y,Z,400,'edgecolor','none')
112 colormap('jet')
113 shading interp
114 colorbar()
115 ylim([0,2]);xlim([0,12]);
116 t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:k-\
        epsilon$ Turbulence Model using Coarse mesh');
117 set(t1,'Interpreter','latex')
118 set(t1,'Fontsize',12)
119 x2=xlabel('$x/H$');
120 set(x2,'Interpreter','latex')
121 set(x2,'Fontsize',12)
122 y2=ylabel('$y/H$');
123 set(y2,'Interpreter','latex')
124 set(y2,'Fontsize',12)
125 set(gca,'ytick',0:0.5:2)
126 set(gca,'xtick',0:2:12)
127 set(gcf,'position',[10,10,1050,300])
128
129 %k
130 figure(6);
131 [X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
132 F=scatteredInterpolant(x,y,ep);
133 Z=F(X, Y);
134 contourf(X,Y,Z,400,'edgecolor','none')
135 colormap('jet')
136 shading interp
137 colorbar()
138 ylim([0,2]);xlim([0,12]);
139 t1=sgtitle('$(k/U_{ref}^2):k-\epsilon$ Turbulence Model using Coarse mesh');
140 set(t1,'Interpreter','latex')
141 set(t1,'Fontsize',12)
142 x2=xlabel('$x/H$');
143 set(x2,'Interpreter','latex')
144 set(x2,'Fontsize',12)
145 y2=ylabel('$y/H$');
146 set(y2,'Interpreter','latex')
147 set(y2,'Fontsize',12)
148 set(gca,'ytick',0:0.5:2)
149 set(gca,'xtick',0:2:12)
150 set(gcf,'position',[10,10,1050,300])
151
152
153 %e
154 figure(7);
155 [X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
```

```
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:k-\epsilon$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all $k-\epsilon$ Medium

```
H=0.0127;
mediumke=xlsread("mediumke.csv");
x=(mediumke(:,2)/H)-15;
y=(mediumke(:,3)/H);
u=mediumke(:,7)/44.2;
v=mediumke(:,8)/44.2;
uu=(mediumke(:,4)*1000)/(44.2*44.2);
vv=(mediumke(:,5)*1000)/(44.2*44.2);
uv=(mediumke(:,6)*1000)/(44.2*44.2);
k=mediumke(:,9)/(44.2*44.2);
ep=(mediumke(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:k-\epsilon$ Turbulence Model using Medium mesh');
```

```
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:k-\epsilon$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2)}}:k-\epsilon$ Turbulence
    Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
```

```
78 set(y2,'Fontsize',12)
79 set(gca,'ytick',0:0.5:2)
80 set(gca,'xtick',0:2:12)
81 set(gcf,'position',[10,10,1050,300])
82
83 %vv
84 figure(4);
85 [X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
86 F=scatteredInterpolant(x,y,vv);
87 Z=F(X, Y);
88 contourf(X,Y,Z,400,'edgecolor','none')
89 colormap('jet')
90 shading interp
91 colorbar()
92 ylim([0,2]);xlim([0,12]);
93 t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:k-\epsilon$ Turbulence
       Model using Medium mesh');
94 set(t1,'Interpreter','latex')
95 set(t1,'Fontsize',12)
96 x2=xlabel('$x/H$');
97 set(x2,'Interpreter','latex')
98 set(x2,'Fontsize',12)
99 y2=ylabel('$y/H$');
100 set(y2,'Interpreter','latex')
101 set(y2,'Fontsize',12)
102 set(gca,'ytick',0:0.5:2)
103 set(gca,'xtick',0:2:12)
104 set(gcf,'position',[10,10,1050,300])
105
106 %uv
107 figure(5);
108 [X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
109 F=scatteredInterpolant(x,y,uv);
110 Z=F(X, Y);
111 contourf(X,Y,Z,400,'edgecolor','none')
112 colormap('jet')
113 shading interp
114 colorbar()
115 ylim([0,2]);xlim([0,12]);
116 t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:k-\
       epsilon$ Turbulence Model using Medium mesh');
117 set(t1,'Interpreter','latex')
118 set(t1,'Fontsize',12)
119 x2=xlabel('$x/H$');
120 set(x2,'Interpreter','latex')
121 set(x2,'Fontsize',12)
122 y2=ylabel('$y/H$');
123 set(y2,'Interpreter','latex')
124 set(y2,'Fontsize',12)
125 set(gca,'ytick',0:0.5:2)
126 set(gca,'xtick',0:2:12)
127 set(gcf,'position',[10,10,1050,300])
128
129 %k
```

```
figure(6);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(k/U_{ref}^2):k-\epsilon$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])


%e
figure(7);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:k-\epsilon$ Turbulence Model using Medium
    mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all $k-\epsilon$ Fine

```
H=0.0127;
fineke=xlsread("fineke.csv");
x=(fineke(:,2)/H)-15;
y=(fineke(:,3)/H);
u=fineke(:,7)/44.2;
v=fineke(:,8)/44.2;
uu=(fineke(:,4)*1000)/(44.2*44.2);
vv=(fineke(:,5)*1000)/(44.2*44.2);
uv=(fineke(:,6)*1000)/(44.2*44.2);
k=fineke(:,9)/(44.2*44.2);
ep=(fineke(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:k-\epsilon$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:k-\epsilon$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
```

```
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2}}:k-\epsilon$ Turbulence
    Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%vv
figure(4);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,vv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:k-\epsilon$ Turbulence
    Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

```

```
%uv
figure(5);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:k-\
    epsilon$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%k
figure(6);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(k/U_{ref}^2):k-\epsilon$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])


%e
figure(7);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
```

```
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:k-\epsilon$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all $k-\omega$ coarse

```
H=0.0127;
coarsekw=xlsread("coarsekw.csv");
x=(coarsekw(:,2)/H)-15;
y=(coarsekw(:,3)/H);
u=coarsekw(:,7)/44.2;
v=coarsekw(:,8)/44.2;
uu=(coarsekw(:,4)*1000)/(44.2*44.2);
vv=(coarsekw(:,5)*1000)/(44.2*44.2);
uv=(coarsekw(:,6)*1000)/(44.2*44.2);
k=coarsekw(:,9)/(44.2*44.2);
ep=(coarsekw(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:k-\omega$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
```

```
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:k-\omega$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2)}}:k-\omega$ Turbulence
    Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
```

```
set(gcf,'position',[10,10,1050,300])

%vv
figure(4);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,vv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:k-\omega$ Turbulence
    Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uv
figure(5);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:k-\
    omega$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%k
figure(6);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
```

```
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(k/U_{ref}^2):k-\omega$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])


%e
figure(7);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:k-\omega$ Turbulence Model using Coarse
    mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all $k-\omega$ medium

```
H=0.0127;
```

```
mediumkw=xlsread("mediumkw.csv");
x=(mediumkw(:,2)/H)-15;
y=(mediumkw(:,3)/H);
u=mediumkw(:,7)/44.2;
v=mediumkw(:,8)/44.2;
uu=(mediumkw(:,4)*1000)/(44.2*44.2);
vv=(mediumkw(:,5)*1000)/(44.2*44.2);
uv=(mediumkw(:,6)*1000)/(44.2*44.2);
k=mediumkw(:,9)/(44.2*44.2);
ep=(mediumkw(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:k-\omega$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:k-\omega$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
```

```
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2)}}:k-\omega$ Turbulence
    Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%vv
figure(4);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,vv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:k-\omega$ Turbulence
    Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uv
figure(5);
```

```
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:k-\
    omega$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%k
figure(6);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(k/U_{ref}^2):k-\omega$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])


%e
figure(7);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
```

```
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:k-\omega$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all $k-\omega$ Fine

```
H=0.0127;
finekw=xlsread("finekw.csv");
x=(finekw(:,2)/H)-15;
y=(finekw(:,3)/H);
u=finekw(:,7)/44.2;
v=finekw(:,8)/44.2;
uu=(finekw(:,4)*1000)/(44.2*44.2);
vv=(finekw(:,5)*1000)/(44.2*44.2);
uv=(finekw(:,6)*1000)/(44.2*44.2);
k=finekw(:,9)/(44.2*44.2);
ep=(finekw(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:k-\omega$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
```

```
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:k-\omega$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2)}}:k-\omega$ Turbulence
    Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

```

```
%vv
figure(4);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,vv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:k-\omega$ Turbulence
    Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uv
figure(5);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:k-\
    omega$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%k
figure(6);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
```

```
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(k/U_{ref}^2):k-\omega$ Turbulence Model using Fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])


%e
figure(7);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:k-\omega$ Turbulence Model using Fine mesh
    ');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all RSTM Coarse

```
H=0.0127;
coarseRSTM=xlsread("coarseRSTM.csv");
x=(coarseRSTM(:,2)/H)-15;
```

```
y=(coarseRSTM(:,3)/H);
u=coarseRSTM(:,7)/44.2;
v=coarseRSTM(:,8)/44.2;
uu=(coarseRSTM(:,4)*1000)/(44.2*44.2);
vv=(coarseRSTM(:,5)*1000)/(44.2*44.2);
uv=(coarseRSTM(:,6)*1000)/(44.2*44.2);
k=coarseRSTM(:,9)/(44.2*44.2);
ep=(coarseRSTM(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:RSTM$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:RSTM$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
```

```
set(gcf,'position',[10,10,1050,300])

%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2)}}:RSTM$ Turbulence Model
    using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%vv
figure(4);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,vv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:RSTM$ Turbulence Model
    using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uv
figure(5);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uv);
```

```
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:RSTM$
    Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%k
figure(6);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(k/U_{ref}^2):RSTM$ Turbulence Model using Coarse mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])


%e
figure(7);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
```

```
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:RSTM$ Turbulence Model using Coarse mesh')
    ;
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all RSTM Medium

```
H=0.0127;
mediumRSTM=xlsread("mediumRSTM.csv");
x=(mediumRSTM(:,2)/H)-15;
y=(mediumRSTM(:,3)/H);
u=mediumRSTM(:,7)/44.2;
v=mediumRSTM(:,8)/44.2;
uu=(mediumRSTM(:,4)*1000)/(44.2*44.2);
vv=(mediumRSTM(:,5)*1000)/(44.2*44.2);
uv=(mediumRSTM(:,6)*1000)/(44.2*44.2);
k=mediumRSTM(:,9)/(44.2*44.2);
ep=(mediumRSTM(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:RSTM$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
```

```
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:RSTM$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2)}}:RSTM$ Turbulence Model
    using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%vv
figure(4);
```

```
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,vv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:RSTM$ Turbulence Model
    using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uv
figure(5);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:RSTM$
     Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%k
figure(6);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
```

```
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(k/U_{ref}^2):RSTM$ Turbulence Model using Medium mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])


%e
figure(7);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:RSTM$ Turbulence Model using Medium mesh')
    ;
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all RSTM Fine

```
H=0.0127;
fineRSTM=xlsread("fineRSTM.csv");
x=(fineRSTM(:,2)/H)-15;
y=(fineRSTM(:,3)/H);
u=fineRSTM(:,7)/44.2;
```

```
v=fineRSTM(:,8)/44.2;
uu=(fineRSTM(:,4)*1000)/(44.2*44.2);
vv=(fineRSTM(:,5)*1000)/(44.2*44.2);
uv=(fineRSTM(:,6)*1000)/(44.2*44.2);
k=fineRSTM(:,9)/(44.2*44.2);
ep=(fineRSTM(:,10)*H)/(44.2*44.2*44.2);
N=size(x,1);

%u
figure(1);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,u);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{u}/U_{ref}:RSTM$ Turbulence Model using fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%v
figure(2);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,v);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$\bar{v}/U_{ref}:RSTM$ Turbulence Model using fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

```

```
%uu
figure(3);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uu);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime2)}}:RSTM$ Turbulence Model
    using fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%vv
figure(4);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,vv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime2}}:RSTM$ Turbulence Model
    using fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%uv
figure(5);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,uv);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
```

```
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}}\overline{v^{\prime}}:RSTM$
    Turbulence Model using fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

%k
figure(6);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(k/U_{ref}^2):RSTM$ Turbulence Model using fine mesh');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])


%e
figure(7);
[X, Y]=meshgrid(linspace(0,12,N),linspace(0,2,N));
F=scatteredInterpolant(x,y,ep);
Z=F(X, Y);
contourf(X,Y,Z,400,'edgecolor','none')
colormap('jet')
shading interp
colorbar()
ylim([0,2]);xlim([0,12]);
t1=sgtitle('$(H/U_{ref}^3)*\epsilon:RSTM$ Turbulence Model using fine mesh');
set(t1,'Interpreter','latex')
```

```
set(t1,'Fontsize',12)
x2=xlabel('$x/H$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
set(gca,'ytick',0:0.5:2)
set(gca,'xtick',0:2:12)
set(gcf,'position',[10,10,1050,300])

saveas(figure(1),'u','jpg')
saveas(figure(2),'v','jpg')
saveas(figure(3),'k','jpg')
saveas(figure(4),'ep','jpg')
saveas(figure(5),'uu','jpg')
saveas(figure(6),'vv','jpg')
saveas(figure(7),'uv','jpg'
```

Code for all fine Plots (in specific x/H) compared to Experimental Values

```
%% Code to plot all fine meshes with Experimental Data

%% Fine ke
fineke=xlsread('fineke.csv');
finekw=xlsread("finekw.csv");
finerstm=xlsread("finerstm.csv");
%% Fine ke
H=0.0127;
xc=(fineke(:,2)/H)-15;
yc=(fineke(:,3)/H);
uc=fineke(:,7)/44.2;
vc=fineke(:,8)/44.2;
kc=fineke(:,9)/(44.2*44.2);
ec=(fineke(:,10)*H)/(44.2*44.2*44.2);
uuc=(fineke(:,4)*1000)/(44.2*44.2);
vvc=(fineke(:,5)*1000)/(44.2*44.2);
uvc=(fineke(:,6)*1000)/(44.2*44.2);

%% Fine kw
H=0.0127;
xm=(finekw(:,2)/H)-15;
ym=(finekw(:,3)/H);
um=finekw(:,7)/44.2;
vm=finekw(:,8)/44.2;
km=finekw(:,9)/(44.2*44.2);
em=(finekw(:,10)*H)/(44.2*44.2*44.2);
uum=(finekw(:,4)*1000)/(44.2*44.2);
vvm=(finekw(:,5)*1000)/(44.2*44.2);
uvm=(finekw(:,6)*1000)/(44.2*44.2);

%% Fine rstm
H=0.0127;
xf=(finerstm(:,2)/H)-15;
yf=(finerstm(:,3)/H);
```

```
uf=finerstm(:,4)/44.2;
vf=finerstm(:,5)/44.2;
kf=finerstm(:,6)/(44.2*44.2);
ef=(finerstm(:,10)*H)/(44.2*44.2*44.2);
uuf=(finerstm(:,7)*1000)/(44.2*44.2);
vvf=(finerstm(:,8)*1000)/(44.2*44.2);
uvf=(finerstm(:,9)*1000)/(44.2*44.2);
%% Plots for u


[idxc1,idxc4,idxc6,idxc10]=index(xc,yc);
[idxm1,idxm4,idxm6,idxm10]=index(xm,ym);
[idxf1,idxf4,idxf6,idxf10]=index(xf,yf);

figure(1)
plot(uc(idxc1),yc(idxc1),'r',um(idxm1),ym(idxm1),'b',uf(idxf1),yf(idxf1),'g',
    xh1(:,2),xh1(:,1),'k-d')
t1=sgtitle('$\bar{u}/U_{ref}$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{u}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
    Mesh', ...
     'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
        northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(2)
plot(uc(idxc4),yc(idxc4),'r',um(idxm4),ym(idxm4),'b',uf(idxf4),yf(idxf4),'g',
    xh4(:,2),xh4(:,1),'k-d')
t1=sgtitle('$\bar{u}/U_{ref}$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{u}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
    Mesh', ...
     'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
        northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(3)
```

```
83  plot(uc(idxc6),yc(idxc6),'r',um(idxm6),ym(idxm6),'b',uf(idxf6),yf(idxf6),'g',
        xh6(:,2),xh6(:,1),'k-d')
84  t1=sgtitle('$\bar{u}/U_{ref}$: For Various Methods at x/H=6');
85  set(t1,'Interpreter','latex')
86  set(t1,'Fontsize',12)
87  x2=xlabel('$\bar{u}/U_{ref}$');
88  set(x2,'Interpreter','latex')
89  set(x2,'Fontsize',12)
90  y2=ylabel('$y/H$');
91  set(y2,'Interpreter','latex')
92  set(y2,'Fontsize',12)
93  l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
        Mesh', ...
94       'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
            northwest');
95  set(l2,'Interpreter','latex')
96  set(l2,'Fontsize',9)
97
98  figure(4)
99  plot(uc(idxc10),yc(idxc10),'r',um(idxm10),ym(idxm10),'b',uf(idxf10),yf(idxf10)
        ,'g',xh10(:,2),xh10(:,1),'k-d')
100 t1=sgtitle('$\bar{u}/U_{ref}$: For Various Methods at x/H=10');
101 set(t1,'Interpreter','latex')
102 set(t1,'Fontsize',12)
103 x2=xlabel('$\bar{u}/U_{ref}$');
104 set(x2,'Interpreter','latex')
105 set(x2,'Fontsize',12)
106 y2=ylabel('$y/H$');
107 set(y2,'Interpreter','latex')
108 set(y2,'Fontsize',12)
109 l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
        Mesh', ...
110      'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
            northwest');
111 set(l2,'Interpreter','latex')
112 set(l2,'Fontsize',9)
113
114
115 %% Plots for v
116
117 figure(5)
118 plot(vc(idxc1),yc(idxc1),'r',vm(idxm1),ym(idxm1),'b',vf(idxf1),yf(idxf1),'g',
        xh1(:,3),xh1(:,1),'k-d')
119 t1=sgtitle('$\bar{v}/U_{ref}$: For Various Methods at x/H=1');
120 set(t1,'Interpreter','latex')
121 set(t1,'Fontsize',12)
122 x2=xlabel('$\bar{v}/U_{ref}$');
123 set(x2,'Interpreter','latex')
124 set(x2,'Fontsize',12)
125 y2=ylabel('$y/H$');
126 set(y2,'Interpreter','latex')
127 set(y2,'Fontsize',12)
128 l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
        Mesh', ...
```

```
129       'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
              northeast');
130 set(l2,'Interpreter','latex')
131 set(l2,'Fontsize',9)
132
133
134 figure(6)
135 plot(vc(idxc4),yc(idxc4),'r',vm(idxm4),ym(idxm4),'b',vf(idxf4),yf(idxf4),'g',
        xh4(:,3),xh4(:,1),'k-d')
136 t1=sgtitle('$\bar{v}/U_{ref}$: For Various Methods at x/H=4');
137 set(t1,'Interpreter','latex')
138 set(t1,'Fontsize',12)
139 x2=xlabel('$\bar{v}/U_{ref}$');
140 set(x2,'Interpreter','latex')
141 set(x2,'Fontsize',12)
142 y2=ylabel('$y/H$');
143 set(y2,'Interpreter','latex')
144 set(y2,'Fontsize',12)
145 l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
        Mesh', ...
146       'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
              northeast');
147 set(l2,'Interpreter','latex')
148 set(l2,'Fontsize',9)
149
150 figure(7)
151 plot(vc(idxc6),yc(idxc6),'r',vm(idxm6),ym(idxm6),'b',vf(idxf6),yf(idxf6),'g',
        xh6(:,3),xh6(:,1),'k-d')
152 t1=sgtitle('$\bar{v}/U_{ref}$: For Various Methods at x/H=6');
153 set(t1,'Interpreter','latex')
154 set(t1,'Fontsize',12)
155 x2=xlabel('$\bar{v}/U_{ref}$');
156 set(x2,'Interpreter','latex')
157 set(x2,'Fontsize',12)
158 y2=ylabel('$y/H$');
159 set(y2,'Interpreter','latex')
160 set(y2,'Fontsize',12)
161 l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
        Mesh', ...
162       'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
              northeast');
163 set(l2,'Interpreter','latex')
164 set(l2,'Fontsize',9)
165
166
167 figure(8)
168 plot(vc(idxc10),yc(idxc10),'r',vm(idxm10),ym(idxm10),'b',vf(idxf10),yf(idxf10)
        ,'g',xh10(:,3),xh10(:,1),'k-d')
169 t1=sgtitle('$\bar{v}/U_{ref}$: For Various Methods at x/H=10');
170 set(t1,'Interpreter','latex')
171 set(t1,'Fontsize',12)
172 x2=xlabel('$\bar{v}/U_{ref}$');
173 set(x2,'Interpreter','latex')
174 set(x2,'Fontsize',12)
```

```
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% PLots for uu

figure(9)
plot(uuc(idxc1),yc(idxc1),'r',uum(idxm1),ym(idxm1),'b',uuf(idxf1),yf(idxf1),'g',xh1(:,4),xh1(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(10)
plot(uuc(idxc4),yc(idxc4),'r',uum(idxm4),ym(idxm4),'b',uuf(idxf4),yf(idxf4),'g',xh4(:,4),xh4(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

```

```
figure(11)
plot(uuc(idxc6),yc(idxc6),'r',uum(idxm6),ym(idxm6),'b',uuf(idxf6),yf(idxf6),'g',xh6(:,4),xh6(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(12)
plot(uuc(idxc10),yc(idxc10),'r',uum(idxm10),ym(idxm10),'b',uuf(idxf10),yf(idxf10),'g',xh10(:,4),xh10(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% Plots for vv

figure(13)
plot(vvc(idxc1),yc(idxc1),'r',vvm(idxm1),ym(idxm1),'b',vvf(idxf1),yf(idxf1),'g',xh1(:,5),xh1(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
```

```
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(14)
plot(vvc(idxc4),yc(idxc4),'r',vvm(idxm4),ym(idxm4),'b',vvf(idxf4),yf(idxf4),'g',xh4(:,5),xh4(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(15)
plot(vvc(idxc6),yc(idxc6),'r',vvm(idxm6),ym(idxm6),'b',vvf(idxf6),yf(idxf6),'g',xh6(:,5),xh6(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(16)
plot(vvc(idxc10),yc(idxc10),'r',vvm(idxm10),ym(idxm10),'b',vvf(idxf10),yf(
```

```
    idxf10),'g',xh10(:,5),xh10(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northeast');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% PLots for uv

figure(17)
plot(uvc(idxc1),yc(idxc1),'r',uvm(idxm1),ym(idxm1),'b',uvf(idxf1),yf(idxf1),'g',xh1(:,6),xh1(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(18)
plot(uvc(idxc4),yc(idxc4),'r',uvm(idxm4),ym(idxm4),'b',uvf(idxf4),yf(idxf4),'g',xh4(:,6),xh4(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
```

```
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(19)
plot(uvc(idxc6),yc(idxc6),'r',uvm(idxm6),ym(idxm6),'b',uvf(idxf6),yf(idxf6),'g',xh6(:,6),xh6(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(20)
plot(uvc(idxc10),yc(idxc10),'r',uvm(idxm10),ym(idxm10),'b',uvf(idxf10),yf(idxf10),'g',xh10(:,6),xh10(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% Plot for k

figure(21)
plot(kc(idxc1),yc(idxc1),'r',km(idxm1),ym(idxm1),'b',kf(idxf1),yf(idxf1),'g')
```

```
t1=sgtitle('$k/U_{ref}^2$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$k/U_{ref}^2$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(22)
plot(kc(idxc4),yc(idxc4),'r',km(idxm4),ym(idxm4),'b',kf(idxf4),yf(idxf4),'g')
t1=sgtitle('$k/U_{ref}^2$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$k/U_{ref}^2$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(23)
plot(kc(idxc6),yc(idxc6),'r',km(idxm6),ym(idxm6),'b',kf(idxf6),yf(idxf6),'g')
t1=sgtitle('$k/U_{ref}^2$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$k/U_{ref}^2$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine Mesh', ...
    'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


```

```
figure(24)
plot(kc(idxc10),yc(idxc10),'r',km(idxm10),ym(idxm10),'b',kf(idxf10),yf(idxf10)
    ,'g')
t1=sgtitle('$k/U_{ref}^2$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$k/U_{ref}^2$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
    Mesh', ...
     'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
        northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% plots for e

figure(25)
plot(ec(idxc1),yc(idxc1),'r',em(idxm1),ym(idxm1),'b',ef(idxf1),yf(idxf1),'g')
t1=sgtitle('$(H/U_{ref}^3)*\epsilon$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(H/U_{ref}^3)*\epsilon$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
    Mesh', ...
     'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
        northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(26)
plot(ec(idxc4),yc(idxc4),'r',em(idxm4),ym(idxm4),'b',ef(idxf4),yf(idxf4),'g')
t1=sgtitle('$(H/U_{ref}^3)*\epsilon$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(H/U_{ref}^3)*\epsilon$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
    Mesh', ...
```

```
491       'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
              northwest');
492 set(l2,'Interpreter','latex')
493 set(l2,'Fontsize',9)
494
495 figure(27)
496 plot(ec(idxc6),yc(idxc6),'r',em(idxm6),ym(idxm6),'b',ef(idxf6),yf(idxf6),'g')
497 t1=sgtitle('$(H/U_{ref}^3)*\epsilon$: For Various Methods at x/H=6');
498 set(t1,'Interpreter','latex')
499 set(t1,'Fontsize',12)
500 x2=xlabel('$(H/U_{ref}^3)*\epsilon$');
501 set(x2,'Interpreter','latex')
502 set(x2,'Fontsize',12)
503 y2=ylabel('$y/H$');
504 set(y2,'Interpreter','latex')
505 set(y2,'Fontsize',12)
506 l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
      Mesh', ...
507       'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
              northwest');
508 set(l2,'Interpreter','latex')
509 set(l2,'Fontsize',9)
510
511
512 figure(28)
513 plot(ec(idxc10),yc(idxc10),'r',em(idxm10),ym(idxm10),'b',ef(idxf10),yf(idxf10)
      ,'g')
514 t1=sgtitle('$(H/U_{ref}^3)*\epsilon$: For Various Methods at x/H=10');
515 set(t1,'Interpreter','latex')
516 set(t1,'Fontsize',12)
517 x2=xlabel('$(H/U_{ref}^3)*\epsilon$');
518 set(x2,'Interpreter','latex')
519 set(x2,'Fontsize',12)
520 y2=ylabel('$y/H$');
521 set(y2,'Interpreter','latex')
522 set(y2,'Fontsize',12)
523 l2=legend('$k-\epsilon$ Model Using Fine Mesh','$k-\omega$ Model Using Fine
      Mesh', ...
524       'RSTM Model Using Fine Mesh','Driver and Seegmiller Data','Location','
              northwest');
525 set(l2,'Interpreter','latex')
526 set(l2,'Fontsize',9)
527
528 %% Saving figures
529
530 saveas(figure(1),'u1','jpg')
531 saveas(figure(2),'u4','jpg')
532 saveas(figure(3),'u6','jpg')
533 saveas(figure(4),'u10','jpg')
534 saveas(figure(5),'v1','jpg')
535 saveas(figure(6),'v4','jpg')
536 saveas(figure(7),'v6','jpg')
537 saveas(figure(8),'v10','jpg')
538 saveas(figure(9),'uu1','jpg')
```

```
saveas(figure(10),'uu4','jpg')
saveas(figure(11),'uu6','jpg')
saveas(figure(12),'uu10','jpg')
saveas(figure(13),'vv1','jpg')
saveas(figure(14),'vv4','jpg')
saveas(figure(15),'vv6','jpg')
saveas(figure(16),'vv10','jpg')
saveas(figure(17),'uv1','jpg')
saveas(figure(18),'uv4','jpg')
saveas(figure(19),'uv6','jpg')
saveas(figure(20),'uv10','jpg')
saveas(figure(21),'k1','jpg')
saveas(figure(22),'k4','jpg')
saveas(figure(23),'k6','jpg')
saveas(figure(24),'k10','jpg')
saveas(figure(25),'ep1','jpg')
saveas(figure(26),'ep4','jpg')
saveas(figure(27),'ep6','jpg')
saveas(figure(28),'ep10','jpg')
```

Code for all $k-\epsilon$ fine Plots and $k-\epsilon$ Enhanced Wall Plots (in specific x/H) compared to Experimental Values

```
fineke=xlsread('fineke.csv');
enhancedke=xlsread("enhancedwall.csv");
%% Fine ke
H=0.0127;
xc=(fineke(:,2)/H)-15;
yc=(fineke(:,3)/H);
uc=fineke(:,7)/44.2;
vc=fineke(:,8)/44.2;
kc=fineke(:,9)/(44.2*44.2);
ec=(fineke(:,10)*H)/(44.2*44.2*44.2);
uuc=(fineke(:,4)*1000)/(44.2*44.2);
vvc=(fineke(:,5)*1000)/(44.2*44.2);
uvc=(fineke(:,6)*1000)/(44.2*44.2);

%% Enhanced ke
H=0.0127;
xm=(enhancedke(:,2)/H)-15;
ym=(enhancedke(:,3)/H);
um=enhancedke(:,7)/44.2;
vm=enhancedke(:,8)/44.2;
km=enhancedke(:,9)/(44.2*44.2);
em=(enhancedke(:,10)*H)/(44.2*44.2*44.2);
uum=(enhancedke(:,4)*1000)/(44.2*44.2);
vvm=(enhancedke(:,5)*1000)/(44.2*44.2);
uvm=(enhancedke(:,6)*1000)/(44.2*44.2);

%% Plots for u


[idxc1,idxc4,idxc6,idxc10]=index(xc,yc);
[idxm1,idxm4,idxm6,idxm10]=index(xm,ym);

```

```
figure(1)
plot(uc(idxc1),yc(idxc1),'r',um(idxm1),ym(idxm1),'b',xh1(:,2),xh1(:,1),'k-d')
t1=sgtitle('$\bar{u}/U_{ref}$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{u}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(2)
plot(uc(idxc4),yc(idxc4),'r',um(idxm4),ym(idxm4),'b',xh4(:,2),xh4(:,1),'k-d')
t1=sgtitle('$\bar{u}/U_{ref}$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{u}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(3)
plot(uc(idxc6),yc(idxc6),'r',um(idxm6),ym(idxm6),'b',xh6(:,2),xh6(:,1),'k-d')
t1=sgtitle('$\bar{u}/U_{ref}$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{u}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(4)
plot(uc(idxc10),yc(idxc10),'r',um(idxm10),ym(idxm10),'b',xh10(:,2),xh10(:,1),'
```

```
    k-d')
t1=sgtitle('$\bar{u}/U_{ref}$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{u}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% Plots for v

figure(5)
plot(vc(idxc1),yc(idxc1),'r',vm(idxm1),ym(idxm1),'b',xh1(:,3),xh1(:,1),'k-d')
t1=sgtitle('$\bar{v}/U_{ref}$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{v}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(6)
plot(vc(idxc4),yc(idxc4),'r',vm(idxm4),ym(idxm4),'b',xh4(:,3),xh4(:,1),'k-d')
t1=sgtitle('$\bar{v}/U_{ref}$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{v}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

```

```
figure(7)
plot(vc(idxc6),yc(idxc6),'r',vm(idxm6),ym(idxm6),'b',xh6(:,3),xh6(:,1),'k-d')
t1=sgtitle('$\bar{v}/U_{ref}$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{v}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(8)
plot(vc(idxc10),yc(idxc10),'r',vm(idxm10),ym(idxm10),'b',xh10(:,3),xh10(:,1),'
    k-d')
t1=sgtitle('$\bar{v}/U_{ref}$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$\bar{v}/U_{ref}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% PLots for uu

figure(9)
plot(uuc(idxc1),yc(idxc1),'r',uum(idxm1),ym(idxm1),'b',xh1(:,4),xh1(:,1),'k-d'
    )
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$: For Various Methods
    at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
```

```
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(10)
plot(uuc(idxc4),yc(idxc4),'r',uum(idxm4),ym(idxm4),'b',xh4(:,4),xh4(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(11)
plot(uuc(idxc6),yc(idxc6),'r',uum(idxm6),ym(idxm6),'b',xh6(:,4),xh6(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(12)
plot(uuc(idxc10),yc(idxc10),'r',uum(idxm10),ym(idxm10),'b', xh10(:,4),xh10(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
```

```
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% Plots for vv

figure(13)
plot(vvc(idxc1),yc(idxc1),'r',vvm(idxm1),ym(idxm1),'b',xh1(:,5),xh1(:,1),'k-d'
    )
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$: For Various Methods
    at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(14)
plot(vvc(idxc4),yc(idxc4),'r',vvm(idxm4),ym(idxm4),'b',xh4(:,5),xh4(:,1),'k-d'
    )
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$: For Various Methods
    at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(15)
plot(vvc(idxc6),yc(idxc6),'r',vvm(idxm6),ym(idxm6),'b',xh6(:,5),xh6(:,1),'k-d'
    )
```

```
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(16)
plot(vvc(idxc10),yc(idxc10),'r',vvm(idxm10),ym(idxm10),'b',xh10(:,5),xh10(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% PLots for uv

figure(17)
plot(uvc(idxc1),yc(idxc1),'r',uvm(idxm1),ym(idxm1),'b',xh1(:,6),xh1(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
```

```
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(18)
plot(uvc(idxc4),yc(idxc4),'r',uvm(idxm4),ym(idxm4),'b',xh4(:,6),xh4(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(19)
plot(uvc(idxc6),yc(idxc6),'r',uvm(idxm6),ym(idxm6),'b',xh6(:,6),xh6(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data','Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(20)
plot(uvc(idxc10),yc(idxc10),'r',uvm(idxm10),ym(idxm10),'b',xh10(:,6),xh10(:,1),'k-d')
t1=sgtitle('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(10^3/U_{ref}^2)*\overline{u^{\prime}v^{\prime{2}}}$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
```

```
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% Plot for k

figure(21)
plot(kc(idxc1),yc(idxc1),'r',km(idxm1),ym(idxm1),'b')
t1=sgtitle('$k/U_{ref}^2$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$k/U_{ref}^2$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(22)
plot(kc(idxc4),yc(idxc4),'r',km(idxm4),ym(idxm4),'b')
t1=sgtitle('$k/U_{ref}^2$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$k/U_{ref}^2$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(23)
plot(kc(idxc6),yc(idxc6),'r',km(idxm6),ym(idxm6),'b')
t1=sgtitle('$k/U_{ref}^2$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$k/U_{ref}^2$');
set(x2,'Interpreter','latex')
```

```
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(24)
plot(kc(idxc10),yc(idxc10),'r',km(idxm10),ym(idxm10),'b')
t1=sgtitle('$k/U_{ref}^2$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$k/U_{ref}^2$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


%% plots for e

figure(25)
plot(ec(idxc1),yc(idxc1),'r',em(idxm1),ym(idxm1),'b')
t1=sgtitle('$(H/U_{ref}^3)*\epsilon$: For Various Methods at x/H=1');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(H/U_{ref}^3)*\epsilon$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(26)
plot(ec(idxc4),yc(idxc4),'r',em(idxm4),ym(idxm4),'b')
t1=sgtitle('$(H/U_{ref}^3)*\epsilon$: For Various Methods at x/H=4');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
```

```
x2=xlabel('$(H/U_{ref}^3)*\epsilon$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

figure(27)
plot(ec(idxc6),yc(idxc6),'r',em(idxm6),ym(idxm6),'b')
t1=sgtitle('$(H/U_{ref}^3)*\epsilon$: For Various Methods at x/H=6');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(H/U_{ref}^3)*\epsilon$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)


figure(28)
plot(ec(idxc10),yc(idxc10),'r',em(idxm10),ym(idxm10),'b')
t1=sgtitle('$(H/U_{ref}^3)*\epsilon$: For Various Methods at x/H=10');
set(t1,'Interpreter','latex')
set(t1,'Fontsize',12)
x2=xlabel('$(H/U_{ref}^3)*\epsilon$');
set(x2,'Interpreter','latex')
set(x2,'Fontsize',12)
y2=ylabel('$y/H$');
set(y2,'Interpreter','latex')
set(y2,'Fontsize',12)
l2=legend('$k-\epsilon$ Model Using Fine Mesh (w/o wall function)','$k-\
    epsilon$ Model Using Enhanced Wall Function','Driver and Seegmiller Data',
    'Location','northwest');
set(l2,'Interpreter','latex')
set(l2,'Fontsize',9)

%% Saving figures

saveas(figure(1),'u1','jpg')
saveas(figure(2),'u4','jpg')
saveas(figure(3),'u6','jpg')
saveas(figure(4),'u10','jpg')
saveas(figure(5),'v1','jpg')
```

```
saveas(figure(6),'v4','jpg')
saveas(figure(7),'v6','jpg')
saveas(figure(8),'v10','jpg')
saveas(figure(9),'uu1','jpg')
saveas(figure(10),'uu4','jpg')
saveas(figure(11),'uu6','jpg')
saveas(figure(12),'uu10','jpg')
saveas(figure(13),'vv1','jpg')
saveas(figure(14),'vv4','jpg')
saveas(figure(15),'vv6','jpg')
saveas(figure(16),'vv10','jpg')
saveas(figure(17),'uv1','jpg')
saveas(figure(18),'uv4','jpg')
saveas(figure(19),'uv6','jpg')
saveas(figure(20),'uv10','jpg')
saveas(figure(21),'k1','jpg')
saveas(figure(22),'k4','jpg')
saveas(figure(23),'k6','jpg')
saveas(figure(24),'k10','jpg')
saveas(figure(25),'ep1','jpg')
saveas(figure(26),'ep4','jpg')
saveas(figure(27),'ep6','jpg')
saveas(figure(28),'ep10','jpg')
```

Code for the index function

```
%This file is saved as index.m and is called for the Sections 3 and 4 of the
    Project Assignment


function [idx1,idx4,idx6,idx10] = data(x,y)

%x/H=1
idx1=[];
c=1;
for i=1:length(x)
    if x(i)>0.9 && x(i)<1.1
        idx1(c,1)=i;
        c=c+1;
    end
end
idx1(y(idx1)>2.6)=nan;
idx1=rmmissing(idx1);


%x/H=4
idx4=[];
c=1;
for i=1:length(x)
    if x(i)>3.9 && x(i)<4.1
        idx4(c,1)=i;
        c=c+1;
    end
end
idx4(y(idx4)>2.6)=nan;
```

```
idx4=rmmissing(idx4);

%x/H=6
idx6=[];
c=1;
for i=1:length(x)
    if x(i)>5.9 && x(i)<6.1
        idx6(c,1)=i;
        c=c+1;
    end
end
idx6(y(idx6)>2.6)=nan;
idx6=rmmissing(idx6);


%x/H=10
idx10=[];
c=1;
for i=1:length(x)
    if x(i)>9.9 && x(i)<10.1
        idx10(c,1)=i;
        c=c+1;
    end
end
idx10(y(idx10)>2.6)=nan;
idx10=rmmissing(idx10);


end
```