Using Open Source Software to Prepare Students for Senior Design

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Abstract

This paper deals with the complication and use of engineering software during a student's capstone design course. Often, students are simply pointed to the computer and told to use engineering software to analyze their designs. As a result, some interesting and outlandish simulations are presented in support of their designs. As is often the case, there is very little benchmarking, verification or analytical/critical thinking of their simulations. This paper will describe one method that can be used to help remediate this problem.

Online Approach

In order to address this issue I created an online course for our Special Problems course. The course runs constantly and can be started by students at any time. The course is placed on a Moodle server and is available both during each semester and during breaks between semesters. Since the course is self study, I allow student to spend as much time completing the assignments as possible. Once they complete the all assignments in the course, they may register for the official course in order to receive credit. If, however, they spend time in the online course and find out for whatever reason they have no interest in the course, they may simply stop doing the assignments. They may also look through the material without any intention of completing the course. The course has written material, video material, tutorials and assignments. A snapshot of the course is shown below. All entries with a small brown box are SCORM (Shared Content Object Reference Model) items. These items are video tutorials create with the idea that students should follow along with the video. An example of one of these videos is shown in figure 2 below. Assignments are placed throughout the course as shown in figure 3. Once these are completed the student may upload his/her work by clicking the assignment, which sends them to an upload page, figure 4. Once these assignments are all submitted, the student will simply come by and inform the professor that all the assignments have been completed and everything is ready to be graded. All the assignments in this course are computer simulations, either computational fluids dynamics or computational solid mechanics simulations. This gives the professor the ability to have students perform a set of key simulations to make sure the student has a grasp of the importance of verification. An example of this verification is shown in figure 5. In this figure, students are required to simulate the drag of a sphere and adjust the grid to determine its effect of the drag coefficient.

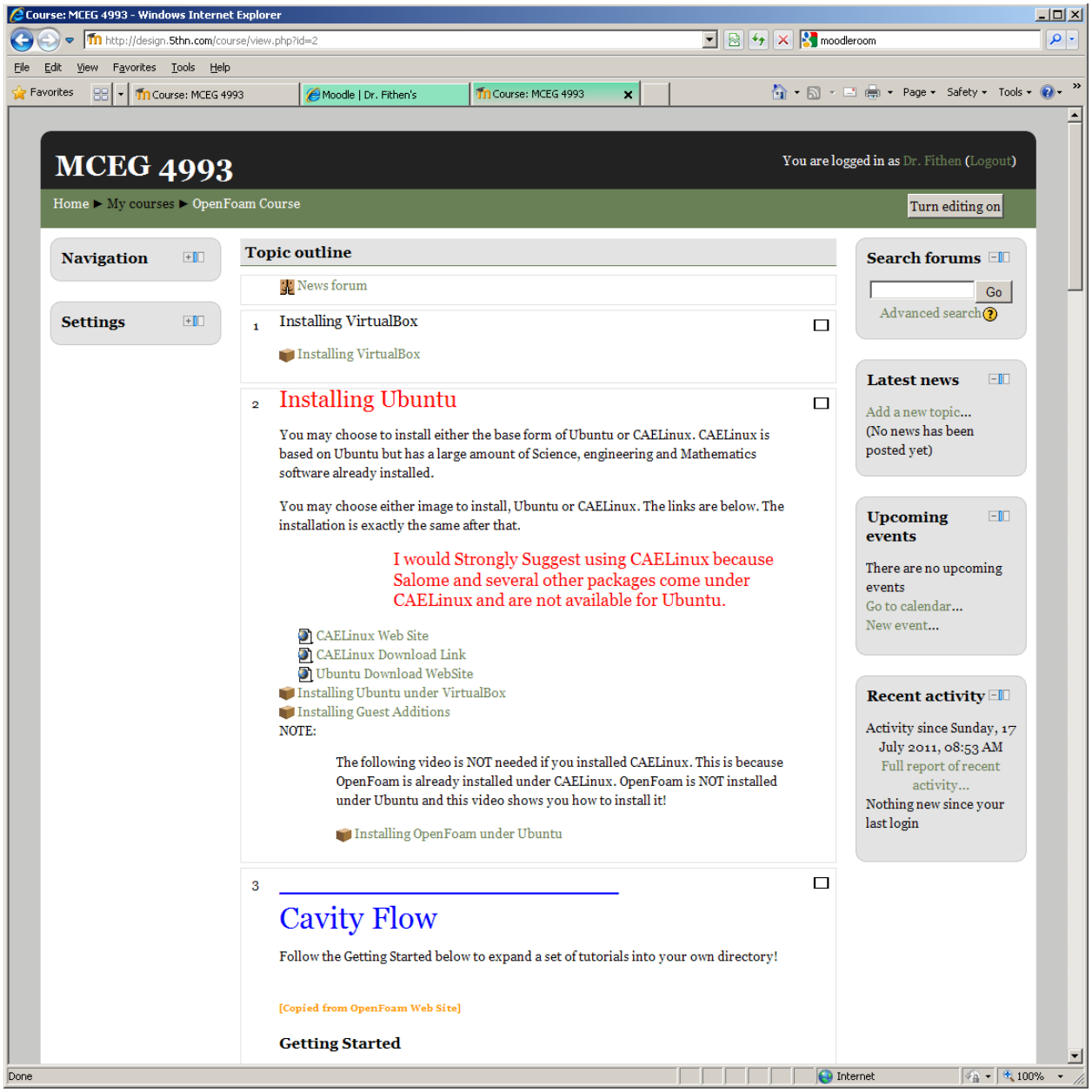
Course: MCEG 4993 - Windows Internet Explorer
MCEG 4993
You are logged in as Dr. Fithen (Logout)
Home ► My courses ► OpenFoam Course
Turn editing on
Navigation
Settings
Topic outline
News forum
1 Installing VirtualBox
Installing VirtualBox
2 Installing Ubuntu
You may choose to install either the base form of Ubuntu or CAELinux. CAELinux is based on Ubuntu but has a large amount of Science, engineering and Mathematics software already installed.
You may choose either image to install, Ubuntu or CAELinux. The links are below. The installation is exactly the same after that.
I would Strongly Suggest using CAELinux because Salome and several other packages come under CAELinux and are not available for Ubuntu.
CAELinux Web Site
CAELinux Download Link
Ubuntu Download WebSite
Installing Ubuntu under VirtualBox
Installing Guest Additions
NOTE:
The following video is NOT needed if you installed CAELinux. This is because OpenFoam is already installed under CAELinux. OpenFoam is NOT installed under Ubuntu and this video shows you how to install it!
Installing OpenFoam under Ubuntu
3
Cavity Flow
Follow the Getting Started below to expand a set of tutorials into your own directory!
[Copied from OpenFoam Web Site]
Getting Started
Search forums
Go
Advanced search
Latest news
Add a new topic...
(No news has been posted yet)
Upcoming events
There are no upcoming events
Go to calendar...
New event...
Recent activity
Activity since Sunday, 17 July 2011, 08:53 AM
Full report of recent activity...
Nothing new since your last login
Done
Internet
100%

Figure 1

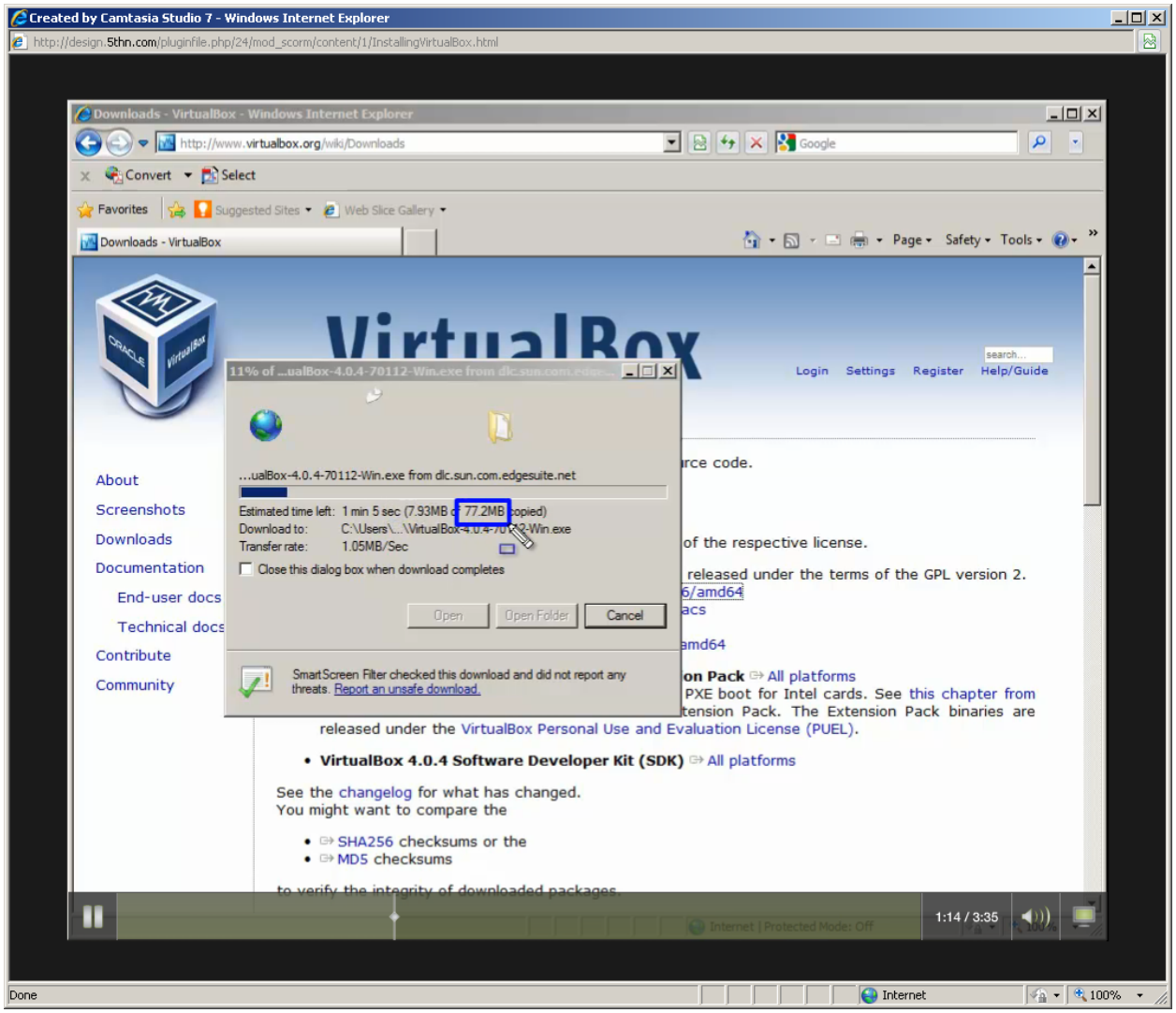
Created by Camtasia Studio 7 - Windows Internet Explorer
http://design.5thn.com/pluginfile.php/24/mod_scorm/content/1/InstallingVirtualBox.html
Downloads - VirtualBox - Windows Internet Explorer
http://www.virtualbox.org/wiki/Downloads
Convert
Select
Favorites
Suggested Sites
Web Slice Gallery
Downloads - VirtualBox
Page
Safety
Tools
VirtualBox
Login
Settings
Register
Help/Guide
About
Screenshots
Downloads
Documentation
End-user docs
Technical docs
Contribute
Community
...ualBox-4.0.4-70112-Win.exe from dlc.sun.com.edgesuite.net
Estimated time left: 1 min 5 sec (7.93MB of 77.2MB copied)
Download to: C:\Users\...\VirtualBox-4.0.4-70112-Win.exe
Transfer rate: 1.05MB/Sec
Close this dialog box when download completes
Open
Open Folder
Cancel
SmartScreen Filter checked this download and did not report any threats. Report an unsafe download.
of the respective license.
released under the terms of the GPL version 2.
released under the VirtualBox Personal Use and Evaluation License (PUEL).
VirtualBox 4.0.4 Software Developer Kit (SDK)
All platforms
See the changelog for what has changed.
You might want to compare the
SHA256 checksums or the
MD5 checksums
1:14 / 3:35
Done
Internet
100%

Figure 2

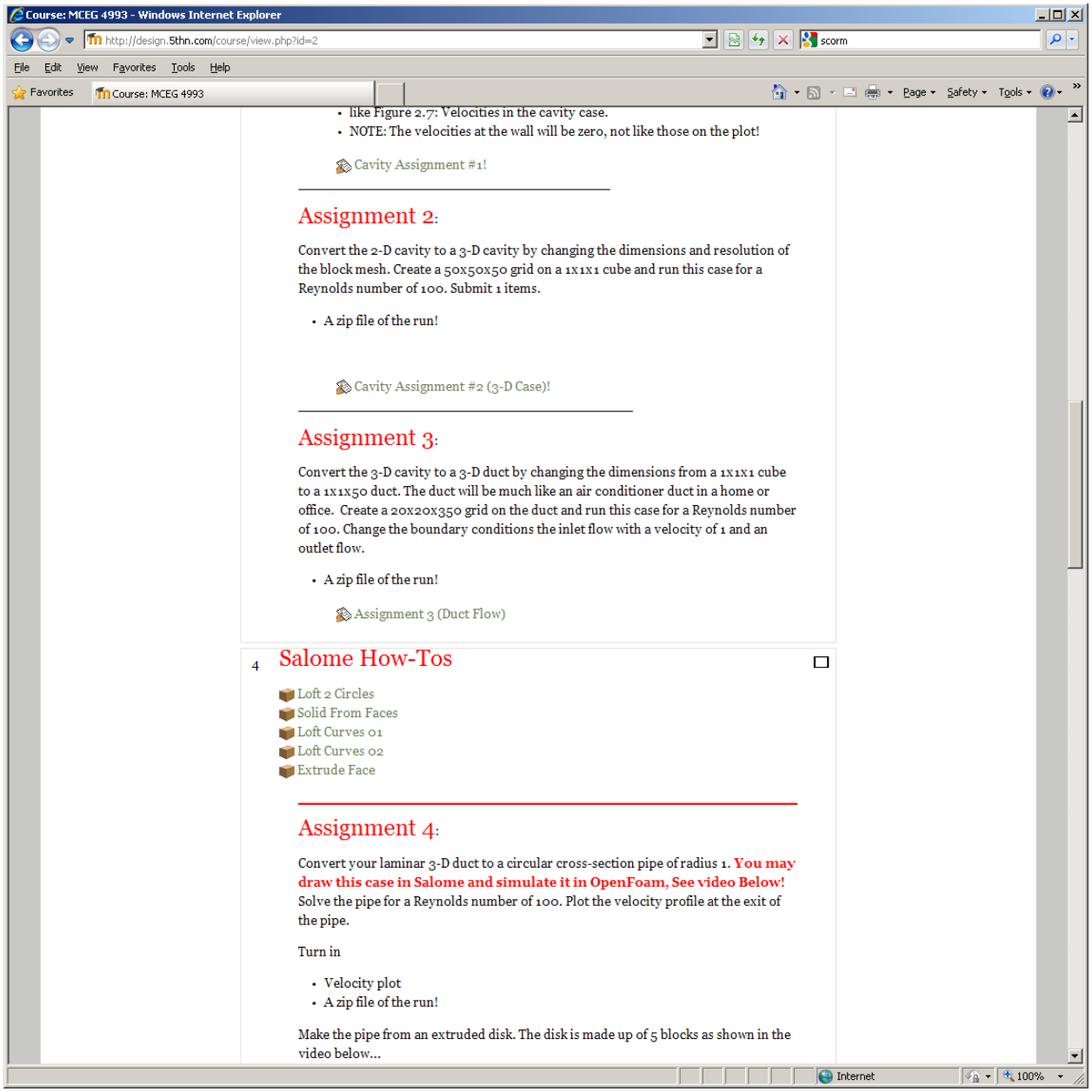
Course: MCEG 4993 - Windows Internet Explorer
http://design.5thn.com/course/view.php?id=2
File Edit View Favorites Tools Help
Favorites
Course: MCEG 4993
Page Safety Tools
like Figure 2.7: Velocities in the cavity case.
NOTE: The velocities at the wall will be zero, not like those on the plot!
Cavity Assignment #1!
Assignment 2:
Convert the 2-D cavity to a 3-D cavity by changing the dimensions and resolution of the block mesh. Create a 50x50x50 grid on a 1x1x1 cube and run this case for a Reynolds number of 100. Submit 1 items.
A zip file of the run!
Cavity Assignment #2 (3-D Case)!
Assignment 3:
Convert the 3-D cavity to a 3-D duct by changing the dimensions from a 1x1x1 cube to a 1x1x50 duct. The duct will be much like an air conditioner duct in a home or office. Create a 20x20x350 grid on the duct and run this case for a Reynolds number of 100. Change the boundary conditions the inlet flow with a velocity of 1 and an outlet flow.
A zip file of the run!
Assignment 3 (Duct Flow)
4
Salome How-Tos
Loft 2 Circles
Solid From Faces
Loft Curves 01
Loft Curves 02
Extrude Face
Assignment 4:
Convert your laminar 3-D duct to a circular cross-section pipe of radius 1. You may draw this case in Salome and simulate it in OpenFoam, See video Below! Solve the pipe for a Reynolds number of 100. Plot the velocity profile at the exit of the pipe.
Turn in
Velocity plot
A zip file of the run!
Make the pipe from an extruded disk. The disk is made up of 5 blocks as shown in the video below...
Internet
100%

Figure 3

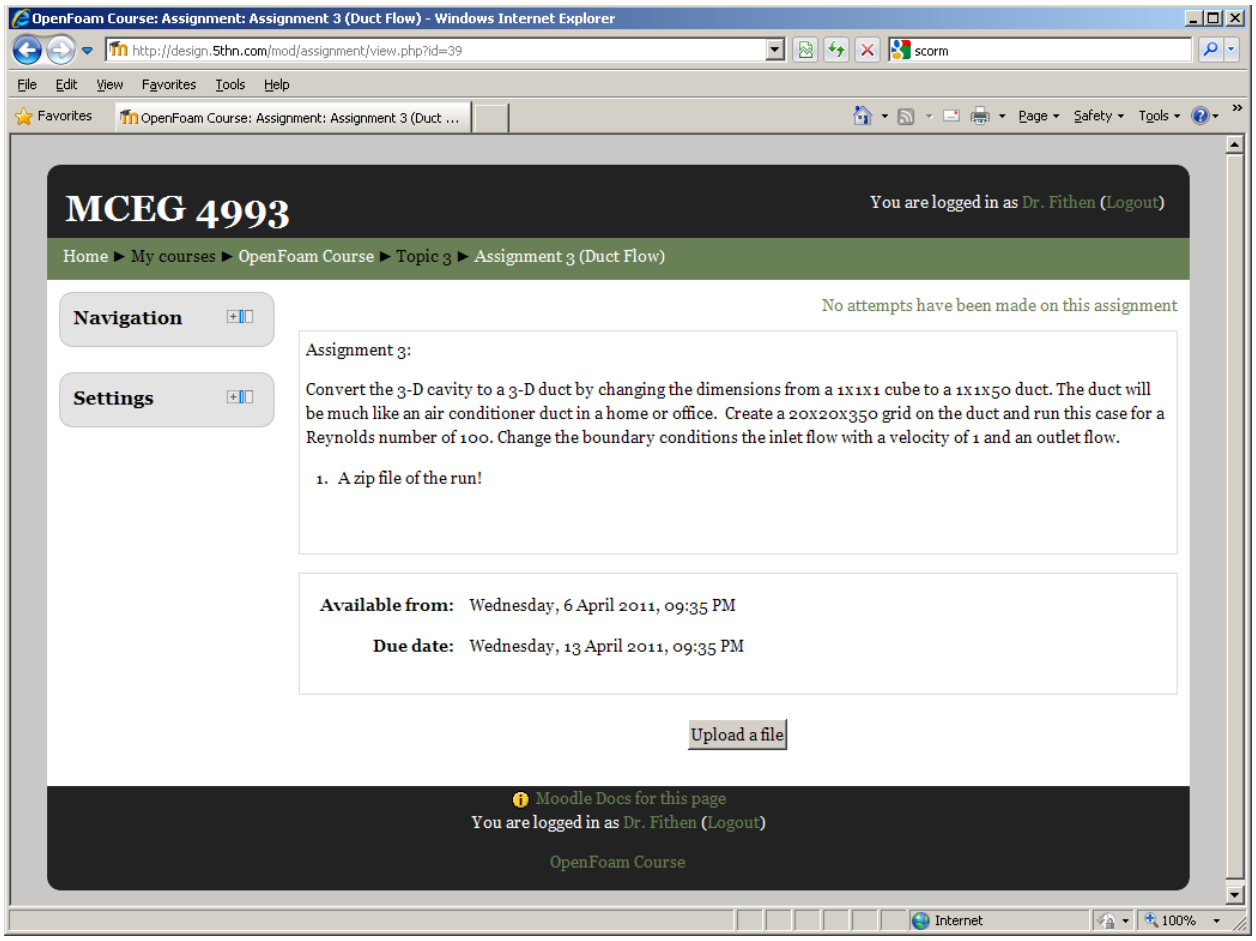
OpenFoam Course: Assignment: Assignment 3 (Duct Flow) - Windows Internet Explorer
http://design.5thn.com/mod/assignment/view.php?id=39
File Edit View Favorites Tools Help
Favorites
OpenFoam Course: Assignment: Assignment 3 (Duct ...
Page Safety Tools
MCEG 4993
You are logged in as Dr. Fithen (Logout)
Home ► My courses ► OpenFoam Course ► Topic 3 ► Assignment 3 (Duct Flow)
Navigation
Settings
No attempts have been made on this assignment
Assignment 3:
Convert the 3-D cavity to a 3-D duct by changing the dimensions from a 1x1x1 cube to a 1x1x50 duct. The duct will be much like an air conditioner duct in a home or office. Create a 20x20x350 grid on the duct and run this case for a Reynolds number of 100. Change the boundary conditions the inlet flow with a velocity of 1 and an outlet flow.
1. A zip file of the run!
Available from: Wednesday, 6 April 2011, 09:35 PM
Due date: Wednesday, 13 April 2011, 09:35 PM
Upload a file
Moodle Docs for this page
You are logged in as Dr. Fithen (Logout)
OpenFoam Course
Internet
100%

Figure 4

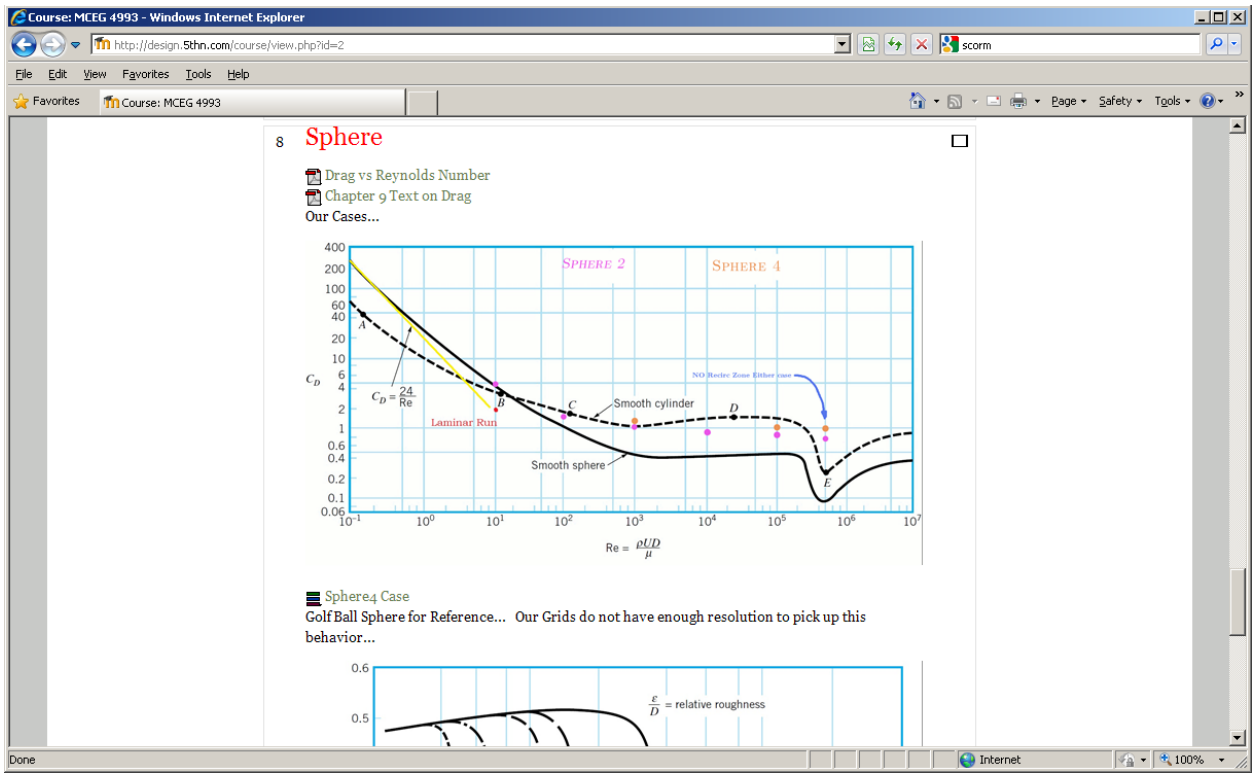

Figure 5

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