הטכניון – מכון טכנולוגי לישראל

NUMERICAL METHODS IN AEROSPACE ENGINEERING

HOMEWORK ASSIGNMENT x

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GRADE	OUT OF	CHAPTER
	2	ABSTRACT
	2	CONTENTS, STYLE &C.
	4	PHYSICAL PROBLEM
	4	MATHEMATICAL MODEL
	26	NUMERICAL METHODS
	20	INFLUENCE OF NUMERICAL METHODS
	20	RESULTS
	2	SUMMARY & CONCLUSIONS
	20	COMPUTER PROGRAM
	100	**TOTAL**

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Abstract

hii

Contents

List of Figures

Listings

Nomenclature

μ	viscosity of the fluid
c	pressure gradient on the flow in a section

1 The Physical Problem

An incompressible viscose Newtonian fluid flows in a channel.

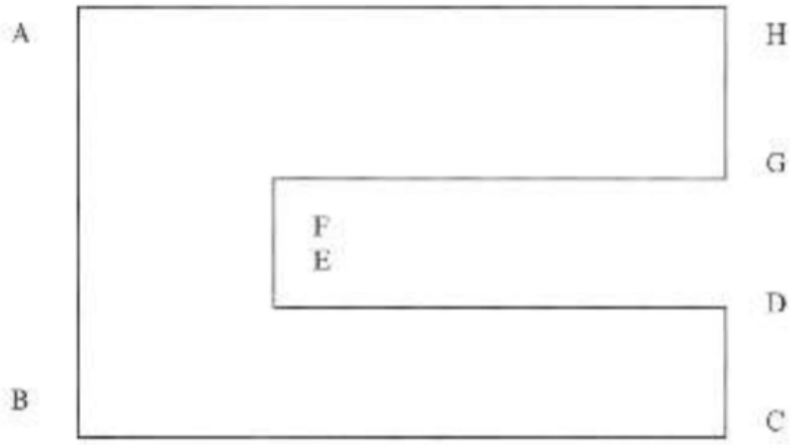

Figure 1: The Channel

Where:

- $AB = 12\,[in]$
- $BC = 12\,[in]$
- $CD = 2\,[in]$
- $DE = 6\,[in]$
- $EF = 6\,[in]$
- $FG = 6\,[in]$
- $GH = 4\,[in]$
- $HA = 12\,[in]$

2 The Mathematical Model

The steady-state velocity of the fluid is given by:

$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = -\frac{c}{\mu} \tag{1}$$

In our case:

- $c = 0.0002\,\left[\frac{lb}{in^3}\right]$
- $\mu = 0.25 \cdot 10^{-5}\,\left[\frac{lb \cdot sec}{in^2}\right]$

2.1 Boundary Conditions

Since the flow is viscose, the boundary conditions are no penetration and no slip. The flow is at steady state so the only direction of the flow is normal the sectional area (outside the paper). Hence the velocity at the boundaries is:

$$\psi|_{AB} = \psi|_{BC} = \psi|_{CD} = \psi|_{DE} = \psi|_{EF} = \psi|_{FG} = \psi|_{GH} = \psi|_{HA} = 0 \tag{2}$$

A Listing of The Computer Program

A.1 Parameters

A.2 Main Code