



הטכניון – מכון טכנולוגי לישראל

**NUMERICAL METHODS IN AEROSPACE
ENGINEERING**

HOMEWORK ASSIGNMENT x

סמסטר אביב תשפ"ה

SPRING SEMESTER 2025

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

Almog Dobrescu

ID 214254252

June 20, 2025

Contents

1	The Physical Problem	1
2	The Mathematical Model	1
2.1	Boundary Conditions	1
3	The Numerical Methods	2
3.1	Finite Differencing	2
3.2	Stability Analysis	2
3.3	Convergence Criteria	2
4	Influence of The Numerical Methods	2
4.1	Influence of Number of Elements N	2
4.2	Influence of Convergence Criteria ε	2
4.3	Influence of The Numerical Parameter R	2
5	Results and Discussion	2
6	Summary and Conclusion	2
A	Listing of The Computer Program	3
A.1	Parameters	3
A.2	Main Code	3

List of Figures

1	The Channel	1
---	-----------------------	---

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.

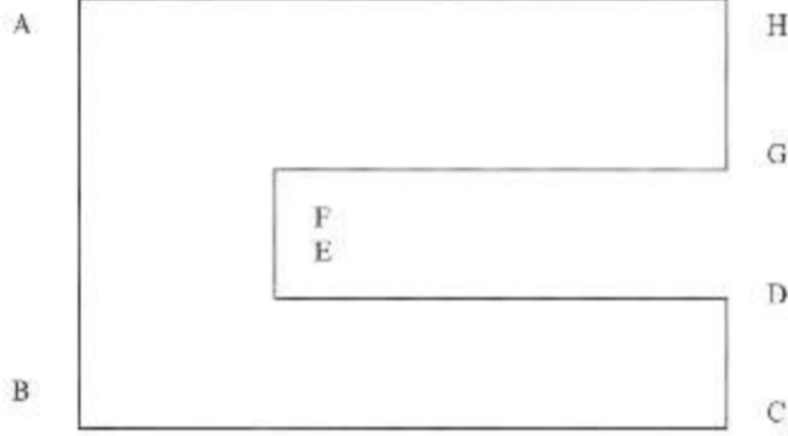


Figure 1: The Channel

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:

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

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:

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



3 The Numerical Methods

3.1 Finite Differencing

3.2 Stability Analysis

3.3 Convergence Criteria

4 Influence of The Numerical Methods

4.1 Influence of Number of Elements N

4.2 Influence of Convergence Criteria ε

4.3 Influence of The Numerical Parameter R

5 Results and Discussion

6 Summary and Conclusion



A Listing of The Computer Program

A.1 Parameters

A.2 Main Code