UNIVERSITY OF JOHANNESBURG

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| **PROGRAM** | : | NATIONAL DIPLOMA<br>*ENGINEERING : CIVIL* |
| **SUBJECT** | : | **WATER AND SEWERAGE RETICULATION 3A** |
| **CODE** | : | **CEW3A21** |
| **DATE** | : | SUMMER SSA EXAMINATION 2015<br>8 DECEMBER 2015 |
| **DURATION** | : | (SESSION 1) 08:00 - 11:00 |
| **WEIGHT** | : | 40 : 60 |
| **TOTAL MARKS** | : | 106 |
| **FULL MARKS** | : | 100 |

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| **EXAMINER** | : | MR LF SHIRLEY |
| **MODERATOR** | : | DR AM CASSA |
| **NUMBER OF PAGES** | : | 3 PAGES, 1 FORMULA SHEET AND 3 ANNEXURES |

2296

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**INSTRUCTIONS**

1. THIS IS A CLOSED BOOK EXAMINATION.
2. ANY TYPE OF POCKET CALCULATOR PERMITTED.
3. **QUESTION PAPER MUST BE HANDED IN.**

**REQUIREMENTS** : NONE

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## INSTRUCTIONS TO STUDENTS

PLEASE ANSWER ALL THE QUESTIONS.

## QUESTION 1

In a 300mm diameter pipe water flows with a velocity of 1,5m/s. At point A the pipe branches into a 250mm diameter pipe 100m long and a 150mm diameter pipe 150m long. The pipes join again at B. Both pipes have the same f value.

Using the d'Arcy-Weisbach formula, calculate the flow rate in each of these two parallel pipes.

**[12]**

## QUESTION 2

Calculate the steady rate at which water at 20°C (dynamic viscosity = 1 x $10^{-3}$ kg/m.s ) will flow through a commercial steel pipe 225 mm in diameter and 2,0km long under a head difference of 10 m. Make use of the d' Arcy-Weisbach formula and Moody diagram attached as Annexure 1. Make an informed assumption of f and then do one iteration to get a more accurate value of f.

**[15]**

## QUESTION 3

Water is pumped from a reservoir A to a reservoir B through a piping system which consists of one 610mm diameter pipe 450m long branching into two pipes of diameter 305mm and 457mm, each 600m long. The pumping station is situated adjacent to reservoir A and the surface level of reservoir B is 60m above that of A.

3.1 Determine the head on the pumps if water is to be transferred at a rate of $0,40 m^3/s$. (12)

3.2 Determine the flow in each of the parallel pipes. (8)

Take f = 0,005 for all the pipes.

**[20]**

## QUESTION 4

The depth of flow in a 250mm inside diameter sewer sloping at 1 in 500 is 125mm.

4.1 Calculate the discharge using Manning's formula taking n = 0,0150. (7)

4.2 Would you recommend the installation of this sewer at this slope? (3)

**[10]**

## QUESTION 5

The system curve of a pumping installation is given by:

$$H_{sys} = {}^{1}/_{16}\, Q^2 + 20$$

The H-Q curve of the pump is given by:

$$H_{H\text{-}Q} = -{}^{1}\!/_{4}\, Q^2 + 25$$

With H in m and Q in $m^3/s$.

5.1 Prepare neat free hand graphs of $H_{sys}$ and $H_{H\text{-}Q}$ on the same set of axis; (6)

5.2 Determine the pumping rate Q. (9)

**[15]**

## QUESTION 6

Annexure 2 shows part of the layout of a new residential development to a scale of 1 in 2000. A gravity sewer line will be laid along route A, A', B, C, D, E, F, G and H.

6.1 Furnish the listed information on Annexure 3 for the sewer running between **manholes A, A', B to C only.** Take n = 0,0120 in Manning's formula. Ignore the 50mm drop through manholes. (28)

6.2 Draw a long section of the natural ground level (NGL) and sewer along **manholes A, A', B to C only** on Annexure 3. (6)

**[34]**

**TOTAL = 106**

## Formulae

$$h_f = \frac{4fL}{d}\frac{v^2}{2g}$$

$$h_f = \frac{10{,}67LQ^{1{,}85}}{C_H^{\ 1{,}85} d^{4{,}87}}$$

$$v = \frac{1}{n} m^{\frac{2}{3}} i^{\frac{1}{2}}$$

$$h_f = \frac{fLQ^2}{3{,}03d^5}$$

$$H_{sys} = H_{stat} + H_f + H_v$$

$$Q = av$$

$$m = \frac{A}{P}$$

$$L_e = \frac{d_e^5}{f_e}\left(\frac{f_1 L_1}{d_1^5} + \frac{f_2 L_2}{d_2^5}\right)$$

$$\left(\frac{d_e^5}{f_e L_e}\right)^{.5} = \left(\frac{d_1^5}{f_1 L_1}\right)^{.5} + \left(\frac{d_2^5}{f_2 L_2}\right)^{.5}$$

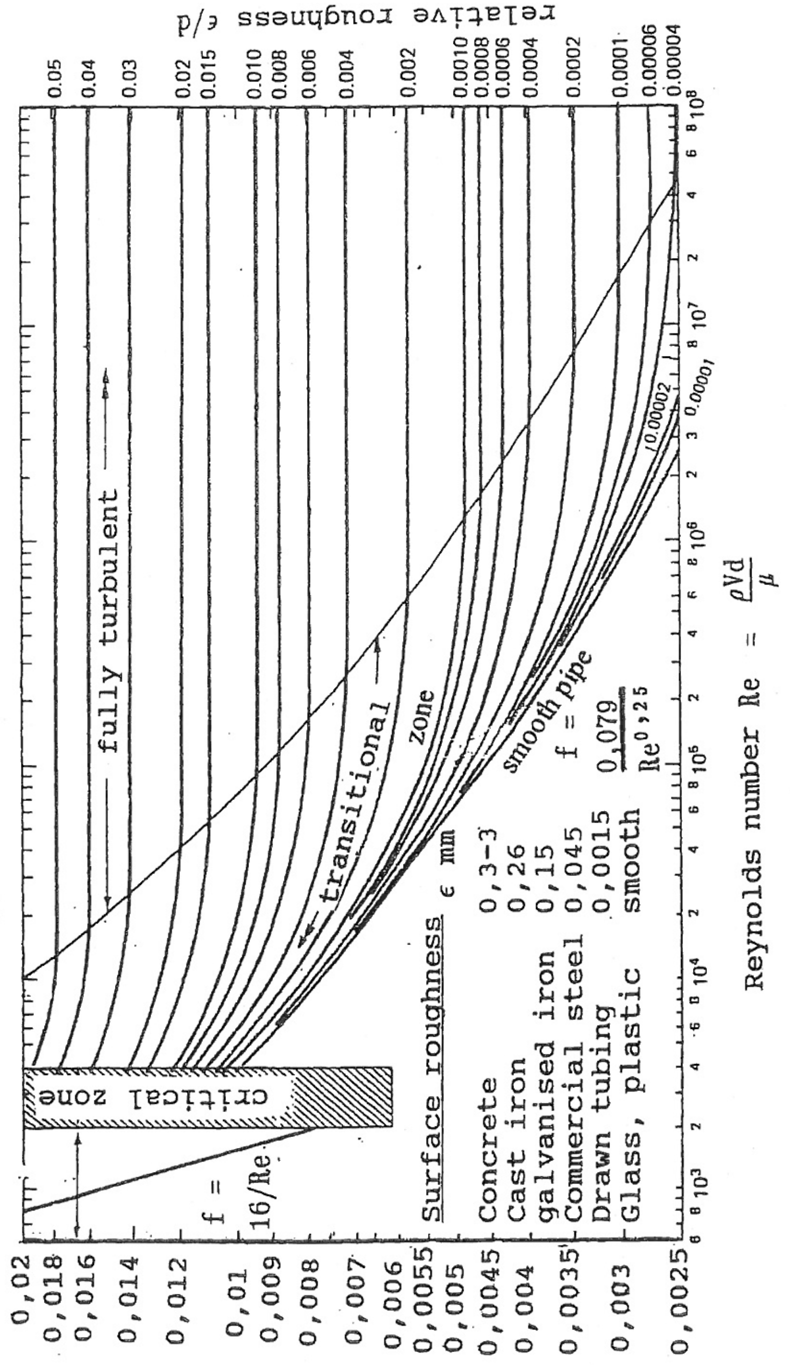
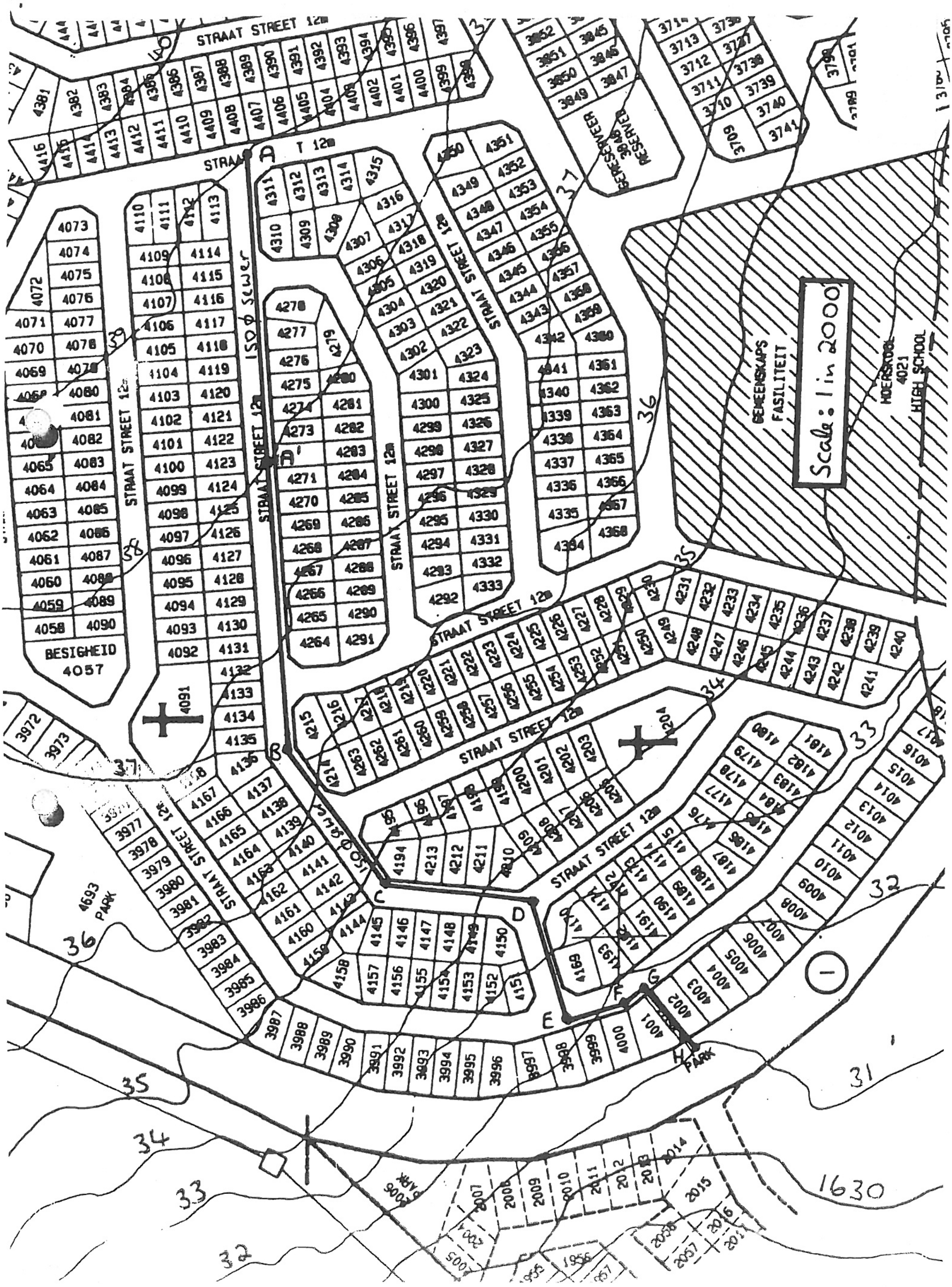



Figure 7.3 Moody-diagram


STRAAT STREET 12m
150 Ø Sewer
STRAAT STREET 12m
BESIGHEID
4057
GEMEENSKAPS
FASILITEIT
HOERSKOOL
4021
HIGH SCHOOL
Scale: 1 in 2000
GERESERVEER
3848
RESERVED
4693
PARK
PARK
1630

# Water & Sewerage Reticulation 3A CEW3A21

**Annexure 3**

Scale : Hor: 1 in 2000 ; Vert: 1 in 100

Elevation (m)

40

38

36

34

16 32

| | |
|---|---|
| Manhole | A |
| Chainage (m) | 00 |
| NGL (m) | 39,0 |
| Cover (m) | 1,40 |
| Pipe diameter (mm) | 150 |
| Invert level (m) | |
| Slope (1 in .....) | |
| Full bore velocity (m/s) | |
| 85% full bore capacity (l/s) | |