higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

FLUÏEDMEGANIKA N6

15 April 2021

Hierdie nasienriglyn bestaan uit 6 bladsye.

VRAAG 1

1.1   1.1.1 $h_{fT} = h_{f1} + h_{f2}$

$$= \frac{flQ^2}{3d^5} + \frac{flQ^2}{3d^5}$$

$$12,2 = \frac{0,006 \times 10 \times Q^2}{3(0,182)^5} + \frac{0,006 \times 8 \times Q^2}{3(0,102)^5} \checkmark$$

$$Q = 0,0887 \ m^3/s \checkmark$$

$$= 88,738 \ l/s \checkmark \tag{3}$$

1.1.2 $v_1 = \frac{Q}{A}$ $v_2 = \frac{Q}{A}$

$$= \frac{0,0887 \times 4}{\pi \times (0,182)^2} \checkmark \qquad\qquad\qquad\qquad\qquad =$$

$$\frac{0,0887 \times 4}{\pi \times (0,102)^2} \checkmark$$

$$= 3,411 \ m/s \checkmark \qquad\qquad\qquad\qquad\qquad =$$
$$10,86 \ m/s \checkmark \tag{4}$$

1.1.3 $h_T = h_x + h_y + h_z$

$$= \frac{0,5 \, v_1^2}{2g} + \frac{0,5 \, v_2^2}{2g} + \frac{(v_2 - v_1)^2}{2g} \ \checkmark$$

$$= \frac{0,5 \times 3,411^2}{2 \times 9,81} + \frac{0,5 \times 10,8597^2}{2 \times 9,81} + \frac{(10,8597 - 0)^2}{2 \times 9,81} \checkmark$$

$$= 9,16 \ m \checkmark \tag{3}$$

1.1.4 $m_1 = \frac{d_1}{4}$ $m_2 = \frac{d_2}{4}$

$$= \frac{0,182}{4} \ \checkmark \qquad\qquad\qquad\qquad\qquad = \frac{0,102}{4} \ \checkmark$$

$$= 0,0455 \ \checkmark \qquad\qquad\qquad\qquad\qquad = 0,0255 \ m \ \checkmark \tag{4}$$

1.1.5 $i_1 = \frac{h_{f1}}{L}$ $i_2 = \frac{h_{f2}}{L}$

$$i_1 = \frac{0,788}{10} \ \checkmark \qquad\qquad\qquad\qquad\qquad = \frac{11,411}{8} \ \checkmark$$

$$= 0,0788 \ \checkmark \qquad\qquad\qquad\qquad\qquad = 1,426 \ \checkmark \tag{4}$$

1.2 $h_{fp} = h_{fq}$

$$\left(\frac{flQ^2}{3d^5}\right)_p = \left(\frac{flQ^2}{3d^5}\right)_q$$

$$\frac{Q_p^2}{d^5} = \frac{Q_p^2}{(3d)^5} = \frac{Q_p^2}{243 d^5} \checkmark$$

$Q_q = 15,588 \, Q_P$ alternatiewelik $Q_P = 0,0642 Q_q$

$Q_T = Q_P + Q_q$ $Q_T = Q_P + Q_q$

$1,5 = 15,588 \, Q_P + Q_P$ ✓ $1,5 = 0,0642 Q_q + Q_q$ ✓

$Q_P = 0,0904 \ m^3/s$ ✓ $Q_q = 1,41 \ m^3/s$ ✓

$Q_q = 1,41 \ m^3/s$ ✓ $Q_P = 0,0904 \ m^3/s$ ✓   (4)

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VRAAG 2

2.1   2.1.1

$$V_A = \sqrt{\frac{gx^2}{2y}}$$

$$= \sqrt{\frac{9,81 \times 1,8^2}{2 \times 0,55}} \checkmark$$
$$= 5,375 \text{ m/s} \checkmark$$

Reaksie van die spuit = $\rho Q V_A$

$$= 10^3 \times \frac{0,13}{60} \checkmark \times 5,375 \checkmark$$

$$= 11,647 \text{ N} \checkmark \qquad (5)$$

2.1.2

$$A_A = \frac{Q_A}{V_A} \qquad\qquad\qquad A_{th} = \frac{\pi}{4}(0,035)^2 \checkmark$$

$$= \frac{0,00217}{5,375}\checkmark \qquad\qquad\qquad = 0,000962 \text{ m}^2 \checkmark$$

$$= 0,000403 \text{ m}^2 \checkmark$$

$$C_c = \frac{A_A}{A_{th}}$$

$$= \frac{0,000403}{0,000962} \checkmark$$
$$= 0,419 \checkmark \qquad (6)$$

2.2 $x = \frac{2}{\tan 26,67^0} = 3,981 \text{ m} \checkmark$ $\qquad\qquad$ r $= \frac{2}{\sin 26,67^0} = 4,456 \text{ m} \checkmark$

Perimeter = 2(4,456) + 4 $\qquad\qquad$ Oppervlakte = ½[4 + (4 + 7,963)] × 2$\checkmark$
$\qquad\qquad$ = 12,912 m $\checkmark$ $\qquad\qquad\qquad\qquad$ = 15,963 m² $\checkmark$

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

$= \frac{15,963}{12,912}$ $\qquad\qquad\qquad$ Oppervlakte = [(4 + 3,981) x 2]$\checkmark$

= 1,236 m$\checkmark$ $\qquad\qquad\qquad\qquad$ = 15,963 m²$\checkmark$

Q $= AC\sqrt{mi}$

$\qquad = 15,963 \times 55 \sqrt{1,236 \; x \; \frac{2}{3000}} \checkmark$

$\qquad = 25,207 \text{ m}^3\text{/s} \checkmark$

Die kanaal sal minder vrystelling kan hanteer was wat verwag word.$\checkmark$ $\qquad$ (9)

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VRAAG 3

3.1 $\text{Hat} = \frac{P}{\rho g}$ $\qquad\qquad$ $H_{sep} = \frac{P}{\rho g}$

$\qquad = \frac{101 \; x \; 10^3}{0,77 \; x \; 10^3 \; x \; 9,81}$ ✓ $\qquad\qquad = \frac{1,4 \; x \; 10^3}{0,77 \; x \; 10^3 \; x \; 9,81}$ ✓

$\qquad = 13,371$ m ✓ $\qquad\qquad\qquad = 0,185$ m ✓

$H_a = H_{at} - H_s - H_{sep}$ $\qquad\qquad$ $H_a = \frac{l}{g}\left(\frac{D}{d}\right)^2 \text{x } \omega^2 R$

$\qquad = 13,371 - 5 - 0,185$ ✓ $\qquad\quad 8,186 = \frac{9}{9,81}\left(\frac{0,08}{0,11}\right)^2 \times \omega^2 \times \frac{0,355}{2}$ ✓

$\qquad = 8,186$ m ✓ $\qquad\qquad\qquad \omega = 9,749$ rad/s ✓

$\qquad\qquad\qquad \omega = \frac{2\pi N}{60}$

$\qquad\qquad\qquad N = \frac{9,749 \; x \; 60}{2\pi}$ ✓

$\qquad\qquad\qquad\quad = 93,096$ rev/s ✓ $\qquad\qquad\qquad\qquad$ (10)

3.2 3.2.1 $Q = ALSE\frac{N}{60}$

$\qquad\qquad = \frac{\pi}{4}(0,13)^2 \times 0,28 \times 1 \times 1 \times \frac{39}{60}$ ✓

$\qquad\qquad = 0,00242$ m³/s ✓

$\qquad$ 3.2.2 $P = \rho g ASHN$

$\qquad\qquad = 10^3 \times 9,81 \times \frac{\pi}{4}(0,13)^2 \times 0,28 \text{ x } 25 \times \frac{39}{60}$ ✓

$\qquad\qquad = 592,457$ W ✓

$\qquad\qquad\quad$ Alternatiewelik

$\qquad P = \rho g Q H$

$\qquad\qquad = 10^3 \times 9,81 \times 0,00242 \times 25$ ✓

$\qquad\qquad = 592,457$ W ✓

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ (2 × 2) $\qquad$ (4)

3.3 $Q = \frac{3}{60} = 0,05$ m³/s ✓ $\qquad\qquad$ $V_{wo} = U_o - \text{x}$

$\text{Tan}\phi = \frac{V_{fo}}{x}$ $\qquad\qquad\qquad\qquad = 9 - 1,919$

$\qquad x = \frac{1,5}{\tan 38^0}$ ✓ $\qquad\qquad\qquad\quad = 7,08$ m/s ✓

$\qquad\quad = 1,919$ m/s ✓

$\qquad\qquad\qquad T = \rho Q V_{wo} R_{imp}$

$\qquad\qquad\qquad\quad = 10^3 \times 0,05 \times 7,08 \times \frac{1,2}{2}$ ✓

$\qquad\qquad\qquad\quad = 212,403$ Nm ✓ $\qquad\qquad\qquad\qquad$ (6)

3.4 $a = \frac{\pi}{4}(0,793)^2 = 0,494 \text{ m}^2$✓ $v = \frac{9,3}{0,494} = 18,83 \text{ m/s}$✓

$S = \square \times 0,793 \times L = 2,491L$✓

$$Pr = \frac{kS\,v^2}{a}$$

$$198,3 = \frac{0,00225 \times 2,491\,L \times (18,83)^2}{0,494}$$ ✓

$$L = 49,279 \text{ m}$$✓   (5)

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VRAAG 4

4.1   4.1.1 $V_i = 0,17\sqrt{2gH}$

                  $= 0,17\sqrt{2 \times 9,81 \times 14}$ ✓

                  $= 2,817$ m/s ✓   (2)

        4.1.2 $E = \frac{H \times \eta}{100}$ $E = \frac{U_i^2}{g}$ $\tan\theta_i = \frac{V_i}{U_i}$

                  $= \frac{14 \times 0,81}{100}$✓ $U_i = \sqrt{11,34 \times 9,81}$✓ $= \frac{2,817}{10,547}$✓

                  $= 11,34$ m✓ $= 10,547$ m/s✓ $\theta_i =$

                  14,956°✓   (6)

        4.1.3   Binnedeursnee = ½ Buitedeursnee

                  $U_o = \frac{1}{2}U_i$ $V_o = V_i$

                    $= \frac{1}{2}(10,547)$ ✓ $\tan\beta_O = \frac{V_O}{U_0}$

                    $= 5,274$ m/s ✓ $= \frac{2,817}{5,274}$ ✓

                                                          $\beta_O = 28,114°$✓   (4)

        4.1.4 $U_i = \frac{\pi\,D\,N}{60}$

                  $D = \frac{10,547 \times 60}{\pi \times 295}$✓ $d = \frac{1}{2}(682,842)$

                    $= 682,842$ mm✓ $= 341,421$ mm✓   (3)

        4.1.5 $Q = V_i$ x A

                  $A = \frac{0,4}{2,817}$ ✓

                  $= 0,142$ m² ✓

                  Maar A = $\square$DW

                  $W_i = \frac{0,142}{0,89 \times \pi \times 0,683}$ ✓ $W_o = \frac{0,142}{0,89 \times \pi \times 0,341}$ ✓

                    $= 73,533$ mm ✓ $= 147,067$ mm ✓   (6)

4.2   4.2.1 $U = \frac{\pi DN}{60}$ $H = \frac{P}{\rho g}$ $V = 0{,}98\sqrt{2gH}$

$= \frac{\pi \, x \, 0{,}95 \, x \, 300}{60}$ ✓ $= \frac{700}{9{,}81}$ ✓ $=$

$0{,}98\sqrt{2 \, x \, 9{,}81 \, x \, 71{,}356}$ ✓

= 14,923 m/s ✓   = 71,356 m ✓   = 36,668 m/s ✓

Q = V x A

$= 36{,}668 \times \frac{\pi}{4} (0{,},075)^2$ ✓

= 0,162 m³/s ✓

P = ρQU (V − U)(1 + nCosy)

= $10^3 \times 0{,}162 \times 14{,}923(36{,}668 - 14{,}923)(1 + 0{,}86\text{Cos}(180^0 - 160^0)$✓

=95,05 kW✓   (10)

4.2.2   η = $\frac{U}{gH}$(V − U)(1 + nCosy) × 100%

=$\frac{14{,}923}{9{,}81 \, x \, 71{,}356}$ (36,668 - 14,923)(1 + 0,86Cos(180° - 160°) × 100%✓

=83,820%✓   (2)
                                                                          [33]

                                                          TOTAAL: 100