

$$\begin{aligned}
 2. \quad \left. \begin{aligned} \Delta_{M1-A} &= 1.457 - 1.785 = -0.328 \\ \Delta_{A-B} &= 1.932 - 1.321 = 0.611 \\ \Delta_{B-C} &= 1.508 - 1.513 = -0.005 \\ \Delta_{C-M2} &= 0.065 - 2.880 = -2.815 \end{aligned} \right\} \Sigma \Delta = -2.537 \text{ m}
 \end{aligned}$$

$$e_a = H_A - H_B + \Sigma \Delta = \underbrace{99.877 - 97.346}_{2.531} - 2.537 = -0.006 \text{ m}$$

$$\left. \begin{aligned} M_1-A &= 22.5 + 22.6 = 45.1 \text{ m} \\ A-B &= 25.4 + 25.3 = 50.7 \text{ m} \\ B-C &= 30.2 + 30.5 = 60.7 \text{ m} \\ C-M_2 &= 23.7 + 23.7 = 47.4 \text{ m} \end{aligned} \right\} L = 45.1 + 50.7 + 60.7 + 47.4 = 203.9 \text{ m}$$

$$t_a = 20 \sqrt{L_{\text{km}}} = 20 \sqrt{0.2039} \approx 9.1 \text{ mm}$$

$$|e_a| = 6 \text{ mm} < t_a \approx 9 \text{ mm} \quad \checkmark, \text{ acutan ok., ajuslan obs.}$$

$$\bar{\Delta}_{M1-A} = \Delta_{M1-A} - e_a \frac{45.1}{203.9} = -0.328 - (-0.006) \frac{45.1}{203.9} = -0.3267 \text{ m}$$

$$\bar{\Delta}_{A-B} = \Delta_{A-B} - e_a \frac{50.7}{203.9} = 0.611 - (-0.006) \frac{50.7}{203.9} = 0.6125 \text{ m}$$

$$\bar{\Delta}_{B-C} = \Delta_{B-C} - e_a \frac{60.7}{203.9} = -0.005 - (-0.006) \frac{60.7}{203.9} = -0.0032 \text{ m}$$

$$\bar{\Delta}_{C-M2} = \Delta_{C-M2} - e_a \frac{47.4}{203.9} = -2.815 - (-0.006) \frac{47.4}{203.9} = -2.8136 \text{ m}$$

$$\Sigma \bar{\Delta} = 2.5310 \text{ m}$$

$$H_A = H_{M1} + \bar{\Delta}_{M1-A} = 99.877 - 0.3267 = 99.5503 = \underline{99.550 \text{ m}}$$

$$H_B = H_A + \bar{\Delta}_{A-B} = 99.5503 + 0.6125 = 100.1628 = \underline{100.163 \text{ m}}$$

$$H_C = H_B + \bar{\Delta}_{B-C} = 100.1628 - 0.0032 = 100.1596 = \underline{100.160 \text{ m}}$$

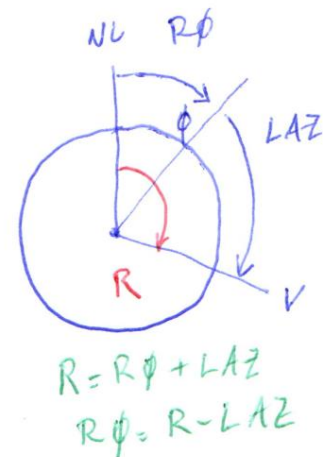
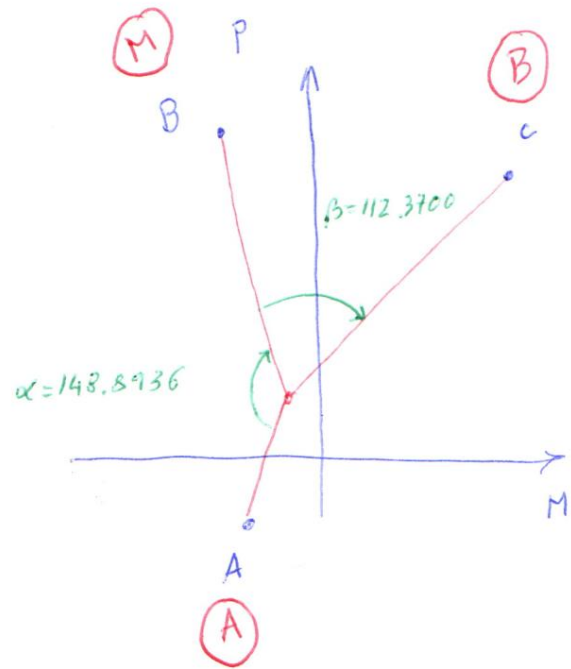
$$(H_{M2} = H_C + \bar{\Delta}_{C-M2} = 100.1596 - 2.8136 = 97.346 \text{ m})$$

3.

```

> # a) interseccao inversa
> MA:=-1892.347;
MA := -1892.347
> PA:=-3109.654;
PA := -3109.654
> MB:=-2238.727;
MB := -2238.727
> PB:=3123.593;
PB := 3123.593
> MC:=4342.500;
MC := 4342.500
> PC:=2231.474;
PC := 2231.474
> alfa:=148.8936*evalf(Pi)/200;
alfa := 2.338815200
> beta:=112.3700*evalf(Pi)/200;
β := 1.765103833
>
> TM:=( (PC-PA)+(MB-MA)*cot(alfa)+(MB-MC)*cot(beta))/( (MA-MC)+(PB-P
A)*cot(alfa)+(PB-PC)*cot(beta));
TM := -0.5607736301
> TA:=(TM-tan(alfa))/(1+TM*tan(alfa));
TA := 0.3002655355
> TB:=(TM+tan(beta))/(1-TM*tan(beta));
TB := 3.050565965
> # coordenadas do ponto D por interseccao inversa
> PD_inv:=(MB-MA-PB*TM+PA*TA)/(TA-TM);
PD_inv := 547.6251039
> MD_inv:=MA-(PA-PD_inv)*TA;
MD_inv := -794.192131
> # b) R0 em D
> R_DA:=arctan((MA-MD_inv)/(PA-PD_inv));
R_DA := 0.2917003873
> if (PA<PD_inv) then R_DA:=R_DA+evalf(Pi) end if;
R_DA := 3.433293041
> if (PA>PD_inv and MA<MD_inv) then R_DA:=R_DA+2*evalf(Pi) end if;
> R0A:=R_DA-112.5467*evalf(Pi)/200;
R0A := 1.665413611
> if R0A<0 then R0A:=R0A+2*evalf(Pi) end if;
> R_DB:=arctan((MB-MD_inv)/(PB-PD_inv));
R_DB := -0.5110770669
> if (PB<PD_inv) then R_DB:=R_DB+evalf(Pi) end if;
> if (PB>PD_inv and MB<MD_inv) then R_DB:=R_DB+2*evalf(Pi) end if;

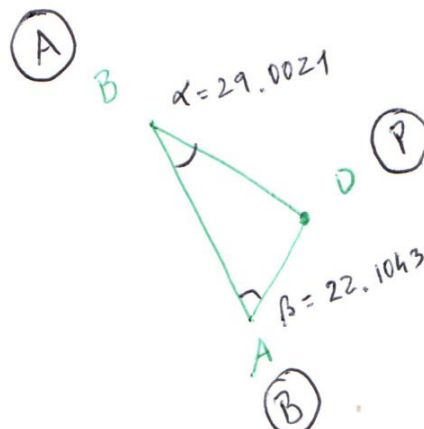
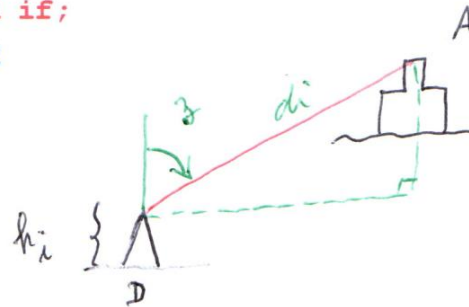
```



```

[ > R_DB:=R_DB-261.4403*evalf(Pi)/200;
    R_DB:=5.772108241
[ > R0B:=R_DB-261.4403*evalf(Pi)/200;
    R0B:=1.665413611
[ > if R0B<0 then R0B:=R0B+2*evalf(Pi) end if;
[ > R_DC:=arctan((MC-MD_inv)/(PC-PD_inv));
    R_DC:=1.254026766
[ > if (PC<PD_inv) then R_DC:=R_DC+evalf(Pi) end if;
[ > if (PC>PD_inv and MC<MD_inv) then R_DC:=R_DC+2*evalf(Pi) end if;
[ > R0C:=R_DC-373.8103*evalf(Pi)/200;
    R0C:=-4.617771696
[ > if R0C<0 then R0C:=R0C+2*evalf(Pi) end if;
    R0C:=1.665413612
[ > R0:=(R0A+R0B+R0C)/3*200/evalf(Pi);
    R0:=106.0235234
[ > # c)
[ > HA:=387.022;
    HA:=387.022
[ > z_DA:=101.2255*evalf(Pi)/200;
    z_DA:=1.590046436
[ > hi_D:=1.670;
    hi_D:=1.670
[ > dist_DA:=sqrt((MD_inv-MA)^2+(PD_inv-PA)^2);
    dist_DA:=3818.590651
[ > H_D:=HA-hi_D-dist_DA*cos(z_DA);
[ >
    H_D:=458.8557472
[ > # d) interseccao directa
[ > alfa1:=29.0021*evalf(Pi)/200;
    alfa1:=.4555639216
[ > beta1:=22.1046*evalf(Pi)/200;
    beta1:=.3472182449
[ > MP_dir:=(MB*cot(beta1)+MA*cot(alfa1)-(PA-PB))/(cot(beta1)+cot(alfa1));
    MP_dir:=-794.1792077
[ > PP_dir:=(PB*cot(beta1)+PA*cot(alfa1)+(MA-MB))/(cot(beta1)+cot(alfa1));
    PP_dir:=547.5991250
[ >

```



I) estação 1 (A)

↳ $RAB - LAZB$

$$\text{atau } \frac{-3875.39 + 3642.32}{7188.68 - 7282.08} = 236.3280$$

$$\begin{array}{r} \text{atom} \quad - 233.07 \\ \hline \quad \quad - 93.40 \\ \hline \quad \quad - 236.3280 \end{array}$$

75.7357 - 236.3280

239, 4077

$$RFA = 16.2695$$

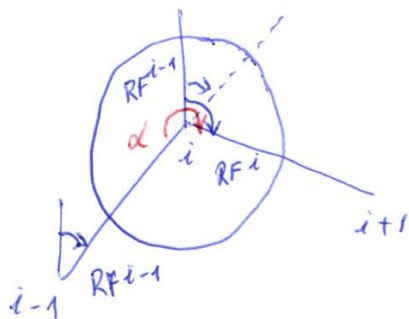
II) etapa i , $1 \leq i \leq m = 4$ (c e D)

$$\rightarrow LAZ^{i+1} - LAZ^{i-1}$$

$$RF^i = RF^{i-1} - 200 + \alpha$$

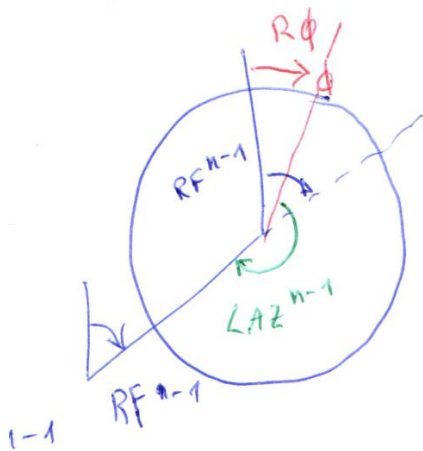
$$RF^C = RFA - 200 + (181.3486 - 314.1802) = 83.4379$$

$$RF^D = RF^C - 200 + (397.2090 - 112.9323) = 167.7146$$



III) estação n (B)

$$R\phi + LAZ^{n-1} - 200 - RF^{n-1} = ef = \underline{\underline{-0.0022}}$$



RBA-LAZA

$$275.7357 - 57.2969$$

218.4388

