MEMORIAL DE CÁLCULO DE FÍSICA ESTÁTICA E CIRCUITOS ELÉTRICOS DO PROJETO INTEGRADO DA PONTE DE MARCARRÃO

Curso de Engenharia Civil – EAD

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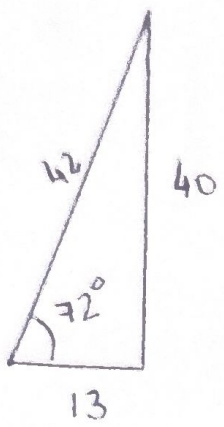
① TIPO DE ESTRUTURA

$2 \cdot n = B + R$

$2 \cdot 16 = 29 + 3$

$32 = 32$

② CÁLCULO DO ÂNGULO



$tg \frac{40}{13} = 3.076$

$tg^{-1} = 3.076 = 72°$

$\cos 72° = 0,309$

$\text{sen } 72° = 0,951$

③ CÁLCULO DAS REAÇÕES DE APOIO

$\Sigma F_X = 0$

$+ HA = 0$

$\Sigma F_Y = VA - 200 + VQ = 0$

$\Sigma F_Y = VA + VQ = 200$

$VA + 100 = 200$

$VA = 200 - 100$

$\boxed{VA = 100}$

FORÇA DE MOMENTO

$+\circlearrowleft \Sigma M_A = -200 \times 52 + VR \times 104 = 0$

$-10400 + 104 \cdot VR = 0$

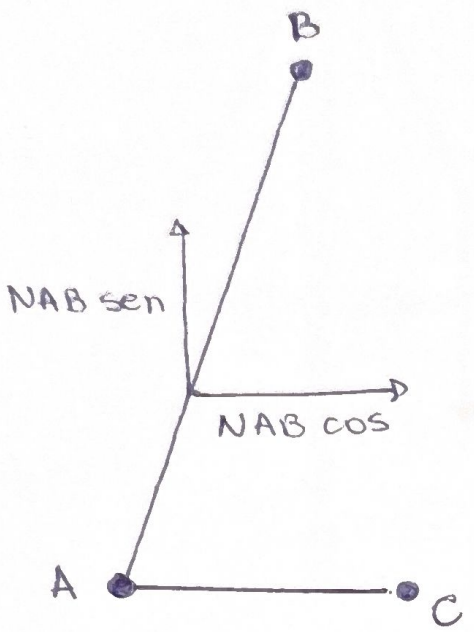
$104\, VR = 10.400$

$VR = \frac{10.400}{104}$

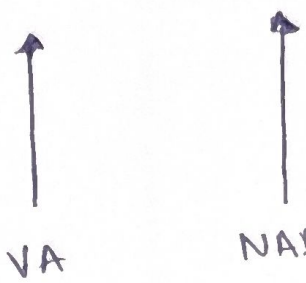
$\boxed{VR = 100\ N}$

④ CÁLCULO DOS NÓS

NÓ (A)



FORÇAS VERTICAIS



$$VA + NAB \times sen72° = 0$$

$$100 + NAB \times 0{,}95 = 0$$

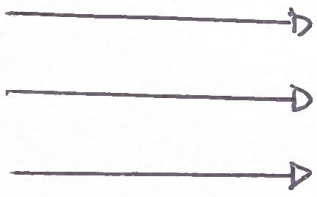
$$0{,}95\,NAB = -100$$

$$NAB = \frac{-100}{0{,}95}$$

$$\boxed{NAB = -105.26}$$

COMPRESSÃO

FORÇAS HORIZONTAIS



$$HA + NAB \cos 72° + NAC = 0$$

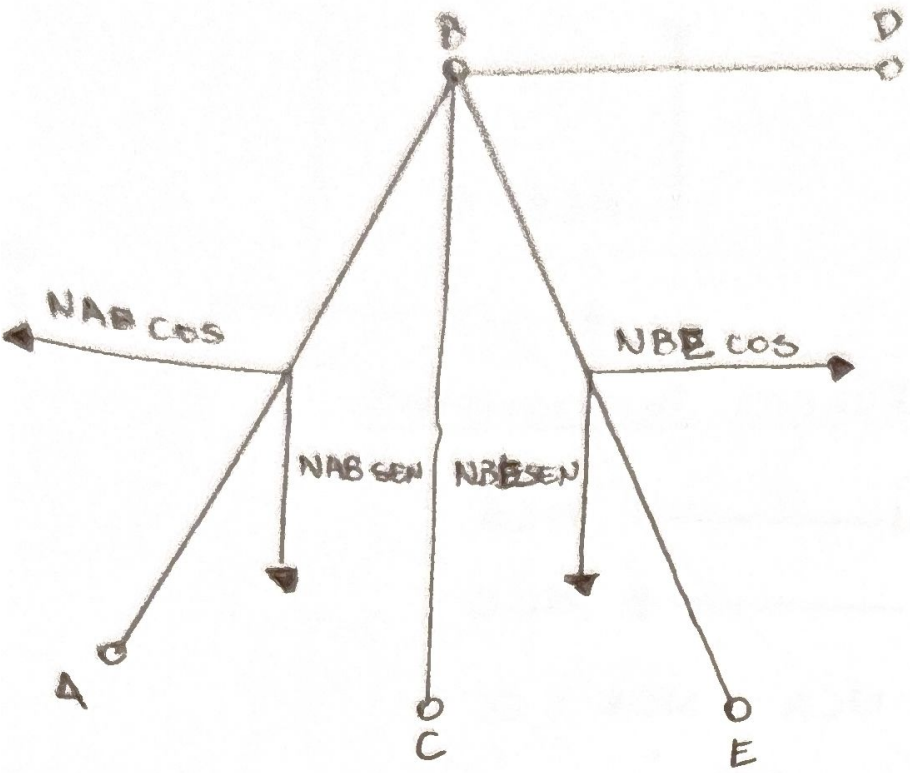
$$0 + (-105.26 \times 0{,}31) + NAC = 0$$

$$-32.63 + NAC = 0$$

$$\boxed{NAC = 32.63}$$

TRAÇÃO

NÓ (B)



FORÇAS HORIZONTAIS

NAB COS

NBE COS

NBD

$-NAB \times \cos 72° + NBE \cos 72° + NBD = 0$

$-(-105,26 \times 0,31) + (-105,26 \times 0,31) + NBD = 0$

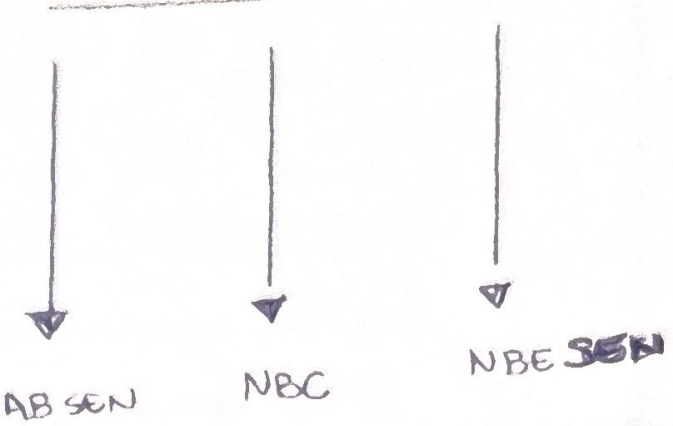
$+ 32,63 + 32,63 + NBD = 0$

$65,26 + NBD = 0$

$\boxed{NBD = -65,26}$

COMPRESSÃO

FORÇAS VERTICAIS



$-NAB \times SEN 72° - NBC - NBE \, sen 72° = 0$

$-(-105,26 \times 0,95) - NBC - NBE \times 0,95 = 0$

$99,99 - 0 - NBE \times 0,95 = 0$

$-NBE \times 0,95 = -99,99$

$-NBE = \frac{-99,99}{0,95}$

$-NBE = -105,26 \ (\times -1)$

$\boxed{NBE = 105,26}$

TRAÇÃO

$-NAB \, SEN \, 72° - NBC - NBE \, sen \, 72° = 0$

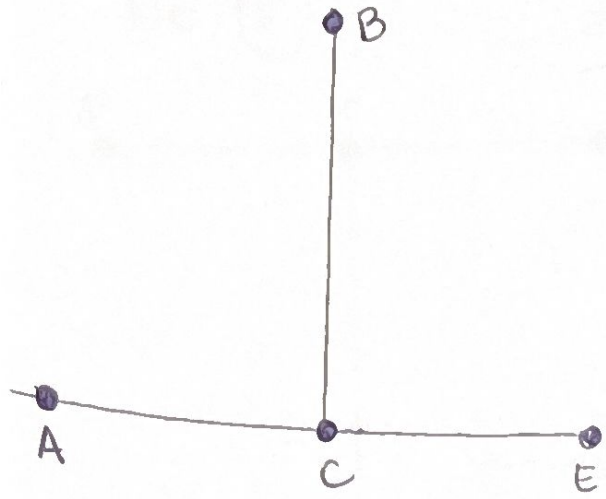
$-(-105,26 \times 0,95) - NBC - (105,26 \times 0,95) =$

$+ 99,99 - NBC - 99,99 = 0$

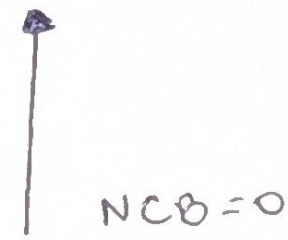
$-NBC = 0$

$\boxed{NBC = 0}$

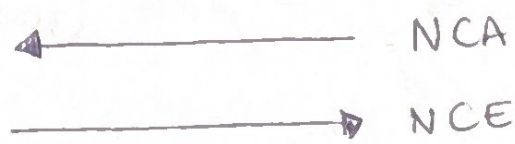
NÓ (C)



FORÇAS VERTICAIS



FORÇAS HORIZONTAIS

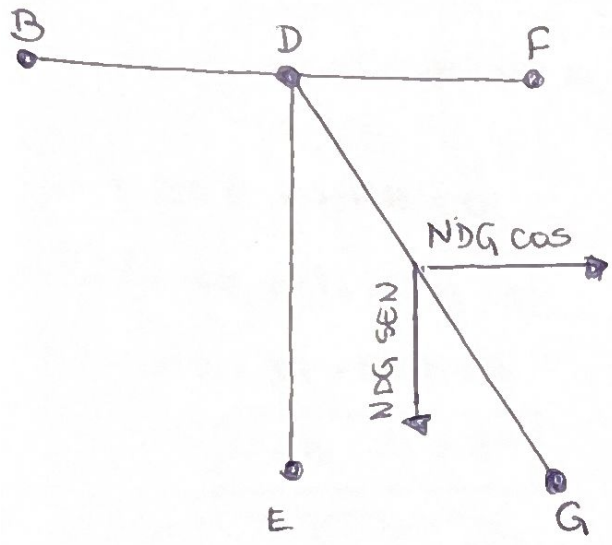


$-NCA + NCE = 0$

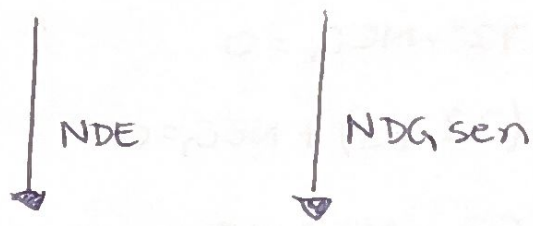
$-(32.63) + NCE = 0$

$\boxed{NCE = 32.63}$ TRAÇÃO

NÓ (D)



FORÇAS VERTICAIS



$-NDE - NDG \times \text{sen } 72° = 0$

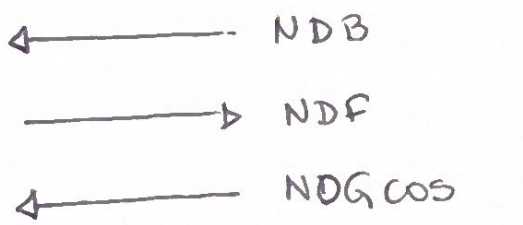
$-NDE - (105.26 \times 0,95) = 0$

$-NDE - 99.99 = 0$

$-NDE = 99.99 \quad (\times -1)$

$\boxed{NDE = -99.99}$ COMPRESSÃO

FORÇAS HORIZONTAIS



$-NDB + NDF + NDG \cos 72° = 0$

$-(-65.26) + NDF + (105.26 \times 0,31) = 0$

$+65.26 + NDF + 32.63 = 0$

$\boxed{NDF = -97.89}$

COMPRESSÃO

$-NDB + NDF + NDG \times \cos 72° = 0$

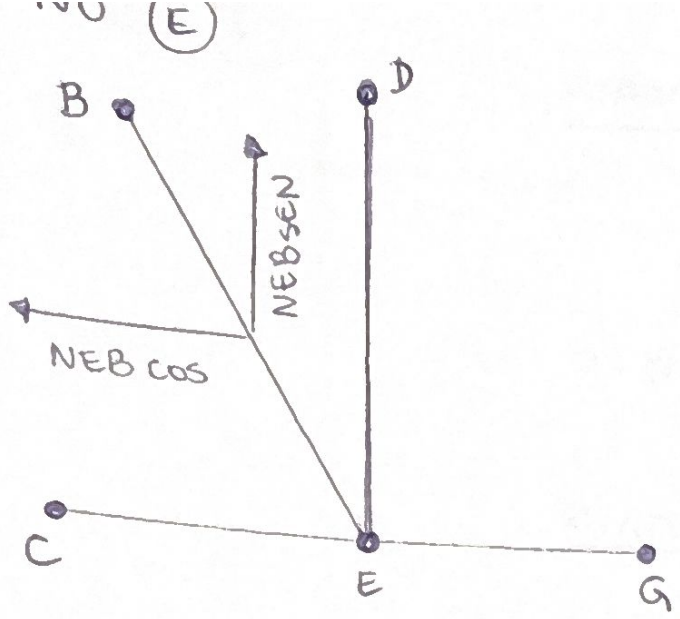
$-(-65,26) + (-97.89) + NDG \times 0,31 = 0$

$+65,26 - 97.89 + NDG \times 0,31 = 0$

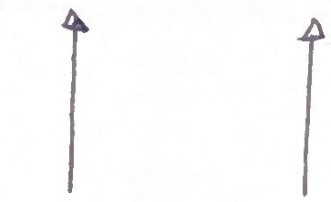
$-32.63 + NDG \times 0,31$

$NDG = \frac{32.63}{0,31}$

$\boxed{NDG = 105,26}$ TRAÇÃO



FORÇAS VERTICAIS



$NEB \times \operatorname{sen} 72° + NED = 0$

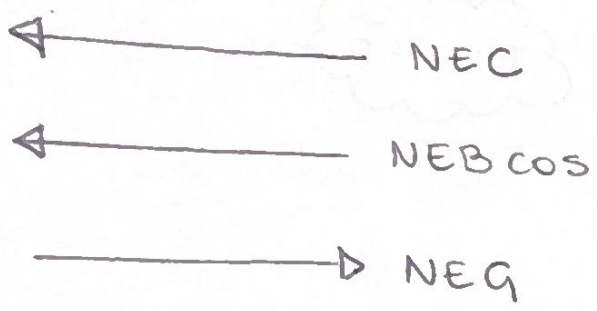
$(105.26 \times 0{,}95) + NED = 0$

$99.99 + NED = 0$

$\boxed{NED = -99.99}$

COMPRESSÃO

FORÇAS HORIZONTAIS



$-NEC - NEB \times \cos 72° + NEG = 0$

$-(105.26 \times 0{,}31) - (32.63) + NEG = 0$

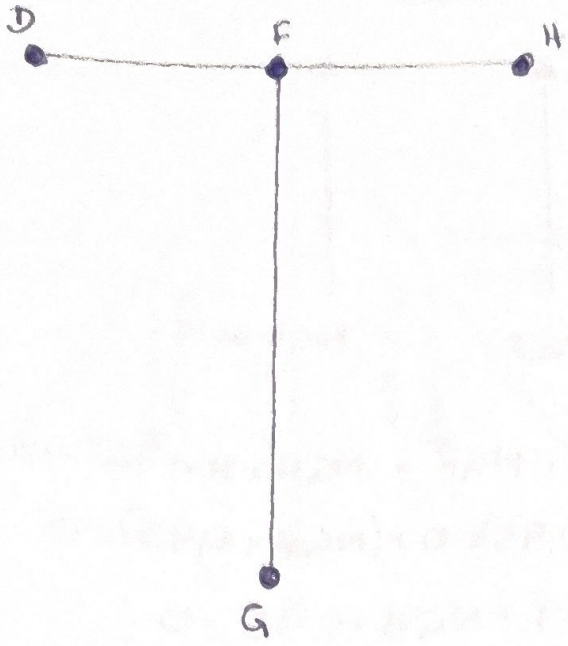
$-32.63 - 32.63 + NEG = 0$

$-65.26 + NEG = 0$

$\boxed{NEG = 65.26}$

TRAÇÃO

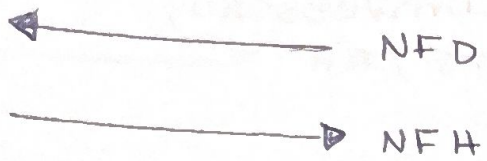
No' (F)



FORÇAS VERTICAIS

NFG = 0

FORÇAS HORIZONTAIS



- NFD + NFH = 0

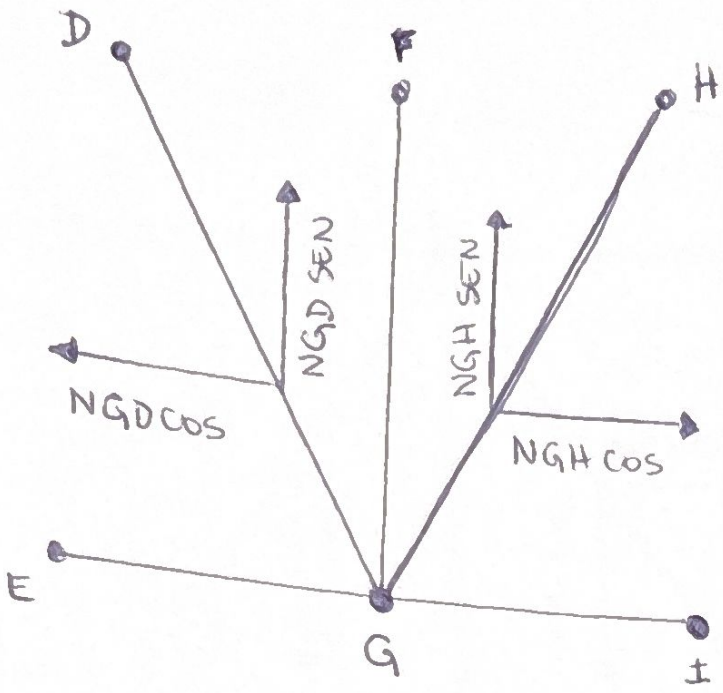
- (- 97,89) + NFH = 0

+ 97.89 + NFH = 0

NFH = -97.89

COMPRESSÃO

NÓ (G)



FORÇAS HORIZONTAIS

NGD COS

NGH COS

NGE

NGI

$-NGD \times \cos 72^\circ + NGH \times \cos 72^\circ + NGE + NGI = 0$

$-NGD \times 0{,}31 + (-105.26 \times 0{,}31) - (65.26) + NGI = 0$

$-105.26 \times 0{,}31 - 105.26 \times 0{,}31 - 65{,}26 + NGI = 0$

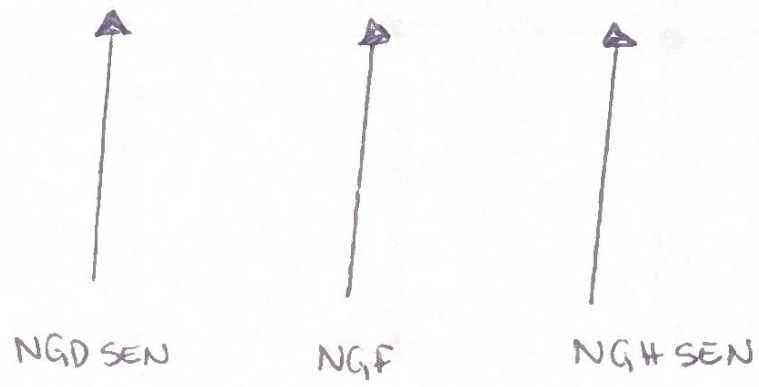
$-32.63 - 32.63 - 65{,}26 + NGI = 0$

$-130.52 + NGI = 0$

$\boxed{NGI = 130.52}$

TRAÇÃO

FORÇAS VERTICAIS



$NGD \operatorname{sen} 72^\circ + NGF + NGH \times \operatorname{sen} 72^\circ = 0$

$(105.26 \times 0{,}95) + 0 + (NGH \times 0{,}95) = 0$

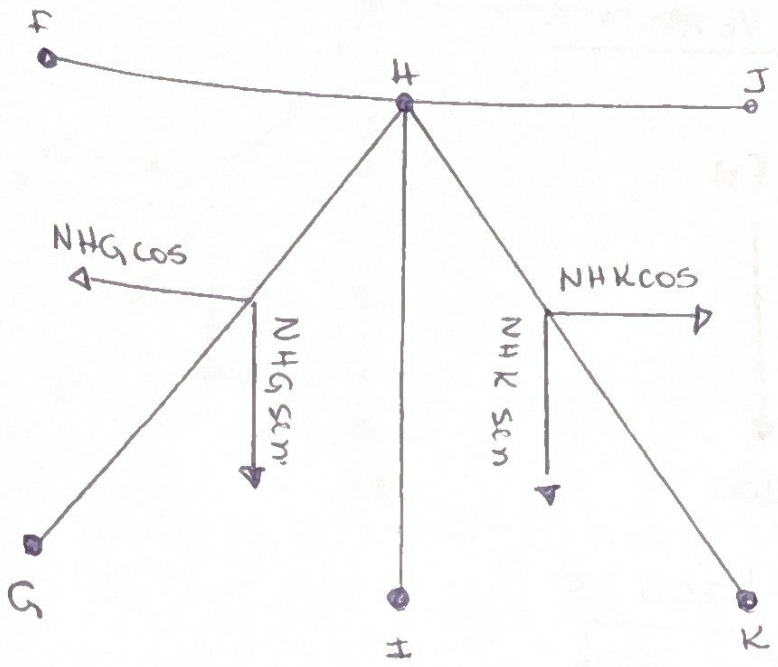
$99.99 + NGH \times 0{,}95 = 0$

$NGH = -\frac{99.99}{0{,}95}$

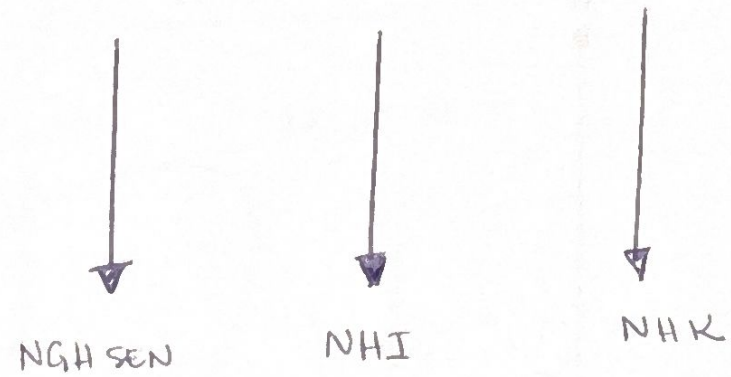
$\boxed{NGH = -105.26}$

COMPRESSÃO

NÓ (H)



FORÇAS VERTICAIS



$-NGH \times sen - NHI - NHK \times sen$

$-(-105.26 \times 0,95) - NHI - (-105.26 \times 0,95) = 0$

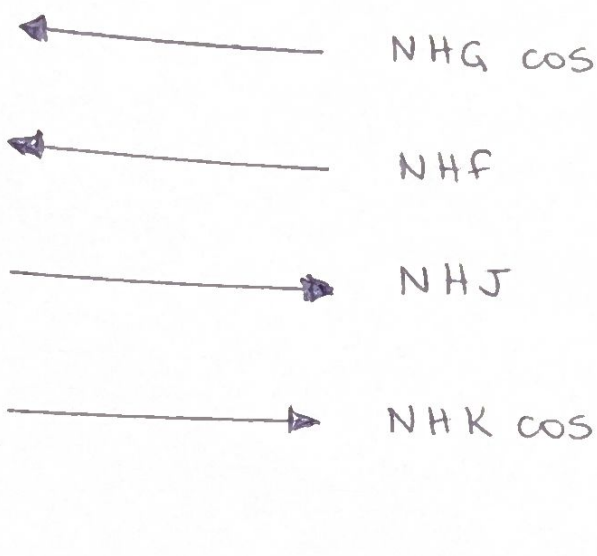
$+99.99 + 99.99 - NHI = 0$

$-NHI = -199.98 \ (\times -1)$

$\boxed{+NHI = 199.98}$

TRAÇÃO

FORÇAS HORIZONTAIS



$-NHG \times COS - NHF + NHJ + NHK \cos = 0$

$-(-105.26 \times 0,31) - 97,89) + NHJ + (-105.26 \times 0,31) = 0$

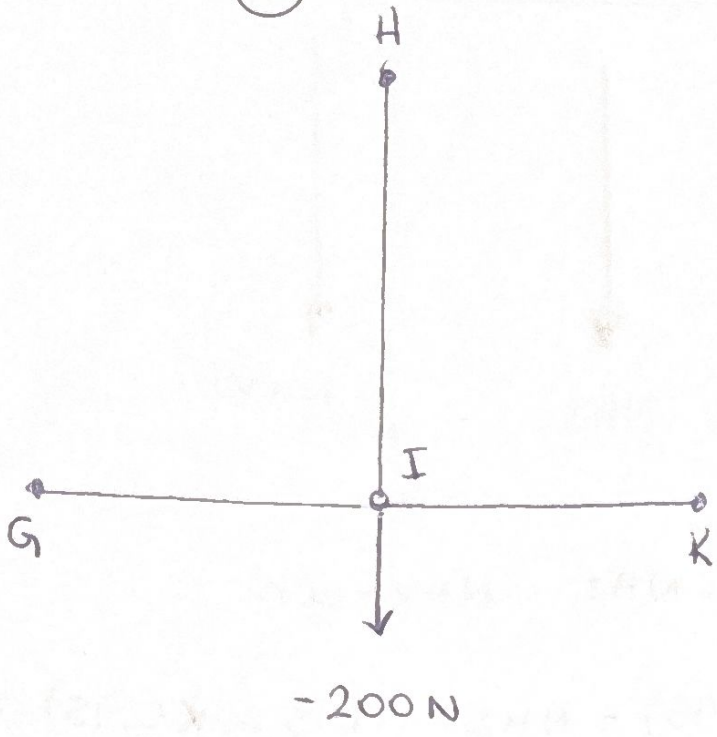
$+32.63 + 97.89 - 32.63 + NHJ = 0$

$97.89 + NHJ = 0$

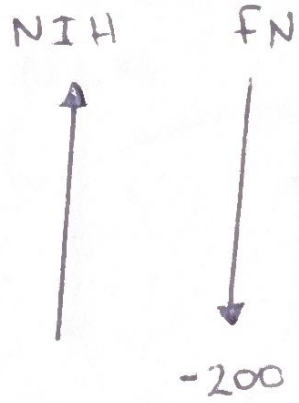
$\boxed{NHJ = -97.89}$

COMPRESSÃO

NÓ (I)



FORÇAS VERTICAIS

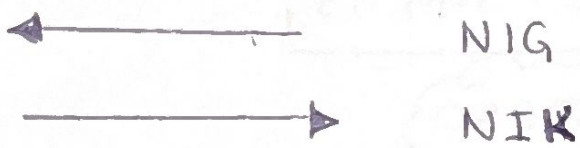


$NHI - 200 = 0$

$\boxed{NHI = 200}$

TRAÇÃO

FORÇA HORIZONTAL



$-NIG + NIK = 0$

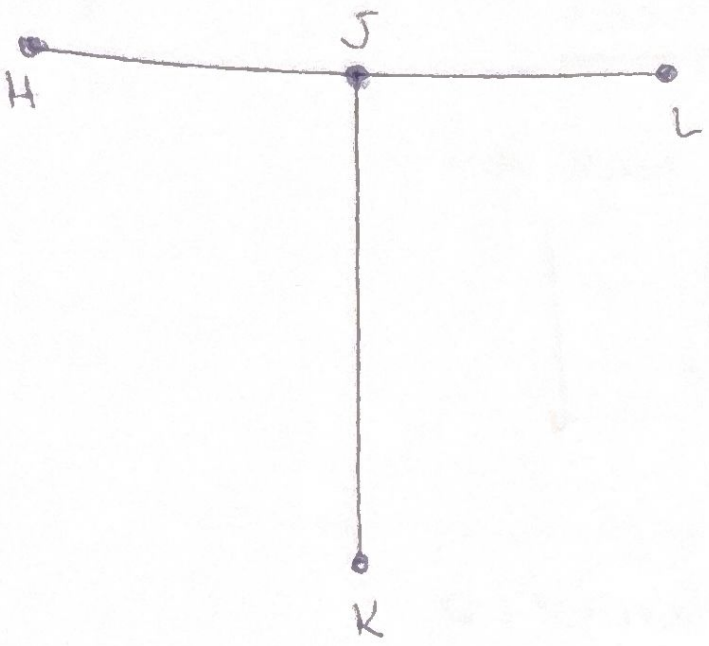
$-(130.52) + NIK = 0$

$-130.52 + NIK = 0$

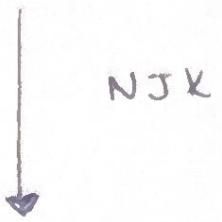
$\boxed{NIK = 130.52}$

TRAÇÃO

NÓ (J)

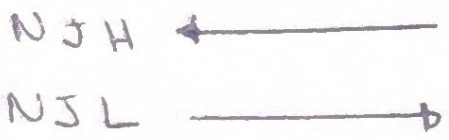


FORÇAS VERTICAIS



$$\boxed{NJK = 0}$$

FORÇAS HORIZONTAIS



$$-NJH + NJL = 0$$

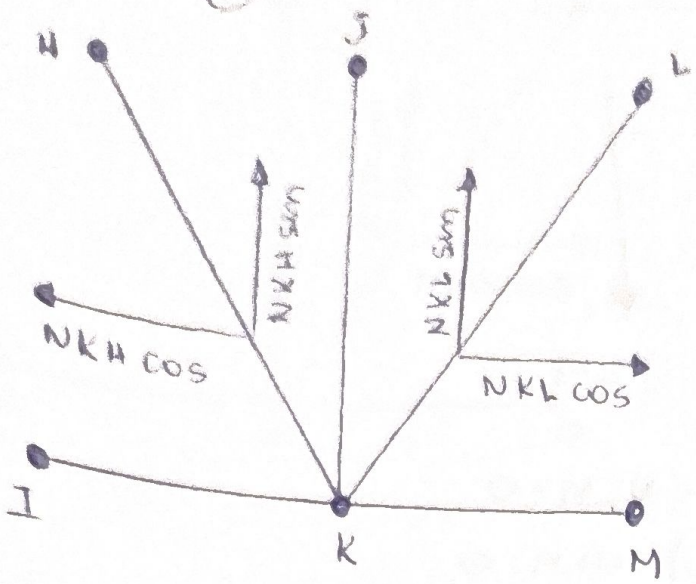
$$-(-97.89) + NJL = 0$$

$$+ 97.89 + NJL = 0$$

$$\boxed{NJL = -97.89}$$

COMPRESSÃO

NÓ (K)



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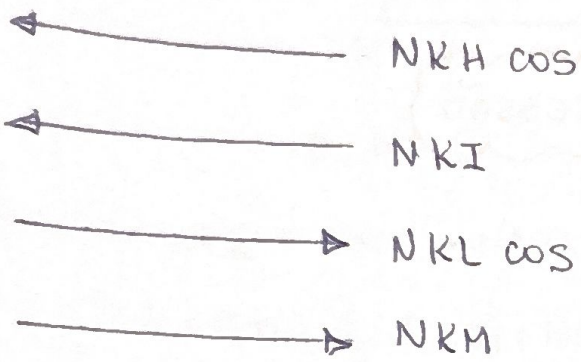


$-NKH\cos + NKI + NKL\cos + NKM = 0$

$-(-105,26 \times 0,31) - (130,52) + (105,26 \times 0,31) + NKM = 0$

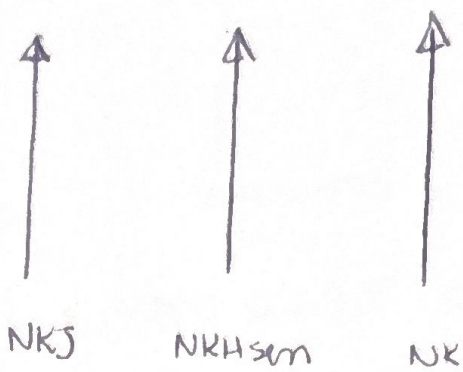
$+ 32.63 - 130,52 + 32,63 + NKM = 0$

$-65,23 + NKM = 0$

$\boxed{NKM = 65,23}$

TRAÇÃO

FORÇAS VERTICAIS



$NKJ + NKH \operatorname{sen} 72^\circ + NKL \operatorname{sen} 72^\circ = 0$

$0 + (-105,26 \times 0,95) + NKL \times 0,95 = 0$

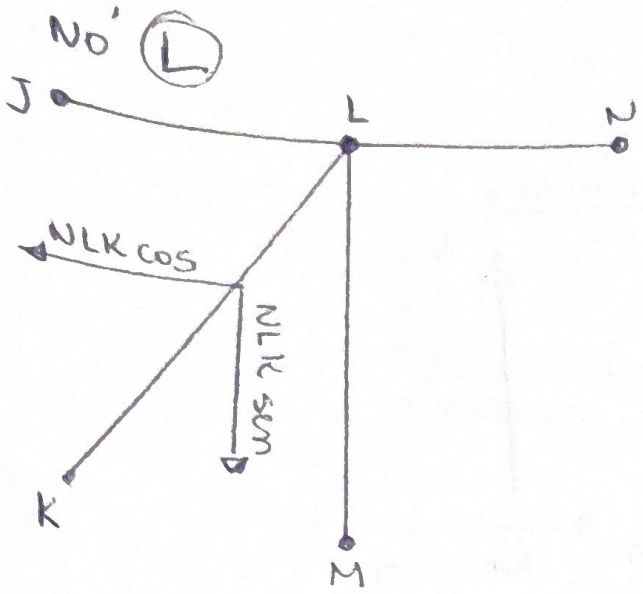
$-105.26 \times 0,95 + NKL \times 0,95 = 0$

$-99.99 + NKL \times 0,95 = 0$

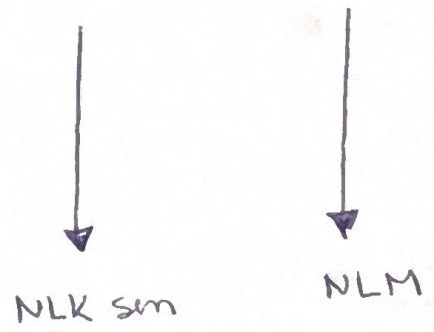
$NKL = \frac{99,99}{0,95}$

$\boxed{NKL = 105,26}$

TRAÇÃO



FORÇAS VERTICAIS



$-NLK \sin 72° - NLM = 0$

$-(105{,}26 \times 0{,}95) - NLM = 0$

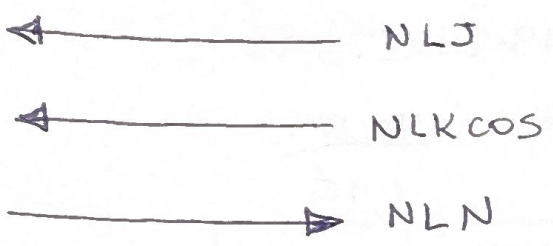
$-99{,}99 - NLM = 0$

$-NLM = +99.99 \quad (x-1)$

$\boxed{NLM = -99.99}$

COMPRESSÃO

FORÇAS HORIZONTAIS



$-NLJ - NLK \cos 72° + NLN = 0$

$-(-97.89) - (105.26 \times 0{,}31) + NLN = 0$

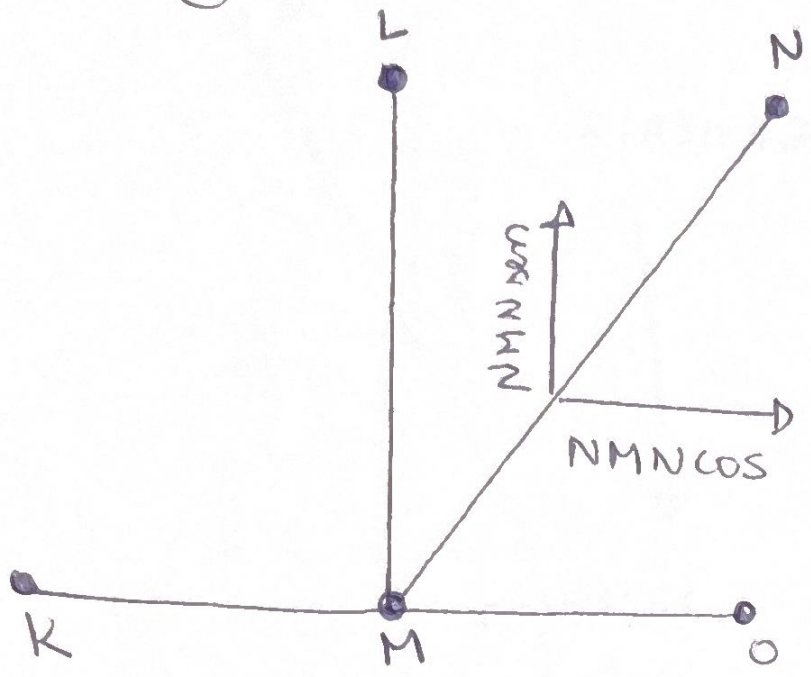
$97.89 - 32.63 + NLN = 0$

$65.26 + NLN = 0$

$\boxed{NLN = -65.26}$

COMPRESSÃO

NÓ (M)



FORÇAS HORIZONTAIS

→ NMN cos

← NMK

→ NMO

NMN cos 72 − NMK + NMO = 0

(105.26 x 0,31) − (65.23) + NMO = 0

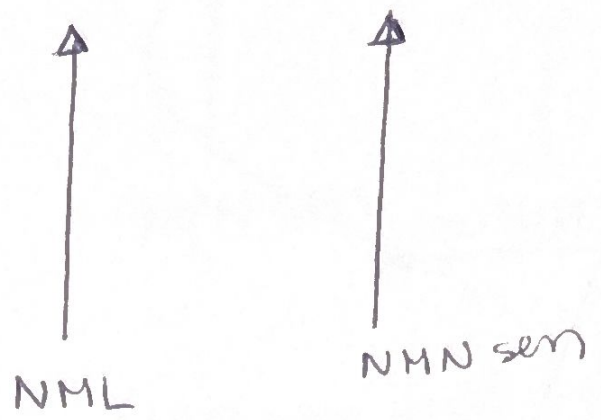
32.63 − 65.23 + NMO = 0

− 32.63 + NMO = 0

NMO = 32.63

TRAÇÃO

FORÇAS VERTICAIS



NML + NMN sen 72° = 0

− 99.99 + NMN x 0,95 = 0

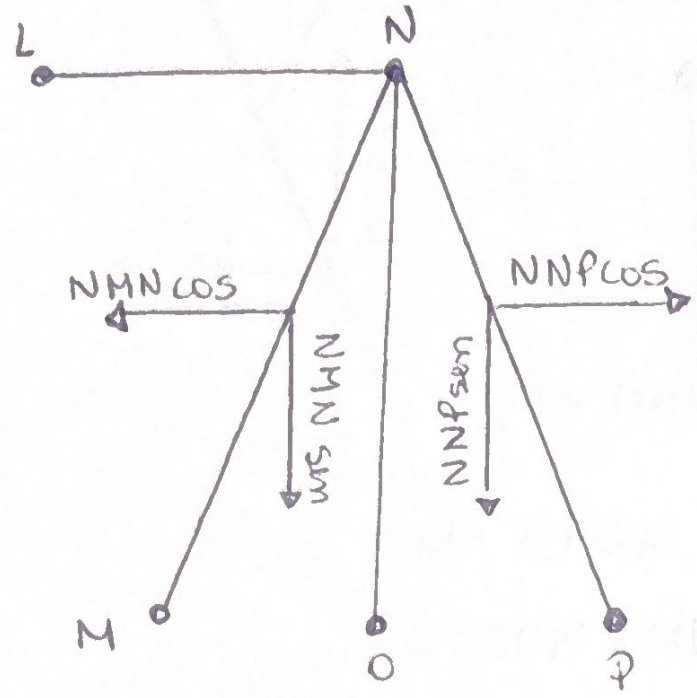
− 99.99 + NMN x 0,95 = 0

$$NMN = \frac{99.99}{0.95}$$

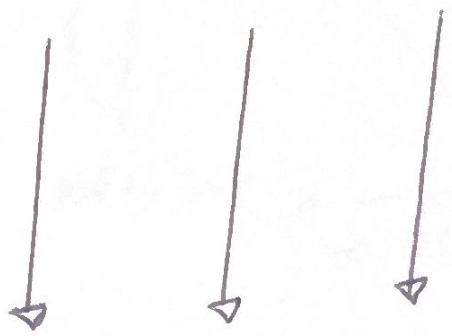
NMN = 105.26

TRAÇÃO

NÓ (N)



FORÇAS VERTICAIS



NNM sen NNO NNP sen

$-(105.26 \times 0,95) - 0 - NNP \times 0,95 = 0$

$-99.99 - NNP \times 0,95 = 0$

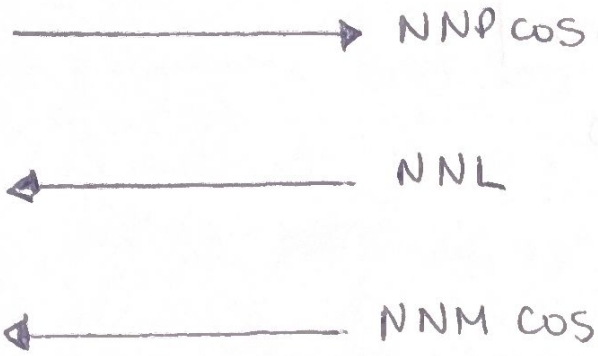
$-NNP = \frac{99.99}{0.95}$

$-NNP = 105.26 \ (\times -1)$

$\boxed{NNP = -105,26}$

COMPRESSÃO

FORÇAS HORIZONTAIS



$NNP \cos 72° - NNL - NNM \cos 72° = 0$

$(NNP \times 0,31) - (-65.26) - (105.26 \times 0,31) = 0$

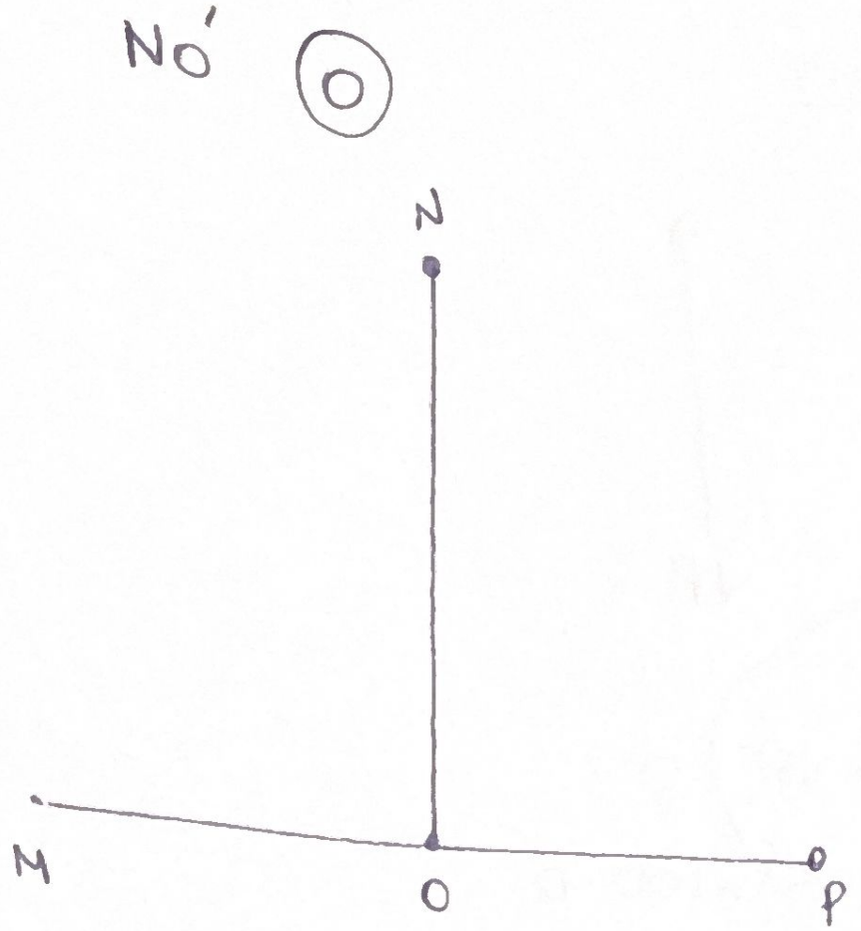
$NNP \times 031 + 65.26 - 32.63 = 0$

$NNP \times 0,31 + 32.63 = 0$

$NNP = \frac{-32.63}{0,31}$

$\boxed{NNP = -105,26}$

COMPRESSÃO



FORÇAS VERTICAIS

NON

NON = 0

FORÇAS HORIZONTAIS

NOM

NOP

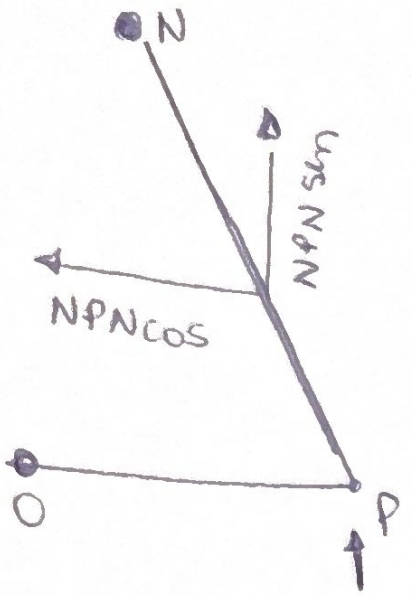
- NOM + NOP = 0

- (32.63) + NOP = 0

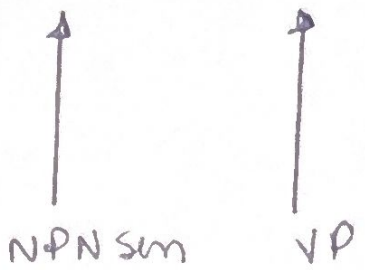
NOP = 32.63

TRAÇÃO

NO' (P)



FORÇAS VERTICAIS



$NPN_Y \sin 72 + VP = 0$

$NPN_Y \times 0{,}95 + 100 = 0$

$NPN = -\frac{100}{0{,}95}$

$NPN = -105.26$

COMPRESSÃO

FORÇAS HORIZONTAIS

← NPO

← NPN cos

$-NPO - NPN \cos 72° = 0$

$-(32.63) - NPN \times 0{,}31 = 0$

$-NPN = \frac{32.63}{0{,}31}$

$-NPN = 105.26 \ (\times -1)$

$NPN = -105{,}26$

COMPRESSÃO

CÁLCULO NÚMERO DE FIOS DE MACARRÃO (TRAÇÃO)

$$\frac{N}{4.267}$$

F = 105.26

$$\frac{105.26}{4.267}$$ 24. (12 FIOS DE CADA LADO)

F = 65.26

$$\frac{65.26}{4.267} = 16$$ (8 FIOS DE CADA LADO)

f = 32.63

$$\frac{32.63}{4.267} = 8$$ (4 FIOS DE CADA LADO)

F = 199.98

$$\frac{199.98}{4.267} = 46$$ (23 FIOS DE CADA LADO)

F = 130.52

$$\frac{130.52}{4.267} = 30$$ (15 FIOS DE CADA LADO)

⑤ CÁLCULO DE NÚMERO DE FIOS DE MACARRÃO (COMPRESSÃO)

$$\sqrt{\frac{N.L^2}{27906 \times r^4}}^{1}$$

F = - 105.26

$$\sqrt{\frac{-105.26 \times (420)^2}{27906 \times (0.95)^4}}^{1} = 28 \quad (14 \text{ FIOS DE CADA LADO})$$

F = - 65.26

$$\sqrt{\frac{-65.26 \times (130)^2}{27906 \times (0,95)^4}}^{1} = 7 \quad (4 \text{ FIOS DE CADA LADO})$$

---

f = - 99.99

$$\sqrt{\frac{-99.99 \times (400)^2}{27906 \times (0,95)^4}}^{1} = 26 \quad (13 \text{ FIOS DE CADA LADO})$$

F = - 97.89

$$\sqrt{\frac{-97.89 \times (130)^2}{27906 \times (0,95)^4}}^{1} = 8 \quad (4 \text{FIOS DE CADA LADO})$$

DATA / FECHA / DATE

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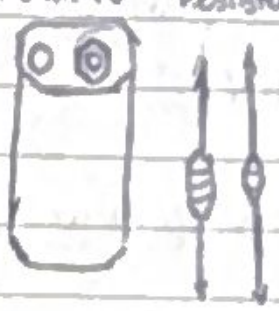
RELATÓRIO

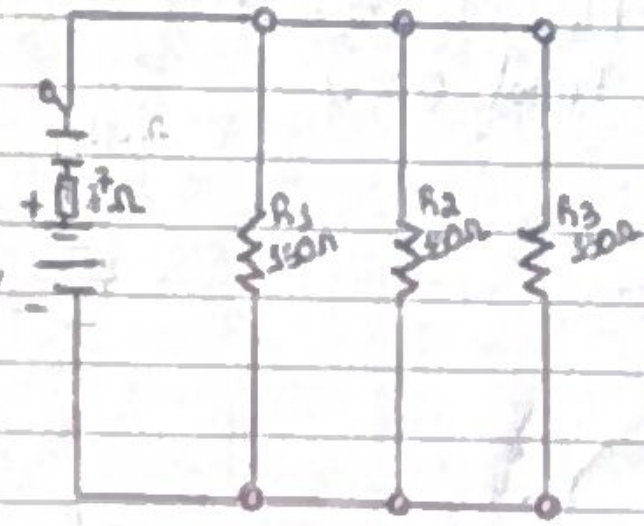
1) Descrição do circuito elétrico

O circuito consiste em uma fonte de 9V que alimenta três lampadas de led de 3V. O circuito inclui um resistor de 3,6Ω no trecho em série e um resistor de 7Ω no trecho paralelo.

Os fios utilizados são de bitola de 0,5 mm², o circuito por meio de um interruptor, permite o acionamento das lampadas de forma controlada distribuindo a corrente de maneira adequada para evitar danos aos componentes.

Componentes e diagrama esquematico





CIRCUITO PARALELO

2) Resistencia

$R = V/I \quad R = \frac{3V}{0,02A} = 150\Omega$

$R_{equiv.} = \frac{1}{150} + \frac{1}{150} + \frac{1}{150} = 50\Omega$

$R_{paralelo} = \frac{1}{50} + \frac{1}{7} \rightarrow 0,02 + 0,142 = 0,162B$

$R_{paralelo} = 14\Omega \quad R_{total} = 150 + 7\Omega = 467\Omega$

3) Calculo das potências dissipadas

$P_{R1} = V \times I \quad 3V \times 0,48A = 1,86W$

$P_{total} = V \times I = 3V \times 0,245A = 0,145W$

$P_{total} = 3 \times 0,795W = 2,205W$

$P_{total\ do\ circuito} = V \times I = 9V \times 1,163A = 10,47W$

$I_{total} = V/R = \frac{9}{7,74} = 1,163$

$I_{total} = V/R = \frac{9}{7,74} = 1,163A$

DATA / FECHA / DATE

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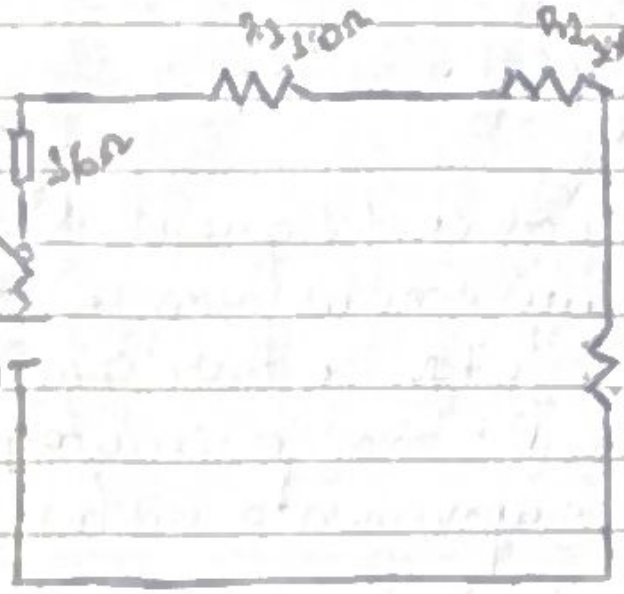


1) Resistencia:
$R = V/I = \frac{3V}{0,02A} = 150\Omega$

Rtotal: $150 \times 3 = 450\Omega$

Rtotal circuito = Rtotal + Ras
Rtotal: $450 + 1,6\Omega = 451,6\Omega$

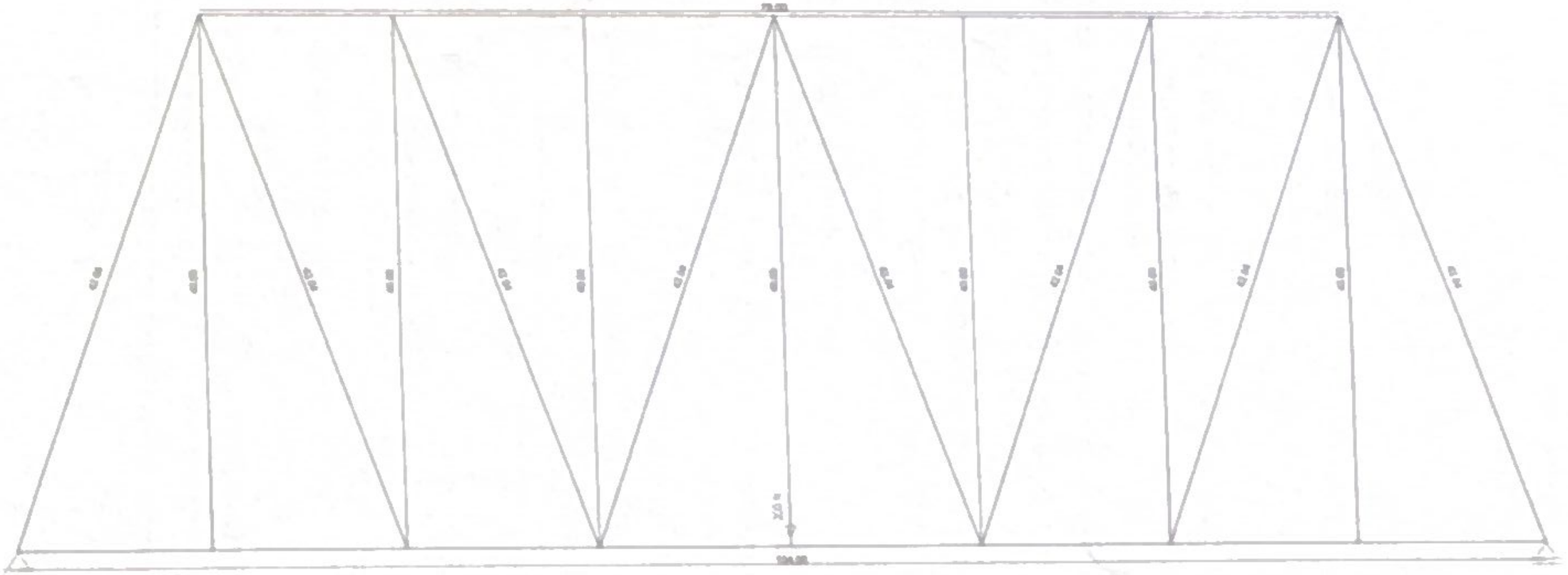
CIRCUITO EM SÉRIE

Itotal = $\frac{V}{R}$ $\frac{9}{451,6} = 0,01993A$

2) Queda de tensão
Vled = $i \times R = 0,01993A \times 150\Omega$
Vled = 2,99V
Vtotal = $2,99 \times 3 = 8,97V$
b) Resistor
Vas = $I \times R = 0,01995A \times 1,6\Omega$
Vas = 0,032V

3) Calculo da potência dissipada
P = V x i
Pled = $2,99 \times 0,01993 = 0,0596W$
total = $3 \times 0,0596 = 0,179W$
b) Resistor
Pas = $0,032V \times 0,01995 = 0,64 mW$
c) total do circuito
Ptotal leds + Pas = $0,179W + 0,64 mW$
Ptotal = 0,18W

4) Analise dos problemas encontrados e soluções aplicadas
No processo de montagem do circuito em série encontramos dificuldade em acender as lâmpadas de led.
Com isso fomos revisando por partes os componentes do circuito refazendo os pontos de solda, mudando as lampadas de led de 5V para 3V, trocando os resistores do trecho.
O modo de falha só foi resolvido após mudarmos a bateria que estava sendo utilizada, aparentemente a bateria anterior não possuia carga suficiente



ELEVAÇÃO FRONTAL
ESCALA 1/50