SINFRAC S.A.S

# MEMORIAS DE CALCULO ESTRUCTURAL

Estructura para Soporte de Paneles Solares
(Nuqui- Choco)

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## 1. DESCRIPCIÓN DEL PROYECTO

Se plantea la estructura de soporte para paneles solares la cual estará ubicada en el corregimiento de Guachalito, municipio de Nuqui, departamento del El Choco

Los refuerzos, detalles y demás especificaciones necesarias para construir y la estructura de este proyecto se indicarán en los planos estructurales anexos a estas memorias

## 2. ESPECIFICACION DE MATERIALES

***ACERO***: fy = 420 Mpa para todos los diámetros
A-500 C fy= 3200 kg/cm2 Tubería estructural
A-36 fy= 2500 kg/cm2 Platinas

***SOLDADURA***: E-7018

***CONCRETO***: f´c = 21MPa (210 kgf/cm2) Placa

## 3. EVALUACION DE CARGAS

| | | |
|---|---|---|
| Sobrecarga (Panel solar) (Catalogo) | 0.18 | kN/m2 |
| Viento | 0.50 | kN/m2 |

**Unidades: KN, m**

| | |
|---|---|
| Velocidad Viento (km/h) | 130 |
| Altura Cornisa (he) | 3 |
| Altura Cumbrera (hr) | 3.9 |
| Ancho Edificación (L) | 6 |
| Largo Edificación (B) | 26 |
| Factor Topografía (Ft) | 1 |
| Factor Dirección (Fd) | .85 |
| Relación Amortiguamiento | 0.05 |
| Dirección Viento (Cumbrera) | Normal |
| Tipo de Cubierta | Un Agua |
| Tipo Edificación | Abierto |
| Exposición | B |
| Ocupación | I |

RESULTADOS

| | |
|---|---|
| Angulo de Techo | 8.53 |
| Altura Media | 3.00 |
| Coef. Muro Barlov. | 0.80 |
| Coef. Muro Sotav. | -0.50 |
| Coef. Muro Lat. | -0.70 |
| Coef. Pres. Int. - | 0.00 |
| Coef. Pres. Int. + | 0.00 |
| Presión x Vel. | 0.33 |
| Factor de Ráfaga | 0.86 |
| Peridodo (segs.) | 0.17 |

| | | |
|---|---|---|
| Coef. Pres. Cubierta Zona 1 | 0.00 | 0.00 |
| Coef. Pres. Cubierta Zona 2 | 0.00 | 0.00 |
| Coef. Pres. Cubierta Zona 3 | 0.00 | 0.00 |
| Coef. Pres. Cubierta Zona 4 | 0.00 | 0.00 |

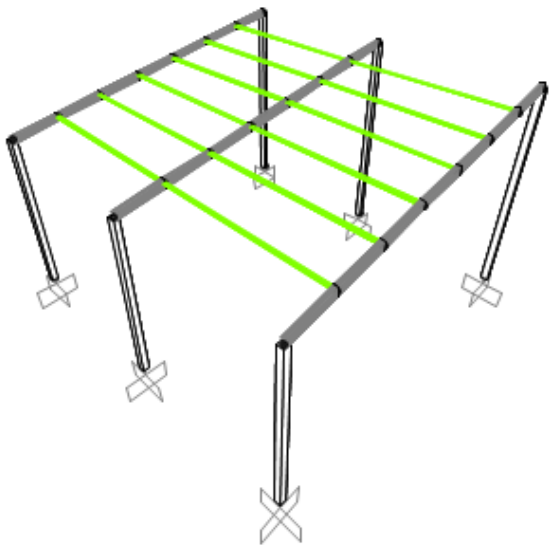
| Z | Kz | Qz | Cp | W/+GCpi | W/-GCpi |
|---|---|---|---|---|---|
| 0.00 | 0.34 | 0.20 | 0.80 | 0.14 | 0.14 |
| 3.00 | 0.34 | 0.20 | 0.80 | 0.14 | 0.14 |

| | Cp | W/+GCpi | W/-GCpi |
|---|---|---|---|
| Muro Sotavento | -0.50 | -0.14 | -0.14 |
| Paredes Laterales | -0.70 | -0.20 | -0.20 |

Presión neta para cubiertas en edificaciones abiertas

| | CN | PCN |
|---|---|---|
| 0_CNWLA | -0.6412306 | -0.18 |
| 0_CNLLA | -1.041231 | -0.30 |
| 0_CNWOA | -1.013744 | -0.29 |
| 0_CNLOA | -1.5 | -0.43 |
| 0_CNWLB | -1.468718 | -0.42 |
| 0_CNLLB | 0 | 0.00 |
| 0_CNWOB | -1.754974 | -0.50 |
| 0_CNLOB | -0.7725129 | -0.22 |

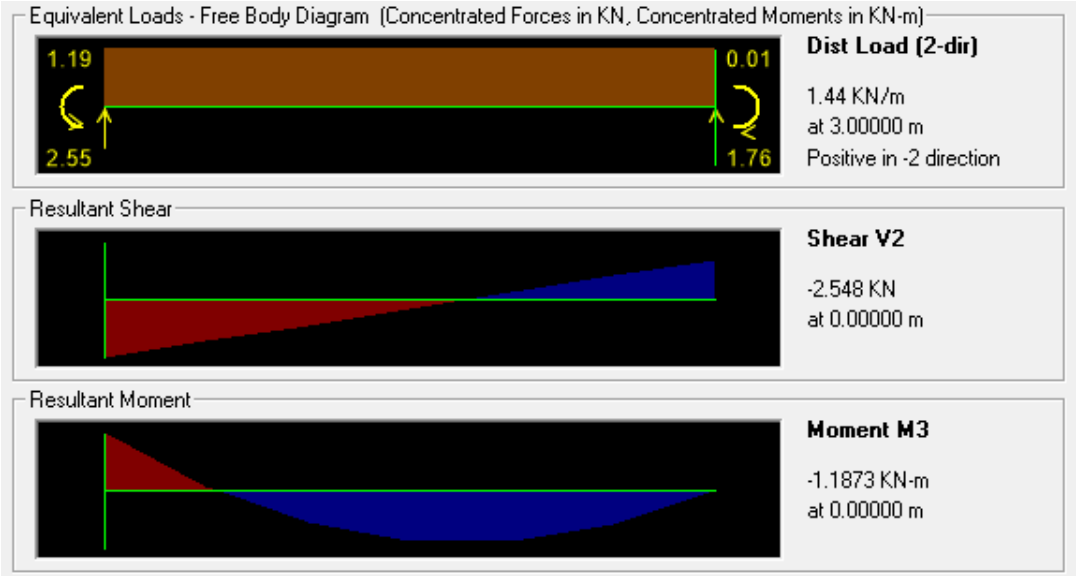
## 4. MODELO MATEMATICO



## 5. DISEÑO DE ELEMENTOS ESTRUCTURALES

### Diseño de Correa

***Solicitaciones***




***Capacidad del perfil***

| PERFIL OMEGA | | |
|---|---|---|
| **ESPECIFICACIONES DE SECCION** | | |
| Radio de giro r | 2.94 | cm |
| Modulo elástico E | 2038901 | Kg/cm2 |
| Esfuerzo fluencia fy | 3500 | Kg/cm2 |
| Sección Transversal | 3.07 | cm2 |
| Ancho (b) | 3.6 | cm |
| Alto (h) | 5.4 | cm |
| Espesor patin (tf) | 1.5 | mm |
| Espesor alma (tw) | 1.5 | mm |

| **ESPECIFICACION GEOMETRICA** | | |
|---|---|---|
| Longitud | 312 | cm |
| S | 5.75 | cm3 |
| Área cortante | 3.07 | cm2 |

***Capacidad del perfil***

| DISEÑO A FLEXION | | |
|---|---|---|
| | | |
| Mcr | 18112.5 | Kg*cm |
| Mcr | 1.81 | KN*m |

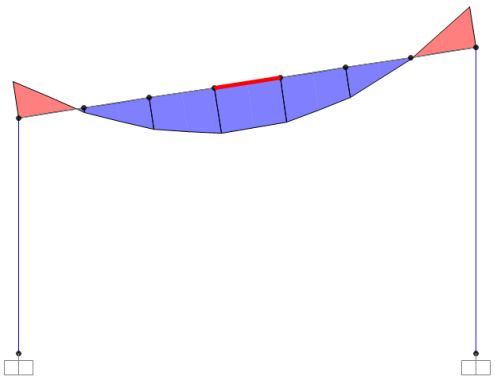
| DISEÑO A CORTANTE | | |
|---|---|---|
| Vn | 6447 | Kg |
| Vn | 64.47 | KN |

***Deflexion Correa* (CM+Sobrecarga)**

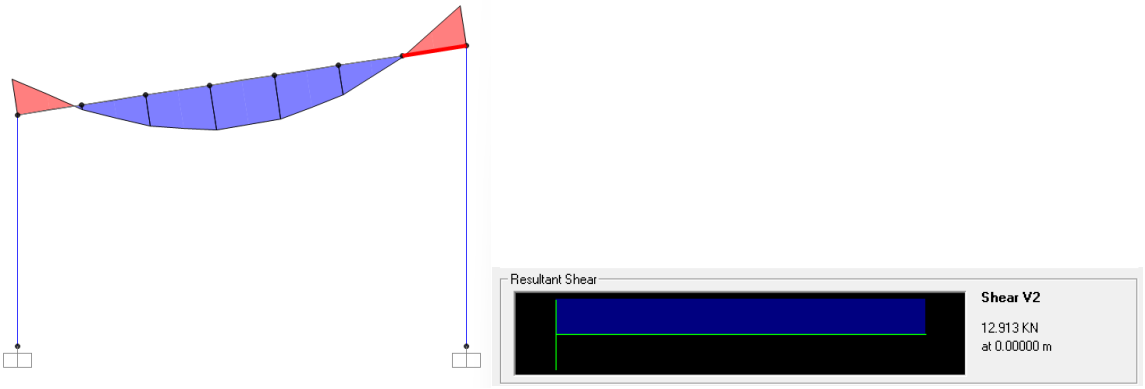



**Diseño Vigueta Critica**

***Solicitaciones***








***Capacidad del Perfil***

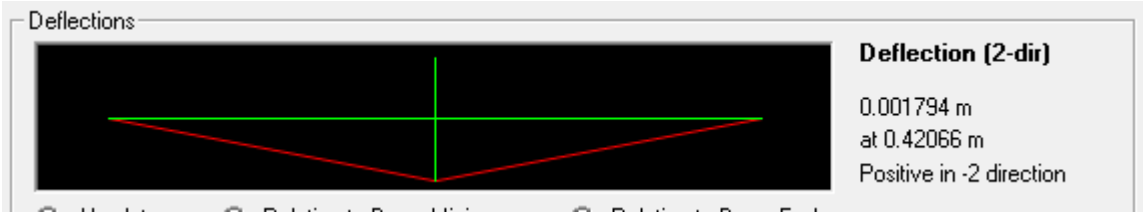
| PERLIN | | |
|---|---|---|
| **ESPECIFICACIONES DE SECCION** | | |
| Radio de giro r | 6.02 | cm |
| Modulo elastico E | 2038901 | Kg/cm2 |
| Esfuerzo fluencia fy | 2500 | Kg/cm2 |
| Seccion Transversal | 5.69 | cm2 |
| Ancho (b) | 6.35 | cm |
| Alto (h) | 15.24 | cm |
| Espesor patin (tf) | 1.9 | mm |
| Espesor alma (tw) | 1.9 | mm |

| **ESPECIFICACION GEOMETRICA** | | |
|---|---|---|
| S | 27.05 | cm3 |
| Area cortante | 5.69 | cm2 |

| **DISEÑO A FLEXION** | | |
|---|---|---|
| Mcr | 60862.5 | Kg*cm |
| Mcr | 6.09 | KN*m |

| **DISEÑO A CORTANTE** | | |
|---|---|---|
| Vn | 8535 | Kg |
| Vn | 85.35 | KN |

***Verificacion de Deflexion***



## Diseño de Columnas

### *Solicitaciones*

| Frame | Station | OutputCase | CaseType | P | V2 | V3 | T | M2 | M3 |
|---|---|---|---|---|---|---|---|---|---|
| Text | m | Text | Text | KN | KN | KN | KN-m | KN-m | KN-m |
| 1 | 0 | COMB1 | Combination | -8.369 | 1.263 | 1.63 | -0.0146 | 1.3039 | 1.2884 |
| 1 | 1.5 | COMB1 | Combination | -8.208 | 1.263 | 1.63 | -0.0146 | -1.1406 | -0.6054 |
| 1 | 3 | COMB1 | Combination | -8.047 | 1.263 | 1.63 | -0.0146 | -3.5852 | -2.4992 |
| 1 | 0 | COMB2 | Combination | -8.369 | 1.263 | 1.63 | -0.0146 | 1.3039 | 1.2884 |
| 1 | 1.5 | COMB2 | Combination | -8.208 | 1.263 | 1.63 | -0.0146 | -1.1406 | -0.6054 |
| 1 | 3 | COMB2 | Combination | -8.047 | 1.263 | 1.63 | -0.0146 | -3.5852 | -2.4992 |
| 1 | 0 | COMB3 | Combination | -1.584 | 0.706 | -1.176 | 0.5332 | -2.5148 | 1.0797 |
| 1 | 1.5 | COMB3 | Combination | -1.422 | 0.706 | -1.176 | 0.5332 | -0.7506 | 0.0209 |
| 1 | 3 | COMB3 | Combination | -1.261 | 0.706 | -1.176 | 0.5332 | 1.0136 | -1.0379 |
| 1 | 0 | COMB3-1 | Combination | -2.363 | 1.863 | -0.301 | 1.0065 | -0.901 | 3.2304 |
| 1 | 1.5 | COMB3-1 | Combination | -2.202 | 1.863 | -0.301 | 1.0065 | -0.4491 | 0.4354 |
| 1 | 3 | COMB3-1 | Combination | -2.041 | 1.863 | -0.301 | 1.0065 | 0.0027 | -2.3596 |
| 2 | 0 | COMB1 | Combination | -10.611 | 0.017 | -0.01 | -0.0171 | -0.0705 | 0.052 |
| 2 | 1.5 | COMB1 | Combination | -10.45 | 0.017 | -0.01 | -0.0171 | -0.0551 | 0.0266 |
| 2 | 3 | COMB1 | Combination | -10.288 | 0.017 | -0.01 | -0.0171 | -0.0397 | 0.0011 |
| 2 | 0 | COMB2 | Combination | -10.611 | 0.017 | -0.01 | -0.0171 | -0.0705 | 0.052 |
| 2 | 1.5 | COMB2 | Combination | -10.45 | 0.017 | -0.01 | -0.0171 | -0.0551 | 0.0266 |
| 2 | 3 | COMB2 | Combination | -10.288 | 0.017 | -0.01 | -0.0171 | -0.0397 | 0.0011 |
| 2 | 0 | COMB3 | Combination | -2.471 | 0.605 | -1.184 | -0.0132 | -3.5475 | 0.9785 |
| 2 | 1.5 | COMB3 | Combination | -2.31 | 0.605 | -1.184 | -0.0132 | -1.7722 | 0.0714 |
| 2 | 3 | COMB3 | Combination | -2.149 | 0.605 | -1.184 | -0.0132 | 0.0031 | -0.8356 |
| 2 | 0 | COMB3-1 | Combination | -2.466 | 2.216 | -0.465 | -0.0942 | -1.398 | 3.5742 |
| 2 | 1.5 | COMB3-1 | Combination | -2.305 | 2.216 | -0.465 | -0.0942 | -0.7006 | 0.2509 |
| 2 | 3 | COMB3-1 | Combination | -2.144 | 2.216 | -0.465 | -0.0942 | -0.0033 | -3.0724 |
| 3 | 0 | COMB1 | Combination | -5.305 | -1.234 | 0.011 | -0.0316 | 0.014 | -1.1895 |
| 3 | 1.5 | COMB1 | Combination | -5.144 | -1.234 | 0.011 | -0.0316 | -0.0024 | 0.6611 |
| 3 | 3 | COMB1 | Combination | -4.983 | -1.234 | 0.011 | -0.0316 | -0.0189 | 2.5118 |
| 3 | 0 | COMB2 | Combination | -5.305 | -1.234 | 0.011 | -0.0316 | 0.014 | -1.1895 |
| 3 | 1.5 | COMB2 | Combination | -5.144 | -1.234 | 0.011 | -0.0316 | -0.0024 | 0.6611 |
| 3 | 3 | COMB2 | Combination | -4.983 | -1.234 | 0.011 | -0.0316 | -0.0189 | 2.5118 |
| 3 | 0 | COMB3 | Combination | -1.157 | 0.179 | -0.854 | -0.2534 | -2.5619 | 0.5555 |
| 3 | 1.5 | COMB3 | Combination | -0.995 | 0.179 | -0.854 | -0.2534 | -1.2809 | 0.2867 |
| 3 | 3 | COMB3 | Combination | -0.834 | 0.179 | -0.854 | -0.2534 | 0.00005047 | 0.0179 |
| 3 | 0 | COMB3-1 | Combination | -0.76 | 1.383 | -0.207 | -0.1326 | -0.6235 | 2.743 |
| 3 | 1.5 | COMB3-1 | Combination | -0.599 | 1.383 | -0.207 | -0.1326 | -0.313 | 0.6678 |
| 3 | 3 | COMB3-1 | Combination | -0.438 | 1.383 | -0.207 | -0.1326 | -0.0026 | -1.4074 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4 | 0 | COMB1 | Combination | -5.321 | -1.054 | -0.007228 | -0.0316 | -0.0057 | -1.1753 |
| 4 | 1.7 | COMB1 | Combination | -5.138 | -1.054 | -0.007228 | -0.0316 | 0.0066 | 0.6162 |
| 4 | 3.4 | COMB1 | Combination | -4.955 | -1.054 | -0.007228 | -0.0316 | 0.0188 | 2.4077 |
| 4 | 0 | COMB2 | Combination | -5.321 | -1.054 | -0.007228 | -0.0316 | -0.0057 | -1.1753 |
| 4 | 1.7 | COMB2 | Combination | -5.138 | -1.054 | -0.007228 | -0.0316 | 0.0066 | 0.6162 |
| 4 | 3.4 | COMB2 | Combination | -4.955 | -1.054 | -0.007228 | -0.0316 | 0.0188 | 2.4077 |
| 4 | 0 | COMB3 | Combination | -1.313 | 0.006988 | -0.59 | -0.2165 | -2.001 | 0.227 |
| 4 | 1.7 | COMB3 | Combination | -1.13 | 0.006988 | -0.59 | -0.2165 | -0.9972 | 0.2151 |
| 4 | 3.4 | COMB3 | Combination | -0.947 | 0.006988 | -0.59 | -0.2165 | 0.0066 | 0.2032 |
| 4 | 0 | COMB3-1 | Combination | -1.058 | 0.61 | -0.144 | -0.1096 | -0.487 | 1.4455 |
| 4 | 1.7 | COMB3-1 | Combination | -0.876 | 0.61 | -0.144 | -0.1096 | -0.2413 | 0.4088 |
| 4 | 3.4 | COMB3-1 | Combination | -0.693 | 0.61 | -0.144 | -0.1096 | 0.0043 | -0.6279 |
| 5 | 0 | COMB1 | Combination | -10.716 | -0.013 | -0.038 | -0.0147 | -0.0904 | -0.0024 |
| 5 | 1.7 | COMB1 | Combination | -10.533 | -0.013 | -0.038 | -0.0147 | -0.0251 | 0.0198 |
| 5 | 3.4 | COMB1 | Combination | -10.351 | -0.013 | -0.038 | -0.0147 | 0.0402 | 0.042 |
| 5 | 0 | COMB2 | Combination | -10.716 | -0.013 | -0.038 | -0.0147 | -0.0904 | -0.0024 |
| 5 | 1.7 | COMB2 | Combination | -10.533 | -0.013 | -0.038 | -0.0147 | -0.0251 | 0.0198 |
| 5 | 3.4 | COMB2 | Combination | -10.351 | -0.013 | -0.038 | -0.0147 | 0.0402 | 0.042 |
| 5 | 0 | COMB3 | Combination | -2.625 | 0.317 | -0.82 | -0.0154 | -2.7722 | 0.5772 |
| 5 | 1.7 | COMB3 | Combination | -2.443 | 0.317 | -0.82 | -0.0154 | -1.3778 | 0.0383 |
| 5 | 3.4 | COMB3 | Combination | -2.26 | 0.317 | -0.82 | -0.0154 | 0.0166 | -0.5006 |
| 5 | 0 | COMB3-1 | Combination | -2.568 | 1.107 | -0.326 | -0.0817 | -1.0971 | 2.0068 |
| 5 | 1.7 | COMB3-1 | Combination | -2.385 | 1.107 | -0.326 | -0.0817 | -0.543 | 0.1247 |
| 5 | 3.4 | COMB3-1 | Combination | -2.202 | 1.107 | -0.326 | -0.0817 | 0.011 | -1.7574 |
| 7 | 0 | COMB1 | Combination | -3.3 | 1.035 | -0.067 | 0.0362 | -0.2262 | 1.1785 |
| 7 | 1.7 | COMB1 | Combination | -3.118 | 1.035 | -0.067 | 0.0362 | -0.1118 | -0.5806 |
| 7 | 3.4 | COMB1 | Combination | -2.935 | 1.035 | -0.067 | 0.0362 | 0.0025 | -2.3397 |
| 7 | 0 | COMB2 | Combination | -3.3 | 1.035 | -0.067 | 0.0362 | -0.2262 | 1.1785 |
| 7 | 1.7 | COMB2 | Combination | -3.118 | 1.035 | -0.067 | 0.0362 | -0.1118 | -0.5806 |
| 7 | 3.4 | COMB2 | Combination | -2.935 | 1.035 | -0.067 | 0.0362 | 0.0025 | -2.3397 |
| 7 | 0 | COMB3 | Combination | -1.121 | 0.465 | -0.539 | 0.2965 | -1.8315 | 0.7441 |
| 7 | 1.7 | COMB3 | Combination | -0.939 | 0.465 | -0.539 | 0.2965 | -0.9154 | -0.0464 |
| 7 | 3.4 | COMB3 | Combination | -0.756 | 0.465 | -0.539 | 0.2965 | 0.0008121 | -0.8369 |
| 7 | 0 | COMB3-1 | Combination | -1.336 | 1.049 | -0.362 | 0.186 | -1.2306 | 1.9408 |
| 7 | 1.7 | COMB3-1 | Combination | -1.154 | 1.049 | -0.362 | 0.186 | -0.615 | 0.1566 |
| 7 | 3.4 | COMB3-1 | Combination | -0.971 | 1.049 | -0.362 | 0.186 | 0.0006766 | -1.6275 |

## *Capacidad del Perfil*

| **SECCION 100x100x3mm** | | |
|---|---|---|
| **ESPECIFICACIONES DE SECCION** | | |
| Radio de giro r | 3.97 | cm |
| Modulo elastico E | 2038901 | Kg/cm2 |

| | | |
|---|---|---|
| Esfuerzo fluencia fy | 3200 | Kg/cm2 |
| Seccion Transversal | 11.25 | cm2 |
| Ancho (b) | 10 | cm |
| Alto (h) | 10 | cm |
| Espesor(t) | 0.3 | cm |

| **ESPECIFICACION GEOMETRICA** | | |
|---|---|---|
| Longitud | 390 | cm |
| K | 1 | |
| Z | 41.21 | cm3 |
| S | 34.03 | cm3 |
| Area cortante | 11.25 | cm2 |
| J | 278.67 | cm4 |

| **DISEÑO COMPRESION** | | |
|---|---|---|
| KL/r | 98.24 | |
| 4.71√(E/fy) | 118.889633 | |
| Fe | 2086.53729 | Kg/cm2 |
| fy/Fe | 1.53364141 | |
| Fcr | 1684.12251 | Kg/cm2 |
| Φ | 0.9 | |
| Pn | 17051.7404 | Kg |
| √(E/fy) | 25.2419604 | |

| **DISEÑO A FLEXION** | | |
|---|---|---|
| Mcr | 118684.8 | Kg*cm |
| Mcr | 1186.848 | kg*m |

| **DISEÑO A CORTANTE** | | |
|---|---|---|
| Kv | 5 | |
| 1.1√KvE/fy | 62.09 | |
| Cv | 1 | |
| Vn | 21600 | Kg |

*Indice de Sobresfuerzo*

| Frame | DesignSect | DesignType | Ratio | RatioType | Combo |
|---|---|---|---|---|---|
| Text | Text | Text | Unitless | Text | Text |
| 1 | TUBO100X100X3MM | Column | 0.564495 | PMM | COMB1 |
| 2 | TUBO100X100X3MM | Column | 0.44627 | PMM | COMB3-1 |
| 3 | TUBO100X100X3MM | Column | 0.299689 | PMM | COMB3-1 |

| | | | | | |
|---|---|---|---|---|---|
| 4 | TUBO100X100X3MM | Column | 0.234521 | PMM | COMB1 |
| 5 | TUBO100X100X3MM | Column | 0.304963 | PMM | COMB3 |
| 7 | TUBO100X100X3MM | Column | 0.285364 | PMM | COMB3-1 |

## 6. DISEÑO DE CIMENTACION

### Reaccionese en la Base

| Joint | OutputCase | CaseType | F1 | F2 | F3 | M1 | M2 | M3 |
|---|---|---|---|---|---|---|---|---|
| Text | Text | Text | KN | KN | KN | KN-m | KN-m | KN-m |
| 1 | COMBCIM1 | Combination | 0.908 | -1.094 | 6.111 | 1.1007 | 0.7371 | -0.0168 |
| 1 | COMBCIM 1 | Combination | 0.908 | -1.094 | 6.111 | 1.1007 | 0.7371 | -0.0168 |
| 3 | COMBCIM1 | Combination | 0.18 | -0.022 | 9.042 | 0.0364 | 0.1255 | 0.0126 |
| 3 | COMBCIM 1 | Combination | 0.18 | -0.022 | 9.042 | 0.0364 | 0.1255 | 0.0126 |
| 5 | COMBCIM1 | Combination | 0.001476 | 1.063 | 3.327 | -1.0403 | 0.0016 | 0.023 |
| 5 | COMBCIM 1 | Combination | 0.001476 | 1.063 | 3.327 | -1.0403 | 0.0016 | 0.023 |
| 10 | COMBCIM1 | Combination | -0.001211 | 0.913 | 3.344 | -1.0367 | -0.0013 | 0.0229 |
| 10 | COMBCIM 1 | Combination | -0.001211 | 0.913 | 3.344 | -1.0367 | -0.0013 | 0.0229 |
| 11 | COMBCIM1 | Combination | -0.209 | 0.013 | 9.092 | -0.0225 | -0.2778 | 0.0111 |
| 11 | COMBCIM 1 | Combination | -0.209 | 0.013 | 9.092 | -0.0225 | -0.2778 | 0.0111 |
| 14 | COMBCIM1 | Combination | -0.054 | -0.893 | 3.304 | 0.998 | -0.1821 | -0.0238 |
| 14 | COMBCIM 1 | Combination | -0.054 | -0.893 | 3.304 | 0.998 | -0.1821 | -0.0238 |
| | | MAXIMOS | | | 9.092 | 1.1007 | 1.8036 | 0.023 |

### Diseño del cimiento

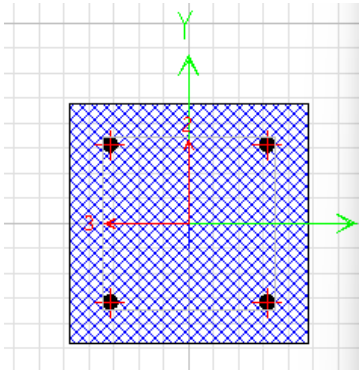
| | | | | | |
|---|---|---|---|---|---|
| **ZAPATA CONCENTRICA** | | | | | |
| **DIMENSIONAMIENTO DEL CIMIENTO** | | | | | |
| | | | | | |
| CARGA P: | 9.1 | KN | | | |
| COLUMNA | ANCHO(m) | LARGO(m) | Nº REFUERZO | DIAMETRO (mm) | |
| | 0.3 | 0.3 | 6 | 19.05 | |
| RESISTENCIA SUELO | 75 | Kpa | | | |
| | | | | | |
| LONGITUD DE ANCLAJE | 279 | mm | | | |
| RECUBRIMIENTO | 50 | mm | | | |
| | | | ALTURA APROX | | |
| ALTURA DEL CIMIENTO | 365 | mm | 0.25 | m | |
| | | | | | |
| | | | | | |
| ESFUERZO NETO: | 69.0 | Kpa | | | |
| | | | | | |
| DIMENSION DEL CIMIENTO | 0.70 | m | | | |
| | | | | | |
| ESFUERZO DISPONIBLE | 18.57 | Kpa | CUMPLE | | |

| REVISION POR CORTANTE | | | |
|---|---|---|---|
| | | | |
| **1. COMO VIGA** | | | |
| | | | |
| f`c | 21 | Mpa | |
| | | | |
| Vc | 0.76 | Mpa | |
| | | | |
| d | 0.25 | m | |
| | | | |
| v | 2.60 | Kpa | |
| | | | |
| Vu | 3.90 | KN | |
| | | | |
| Vn | 0.026 | Mpa | CUMPLE |

| **2. COMO PLACA** | | | |
|---|---|---|---|
| | | | |
| Bo | 1 | | |
| Vc 1 | 2.29 | Mpa | |
| α | 20 | | |
| bo | 2 | m | |
| Vc 2 | 1.72 | Mpa | |
| Vc 3 | 1.53 | Mpa | |
| | | | |
| Vu | 6.69 | KN | |
| Vn | 0.02 | Mpa | CUMPLE |

| CALCULO DEL REFUERZO | | |
|---|---|---|
| | | |
| M | 0.33 | KN-m |
| ORn | 0.011282143 | |
| φ | 0.002 | |
| As | 350 | |
| Barra Nº | 4 | |
| area | 129 | mm2 |
| Cuantia | 3 | |
| 22.1 | | |
| **1Nº4 c/17cm** | En Ambos Sentidos | |

## Diseño del Pedestal *(kN-m)*




| | P | M2 | M3 |
|---|---|---|---|
| 1 | -1057 | 0. | 0. |
| 2 | -1057 | 0. | 26.5472 |
| 3 | -952.813 | 0. | 40.253 |
| 4 | -796.4493 | 0. | 51.3577 |
| 5 | -624.1548 | 0. | 59.8432 |
| 6 | -414.2585 | 0. | 66.2073 |
| 7 | -360.6076 | 0. | 71.2592 |
| 8 | -264.8629 | 0. | 72.7962 |
| 9 | -66.1656 | 0. | 54.5184 |
| 10 | 303.9415 | 0. | 16.3356 |
| 11 | 422.759 | 0. | 0. |

### *Diseño de anclaje*

**RESISTENCIA A LA TRACCION**

**Resistencia del acero de un anclaje a traccion**

$$N_{sa} = nA_{se} f_{uta}$$

| | | | |
|---|---|---|---|
| Numero de anclajes | n | 4 | un |
| Seccion transversal | Ase | 71 | mm2 |
| Rsistencia a la traccion del acero | futa | 460 | Mpa |
| Resistencia a la fluecia del acero | fya | 460 | Mpa |
| | 1.9 fya | 874 | Mpa |
| Comprobacion | futa<1.9fya | ok | |
| Resistencia a la traccion anclaje | Nsa | 130640 | N |
| Resistencia a la traccion anclaje | Nsa | 13.064 | Ton |

**Resistencia a la extraccion por deslizamiento**

$$N_{pn} = \psi_c N_p \qquad N_p = 8 A_{brg} f'c$$

| | | | |
|---|---|---|---|
| Resistencia a la extraccion | Np | 11928 | N |
| Area del anclaje | Abrg | 71 | mm2 |
| Resistencia nominal la extraccion | Npn | 14910 | N |
| Resistencia nominal la extraccion | Npn | 1.491 | Ton |

**Resistencia al arrancamiento del concreto de un anclaje a traccion**

un solo anclaje $N_{cb} = \frac{A_{NC}}{A_{NCO}} \psi_{ed} \psi_c \psi_{cp} N_b$

grupo de anclajes $N_{cb} = \frac{A_{NC}}{A_{NCO}} \psi_{ec} \psi_{ed} \psi_c \psi_{cp} N_b$

| | | | |
|---|---|---|---|
| Area proyectada de la superficie de falla | Anc | 468750 | mm2 |
| Altura efectiva del anclaje | hef | 250 | mm |
| | 1.5hef | 375 | mm |
| | Ca1 | 50 | mm |
| | s1 | 200 | mm |
| | 3hef | 750 | mm |
| Area proyectada de un solo anclaje | Anoc | 562500 | |
| | nAnoc | 2250000 | mm2 |
| Comprobacion | Anc<Anco | ok | |

$$N_b = k_c \lambda \sqrt{f'c}\, h_{ef}^{1.5}$$

| | | | |
|---|---|---|---|
| Resistencia al arrancamiento | Nb | 181142.2 | N |
| Tipo de anclaje | | Preinstalados | |
| Coef para resistencia a arrancamineto | Kc | 10 | |
| Resistencia a la compresion concreto | f'c | 21 | Mpa |
| | hef^1.5 | 3952.847075 | mm |
| Factor modificacion concreto | λ | 1 | |
| Factor de modificacion para grupos | ψec | 1 | |
| Excentricidad del grupo | e´n | 0 | |
| Factor de modificacion efectos de borde | ψed | 1 | |
| Factor de modificacion de fisuracion | ψc | 1.25 | |
| Factor de modificacion de fisuracion | ψcp | 1 | |
| Resistencia al arancamiento del concreto | Ncb | 188689.8 | N |
| Resistencia al arancamiento del concreto | Ncb | 18.87 | Ton |

**RESISTENCIA AL CORTANTE**

**Resistencia del acero de un anclaje a cortante**

$$Vsa = n0.6A_{se}\,f_{uta}$$

| | | | |
|---|---|---|---|
| Resistencia del acero a cortante | Vsa | 78384 | N |
| Resistencia del acero a cortante | Vsa | 7.84 | Ton |

**Resistencia al arrancamiento del concreto de un anclaje a cortante**

un solo anclaje

$$V_{cb} = \frac{A_{vc}}{A_{vco}}\psi_{ed}\psi_c\psi_h V_b$$

grupo de anclajes

$$V_{cb} = \frac{A_{vc}}{A_{vco}}\psi_{ec}\psi_{ed}\psi_c\psi_h V_b$$

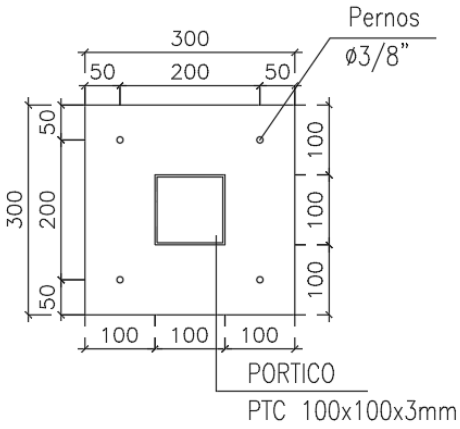
| | | | |
|---|---|---|---|
| Area proyectada de la superficie de falla | Avc | 37500 | mm2 |
| | ca1 | 50 | mm |
| Espesor del elemento donde se ancla | ha | 250 | mm |
| | 1.5Ca1 | 75 | mm |
| | s1 | 200 | mm |
| Area proyectada de un solo anclaje | Avco | 11250 | mm2 |
| | nAvco | 45000 | mm2 |
| Comprobacion | Avc<nAvco | ok | |

$$V_b = 0.66\left(\frac{lc}{d_a}\right)^{0.2}\sqrt{d_a}\,\lambda\sqrt{f'c}\,(c_{a1})^{1.5}$$

| | | | |
|---|---|---|---|
| Resistencia al arrancamineto por cortante | Vb | 6236.9 | N |
| Longitud de apoyo de la carga de anclaje | le | 250 | mm |
| Diámetro del anclaje | da | 9 | mm |
| | lc/da | 27.78 | |
| Factor de modificacion para grupos | ψec | 1 | |
| Excentricidad del grupo | e´v | 0 | |
| Factor de modificacion efectos de borde | ψed | 1 | |
| Factor de modificacion de fisuracion | ψc | 1.2 | |
| Factor de modificacion de fisuracion | ψh | 1 | |
| Resistencia al arrancamiento cortante | Vcb | 24947.6 | N |
| Resistencia al arrancamiento cortante | Vcb | 2.49 | Ton |

## Diseño de Conexiones

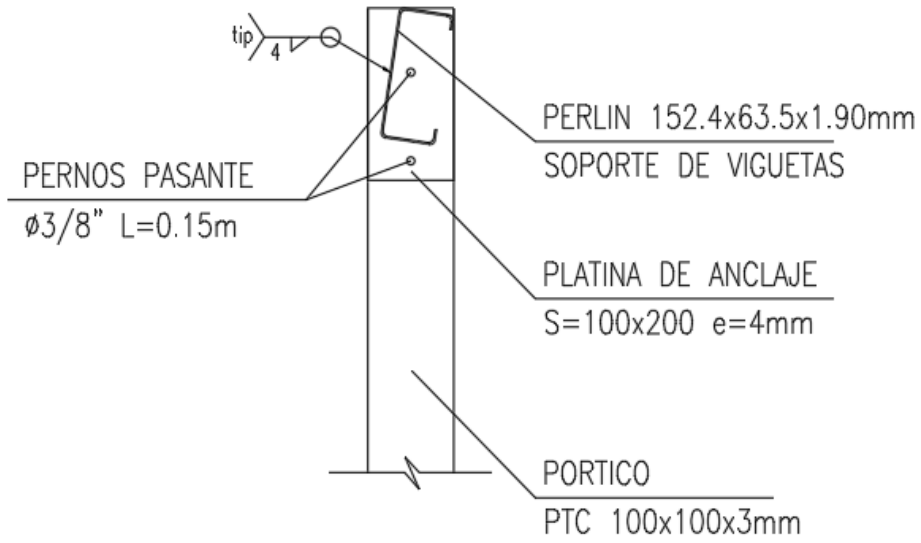
### *Placa Base*




| PLACA BASE | | |
|---|---|---|
| PERFIL | 100x100x3mm | |
| Area | 1125 | mm2 |
| Ancho (bf) | 100 | mm |
| Alto (d) | 100 | mm |
| Carga | 20 | KN |
| f´c | 21 | Mpa |
| fy | 320 | Mpa |
| | | |
| Area req pedestal | 1867.4 | mm2 |
| Lado req pedestal | 43.21 | mm |
| Ancho placa (B) | 300 | mm |

| | | |
|---|---|---|
| Largo placa(N) | 300 | mm |
| m | 102.5 | mm |
| n | 107.5 | mm |
| Esfuerzo efectivo (qu) | 0.22 | N/mm2 |
| Espesor req (tf) | 3.20 | mm |
| Espesor asumido /tf) | 4 | mm |

***Perlin a Columna***

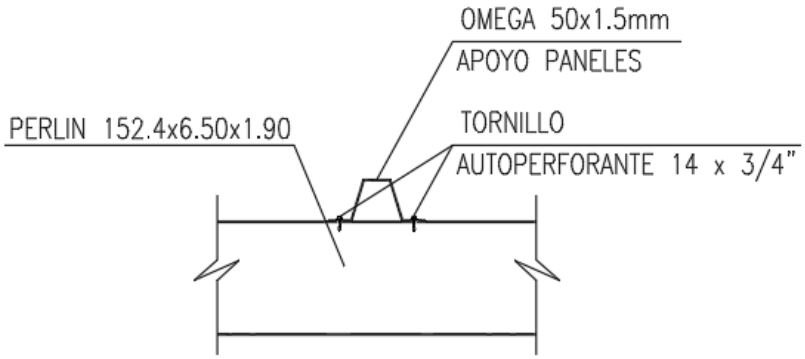



| | | | |
|---|---|---|---|
| **Materiales** | | | |
| Fy Platina | A 36 | 220 | Mpa |
| Perno | A325 | 460 | Mpa |
| | | 620 | Mpa |
| **Resistencia Pernos al cortante** | | | |
| Perno | 3/8" | 9.53 | mm |
| Anp | 71.26 | mm2 | |
| Fn | 24.58 | KN | |
| # pernos | 2 | | |
| Fn total | 49.17 | KN | |

| | | | |
|---|---|---|---|
| **Resistencia Pernos al cortante** | | | |
| Perno | 3/8" | 9.53 | mm |
| Anp | 71.26 | mm2 | |
| Fn | 24.58 | KN | |
| # pernos | 1 | | |
| Fn total | 24.58 | KN | |

| DISEÑO DE SOLDADURA | | | |
|---|---|---|---|
| D | 3 | mm | Garganta de soldadura |
| t | 2.12 | mm | Espesor efectivo de soldadura |
| Φ | 0.75 | | Factor de reduccion de resistencia |
| Vu | 13000 | N | Reaccion factorizada |
| Fw | 294 | Mpa | Esuerzo efectivo de la soldadura |
| Ls | 13.90 | mm | Longitud de soldadura |

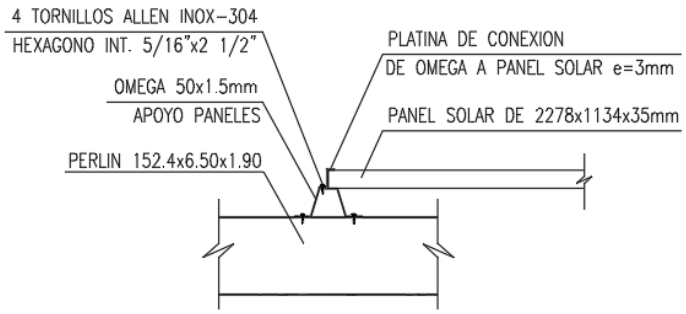
***Omega a Perlin***




**Materiales**

| | | |
|---|---|---|
| Perno Autoperforante | TKS3 | |
| Autoperforante | cal14/6.30mm | |
| **Resistencia Pernos al cortante** | | |
| Fn | 12.27 | KN |
| # pernos | 2 | |
| Fn total | 24.54 | KN |
| **Resistencia Pernos a Traccion** | | |
| Fn | 17.00 | KN |
| # pernos | 2 | |
| Fn total | 34.00 | KN |
| **Resistencia Arrancamiento** | | |
| Fn | 7.93 | KN |
| # pernos | 2 | |
| Fn total | 15.86 | KN |

*Omega a Panel*




**Materiales**

| | | | |
|---|---|---|---|
| Perno | A304 | Cortante190 | Mpa |
| | | Tension310 | Mpa |

**Resistencia Pernos al cortante**

| | | | |
|---|---|---|---|
| Perno | 5/16" | 7.94 | mm |
| Anp | 49.48 | mm2 | |
| Fn | 7.05 | KN | |
| # pernos | 4 | | |
| Fn total | 28.21 | KN | |

**Resistencia Pernos a tensión**

| | | | |
|---|---|---|---|
| Perno | 5/16" | 7.94 | mm |
| Anp | 49.48 | mm2 | |
| Fn | 11.50 | KN | |
| # pernos | 4 | | |
| Fn total | 46.02 | KN | |

**Ing. German Camilo Alfonso**
**MP25202129084CND**
**SINFRAC S.A.S**

## ANEXO

## CERTIFICADO DE VIGENCIA Y ANTECEDENTES DISCIPLINARIOS

REPÚBLICA DE COLOMBIA
COPNIA
Consejo Profesional Nacional de Ingeniería

Certificado de vigencia y antecedentes disciplinarios
CVAD-2025-3451694

**CONSEJO PROFESIONAL NACIONAL DE INGENIERÍA**
**COPNIA**

**EL DIRECTOR GENERAL**

**CERTIFICA:**

1. Que GERMAN CAMILO ALFONSO GONZALEZ, identificado(a) con CEDULA DE CIUDADANIA 80010131, se encuentra inscrito(a) en el Registro Profesional Nacional que lleva esta entidad, en la profesión de INGENIERIA CIVIL con MATRICULA PROFESIONAL 25202-129084 desde el 22 de Marzo de 2006, otorgado(a) mediante Resolución Nacional 117.

2. Que el(la) MATRICULA PROFESIONAL es la autorización que expide el Estado para que el titular ejerza su profesión en todo el territorio de la República de Colombia, de conformidad con lo dispuesto en la Ley 842 de 2003.

3. Que el(la) referido(a) MATRICULA PROFESIONAL se encuentra **VIGENTE**

4. Que el profesional no tiene antecedentes disciplinarios ético-profesionales.

5. Que la presente certificación se expide en Bogotá, D.C., a los once (11) días del mes de Marzo del año dos mil veinticinco (2025).

**Rubén Dario Ochoa Arbeláez**

Firmal del titular (*)

(*)Con el fin de verificar que el titular autoriza su participación en procesos estatales de selección de contratistas. La falta de firma del titular no invalida el Certificado
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## DOCUMENTOS


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C.C. 80010131
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PRESIDENTE DEL CONSEJO


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FECHA DE NACIMIENTO 15-OCT-1979
BOGOTA D.C.
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LUGAR DE NACIMIENTO
1.81
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M
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14-NOV-1997 BOGOTA D.C.
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REGISTRADOR NACIONAL
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