UNIVERSIDAD AUTONOMA "JUAN MISAEL SARACHO"
FACULTAD DE CIENCIAS Y TECNOLOGIA
PROGRAMA DE INGENIERIA CIVIL
LABORTARIO DE SUELOS

# HUMEDAD NATURAL Y RESUMEN DE CLASIFICACION DEL SUELO

| | | |
|---|---|---|
| **Proyecto:** | COMPARACIÓN DEL DIMENSIONAMIENTO DE PAVIMENTOS DE CONCRETO ENTRE LOS MÉTODOS PCA CÁLCULO Y STREET PAVE EN PROCESAMIENTO Y RESULTADOS APLICADO A NUESTRA REGIÓN | **Identificacion:**<br>Muestra-Tabladita |
| **Elaborado por:** | Univ. Roye Velasco Cardenas | |

Sub Rasante

| HUMEDAD NATURAL | |
|---|---|
| Peso de suelo húmedo | 11.35 |
| Peso de suelo seco | 11.11 |
| Peso del agua | 0.24 |
| Contenido de humedad | 2.16 |

Resumen:

| CLASIFICACIÓN DEL SUELO | | DESCRIPCIÓN |
|---|---|---|
| **SUCS:** | GM-GC | Suelo gravoso conpresencia de limo organico o arcilla |
| **AASHTO:** | A-4 (2) | |

Univ. Roye Velasco Cardenas
**LABORATORISTA**

Ing. José Ricardo Arce
**ENCARGADO DEL LABORATORIO DE SUELOS**

NOTA: El laboratorio de suelos de ingenieria civil no se hace responsable de los resultados que plantea esta investigacion, es completamente responsabilidad del autor.

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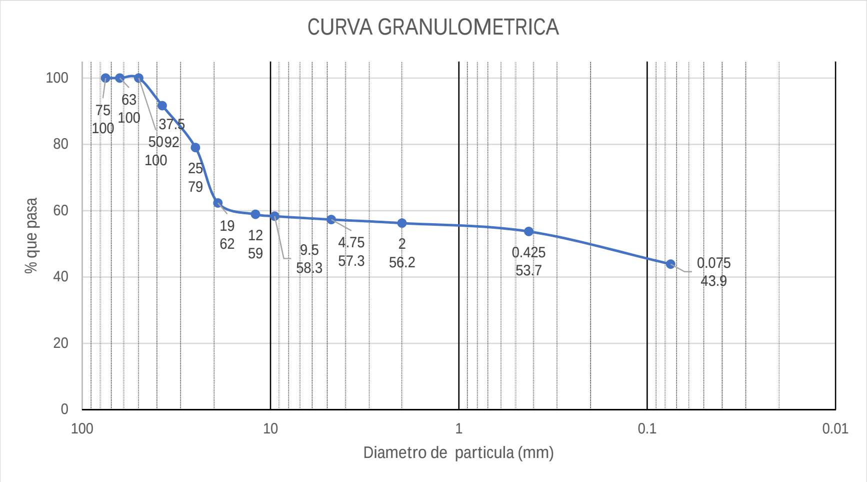
## ANALISIS GRANULOMETRICO POR TAMICES

| | | | |
|---|---|---|---|
| **Proyecto:** | COMPARACIÓN DEL DIMENSIONAMIENTO DE PAVIMENTOS DE CONCRETO ENTRE LOS MÉTODOS PCA CÁLCULO Y STREET PAVE EN PROCESAMIENTO Y RESULTADOS APLICADO A NUESTRA REGIÓN | **Identificacion:** | Muestra-Tabladita |
| **Elaborado por:** | Univ. Roye Velasco Cardenas | | |

| Peso suelo seco (g) | | 4000 | | | |
|---|---|---|---|---|---|
| Tamaño nominal del tamiz | | Peso retenido (g) | Peso retenido Acum. | % retenido | % que pasa |
| (mm) | alternativo (plg) | | | | |
| 75 | 3 | 0 | 0 | 0.0 | 100 |
| 63 | 2 1/2 | 0 | 0 | 0.0 | 100 |
| 50 | 2 | 0 | 0 | 0.0 | 100 |
| 37.5 | 1 1/2 | 333.16 | 333.16 | 8.3 | 92 |
| 25 | 1 | 505.5 | 838.66 | 21.0 | 79 |
| 19 | 3/4 | 667.82 | 1506.48 | 37.7 | 62 |
| 12 | 1/2 | 137.65 | 1644.13 | 41.1 | 59 |
| 9.5 | 3/8 | 21.96 | 1666.09 | 41.7 | 58.3 |
| 4.75 | N° 4 | 40.58 | 1706.67 | 42.7 | 57.3 |
| 2 | N° 10 | 43.63 | 1750.3 | 43.8 | 56.2 |
| 0.425 | N° 40 | 100.2 | 1850.5 | 46.3 | 53.7 |
| 0.075 | N° 200 | 394.0 | 2244.5 | 56.1 | 43.9 |
| TABLA AUXILIAR | | Metodo de lavado | | | |
| Peso suelo seco (g) | | 503.2 | | | |
| 0.425 | N° 40 | 50.8 | 101.6 | 20.2 | 79.8 |
| 0.075 | N° 200 | 150.1 | 251.7 | 50.0 | 50.0 |



Resumen:

| Limites de tamaño de suelos separados | |
|---|---|
| Grava (%) | 42.667 |
| Arena gruesa a media (%) | 3.596 |
| Arena fina (%) | 9.851 |
| Limo Y Arcilla (%) | 43.887 |

| | |
|---|---|
| Univ. Roye Velasco Cardenas | Ing. José Ricardo Arce |
| **LABORATORISTA** | **ENCARGADO DEL LABORATORIO DE SUELOS** |

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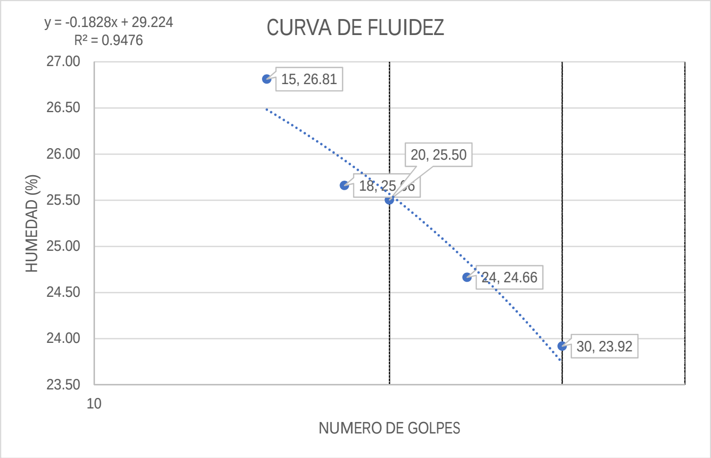
LABORTARIO DE SUELOS

## LÍMITE LÍQUIDO, LÍMITE PLÁSTICO E ÍNDICE DE PLASTICIDAD

| | | |
|---|---|---|
| **Proyecto:** | COMPARACIÓN DEL DIMENSIONAMIENTO DE PAVIMENTOS DE CONCRETO ENTRE LOS MÉTODOS PCA CÁLCULO Y STREET PAVE EN PROCESAMIENTO Y RESULTADOS APLICADO A NUESTRA REGIÓN | **Identificacion:** |
| **Elaborado por:** | Univ. Roye Velasco Cardenas | Muestra-Tabladita |

| | ENSAYO N° | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|---|
| | CAPSULA N° | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 |
| | NUMERO DE GOLPES | 15 | 18 | 20 | 24 | 30 | | | |
| 1 | PESO CAPSULA + SUELO HUM. (g) | 24.84 | 24.36 | 27.64 | 28.75 | 25.42 | 13.4 | 12.65 | 13.01 |
| 2 | PESO CAPSULA + SUELO SECO (g) | 21.77 | 21.93 | 24.6 | 25.81 | 22.93 | 13.27 | 12.51 | 12.94 |
| 3 | PESO DE LA CAPSULA (g) | 10.32 | 12.46 | 12.68 | 13.89 | 12.52 | 12.65 | 11.78 | 12.56 |
| 4 | PESO DEL AGUA (1-2) (g) | 3.07 | 2.43 | 3.04 | 2.94 | 2.49 | 0.13 | 0.14 | 0.07 |
| 5 | PESO DEL SUELO SECO (2-3) (g) | 11.45 | 9.47 | 11.92 | 11.92 | 10.41 | 0.62 | 0.73 | 0.38 |
| 6 | HUMEDAD (4/5)*100 (%) | 26.81 | 25.66 | 25.50 | 24.66 | 23.92 | 20.97 | 19.18 | 18.42 |
| 7 | PROMEDIO LIMITE PLASTICO (%) | | | | | | 18.80 | | |



Resumen:

| | | |
|---|---|---|
| Ecuacion | -0.1828 | 29.224 |
| Limite Liquido (%) | 24.654 | |
| Limite Plastico (%) | 18.80 | |
| Indice de Plasticidad (%) | 5.85 | |

| | |
|---|---|
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## CLASIFICACION DE SUELOS AASHTO - SUCS

| | | |
|---|---|---|
| **Proyecto:** | COMPARACIÓN DEL DIMENSIONAMIENTO DE PAVIMENTOS DE CONCRETO ENTRE LOS MÉTODOS PCA CÁLCULO Y STREET PAVE EN PROCESAMIENTO Y RESULTADOS APLICADO A NUESTRA REGIÓN | **Identificacion:** |
| | | Muestra-Tabladita |
| **Elaborado por:** | Univ. Roye Velasco Cardenas | |

| | |
|---|---|
| Indice de grupo | 2 |
| a | 9 |
| b | 29 |
| c | 0 |
| d | 0 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLASIFICACION | Materiales Granulares (35% o menos del total pasa el Tamiz N° 200 | | | | | | | Materiales Limos Arcillosos (mas del 35% del total pasa el Tamiz N° 200 | | | | |
| | NO CUMPLE | | | | | | | CUMPLE | | | | |
| Clasificacion de grupo | A-1 | | A-3 | A-2 | | | | A-4 | A-5 | A-6 | A-7 | |
| | A-1-a | A-1-b | | A-2-4 | A-2-5 | A-2-6 | A-2-7 | | | | A-7-5 | A-7-6 |
| Porcentaje de material que pasa el tamiz | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| N°10 | 50 máx | | | | | | | | | | | |
| | NO CUMPLE | | | | | | | | | | | |
| N°40 | 30 máx | 50 máx | 51 min | | | | | | | | | |
| | NO CUMPLE | NO CUMPLE | CUMPLE | | | | | | | | | |
| N°200 | 15 máx | 25 máx | 10 máx | 35 máx | 35 máx | 35 máx | 35 máx | 36 min | 36 min | 36 min | 36 min | |
| | NO CUMPLE | NO CUMPLE | NO CUMPLE | NO CUMPLE | NO CUMPLE | NO CUMPLE | NO CUMPLE | CUMPLE | CUMPLE | CUMPLE | CUMPLE | |
| Caracteristicas de la fraccion que pasa el tamiz N°40 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| LL | | | | 40 máx | 41 min | 40 máx | 41 min | 40 máx | 41 min | 40 máx | 41 min | |
| | | | | CUMPLE | NO CUMPLE | CUMPLE | NO CUMPLE | CUMPLE | NO CUMPLE | CUMPLE | NO CUMPLE | |
| IP | 6 máx | | NP | 10 max | 10 max | 11 min | 11 min | 10 max | 10 max | 11 min | 11 min | |
| | CUMPLE | | | CUMPLE | CUMPLE | NO CUMPLE | NO CUMPLE | CUMPLE | CUMPLE | NO CUMPLE | NO CUMPLE | |
| Indice de grupo | 0 | | 0 | 0 | | 4 máx | | 8 máx | 12 máx | 16 máx | 20 máx | |
| | NO CUMPLE | | NO CUMPLE | NO CUMPLE | | CUMPLE | | CUMPLE | CUMPLE | CUMPLE | CUMPLE | |

Resumen:

| **CLASIFICACIÓN DEL SUELO** | | **DESCRIPCIÓN** |
|---|---|---|
| **SUCS:** | GM-GC | Suelo gravoso conpresencia de limo organico o arcilla |
| **AASHTO:** | A-4 (2) | |

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## RELACIONES DE PESO UNITARIO – HUMEDAD EN LOS SUELOS – MÉTODO MODIFICADO

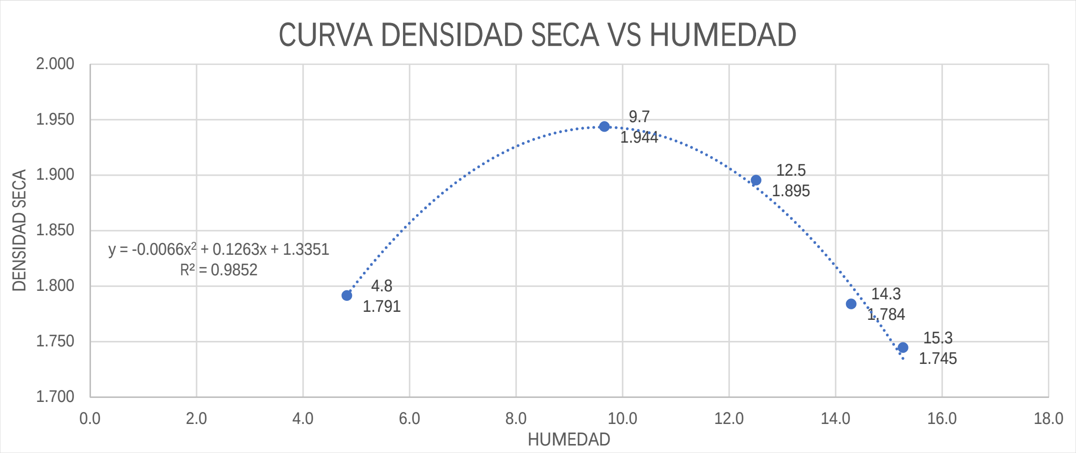
| | | |
|---|---|---|
| **Proyecto:** | COMPARACION DEL DIMENSIONAMIENTO DE PAVIMENTOS DE CONCRETO ENTRE LOS MÉTODOS PCA CÁLCULO Y STREET PAVE EN PROCESAMIENTO Y RESULTADOS APLICADO A NUESTRA REGIÓN | **Identificacion:** |
| **Elaborado por:** | Univ. Roye Velasco Cardenas | Muestra-Tabladita |

Determinacion del contenido de humedad

| Muestra N° | 1 | | 2 | | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| CAPSULA N° | 1.1 | 1.2 | 2.1 | 2.2 | 3.1 | 3.2 | 4.1 | 4.2 | 0 | 0 |
| PESO CAPSULA + SUELO HUM. (g) | 61.38 | 61.38 | 47.35 | 47.35 | 45.62 | 45.62 | 53.25 | 53.25 | 76.38 | 76.38 |
| PESO CAPSULA + SUELO SECO (g) | 59.03 | 59.03 | 44.38 | 44.38 | 41.95 | 41.95 | 48.18 | 48.18 | 67.92 | 67.92 |
| PESO DE LA CAPSULA (g) | 10.32 | 10.32 | 13.64 | 13.64 | 12.61 | 12.61 | 12.71 | 12.71 | 12.51 | 12.51 |
| PESO DEL AGUA (1-2) (g) | 2.4 | 2.4 | 3.0 | 3.0 | 3.7 | 3.7 | 5.1 | 5.1 | 8.5 | 8.5 |
| PESO DEL SUELO SECO (2-3) (g) | 48.7 | 48.7 | 30.7 | 30.7 | 29.3 | 29.3 | 35.5 | 35.5 | 55.4 | 55.4 |
| HUMEDAD (4/5)*100 (%) | 4.8 | 4.8 | 9.7 | 9.7 | 12.5 | 12.5 | 14.3 | 14.3 | 15.3 | 15.3 |
| Contenido de humedad w% | 4.8 | | 9.7 | | 12.5 | | 14.3 | | 15.3 | |

Determinacion de la densidad

| Contenido de humedad deseado % | 4 | 8 | 12 | 16 | 0 |
|---|---|---|---|---|---|
| N° de capas | 5 | 5 | 5 | 5 | 5 |
| N° de golpes por capa | 56 | 56 | 56 | 56 | 56 |
| Contenido de humedad w% | 4.8 | 9.7 | 12.5 | 14.3 | 15.3 |
| Peso de suelo humedo + molde (g) | 10413.2 | 10952.0 | 10954.2 | 10755.3 | 10695.8 |
| Peso del molde (g) | 6424.7 | 6424.7 | 6424.7 | 6424.7 | 6424.7 |
| Peso del suelo humedo sin molde (g) | 3988.5 | 4527.3 | 4529.5 | 4330.6 | 4271.1 |
| Volumen de la muestra | 2124.0 | 2124.0 | 2124.0 | 2124.0 | 2124.0 |
| Densidad humeda (gr/cm^3) | 1.878 | 2.131 | 2.133 | 2.039 | 2.011 |
| densidad seca (gr/cm^3) | 1.791 | 1.944 | 1.895 | 1.784 | 1.745 |



| Resumen | x^2 | x | c |
|---|---|---|---|
| Ecuacion | -0.0066 | 0.1263 | 1.3351 |
| Humedad optima % | 9.57 | | |
| Densidad maxima (gr/cm^3) | 1.939 | | |

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# CALIFORNIA BEARING RATIO C.B.R.

| | | | |
|---|---|---|---|
| **Proyecto:** | COMPARACION DEL DIMENSIONAMIENTO DE PAVIMENTOS DE CONCRETO ENTRE LOS MÉTODOS PCA CÁLCULO Y STREET PAVE EN PROCESAMIENTO Y RESULTADOS APLICADO A NUESTRA REGIÓN | **Identificacion:** | Muestra-Tabladita |
| **Elaborado por:** | Univ. Roye Velasco Cardenas | | |

| Muestra | **LL** | **IP** | Clasifi | H. Opt. | D. Max. |
|---|---|---|---|---|---|
| | | | A-4(2) | 9.57 | 1.94 |

## CONTENIDO DE HUMEDAD Y PESO UNITARIO DE LAS MUESTRAS

| Molde N° | 1 | | | 2 | | | 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Nº de Capas | 5 | | | 5 | | | 5 | | |
| Nº de Golpes por capa | 12 | | | 25 | | | 56 | | |
| **CONDICIONES DE SATURACION DE LA MUESTRA** | **ANTES DE SATURARSE** | | **DESPUES DE SAT.** | **ANTES DE SATURARSE** | | **DESPUES DE SAT.** | **ANTES DE SATURARSE** | | **DESPUES DE SAT.** |
| Peso de muestra húmeda+molde (gr) | 11660 | | 11890 | 12040 | | 12220 | 12320 | | 12480 |
| Peso del molde (gr) | 7886 | | 7886 | 7860 | | 7860 | 7890 | | 7890 |
| Peso de muestra húmeda (gr) | 3774 | | 4004 | 4180 | | 4360 | 4430 | | 4590 |
| Volumen de la muestra (cm3) | 2124.0 | | 2124.0 | 2124.0 | | 2124.0 | 2124.0 | | 2124.0 |
| Densidad de muestra humeda (gr/cm3) | 1.78 | | 1.89 | 1.97 | | 2.05 | 2.09 | | 2.16 |
| **MUESTRAS PARA HUMEDAD** | **FONDO** | **SUPERF.** | **2" SUP.** | **FONDO** | **SUPERF.** | **2" SUP.** | **FONDO** | **SUPERF.** | **2" SUP.** |
| Capsula Nº | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 3.3 |
| Peso muestra húm.+ capsula (gr) | 77.09 | 57.20 | 43.17 | 54.51 | 64.24 | 66.25 | 58.66 | 40.63 | 63.19 |
| Peso muestra seca + capsula (gr) | 67.03 | 50.35 | 38.15 | 48.97 | 57.01 | 58.58 | 53.73 | 37.56 | 57.12 |
| Peso del agua (gr) | 10.06 | 6.85 | 5.02 | 5.54 | 7.23 | 7.67 | 4.93 | 3.07 | 6.07 |
| Peso de la capsula (gr) | 12.53 | 13.72 | 12.61 | 13.29 | 13.16 | 12.77 | 13.13 | 12.58 | 11.71 |
| Peso de la muestra seca (gr) | 54.50 | 36.63 | 25.54 | 35.68 | 43.85 | 45.81 | 40.60 | 24.98 | 45.41 |
| Contenido de Humedad (%) | 18.46 | 18.70 | 19.66 | 15.53 | 16.49 | 16.74 | 12.14 | 12.29 | 13.37 |
| Promedio contenido humedad (%) | 18.580 | | 19.655 | 16.007 | | 16.743 | 12.216 | | 13.367 |
| Densidad de muestra seca (gr/cm3) | 1.498 | | 1.575 | 1.696 | | 1.758 | 1.859 | | 1.906 |

| FECHA | HORA | TIEMPO EN DIAS |
|---|---|---|
| 04-dic | 11:00 | INICIO |
| 05-dic | 09:00 | 1 |
| 06-dic | 11:00 | 2 |
| 07-dic | 07:32 | 3 |
| 08-dic | 08:32 | 4 |

| MOLDE Nº 1 | | | MOLDE Nº 2 | | | MOLDE Nº 3 | | |
|---|---|---|---|---|---|---|---|---|
| LECT. EXTENS. | EXPANSION | | LECT. EXTENS. | EXPANSION | | LECT. EXTENS. | EXPANSION | |
| | mm. | % | | mm. | % | | mm. | % |
| 15.74 | 0 | 0 | 16.5 | 0 | 0 | 20.11 | 0 | 0 |
| 20.28 | 4.54 | 3.89 | 19.7 | 3.20 | 2.74 | 22.33 | 2.22 | 1.90 |
| 20.75 | 5.01 | 4.30 | 20.12 | 3.62 | 3.10 | 23 | 2.89 | 2.48 |
| 20.93 | 5.19 | 4.45 | 20.26 | 3.76 | 3.22 | 23.07 | 2.96 | 2.54 |
| 21.02 | 5.28 | 4.53 | 20.3 | 3.80 | 3.26 | 23.12 | 3.01 | 2.58 |

## ENSAYO DE PENETRACION

| PENETRACION | | MOLDE Nº º1 | | | | MOLDE Nº 2 | | | | MOLDE 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pulg. | Cm. | Carga de ensayo | | | CBR | Carga de ensayo | | | CBR | Carga de ensayo | | | CBR |
| | | Lect. | Kg | kg/cm2 | % | Lect. | Kg | kg/cm2 | % | Lect. | Kg | Kg/cm2 | % |
| 0 | 0 | 0.0 | 0.0 | 0.0 | | 0 | 0 | 0 | | 0 | 0 | 0 | |
| 0.025 | 0.63 | 1.0 | 47.6 | 2.46 | | 3 | 53.7 | 2.77 | | 7.5 | 67.4 | 3.48 | |
| 0.050 | 1.270 | 2.5 | 52.2 | 2.69 | | 5.5 | 61.3 | 3.17 | | 15.5 | 91.9 | 4.75 | |
| 0.075 | 1.9 | 4.0 | 56.7 | 2.93 | | 7.5 | 67.4 | 3.48 | | 21 | 108.7 | 5.62 | |
| 0.1 | 2.54 | 5.5 | 61.3 | 3.17 | 4.51 | 12 | 81.2 | 4.19 | 5.97 | 30 | 136.2 | 7.04 | 10.01 |
| 0.2 | 5.08 | 14.0 | 87.3 | 4.51 | 4.28 | 26 | 124.0 | 6.40 | 6.08 | 51.5 | 201.9 | 10.43 | 9.90 |
| 0.3 | 7.62 | 17.0 | 96.5 | 4.98 | | 31 | 139.2 | 7.19 | | 61.5 | 232.5 | 12.01 | |
| 0.4 | 10.16 | 20.0 | 105.6 | 5.46 | | 35.5 | 153.0 | 7.90 | | 69 | 255.4 | 13.19 | |
| 0.5 | 12.7 | 23.0 | 114.8 | 5.93 | | 41 | 169.8 | 8.77 | | 72 | 264.5 | 13.67 | |

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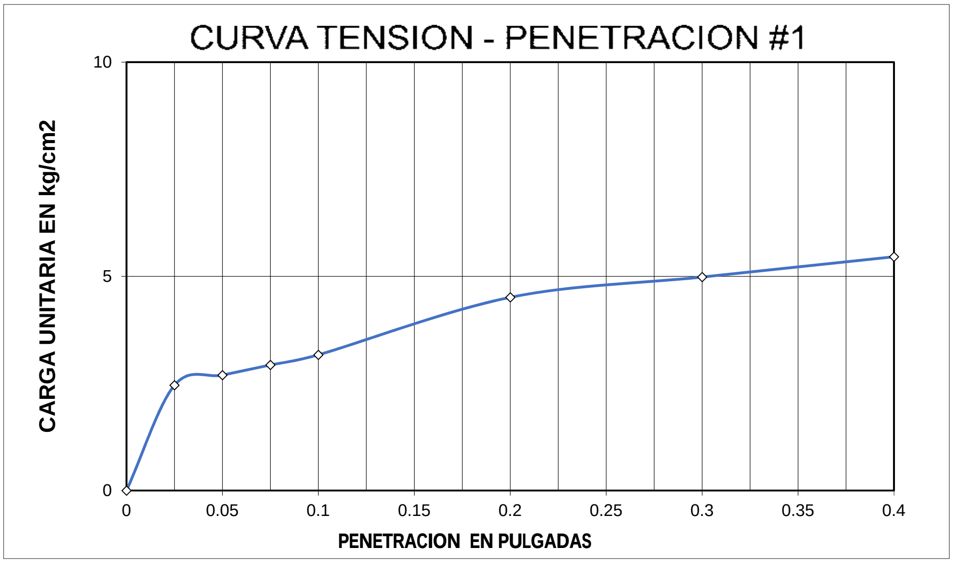

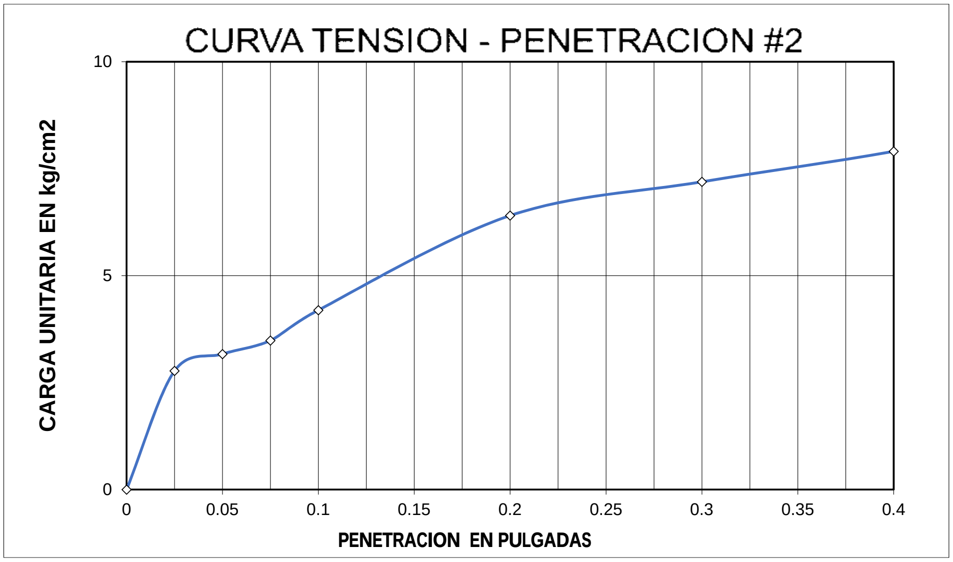

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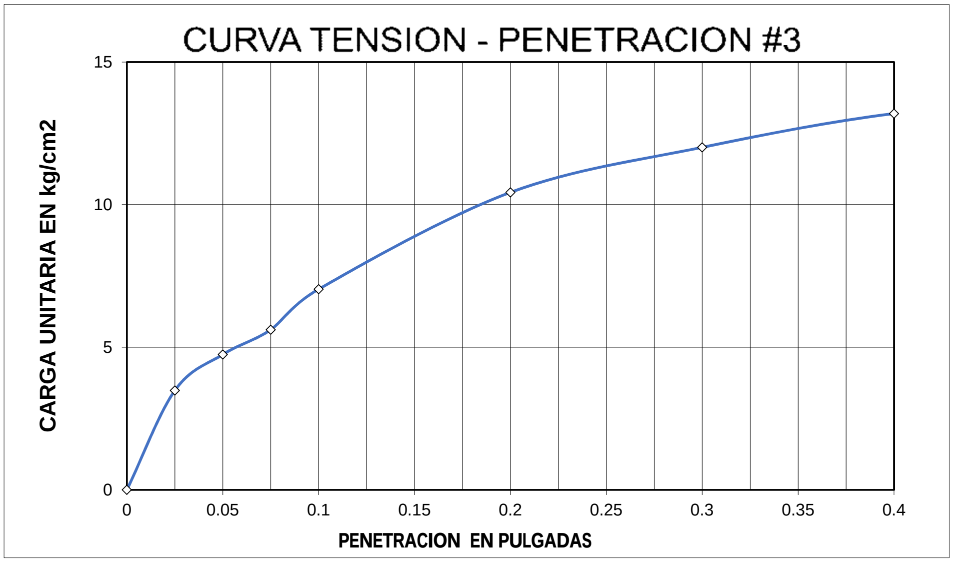

ENSAYO DE PENETRACION FINAL

| PENETRACION | | MOLDE Nº º1 | | | | MOLDE Nº 2 | | | | MOLDE 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Carga de ensayo | | | CBR | Carga de ensayo | | | CBR | Carga de ensayo | | | CBR |
| Pulg. | Cm. | Lect. | Kg | kg/cm2 | % | Lect. | Kg | kg/cm2 | % | Lect. | Kg | Kg/cm2 | % |
| 0.1 | 2.54 | | 61.3 | 3.17 | 4.51 | | 81.2 | 4.19 | 5.97 | | 136.2 | 7.04 | 10.01 |
| 0.2 | 5.08 | | 87.3 | 4.51 | 4.28 | | 124.0 | 6.40 | 6.08 | | 201.9 | 10.43 | 9.90 |

| **NUMERO DE GOLPES** | 12 | 25 | 56 |
|---|---|---|---|
| **CBR (%) CORREGIDOS** | 4.28 | 6.08 | 9.90 |
| **DENSIDAD SECA (gr/cm3)** | 1.4984 | 1.6964 | 1.8586 |

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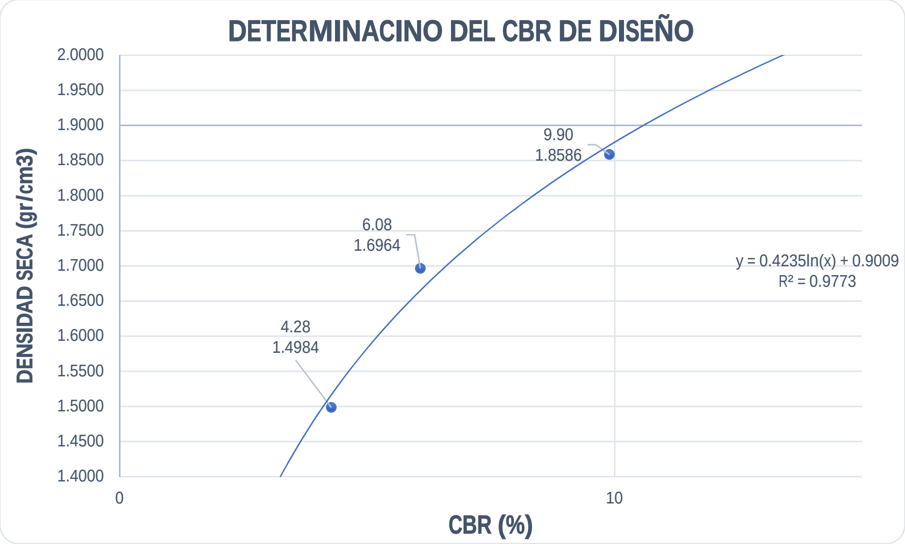

| Resumen | x | c |
|---|---|---|
| Ecuacion | 0.4235 | 0.9009 |
| CBR 100% D.máx | 11.6118 | |
| CBR 95% D.Máx. | 9.2355 | |
| Peso unitario (gr/cm3) | 1.939 | |
| Hum. Opt. (%) | 9.570 | |

Univ. Roye Velasco Cardenas
**LABORATORISTA**

Ing. José Ricardo Arce
**ENCARGADO DEL LABORATORIO DE SUELOS**

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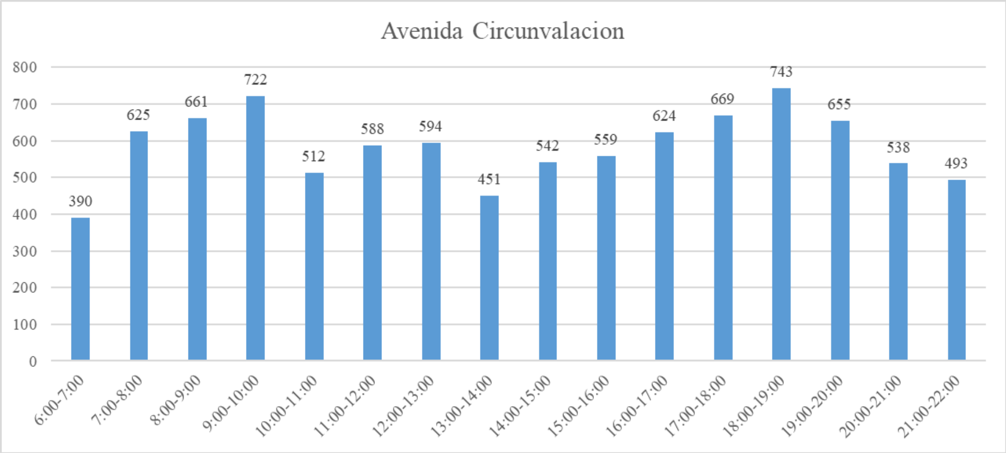
# ANEXO N°2

## AFORO DE TRAFICO

## Aforo diario del tramo avenida circunvalación

| Avenida Circunvalacion (23/04/2021) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tipo de vehiculo** | **Numero de vehiculos** | | | | | | | | | | | | | | | |
| | 6:00-7:00 | 7:00-8:00 | 8:00-9:00 | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-13:00 | 13:00-14:00 | 14:00-15:00 | 15:00-16:00 | 16:00-17:00 | 17:00-18:00 | 18:00-19:00 | 19:00-20:00 | 20:00-21:00 | 21:00-22:00 |
| Autos | 354 | 552 | 590 | 636 | 453 | 515 | 529 | 410 | 490 | 505 | 555 | 598 | 678 | 608 | 494 | 458 |
| Micros | 1 | 20 | 13 | 14 | 8 | 6 | 9 | 8 | 10 | 15 | 11 | 11 | 12 | 18 | 16 | 10 |
| Flotas | 1 | 0 | 3 | 1 | 2 | 4 | 3 | 2 | 2 | 0 | 7 | 9 | 10 | 5 | 10 | 7 |
| Camiones (Eje Simple) | 32 | 44 | 39 | 57 | 39 | 52 | 39 | 20 | 30 | 30 | 41 | 40 | 30 | 20 | 12 | 14 |
| Camiones (Eje tandem) | 2 | 5 | 10 | 12 | 5 | 5 | 7 | 9 | 7 | 2 | 4 | 7 | 9 | 1 | 4 | 3 |
| Trailer | 0 | 2 | 3 | 1 | 5 | 5 | 4 | 2 | 3 | 6 | 6 | 4 | 4 | 3 | 2 | 1 |
| Otros | 0 | 2 | 3 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 390 | 625 | 661 | 722 | 512 | 588 | 594 | 451 | 542 | 559 | 624 | 669 | 743 | 655 | 538 | 493 |

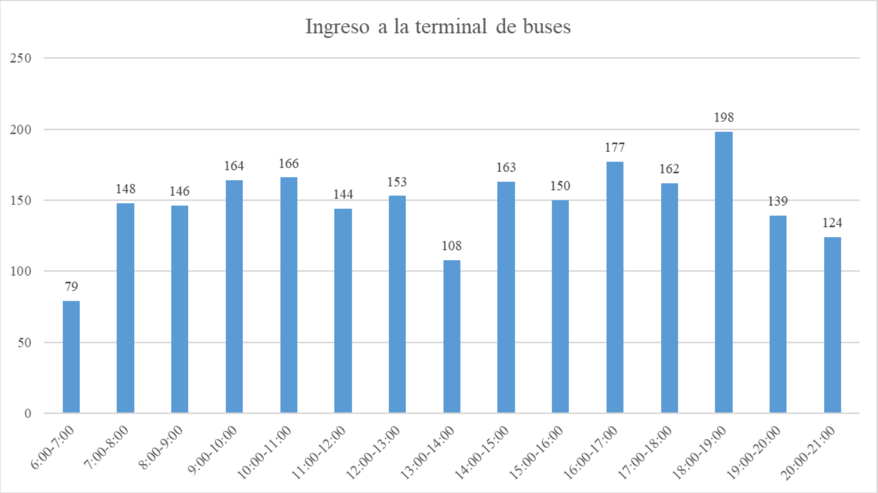
Histograma de flujo vehicular diario



## Aforo diario del tramo ingreso a la terminal de buses

| Ingreso a la terminal de buses (26/04/2021) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tipo de vehiculo** | **Numero de vehiculos** | | | | | | | | | | | | | | | |
| | 6:00-7:00 | 7:00-8:00 | 8:00-9:00 | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-13:00 | 13:00-14:00 | 14:00-15:00 | 15:00-16:00 | 16:00-17:00 | 17:00-18:00 | 18:00-19:00 | 19:00-20:00 | 20:00-21:00 | 21:00-22:00 |
| Autos | 63 | 102 | 113 | 128 | 126 | 109 | 114 | 82 | 122 | 121 | 140 | 138 | 156 | 119 | 110 | 94 |
| Micros | 10 | 26 | 20 | 23 | 21 | 20 | 21 | 16 | 22 | 16 | 17 | 18 | 22 | 16 | 10 | 6 |
| Flotas | 3 | 8 | 1 | 1 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 2 |
| Camiones (Eje Simple) | 1 | 2 | 2 | 0 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 0 | 2 | 0 | 0 | 1 |
| Camiones (Eje tandem) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trailer | 2 | 10 | 10 | 12 | 14 | 12 | 15 | 8 | 17 | 10 | 17 | 6 | 16 | 4 | 3 | 0 |
| Otros | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 79 | 148 | 146 | 164 | 166 | 144 | 153 | 108 | 163 | 150 | 177 | 162 | 198 | 139 | 124 | 103 |

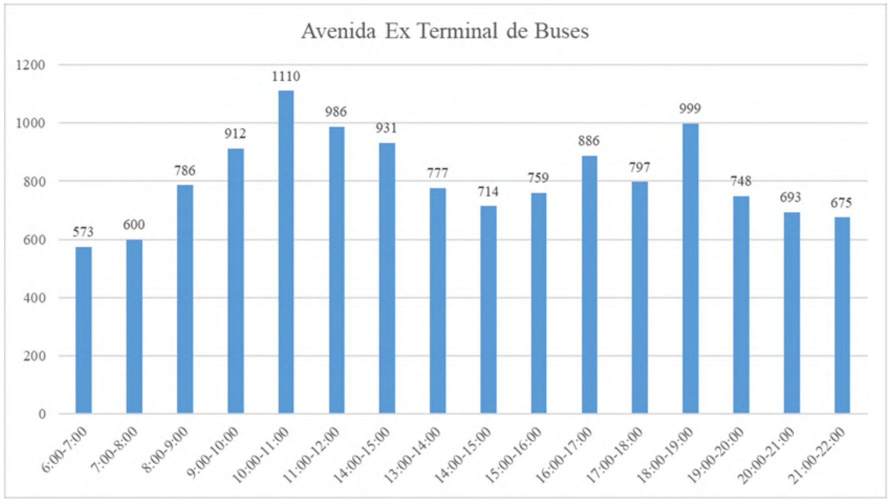
## Histograma de flujo vehicular diario



# Aforo diario del tramo avenida Jaime Paz Zamora (Ex terminal de buses)

| **Avenida Ex Terminal de Buses (24/04/2021)** | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tipo de vehiculo** | **Numero de vehiculos** | | | | | | | | | | | | | | | |
| | 6:00-7:00 | 7:00-8:00 | 8:00-9:00 | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-13:00 | 13:00-14:00 | 14:00-15:00 | 15:00-16:00 | 16:00-17:00 | 17:00-18:00 | 18:00-19:00 | 19:00-20:00 | 20:00-21:00 | 21:00-22:00 |
| Autos | 553 | 558 | 728 | 857 | 1038 | 940 | 903 | 744 | 690 | 740 | 865 | 770 | 992 | 735 | 684 | 669 |
| Micros | 1 | 3 | 4 | 0 | 4 | 4 | 1 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 0 | 1 |
| Flotas | 1 | 0 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 0 | 0 | 2 | 1 |
| Camiones (Eje Simple) | 16 | 31 | 48 | 50 | 62 | 40 | 24 | 24 | 19 | 14 | 17 | 19 | 6 | 10 | 6 | 4 |
| Camiones (Eje tandem) | 2 | 8 | 3 | 3 | 2 | 1 | 2 | 4 | 3 | 1 | 0 | 6 | 0 | 2 | 1 | 0 |
| Trailer | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Otros | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 573 | 600 | 786 | 912 | 1110 | 986 | 931 | 777 | 714 | 759 | 886 | 797 | 999 | 748 | 693 | 675 |

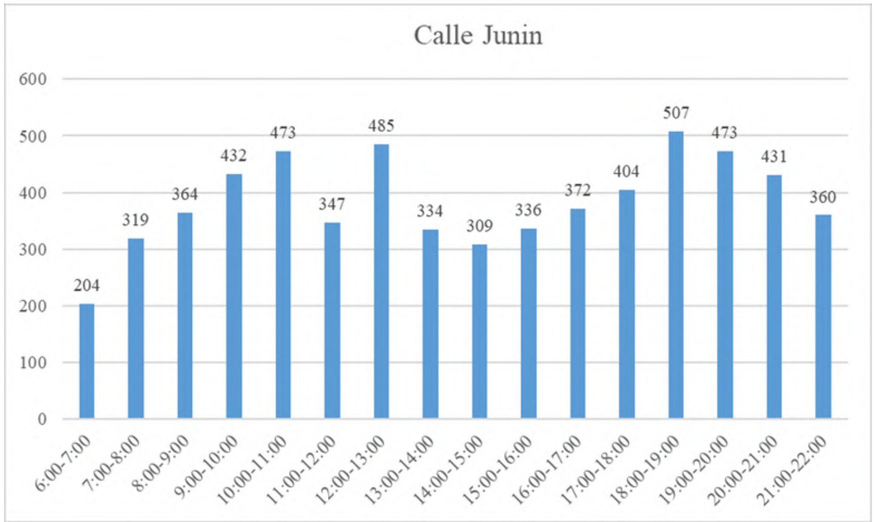
Histograma de flujo vehicular diario



# Aforo diario del tramo calle Junín

| Calle Junin (27/04/2021) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tipo de vehiculo** | **Numero de vehiculos** | | | | | | | | | | | | | | | |
| | 6:00-7:00 | 7:00-8:00 | 8:00-9:00 | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-13:00 | 13:00-14:00 | 14:00-15:00 | 15:00-16:00 | 16:00-17:00 | 17:00-18:00 | 18:00-19:00 | 19:00-20:00 | 20:00-21:00 | 21:00-22:00 |
| Autos | 190 | 280 | 314 | 348 | 392 | 261 | 386 | 264 | 243 | 265 | 294 | 328 | 413 | 388 | 356 | 297 |
| Micros | 3 | 5 | 6 | 6 | 8 | 4 | 6 | 8 | 6 | 3 | 5 | 6 | 8 | 5 | 4 | 1 |
| Flotas | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Camiones (Eje Simple) | 1 | 4 | 7 | 9 | 5 | 6 | 10 | 0 | 2 | 3 | 1 | 6 | 2 | 4 | 0 | 0 |
| Camiones (Eje tandem) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trailer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Otros | 10 | 30 | 37 | 69 | 68 | 76 | 83 | 62 | 58 | 65 | 72 | 64 | 84 | 76 | 71 | 62 |
| **Total** | 204 | 319 | 364 | 432 | 473 | 347 | 485 | 334 | 309 | 336 | 372 | 404 | 507 | 473 | 431 | 360 |

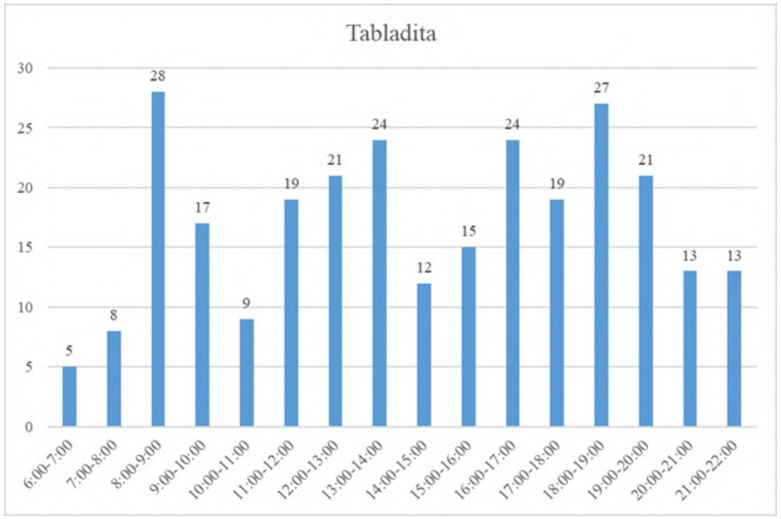
Histograma de flujo vehicular diario



# Aforo diario del tramo avenida Violín Chapaco

| Tabladita (28/04/2021) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tipo de vehiculo** | **Numero de vehiculos** | | | | | | | | | | | | | | | |
| | 6:00-7:00 | 7:00-8:00 | 8:00-9:00 | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-13:00 | 13:00-14:00 | 14:00-15:00 | 15:00-16:00 | 16:00-17:00 | 17:00-18:00 | 18:00-19:00 | 19:00-20:00 | 20:00-21:00 | 21:00-22:00 |
| Autos | 1 | 0 | 16 | 5 | 1 | 10 | 13 | 9 | 3 | 1 | 10 | 7 | 12 | 6 | 4 | 3 |
| Micros | 4 | 6 | 11 | 8 | 8 | 7 | 7 | 10 | 6 | 8 | 10 | 10 | 11 | 8 | 5 | 3 |
| Flotas | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Camiones (Eje Simple) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Camiones (Eje tandem) | 0 | 2 | 1 | 4 | 0 | 2 | 1 | 5 | 3 | 6 | 4 | 2 | 4 | 6 | 4 | 7 |
| Trailer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Otros | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 5 | 8 | 28 | 17 | 9 | 19 | 21 | 24 | 12 | 15 | 24 | 19 | 27 | 21 | 13 | 13 |

Histograma de flujo vehicular diario



## Trafico promedio diario

- **Tramo Avenida circunvalación**

### Aforo en horas pico para vehículos

| Número de vehículos | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Fecha** | **Izquierda** | | | **Derecha** | | |
| | | **9:00-10:00** | **12:00-13:00** | **18:00-19:00** | **9:00-10:00** | **12:00-13:00** | **18:00-19:00** |
| **Autos** | 27/04/2021 | 556 | 565 | 645 | 769 | 675 | 813 |
| | 30/04/2021 | 765 | 707 | 801 | 860 | 750 | 726 |
| | 01/05/2021 | 585 | 668 | 565 | 880 | 684 | 787 |
| **Promedio** | | 636 | 647 | 671 | 837 | 703 | 776 |

### Tabla resumen de trafico promedio diario

| **Trafico promedio diario ( Hacia el mástil)** | |
|---|---|
| **Tipo de vehículo** | **Cantidad** |
| Autos | 5592 |
| Micros | 100 |
| Flotas (Eje simple | 25 |
| Flotas (Eje tándem) | 50 |
| Camiones (Eje simple) | 384 |
| Camiones (Eje tándem) | 100 |
| Tráiler | 50 |
| Otros | 1275 |

| Trafico promedio diario (Hacia la torre) | |
|---|---|
| **Tipo de vehículo** | **Cantidad** |
| Autos | 6975 |
| Micros | 84 |
| Flotas (Eje simple) | 17 |
| Flotas (Eje tándem) | 42 |
| Camiones (Eje simple) | 450 |
| Camiones (Eje tándem) | 92 |
| Tráiler | 67 |
| Otros | 1484 |

- **Tramo Ingreso a la nueva terminal**

## Aforo en horas pico para vehículos

| | **Fecha** | **Número de vehículos** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Izquierda** | | | **Derecha** | | |
| | | 10:00-11:00 | 14:00-15:00 | 18:00-19:00 | 10:00-11:00 | 14:00-15:00 | 18:00-19:00 |
| **Autos** | 29/04/2021 | 256 | 194 | 152 | 133 | 150 | 104 |
| | 30/04/2021 | 249 | 188 | 138 | 161 | 118 | 93 |
| | 01/05/2021 | 210 | 154 | 111 | 164 | 126 | 86 |
| **Promedio** | | 239 | 179 | 134 | 153 | 132 | 95 |

## Tabla resumen de trafico promedio diario

| Trafico promedio diario | |
|---|---|
| **Tipo de vehículo** | **Cantidad** |
| Autos | 1992 |
| Micros | 334 |
| Flotas (Eje simple | 0 |
| Flotas (Eje tándem) | 0 |
| Camiones (Eje simple) | 84 |
| Camiones (Eje tándem) | 0 |
| Tráiler | 0 |
| Otros | 242 |

- **Tramo Avenida Jaime Paz**

## Aforo en horas pico para vehículos

| Avenida frente a la ex terminal | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Autos** | **Fecha** | **Número de vehículos** | | | | | |
| | | **Izquierda** | | | **Derecha** | | |
| | | 9:00-10:00 | 14:00-15:00 | 18:00-19:00 | 9:00-10:00 | 14:00-15:00 | 18:00-19:00 |
| | 27/04/2021 | 618 | 496 | 501 | 134 | 143 | 124 |
| | 30/04/2021 | 633 | 581 | 531 | 151 | 159 | 136 |
| | 01/05/2021 | 585 | 541 | 498 | 135 | 684 | 101 |
| **Promedio** | | 612 | 540 | 510 | 140 | 329 | 121 |

## Tabla resumen de trafico promedio diario

| Trafico promedio diario (Avenida frente a la ex terminal) | |
|---|---|
| **Tipo de vehículo** | **Cantidad** |
| Autos | 5100 |
| Micros | 492 |
| Flotas (Eje simple | 0 |
| Flotas (Eje tándem) | 0 |
| Camiones (Eje simple) | 75 |
| Camiones (Eje tándem) | 0 |
| Tráiler | 0 |
| Otros | 642 |

| Trafico promedio diario (Avenida del medio) | |
|---|---|
| **Tipo de vehículo** | **Cantidad** |
| Autos | 8664 |
| Micros | 0 |
| Flotas (Eje simple | 34 |
| Flotas (Eje tándem) | 0 |
| Camiones (Eje simple) | 316 |
| Camiones (Eje tándem) | 50 |
| Tráiler | 0 |
| Otros | 1933 |

| Trafico promedio diario (Avenida sobre la ex terminal) | |
|---|---|
| **Tipo de vehículo** | **Cantidad** |
| Autos | 9442 |
| Micros | 408 |
| Flotas (Eje simple | 17 |
| Flotas (Eje tándem) | 0 |
| Camiones (Eje simple) | 367 |
| Camiones (Eje tándem) | 50 |
| Tráiler | 0 |
| Otros | 1267 |

- **Tramo calle Junín**

| | **Fecha** | **Número de vehículos** | | |
|---|---|---|---|---|
| | | **9:00-10:00** | **12:00-13:00** | **18:00-19:00** |
| **Autos** | 03/05/2021 | 356 | 376 | 291 |
| | 05/05/2021 | 368 | 396 | 296 |
| | 08/05/2021 | 224 | 284 | 284 |
| **Promedio** | | 316 | 352 | 291 |

## Tabla resumen de trafico promedio diario

| Trafico promedio diario | |
|---|---|
| **Tipo de vehículo** | **2021** |
| Autos | 2934 |
| Micros | 34 |
| Flotas (Eje simple | 0 |
| Flotas (Eje tándem) | 0 |
| Camiones (Eje simple) | 75 |
| Camiones (Eje tándem) | 0 |
| Tráiler | 0 |
| Otros | 809 |

- **Tramo avenida Violín Chapaco**

| | **Fecha** | **Número de vehículos** | | |
|---|---|---|---|---|
| | | **8:00-9:00** | **13:00-14:00** | **18:00-19:00** |
| **Autos** | 03/05/2021 | 15 | 8 | 10 |
| | 05/05/2021 | 14 | 10 | 7 |
| | 08/05/2021 | 10 | 6 | 7 |
| **Promedio** | | 13 | 8 | 8 |

## Tabla resumen de trafico promedio diario

| Trafico promedio diario | |
|---|---|
| **Tipo de vehículo** | **2021** |
| Autos | 109 |
| Micros | 84 |
| Flotas (Eje simple | 0 |
| Flotas (Eje tándem) | 0 |
| Camiones (Eje simple) | 9 |
| Camiones (Eje tándem) | 0 |
| Tráiler | 0 |
| Otros | 34 |

# ANEXO N°3

## CALCULO DE EJES EQUIVALENTES EN LOS DISTINTOS TRAMOS PARA LA PRESENTE GESTIÓN Y AÑO DE EJECUCIÓN

## Calculo de los tramos en estudio para la presente gestión

- **Tramo avenida circunvalación**

### Tránsito de diseño para dirección hacia el mástil

| Hacia el mástil | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de crecimiento** | **Tránsito de diseño** |
| Autos | 5592 | 108.629 | 221720320.829 |
| Micros | 100 | 108.629 | 3964955.666 |
| Flotas (Eje simple | 25 | 108.629 | 991238.916 |
| Flotas (Eje tándem) | 50 | 108.629 | 1982477.833 |
| Camiones (Eje simple) | 384 | 108.629 | 15225429.756 |
| Camiones (Eje tándem) | 100 | 108.629 | 3964955.666 |
| | | | |
| Tráiler | 50 | 108.629 | 1982477.833 |
| Otros | 1275 | 108.629 | 50553184.738 |

## Tránsito de diseño para dirección hacia la torre

| Hacia la torre | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 6975 | 108.629 | 276555657.686 |
| Micros | 84 | 108.629 | 3330562.759 |
| Flotas (Eje simple | 17 | 108.629 | 674042.463 |
| Flotas (Eje tándem) | 42 | 108.629 | 1665281.380 |
| Camiones (Eje simple) | 450 | 108.629 | 17842300.496 |
| Camiones (Eje tándem) | 92 | 108.629 | 3647759.212 |
| Tráiler | 67 | 108.629 | 2656520.296 |
| Otros | 1484 | 108.629 | 58839942.080 |

## Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes – Tramo circunvalación (Hacia la torre)

| Hacia la torre | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 276555657.7 | 0.001 | 212419.604 | 28822791.654 |
| Micros | 3330562.759 | 0.021 | 68912.711 | |
| Flotas (Eje simple | 674042.4632 | 0.300 | 202140.791 | |
| Flotas (Eje tándem) | 1665281.38 | 1.701 | 2831874.604 | |
| Camiones (Eje simple) | 17842300.5 | 1.640 | 29264959.093 | |
| Camiones (Eje tándem) | 3647759.212 | 1.817 | 6628244.898 | |
| Tráiler | 2656520.296 | 3.324 | 8829434.388 | |
| **Sumatoria** | | | 48037986.090 | |

## Numero de ejes equivalentes – Tramo circunvalación (Hacia el mástil)

| Hacia el mástil | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 221720320.8 | 0.001 | 170301.136 | 25612436.694 |
| Micros | 3964955.666 | 0.021 | 82038.942 | |
| Flotas (Eje simple | 991238.9164 | 0.299 | 297265.869 | |
| Flotas (Eje tándem) | 1982477.833 | 1.700 | 3371279.290 | |
| Camiones (Eje simple) | 15225429.76 | 1.642 | 24972765.093 | |
| Camiones (Eje tándem) | 3964955.666 | 1.817 | 7204614.020 | |
| Tráiler | 1982477.833 | 3.324 | 6589130.141 | |
| **Sumatoria** | | | 42687394.491 | |

## - Tramo Ingreso a la nueva terminal

### Tránsito de diseño para dirección hacia la torre

| Tipo de vehículo | Volumen diario 2021 | Factor de Crecimiento | Tránsito de Diseño |
|---|---|---|---|
| Autos | 1992 | 77.409 | 56282248.937 |
| Micros | 334 | 77.409 | 9436883.105 |
| Flotas (Eje simple | 0 | 77.409 | 0.000 |
| Flotas (Eje tándem) | 0 | 77.409 | 0.000 |
| Camiones (Eje simple) | 84 | 77.409 | 2373347.847 |
| Camiones (Eje tándem) | 0 | 77.409 | 0.000 |
| Tráiler | 0 | 77.409 | 0.000 |

### Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes

| Tipo de vehículo | Tránsito de Diseño | Factor equivalente de carga total | N° de ESALs p/diseño | ESALs diseño |
|---|---|---|---|---|
| Autos | 56282248.94 | 0.001 | 43229.826 | 1652502.396 |
| Micros | 9436883.105 | 0.021 | 195258.654 | |
| Flotas (Eje simple | 0.000 | 0.300 | 0.000 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 2373347.847 | 1.640 | 3892767.509 | |
| Camiones (Eje tándem) | 0.000 | 1.817 | 0.000 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 4131255.989 | |

- **Tramo Avenida Jaime Paz Zamora**

## Tránsito de diseño (Ex terminal)

| Avenida sobre la ex terminal | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 9442 | 108.629 | 374371113.961 |
| Micros | 408 | 108.629 | 16177019.116 |
| Flotas (Eje simple | 17 | 108.629 | 674042.463 |
| Flotas (Eje tándem) | 0 | 108.629 | 0.000 |
| Camiones (Eje simple) | 367 | 108.629 | 14551387.293 |
| Camiones (Eje tándem) | 50 | 108.629 | 1982477.833 |
| Tráiler | 0 | 108.629 | 0.000 |
| Otros | 1267 | 108.629 | 50235988.285 |

## Tránsito de diseño (Medio)

| Avenida del medio | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 8664 | 108.629 | 343523758.881 |
| Micros | 0 | 108.629 | 0.000 |
| Flotas (Eje simple | 34 | 108.629 | 1348084.926 |
| Flotas (Eje tándem) | 0 | 108.629 | 0.000 |
| Camiones (Eje simple) | 316 | 108.629 | 12529259.904 |
| Camiones (Eje tándem) | 50 | 108.629 | 1982477.833 |
| Tráiler | 0 | 108.629 | 0.000 |
| Otros | 1933 | 108.629 | 76642593.019 |

## Tránsito de diseño (Frente)

| Avenida frente a la ex terminal | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 5100 | 108.6289223 | 202212738.950 |
| Micros | 492 | 108.6289223 | 19507581.880 |
| Flotas (Eje simple | 0 | 108.6289223 | 0.000 |
| Flotas (Eje tándem) | 0 | 108.6289223 | 0.000 |
| Camiones (Eje simple) | 75 | 108.6289223 | 2973716.750 |
| Camiones (Eje tándem) | 0 | 108.6289223 | 0.000 |
| Tráiler | 0 | 108.6289223 | 0.000 |
| Otros | 642 | 108.6289223 | 25455015.370 |

## Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes (Ex terminal)

| Avenida sobre la ex terminal | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 374371114 | 0.001 | 287550.667 | 16976350.394 |
| Micros | 16177019.12 | 0.021 | 334718.884 | |
| Flotas (Eje simple | 674042.4632 | 0.300 | 202140.791 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 14551387.29 | 1.640 | 23867199.972 | |
| Camiones (Eje tándem) | 1982477.833 | 1.817 | 3602307.010 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 28293917.324 | |

## Numero de ejes equivalentes (Medio)

| Avenida del medio | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 343523758.9 | 0.001 | 263857.125 | 19856760.260 |
| Micros | 0.000 | 0.021 | 0.000 | |
| Flotas (Eje simple | 1348084.926 | 0.300 | 404281.581 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 12529259.9 | 1.640 | 20550504.608 | |
| Camiones (Eje tándem) | 1982477.833 | 1.817 | 3602307.010 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 24820950.324 | |

## Numero de ejes equivalentes (Frente)

| Avenida frente a la ex terminal | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 202212739 | 0.001 | 155317.560 | 2174576.935 |
| Micros | 19507581.88 | 0.021 | 403631.596 | |
| Flotas (Eje simple | 0.000 | 0.300 | 0.000 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 2973716.749 | 1.640 | 4877493.182 | |
| Camiones (Eje tándem) | 0.000 | 1.817 | 0.000 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 5436442.338 | |

- **Tramo Calle Junín**

### Tránsito de diseño

| Tipo de vehículo | Volumen diario 2021 | Factor de Crecimiento | Tránsito de Diseño |
|---|---|---|---|
| Autos | 2934 | 77.409 | 82897649.790 |
| Micros | 34 | 77.409 | 960640.795 |
| Flotas (Eje simple | 0 | 77.409 | 0.000 |
| Flotas (Eje tándem) | 0 | 77.409 | 0.000 |
| Camiones (Eje simple) | 75 | 77.409 | 2119060.577 |
| Camiones (Eje tándem) | 0 | 77.409 | 0.000 |
| Tráiler | 0 | 77.409 | 0.000 |
| Otros | 809 | 77.409 | 22857600.095 |

### Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes

| Tipo de vehículo | Tránsito de Diseño | Factor equivalente de carga total | N° de ESALs p/diseño | ESALs diseño |
|---|---|---|---|---|
| Autos | 82897649.79 | 0.001 | 63672.847 | 2847387.801 |
| Micros | 960640.7951 | 0.021 | 19876.629 | |
| Flotas (Eje simple | 0.000 | 0.300 | 0.000 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 2119060.577 | 1.640 | 3475685.276 | |
| Camiones (Eje tándem) | 0.000 | 1.817 | 0.000 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 3559234.752 | |

- **Tramo Avenida Violín Chapaco**

### Tránsito de diseño

| Tipo de vehículo | Volumen diario 2021 | Factor de Crecimiento | Tránsito de Diseño |
|---|---|---|---|
| Autos | 109 | 77.409 | 3079701.373 |
| Micros | 84 | 77.409 | 2373347.847 |
| Flotas (Eje simple | 0 | 77.409 | 0.000 |
| Flotas (Eje tándem) | 0 | 77.409 | 0.000 |
| Camiones (Eje simple) | 9 | 77.409 | 254287.269 |
| Camiones (Eje tándem) | 0 | 77.409 | 0.000 |
| Tráiler | 0 | 77.409 | 0.000 |
| Otros | 34 | 77.409 | 960640.795 |

### Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes

| Tipo de vehículo | Tránsito de Diseño | Factor equivalente de carga total | N° de ESALs p/diseño | ESALs diseño |
|---|---|---|---|---|
| Autos | 3079701.373 | 0.001 | 2365.487 | 374843.750 |
| Micros | 2373347.847 | 0.021 | 49106.967 | |
| Flotas (Eje simple | 0.000 | 0.300 | 0.000 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 254287.269 | 1.640 | 417082.233 | |
| Camiones (Eje tándem) | 0.000 | 1.817 | 0.000 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 468554.688 | |

## Calculo de los tramos en estudio para la presente gestión

- **Tramo Avenida circunvalación**

### Tránsito de diseño para dirección hacia el mástil

| Hacia el mástil | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 5592 | 108.629 | 221720320.829 |
| Micros | 100 | 108.629 | 3964955.666 |
| Flotas (Eje simple | 25 | 108.629 | 991238.916 |
| Flotas (Eje tándem) | 50 | 108.629 | 1982477.833 |
| Camiones (Eje simple) | 384 | 108.629 | 15225429.756 |
| Camiones (Eje tándem) | 100 | 108.629 | 3964955.666 |
| | | | |
| Tráiler | 50 | 108.629 | 1982477.833 |
| Otros | 1275 | 108.629 | 50553184.738 |

### Tránsito de diseño para dirección hacia la torre

| Hacia la torre | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 6975 | 108.629 | 276555657.686 |
| Micros | 84 | 108.629 | 3330562.759 |
| Flotas (Eje simple | 17 | 108.629 | 674042.463 |
| Flotas (Eje tándem) | 42 | 108.629 | 1665281.380 |
| Camiones (Eje simple) | 450 | 108.629 | 17842300.496 |
| Camiones (Eje tándem) | 92 | 108.629 | 3647759.212 |
| Tráiler | 67 | 108.629 | 2656520.296 |
| Otros | 1484 | 108.629 | 58839942.080 |

## Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes – Tramo circunvalación (Hacia la Torre)

| Hacia la torre | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 276555657.700 | 0.001 | 212419.604 | 28822791.654 |
| Micros | 3330562.759 | 0.021 | 68912.711 | |
| Flotas (Eje simple | 674042.463 | 0.300 | 202140.791 | |
| Flotas (Eje tándem) | 1665281.380 | 1.701 | 2831874.604 | |
| Camiones (Eje simple) | 17842300.500 | 1.640 | 29264959.093 | |
| Camiones (Eje tándem) | 3647759.212 | 1.817 | 6628244.898 | |
| Tráiler | 2656520.296 | 3.324 | 8829434.388 | |
| **Sumatoria** | | | 48037986.090 | |

## Numero de ejes equivalentes – Tramo circunvalación (Hacia el Mástil)

| Hacia el mástil | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 221720320.800 | 0.001 | 170301.136 | 25612436.694 |
| Micros | 3964955.666 | 0.021 | 82038.942 | |
| Flotas (Eje simple | 991238.916 | 0.299 | 297265.869 | |
| Flotas (Eje tándem) | 1982477.833 | 1.700 | 3371279.290 | |
| Camiones (Eje simple) | 15225429.760 | 1.640 | 24972765.093 | |
| Camiones (Eje tándem) | 3964955.666 | 1.817 | 7204614.020 | |
| Tráiler | 1982477.833 | 3.324 | 6589130.141 | |
| **Sumatoria** | | | 42687394.491 | |

- **Tramo Ingreso a la nueva terminal**

### Tránsito de diseño para dirección hacia la torre

| Tipo de vehículo | Volumen diario 2021 | Factor de Crecimiento | Tránsito de Diseño |
|---|---|---|---|
| Autos | 1992 | 77.409 | 56282248.937 |
| Micros | 334 | 77.409 | 9436883.105 |
| Flotas (Eje simple | 0 | 77.409 | 0.000 |
| Flotas (Eje tándem) | 0 | 77.409 | 0.000 |
| Camiones (Eje simple) | 84 | 77.409 | 2373347.847 |
| Camiones (Eje tándem) | 0 | 77.409 | 0.000 |
| Tráiler | 0 | 77.409 | 0.000 |

### Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes

| Tipo de vehículo | Tránsito de Diseño | Factor equivalente de carga total | N° de ESALs p/diseño | ESALs diseño |
|---|---|---|---|---|
| Autos | 56282248.94 | 0.001 | 43229.826 | 1652502.396 |
| Micros | 9436883.105 | 0.021 | 195258.654 | |
| Flotas (Eje simple | 0.000 | 0.300 | 0.000 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 2373347.847 | 1.640 | 3892767.509 | |
| Camiones (Eje tándem) | 0.000 | 1.817 | 0.000 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 4131255.989 | |

- **Tramo Avenida Jaime Paz Zamora**

## Tránsito de diseño (Ex terminal)

| Avenida sobre la ex terminal | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 9442 | 108.629 | 374371113.961 |
| Micros | 408 | 108.629 | 16177019.116 |
| Flotas (Eje simple | 17 | 108.629 | 674042.463 |
| Flotas (Eje tándem) | 0 | 108.629 | 0.000 |
| Camiones (Eje simple) | 367 | 108.629 | 14551387.293 |
| Camiones (Eje tándem) | 50 | 108.629 | 1982477.833 |
| Tráiler | 0 | 108.629 | 0.000 |
| Otros | 1267 | 108.629 | 50235988.285 |

## Tránsito de diseño (Medio)

| Avenida del medio | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 8664 | 108.629 | 343523758.881 |
| Micros | 0 | 108.629 | 0.000 |
| Flotas (Eje simple | 34 | 108.629 | 1348084.926 |
| Flotas (Eje tándem) | 0 | 108.629 | 0.000 |
| Camiones (Eje simple) | 316 | 108.629 | 12529259.904 |
| Camiones (Eje tándem) | 50 | 108.629 | 1982477.833 |
| Tráiler | 0 | 108.629 | 0.000 |
| Otros | 1933 | 108.629 | 76642593.019 |

## Tránsito de diseño (Frente)

| Avenida frente a la ex terminal | | | |
|---|---|---|---|
| **Tipo de vehículo** | **Volumen diario 2021** | **Factor de Crecimiento** | **Tránsito de Diseño** |
| Autos | 5100 | 108.629 | 202212738.950 |
| Micros | 492 | 108.629 | 19507581.880 |
| Flotas (Eje simple | 0 | 108.629 | 0.000 |
| Flotas (Eje tándem) | 0 | 108.629 | 0.000 |
| Camiones (Eje simple) | 75 | 108.629 | 2973716.750 |
| Camiones (Eje tándem) | 0 | 108.629 | 0.000 |
| Tráiler | 0 | 108.629 | 0.000 |
| Otros | 642 | 108.629 | 25455015.370 |

## Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes (Ex terminal)

| Avenida sobre la ex terminal | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 374371114.000 | 0.001 | 287550.667 | 16976350.394 |
| Micros | 16177019.120 | 0.021 | 334718.884 | |
| Flotas (Eje simple | 674042.463 | 0.300 | 202140.791 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 14551387.290 | 1.640 | 23867199.972 | |
| Camiones (Eje tándem) | 1982477.833 | 1.817 | 3602307.010 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 28293917.324 | |

## Numero de ejes equivalentes (Medio)

| Avenida del medio | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 343523758.900 | 0.001 | 263857.125 | 19856760.260 |
| Micros | 0.000 | 0.021 | 0.000 | |
| Flotas (Eje simple | 1348084.926 | 0.300 | 404281.581 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 12529259.900 | 1.640 | 20550504.608 | |
| Camiones (Eje tándem) | 1982477.833 | 1.817 | 3602307.010 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 24820950.324 | |

## Numero de ejes equivalentes (Frente)

| Avenida frente a la ex terminal | | | | |
|---|---|---|---|---|
| **Tipo de vehículo** | **Tránsito de Diseño** | **Factor equivalente de carga total** | **N° de ESALs p/diseño** | **ESALs diseño** |
| Autos | 202212739.000 | 0.001 | 155317.560 | 2174576.935 |
| Micros | 19507581.880 | 0.021 | 403631.596 | |
| Flotas (Eje simple | 0.000 | 0.300 | 0.000 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 2973716.749 | 1.640 | 4877493.182 | |
| Camiones (Eje tándem) | 0.000 | 1.817 | 0.000 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 5436442.338 | |

- **Tramo Calle Junín**

## Tránsito de diseño para dirección hacia la torre

| Tipo de vehículo | Volumen diario 2021 | Factor de Crecimiento | Tránsito de Diseño |
|---|---|---|---|
| Autos | 2934 | 77.409 | 82897649.790 |
| Micros | 34 | 77.409 | 960640.795 |
| Flotas (Eje simple | 0 | 77.409 | 0.000 |
| Flotas (Eje tándem) | 0 | 77.409 | 0.000 |
| Camiones (Eje simple) | 75 | 77.409 | 2119060.577 |
| Camiones (Eje tándem) | 0 | 77.409 | 0.000 |
| Tráiler | 0 | 77.409 | 0.000 |
| Otros | 809 | 77.409 | 22857600.095 |

## Tabla resumen de factores equivalentes para los distintos tipos de vehículos

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes

| Tipo de vehículo | Tránsito de Diseño | Factor equivalente de carga total | N° de ESALs p/diseño | ESALs diseño |
|---|---|---|---|---|
| Autos | 82897649.790 | 0.001 | 63672.847 | 2847387.801 |
| Micros | 960640.795 | 0.021 | 19876.629 | |
| Flotas (Eje simple | 0.000 | 0.300 | 0.000 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 2119060.577 | 1.640 | 3475685.276 | |
| Camiones (Eje tándem) | 0.000 | 1.817 | 0.000 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 3559234.752 | |

- **Tramo Avenida Violín Chapaco**

## Tránsito de diseño para dirección hacia la torre

| Tipo de vehículo | Volumen diario 2021 | Factor de Crecimiento | Tránsito de Diseño |
|---|---|---|---|
| Autos | 109 | 77.409 | 3079701.373 |
| Micros | 84 | 77.409 | 2373347.847 |
| Flotas (Eje simple | 0 | 77.409 | 0.000 |
| Flotas (Eje tándem) | 0 | 77.409 | 0.000 |
| Camiones (Eje simple) | 9 | 77.409 | 254287.269 |
| Camiones (Eje tándem) | 0 | 77.409 | 0.000 |
| Tráiler | 0 | 77.409 | 0.000 |
| Otros | 34 | 77.409 | 960640.795 |

| Tipo de vehiculo | Eje | Tipo de eje | Peso | | Factor equivalente de carga | Factor equivalente de carga total |
|---|---|---|---|---|---|---|
| | | | Tn | KN | | |
| Autos | Eje delantero | Simple | 1.000 | 9.810 | 0.000 | 0.0008 |
| | 1er eje trasero | Simple | 1.000 | 9.810 | 0.000 | |
| Micros | Eje delantero | Simple | 2.000 | 19.620 | 0.004 | 0.0207 |
| | 1er eje trasero | Simple | 3.000 | 29.430 | 0.017 | |
| Flotas (Eje simple | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 0.2999 |
| | 1er eje trasero | Simple | 6.000 | 58.860 | 0.283 | |
| Flotas (Eje tandem) | Eje delantero | Simple | 3.000 | 29.430 | 0.017 | 1.7005 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Camiones (Eje simple) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.6402 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| Camiones (Eje tandem) | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 1.8171 |
| | 1er eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |
| Trailer | Eje delantero | Simple | 5.000 | 49.050 | 0.134 | 3.3237 |
| | 1er eje trasero | Simple | 9.000 | 88.290 | 1.507 | |
| | 2do eje trasero | Tandem | 15.000 | 147.150 | 1.683 | |

## Numero de ejes equivalentes

| Tipo de vehículo | Tránsito de Diseño | Factor equivalente de carga total | N° de ESALs p/diseño | ESALs diseño |
|---|---|---|---|---|
| Autos | 3079701.373 | 0.001 | 2365.487 | 374843.750 |
| Micros | 2373347.847 | 0.021 | 49106.967 | |
| Flotas (Eje simple | 0.000 | 0.300 | 0.000 | |
| Flotas (Eje tándem) | 0.000 | 1.701 | 0.000 | |
| Camiones (Eje simple) | 254287.269 | 1.640 | 417082.233 | |
| Camiones (Eje tándem) | 0.000 | 1.817 | 0.000 | |
| Tráiler | 0.000 | 3.324 | 0.000 | |
| **Sumatoria** | | | 468554.688 | |

## Anexo 4.1. Esfuerzo equivalente – sin berma de concreto

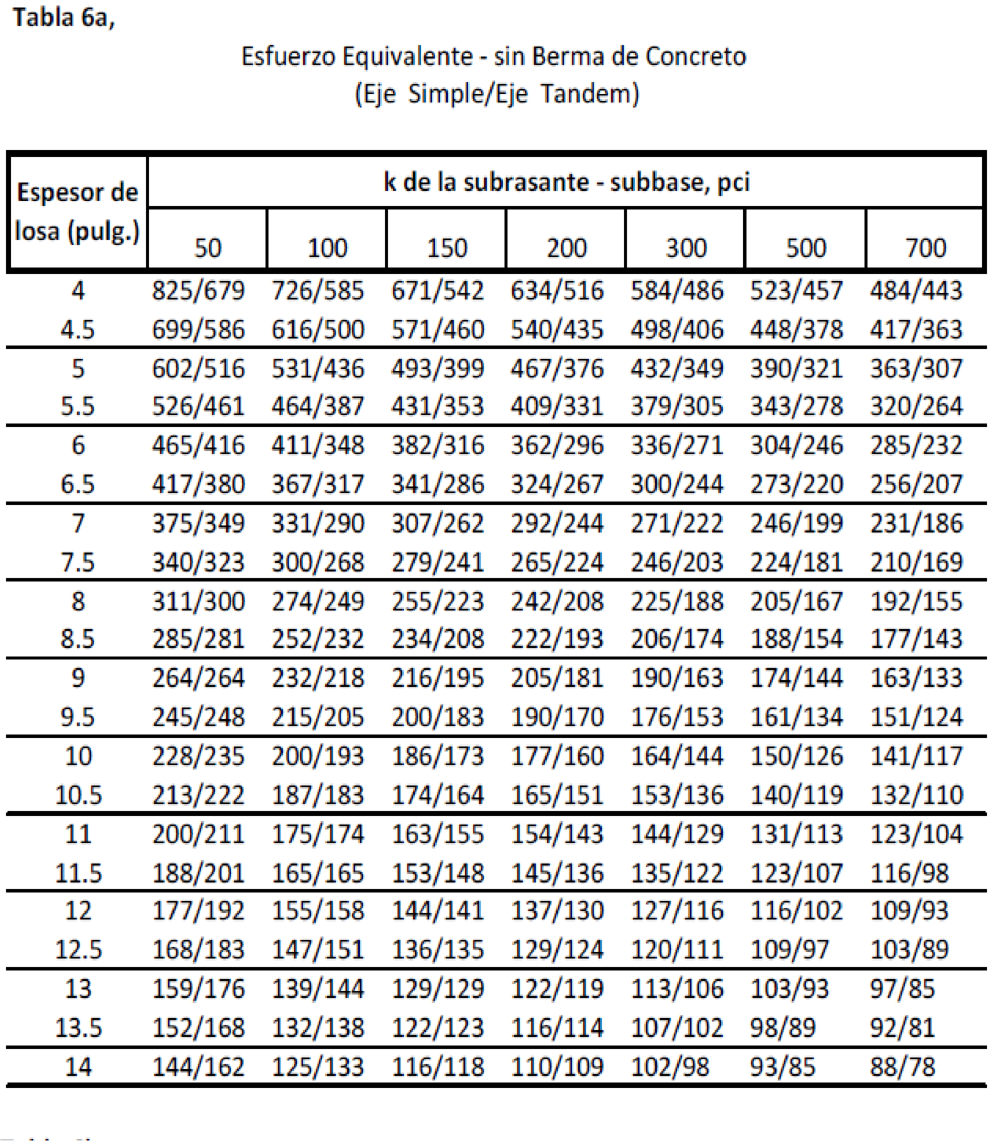
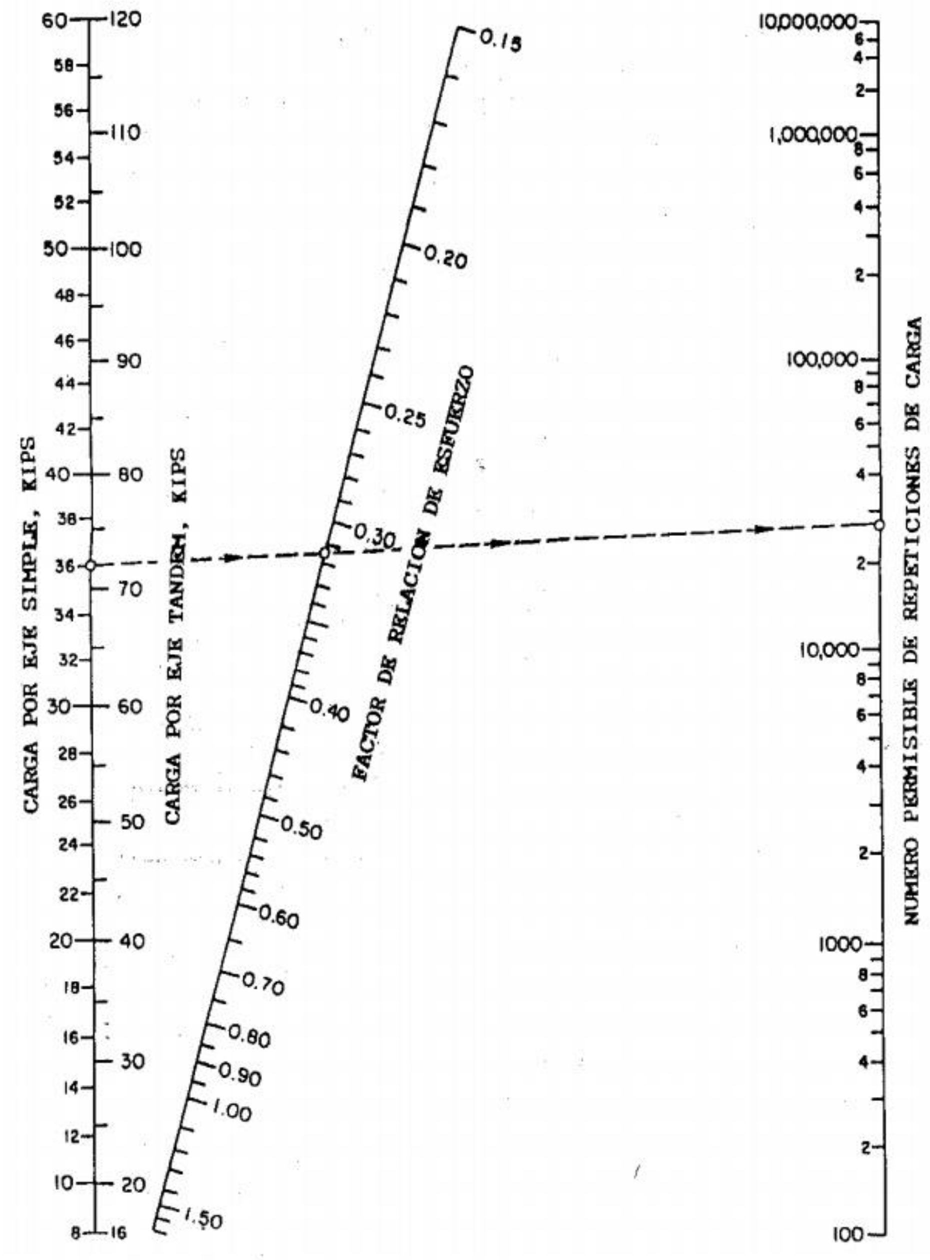


Tabla 6a,

Esfuerzo Equivalente - sin Berma de Concreto
(Eje Simple/Eje Tandem)

| Espesor de losa (pulg.) | k de la subrasante - subbase, pci | | | | | | |
|---|---|---|---|---|---|---|---|
| | 50 | 100 | 150 | 200 | 300 | 500 | 700 |
| 4 | 825/679 | 726/585 | 671/542 | 634/516 | 584/486 | 523/457 | 484/443 |
| 4.5 | 699/586 | 616/500 | 571/460 | 540/435 | 498/406 | 448/378 | 417/363 |
| 5 | 602/516 | 531/436 | 493/399 | 467/376 | 432/349 | 390/321 | 363/307 |
| 5.5 | 526/461 | 464/387 | 431/353 | 409/331 | 379/305 | 343/278 | 320/264 |
| 6 | 465/416 | 411/348 | 382/316 | 362/296 | 336/271 | 304/246 | 285/232 |
| 6.5 | 417/380 | 367/317 | 341/286 | 324/267 | 300/244 | 273/220 | 256/207 |
| 7 | 375/349 | 331/290 | 307/262 | 292/244 | 271/222 | 246/199 | 231/186 |
| 7.5 | 340/323 | 300/268 | 279/241 | 265/224 | 246/203 | 224/181 | 210/169 |
| 8 | 311/300 | 274/249 | 255/223 | 242/208 | 225/188 | 205/167 | 192/155 |
| 8.5 | 285/281 | 252/232 | 234/208 | 222/193 | 206/174 | 188/154 | 177/143 |
| 9 | 264/264 | 232/218 | 216/195 | 205/181 | 190/163 | 174/144 | 163/133 |
| 9.5 | 245/248 | 215/205 | 200/183 | 190/170 | 176/153 | 161/134 | 151/124 |
| 10 | 228/235 | 200/193 | 186/173 | 177/160 | 164/144 | 150/126 | 141/117 |
| 10.5 | 213/222 | 187/183 | 174/164 | 165/151 | 153/136 | 140/119 | 132/110 |
| 11 | 200/211 | 175/174 | 163/155 | 154/143 | 144/129 | 131/113 | 123/104 |
| 11.5 | 188/201 | 165/165 | 153/148 | 145/136 | 135/122 | 123/107 | 116/98 |
| 12 | 177/192 | 155/158 | 144/141 | 137/130 | 127/116 | 116/102 | 109/93 |
| 12.5 | 168/183 | 147/151 | 136/135 | 129/124 | 120/111 | 109/97 | 103/89 |
| 13 | 159/176 | 139/144 | 129/129 | 122/119 | 113/106 | 103/93 | 97/85 |
| 13.5 | 152/168 | 132/138 | 122/123 | 116/114 | 107/102 | 98/89 | 92/81 |
| 14 | 144/162 | 125/133 | 116/118 | 110/109 | 102/98 | 93/85 | 88/78 |

## Anexo 4.2. Grafica para el numero permisible de repeticiones por fatiga



## Anexo 4.3. Factor de erosión – Juntas con dovelas sin berma de concreto

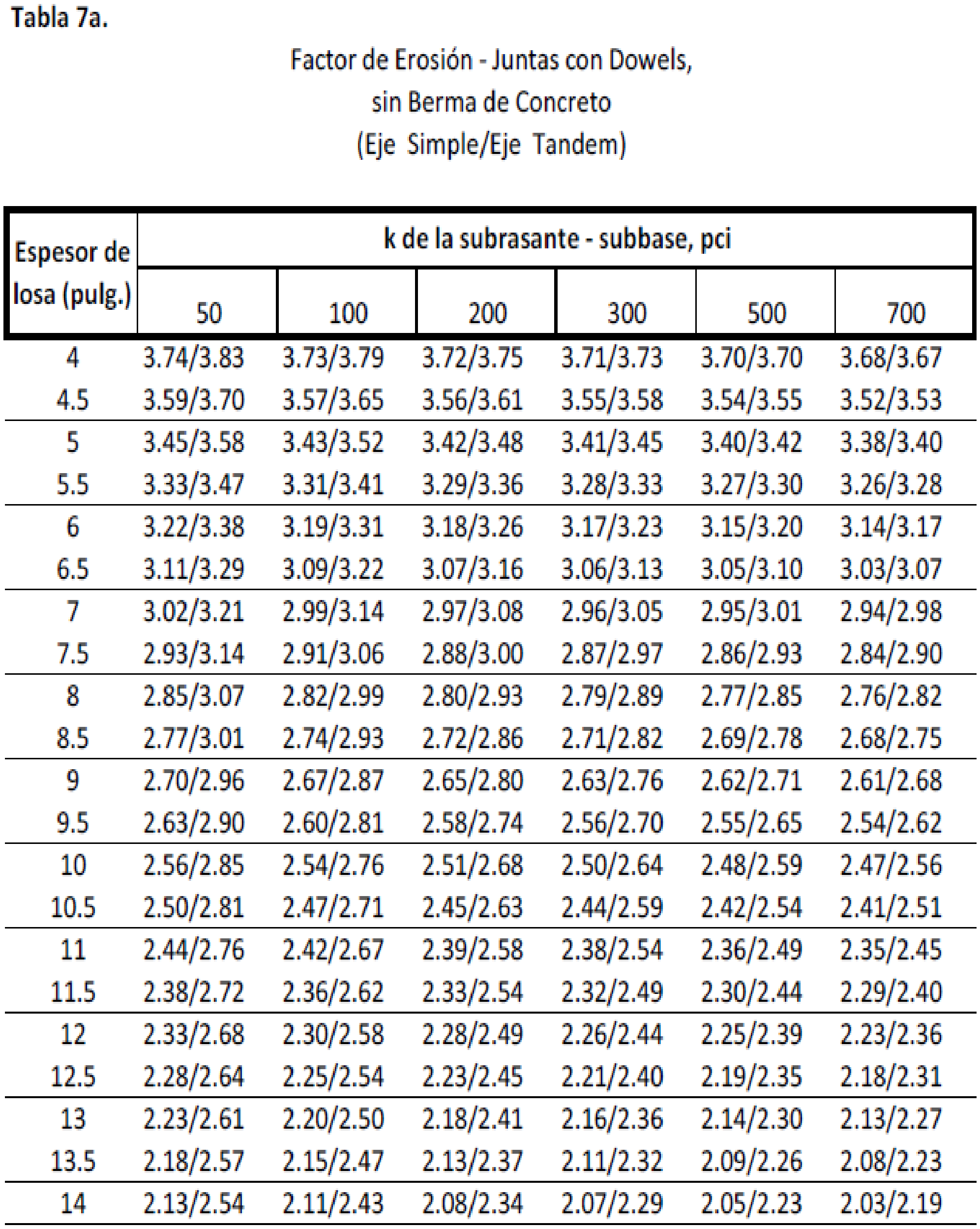
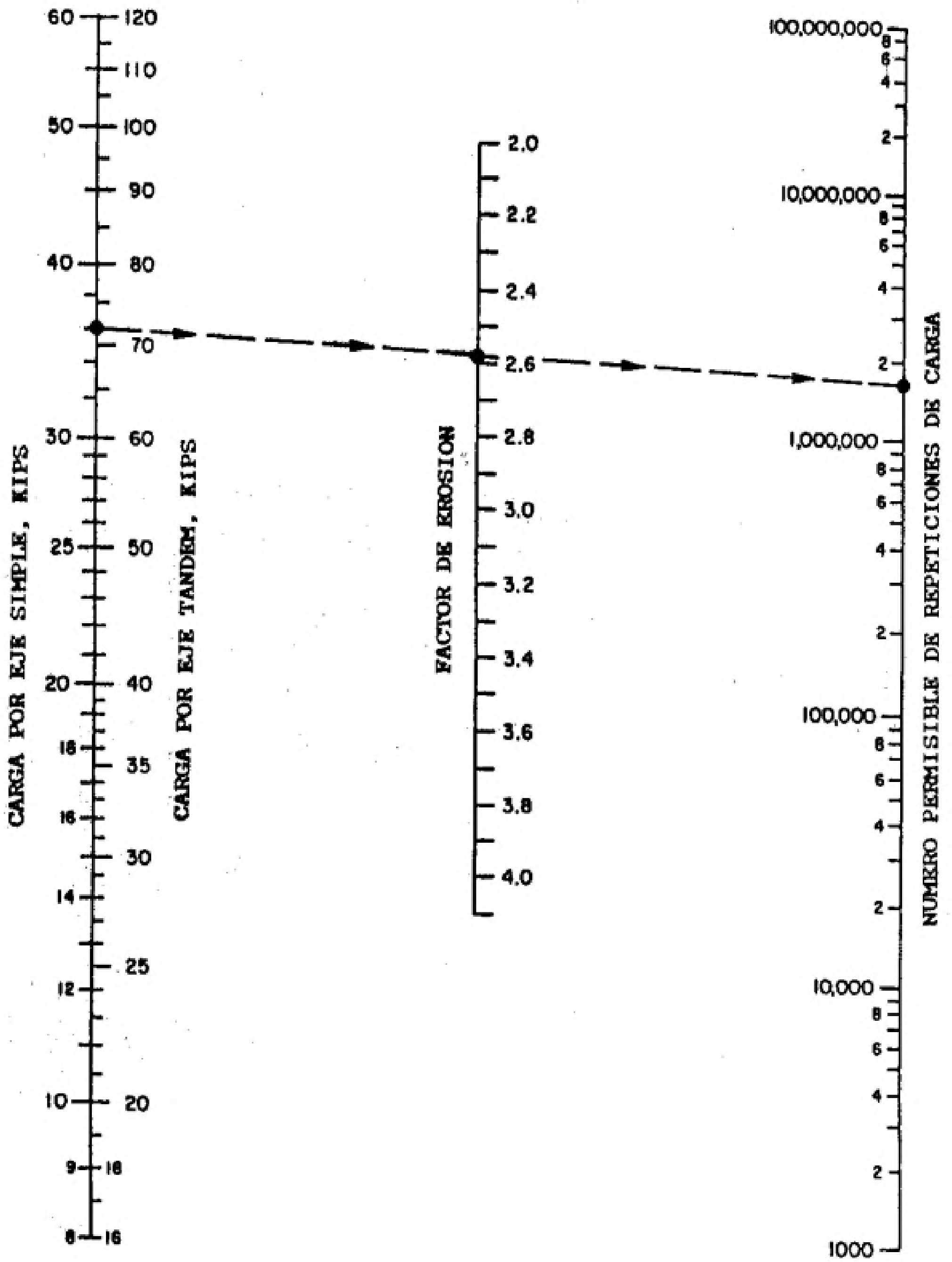


**Tabla 7a.**

Factor de Erosión - Juntas con Dowels,
sin Berma de Concreto
(Eje Simple/Eje Tandem)

| Espesor de losa (pulg.) | k de la subrasante - subbase, pci | | | | | |
|---|---|---|---|---|---|---|
| | 50 | 100 | 200 | 300 | 500 | 700 |
| 4 | 3.74/3.83 | 3.73/3.79 | 3.72/3.75 | 3.71/3.73 | 3.70/3.70 | 3.68/3.67 |
| 4.5 | 3.59/3.70 | 3.57/3.65 | 3.56/3.61 | 3.55/3.58 | 3.54/3.55 | 3.52/3.53 |
| 5 | 3.45/3.58 | 3.43/3.52 | 3.42/3.48 | 3.41/3.45 | 3.40/3.42 | 3.38/3.40 |
| 5.5 | 3.33/3.47 | 3.31/3.41 | 3.29/3.36 | 3.28/3.33 | 3.27/3.30 | 3.26/3.28 |
| 6 | 3.22/3.38 | 3.19/3.31 | 3.18/3.26 | 3.17/3.23 | 3.15/3.20 | 3.14/3.17 |
| 6.5 | 3.11/3.29 | 3.09/3.22 | 3.07/3.16 | 3.06/3.13 | 3.05/3.10 | 3.03/3.07 |
| 7 | 3.02/3.21 | 2.99/3.14 | 2.97/3.08 | 2.96/3.05 | 2.95/3.01 | 2.94/2.98 |
| 7.5 | 2.93/3.14 | 2.91/3.06 | 2.88/3.00 | 2.87/2.97 | 2.86/2.93 | 2.84/2.90 |
| 8 | 2.85/3.07 | 2.82/2.99 | 2.80/2.93 | 2.79/2.89 | 2.77/2.85 | 2.76/2.82 |
| 8.5 | 2.77/3.01 | 2.74/2.93 | 2.72/2.86 | 2.71/2.82 | 2.69/2.78 | 2.68/2.75 |
| 9 | 2.70/2.96 | 2.67/2.87 | 2.65/2.80 | 2.63/2.76 | 2.62/2.71 | 2.61/2.68 |
| 9.5 | 2.63/2.90 | 2.60/2.81 | 2.58/2.74 | 2.56/2.70 | 2.55/2.65 | 2.54/2.62 |
| 10 | 2.56/2.85 | 2.54/2.76 | 2.51/2.68 | 2.50/2.64 | 2.48/2.59 | 2.47/2.56 |
| 10.5 | 2.50/2.81 | 2.47/2.71 | 2.45/2.63 | 2.44/2.59 | 2.42/2.54 | 2.41/2.51 |
| 11 | 2.44/2.76 | 2.42/2.67 | 2.39/2.58 | 2.38/2.54 | 2.36/2.49 | 2.35/2.45 |
| 11.5 | 2.38/2.72 | 2.36/2.62 | 2.33/2.54 | 2.32/2.49 | 2.30/2.44 | 2.29/2.40 |
| 12 | 2.33/2.68 | 2.30/2.58 | 2.28/2.49 | 2.26/2.44 | 2.25/2.39 | 2.23/2.36 |
| 12.5 | 2.28/2.64 | 2.25/2.54 | 2.23/2.45 | 2.21/2.40 | 2.19/2.35 | 2.18/2.31 |
| 13 | 2.23/2.61 | 2.20/2.50 | 2.18/2.41 | 2.16/2.36 | 2.14/2.30 | 2.13/2.27 |
| 13.5 | 2.18/2.57 | 2.15/2.47 | 2.13/2.37 | 2.11/2.32 | 2.09/2.26 | 2.08/2.23 |
| 14 | 2.13/2.54 | 2.11/2.43 | 2.08/2.34 | 2.07/2.29 | 2.05/2.23 | 2.03/2.19 |

**Anexo 4.4. Grafica para el numero permisible de repeticiones por erosión**

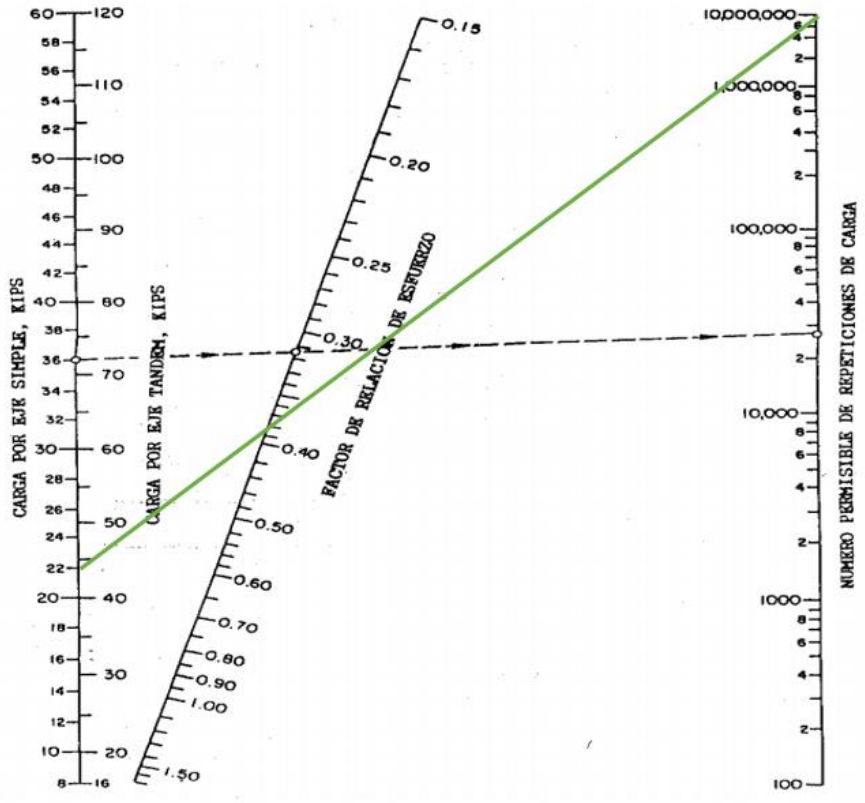


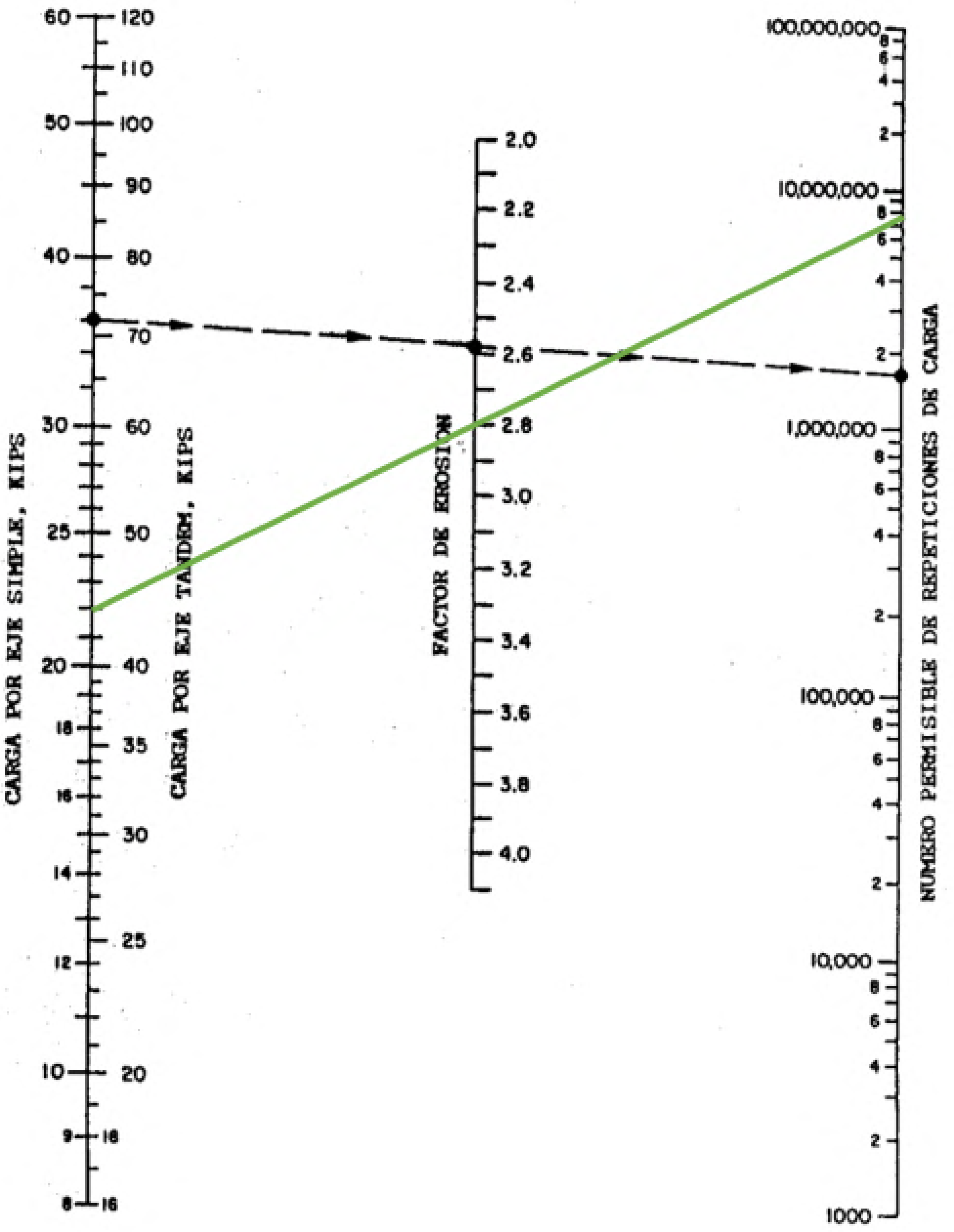
## Anexo 4.5. Calculo de espesores mediante la metodología PCA

### Avenida circunvalación

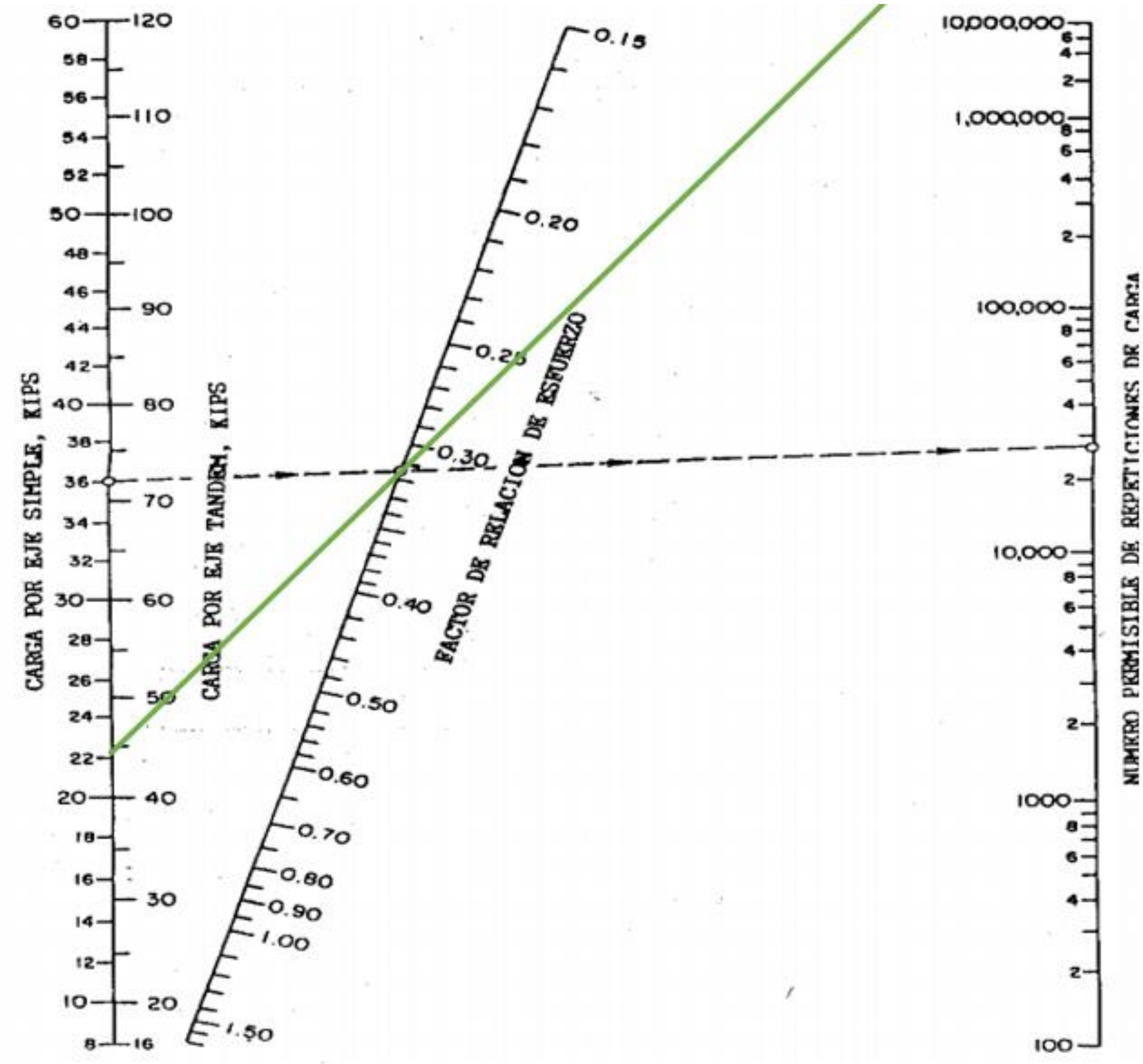
- **Dirección mástil (Año de construcción)**

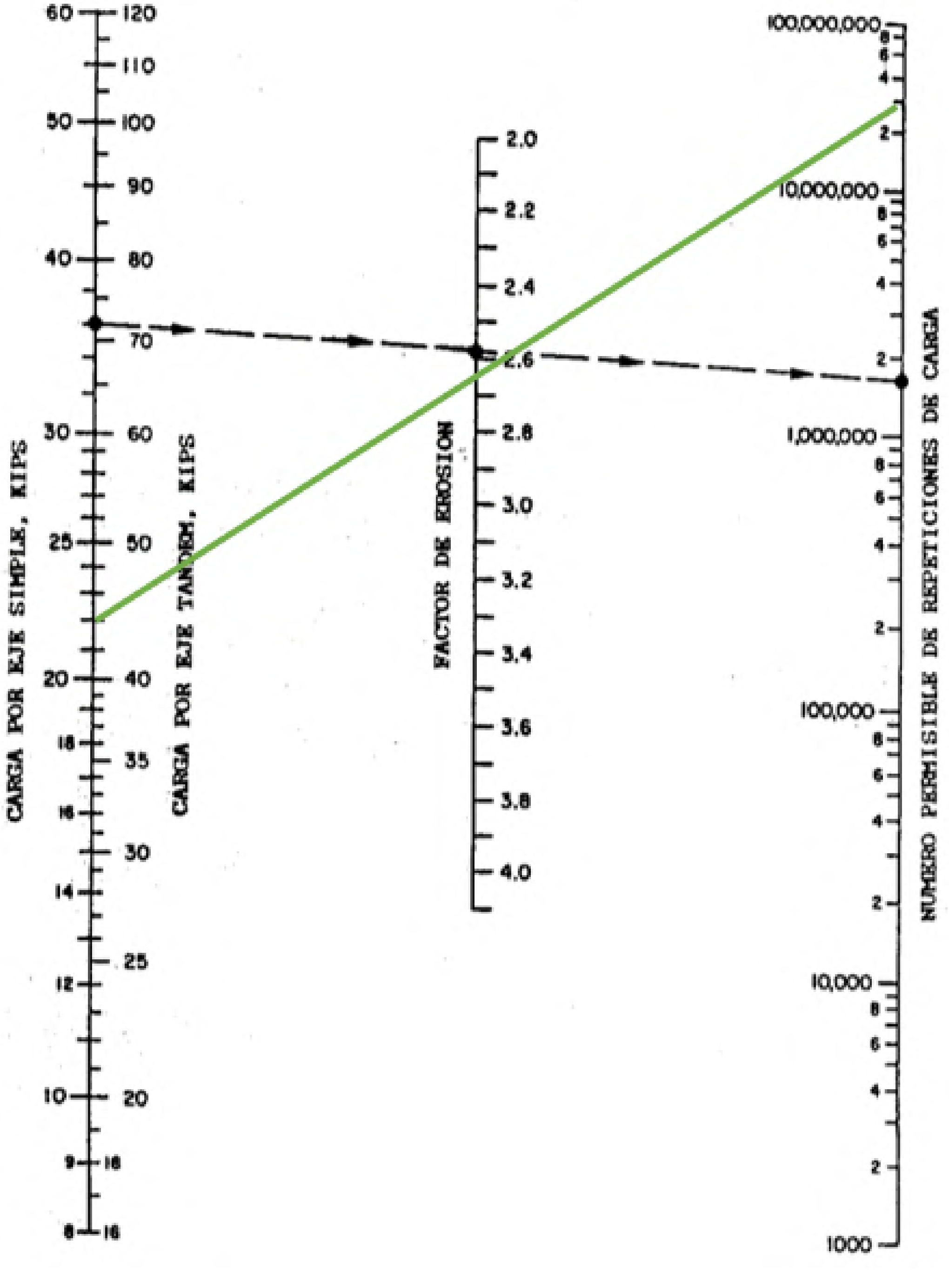
| | | | | | | |
|---|---|---|---|---|---|---|
| **Obra:** | | Circunvalación mástil | | | | |
| **Espesor de tanteo:** | | 8.1 | pulgada | **Pasador:** | si | |
| **K combinado:** | | 184.5 | pci | **Berma:** | no | |
| **Módulo de rotura, MR:** | | 640.035 | psi | **T diseño:** | 35 | |
| **Factor seguridad, FS:** | | 1.2 | | **W18** | 6989265.357 | |
| **Esfuerzo equivalente:** | | | 241.97 | | | |
| **Factor de relación de esfuerzos:** | | | 0.38 | | | |
| **Factor de erosión:** | | | 2.78 | | | |
| **Carga por eje** | **Multiplicado FS** | **Repeticiones esperadas** | **Análisis de fatiga** | | **Análisis de erosión** | |
| | | | **Repeticiones admisibles** | **Porcentaje de fatiga** | **Repeticiones admisibles** | **Porcentaje de daño** |
| 18 | 22 | 6989265.357 | 10000000 | 69.89 | 7500000 | 93.19 |




CARGA POR EJE SIMPLE, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
8
6
4
2
10,000,000
8
6
4
2
1,000,000
8
6
4
2
100,000
8
6
4
2
10,000
8
6
4
2
1000

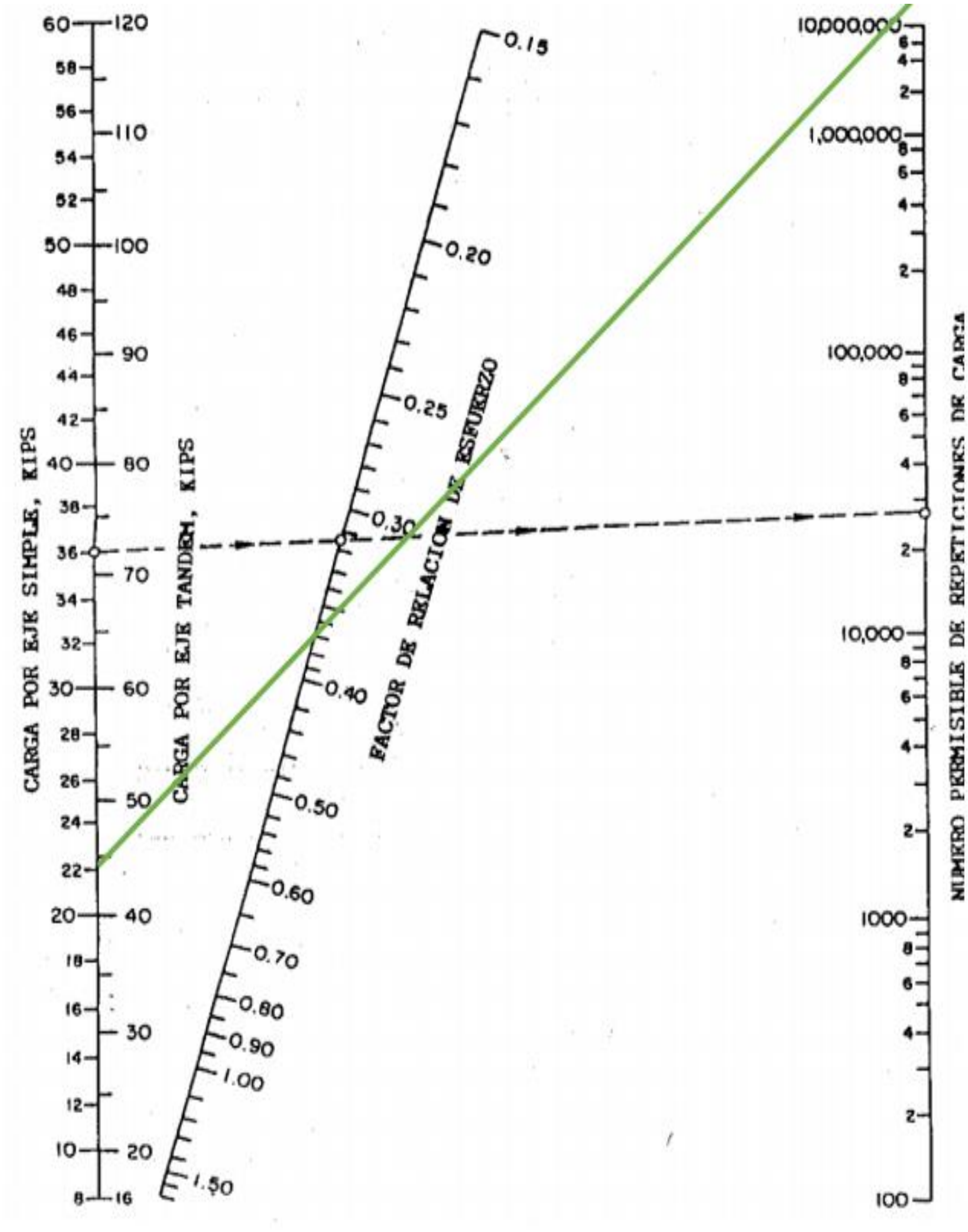
- **Dirección a la torre (Presente gestión)**

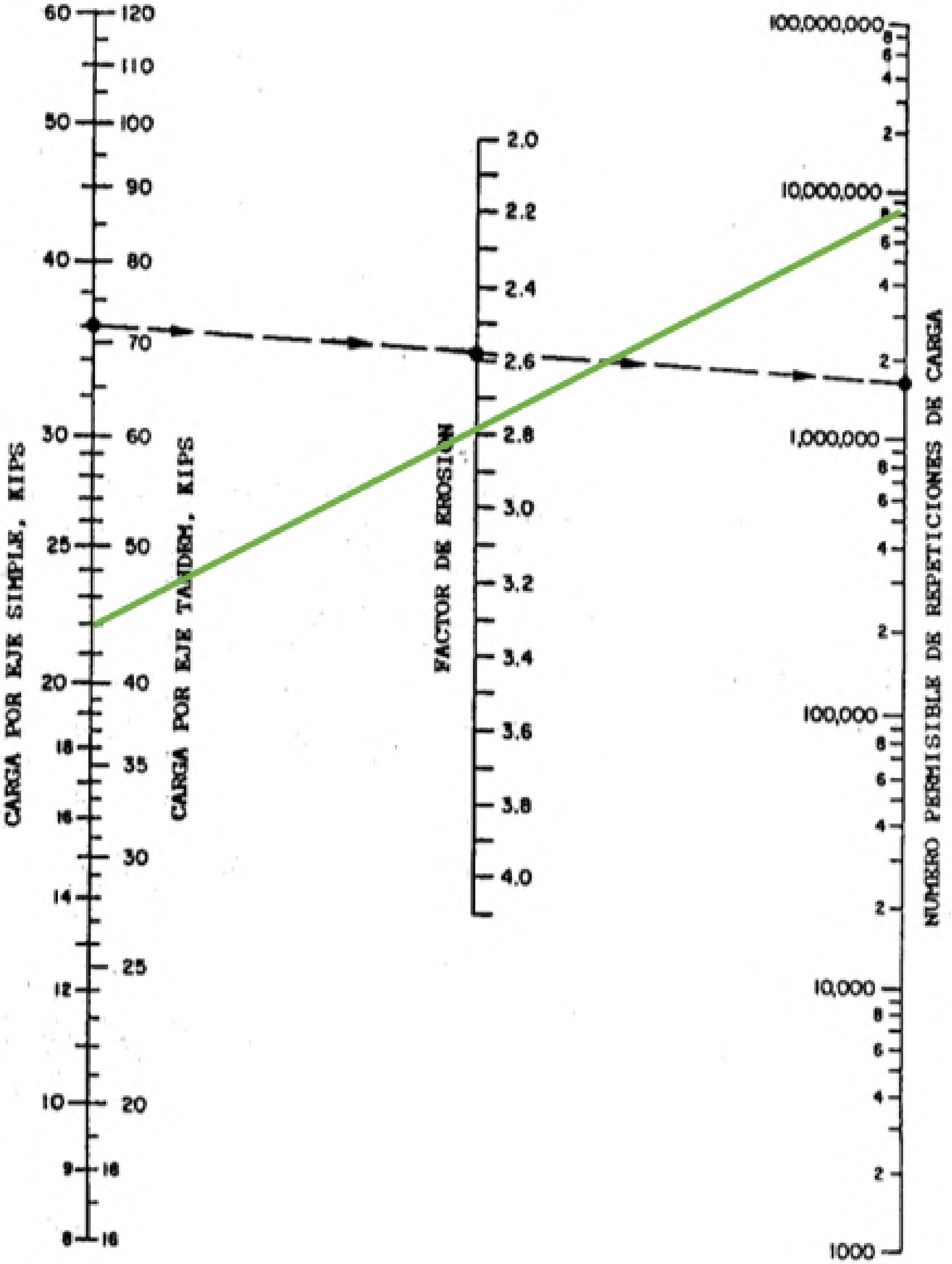



CARGA POR EJE SIMPLE, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

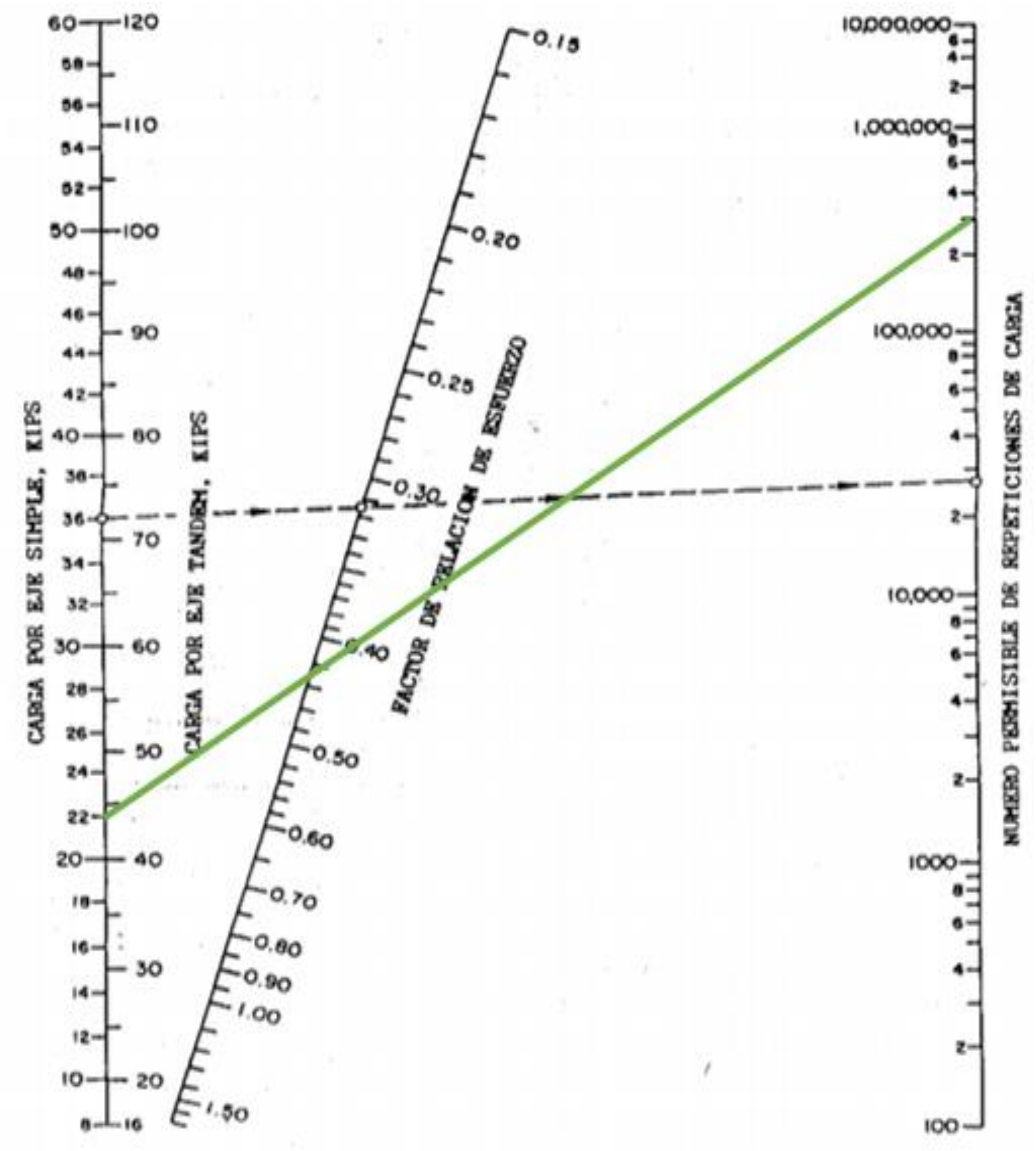
- **Dirección a la torre (Año de construcción)**

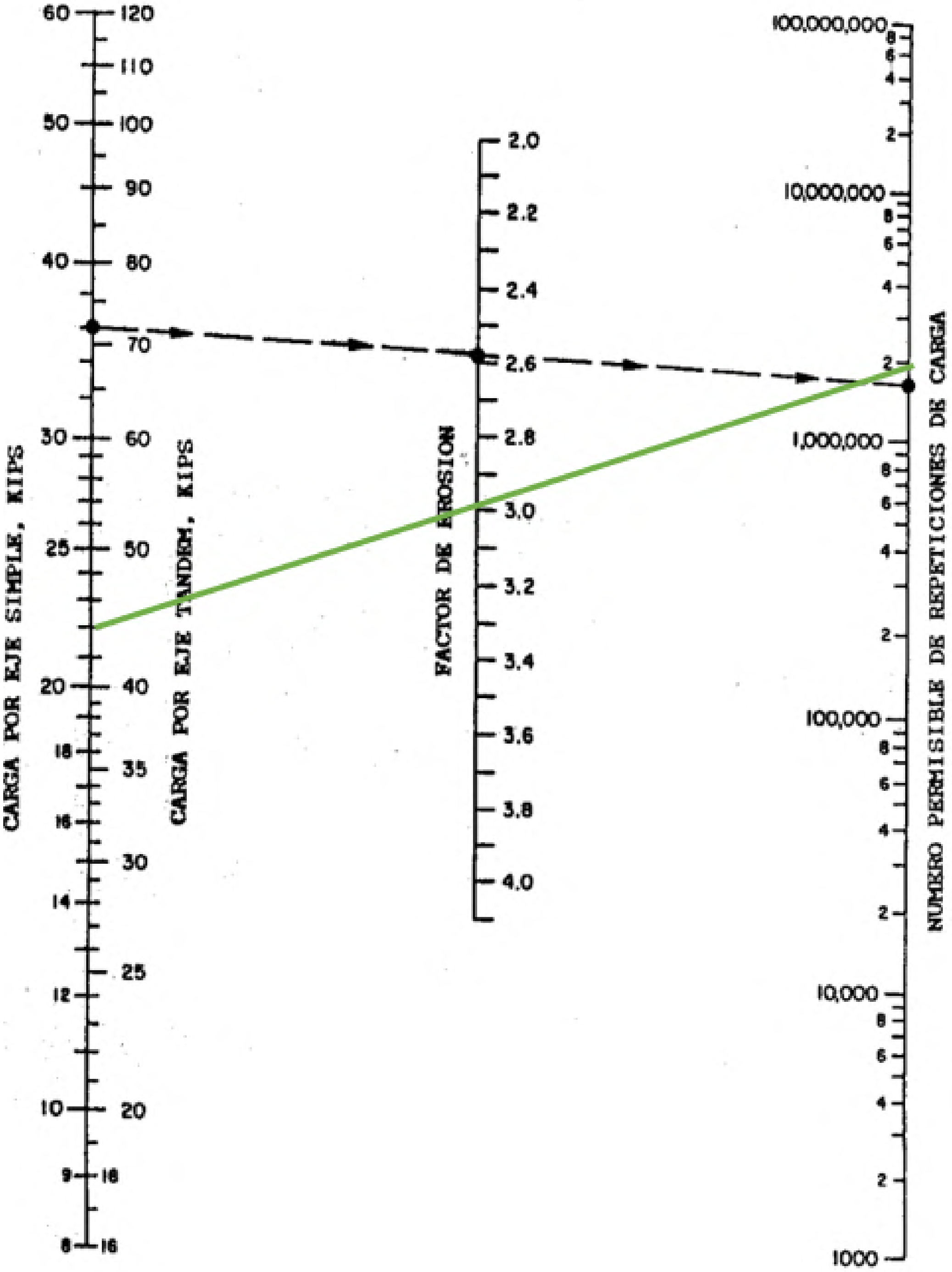
| | | | | | | |
|---|---|---|---|---|---|---|
| **Obra:** | | Circunvalación torre | | | | |
| **Espesor de tanteo:** | | 8.2 | pulgada | **Pasador:** | si | |
| **K combinado:** | | 184.5 | pci | **Berma:** | no | |
| **Módulo de rotura, MR:** | | 640.035 | psi | **T diseño:** | 35 | años |
| **Factor seguridad, FS:** | | 1.2 | | **W18** | 7871145.9 | 7871.1459 |
| **Esfuerzo equivalente:** | | | 237.91 | | | |
| **Factor de relación de esfuerzos:** | | | 0.37 | | | |
| **Factor de erosión:** | | | 2.77 | | | |
| **Carga por eje** | **Multiplicado FS** | **Repeticiones esperadas** | **Análisis de fatiga** | | **Análisis de erosión** | |
| | | | **Repeticiones admisibles** | **Porcentaje de fatiga** | **Repeticiones admisibles** | **Porcentaje de daño** |
| 18 | 22 | 7871145.898 | Ilimitado | 0 | 8000000 | 98.39 |


CARGA POR EJE SIMPLE, KIPS
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
30
20
16
FACTOR DE RELACION DE ESFUERZO
0.15
0.20
0.25
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
1.50
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
10,000,000
6
4
2
1,000,000
8
6
4
2
100,000
8
6
4
2
10,000
8
6
4
2
1000
8
6
4
2
100


CARGA POR EJE SIMPLE, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

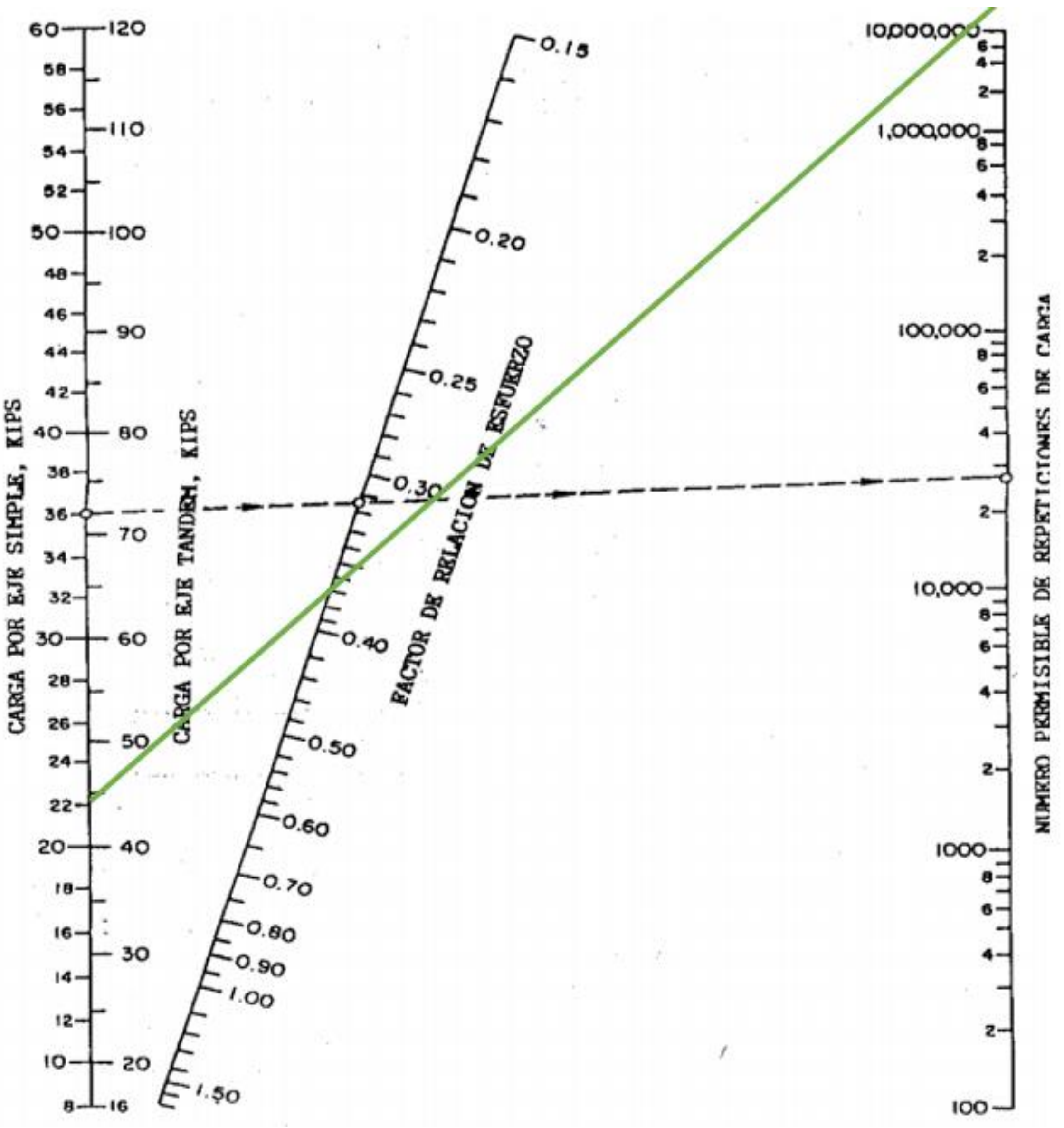
- **Ingreso a la nueva terminal (Presente gestión)**



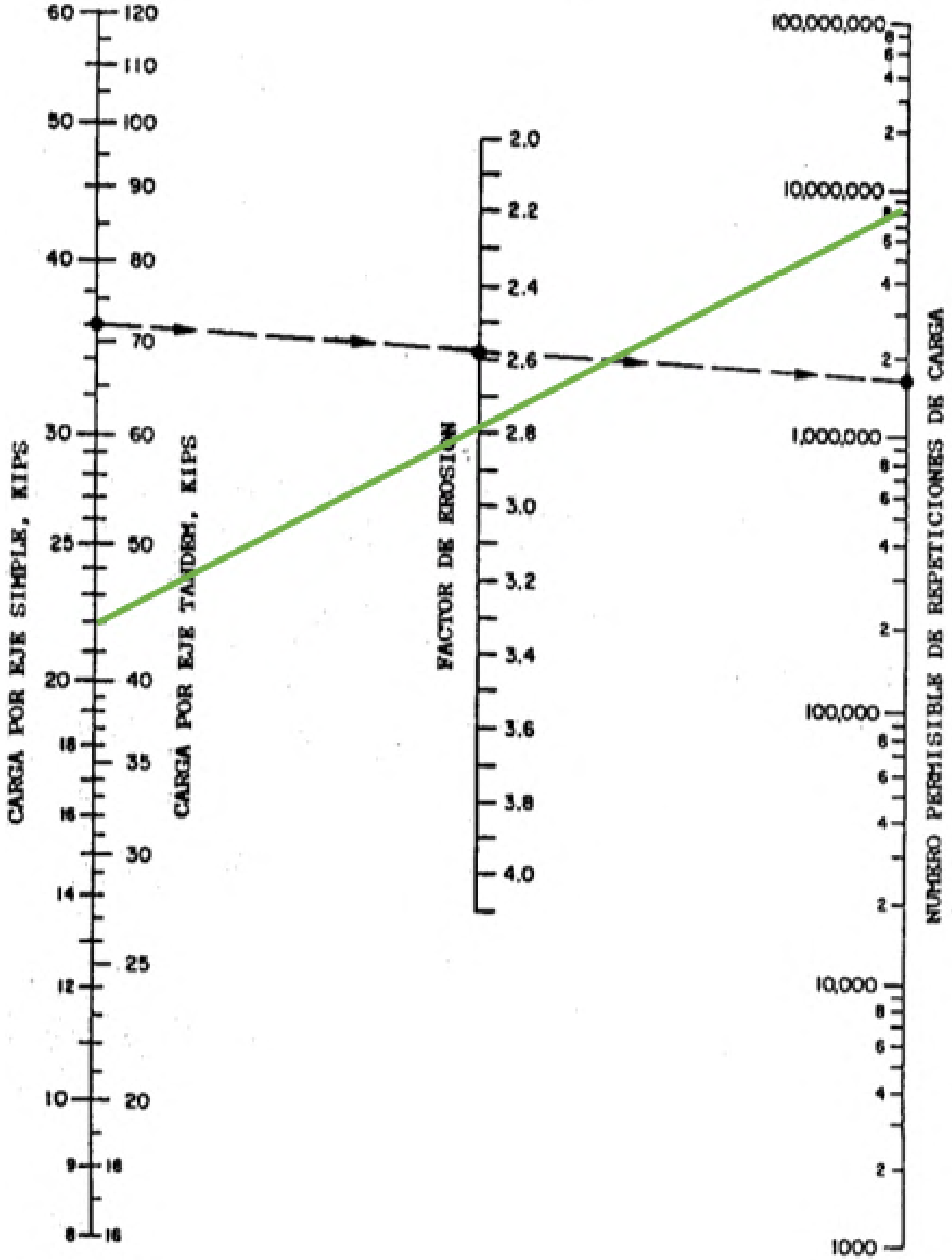

CARGA POR EJE SIMPLE, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

- **Ingreso a la nueva terminal (Año de ejecución)**

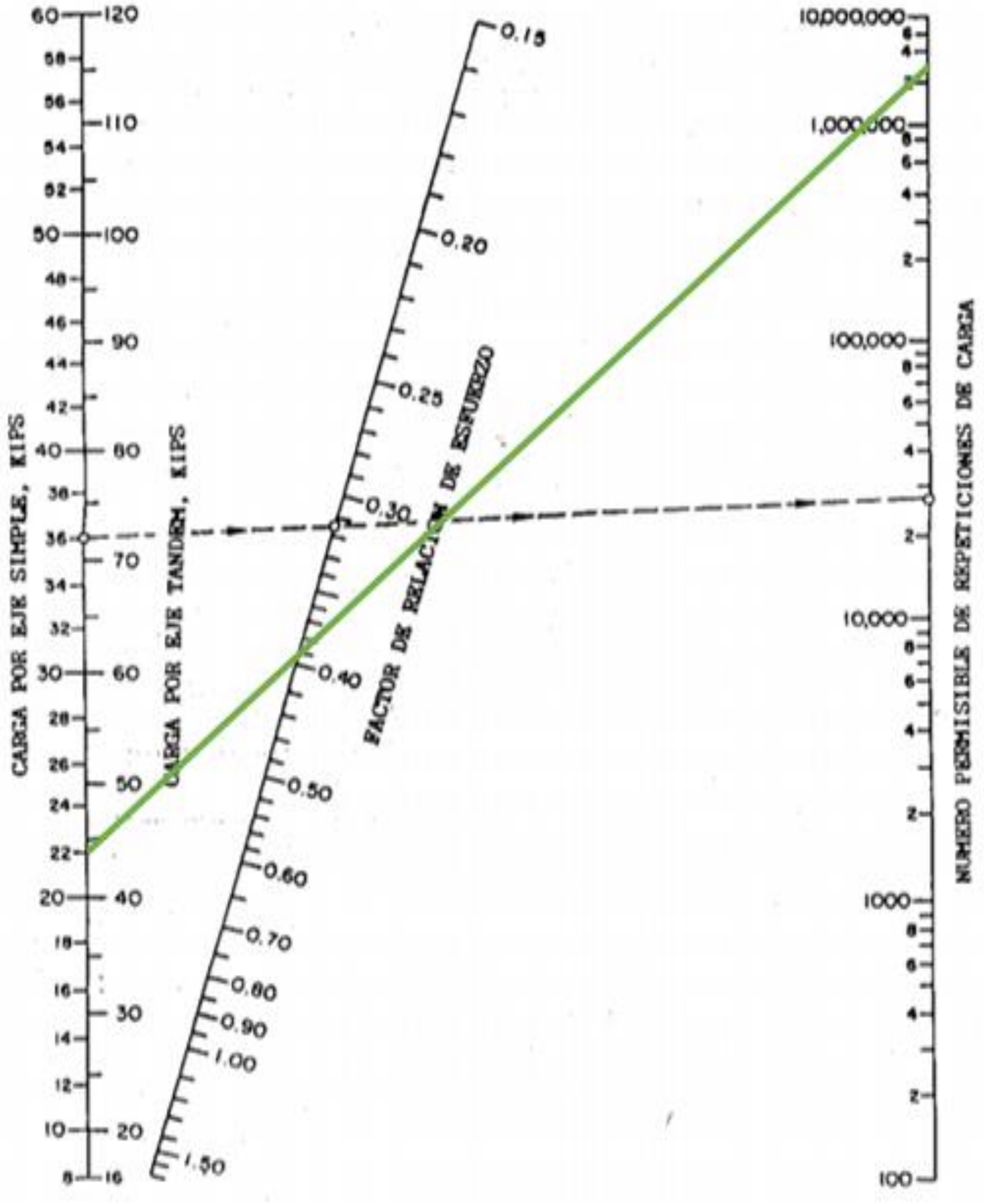
| | | | | | | |
|---|---|---|---|---|---|---|
| **Obra:** | | Ingreso a la nueva terminal | | | | |
| **Espesor de tanteo:** | | 8.2 | pulgada | **Pasador:** | si | |
| **K combinado:** | | 184.5 | pci | **Berma:** | no | |
| **Módulo de rotura, MR:** | | 640.035 | psi | **T diseño:** | 35 | años |
| **Factor seguridad, FS:** | | 1.2 | | **W18** | 7871145.9 | 7871.1459 |
| **Esfuerzo equivalente:** | | | 237.91 | | | |
| **Factor de relación de esfuerzos:** | | | 0.37 | | | |
| **Factor de erosión:** | | | 2.77 | | | |
| **Carga por eje** | **Multiplicado FS** | **Repeticiones esperadas** | **Análisis de fatiga** | | **Análisis de erosión** | |
| | | | **Repeticiones admisibles** | **Porcentaje de fatiga** | **Repeticiones admisibles** | **Porcentaje de daño** |
| 18 | 22 | 7871145.898 | Ilimitado | 0 | 8000000 | 98.39 |

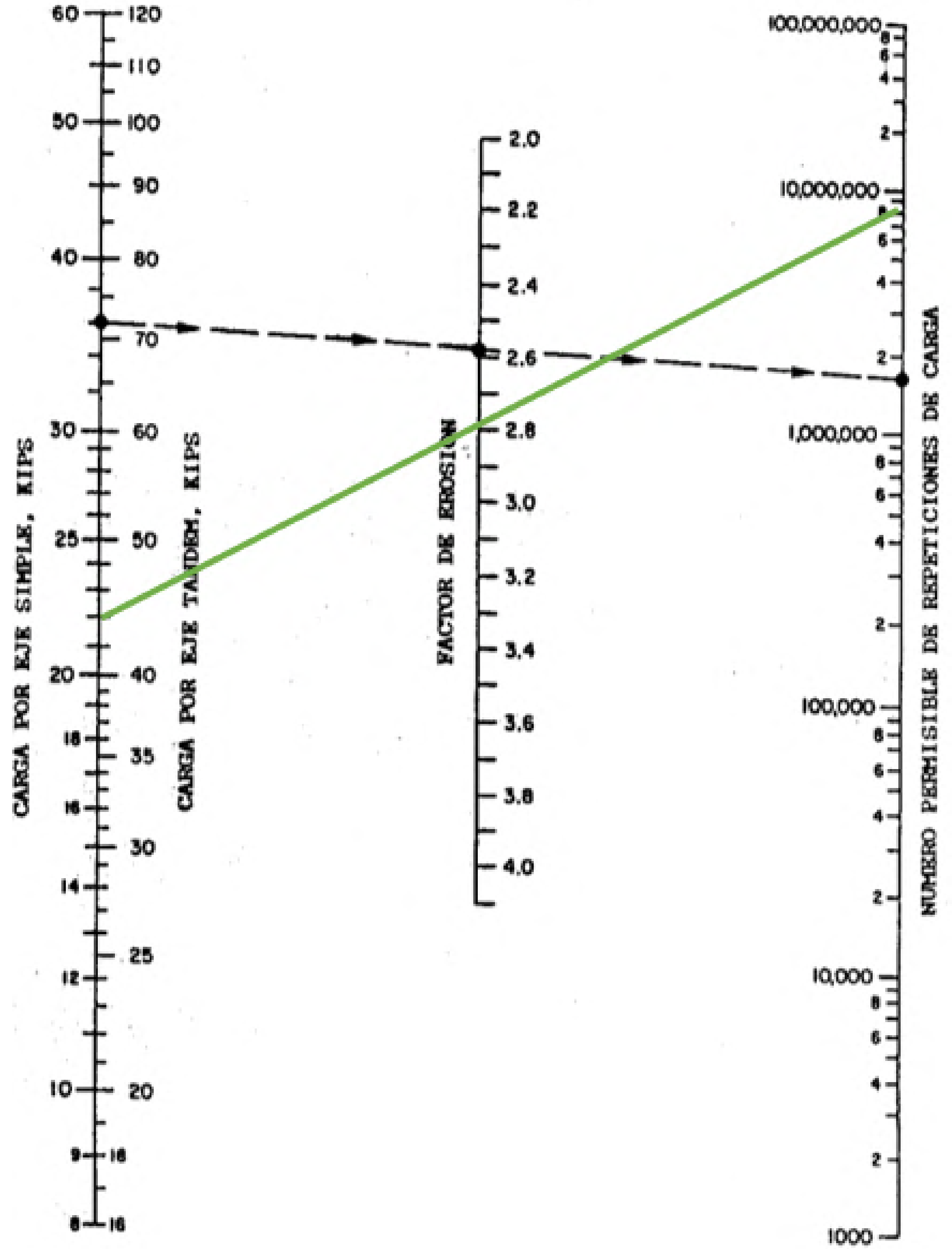


CARGA POR EJE SIMPLE, KIPS
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
30
20
16
FACTOR DE RELACION DE ESFUERZO
0.15
0.20
0.25
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
1.50
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
10,000,000
6
4
2
1,000,000
8
6
4
2
100,000
8
6
4
2
10,000
8
6
4
2
1000
8
6
4
2
100


CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
FACTOR DE EROSION
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
60
50
40
30
25
20
18
16
14
12
10
9
8
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

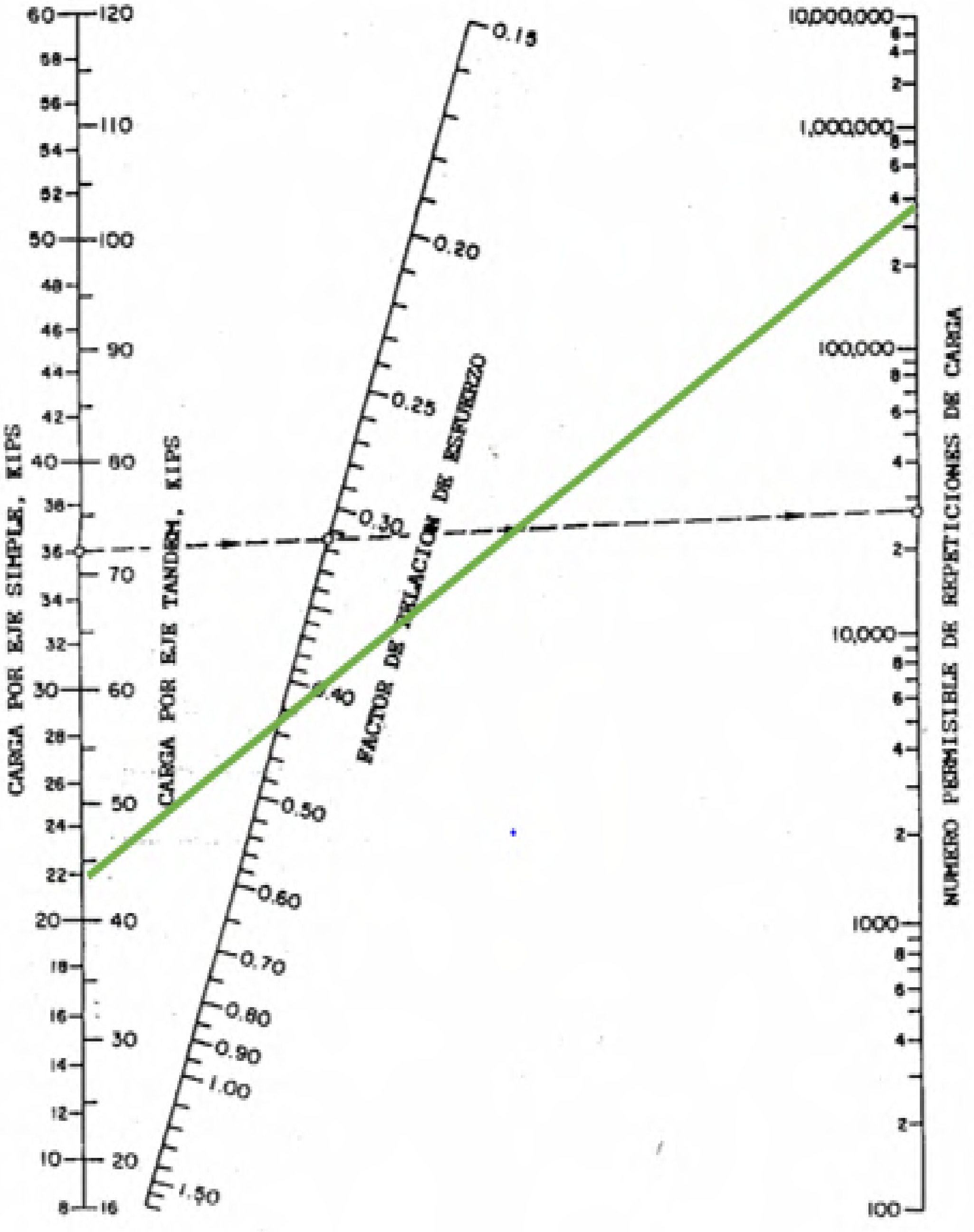
- **Avenida Jaime Paz (Frente para la presente gestión)**

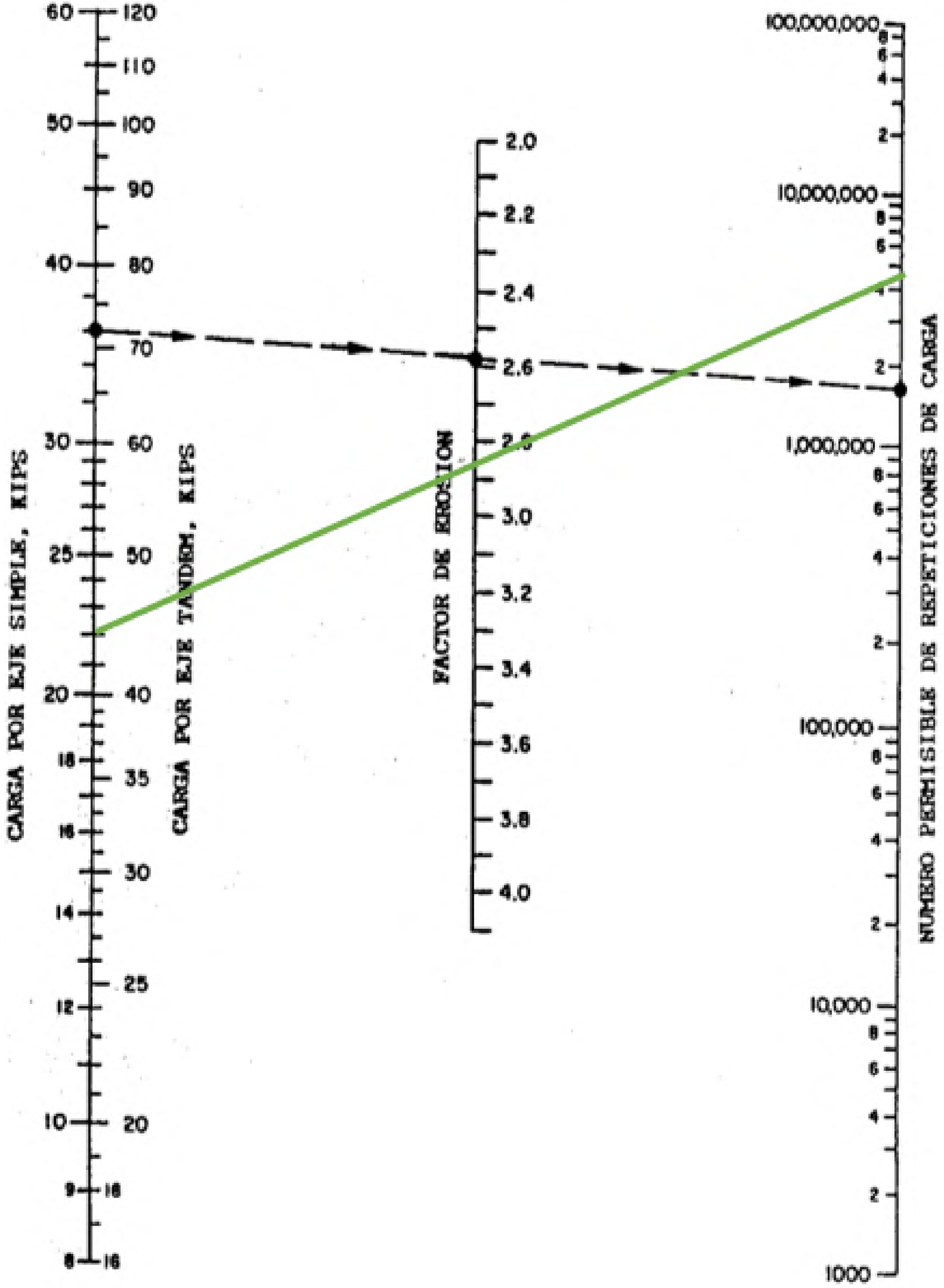



CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
FACTOR DE EROSION
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
60
50
40
30
25
20
18
16
14
12
10
9
8
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

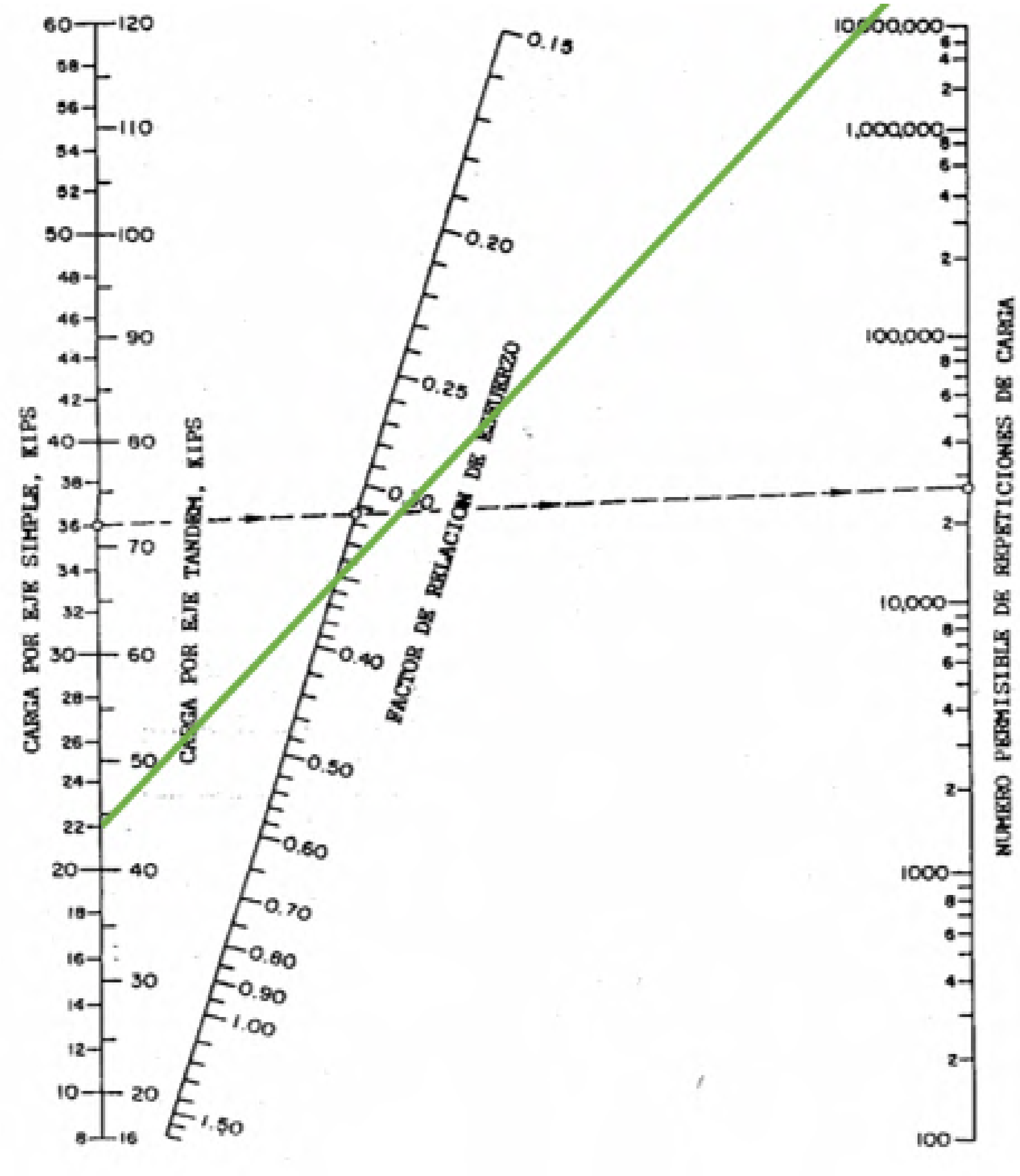
- **Avenida Jaime Paz (Frente año de construcción)**

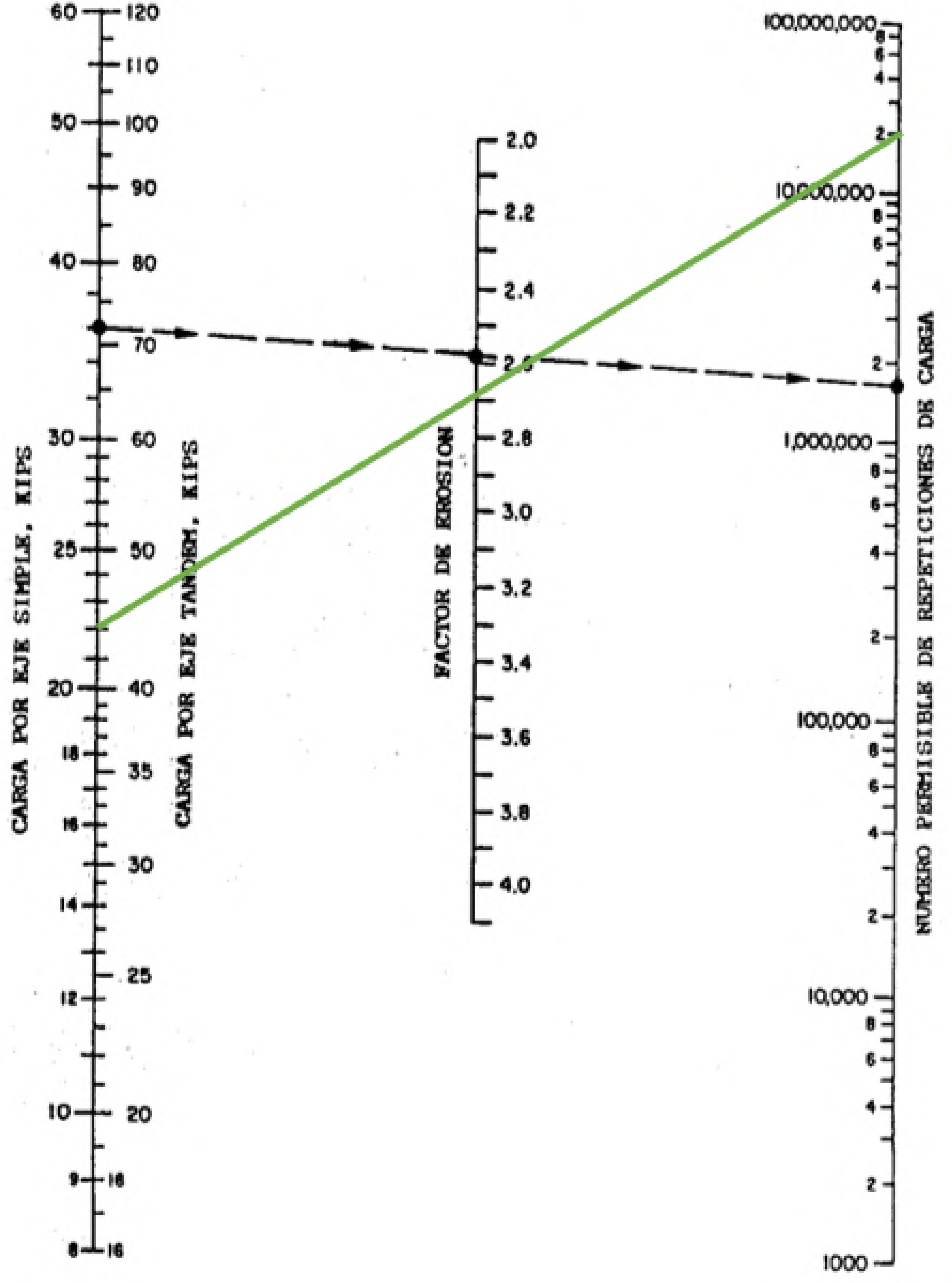
| | | | | | | |
|---|---|---|---|---|---|---|
| **Obra:** | | Avenida Jaime Paz | | | | |
| **Espesor de tanteo:** | | 7.5 | pulgada | **Pasador:** | si | |
| **K combinado:** | | 166.05 | pci | **Berma:** | no | |
| **Módulo de rotura, MR:** | | 640.035 | psi | **T diseño:** | 35 | años |
| **Factor seguridad, FS:** | | 1.2 | | **W18** | 376311.721 | |
| **Esfuerzo equivalente:** | | | 274.51 | | | |
| **Factor de relación de esfuerzos:** | | | 0.43 | | | |
| **Factor de erosión:** | | | 2.89 | | | |
| **Carga por eje** | **Multiplicado FS** | **Repeticiones esperadas** | **Análisis de fatiga** | | **Análisis de erosión** | |
| | | | **Repeticiones admisibles** | **Porcentaje de fatiga** | **Repeticiones admisibles** | **Porcentaje de daño** |
| 18 | 22 | 376311.721 | 400000 | 94.08 | 5000000 | 7.53 |


CARGA POR EJE SIMPLE, KIPS
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
30
20
16
FACTOR DE RELACION DE ESFUERZO
0.15
0.20
0.25
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
1.50
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
10,000,000
6
4
2
1,000,000
8
6
4
2
100,000
8
6
4
2
10,000
8
6
4
2
1000
8
6
4
2
100


CARGA POR EJE SIMPLE, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
8
6
4
2
10,000,000
8
6
4
2
1,000,000
8
6
4
2
100,000
8
6
4
2
10,000
8
6
4
2
1000

- **Avenida Jaime Paz (Medio para la presente gestión)**

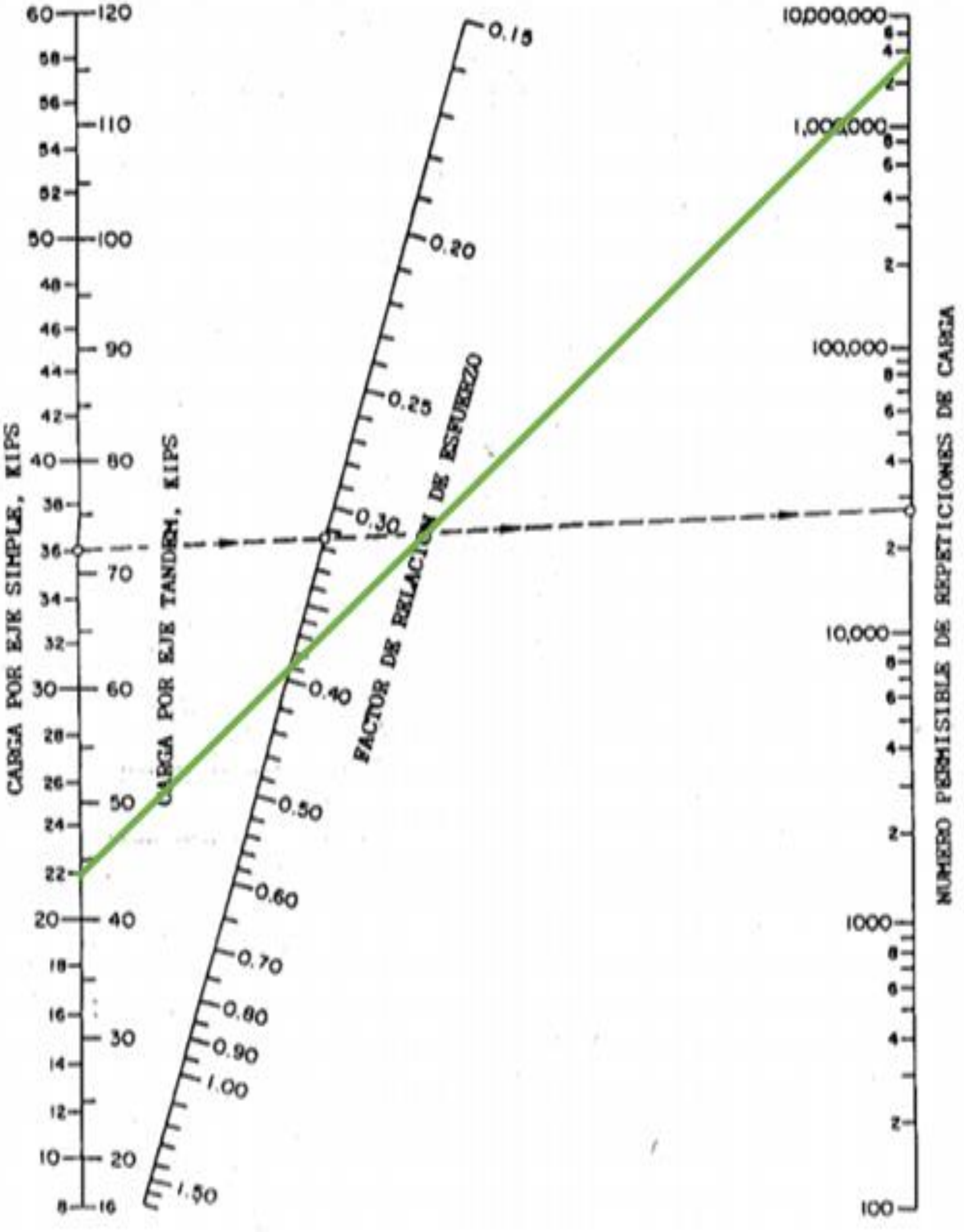


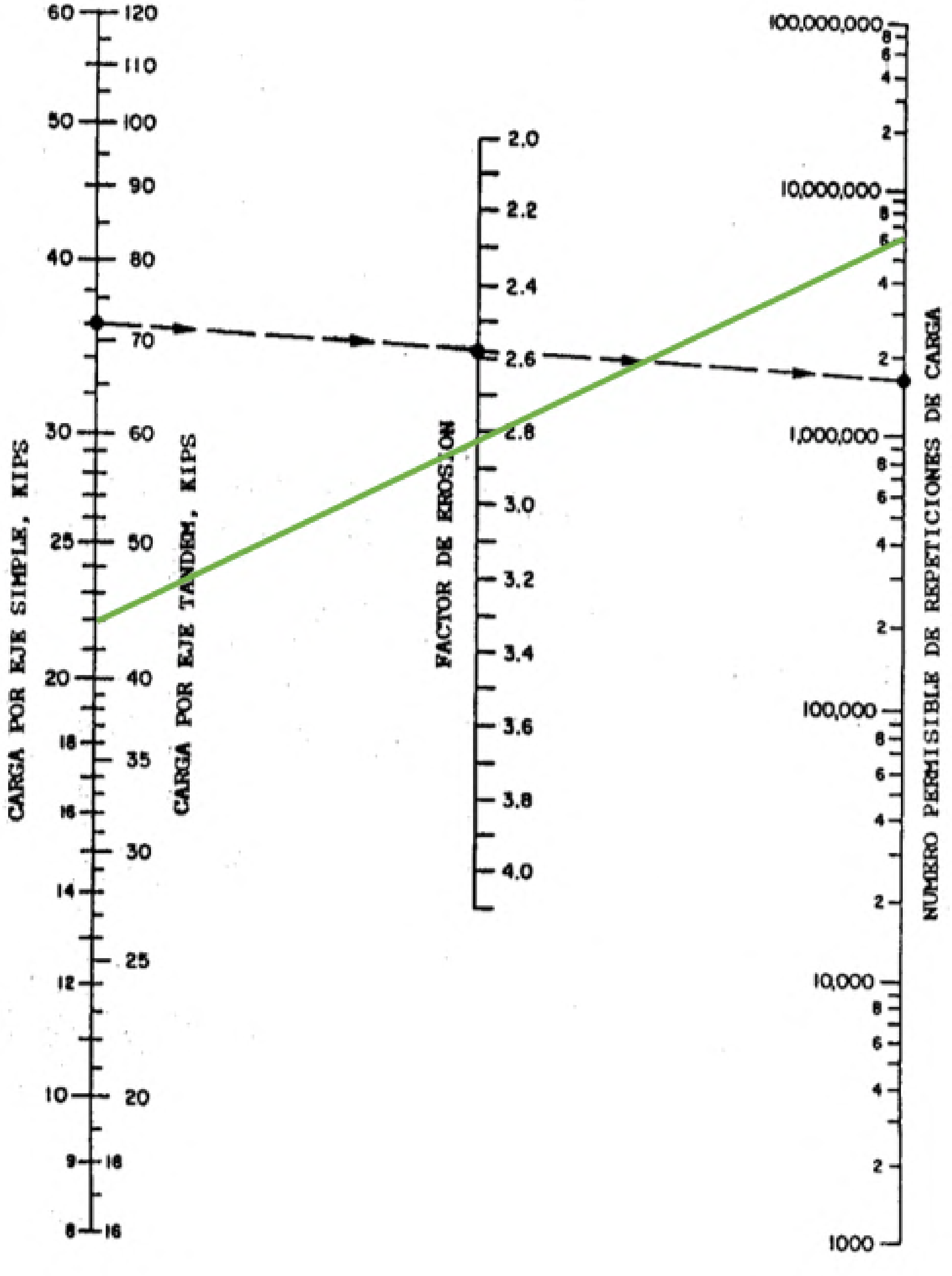


CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
FACTOR DE EROSION
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
60
50
40
30
25
20
18
16
14
12
10
9
8
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

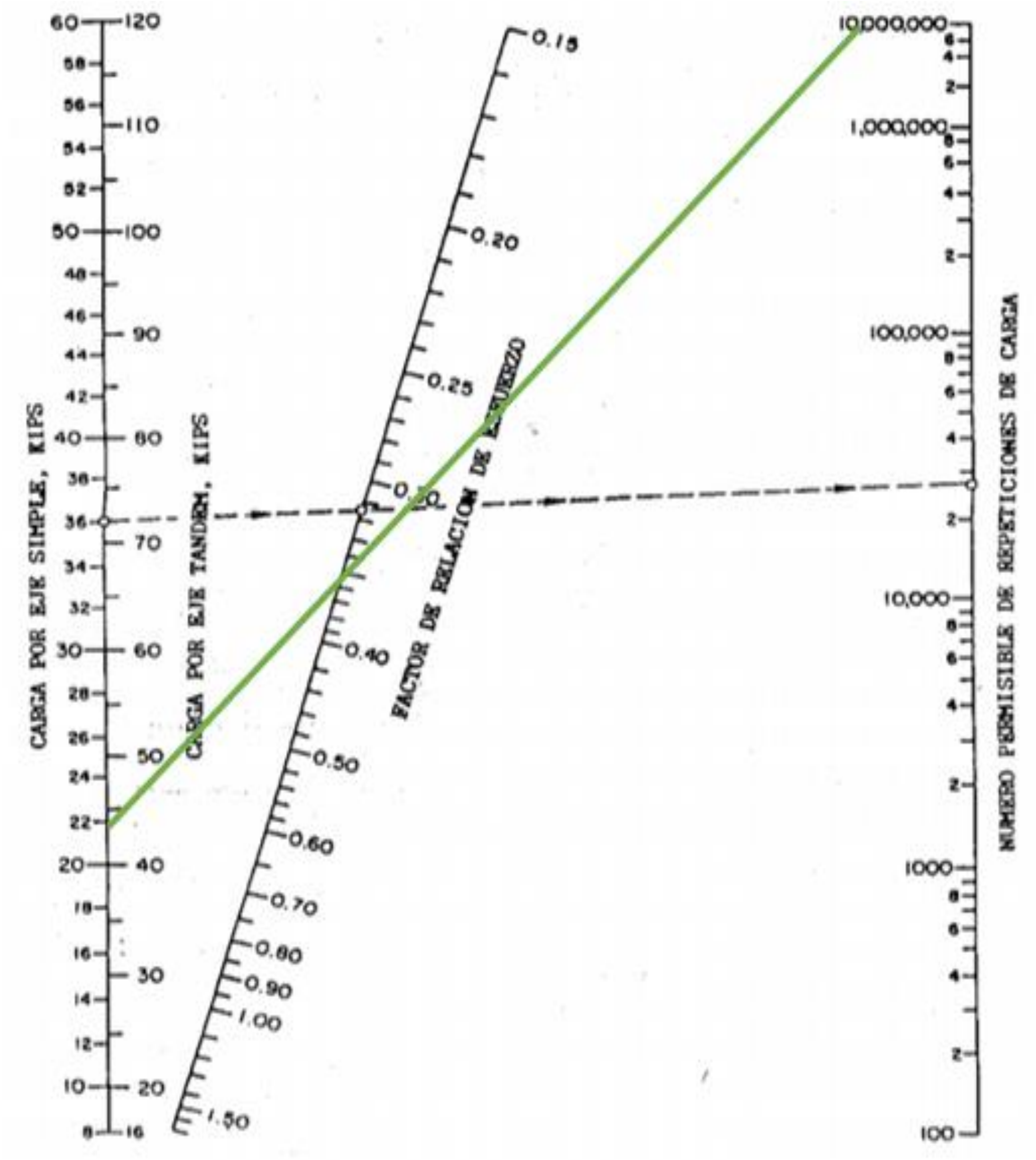
- **Avenida Jaime Paz (Medio para el año de ejecución)**

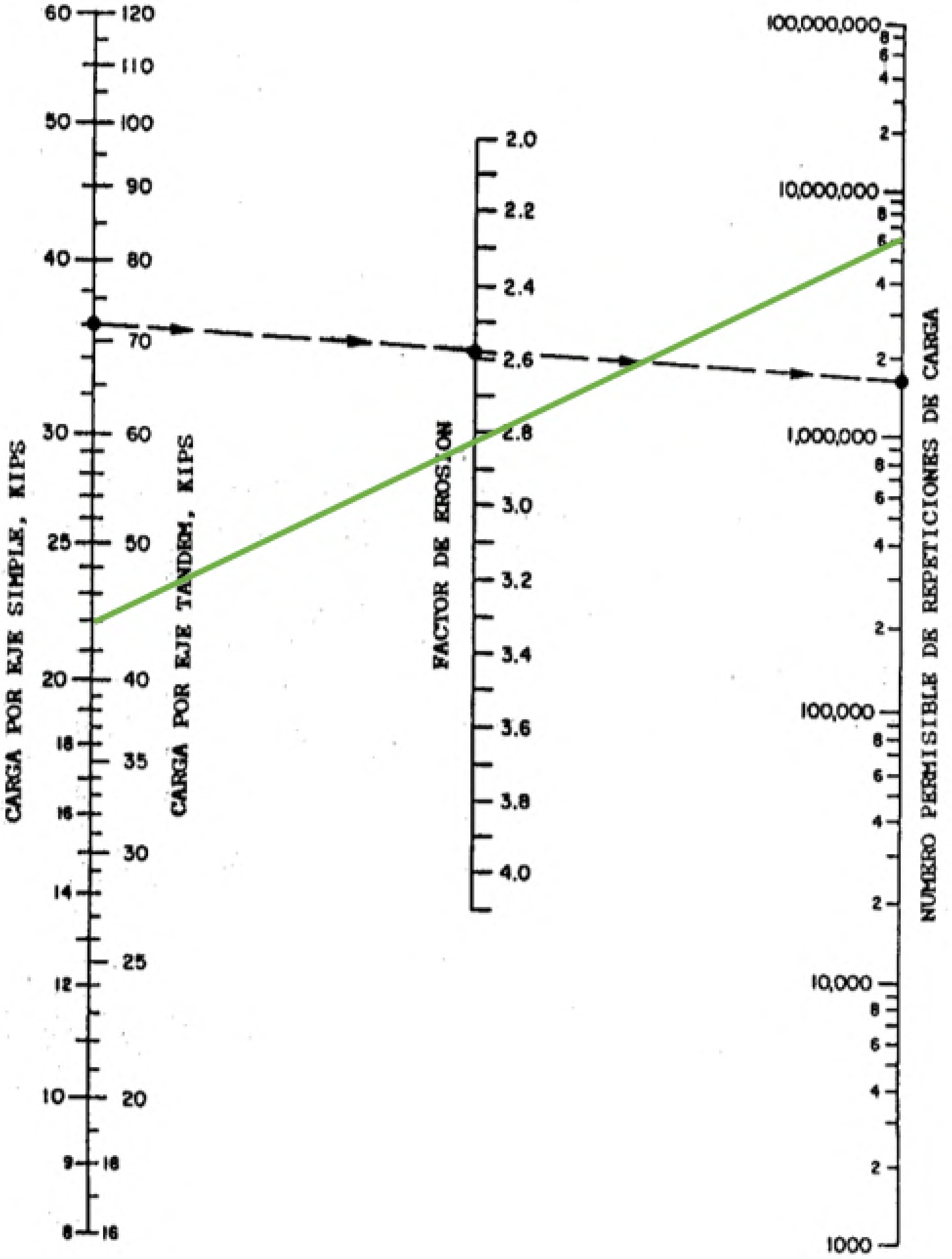
| | | | | | | |
|---|---|---|---|---|---|---|
| **Obra:** | | Avenida Jaime Paz Medio | | | | |
| **Espesor de tanteo:** | | 8 | pulgada | **Pasador:** | si | |
| **K combinado:** | | 166.05 | pci | **Berma:** | no | |
| **Módulo de rotura, MR:** | | 640.035 | psi | **T diseño:** | 35 | años |
| **Factor seguridad, FS:** | | 1.2 | | **W18** | 3421155.185 | |
| **Esfuerzo equivalente:** | | | 250.83 | | | |
| **Factor de relación de esfuerzos:** | | | 0.39 | | | |
| **Factor de erosión:** | | | 2.81 | | | |
| **Carga por eje** | **Multiplicado FS** | **Repeticiones esperadas** | **Análisis de fatiga** | | **Análisis de erosión** | |
| | | | **Repeticiones admisibles** | **Porcentaje de fatiga** | **Repeticiones admisibles** | **Porcentaje de daño** |
| 18 | 22 | 3421155.185 | 4000000 | 85.53 | 6000000 | 57.02 |


CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
FACTOR DE RELACION DE ESFUERZO
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
120
110
100
90
80
70
60
50
40
30
20
16
0.15
0.20
0.25
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
1.50
10,000,000
1,000,000
100,000
10,000
1000
100


CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

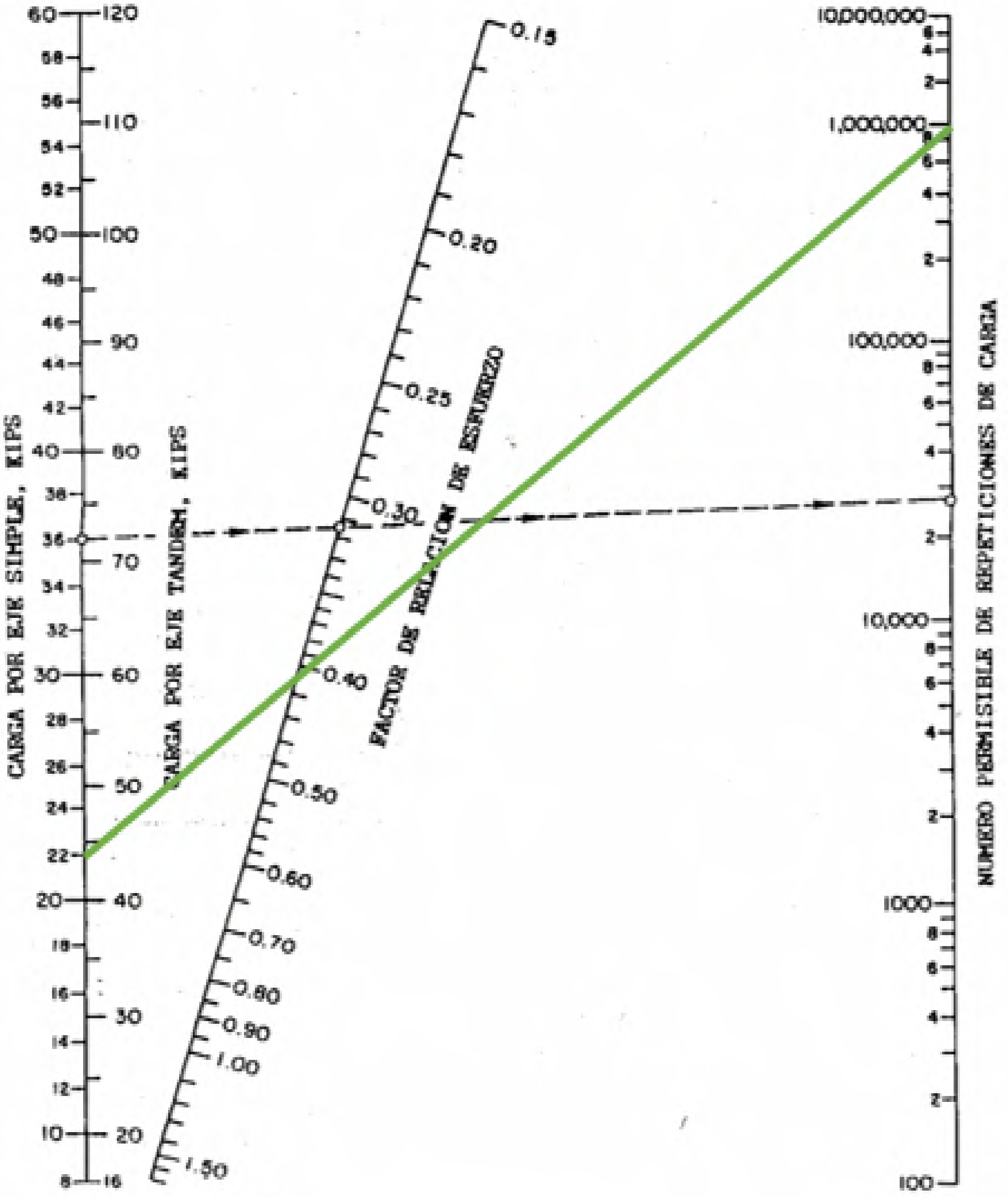
- **Avenida Jaime Paz (Ex terminal para la presente gestión)**



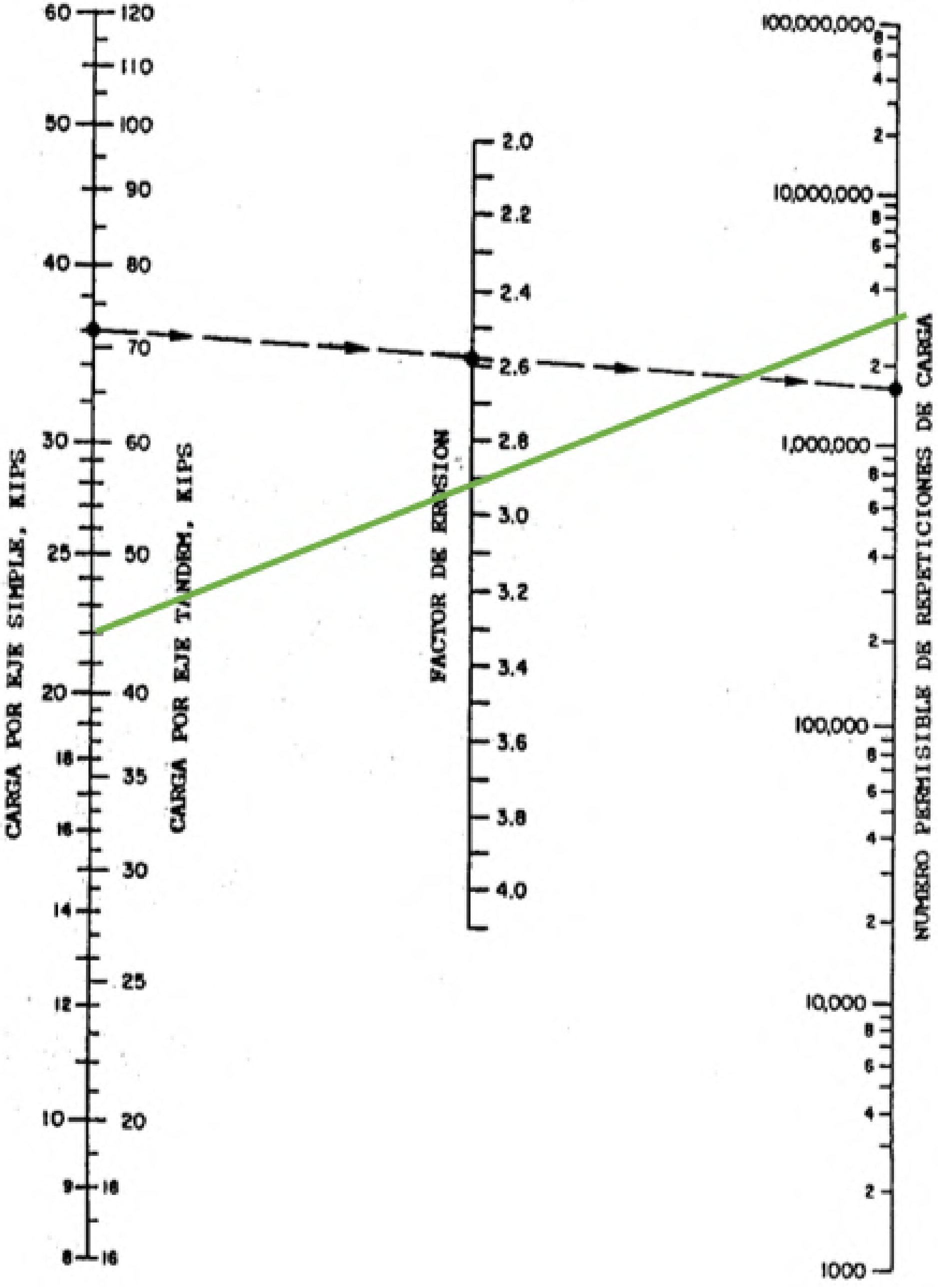

CARGA POR EJE SIMPLE, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

- **Avenida Jaime Paz (Ex terminal para el año de ejecución)**

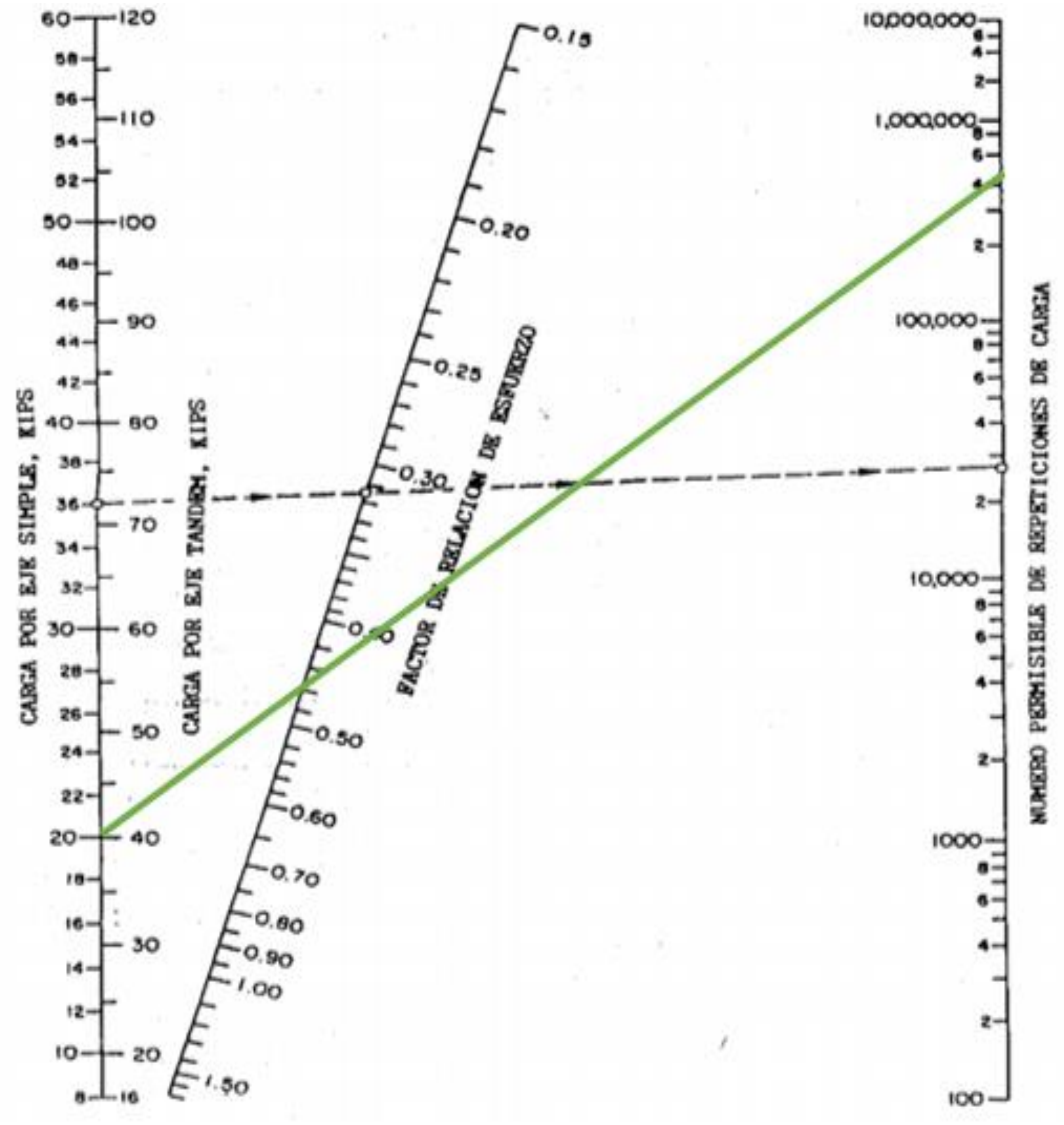
| | | | | | | |
|---|---|---|---|---|---|---|
| **Obra:** | | Avenida Jaime Paz (Ex terminal) | | | | |
| **Espesor de tanteo:** | | 7.7 | pulgada | **Pasador:** | si | |
| **K combinado:** | | 180.81 | pci | **Berma:** | no | |
| **Módulo de rotura, MR:** | | 640.035 | psi | **T diseño:** | 35 | años |
| **Factor seguridad, FS:** | | 1.2 | | **W18** | 1120586.49 | |
| **Esfuerzo equivalente:** | | | 261.02 | | | |
| **Factor de relación de esfuerzos:** | | | 0.41 | | | |
| **Factor de erosión:** | | | 2.91 | | | |
| **Carga por eje** | **Multiplicado FS** | **Repeticiones esperadas** | **Análisis de fatiga** | | **Análisis de erosión** | |
| | | | **Repeticiones admisibles** | **Porcentaje de fatiga** | **Repeticiones admisibles** | **Porcentaje de daño** |
| 18 | 22 | 1120586.488 | 1000000 | 112.06 | 3000000 | 37.35 |

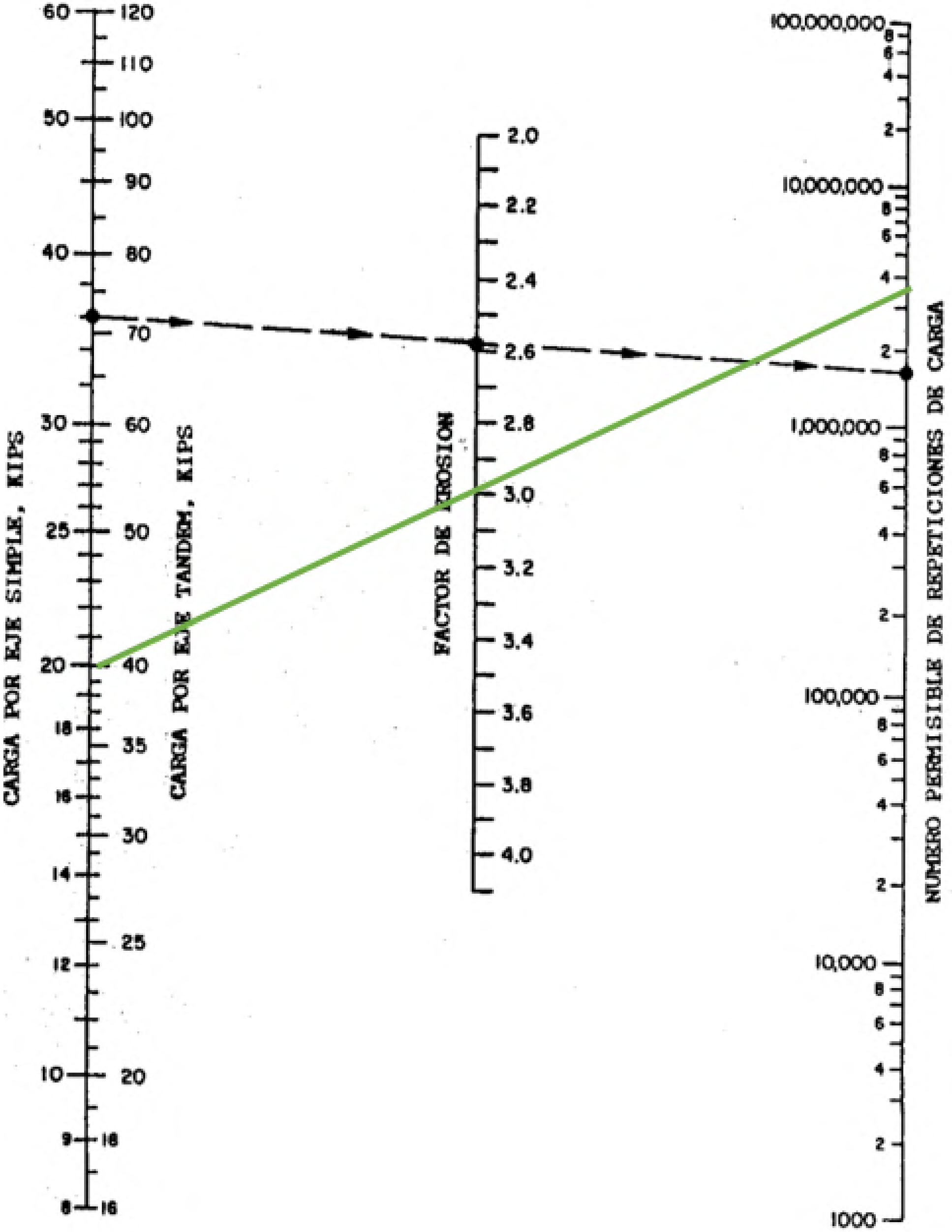


CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
FACTOR DE RELACION DE ESFUERZO
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
120
110
100
90
80
70
60
50
40
30
20
16
0.15
0.20
0.25
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
1.50
10,000,000
1,000,000
100,000
10,000
1000
100
8
6
4
2


CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
FACTOR DE EROSION
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
60
50
40
30
25
20
18
16
14
12
10
9
8
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

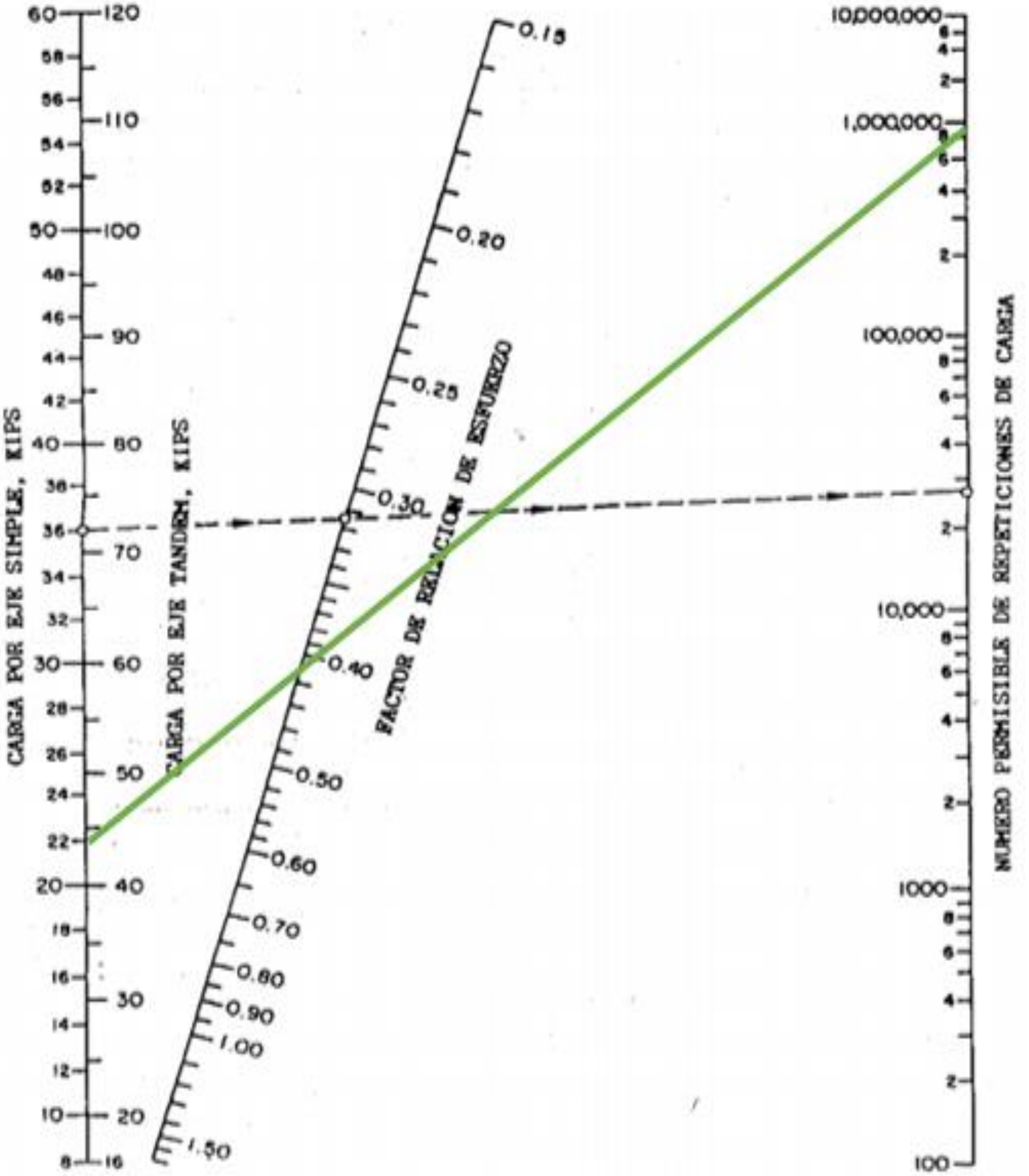
- **Calle Junín (Presente gestión)**

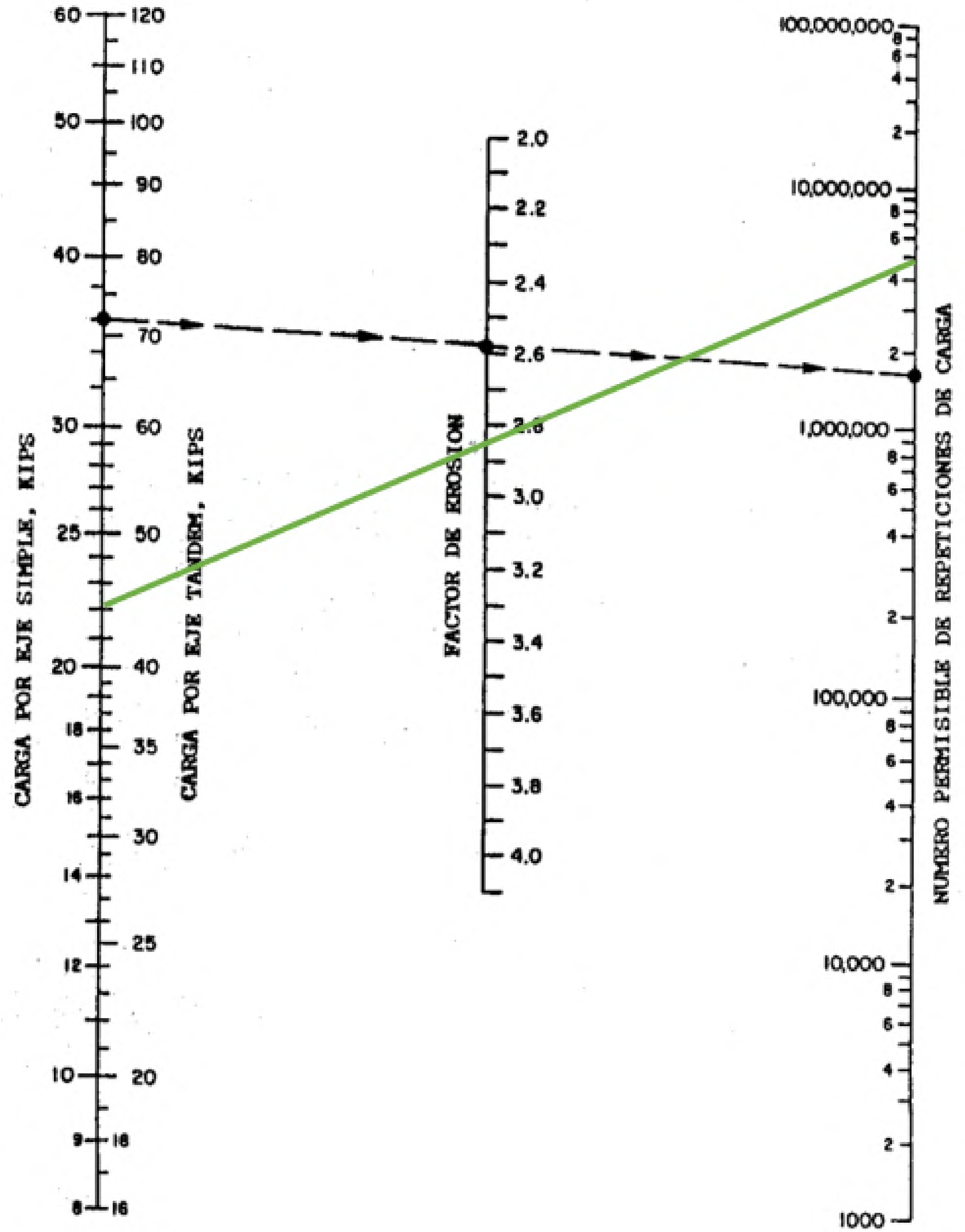



CARGA POR EJE SIMPLE, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
8
6
4
2

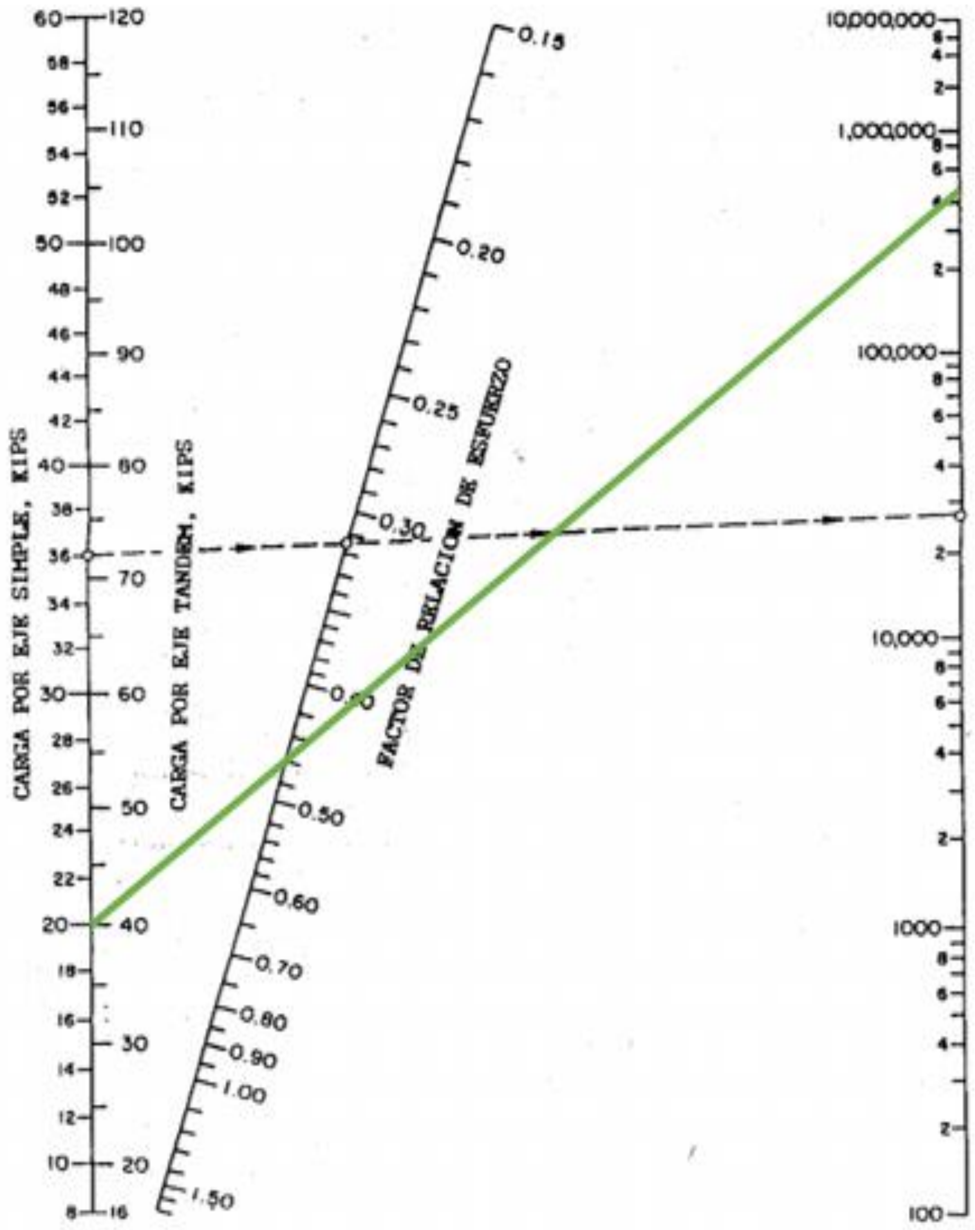
- **Calle Junín (Año de ejecución)**

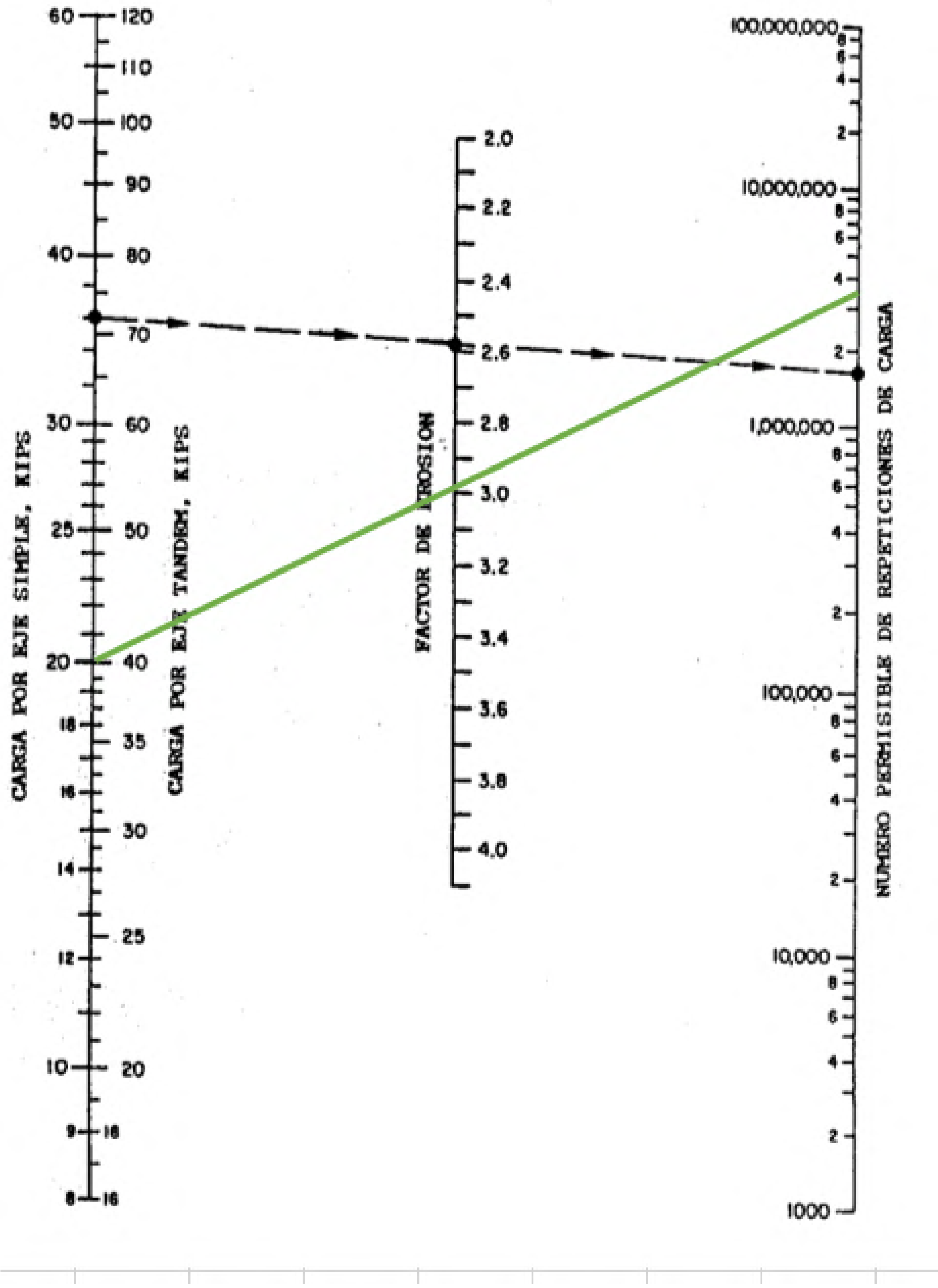
| | | | | | | |
|---|---|---|---|---|---|---|
| **Obra:** | | Calle Junín | | | | |
| **Espesor de tanteo:** | | 7.6 | pulgada | **Pasador:** | si | |
| **K combinado:** | | 202.21 | pci | **Berma:** | no | |
| **Módulo de rotura, MR:** | | 640.035 | psi | **T diseño:** | 35 | años |
| **Factor seguridad, FS:** | | 1.1 | | **W18** | 986740.732 | |
| **Esfuerzo equivalente:** | | | 259.99 | | | |
| **Factor de relación de esfuerzos:** | | | 0.41 | | | |
| **Factor de erosión:** | | | 2.86 | | | |
| **Carga por eje** | **Multiplicado FS** | **Repeticiones esperadas** | **Análisis de fatiga** | | **Análisis de erosión** | |
| | | | **Repeticiones admisibles** | **Porcentaje de fatiga** | **Repeticiones admisibles** | **Porcentaje de daño** |
| 18 | 20 | 986740.732 | 1000000 | 98.67 | 5000000 | 19.73 |


CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
FACTOR DE RELACION DE ESFUERZO
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
120
110
100
90
80
70
60
50
40
30
20
16
0.15
0.20
0.25
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
1.50
10,000,000
8
4
2
1,000,000
8
6
4
2
100,000
8
6
4
2
10,000
8
6
4
2
1000
8
6
4
2
100


CARGA POR EJE SIMPLE, KIPS
CARGA POR EJE TANDEM, KIPS
FACTOR DE EROSION
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
60 50 40 30 25 20 18 16 14 12 10 9 8
120 110 100 90 80 70 60 50 40 35 30 25 20 18 16
2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0
100,000,000 10,000,000 1,000,000 100,000 10,000 1000
8 6 4 2

- **Avenida Violín Chapaco (Presente gestión)**




CARGA POR EJE SIMPLE, KIPS
60
50
40
30
25
20
18
16
14
12
10
9
8
CARGA POR EJE TANDEM, KIPS
120
110
100
90
80
70
60
50
40
35
30
25
20
18
16
FACTOR DE EROSION
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
NUMERO PERMISIBLE DE REPETICIONES DE CARGA
100,000,000
8
6
4
2
10,000,000
8
6
4
2
1,000,000
8
6
4
2
100,000
8
6
4
2
10,000
8
6
4
2
1000

# ANEXO N°5

## PARQUE AUTOMOTOR DE TARIJA

# Tabla general de parque automotor de Tarija

| TIPO DE SERVICIO(2)/CLASE DE VEHÍCULO | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TOTAL** | **25,189** | **27,254** | **28,612** | **31,711** | **37,529** | **43,910** | **48,884** | **53,668** | **59,568** | **65,533** | **71,835** | **79,431** | **87,301** | **95,711** | **102,203** | **108,596** | **114,423** | **118,439** |
| | | | | | | | | | | | | | | | | | | |
| **Particular** | **22,649** | **25,076** | **26,114** | **29,026** | **34,605** | **41,196** | **45,854** | **50,428** | **56,137** | **61,580** | **67,243** | **74,204** | **81,773** | **89,607** | **96,154** | **102,278** | **107,827** | **111,463** |
| Ambulancia(3) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 40 |
| Automóvil | 6,387 | 6,859 | 7,009 | 7,567 | 8,472 | 9,358 | 10,015 | 10,786 | 11,555 | 12,229 | 13,061 | 14,108 | 15,208 | 16,446 | 17,440 | 18,378 | 19,297 | 19,732 |
| Bus(1) | 136 | 173 | 183 | 181 | 212 | 241 | 256 | 249 | 232 | 235 | 235 | 239 | 259 | 275 | 275 | 295 | 295 | 303 |
| Camión | 3,010 | 3,451 | 3,577 | 3,757 | 4,364 | 5,159 | 5,463 | 5,642 | 5,943 | 6,173 | 6,340 | 6,587 | 6,775 | 7,034 | 7,096 | 7,248 | 7,355 | 7,355 |
| Camioneta | 5,014 | 5,328 | 5,448 | 5,660 | 6,099 | 6,573 | 6,975 | 7,433 | 8,036 | 8,547 | 9,152 | 9,972 | 10,745 | 11,650 | 12,349 | 13,017 | 13,510 | 13,690 |
| Furgón | 20 | 24 | 25 | 29 | 33 | 39 | 42 | 48 | 61 | 76 | 97 | 121 | 133 | 157 | 195 | 223 | 244 | 244 |
| Jeep | 1,318 | 1,438 | 1,487 | 1,666 | 1,842 | 1,949 | 2,019 | 2,101 | 2,198 | 2,272 | 2,347 | 2,442 | 2,488 | 2,598 | 2,617 | 2,653 | 2,667 | 2,682 |
| Microbús | 510 | 646 | 631 | 669 | 743 | 885 | 893 | 924 | 958 | 1,005 | 981 | 1,028 | 1,047 | 1,032 | 1,015 | 975 | 934 | 930 |
| Minibús | 472 | 535 | 553 | 567 | 621 | 698 | 758 | 849 | 937 | 1,002 | 1,070 | 1,155 | 1,230 | 1,318 | 1,388 | 1,441 | 1,474 | 1,495 |
| Moto | 885 | 1,120 | 1,292 | 1,516 | 1,937 | 2,675 | 3,604 | 4,671 | 6,154 | 8,663 | 11,642 | 15,319 | 19,408 | 23,181 | 26,717 | 29,903 | 32,904 | 35,402 |
| Quadra-Trac | 1 | 1 | 1 | 2 | 2 | 6 | 7 | 12 | 14 | 25 | 32 | 46 | 70 | 86 | 96 | 107 | 117 | 122 |
| Torpedo | 0 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | 4 | 4 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 4 |
| Tracto - Camión | 14 | 23 | 56 | 98 | 107 | 146 | 178 | 212 | 226 | 257 | 302 | 350 | 362 | 404 | 405 | 418 | 446 | 449 |
| Trimóvil - Camión | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vagoneta | 4,882 | 5,477 | 5,851 | 7,312 | 10,171 | 13,464 | 15,640 | 17,496 | 19,819 | 21,092 | 21,980 | 22,833 | 24,045 | 25,423 | 26,557 | 27,616 | 28,567 | 29,015 |
| | | | | | | | | | | | | | | | | | | |
| **Público** | **2,194** | **1,803** | **1,969** | **2,084** | **2,187** | **1,829** | **1,978** | **2,050** | **2,105** | **2,167** | **2,435** | **2,689** | **2,800** | **3,228** | **3,132** | **3,328** | **3,670** | **3,914** |
| Automóvil | 538 | 420 | 445 | 415 | 402 | 318 | 323 | 325 | 321 | 313 | 327 | 342 | 342 | 532 | 385 | 393 | 445 | 477 |
| Bus(1) | 108 | 95 | 107 | 123 | 128 | 135 | 151 | 170 | 182 | 193 | 205 | 206 | 208 | 251 | 231 | 234 | 235 | 235 |
| Camión | 508 | 413 | 479 | 559 | 637 | 538 | 554 | 568 | 593 | 590 | 626 | 613 | 619 | 664 | 663 | 662 | 709 | 751 |
| Camioneta | 98 | 102 | 102 | 98 | 94 | 81 | 80 | 79 | 76 | 72 | 72 | 76 | 73 | 77 | 75 | 81 | 98 | 136 |
| Furgón | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 3 | 6 | 11 | 19 |
| Jeep | 4 | 4 | 4 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 5 |
| Microbús | 451 | 370 | 399 | 397 | 374 | 332 | 379 | 386 | 386 | 390 | 438 | 439 | 424 | 445 | 439 | 439 | 453 | 457 |
| Minibús | 82 | 77 | 78 | 78 | 81 | 71 | 81 | 77 | 77 | 85 | 102 | 120 | 127 | 137 | 141 | 187 | 242 | 261 |
| Moto | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 16 | 48 | 53 | 69 | 78 | 88 |
| Quadra-Trac | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Torpedo | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tracto - Camión | 7 | 8 | 13 | 24 | 60 | 76 | 116 | 144 | 175 | 203 | 280 | 319 | 392 | 422 | 473 | 519 | 585 | 626 |
| Trimóvil - Camión | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vagoneta | 395 | 314 | 342 | 387 | 408 | 277 | 293 | 300 | 294 | 320 | 384 | 558 | 596 | 649 | 668 | 736 | 810 | 859 |
| | | | | | | | | | | | | | | | | | | |
| **Oficial** | **346** | **375** | **529** | **601** | **737** | **885** | **1,052** | **1,190** | **1,326** | **1,786** | **2,157** | **2,538** | **2,728** | **2,876** | **2,917** | **2,990** | **2,926** | **3,062** |
| Ambulancia(3) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31 | 67 |
| Automóvil | 3 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 13 | 22 | 22 | 22 | 22 | 22 | 23 | 21 | 25 |
| Bus(1) | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 8 | 16 | 19 | 20 | 20 | 20 | 31 | 35 |
| Camión | 40 | 43 | 58 | 85 | 114 | 158 | 193 | 200 | 197 | 323 | 395 | 474 | 535 | 564 | 577 | 580 | 589 | 596 |
| Camioneta | 97 | 104 | 117 | 129 | 152 | 170 | 195 | 210 | 254 | 406 | 537 | 593 | 638 | 690 | 671 | 691 | 678 | 703 |
| Furgón | 0 | 1 | 1 | 5 | 6 | 6 | 6 | 6 | 6 | 8 | 8 | 10 | 10 | 10 | 10 | 11 | 10 | 11 |
| Jeep | 24 | 24 | 24 | 24 | 24 | 36 | 50 | 50 | 68 | 67 | 67 | 85 | 86 | 95 | 90 | 93 | 93 | 93 |
| Microbús | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Minibús | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 9 | 14 | 14 | 15 | 15 | 15 | 17 | 18 |
| Moto | 113 | 120 | 245 | 263 | 337 | 395 | 468 | 571 | 631 | 739 | 846 | 976 | 1,028 | 1,066 | 1,110 | 1,118 | 1,051 | 1,137 |
| Quadra-Trac | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 15 | 24 | 33 | 37 | 76 | 79 | 83 | 90 | 90 | 90 | 90 |
| Torpedo | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| Tracto - Camión | 0 | 0 | 0 | 2 | 2 | 4 | 5 | 5 | 5 | 8 | 16 | 21 | 22 | 23 | 24 | 25 | 25 | 25 |
| Trimóvil - Camión | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vagoneta | 62 | 72 | 73 | 81 | 89 | 104 | 114 | 122 | 129 | 179 | 210 | 235 | 259 | 272 | 272 | 308 | 274 | 246 |

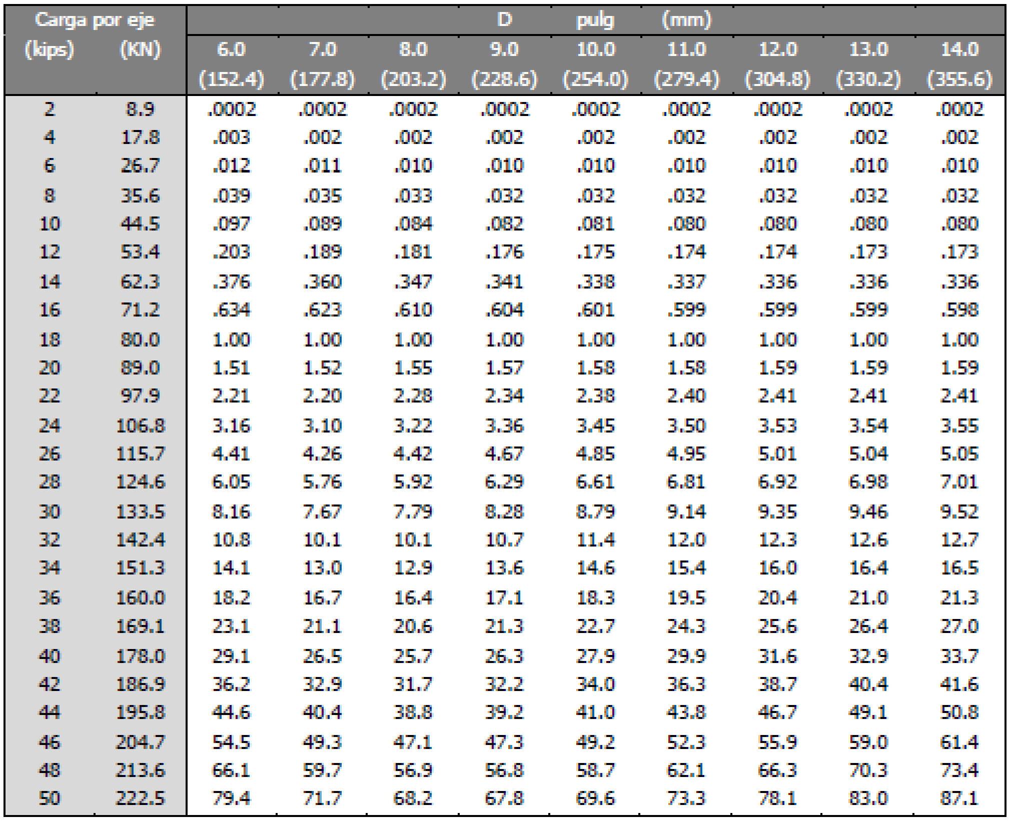
# ANEXO N°6

## FACTORES EQUIVALENTES DE CARGA PARA PAVIMENTOS RÍGIDOS

# Tablas utilizadas para los factores de ejes equivalentes

[1]

*Tabla 3.13. Factores equivalentes de carga para pavimentos rígidos, ejes simples, $p_t$ = 2.5*



| Carga por eje | | D pulg (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (kips) | (KN) | 6.0 (152.4) | 7.0 (177.8) | 8.0 (203.2) | 9.0 (228.6) | 10.0 (254.0) | 11.0 (279.4) | 12.0 (304.8) | 13.0 (330.2) | 14.0 (355.6) |
| 2 | 8.9 | .0002 | .0002 | .0002 | .0002 | .0002 | .0002 | .0002 | .0002 | .0002 |
| 4 | 17.8 | .003 | .002 | .002 | .002 | .002 | .002 | .002 | .002 | .002 |
| 6 | 26.7 | .012 | .011 | .010 | .010 | .010 | .010 | .010 | .010 | .010 |
| 8 | 35.6 | .039 | .035 | .033 | .032 | .032 | .032 | .032 | .032 | .032 |
| 10 | 44.5 | .097 | .089 | .084 | .082 | .081 | .080 | .080 | .080 | .080 |
| 12 | 53.4 | .203 | .189 | .181 | .176 | .175 | .174 | .174 | .173 | .173 |
| 14 | 62.3 | .376 | .360 | .347 | .341 | .338 | .337 | .336 | .336 | .336 |
| 16 | 71.2 | .634 | .623 | .610 | .604 | .601 | .599 | .599 | .599 | .598 |
| 18 | 80.0 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 20 | 89.0 | 1.51 | 1.52 | 1.55 | 1.57 | 1.58 | 1.58 | 1.59 | 1.59 | 1.59 |
| 22 | 97.9 | 2.21 | 2.20 | 2.28 | 2.34 | 2.38 | 2.40 | 2.41 | 2.41 | 2.41 |
| 24 | 106.8 | 3.16 | 3.10 | 3.22 | 3.36 | 3.45 | 3.50 | 3.53 | 3.54 | 3.55 |
| 26 | 115.7 | 4.41 | 4.26 | 4.42 | 4.67 | 4.85 | 4.95 | 5.01 | 5.04 | 5.05 |
| 28 | 124.6 | 6.05 | 5.76 | 5.92 | 6.29 | 6.61 | 6.81 | 6.92 | 6.98 | 7.01 |
| 30 | 133.5 | 8.16 | 7.67 | 7.79 | 8.28 | 8.79 | 9.14 | 9.35 | 9.46 | 9.52 |
| 32 | 142.4 | 10.8 | 10.1 | 10.1 | 10.7 | 11.4 | 12.0 | 12.3 | 12.6 | 12.7 |
| 34 | 151.3 | 14.1 | 13.0 | 12.9 | 13.6 | 14.6 | 15.4 | 16.0 | 16.4 | 16.5 |
| 36 | 160.0 | 18.2 | 16.7 | 16.4 | 17.1 | 18.3 | 19.5 | 20.4 | 21.0 | 21.3 |
| 38 | 169.1 | 23.1 | 21.1 | 20.6 | 21.3 | 22.7 | 24.3 | 25.6 | 26.4 | 27.0 |
| 40 | 178.0 | 29.1 | 26.5 | 25.7 | 26.3 | 27.9 | 29.9 | 31.6 | 32.9 | 33.7 |
| 42 | 186.9 | 36.2 | 32.9 | 31.7 | 32.2 | 34.0 | 36.3 | 38.7 | 40.4 | 41.6 |
| 44 | 195.8 | 44.6 | 40.4 | 38.8 | 39.2 | 41.0 | 43.8 | 46.7 | 49.1 | 50.8 |
| 46 | 204.7 | 54.5 | 49.3 | 47.1 | 47.3 | 49.2 | 52.3 | 55.9 | 59.0 | 61.4 |
| 48 | 213.6 | 66.1 | 59.7 | 56.9 | 56.8 | 58.7 | 62.1 | 66.3 | 70.3 | 73.4 |
| 50 | 222.5 | 79.4 | 71.7 | 68.2 | 67.8 | 69.6 | 73.3 | 78.1 | 83.0 | 87.1 |

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[1] Los nombres de cada tabla, corresponden al manual de diseño de pavimentos IBCH

*Tabla 3.14. Factores equivalentes de carga para pavimentos rígidos, ejes tándem, $p_t = 2.5$*

| Carga por eje | | D pulg (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (kips) | (KN) | 6.0 (152.4) | 7.0 (177.8) | 8.0 (203.2) | 9.0 (228.6) | 10.0 (254.0) | 11.0 279.4) | 12.0 (304.8) | 13.0 (330.2) | 14.0 (355.6) |
| 2 | 8.9 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 |
| 4 | 17.8 | .0006 | .0006 | .0005 | .0005 | .0005 | .0005 | .0005 | .0005 | .0005 |
| 6 | 26.7 | .002 | .002 | .002 | .002 | .002 | .002 | .002 | .002 | .002 |
| 8 | 35.6 | .007 | .006 | .006 | .005 | .005 | .005 | .005 | .005 | .005 |
| 10 | 44.5 | .015 | .014 | .013 | .013 | .012 | .012 | .012 | .012 | .012 |
| 12 | 53.4 | .031 | .028 | .026 | .026 | .025 | .025 | .025 | .025 | .025 |
| 14 | 62.3 | .057 | .052 | .049 | .048 | .047 | .047 | .047 | .047 | .047 |
| 16 | 71.2 | .097 | .089 | .084 | .082 | .081 | .081 | .080 | .080 | .080 |
| 18 | 80.0 | .155 | .143 | .136 | .133 | .132 | .131 | .131 | .131 | .131 |
| 20 | 89.0 | .234 | .220 | .211 | .206 | .204 | .203 | .203 | .203 | .203 |
| 22 | 97.9 | .340 | .325 | .313 | .308 | .305 | .304 | .303 | .303 | .303 |
| 24 | 106.8 | .475 | .462 | .450 | .444 | .441 | .440 | .439 | .439 | .439 |
| 26 | 115.7 | .644 | .637 | .627 | .622 | .620 | .619 | .618 | .618 | .618 |
| 28 | 124.6 | .855 | .854 | .852 | .850 | .850 | .850 | .849 | .849 | .849 |
| 30 | 133.5 | 1.11 | 1.12 | 1.13 | 1.14 | 1.14 | 1.14 | 1.14 | 1.14 | 1.14 |
| 32 | 142.4 | 1.43 | 1.44 | 1.47 | 1.49 | 1.50 | 1.51 | 1.51 | 1.51 | 1.51 |
| 34 | 151.3 | 1.82 | 1.82 | 1.87 | 1.92 | 1.95 | 1.96 | 1.97 | 1.97 | 1.97 |
| 36 | 160.0 | 2.29 | 2.27 | 2.35 | 2.43 | 2.48 | 2.51 | 2.52 | 2.52 | 2.53 |
| 38 | 169.1 | 2.85 | 2.80 | 2.91 | 3.03 | 3.12 | 3.16 | 3.18 | 3.20 | 3.20 |
| 40 | 178.0 | 3.52 | 3.42 | 3.55 | 3.74 | 3.87 | 3.94 | 3.98 | 4.00 | 4.01 |
| 42 | 186.9 | 4.32 | 4.16 | 4.30 | 4.55 | 4.74 | 4.86 | 4.91 | 4.95 | 4.96 |
| 44 | 195.8 | 5.26 | 5.01 | 5.16 | 5.48 | 5.75 | 5.92 | 6.01 | 6.06 | 6.09 |
| 46 | 204.7 | 6.36 | 6.01 | 6.14 | 6.53 | 6.90 | 7.14 | 7.28 | 7.36 | 7.40 |
| 48 | 213.6 | 7.64 | 7.16 | 7.27 | 7.73 | 8.21 | 8.55 | 8.75 | 8.86 | 8.92 |
| so | 222.5 | 9.11 | 8.50 | 8.55 | 9.07 | 9.68 | 10.14 | 10.42 | 10.58 | 10.66 |
| 52 | 231.4 | 10.8 | 10.0 | 10.0 | 10.6 | 11.3 | 11.9 | 12.3 | 12.5 | 12.7 |
| 54 | 240.3 | 12.8 | 11.8 | 11.7 | 12.3 | 13.2 | 13.9 | 14.5 | 14.8 | 14.9 |
| 56 | 249.2 | 15.0 | 13.8 | 13.6 | 14.2 | 15.2 | 16.2 | 16.8 | 17.3 | 17.5 |
| 58 | 258.1 | 17.5 | 16.0 | 15.7 | 16.3 | 17.5 | 18.6 | 19.5 | 20.1 | 20.4 |
| 60 | 267.0 | 20.3 | 18.5 | 18.1 | 18.7 | 20.0 | 21.4 | 22.5 | 23.2 | 23.6 |
| 62 | 275.9 | 23.5 | 21.4 | 20.8 | 21.4 | 22.8 | 24.4 | 25.7 | 26.7 | 27.3 |
| 64 | 284.7. | 27.0 | 24.6 | 23.8 | 24.4 | 25.8 | 27.7 | 29.3 | 30.5 | 31.3 |
| 66 | 293.6 | 31.0 | 28.1 | 27.1 | 27.6 | 29.2 | 31.3 | 33.2 | 34.7 | 35.7 |
| 68 | 302.5 | 35.4 | 32.1 | 30.9 | 31.3 | 32.9 | 35.2 | 37.5 | 39.3 | 40.5 |
| 70 | 311.4 | 40.3 | 36.5 | 35.0 | 35.3 | 37.0 | 39.5 | 42.1 | 44.3 | 45.9 |
| 72 | 320.3 | 45.7 | 41.4 | 39.6 | 39.8 | 41.5 | 44.2 | 47.2 | 49.8 | 51.7 |
| 74 | 329.2 | 51.7 | 46.7 | 44.6 | 44.7 | 46.4 | 49.3 | 52,7 | 55.7 | 58.0 |
| 76 | 338.1 | 58.3 | 52.6 | 50.2 | 50.1 | 51.8 | 54.9 | 58.6 | 62.1 | 64.8 |
| 78 | 347.0 | 65.5 | 59.1 | 56.3 | 56.1 | 57.7 | 60.9 | 65.0 | 69.0 | 72.3 |
| 80 | 355.9 | 73.4 | 66.2 | 62.9 | 62.5 | 64.2 | 67.5 | 71.9 | 76,4 | 80.2 |
| 82 | 364.8 | 82.0 | 73.9 | 70.2 | 69.6 | 71.2 | 74.7 | 79.4 | 84.4 | 88.8 |
| 84 | 373.7 | 91.4 | 82.4 | 78.1 | 77.3 | 78.9 | 82.4 | 87.4 | 93.0 | 98.1 |
| 86 | 382.6 | 102. | 92. | 87. | 86. | 87. | 91. | 96. | 102. | 108. |
| 88 | 391.5 | 113. | 102. | 96. | 95. | 96. | 100. | 105. | 112. | 119. |
| 90 | 400.4 | 125. | 112. | 106. | 105. | 106. | 110. | 115. | 123. | 130. |

*Tabla 3.15. Factores equivalentes de carga para pavimentos rígidos, ejes trídem, $p_t = 2.5$*

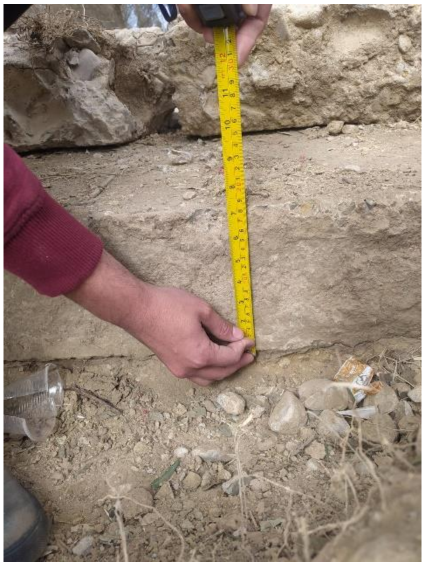
| Carga por eje | | D pulg (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (kips) | (KN) | 6.0<br>(152.4) | 7.0<br>(177.8) | 8.0<br>(203.2) | 9.0<br>(228.6) | 10.0<br>(254.0) | 11.0<br>279.4) | 12.0<br>(304.8) | 13.0<br>(330.2) | 14.0<br>(355.6) |
| 2 | 8.9 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 |
| 4 | 17.8 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 |
| 6 | 26.7 | .001 | .001 | .001 | .001 | .001 | .001 | .001 | .001 | .001 |
| 8 | 35.6 | .003 | .002 | .002 | .002 | .002 | .002 | .002 | .002 | .002 |
| 10 | 44.5 | .006 | .005 | .005 | .005 | .005 | .005 | .005 | .005 | .005 |
| 12 | 53.4 | .011 | .010 | .010 | .009 | .009 | .009 | .009 | .009 | .009 |
| 14 | 62.3 | .020 | .018 | .017 | .017 | .016 | .016 | .016 | .016 | .016 |
| 16 | 71.2 | .033 | .030 | .029 | .028 | .027 | .027 | .027 | .027 | .027 |
| 18 | 80.0 | .053 | .048 | .045 | .044 | .044 | .043 | .043 | .043 | .043 |
| 20 | 89.0 | .080 | .073 | .069 | .067 | .066 | .066 | .066 | .066 | .066 |
| 22 | 97.9 | .116 | .107 | .101 | .099 | .098 | .097 | .097 | .097 | .097 |
| 24 | 106.8 | .163 | .151 | .144 | .141 | .139 | .139 | .138 | .138 | .138 |
| 26 | 115.7 | .222 | .209 | .200 | .195 | .194 | .193 | .192 | .192 | .192 |
| 28 | 124.6 | .295 | .281 | .271 | .265 | .263 | .262 | .262 | .262 | .262 |
| 30 | 133.5 | .384 | .371 | .359 | .354 | .351 | .350 | .349 | .349 | .349 |
| 32 | 142.4 | .490 | .480 | .468 | .463 | .460 | .459 | .458 | .458 | .458 |
| 34 | 151.3 | .616 | .609 | .601 | .596 | .594 | .593 | .592 | .592 | .592 |
| 36 | 160.0 | .765 | .762 | .759 | .757 | .756 | .755 | .755 | .755 | .755 |
| 38 | 169.1 | .939 | .941 | .946 | .948 | .950 | .951 | .951 | .951 | .951 |
| 40 | 178.0 | 1.14 | 1.15 | 1.16 | 1.17 | 1.18 | 1.18 | 1.18 | 1.18 | 1.18 |
| 42 | 186.9 | 1.38 | 1.38 | 1.41 | 1.44 | 1.45 | 1,46 | 1.46 | 1.46 | 1,46 |
| 44 | 195.8 | 1.65 | 1.65 | 1.70 | 1.74 | 1.77 | 1.78 | 1.78 | 1.78 | 1.79 |
| 46 | 204.7 | 1.97 | 1.96 | 2.03 | 2.09 | 2.13 | 2.15 | 2.16 | 2.16 | 2.16 |
| 48 | 213.6 | 2.34 | 2.31 | 2.40 | 2.49 | 2.55 | 2.58 | 2.59 | 2.60 | 2.60 |
| so | 222.5 | 2.76 | 2.71 | 2.81 | 2.94 | 3.02 | 3.07 | 3.09 | 3.10 | 3.11 |
| 52 | 231.4 | 3.24 | 3.15 | 3.27 | 3.44 | 3.56 | 3.62 | 3.66 | 3.68 | 3.68 |
| 54 | 240.3 | 3.79 | 3.66 | 3.79 | 4.00 | 4.16 | 4.26 | 4.30 | 4.33 | 4.34 |
| 56 | 249.2 | 4.41 | 4.23 | 4.37 | 4.63 | 4.84 | 4.97 | 5.03 | 5.07 | 5.09 |
| 58 | 258.1 | 5.12 | 4.87 | 5.00 | 5.32 | 5.59 | 5.76 | 5.85 | 5.90 | 5.93 |
| 60 | 267.0 | 5.91 | 5.59 | 5.71 | 6.08 | 6.42 | 6.64 | 6.77 | 6.84 | 6.87 |
| 62 | 275.9 | 6.80 | 6.39 | 6.50 | 6.91 | 7.33 | 7.62 | 7.79 | 7.88 | 7.93 |
| 64 | 284.7 | 7.79 | 7.29 | 7.37 | 7.82 | 8.33 | 8.70 | 8.92 | 9.04 | 9.11 |
| 66 | 293.6 | 8.90 | 8.28 | 8.33 | 8.83 | 9.42 | 9.88 | 10.17 | 10.33 | 10.42 |
| 68 | 302.5 | 10.1 | 9.4 | 9.4 | 9.9 | 10.6 | 11.2 | 11.5 | 11.7 | 11.9 |
| 70 | 311.4 | 11.5 | 10.6 | 10.6 | 11.1 | 11.9 | 12.6 | 13.0 | 13.3 | 13.5 |
| 72 | 320.3 | 13.0 | 12.0 | 11.8 | 12.4 | 13.3 | 14.1 | 14.7 | 15.0 | 15.2 |
| 74 | 329.2 | 14.6 | 13.5 | 13.2 | 13.8 | 14.8 | 15.8 | 16.5 | 16.9 | 17.1 |
| 76 | 338.1 | 16.5 | 15.1 | 14.8 | 15.4 | 16.5 | 17.6 | 18.4 | 18.9 | 19.2 |
| 78 | 347.0 | 18.5 | 16.9 | 16.5 | 17.1 | 18.2 | 19.5 | 20.5 | 21.1 | 21.5 |
| 80 | 355.9 | 20.6 | 18.8 | 18.3 | 18.9 | 20.2 | 21.6 | 22.7 | 23.5 | 24.0 |
| 82 | 364.8 | 23.0 | 21.0 | 20.3 | 20.9 | 22.2 | 23.8 | 25.2 | 26.1 | 26.7 |
| 84 | 373.7 | 25.6 | 23.3 | 22.5 | 23.1 | 24.5 | 26.2 | 27.8 | 28.9 | 29.6 |
| 86 | 382.6 | 28.4 | 25.8 | 24.9 | 25.4 | 26.9 | 28.8 | 30.5 | 31.9 | 32.8 |
| 88 | 391.5 | 31.5 | 28.6 | 27.5 | 27.9 | 29.4 | 31.5 | 33.5 | 35.1 | 36.1 |
| 90 | 400.4 | 34.8 | 31.5 | 30.3 | 30.7 | 32.2 | 34.4 | 36.7 | 38.5 | 39.8 |

# ANEXO N°7

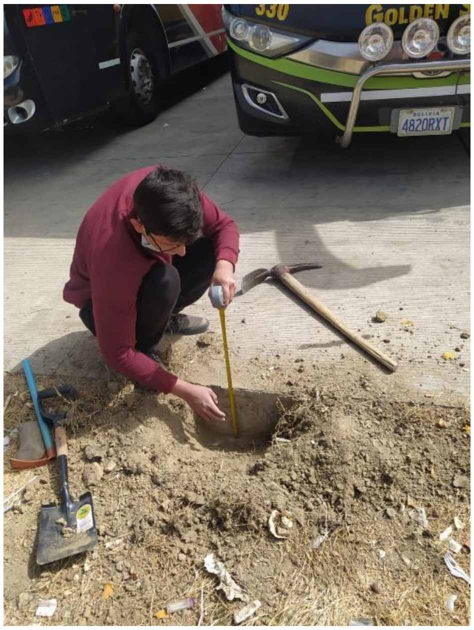
## MEDICIONES EN CAMPO DE ESPESORES

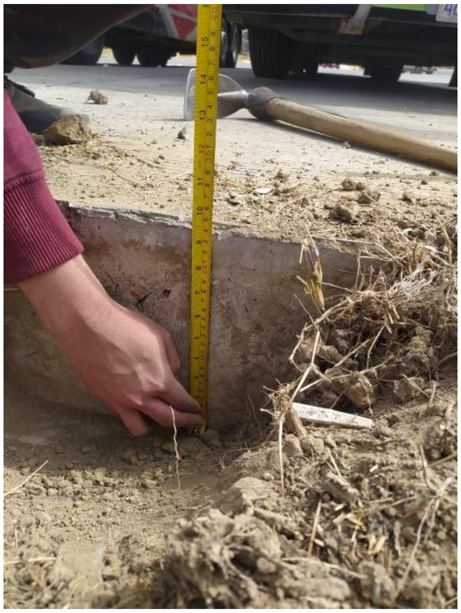
- **Extracción de núcleos avenida Jaime Paz**

- **Medición del espesor de pavimento en avenida circunvalación**



- **Medición del espesor de pavimento el ingreso a la nueva terminal**

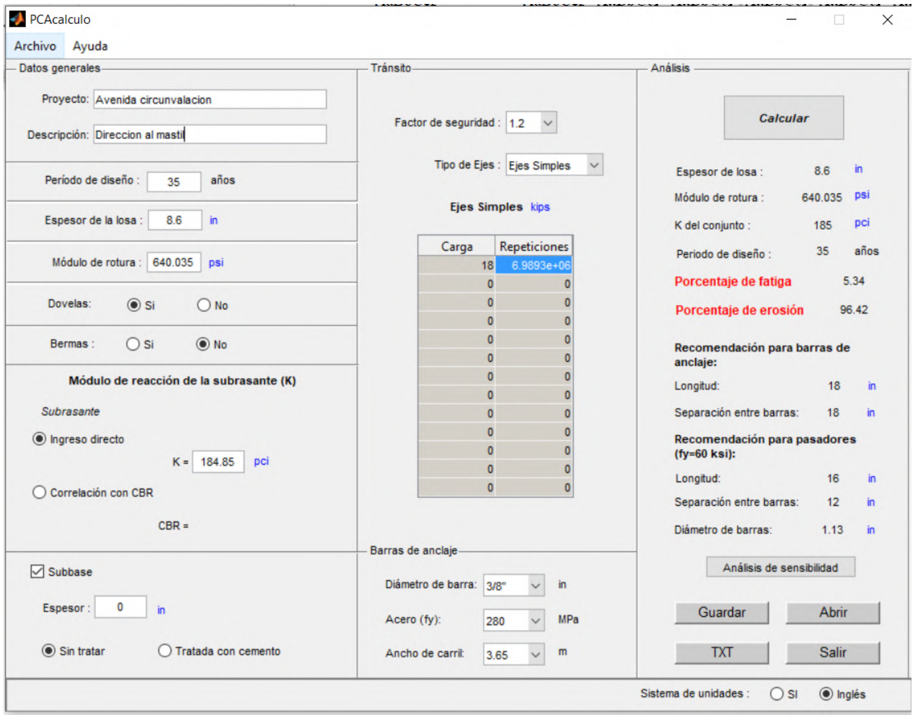

330
GOLDEN
BOLIVIA
4820RXT



# ANEXO N°8

## CALCULO DE ESPESORES PARA AÑO DE EJECUCIÓN CON EL PROGRAMA PCA CALCULO

## - Avenida Circunvalación (Dirección al mástil)



Datos generales

Proyecto: Avenida circunvalacion

Descripción: Direccion al mastil

Período de diseño : 35 años

Espesor de la losa : 8.6 in

Módulo de rotura : 640.035 psi

Dovelas: ● Si ○ No

Bermas : ○ Si ● No

**Módulo de reacción de la subrasante (K)**

*Subrasante*

● Ingreso directo

K = 184.85 pci

○ Correlación con CBR

CBR =

☑ Subbase

Espesor : 0 in

● Sin tratar ○ Tratada con cemento

Tránsito

Factor de seguridad : 1.2

Tipo de Ejes : Ejes Simples

**Ejes Simples** kips

| Carga | Repeticiones |
|---|---|
| 18 | 6.9893e+06 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |

Barras de anclaje

Diámetro de barra: 3/8" in

Acero (fy): 280 MPa

Ancho de carril: 3.65 m

Análisis

Espesor de losa : 8.6 in

Módulo de rotura : 640.035 psi

K del conjunto : 185 pci

Periodo de diseño : 35 años

Porcentaje de fatiga 5.34

Porcentaje de erosión 96.42

**Recomendación para barras de anclaje:**

Longitud: 18 in

Separación entre barras: 18 in

**Recomendación para pasadores (fy=60 ksi):**

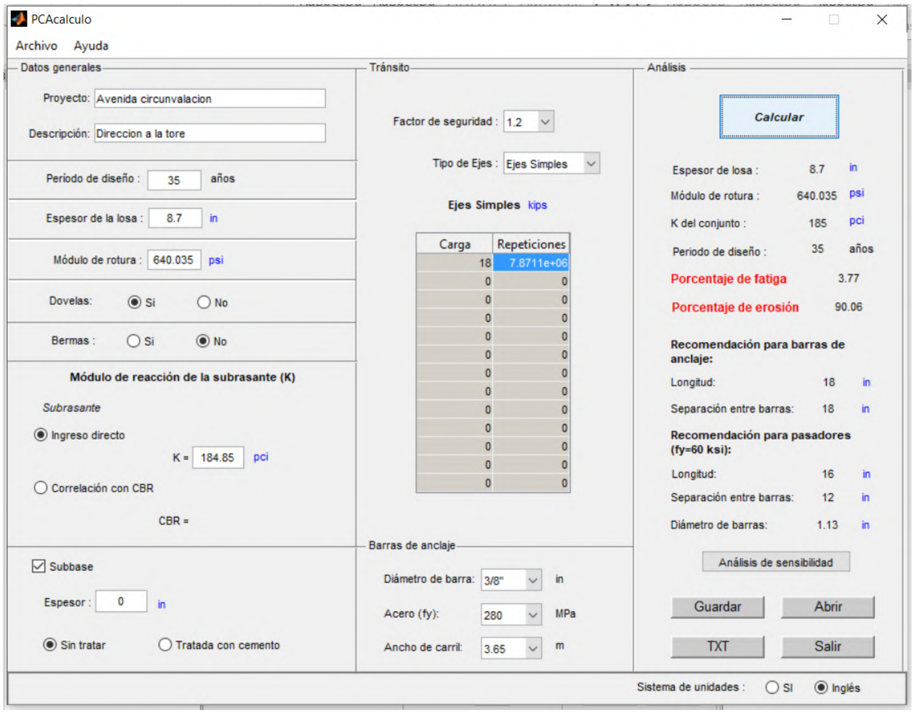
Longitud: 16 in

Separación entre barras: 12 in

Diámetro de barras: 1.13 in

Sistema de unidades : ○ SI ● Inglés

## - Avenida Circunvalación (Dirección a la torre)



Datos generales

Proyecto: Avenida circunvalacion

Descripción: Direccion a la tore

Período de diseño : 35 años

Espesor de la losa : 8.7 in

Módulo de rotura : 640.035 psi

Dovelas: ● Si ○ No

Bermas : ○ Si ● No

**Módulo de reacción de la subrasante (K)**

*Subrasante*

● Ingreso directo

K = 184.85 pci

○ Correlación con CBR

CBR =

☑ Subbase

Espesor : 0 in

● Sin tratar ○ Tratada con cemento

Tránsito

Factor de seguridad : 1.2

Tipo de Ejes : Ejes Simples

**Ejes Simples** kips

| Carga | Repeticiones |
|---|---|
| 18 | 7.8711e+06 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |

Barras de anclaje

Diámetro de barra: 3/8" in

Acero (fy): 280 MPa

Ancho de carril: 3.65 m

Análisis

Espesor de losa : 8.7 in

Módulo de rotura : 640.035 psi

K del conjunto : 185 pci

Periodo de diseño : 35 años

Porcentaje de fatiga 3.77

Porcentaje de erosión 90.06

**Recomendación para barras de anclaje:**

Longitud: 18 in

Separación entre barras: 18 in

**Recomendación para pasadores (fy=60 ksi):**

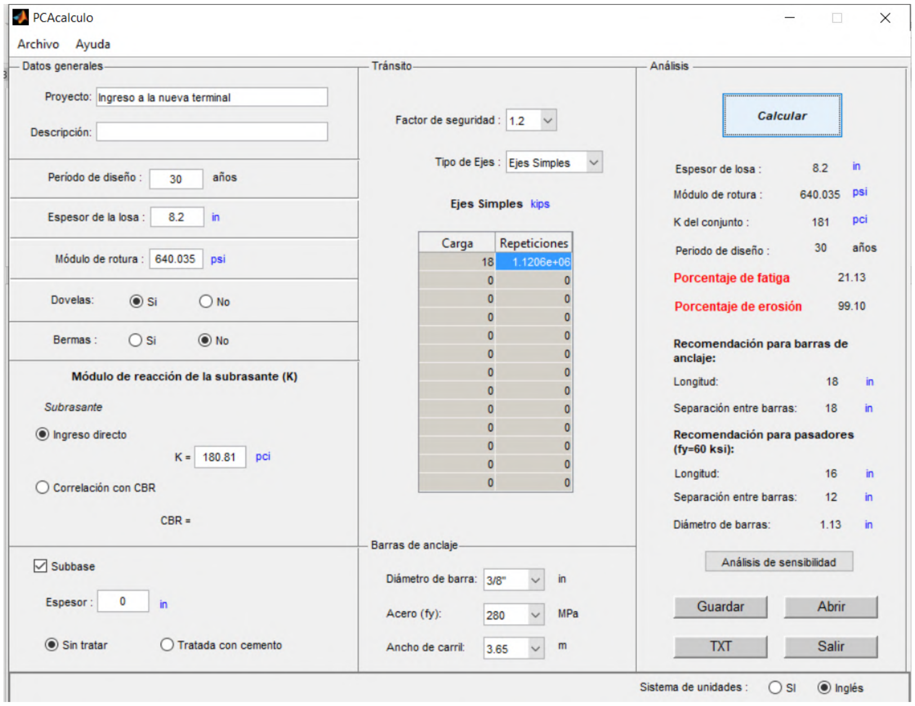
Longitud: 16 in

Separación entre barras: 12 in

Diámetro de barras: 1.13 in

Sistema de unidades : ○ SI ● Inglés

## - Ingreso a la nueva terminal



Datos generales

Proyecto: Ingreso a la nueva terminal

Descripción:

Periodo de diseño: 30 años

Espesor de la losa: 8.2 in

Módulo de rotura: 640.035 psi

Dovelas: ● Si ○ No

Bermas: ○ Si ● No

**Módulo de reacción de la subrasante (K)**

*Subrasante*

● Ingreso directo

K = 180.81 pci

○ Correlación con CBR

CBR =

☑ Subbase

Espesor: 0 in

● Sin tratar ○ Tratada con cemento

Tránsito

Factor de seguridad: 1.2

Tipo de Ejes: Ejes Simples

**Ejes Simples** kips

| Carga | Repeticiones |
|---|---|
| 18 | 1.1206e+06 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |

Barras de anclaje

Diámetro de barra: 3/8" in

Acero (fy): 280 MPa

Ancho de carril: 3.65 m

Análisis

Espesor de losa: 8.2 in

Módulo de rotura: 640.035 psi

K del conjunto: 181 pci

Periodo de diseño: 30 años

**Porcentaje de fatiga** 21.13

**Porcentaje de erosión** 99.10

**Recomendación para barras de anclaje:**

Longitud: 18 in

Separación entre barras: 18 in

**Recomendación para pasadores (fy=60 ksi):**

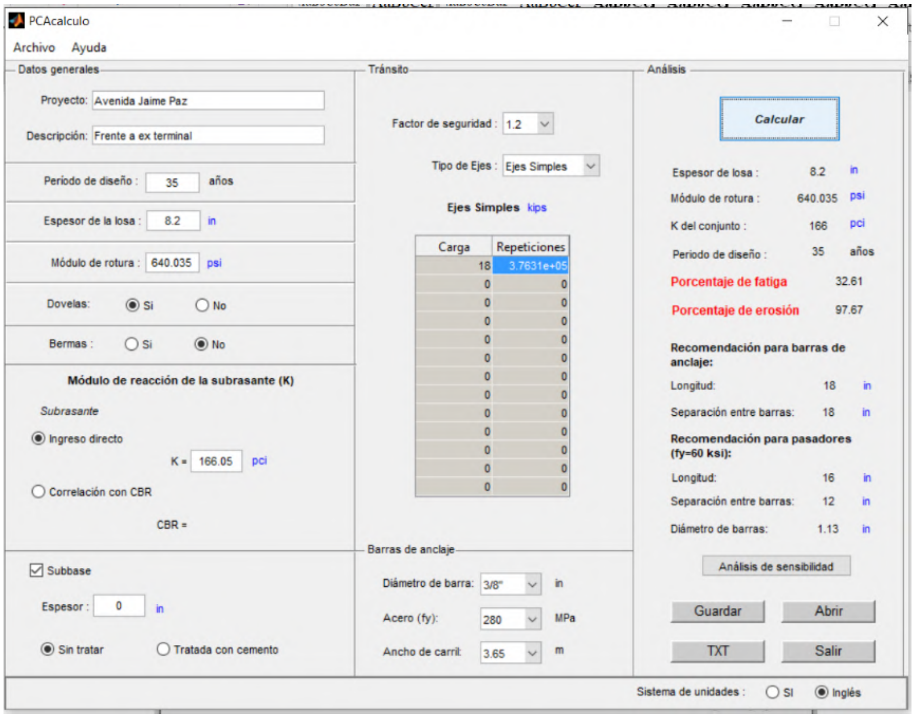
Longitud: 16 in

Separación entre barras: 12 in

Diámetro de barras: 1.13 in

Sistema de unidades: ○ SI ● Inglés

## - Avenida Jaime Paz (Frente)



Datos generales

Proyecto: Avenida Jaime Paz

Descripción: Frente a ex terminal

Periodo de diseño: 35 años

Espesor de la losa: 8.2 in

Módulo de rotura: 640.035 psi

Dovelas: ● Si ○ No

Bermas: ○ Si ● No

**Módulo de reacción de la subrasante (K)**

*Subrasante*

● Ingreso directo

K = 166.05 pci

○ Correlación con CBR

CBR =

☑ Subbase

Espesor: 0 in

● Sin tratar ○ Tratada con cemento

Tránsito

Factor de seguridad: 1.2

Tipo de Ejes: Ejes Simples

**Ejes Simples** kips

| Carga | Repeticiones |
|---|---|
| 18 | 3.7631e+05 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |

Barras de anclaje

Diámetro de barra: 3/8" in

Acero (fy): 280 MPa

Ancho de carril: 3.65 m

Análisis

Espesor de losa: 8.2 in

Módulo de rotura: 640.035 psi

K del conjunto: 166 pci

Periodo de diseño: 35 años

**Porcentaje de fatiga** 32.61

**Porcentaje de erosión** 97.67

**Recomendación para barras de anclaje:**

Longitud: 18 in

Separación entre barras: 18 in

**Recomendación para pasadores (fy=60 ksi):**

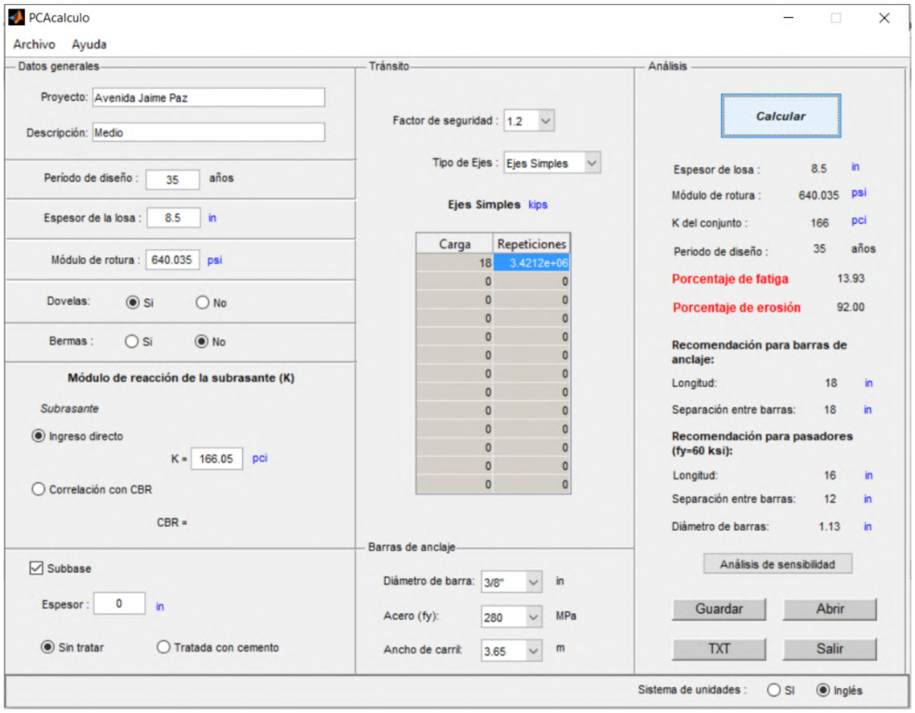
Longitud: 16 in

Separación entre barras: 12 in

Diámetro de barras: 1.13 in

Sistema de unidades: ○ SI ● Inglés

## - Avenida Jaime Paz (Medio)


PCAcalculo

Datos generales

Proyecto: Avenida Jaime Paz

Descripción: Medio

Periodo de diseño: 35 años

Espesor de la losa: 8.5 in

Módulo de rotura: 640.035 psi

Dovelas: ● Si ○ No

Bermas: ○ Si ● No

**Módulo de reacción de la subrasante (K)**

*Subrasante*

● Ingreso directo

K = 166.05 pci

○ Correlación con CBR

CBR =

☑ Subbase

Espesor: 0 in

● Sin tratar ○ Tratada con cemento

Tránsito

Factor de seguridad: 1.2

Tipo de Ejes: Ejes Simples

**Ejes Simples** kips

| Carga | Repeticiones |
|---|---|
| 18 | 3.4212e+06 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |

Barras de anclaje

Diámetro de barra: 3/8" in

Acero (fy): 280 MPa

Ancho de carril: 3.65 m

Análisis

Espesor de losa: 8.5 in

Módulo de rotura: 640.035 psi

K del conjunto: 166 pci

Periodo de diseño: 35 años

**Porcentaje de fatiga** 13.93

**Porcentaje de erosión** 92.00

**Recomendación para barras de anclaje:**

Longitud: 18 in

Separación entre barras: 18 in

**Recomendación para pasadores (fy=60 ksi):**

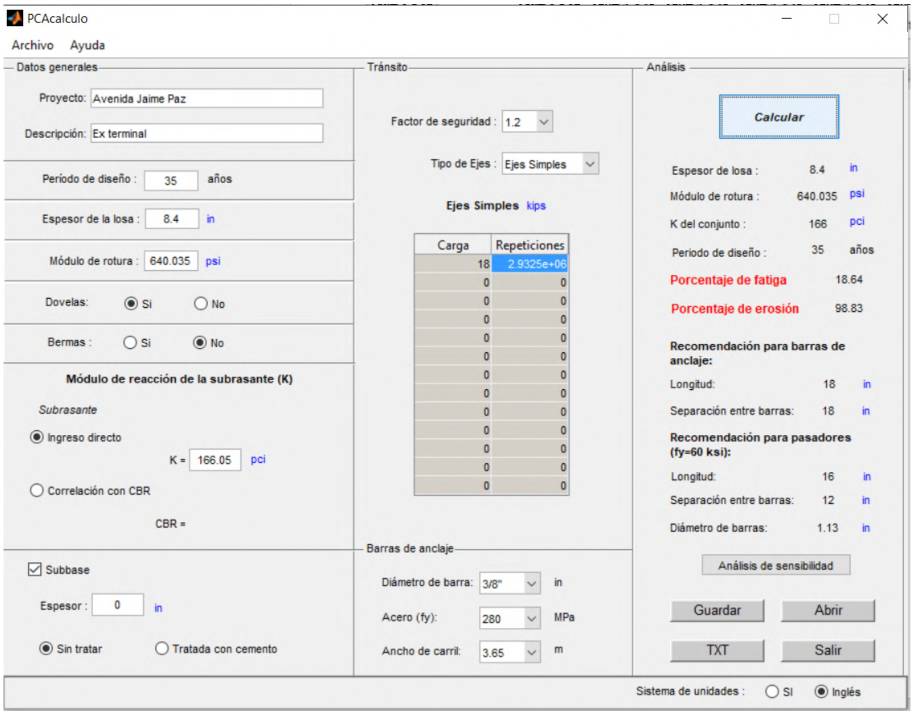
Longitud: 16 in

Separación entre barras: 12 in

Diámetro de barras: 1.13 in

Sistema de unidades: ○ SI ● Inglés

## - Avenida Jaime Paz (Ex terminal)


PCAcalculo

Datos generales

Proyecto: Avenida Jaime Paz

Descripción: Ex terminal

Periodo de diseño: 35 años

Espesor de la losa: 8.4 in

Módulo de rotura: 640.035 psi

Dovelas: ● Si ○ No

Bermas: ○ Si ● No

**Módulo de reacción de la subrasante (K)**

*Subrasante*

● Ingreso directo

K = 166.05 pci

○ Correlación con CBR

CBR =

☑ Subbase

Espesor: 0 in

● Sin tratar ○ Tratada con cemento

Tránsito

Factor de seguridad: 1.2

Tipo de Ejes: Ejes Simples

**Ejes Simples** kips

| Carga | Repeticiones |
|---|---|
| 18 | 2.9325e+06 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |

Barras de anclaje

Diámetro de barra: 3/8" in

Acero (fy): 280 MPa

Ancho de carril: 3.65 m

Análisis

Espesor de losa: 8.4 in

Módulo de rotura: 640.035 psi

K del conjunto: 166 pci

Periodo de diseño: 35 años

**Porcentaje de fatiga** 18.64

**Porcentaje de erosión** 98.83

**Recomendación para barras de anclaje:**

Longitud: 18 in

Separación entre barras: 18 in

**Recomendación para pasadores (fy=60 ksi):**

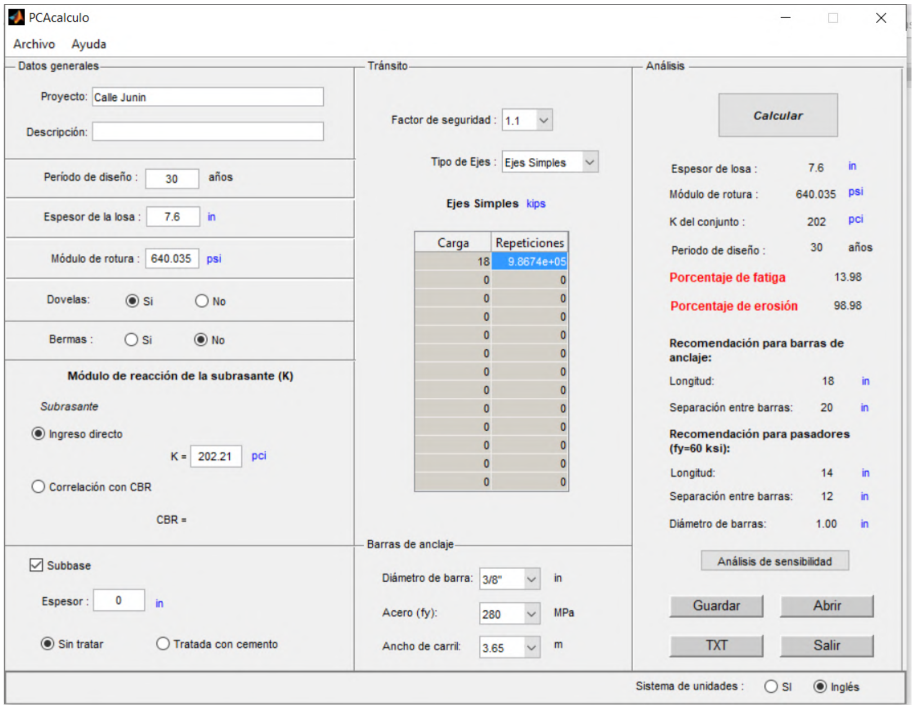
Longitud: 16 in

Separación entre barras: 12 in

Diámetro de barras: 1.13 in

Sistema de unidades: ○ SI ● Inglés

## - Calle Junín



Datos generales

Proyecto: Calle Junin

Descripción:

Período de diseño : 30 años

Espesor de la losa : 7.6 in

Módulo de rotura : 640.035 psi

Dovelas: ● Si ○ No

Bermas : ○ Si ● No

**Módulo de reacción de la subrasante (K)**

*Subrasante*

● Ingreso directo

K = 202.21 pci

○ Correlación con CBR

CBR =

☑ Subbase

Espesor : 0 in

● Sin tratar ○ Tratada con cemento

Tránsito

Factor de seguridad : 1.1

Tipo de Ejes : Ejes Simples

**Ejes Simples** kips

| Carga | Repeticiones |
|---|---|
| 18 | 9.8674e+05 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |

Barras de anclaje

Diámetro de barra: 3/8" in

Acero (fy): 280 MPa

Ancho de carril: 3.65 m

Análisis

Espesor de losa : 7.6 in

Módulo de rotura : 640.035 psi

K del conjunto : 202 pci

Periodo de diseño : 30 años

**Porcentaje de fatiga** 13.98

**Porcentaje de erosión** 98.98

**Recomendación para barras de anclaje:**

Longitud: 18 in

Separación entre barras: 20 in

**Recomendación para pasadores (fy=60 ksi):**

Longitud: 14 in

Separación entre barras: 12 in

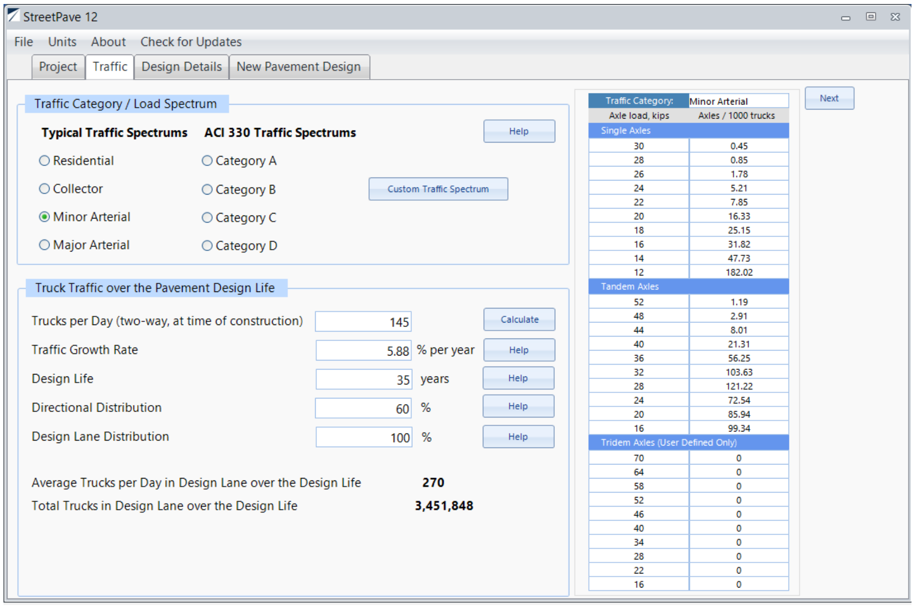
Diámetro de barras: 1.00 in

Sistema de unidades : ○ SI ● Inglés

# ANEXO N°9

## CALCULO DE ESPESORES PARA AÑO DE EJECUCIÓN CON EL PROGRAMA STREET PAVE

## - Avenida Circunvalación (Dirección al mástil)


StreetPave 12
File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Help
Custom Traffic Spectrum
Calculate
Help
Help
Help
Help
Next

Traffic Category / Load Spectrum

**Typical Traffic Spectrums** **ACI 330 Traffic Spectrums**

○ Residential ○ Category A

○ Collector ○ Category B

● Minor Arterial ○ Category C

○ Major Arterial ○ Category D

Truck Traffic over the Pavement Design Life

Trucks per Day (two-way, at time of construction) 145

Traffic Growth Rate 5.88 % per year

Design Life 35 years

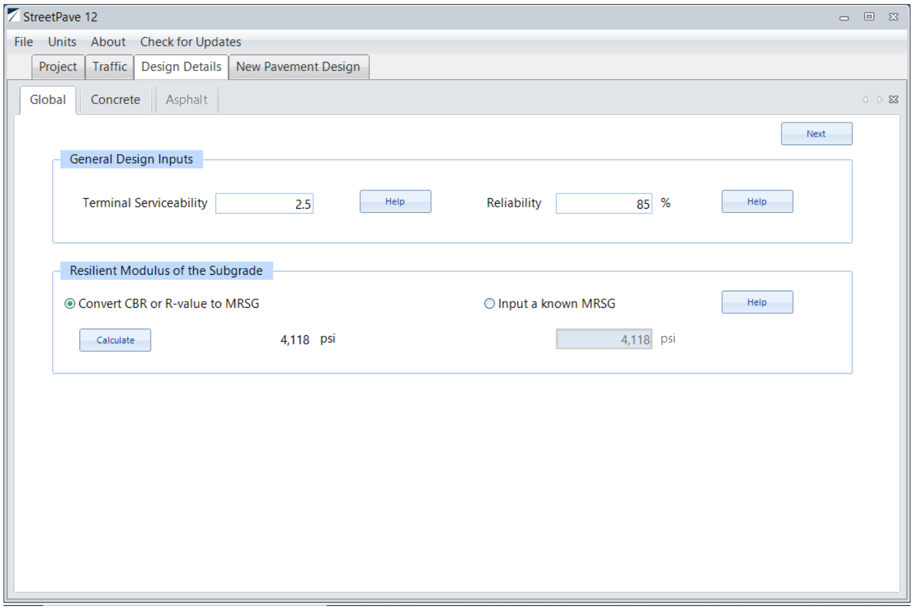
Directional Distribution 60 %

Design Lane Distribution 100 %

Average Trucks per Day in Design Lane over the Design Life **270**

Total Trucks in Design Lane over the Design Life **3,451,848**

| Traffic Category: | Minor Arterial |
|---|---|
| Axle load, kips | Axles / 1000 trucks |
| Single Axles | |
| 30 | 0.45 |
| 28 | 0.85 |
| 26 | 1.78 |
| 24 | 5.21 |
| 22 | 7.85 |
| 20 | 16.33 |
| 18 | 25.15 |
| 16 | 31.82 |
| 14 | 47.73 |
| 12 | 182.02 |
| Tandem Axles | |
| 52 | 1.19 |
| 48 | 2.91 |
| 44 | 8.01 |
| 40 | 21.31 |
| 36 | 56.25 |
| 32 | 103.63 |
| 28 | 121.22 |
| 24 | 72.54 |
| 20 | 85.94 |
| 16 | 99.34 |
| Tridem Axles (User Defined Only) | |
| 70 | 0 |
| 64 | 0 |
| 58 | 0 |
| 52 | 0 |
| 46 | 0 |
| 40 | 0 |
| 34 | 0 |
| 28 | 0 |
| 22 | 0 |
| 16 | 0 |


StreetPave 12
File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Global
Concrete
Asphalt
Next
Help
Help
Help
Calculate

General Design Inputs

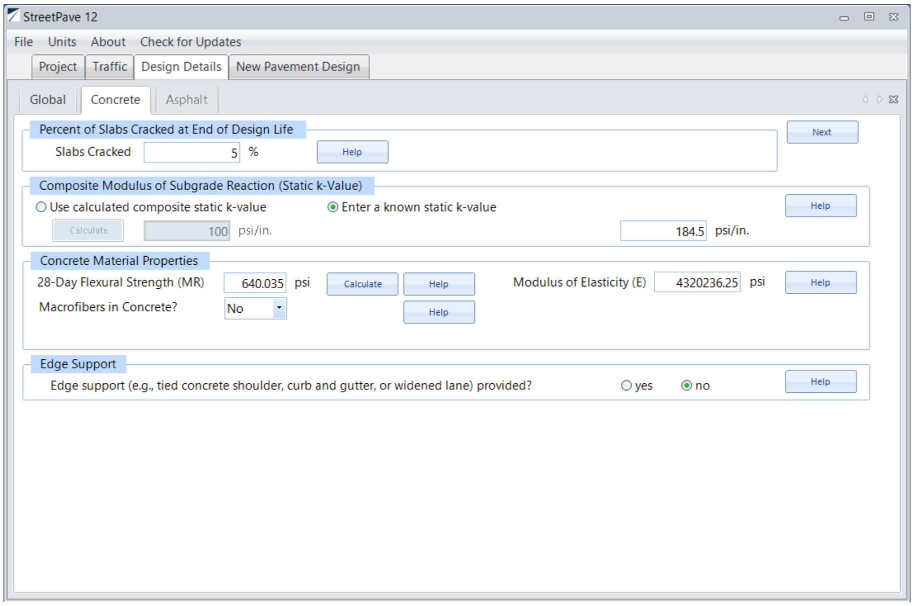
Terminal Serviceability 2.5

Reliability 85 %

Resilient Modulus of the Subgrade

● Convert CBR or R-value to MRSG ○ Input a known MRSG

4,118 psi 4,118 psi


StreetPave 12
File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Global
Concrete
Asphalt
Next
Help
Calculate

Percent of Slabs Cracked at End of Design Life

Slabs Cracked 5 %

Composite Modulus of Subgrade Reaction (Static k-Value)

○ Use calculated composite static k-value ● Enter a known static k-value

100 psi/in. 184.5 psi/in.

Concrete Material Properties

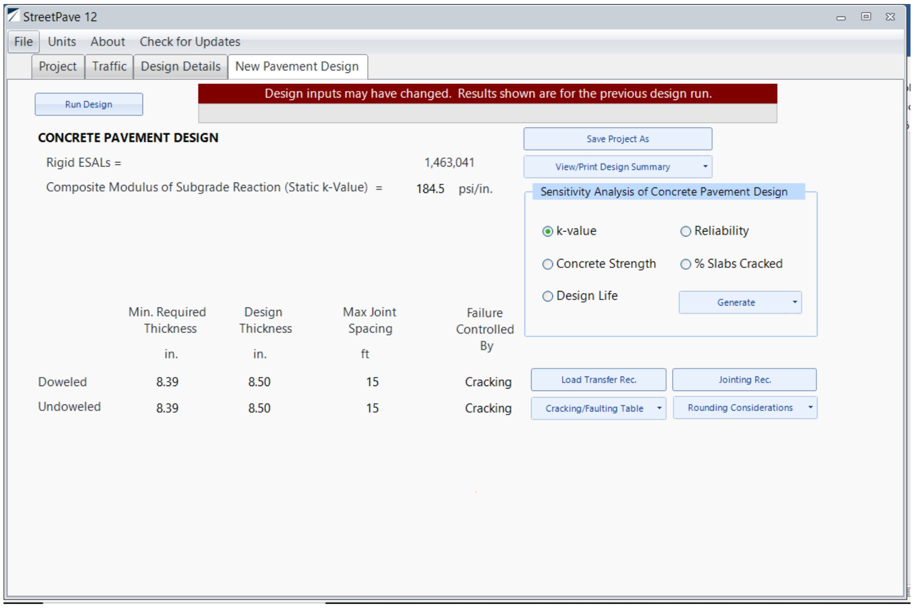
28-Day Flexural Strength (MR) 640.035 psi

Modulus of Elasticity (E) 4320236.25 psi

Macrofibers in Concrete? No

Edge Support

Edge support (e.g., tied concrete shoulder, curb and gutter, or widened lane) provided? ○ yes ● no


StreetPave 12
File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Run Design
Save Project As
View/Print Design Summary
Generate
Load Transfer Rec.
Jointing Rec.
Cracking/Faulting Table
Rounding Considerations

Design inputs may have changed. Results shown are for the previous design run.

**CONCRETE PAVEMENT DESIGN**

Rigid ESALs = 1,463,041

Composite Modulus of Subgrade Reaction (Static k-Value) = 184.5 psi/in.

Sensitivity Analysis of Concrete Pavement Design

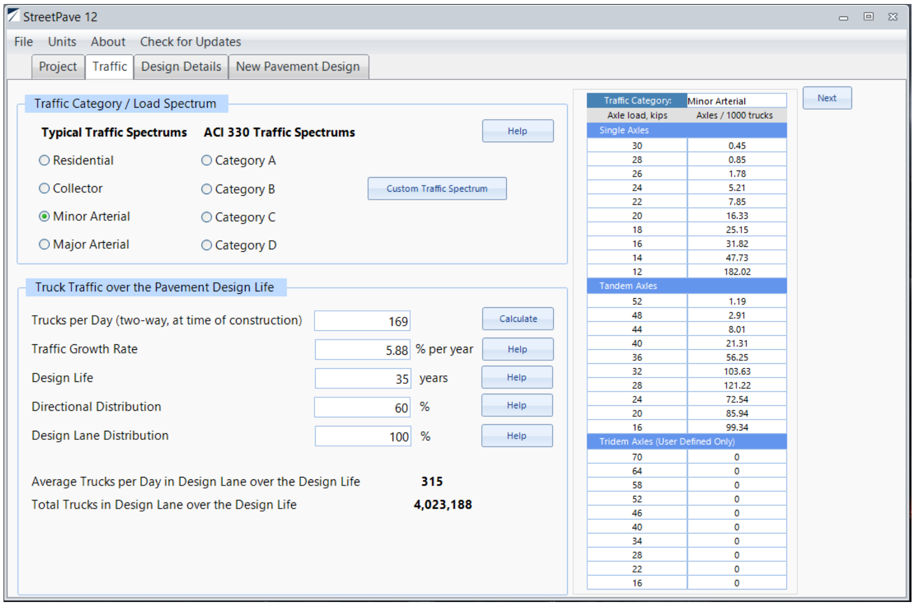
● k-value ○ Reliability

○ Concrete Strength ○ % Slabs Cracked

○ Design Life

| | Min. Required Thickness | Design Thickness | Max Joint Spacing | Failure Controlled By |
|---|---|---|---|---|
| | in. | in. | ft | |
| Doweled | 8.39 | 8.50 | 15 | Cracking |
| Undoweled | 8.39 | 8.50 | 15 | Cracking |

## - Avenida Circunvalación (Dirección a la torre)


StreetPave 12
File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Help
Custom Traffic Spectrum
Calculate
Help
Help
Help
Help
Next

**Traffic Category / Load Spectrum**

| Typical Traffic Spectrums | ACI 330 Traffic Spectrums |
|---|---|
| ○ Residential | ○ Category A |
| ○ Collector | ○ Category B |
| ● Minor Arterial | ○ Category C |
| ○ Major Arterial | ○ Category D |

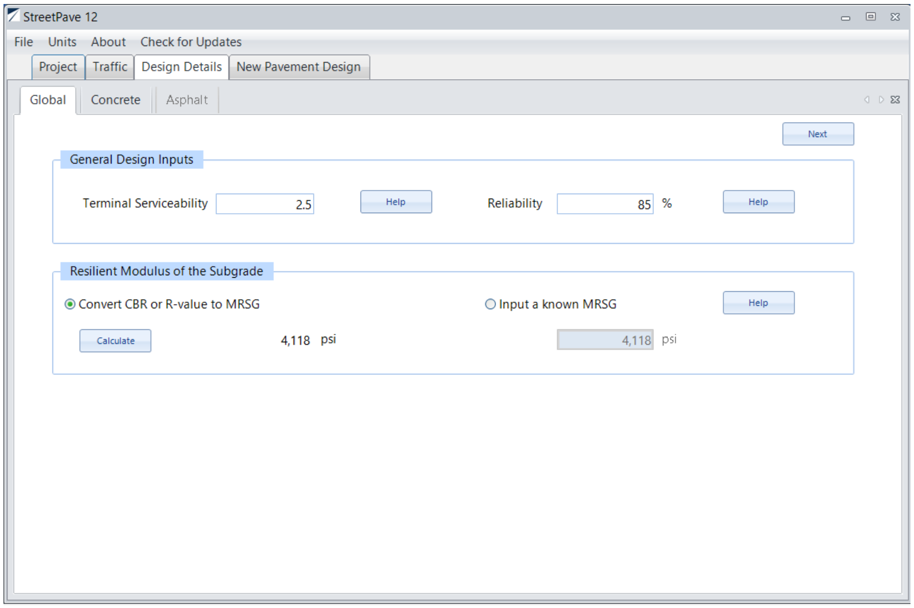
**Truck Traffic over the Pavement Design Life**

| | | |
|---|---|---|
| Trucks per Day (two-way, at time of construction) | 169 | |
| Traffic Growth Rate | 5.88 | % per year |
| Design Life | 35 | years |
| Directional Distribution | 60 | % |
| Design Lane Distribution | 100 | % |

Average Trucks per Day in Design Lane over the Design Life **315**

Total Trucks in Design Lane over the Design Life **4,023,188**

| Traffic Category: | Minor Arterial |
|---|---|
| Axle load, kips | Axles / 1000 trucks |
| Single Axles | |
| 30 | 0.45 |
| 28 | 0.85 |
| 26 | 1.78 |
| 24 | 5.21 |
| 22 | 7.85 |
| 20 | 16.33 |
| 18 | 25.15 |
| 16 | 31.82 |
| 14 | 47.73 |
| 12 | 182.02 |
| Tandem Axles | |
| 52 | 1.19 |
| 48 | 2.91 |
| 44 | 8.01 |
| 40 | 21.31 |
| 36 | 56.25 |
| 32 | 103.63 |
| 28 | 121.22 |
| 24 | 72.54 |
| 20 | 85.94 |
| 16 | 99.34 |
| Tridem Axles (User Defined Only) | |
| 70 | 0 |
| 64 | 0 |
| 58 | 0 |
| 52 | 0 |
| 46 | 0 |
| 40 | 0 |
| 34 | 0 |
| 28 | 0 |
| 22 | 0 |
| 16 | 0 |


StreetPave 12
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Check for Updates
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**General Design Inputs**

Terminal Serviceability 2.5

Reliability 85 %

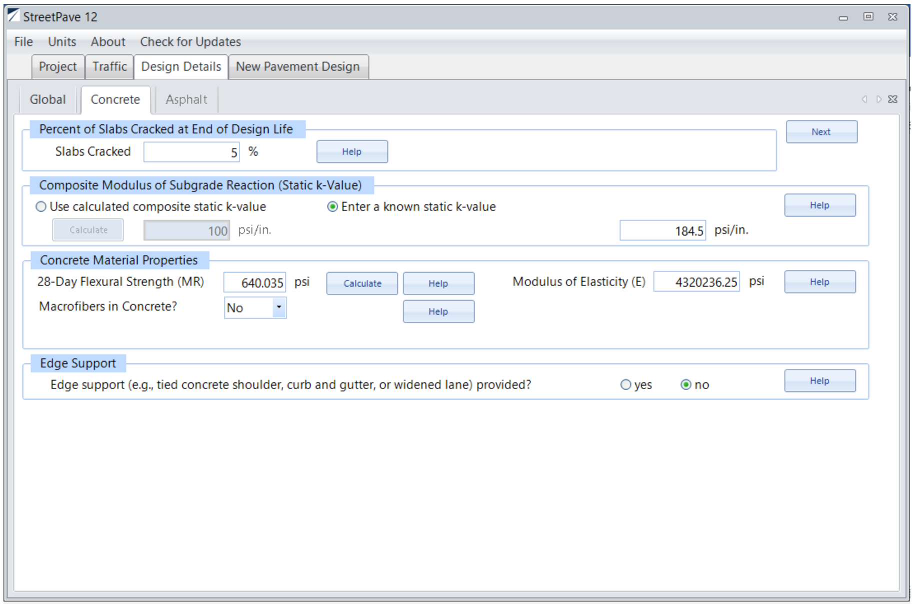
**Resilient Modulus of the Subgrade**

● Convert CBR or R-value to MRSG

○ Input a known MRSG

4,118 psi

4,118 psi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Percent of Slabs Cracked at End of Design Life

Slabs Cracked 5 %

Composite Modulus of Subgrade Reaction (Static k-Value)

○ Use calculated composite static k-value   ● Enter a known static k-value

100 psi/in.   184.5 psi/in.

Concrete Material Properties

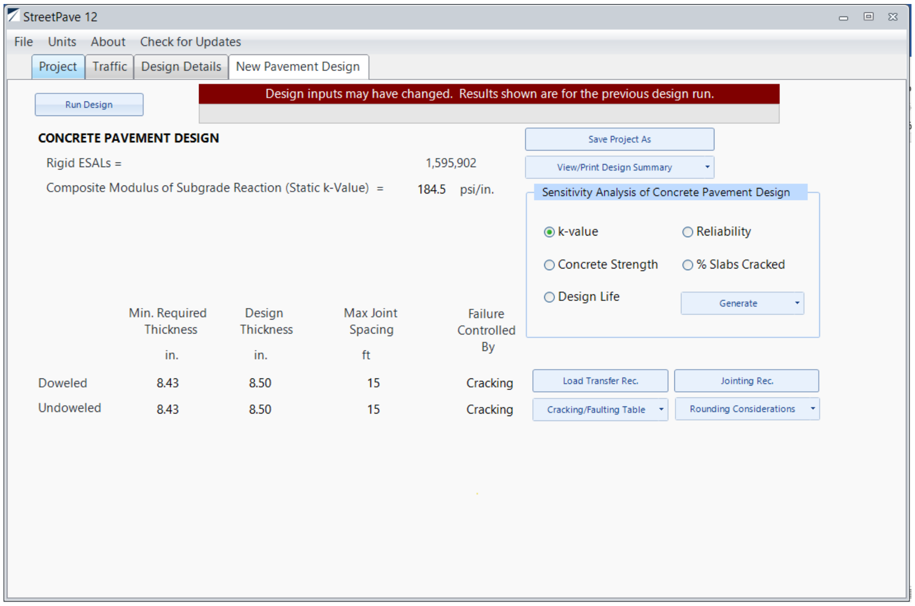
28-Day Flexural Strength (MR) 640.035 psi

Modulus of Elasticity (E) 4320236.25 psi

Macrofibers in Concrete? No

Edge Support

Edge support (e.g., tied concrete shoulder, curb and gutter, or widened lane) provided? ○ yes ● no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Cracking/Faulting Table
Rounding Considerations

Design inputs may have changed. Results shown are for the previous design run.

**CONCRETE PAVEMENT DESIGN**

Rigid ESALs = 1,595,902

Composite Modulus of Subgrade Reaction (Static k-Value) = 184.5 psi/in.

Sensitivity Analysis of Concrete Pavement Design

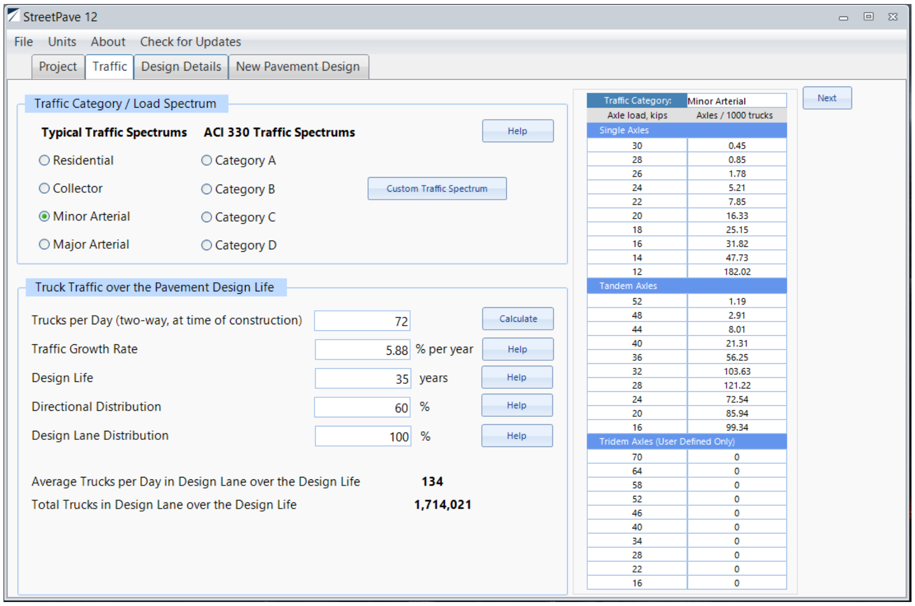
● k-value   ○ Reliability

○ Concrete Strength   ○ % Slabs Cracked

○ Design Life

| | Min. Required Thickness in. | Design Thickness in. | Max Joint Spacing ft | Failure Controlled By |
|---|---|---|---|---|
| Doweled | 8.43 | 8.50 | 15 | Cracking |
| Undoweled | 8.43 | 8.50 | 15 | Cracking |

- **Ingreso a la nueva terminal**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**Traffic Category / Load Spectrum**

| Typical Traffic Spectrums | ACI 330 Traffic Spectrums |
|---|---|
| ○ Residential | ○ Category A |
| ○ Collector | ○ Category B |
| ● Minor Arterial | ○ Category C |
| ○ Major Arterial | ○ Category D |

**Truck Traffic over the Pavement Design Life**

Trucks per Day (two-way, at time of construction): 72

Traffic Growth Rate: 5.88 % per year

Design Life: 35 years

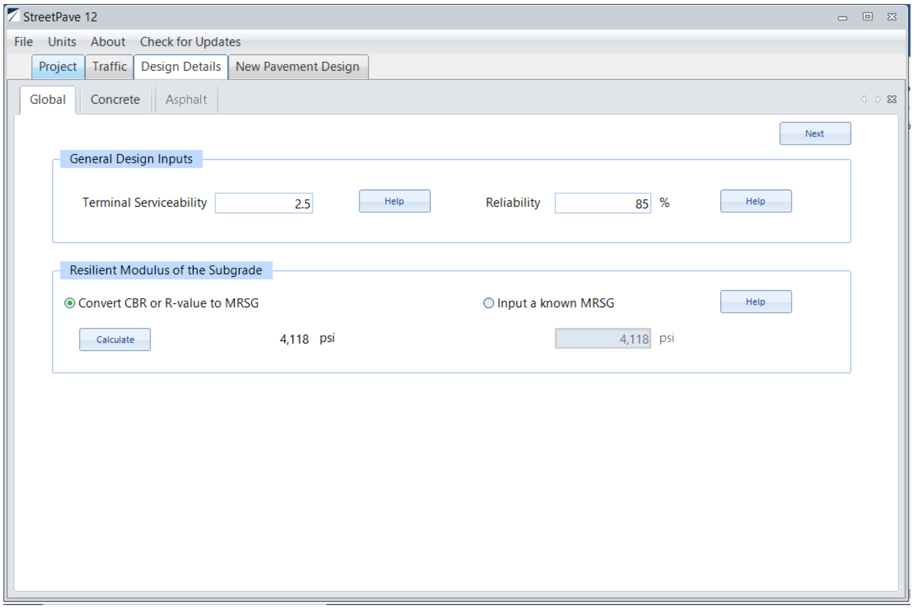
Directional Distribution: 60 %

Design Lane Distribution: 100 %

Average Trucks per Day in Design Lane over the Design Life: 134

Total Trucks in Design Lane over the Design Life: 1,714,021

| Traffic Category: | Minor Arterial |
|---|---|
| Axle load, kips | Axles / 1000 trucks |
| Single Axles | |
| 30 | 0.45 |
| 28 | 0.85 |
| 26 | 1.78 |
| 24 | 5.21 |
| 22 | 7.85 |
| 20 | 16.33 |
| 18 | 25.15 |
| 16 | 31.82 |
| 14 | 47.73 |
| 12 | 182.02 |
| Tandem Axles | |
| 52 | 1.19 |
| 48 | 2.91 |
| 44 | 8.01 |
| 40 | 21.31 |
| 36 | 56.25 |
| 32 | 103.63 |
| 28 | 121.22 |
| 24 | 72.54 |
| 20 | 85.94 |
| 16 | 99.34 |
| Tridem Axles (User Defined Only) | |
| 70 | 0 |
| 64 | 0 |
| 58 | 0 |
| 52 | 0 |
| 46 | 0 |
| 40 | 0 |
| 34 | 0 |
| 28 | 0 |
| 22 | 0 |
| 16 | 0 |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**General Design Inputs**

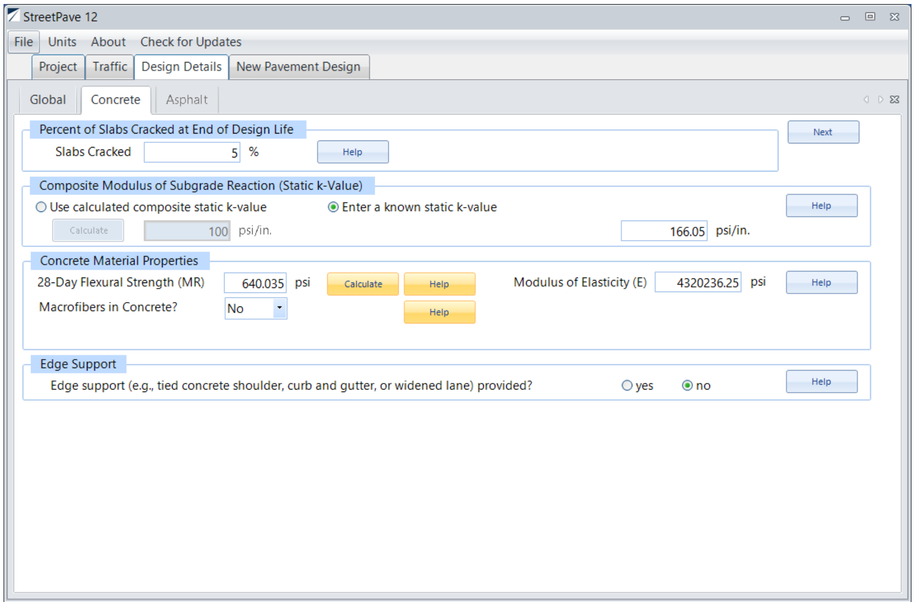
Terminal Serviceability: 2.5

Reliability: 85 %

**Resilient Modulus of the Subgrade**

● Convert CBR or R-value to MRSG: 4,118 psi

○ Input a known MRSG: 4,118 psi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Percent of Slabs Cracked at End of Design Life

Slabs Cracked 5 %

Composite Modulus of Subgrade Reaction (Static k-Value)

○ Use calculated composite static k-value ● Enter a known static k-value

100 psi/in. 166.05 psi/in.

Concrete Material Properties

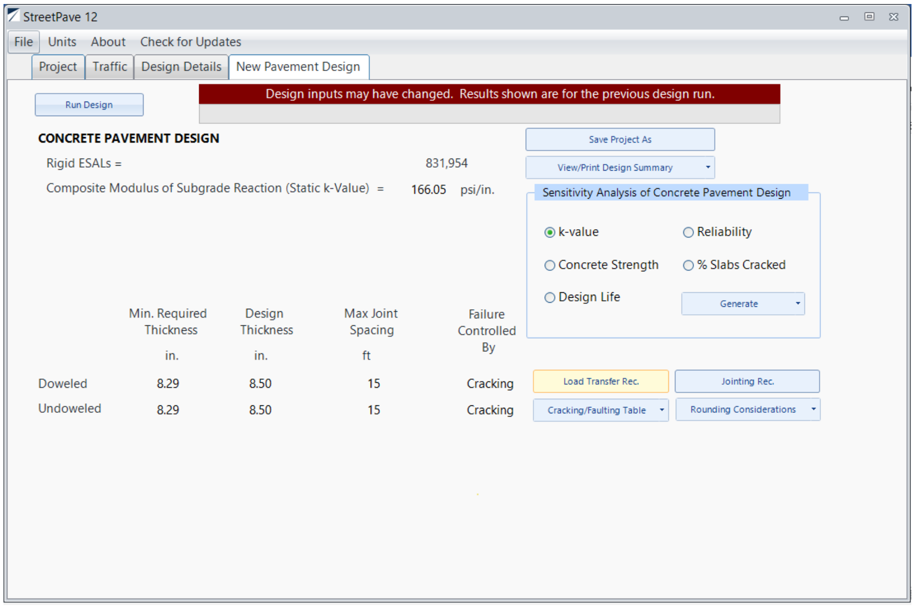
28-Day Flexural Strength (MR) 640.035 psi

Modulus of Elasticity (E) 4320236.25 psi

Macrofibers in Concrete? No

Edge Support

Edge support (e.g., tied concrete shoulder, curb and gutter, or widened lane) provided? ○ yes ● no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Cracking/Faulting Table
Rounding Considerations

Design inputs may have changed. Results shown are for the previous design run.

**CONCRETE PAVEMENT DESIGN**

Rigid ESALs = 831,954

Composite Modulus of Subgrade Reaction (Static k-Value) = 166.05 psi/in.

Sensitivity Analysis of Concrete Pavement Design

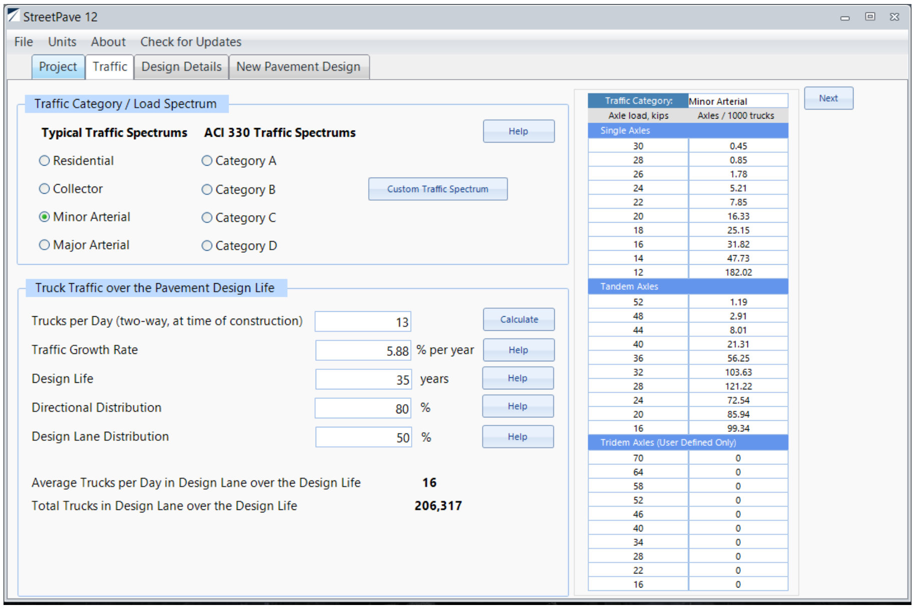
● k-value ○ Reliability

○ Concrete Strength ○ % Slabs Cracked

○ Design Life

| | Min. Required Thickness in. | Design Thickness in. | Max Joint Spacing ft | Failure Controlled By |
|---|---|---|---|---|
| Doweled | 8.29 | 8.50 | 15 | Cracking |
| Undoweled | 8.29 | 8.50 | 15 | Cracking |

## - Avenida Jaime Paz (Frente)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**Traffic Category / Load Spectrum**

| **Typical Traffic Spectrums** | **ACI 330 Traffic Spectrums** |
|---|---|
| ○ Residential | ○ Category A |
| ○ Collector | ○ Category B |
| ● Minor Arterial | ○ Category C |
| ○ Major Arterial | ○ Category D |

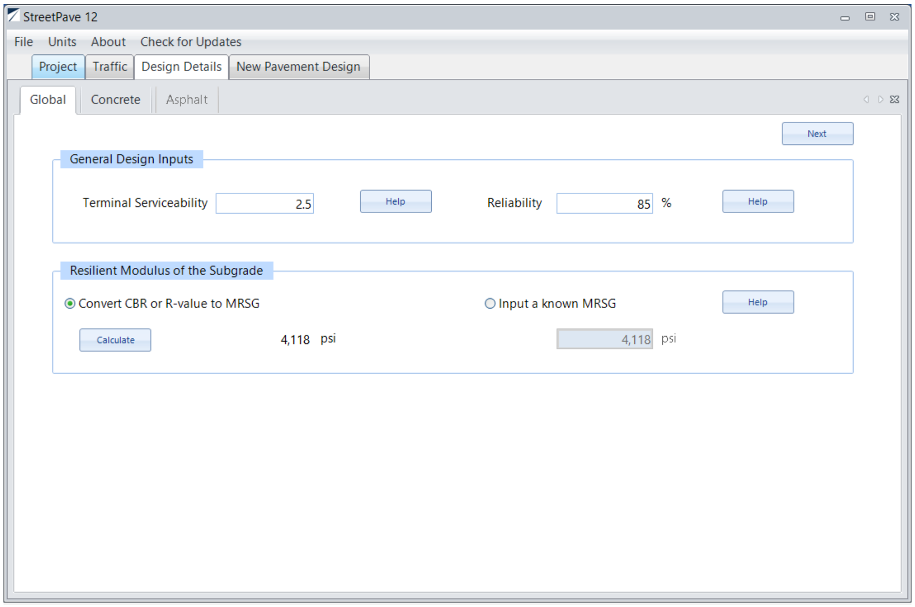
**Truck Traffic over the Pavement Design Life**

| | | |
|---|---|---|
| Trucks per Day (two-way, at time of construction) | 13 | |
| Traffic Growth Rate | 5.88 | % per year |
| Design Life | 35 | years |
| Directional Distribution | 80 | % |
| Design Lane Distribution | 50 | % |

Average Trucks per Day in Design Lane over the Design Life **16**

Total Trucks in Design Lane over the Design Life **206,317**

| Traffic Category: | Minor Arterial |
|---|---|
| Axle load, kips | Axles / 1000 trucks |
| Single Axles | |
| 30 | 0.45 |
| 28 | 0.85 |
| 26 | 1.78 |
| 24 | 5.21 |
| 22 | 7.85 |
| 20 | 16.33 |
| 18 | 25.15 |
| 16 | 31.82 |
| 14 | 47.73 |
| 12 | 182.02 |
| Tandem Axles | |
| 52 | 1.19 |
| 48 | 2.91 |
| 44 | 8.01 |
| 40 | 21.31 |
| 36 | 56.25 |
| 32 | 103.63 |
| 28 | 121.22 |
| 24 | 72.54 |
| 20 | 85.94 |
| 16 | 99.34 |
| Tridem Axles (User Defined Only) | |
| 70 | 0 |
| 64 | 0 |
| 58 | 0 |
| 52 | 0 |
| 46 | 0 |
| 40 | 0 |
| 34 | 0 |
| 28 | 0 |
| 22 | 0 |
| 16 | 0 |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**General Design Inputs**

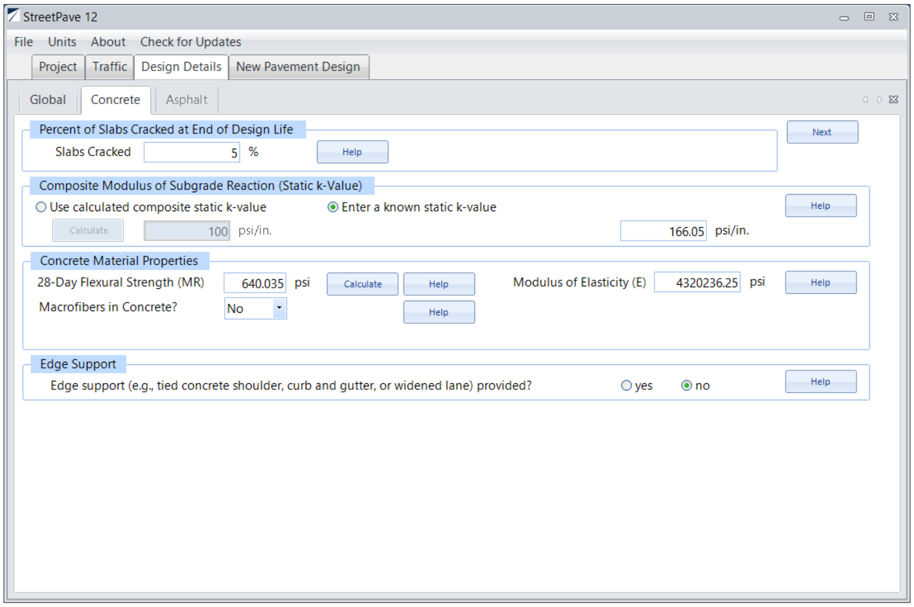
Terminal Serviceability 2.5

Reliability 85 %

**Resilient Modulus of the Subgrade**

● Convert CBR or R-value to MRSG 4,118 psi

○ Input a known MRSG 4,118 psi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Percent of Slabs Cracked at End of Design Life

Slabs Cracked 5 %

Composite Modulus of Subgrade Reaction (Static k-Value)

○ Use calculated composite static k-value ● Enter a known static k-value

100 psi/in. 166.05 psi/in.

Concrete Material Properties

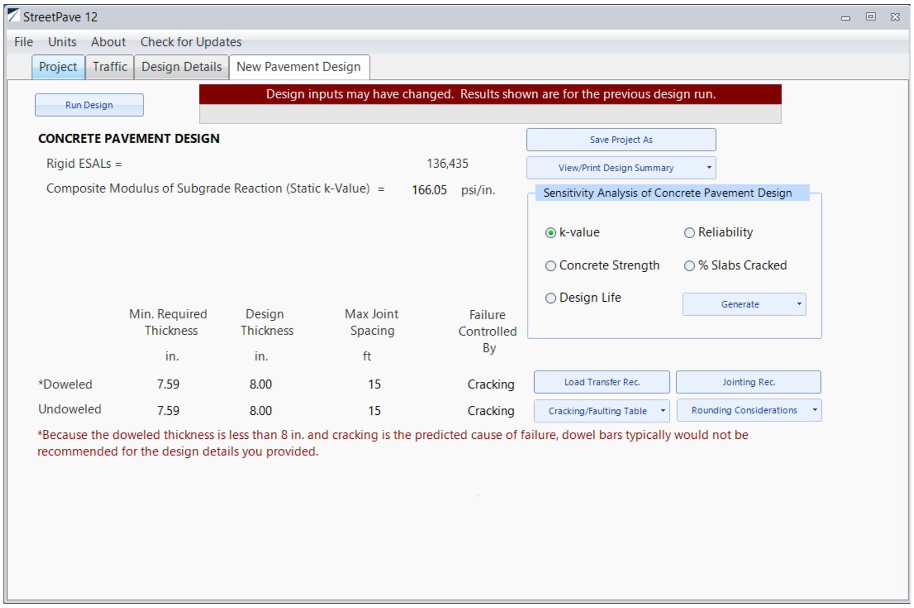
28-Day Flexural Strength (MR) 640.035 psi

Modulus of Elasticity (E) 4320236.25 psi

Macrofibers in Concrete? No

Edge Support

Edge support (e.g., tied concrete shoulder, curb and gutter, or widened lane) provided? ○ yes ● no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Cracking/Faulting Table
Rounding Considerations

Design inputs may have changed. Results shown are for the previous design run.

**CONCRETE PAVEMENT DESIGN**

Rigid ESALs = 136,435

Composite Modulus of Subgrade Reaction (Static k-Value) = 166.05 psi/in.

Sensitivity Analysis of Concrete Pavement Design

● k-value ○ Reliability

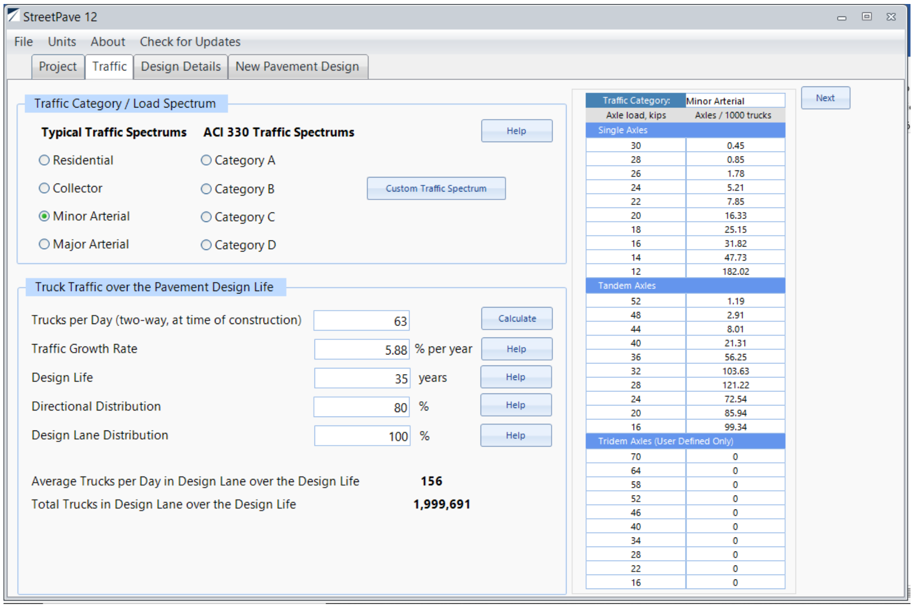
○ Concrete Strength ○ % Slabs Cracked

○ Design Life

|  | Min. Required Thickness<br>in. | Design Thickness<br>in. | Max Joint Spacing<br>ft | Failure Controlled By |
|---|---|---|---|---|
| *Doweled | 7.59 | 8.00 | 15 | Cracking |
| Undoweled | 7.59 | 8.00 | 15 | Cracking |

*Because the doweled thickness is less than 8 in. and cracking is the predicted cause of failure, dowel bars typically would not be recommended for the design details you provided.

- **Avenida Jaime Paz (Medio)**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Custom Traffic Spectrum
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Traffic Category / Load Spectrum

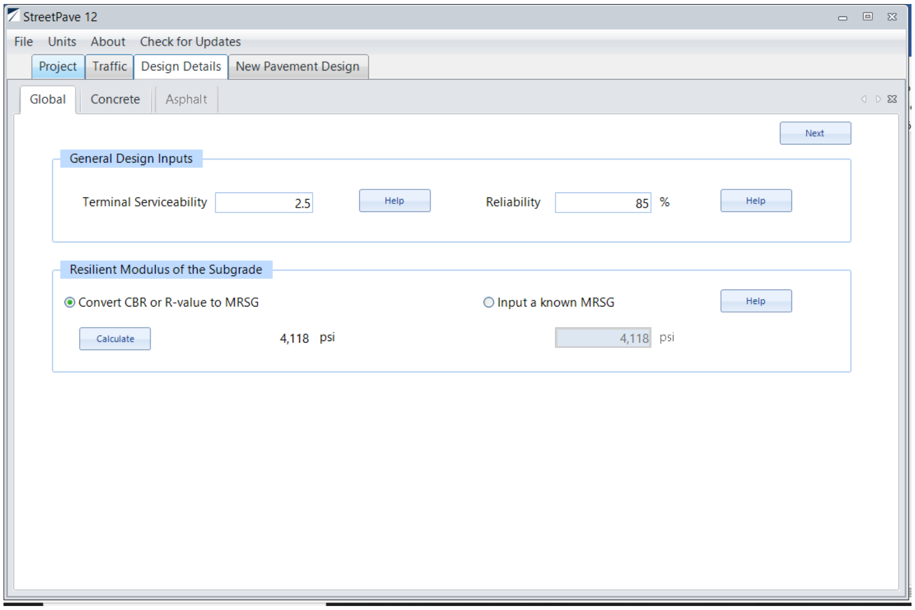
| Typical Traffic Spectrums | ACI 330 Traffic Spectrums |
|---|---|
| ○ Residential | ○ Category A |
| ○ Collector | ○ Category B |
| ● Minor Arterial | ○ Category C |
| ○ Major Arterial | ○ Category D |

Truck Traffic over the Pavement Design Life

Trucks per Day (two-way, at time of construction): 63
Traffic Growth Rate: 5.88 % per year
Design Life: 35 years
Directional Distribution: 80 %
Design Lane Distribution: 100 %

Average Trucks per Day in Design Lane over the Design Life: **156**
Total Trucks in Design Lane over the Design Life: **1,999,691**

| Traffic Category: | Minor Arterial |
|---|---|
| Axle load, kips | Axles / 1000 trucks |
| Single Axles | |
| 30 | 0.45 |
| 28 | 0.85 |
| 26 | 1.78 |
| 24 | 5.21 |
| 22 | 7.85 |
| 20 | 16.33 |
| 18 | 25.15 |
| 16 | 31.82 |
| 14 | 47.73 |
| 12 | 182.02 |
| Tandem Axles | |
| 52 | 1.19 |
| 48 | 2.91 |
| 44 | 8.01 |
| 40 | 21.31 |
| 36 | 56.25 |
| 32 | 103.63 |
| 28 | 121.22 |
| 24 | 72.54 |
| 20 | 85.94 |
| 16 | 99.34 |
| Tridem Axles (User Defined Only) | |
| 70 | 0 |
| 64 | 0 |
| 58 | 0 |
| 52 | 0 |
| 46 | 0 |
| 40 | 0 |
| 34 | 0 |
| 28 | 0 |
| 22 | 0 |
| 16 | 0 |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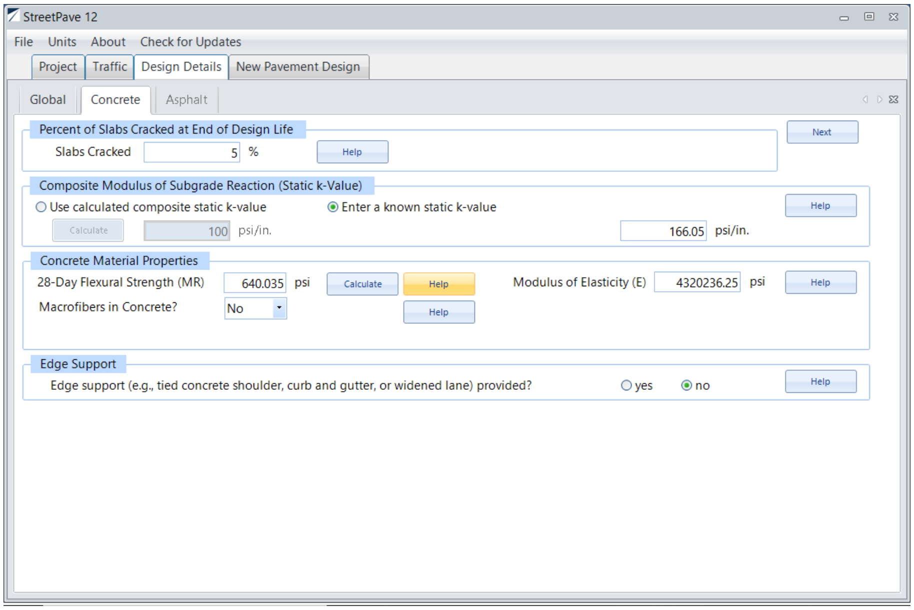
General Design Inputs

Terminal Serviceability: 2.5
Reliability: 85 %

Resilient Modulus of the Subgrade

● Convert CBR or R-value to MRSG
○ Input a known MRSG

4,118 psi
4,118 psi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Percent of Slabs Cracked at End of Design Life

Slabs Cracked 5 %

Composite Modulus of Subgrade Reaction (Static k-Value)

○ Use calculated composite static k-value ● Enter a known static k-value

100 psi/in. 166.05 psi/in.

Concrete Material Properties

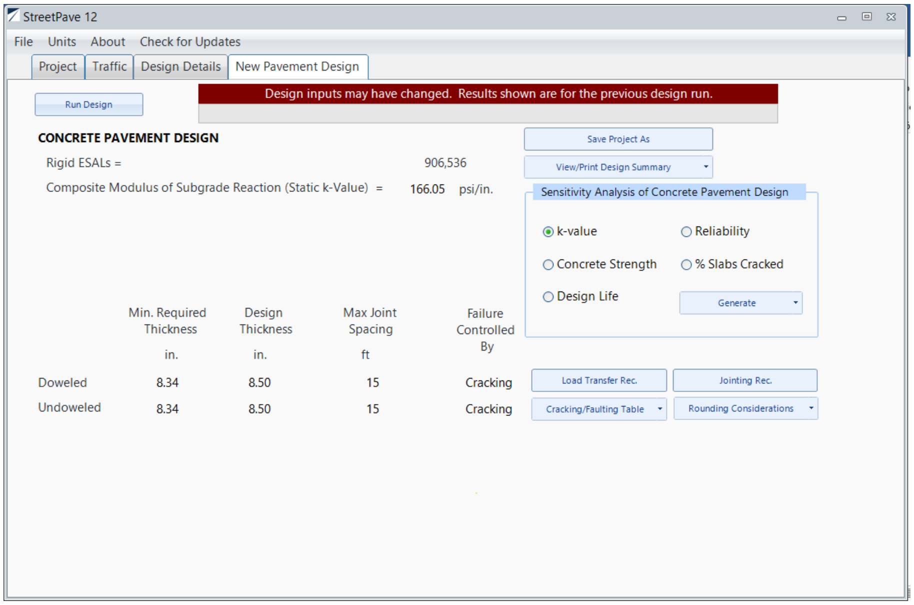
28-Day Flexural Strength (MR) 640.035 psi

Modulus of Elasticity (E) 4320236.25 psi

Macrofibers in Concrete? No

Edge Support

Edge support (e.g., tied concrete shoulder, curb and gutter, or widened lane) provided? ○ yes ● no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Cracking/Faulting Table
Rounding Considerations

Design inputs may have changed. Results shown are for the previous design run.

**CONCRETE PAVEMENT DESIGN**

Rigid ESALs = 906,536

Composite Modulus of Subgrade Reaction (Static k-Value) = 166.05 psi/in.

Sensitivity Analysis of Concrete Pavement Design

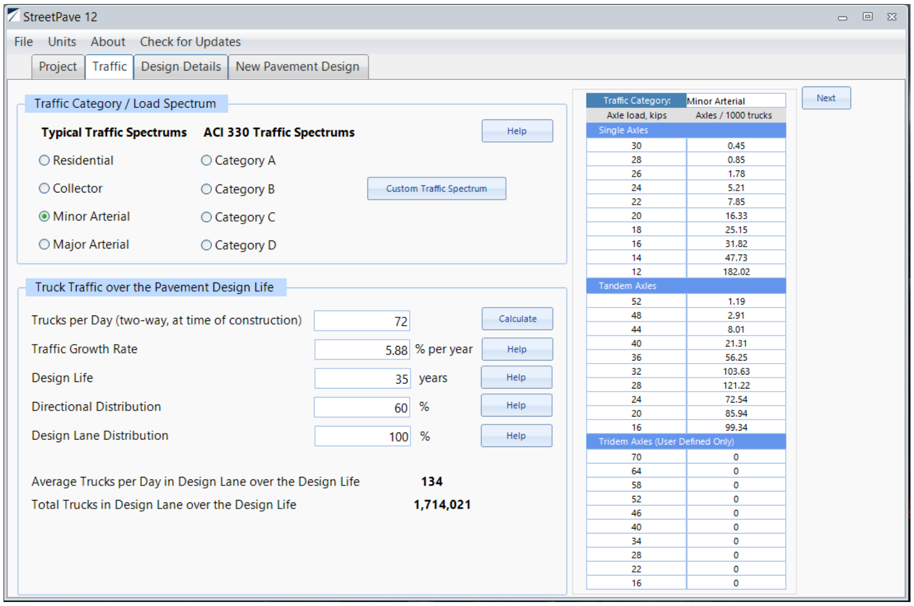
● k-value ○ Reliability

○ Concrete Strength ○ % Slabs Cracked

○ Design Life

| | Min. Required Thickness in. | Design Thickness in. | Max Joint Spacing ft | Failure Controlled By |
|---|---|---|---|---|
| Doweled | 8.34 | 8.50 | 15 | Cracking |
| Undoweled | 8.34 | 8.50 | 15 | Cracking |

## - Avenida Jaime Paz (Ex terminal)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**Traffic Category / Load Spectrum**

| **Typical Traffic Spectrums** | **ACI 330 Traffic Spectrums** |
|---|---|
| ○ Residential | ○ Category A |
| ○ Collector | ○ Category B |
| ● Minor Arterial | ○ Category C |
| ○ Major Arterial | ○ Category D |

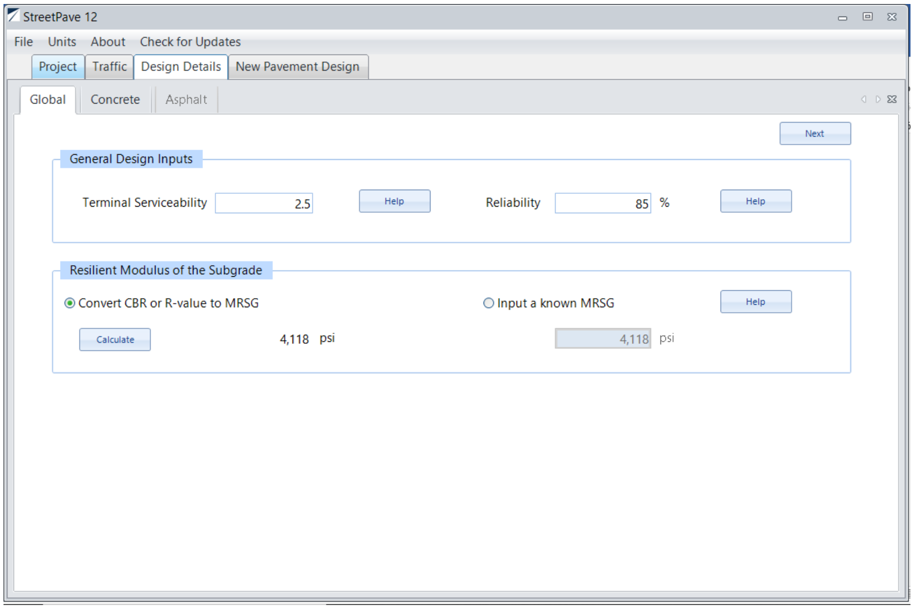
**Truck Traffic over the Pavement Design Life**

| | | |
|---|---|---|
| Trucks per Day (two-way, at time of construction) | 72 | |
| Traffic Growth Rate | 5.88 | % per year |
| Design Life | 35 | years |
| Directional Distribution | 60 | % |
| Design Lane Distribution | 100 | % |

Average Trucks per Day in Design Lane over the Design Life **134**

Total Trucks in Design Lane over the Design Life **1,714,021**

| Traffic Category: | Minor Arterial |
|---|---|
| Axle load, kips | Axles / 1000 trucks |
| Single Axles | |
| 30 | 0.45 |
| 28 | 0.85 |
| 26 | 1.78 |
| 24 | 5.21 |
| 22 | 7.85 |
| 20 | 16.33 |
| 18 | 25.15 |
| 16 | 31.82 |
| 14 | 47.73 |
| 12 | 182.02 |
| Tandem Axles | |
| 52 | 1.19 |
| 48 | 2.91 |
| 44 | 8.01 |
| 40 | 21.31 |
| 36 | 56.25 |
| 32 | 103.63 |
| 28 | 121.22 |
| 24 | 72.54 |
| 20 | 85.94 |
| 16 | 99.34 |
| Tridem Axles (User Defined Only) | |
| 70 | 0 |
| 64 | 0 |
| 58 | 0 |
| 52 | 0 |
| 46 | 0 |
| 40 | 0 |
| 34 | 0 |
| 28 | 0 |
| 22 | 0 |
| 16 | 0 |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**General Design Inputs**

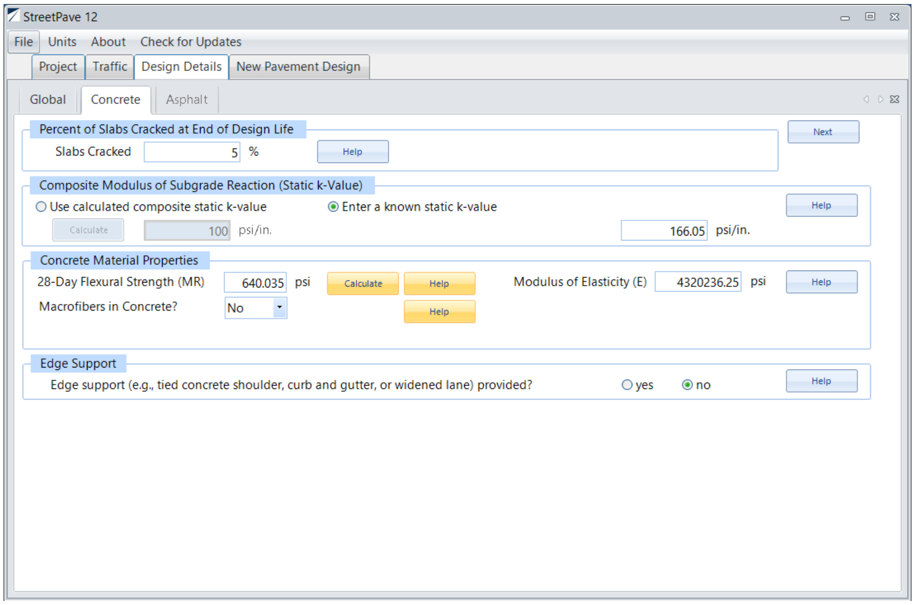
Terminal Serviceability 2.5

Reliability 85 %

**Resilient Modulus of the Subgrade**

● Convert CBR or R-value to MRSG — 4,118 psi

○ Input a known MRSG — 4,118 psi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Percent of Slabs Cracked at End of Design Life

Slabs Cracked 5 %

Composite Modulus of Subgrade Reaction (Static k-Value)

○ Use calculated composite static k-value 100 psi/in.

● Enter a known static k-value 166.05 psi/in.

Concrete Material Properties

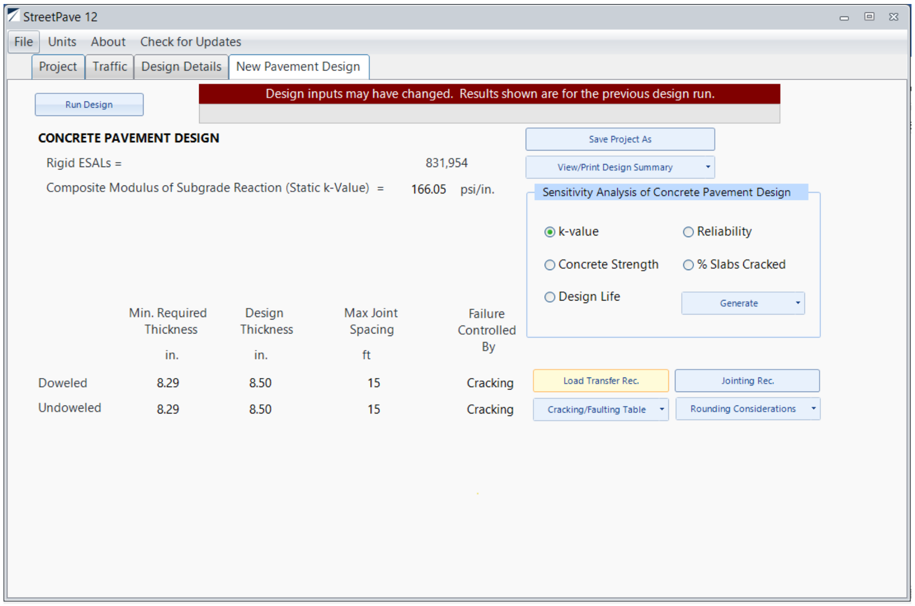
28-Day Flexural Strength (MR) 640.035 psi

Modulus of Elasticity (E) 4320236.25 psi

Macrofibers in Concrete? No

Edge Support

Edge support (e.g., tied concrete shoulder, curb and gutter, or widened lane) provided? ○ yes ● no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Cracking/Faulting Table
Rounding Considerations

Design inputs may have changed. Results shown are for the previous design run.

CONCRETE PAVEMENT DESIGN

Rigid ESALs = 831,954

Composite Modulus of Subgrade Reaction (Static k-Value) = 166.05 psi/in.

Sensitivity Analysis of Concrete Pavement Design

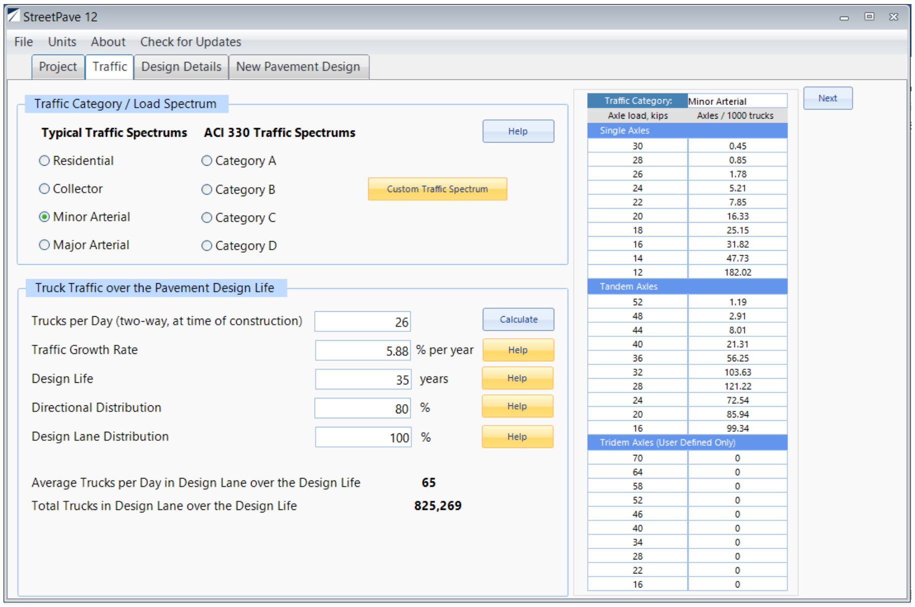
● k-value ○ Reliability

○ Concrete Strength ○ % Slabs Cracked

○ Design Life

| | Min. Required Thickness<br>in. | Design Thickness<br>in. | Max Joint Spacing<br>ft | Failure Controlled By |
|---|---|---|---|---|
| Doweled | 8.29 | 8.50 | 15 | Cracking |
| Undoweled | 8.29 | 8.50 | 15 | Cracking |

- **Calle Junín**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File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Help
Custom Traffic Spectrum
Calculate
Help
Help
Help
Help
Next

Traffic Category / Load Spectrum

**Typical Traffic Spectrums**

○ Residential
○ Collector
● Minor Arterial
○ Major Arterial

**ACI 330 Traffic Spectrums**

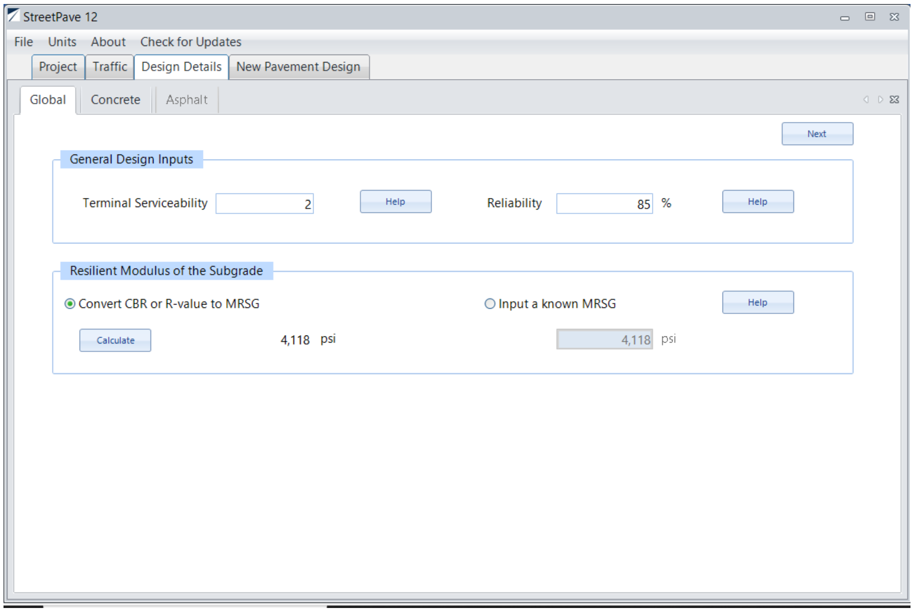
○ Category A
○ Category B
○ Category C
○ Category D

Truck Traffic over the Pavement Design Life

Trucks per Day (two-way, at time of construction) 26
Traffic Growth Rate 5.88 % per year
Design Life 35 years
Directional Distribution 80 %
Design Lane Distribution 100 %

Average Trucks per Day in Design Lane over the Design Life **65**
Total Trucks in Design Lane over the Design Life **825,269**

| Traffic Category: | Minor Arterial |
|---|---|
| Axle load, kips | Axles / 1000 trucks |
| Single Axles | |
| 30 | 0.45 |
| 28 | 0.85 |
| 26 | 1.78 |
| 24 | 5.21 |
| 22 | 7.85 |
| 20 | 16.33 |
| 18 | 25.15 |
| 16 | 31.82 |
| 14 | 47.73 |
| 12 | 182.02 |
| Tandem Axles | |
| 52 | 1.19 |
| 48 | 2.91 |
| 44 | 8.01 |
| 40 | 21.31 |
| 36 | 56.25 |
| 32 | 103.63 |
| 28 | 121.22 |
| 24 | 72.54 |
| 20 | 85.94 |
| 16 | 99.34 |
| Tridem Axles (User Defined Only) | |
| 70 | 0 |
| 64 | 0 |
| 58 | 0 |
| 52 | 0 |
| 46 | 0 |
| 40 | 0 |
| 34 | 0 |
| 28 | 0 |
| 22 | 0 |
| 16 | 0 |


StreetPave 12
File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Global
Concrete
Asphalt
Next
Help
Help
Help
Calculate

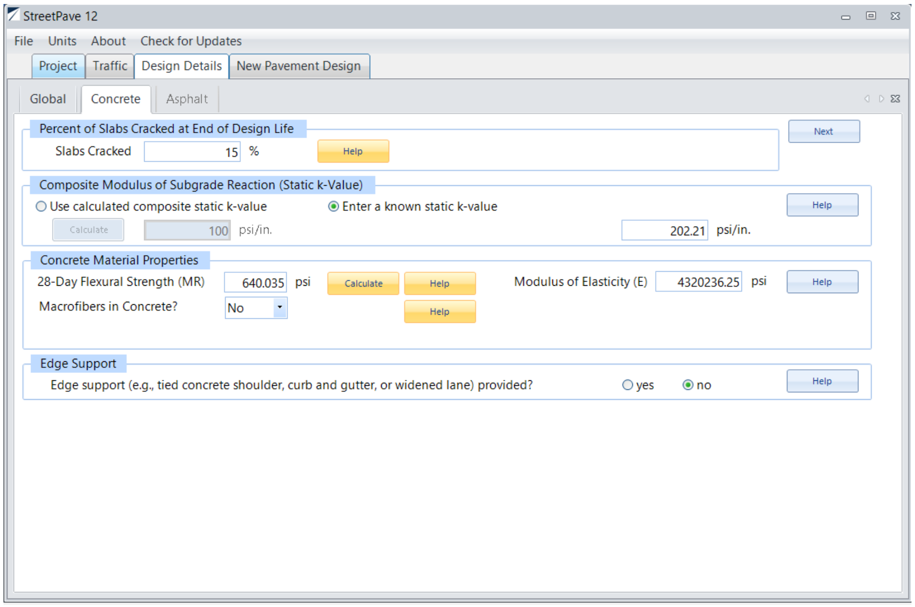
General Design Inputs

Terminal Serviceability 2
Reliability 85 %

Resilient Modulus of the Subgrade

● Convert CBR or R-value to MRSG
○ Input a known MRSG

4,118 psi
4,118 psi


StreetPave 12
File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Global
Concrete
Asphalt
Next
Help
Calculate
Help
Calculate
Help
Help
Help
Help

Percent of Slabs Cracked at End of Design Life

Slabs Cracked 15 %

Composite Modulus of Subgrade Reaction (Static k-Value)

○ Use calculated composite static k-value 100 psi/in.

● Enter a known static k-value 202.21 psi/in.

Concrete Material Properties

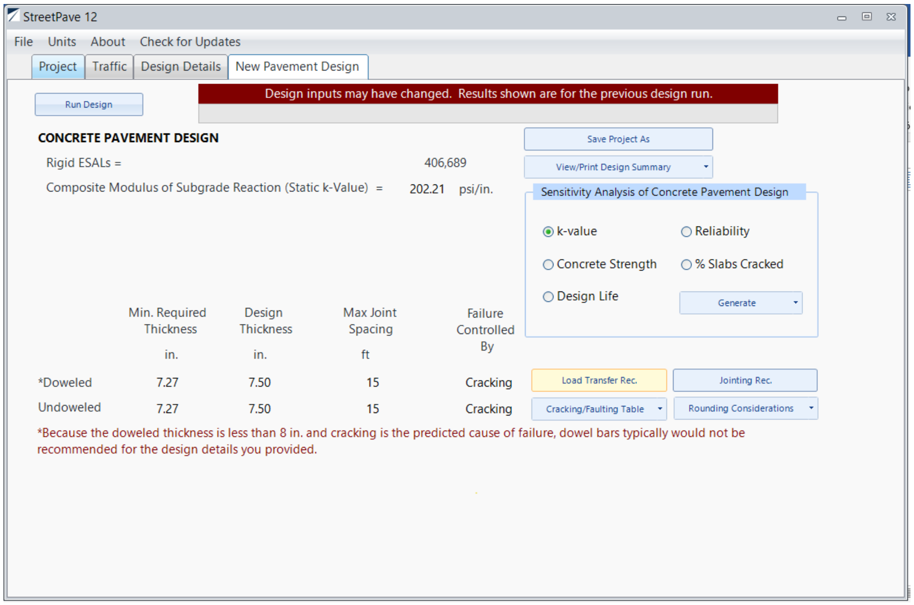
28-Day Flexural Strength (MR) 640.035 psi

Modulus of Elasticity (E) 4320236.25 psi

Macrofibers in Concrete? No

Edge Support

Edge support (e.g., tied concrete shoulder, curb and gutter, or widened lane) provided? ○ yes ● no


StreetPave 12
File
Units
About
Check for Updates
Project
Traffic
Design Details
New Pavement Design
Run Design
Save Project As
View/Print Design Summary
Generate
Load Transfer Rec.
Jointing Rec.
Cracking/Faulting Table
Rounding Considerations

Design inputs may have changed. Results shown are for the previous design run.

**CONCRETE PAVEMENT DESIGN**

Rigid ESALs = 406,689

Composite Modulus of Subgrade Reaction (Static k-Value) = 202.21 psi/in.

Sensitivity Analysis of Concrete Pavement Design

● k-value ○ Reliability

○ Concrete Strength ○ % Slabs Cracked

○ Design Life

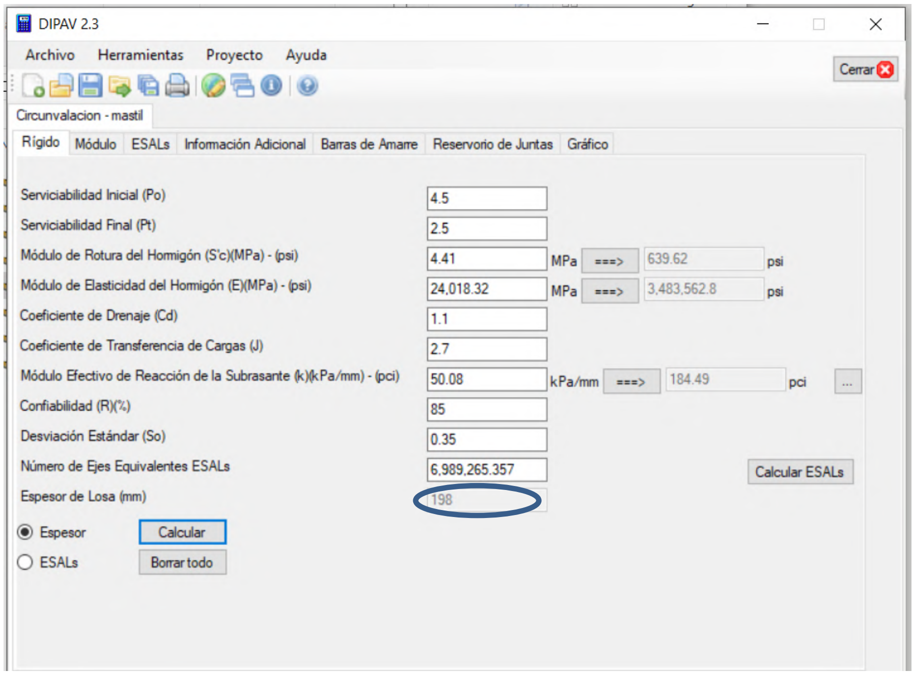
| | Min. Required Thickness in. | Design Thickness in. | Max Joint Spacing ft | Failure Controlled By |
|---|---|---|---|---|
| *Doweled | 7.27 | 7.50 | 15 | Cracking |
| Undoweled | 7.27 | 7.50 | 15 | Cracking |

*Because the doweled thickness is less than 8 in. and cracking is the predicted cause of failure, dowel bars typically would not be recommended for the design details you provided.

# ANEXO N°10

## CALCULO DE ESPESORES PARA AÑO DE EJECUCIÓN CON EL PROGRAMA DIPAV

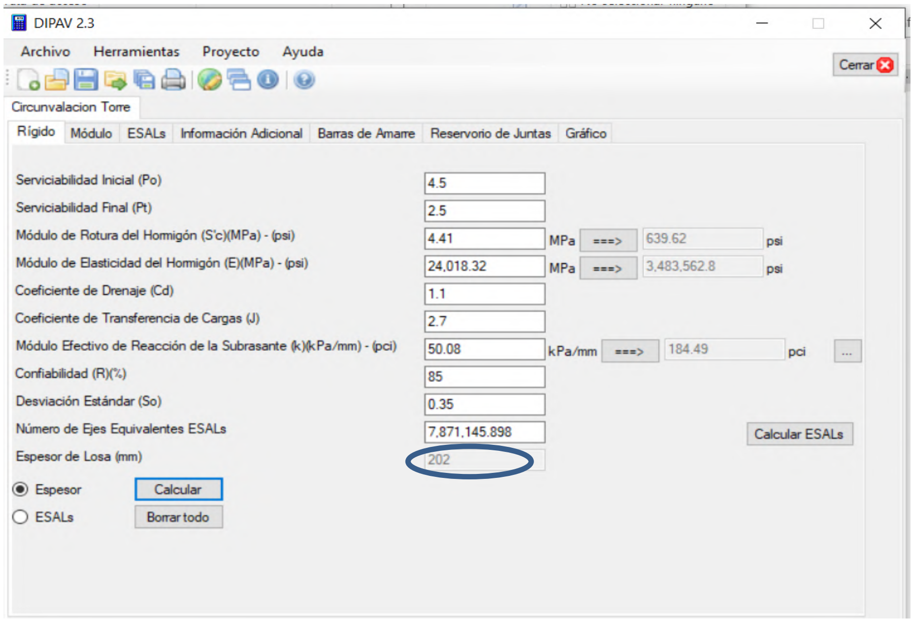
- **Avenida circunvalación (Dirección al mástil)**


DIPAV 2.3
Archivo
Herramientas
Proyecto
Ayuda
Cerrar
Circunvalacion - mastil
Rígido
Módulo
ESALs
Información Adicional
Barras de Amarre
Reservorio de Juntas
Gráfico
===>
...
Calcular ESALs
Calcular
Borrar todo

Serviciabilidad Inicial (Po): 4.5
Serviciabilidad Final (Pt): 2.5
Módulo de Rotura del Hormigón (S'c)(MPa) - (psi): 4.41 MPa ===> 639.62 psi
Módulo de Elasticidad del Hormigón (E)(MPa) - (psi): 24,018.32 MPa ===> 3,483,562.8 psi
Coeficiente de Drenaje (Cd): 1.1
Coeficiente de Transferencia de Cargas (J): 2.7
Módulo Efectivo de Reacción de la Subrasante (k)(kPa/mm) - (pci): 50.08 kPa/mm ===> 184.49 pci
Confiabilidad (R)(%): 85
Desviación Estándar (So): 0.35
Número de Ejes Equivalentes ESALs: 6,989,265.357
Espesor de Losa (mm): 198

● Espesor
○ ESALs

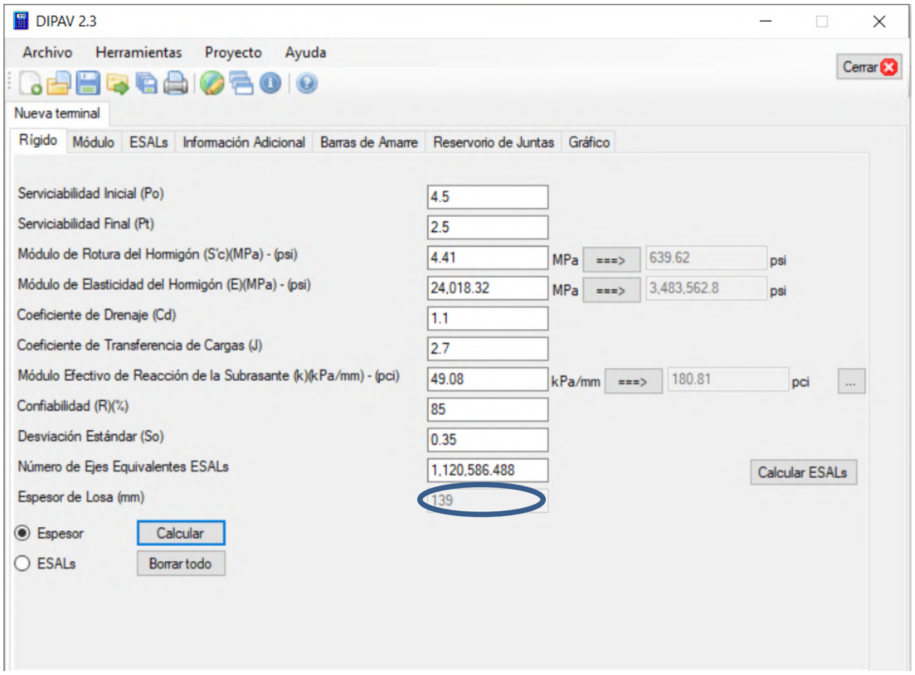
- **Avenida circunvalación (Dirección a la torre)**


DIPAV 2.3
Archivo
Herramientas
Proyecto
Ayuda
Cerrar
Circunvalacion Torre
Rígido
Módulo
ESALs
Información Adicional
Barras de Amarre
Reservorio de Juntas
Gráfico
===>
...
Calcular ESALs
Calcular
Borrar todo

Serviciabilidad Inicial (Po): 4.5
Serviciabilidad Final (Pt): 2.5
Módulo de Rotura del Hormigón (S'c)(MPa) - (psi): 4.41 MPa ===> 639.62 psi
Módulo de Elasticidad del Hormigón (E)(MPa) - (psi): 24,018.32 MPa ===> 3,483,562.8 psi
Coeficiente de Drenaje (Cd): 1.1
Coeficiente de Transferencia de Cargas (J): 2.7
Módulo Efectivo de Reacción de la Subrasante (k)(kPa/mm) - (pci): 50.08 kPa/mm ===> 184.49 pci
Confiabilidad (R)(%): 85
Desviación Estándar (So): 0.35
Número de Ejes Equivalentes ESALs: 7,871,145.898
Espesor de Losa (mm): 202

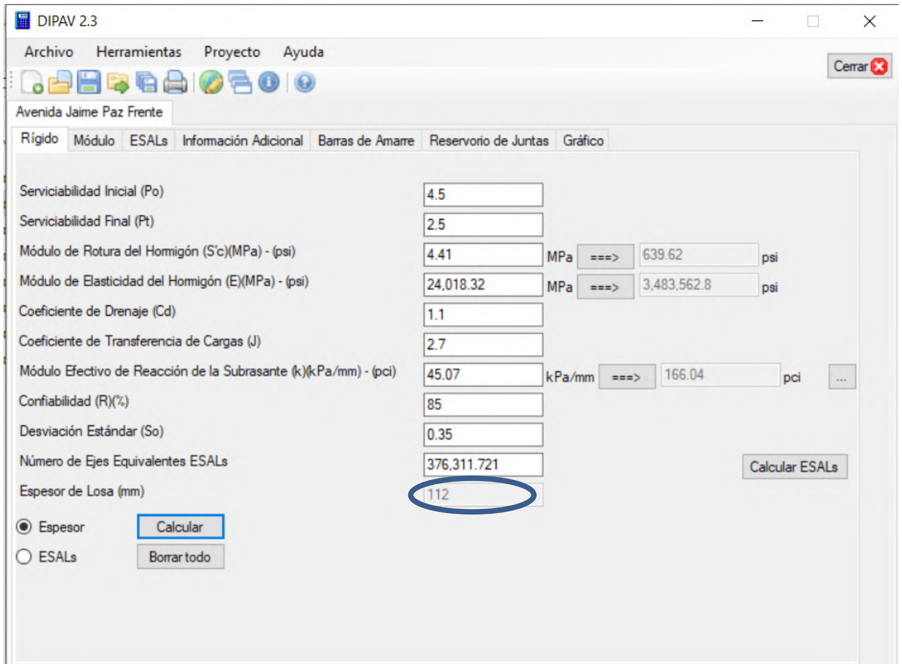
● Espesor
○ ESALs

- **Ingreso a la nueva terminal**


DIPAV 2.3
Archivo
Herramientas
Proyecto
Ayuda
Cerrar
Nueva terminal
Rígido
Módulo
ESALs
Información Adicional
Barras de Amarre
Reservorio de Juntas
Gráfico
===>
...
Calcular ESALs
Calcular
Borrar todo

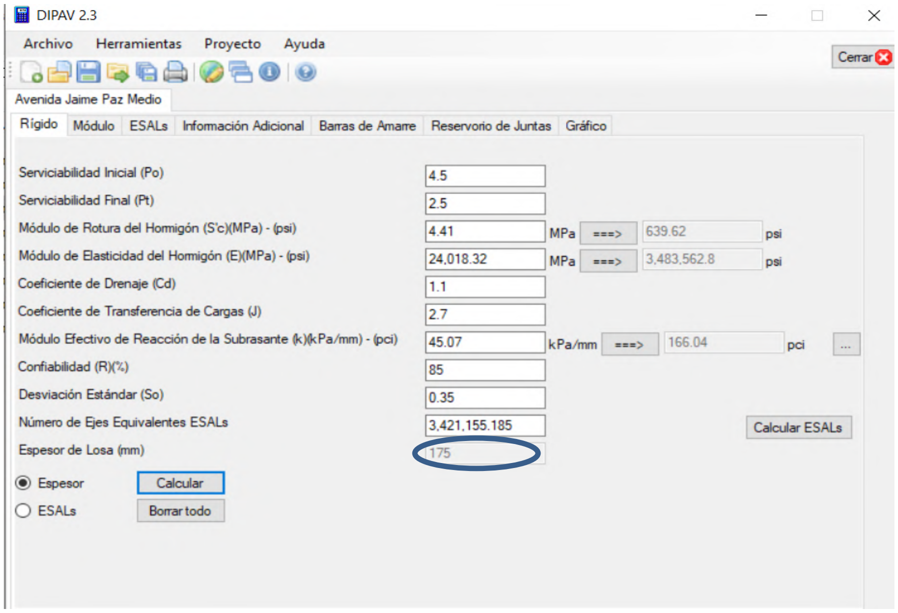
Serviciabilidad Inicial (Po) 4.5
Serviciabilidad Final (Pt) 2.5
Módulo de Rotura del Hormigón (S'c)(MPa) - (psi) 4.41 MPa 639.62 psi
Módulo de Elasticidad del Hormigón (E)(MPa) - (psi) 24,018.32 MPa 3,483,562.8 psi
Coeficiente de Drenaje (Cd) 1.1
Coeficiente de Transferencia de Cargas (J) 2.7
Módulo Efectivo de Reacción de la Subrasante (k)(kPa/mm) - (pci) 49.08 kPa/mm 180.81 pci
Confiabilidad (R)(%) 85
Desviación Estándar (So) 0.35
Número de Ejes Equivalentes ESALs 1,120,586.488
Espesor de Losa (mm) 139
● Espesor
○ ESALs

- **Avenida Jaime Paz (Frente)**


DIPAV 2.3
Archivo
Herramientas
Proyecto
Ayuda
Cerrar
Avenida Jaime Paz Frente
Rígido
Módulo
ESALs
Información Adicional
Barras de Amarre
Reservorio de Juntas
Gráfico
===>
...
Calcular ESALs
Calcular
Borrar todo

Serviciabilidad Inicial (Po) 4.5
Serviciabilidad Final (Pt) 2.5
Módulo de Rotura del Hormigón (S'c)(MPa) - (psi) 4.41 MPa 639.62 psi
Módulo de Elasticidad del Hormigón (E)(MPa) - (psi) 24,018.32 MPa 3,483,562.8 psi
Coeficiente de Drenaje (Cd) 1.1
Coeficiente de Transferencia de Cargas (J) 2.7
Módulo Efectivo de Reacción de la Subrasante (k)(kPa/mm) - (pci) 45.07 kPa/mm 166.04 pci
Confiabilidad (R)(%) 85
Desviación Estándar (So) 0.35
Número de Ejes Equivalentes ESALs 376,311.721
Espesor de Losa (mm) 112
● Espesor
○ ESALs

## - Avenida Jaime Paz (Medio)

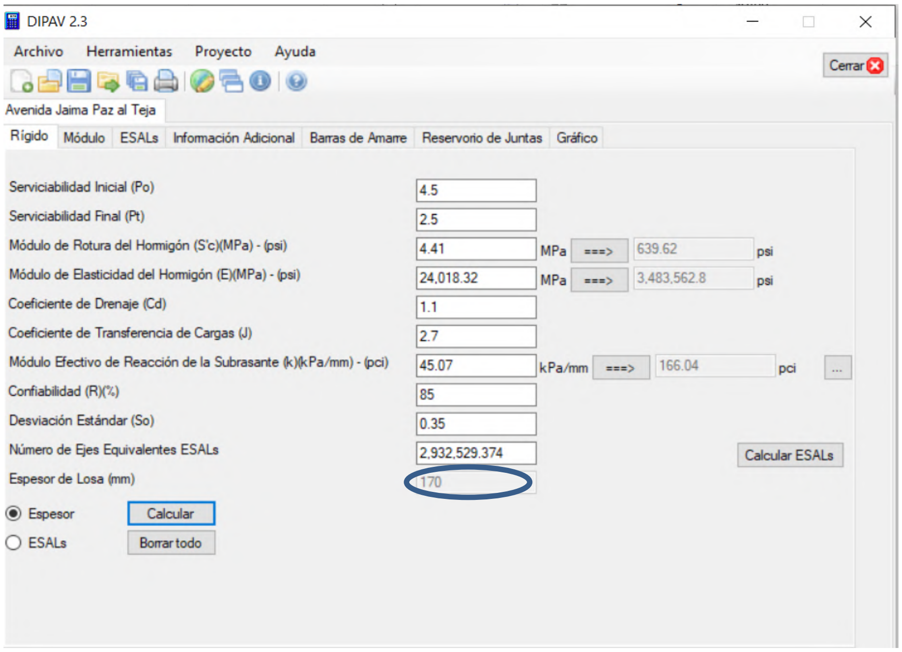

DIPAV 2.3
Archivo
Herramientas
Proyecto
Ayuda
Cerrar
Rígido
Módulo
ESALs
Información Adicional
Barras de Amarre
Reservorio de Juntas
Gráfico
===>
Calcular ESALs
...
Calcular
Borrar todo

Avenida Jaime Paz Medio

Serviciabilidad Inicial (Po): 4.5
Serviciabilidad Final (Pt): 2.5
Módulo de Rotura del Hormigón (S'c)(MPa) - (psi): 4.41 MPa 639.62 psi
Módulo de Elasticidad del Hormigón (E)(MPa) - (psi): 24,018.32 MPa 3,483,562.8 psi
Coeficiente de Drenaje (Cd): 1.1
Coeficiente de Transferencia de Cargas (J): 2.7
Módulo Efectivo de Reacción de la Subrasante (k)(kPa/mm) - (pci): 45.07 kPa/mm 166.04 pci
Confiabilidad (R)(%): 85
Desviación Estándar (So): 0.35
Número de Ejes Equivalentes ESALs: 3,421,155.185
Espesor de Losa (mm): 175

● Espesor
○ ESALs

## - Avenida Jaime Paz (Ex terminal)

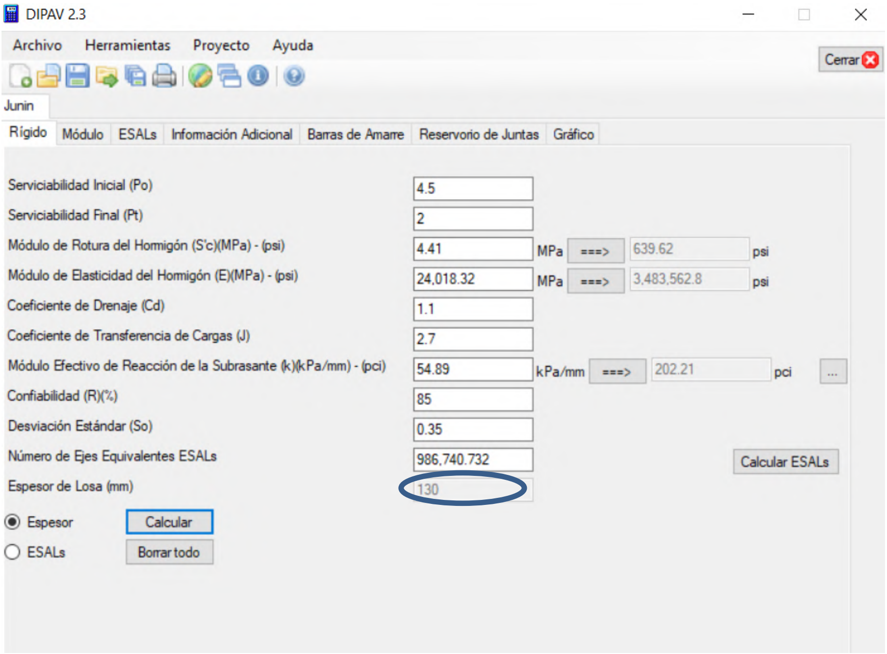

DIPAV 2.3
Archivo
Herramientas
Proyecto
Ayuda
Cerrar
Rígido
Módulo
ESALs
Información Adicional
Barras de Amarre
Reservorio de Juntas
Gráfico
===>
Calcular ESALs
...
Calcular
Borrar todo

Avenida Jaima Paz al Teja

Serviciabilidad Inicial (Po): 4.5
Serviciabilidad Final (Pt): 2.5
Módulo de Rotura del Hormigón (S'c)(MPa) - (psi): 4.41 MPa 639.62 psi
Módulo de Elasticidad del Hormigón (E)(MPa) - (psi): 24,018.32 MPa 3,483,562.8 psi
Coeficiente de Drenaje (Cd): 1.1
Coeficiente de Transferencia de Cargas (J): 2.7
Módulo Efectivo de Reacción de la Subrasante (k)(kPa/mm) - (pci): 45.07 kPa/mm 166.04 pci
Confiabilidad (R)(%): 85
Desviación Estándar (So): 0.35
Número de Ejes Equivalentes ESALs: 2,932,529.374
Espesor de Losa (mm): 170

● Espesor
○ ESALs

## - Calle Junín


DIPAV 2.3
Archivo
Herramientas
Proyecto
Ayuda
Cerrar
Junin
Rígido
Módulo
ESALs
Información Adicional
Barras de Amarre
Reservorio de Juntas
Gráfico
===>
...
Calcular ESALs
Calcular
Borrar todo

Serviciabilidad Inicial (Po): 4.5

Serviciabilidad Final (Pt): 2

Módulo de Rotura del Hormigón (S'c)(MPa) - (psi): 4.41 MPa 639.62 psi

Módulo de Elasticidad del Hormigón (E)(MPa) - (psi): 24,018.32 MPa 3,483,562.8 psi

Coeficiente de Drenaje (Cd): 1.1

Coeficiente de Transferencia de Cargas (J): 2.7

Módulo Efectivo de Reacción de la Subrasante (k)(kPa/mm) - (pci): 54.89 kPa/mm 202.21 pci

Confiabilidad (R)(%): 85

Desviación Estándar (So): 0.35

Número de Ejes Equivalentes ESALs: 986,740.732

Espesor de Losa (mm): 130

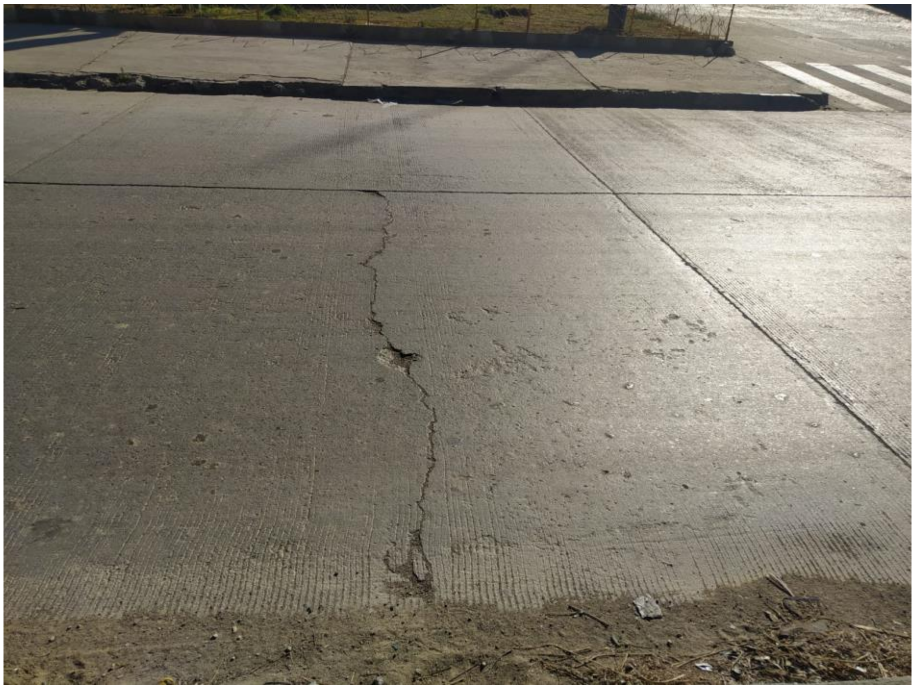
● Espesor

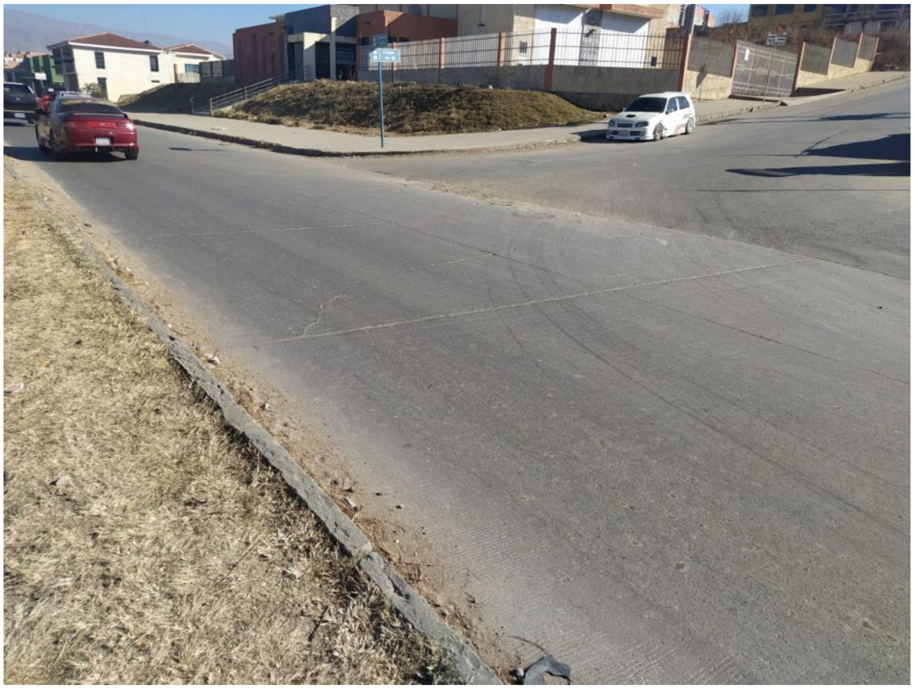
○ ESALs

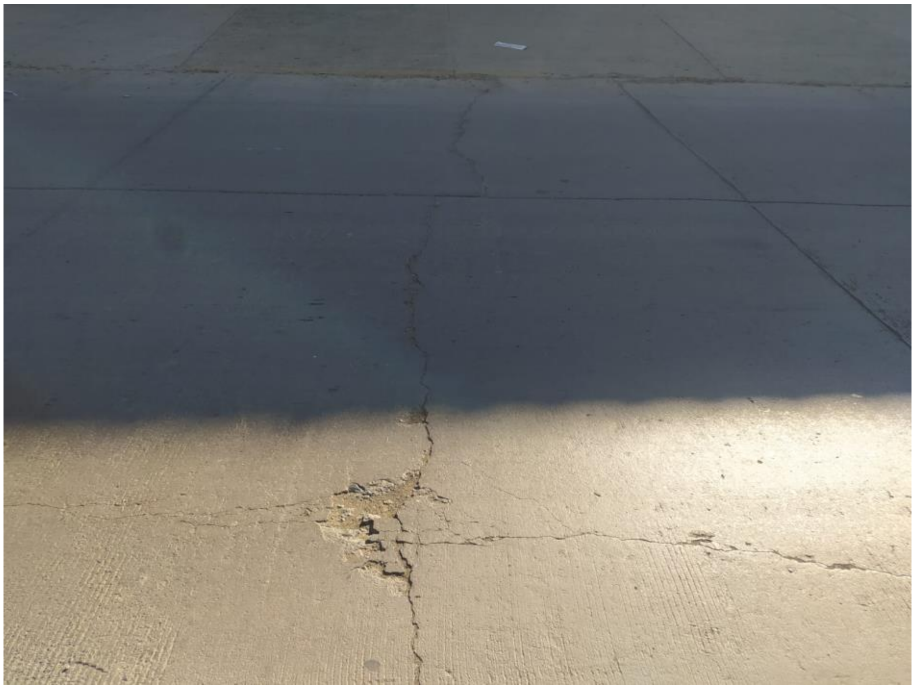
# ANEXO N°11

## INSPECCIÓN VISUAL DE LOS TRAMOS ASFALTADOS EN ESTUDIO

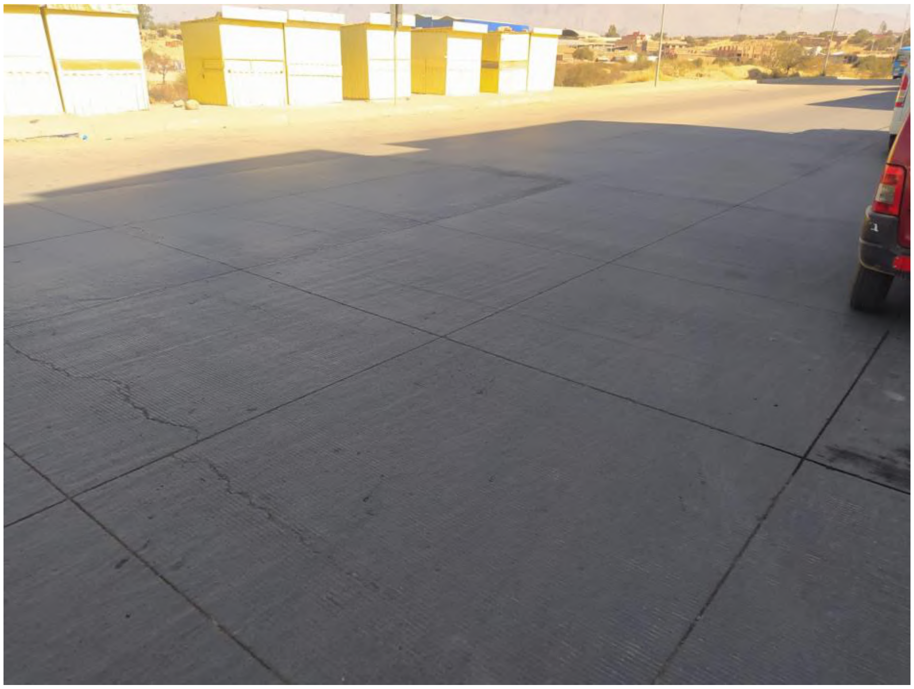
- **Avenida circunvalación**

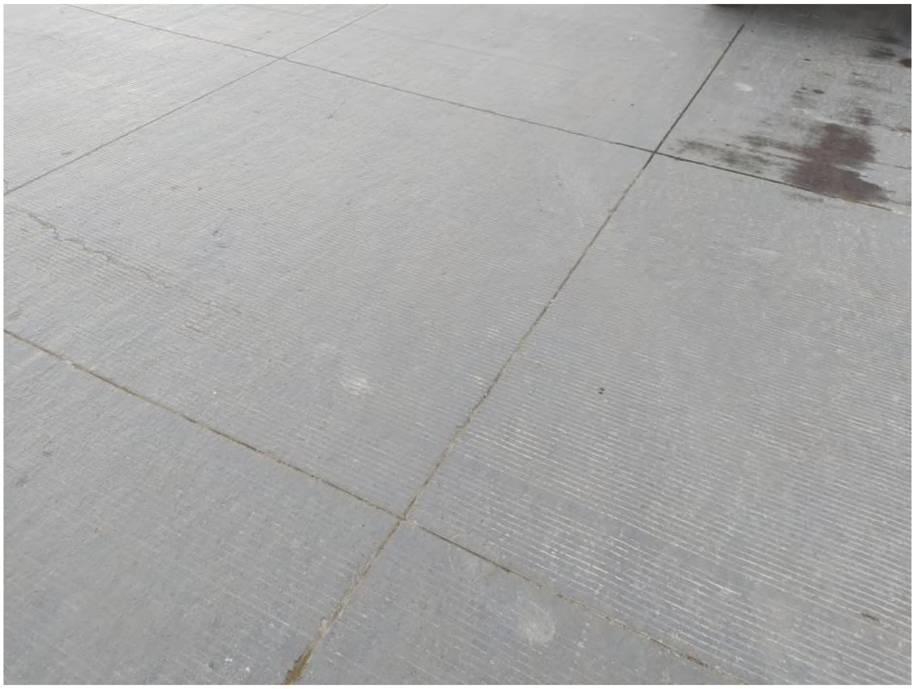




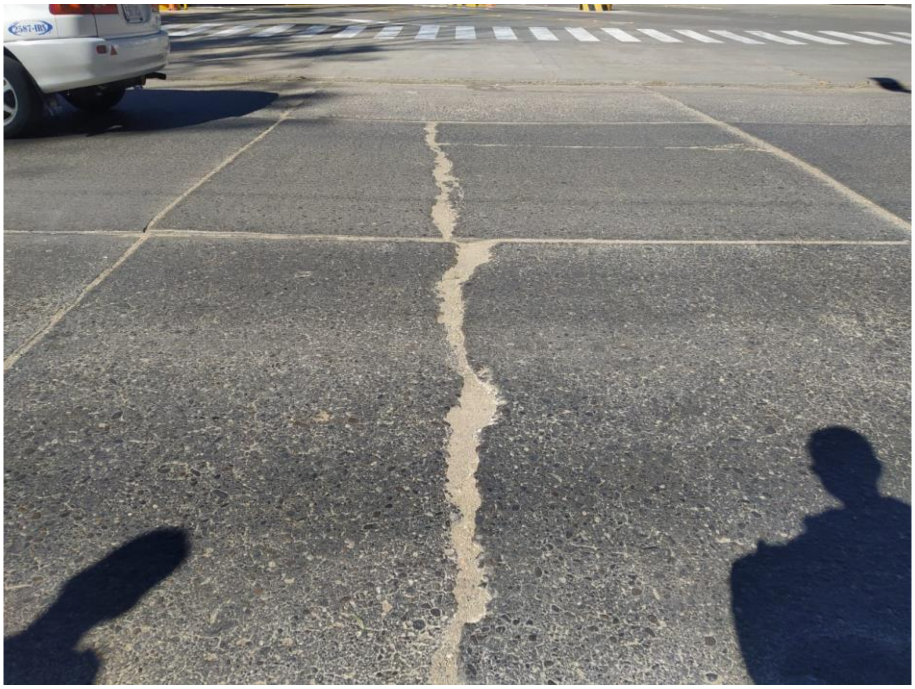


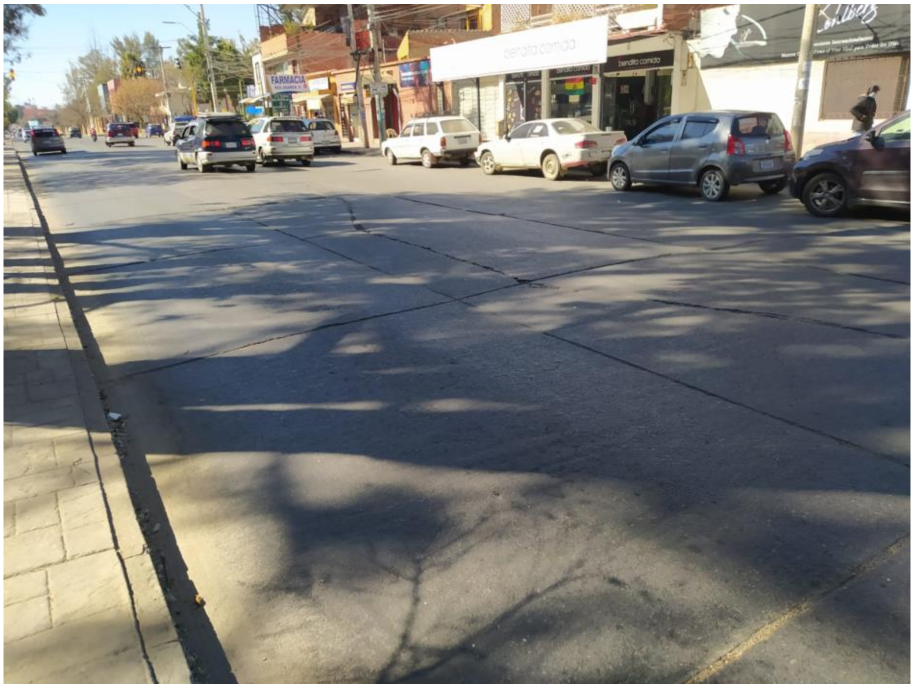
- **Ingreso a la nueva terminal**

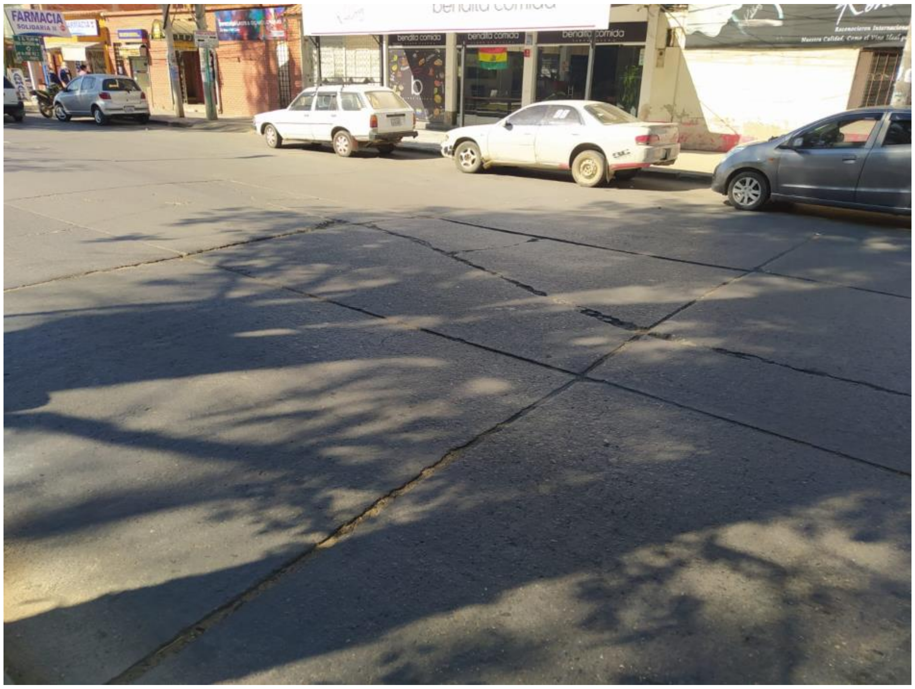


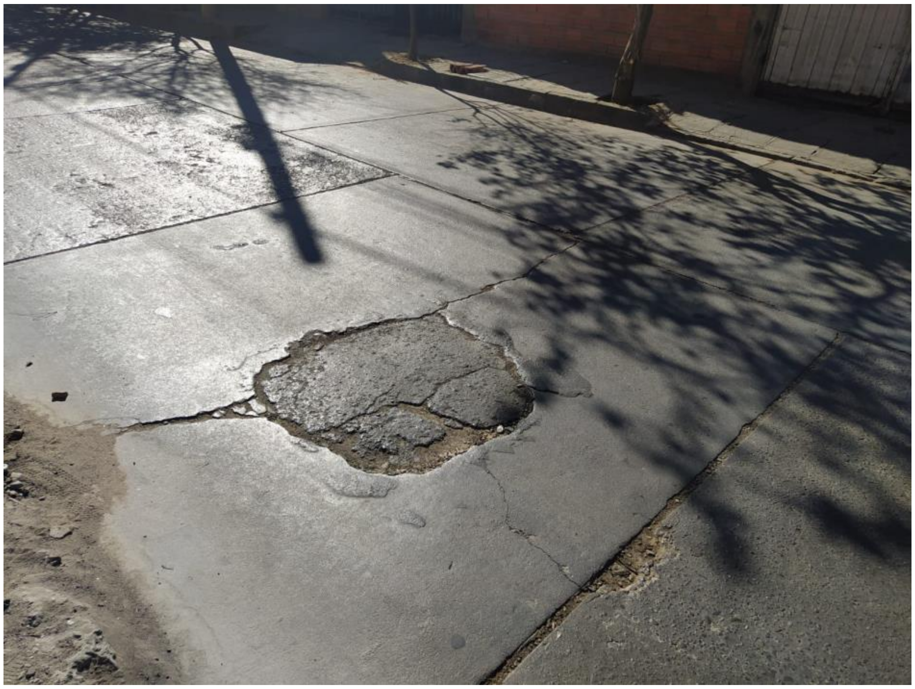
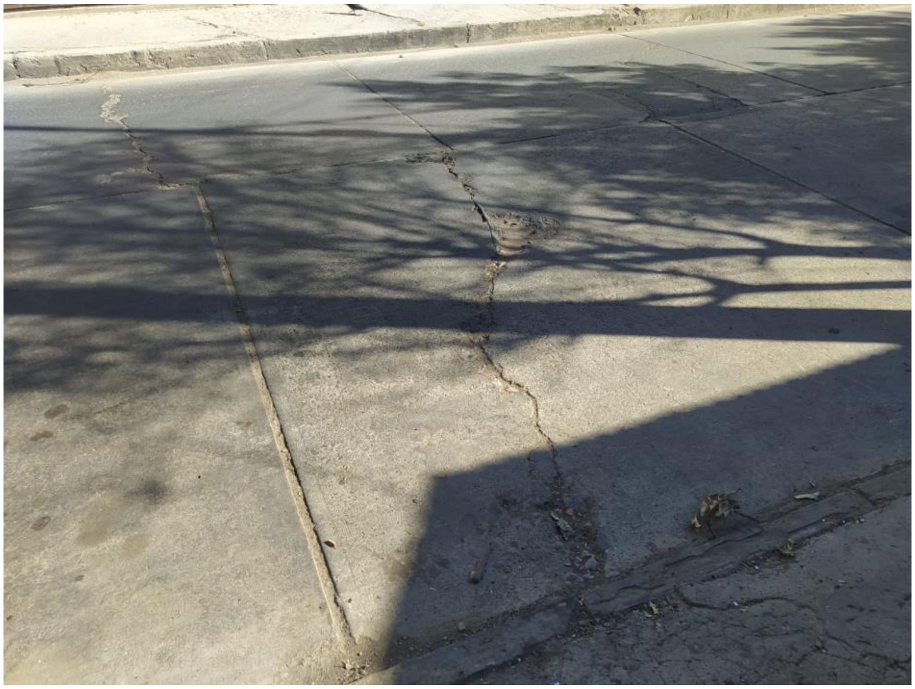
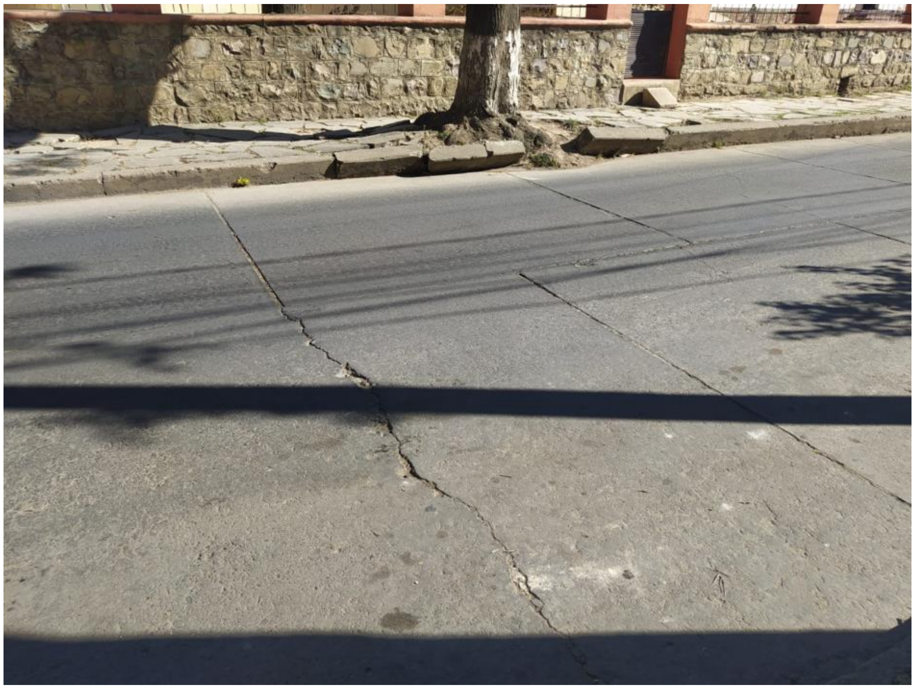


- **Avenida Jaime Paz**




bendita comida
FARMACIA


FARMACIA
SOLIDARIA
bendita comida

- **Calle Junín**